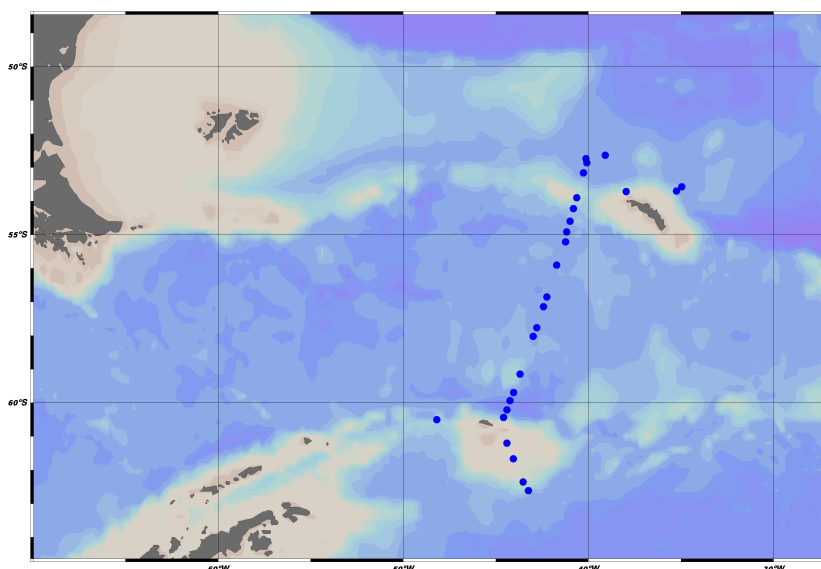


CRUISE REPORT: JR 177

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Highlights

Cruise Summary Information

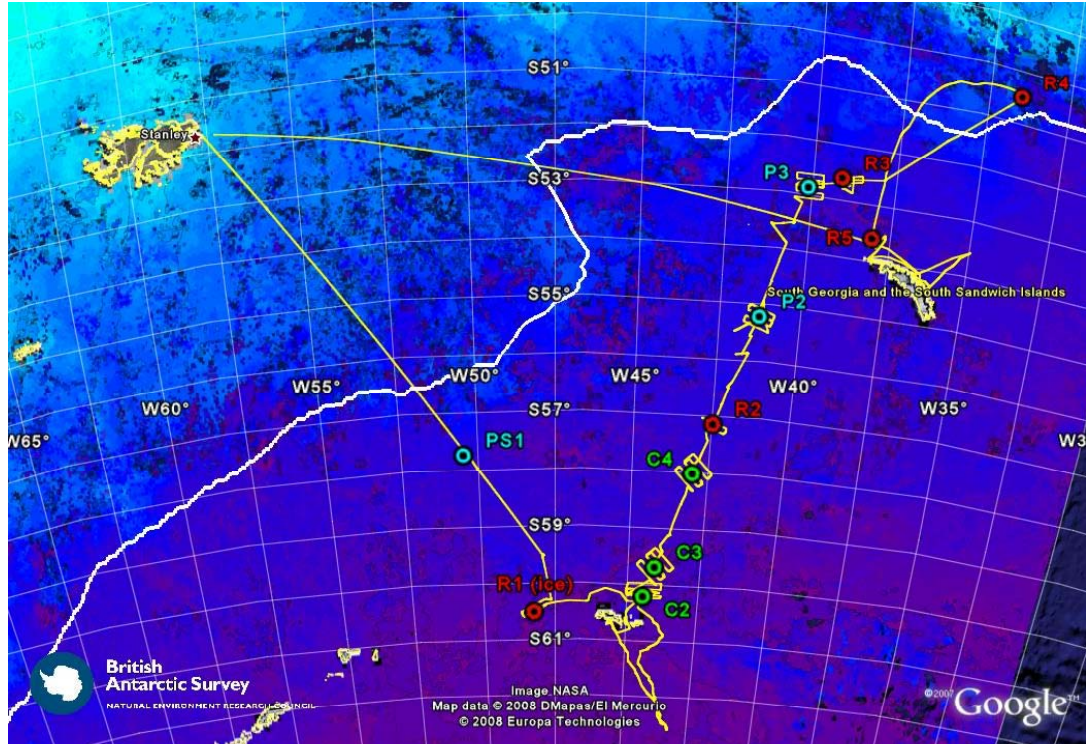
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| Section Designation | JR 177 | | |
| Expedition Designation (ExpoCode) | 74JC20071231 | | |
| Chief Scientist | Geraint Tarling / BAS | | |
| Dates | 31 December 2007 – 16 February 2008 | | |
| Ship | <i>R/V James Clark Ross</i> | | |
| Ports of Call | Port Stanley, Falkland Islands – Port Stanley, Falkland Islands | | |
| Geographic Boundaries | 48° 19'W | 52° 63'S 62° 61'S | 34° 96'W |
| Stations | 59 | | |
| Floats and Drifters Deployed | 0 | | |
| Moorings Deployed and Recovered | 2 | | |

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Report assembled by Savannah Lewis

Discovery 2010 - Summer Cruise



JR 177

December 31st 2007 to February 16th 2008

Life cycles and trophic interactions of the Scotia
Sea pelagic community: from ice-edge to Polar
Front

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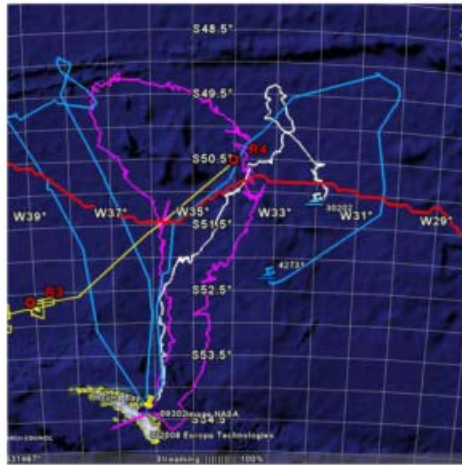
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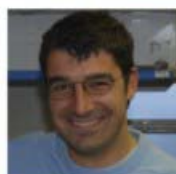
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29 Dec 07 - 18 Feb 08
JR177
Discovery - 2010



JR177 DISCOVERY 2010 SUMMER CRUISE

1 INTRODUCTION

1.1 Rationale

Geraint Tarling PSO

The large-scale Southern Ocean ecosystem is one of the key ocean ecosystems, playing a crucial role in earth systems processes and maintaining a unique biodiversity. A distinct feature of this ecosystem is the large degree of variability evident at a number of spatial and temporal scales. Integrated analyses of biological, chemical and physical processes are required to gain a full understanding of the impact of this variability on earth systems. The principal goal of the DISCOVERY 2010 programme is to determine *how ocean ecosystem structure and function in the Southern Ocean is related to environmental variability*.

A particular aim of the DISCOVERY 2010 programme is to examine the life-cycles and trophic interactions of lower- and mid-trophic level pelagic organisms, and determine their impact on biogeochemical systems. This is to be placed within a wider context through an end-to-end consideration of the ecosystem. Through our own targeted studies, and through collaborations, we wish 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. For this reason, our challenge was to design a sampling programme that, by its very nature, was multidisciplinary, while at the same time, achieved a level of coverage that was both spatially and temporally comprehensive.

The pelagic sampling programme for the DISCOVERY 2010 programme was split into three separate campaigns covering 3 of the 4 seasons, spring, summer and autumn. It was designed 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. It restricted campaigns to a maximum duration of 6 weeks in order to obtain views of the ecosystem that were relatively synoptic. Mesoscale and small-scale surveys were to be interwoven within the larger scale coverage of the cruise to examine the interaction between smaller scale physical and biological processes. Monitoring devices capable of resolving the temporal variability in physical and biological conditions were to be deployed in key ocean regions.

DISCOVERY 2010 is composed of four main projects, of which two, FLEXICON and FOODWEBS, have major components in the pelagic sampling programme. FLEXICON (Flexibility and Constraints in Life Histories) is examining how life-histories of key species are linked to environmental processes. It particularly focuses on “critical” stages in life-cycles and how environmental variability affects recruitment and productivity. It covers a number of trophic-levels, from meso-zooplankton (copepods and pteropods), through krill, myctophid fish and up to higher predators such as penguins, seals, and flighted-birds. Its major aim during the present

cruise series was to determine the influence of body-condition on behaviour and life-cycle processes. It put in place a depth-discrete sampling programme to consider the distribution of different life-cycle stages and body states of key zooplankton species. Acoustic data supplements these studies as well as providing detailed information on krill and fish swarm structures.

FOODWEBS (Scotia Sea Food-webs) is examining the operation of Southern Ocean foodwebs, building from a krill-centred view. It is taking a number of complimentary approaches to consider linkages between different trophic levels, including gut content examinations, stable-isotope analyses and higher-predator tracking studies. In addition to krill-based foodwebs, it is also examining the prevalence of alternative foodwebs, particularly linkages between mesozooplankton, myctophid fish and higher predators. The nature of foodwebs in the Scotia Sea is heavily influenced by the local productivity regime, which may alter dramatically according to the level of micronutrient enrichment. FOODWEBS is sampling across a range of such environments and parameterising the effects of enrichment on primary productivity that will feed through to subsequent trophic levels. The placement of sediment traps (plus accompanying monitoring devices) at sites that were respectively upstream and downstream of South Georgia was another means of examining the effect of iron enrichment on food web structure. These deployments will also provide key insights into carbon flux to the deep ocean.

In addition to the core DISCOVERY 2010 projects, the present cruise has also the benefit of hosting supplementary projects that compliment our core-objectives. The DIMES programme has a remit to obtain greater resolution in physical oceanographic parameters across the Scotia Sea. It contributed a further 3 days to the duration of the cruise and integrated within the cruise programme through increasing the frequency of full-depth CTDs between core-sampling stations. The Antarctic Funding Initiative (AFI) project “Krill clock-genes”, took advantage of our regular catches of live krill to carry out behavioural entrainment studies. Samples will be screened for the expression of clock-genes with a view to explaining what determines diel periodicity in these organisms. Two further AFI collaborative gear scheme (CGS) projects contributed directly to the aims of FOODWEBS: (i) A collaboration with NOC allowed measurements of iron concentration to be made throughout the cruise with additional bioassays to examine the level of micronutrient limitation in primary productivity; (ii) a collaboration with UEA permitted high resolution work on pCO₂ concentrations and alkalinity, both in surface waters and through the water column, complimenting the measurements already being made by their underway sensors installed on this ship last year. This cruise also hosted a student funded by the FAASIS scheme (fellowships in atmospheric and ocean science, jointly hosted by BAS and UEA). The project examined the distribution and abundance of different thecosome pteropod species and life-cycle stages and carried out bioassays to examine their response to elevated levels of pCO₂.

1.2 Discovery 2010 Cruise-track design

Geraint Tarling PSO

The design of the main cruise track had to fulfill a number of criteria:

- 1) It must cover the largest possible range of oceanographic environments common to the Scotia Sea region including the ice-edge, shelf-seas, open ocean, HNLC conditions, iron-enriched conditions and frontal areas
- 2) Some station locations must have a level of responsiveness in order that such conditions can be sampled adequately
- 3) Other station locations must remain fixed so that inter-seasonal (inter-cruise) comparisons are possible
- 4) Some form of continuous sampling must be maintained in order to resolve any temporal variability in physical and biological processes between cruises
- 5) Any spatial coverage must be achieved in as short a timescale as possible in order that samples are relatively synoptic
- 6) There must be adequate physical characterization to place biological samples into an appropriate context
- 7) The transect must not be too remote from the normal area of operations of the BAS research fleet so that transit times are minimised
- 8) Proximity to standard BAS marine operations is imperative for any moored devices, so that there is the potential to deploy and retrieve them on other standard cruises if any technical problems arise

Once a cruise track has been designed, it is essential that it is sampled on all 3 DISCOVERY 2010 cruises, keeping sampling methods as similar as possible in each instance

Transect path

The eventual transect line followed a ERS satellite altimeter track, moving from east of the South Orkneys to west of South Georgia (see Appendix). This transect path met criteria 1) and 7). Following the track also had the advantage that, through calibrating satellite altimetry, greater physical characterization of the transect path could be achieved (criterion 6). In essence, such calibration allows forward and backward projections of dynamic height, so providing some history to the physical context experienced on arrival at a station and also allowing a forward projection of the fate of those waters once the location had been vacated.

Station locations

There was some requirement for a relatively even distribution of stations between water masses, to meet criteria 1 and 3. The water mass between the Southern Boundary (SB) and the SACCF covered a much greater extent of the transect than the water masses south of the SB or north of the SACCF (Fig 1.1). Therefore, the two stations below the SB would necessarily be much closer in spacing than the two between the SB and SACCF.

Above the SACCF, the exact area of the water mass was less predictable because of notable variability in the location of the Polar Front. The exact locations were left responsive to conditions encountered on the cruise (criterion 2). One of these was to be responsive to the location of King Penguin foraging, which we believed to be focused on aggregations of myctophid fish. The other was to be sited at a site of high productivity.

A responsive approach was also taken to determining the exact location of an “ice-edge” station. Such a site was to be as close to the ice edge as possible without compromising the ability to deploy nets,

It was initially envisaged that a HNLC low productivity site would not be encountered along the main transect line. During cruise JR161, an additional station (P1) was located far west of the transect line. However, it was found that productivity was relatively high at that site. Nevertheless, HNLC conditions were encountered mid-way along the main transect line during JR161. During the present cruise, P1 was not included as a full station (although some sampling did occur there as part of a shakedown exercise). A “responsive” station was allocated towards the mid-point of the transect line, to capture low productivity conditions

Mooring locations

To meet criterion 8, any moorings would be preferably sited towards the northern end of the transect, close to the main line of passage between South Georgia and the Falkland Islands. However, it was also valuable to site moorings in contrasting conditions. Making a mooring site into a fixed station location was also considered a sensible move so that the amount of mutually supporting information was maximized. With these considerations in mind, one mooring was located below the SACCF, in lower productivity waters upstream of the main flows past South Georgia. This site became fixed station P2. The other mooring was located to the north of SACCF, in waters that have flowed past South Georgia and so enriched with iron. This region is typically high in productivity. The site became fixed station P3.

1.3 Cruise Strategy

Geraint Tarling PSO

The strategy of the DISCOVERY 2010 cruise programme is to carry out 3 repeats of the same cruise plan, one in spring, one in summer and one in autumn. The first cruise in this series, JR161, was carried out in springtime (October and November 2007). The present cruise (JR177) is the summertime repeat of this previous cruise. Our aim was to replicate as many JR161 activities as possible. It was expected that the ice would have retreated to a greater extent compared to springtime, allowing the main transect, from ice-edge to Polar Front, to cover a greater southerly range. Furthermore, time added to the present cruise via the DIMES project allowed a greater frequency of CTDs to be carried out along the main transect line. Five “fixed” station locations were retained from last year (C2, C3, C4, P2, P3). Four (R1 to R4) were left flexible to be “responsive” to features observed during the cruise, such as ice-edges, fronts, productivity and higher predator foraging tracks (Fig 1.1)

There was a set plan of activities to occur over a 48 h period at each of the 9 stations (Fig 1.2). This included: CTDs for physical oceanography, nutrients, particulates and mesozooplankton; 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. As well as capturing different subsets of the pelagic community, the various nets had a variety of purposes. For instance, Bongo nets obtained depth-integrated samples in the upper 400 m to obtain *Oithona* spp. and *Calanoides acutus* in good enough condition for biochemical analysis. Both the LHPR and the MOCNESS provided vertically stratified samples to a maximum depth of 1000 m, with the LHPR obtaining high depth resolution and the MOCNESS providing lower resolution samples in better condition, suitable for studies on body state. The RMT8 was mainly fished in a targeted way to obtain live krill for incubations. The RMT25, by contrast, was fished in a standard way at all stations with the aim of characterising the abundance and diversity of the macrozooplankton and nekton communities across the Scotia Sea.

The 48 h of sampling activity was to be preceded by a 24 mesoscale survey at the five ‘fixed’ stations to map the physical oceanography, acoustic backscatter and higher predator distribution within a 60 x 60 km grid. This was to be replaced by a small-scale survey (~6 h) at the 4 ‘responsive’ stations. The underway water supply was to be analysed continuously throughout the cruise for Chl-a concentration, macronutrients, phytoplankton physiology and pCO₂ levels. A separate towfish was to extract water for micronutrient analysis in a continuous manner. Moorings located at P2 and P3 (containing CTDs, acoustics and sediment traps) were to be recovered and redeployed.

FIGURE 1.1 JR177 PROPOSED CRUISE TRACK

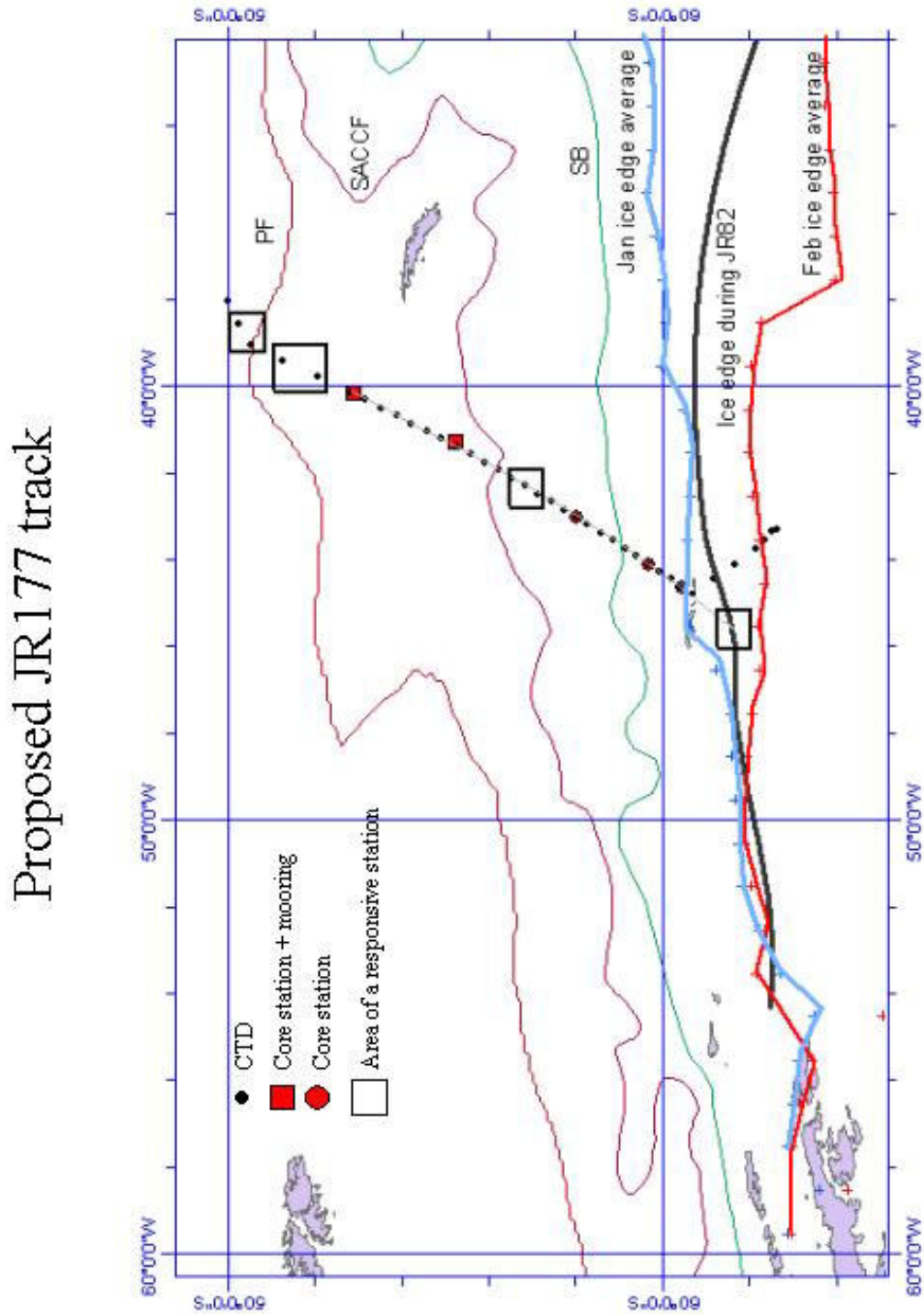
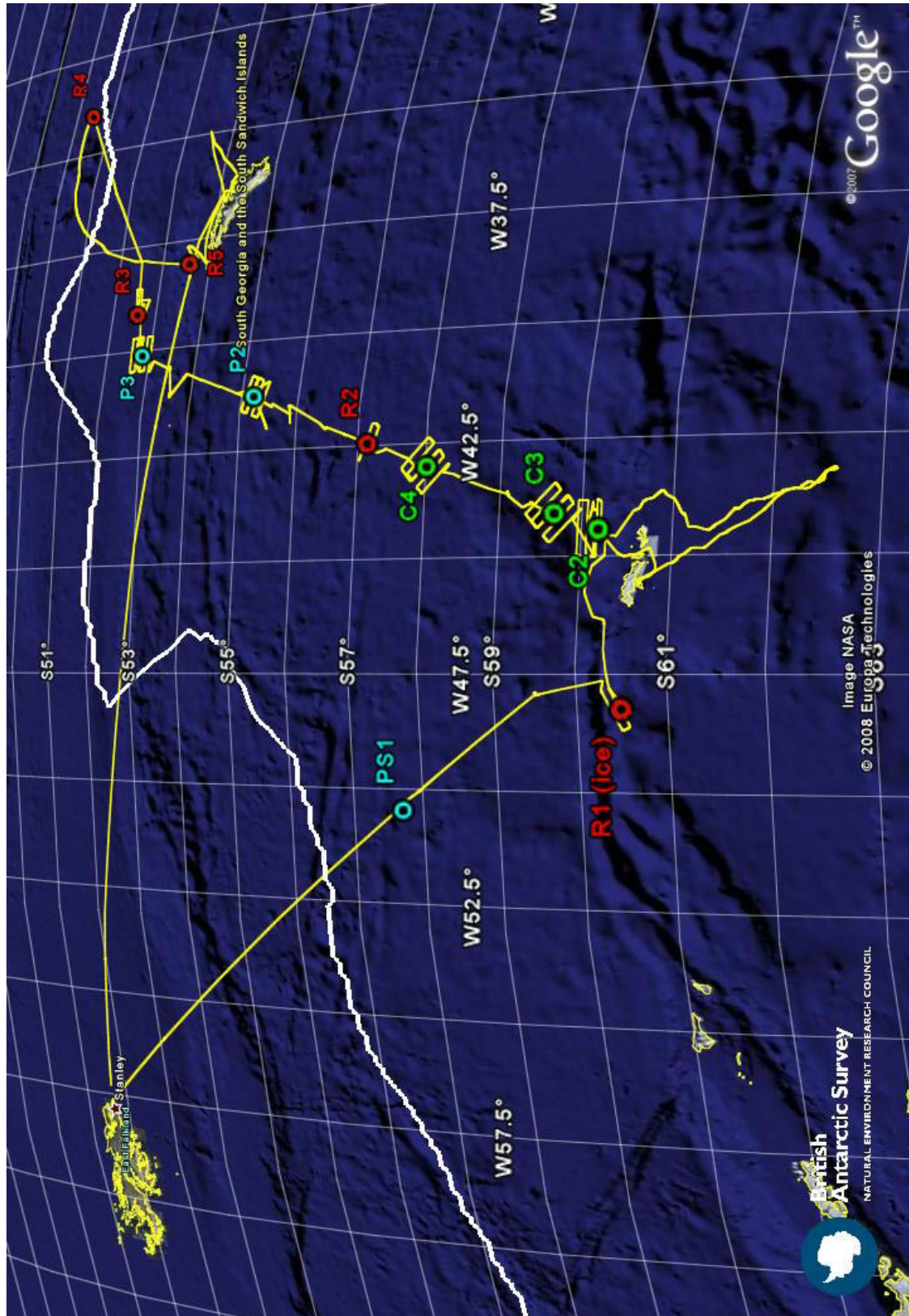


FIGURE 1.2 JR177 48HR SAMPLING PLAN

48 h station sampling plan

| Time (local) | Activity |
|--------------|---------------------------------|
| 22:00 | MOCKESS |
| 23:00 | RMT25 stratified |
| 00:00 | |
| 01:00 | EGRE |
| 02:00 | LHPR to 1000 m |
| 03:00 | |
| 04:00 | CTD for DP |
| 05:00 | (6 bottles 2000m, 6 at CHA max) |
| 06:00 | Bongo & Miribongo |
| 07:00 | |
| 08:00 | Bongo & Miribongo |
| 09:00 | RMT25 stratified |
| 10:00 | CTD (Offshore) |
| 11:00 | LHPR to 1000 m |
| 12:00 | |
| 13:00 | |
| 14:00 | Go FLO and FFS |
| 15:00 | Target fishing (RMT8) |
| 16:00 | |
| 17:00 | MOCKESS to 1000 m |
| 18:00 | |
| 19:00 | |
| 20:00 | Target fishing (RMT8) |
| 21:00 | MOCKESS to 1000 m |
| 22:00 | RMT25 stratified |

FIGURE 1.3 ACTUAL CRUISE TRACK



1.4 Cruise Summary

Geraint Tarling PSO

The cruise left Port Stanley on 31st Dec and headed for the ice-edge west of the South Orkneys (Fig 1.3). XBTs were deployed every 20nm during this leg. There was also a stop en-route at the site of P1 (JR161). This site was not included as a full station-location on the present cruise, since it did not meet its main 'raison d'être' of being a low productivity site. Nevertheless, it was a convenient site for a shakedown test of major pieces of equipment.

The first station (R1) was to be responsive to the position of the ice-edge close to South Orkneys. In fact, the ice was a lot further north than average this year and the most suitable site was 100 nm north of where we originally intended it to be. Sampling operations commenced there on 3rd January. A lot of krill were found close to R1 and those in good condition were incubated for behavioural and feeding/egestion analyses.

Ice conditions meant that we headed next directly to station C2, which is almost due east of R1 and NE of South Orkneys. We located C2 20 nm north of its JR161 location to avoid ice. Operations commenced there on 6th January. The use of the undulating oceanographic recorder during the 24 h mesoscale survey was abandoned at this station because of fatal mechanical problems.

A southerly 150nm passage into the brash ice followed sampling at C2 to carry out a part of the DIMES series of CTDs (R1 was originally intended to be along this transect). A total of 7 CTDs were carried out, accompanied by some opportunistic sampling with GoFlo bottles at some station locations. We called in briefly to Signy base on 12th January to deliver oil drums, provisions and mail on our way northwards to rejoin the main transect line.

There were some technical problems with RMT25 during C2, so a brief stop was made there during our return trip to repeat those hauls, this time successfully. Station C3 was started on 15th January and all deployments were completed successfully. One out of the five CTD stations on the way to C4 was missed as a result of a termination problem. C4 operations commenced on 18th January and all deployments were completed with the exception of 1 LHPR, which suffered a comms. problem.

We decided to locate R2 in a low productivity site around the mid-point of the main transect line. A suitable site was reached on 20th January. Around mid-way through the 48 h sampling programme, conditions became too rough to continue sampling. The forecast did not predict suitable conditions would return until after the time allocated to this station had ended, so we continued northwards. One out of the five CTDs on the way to P2 was missed because of bad weather. We remained hove-to at P2 for 24 h before weather became suitable enough for sampling operations to resume on 26th January. All deployments were successfully completed, including the recovery and redeployment of the mooring. All instruments on the mooring had performed correctly during their previous deployment.

Operations at P3 commenced on 30th January with a mesoscale survey, followed by the recovery of the other mooring. Unfortunately, a technical glitch had prevented the sediment trap on this mooring from collecting samples over the previous year. All other instruments on this mooring performed correctly. It was notable that krill were scarce around both P2 and P3, in contrast to the high abundances observed further south.

R3 was to be sited in a region of very high productivity. A suitable location was found 40 nm to NE of P3. Sampling operations commenced there on 3rd February. All deployments were completed successfully by 5th February, by which time the weather had started to deteriorate. The intended location for R4 was the vicinity of the Polar Front at the site of King Penguin foraging activity. However, weather forecasts predicted unworkable weather in that region until 10th February, which was our cut-off date for sampling there. We made straight for the Polar Front after completing R3 without stopping for any scheduled CTDs so that any sampling opportunity there could be maximised before conditions became unworkable. In fact we achieved a small-scale survey, 2 RMT25 deployments and 1 RMT8 before we were halted by conditions.

The ship remained hove-to for 7th and 8th February although we gradually headed towards South Georgia throughout that time. We arrived on NW South Georgia shelf on 9th February where some whale-buoys were deployed. We also used the opportunity to do some additional science to compliment work on the main transect. This further responsive station, termed R5, included a CTD, Go-Flo bottles, day and night FRRFs, Bongo and MOCNESS nets for zooplankton, and RMT nets for krill and fish. These activities were completed by 10th February.

FIDS were picked-up from Bird Island before proceeding to Stromness, where an acoustic calibration was performed on night of 10th/11th February. We then carried out a CTD transect across the NE shelf and shelf-edge of South Georgia, principally for the DIMES project. This was terminated early when the ship developed some engine problems. We proceeded to Hound Bay to recover a cargo depot and then on to KEP, where time was spent at anchor assessing the engine fault. The ship went alongside KEP on 13th February to exchange cargo and personnel.

We proceeded Stanley on evening of 13th February, at a precautionary speed of 8 to 10 knots as the result of the lack of a back-up motor. We arrived in Stanley on 16th February. Equipment was packed into containers and then science personnel demobilised to accommodation in Stanley on 17th February.

1.5 PSO Narrative - JR177

Geraint Tarling PSO

27/12/2007 06:30

The PSO and around half of science team assembled at BAS HQ for trip South via South America. Took a BA flight from London City airport to Madrid and met up with other half of science team who flew in from Luton. All the science team flew to Santiago that night the majority on an Iberia flight the remainder on a Lan Chile flight (both with approximately the same itinerary). Continued on to Punta Arenas after a 5 h stop over in Santiago. Arrived Punta Arenas around 3pm on 28th Dec. Spent the night in Cabo de Hornos hotel in Punta Arenas. Left next morning on a midday flight to Mount Pleasant airport Falkland Islands

29/12/2007 19:45

Arrived at JCR. Straight to a safety debrief by Purser and then a science debrief by PSO. Both of the science equipment containers had already been unpacked by the 3 science crew members who were already aboard JCR from a previous science cruise (Nathan Cunningham Martin Collins David Pond). They recruited the help of other FIDS. This is a real bonus since we were expecting to unpack these containers tomorrow morning so we have gained at least half a day. Science team members conducting lab experiments have been instructed to set up their labs tomorrow morning. Other team members are to help set up net sampling equipment.

30/12/2007 11:00

The team was split into two those conducting lab experiments concentrated on setting up their labs while those mainly involved in deck operations set up the nets mainly the RMT25 and MOCNESS. One of the trickiest undertakings was organising the cold room since there are 3 major experimental projects using it and a limited amount of space. Simon Wright did a sterling job in coming up with practical solutions to the problems of space limitation. 3 scientists (Peter Ward, Rachael Shreeve and Nathan Cunningham) accompanied the Captain and some other JCR officers to a cocktail party on the HMS Clyde which is berthed alongside. The occasion was reportedly most enjoyable. We plan to set sail mid afternoon tomorrow although there are a number of tasks that must be achieved efficiently tomorrow morning in order to be ready for this departure time.

31/12/2007 18:16

Another sterling effort by the team meant that the remaining work of setting up packing and lashing down was done in time for our departure from FIPASS Port Stanley at 3pm today. The team will shortly have a safety brief followed by a boat drill before settling in for their 46 day voyage.

01/01/2008 13:37

Heading south at between 10 and 12 knots. Weather is currently with us, a moderate northerly aiding our passage south.

During this southerly passage XBTs are being deployed approximately every 20 nautical miles (for which the ship slows to 6 knots). This will enable the physical oceanography of this region to be described and help the interpretation of other variables being measured underway such as nutrients and phytoplankton. Hugh Venables and Mags Wallace are master-minding XBT operations ably assisted by Nathan Cunningham, Libby Jones, Sophie Fielding and Maria Neilsdottir. These deployments will continue until we reach the ice-edge and move onto the main sampling transect.

New Year celebrations last night were a high spirited affair with the traditional ringing of the bell around midnight in the focsle. Nick Dunbar (the oldest member on board) rang out the old year and Libby Jones (the youngest person on board) rang in the new. Then it was back to the bar and some "traditional" pipe music chosen on the duke box by the Chief Officer Robert Paterson. Some further preparations to sampling equipment will be made today in readiness for a "shake down" station scheduled for tomorrow

02/01/2008 23:25

Carried out test deployments at a shakedown station at location where a process station was carried out during the last DISCOVERY 2010 cruise (JR161 Process P1). In order of deployment we tested 1) the MOCNESS net 2) the LHPR net 3) the RMT25 net 4) the Acoustic-Towfish 5) the GoFlo bottles 6) the FRRF and 7) the CTD.

- 1) the depth calibration was faulty in the MOCNESS but was rectified mid deployment.
- 2) the LHPR worked well although a system of identifying when the mouth was open or closed needs to be firmed up
- 3) the RMT25 performed well and even caught relatively large amounts of krill which were preserved for various purposes. Most were recently moulted and so not in ideal condition for incubation
- 4) the acoustic towfish was communicating as expected. However the motor of the winch that lowers it into the water gave way and the wire spooled out to its maximum length (68 m). The crew quickly secured the cable and worked on replacing the motor of the winch to haul it back in. The instrument was recovered around 4 h later.
- 5) the GoFlo bottles could not be connected to the plastic coated cable because the groove in the bottle was too small. I have written to NMF to inform them of our predicament and to suggest that we mill larger grooves in the bottles
- 6) the CTD performed well although better lines of communication between the CTD deployment team and those taking water from the bottles needs to be put in place.

All in all the shakedown station proved to be very worthwhile in identifying snags in advance of arriving at the first true station.

The ice is much further north than average and it is very likely that we will have to move station R1 well away from its original intended position to the south of Signy. We will hit the ice-edge in around 18 h from now. We will look for krill on the way there and stop if necessary to fish them. We will hopefully arrive at the modified location for R1 around 4pm tomorrow and start a small scale survey.

03/01/2008 21:06

We continued to proceed towards the ice-edge throughout the morning. We started to search for krill targets after 8am (local) of which there were plenty. Two subsequent deployments of the RMT8 net yielded substantial amounts of krill (mainly between 30 and 40 mm total body length). The healthiest of these were apportioned to experiments in the cold room investigating the genetic expression diel activity rhythms and moulting rhythms (Ted Gaten). Angus Atkinson also took healthy krill to carry out fecal pellet production experiments. The rest were preserved in a number of different ways for various stable isotope biochemical and genetic analyses back at Cambridge. Our requirement for krill will be ongoing throughout this cruise and these catches have got us off to a good start.

The rest of the afternoon was spent continuing towards the ice edge and trying to predict where we will eventually encounter ice-pack. The captain was receiving hourly updates from various satellite sources which showed two main things (i) that the ice was relatively far north and (ii) that it was moving rapidly. This meant siting a station was relatively tricky since our original intended station position was inaccessible and any other sites in too close proximity to the ice may in turn become populated by pack-ice themselves. A decision was finally made to put the station around 3 nm to the north and west of the ice edge. We hope that the ice will continue its general movement to the south and east and not occupy our chosen spot.

We are presently carrying out a small scale survey (a box with a perimeter of 100 km) around this station to survey its bathymetry and hydrographic features as well as determine if there are many acoustic scatterers in the water column. Our further intention was also to deploy the upward-looking acoustic towfish and the undulating oceanographic recorder (UOR) during this survey but both these instruments presently have technical problems.

We will start core sampling activities for station R1 at midnight tonight.

04/01/2008 19:30

Today was the first full day of core sampling activities at our first full station R1. It started at midnight last night with the FRRF which unfortunately did not work. However the subsequent LHPR deployment was successful and yielded a high resolution depth stratified set of plankton samples between 1000 m and the surface. A CTD to full depth (around 1400 m at this site) followed and then a set of Bongo samples to a maximum depth of 400 m. These latter samples were mainly aimed at the copepod species *Oithona* and *Calanoides acutus* on which we will measure body composition and levels of fecundity. A subsequent CTD was also aimed at collecting *Oithona* which are abundant enough to be caught even within the CTD water bottles. At 10am (local time) there was another LHPR this being the daytime deployment to compliment the nighttime deployment earlier on. Target fishing for krill around lunch time was again successful and two relatively large bucket full of lively krill were distributed amongst the various interested parties. We are presently deploying the MOCNESS net which is a relatively new piece of kit within the BAS sampling programme brought in to obtain plankton from up to 8 different depth strata in good enough condition either to measure body composition or to maintain in incubations on board. We are waiting to see how well it performs in delivering plankton specimens in such a good state.

05/01/2008 22:47

Both MOCNESS deployments were successful last night. Overnight operations were halted for around 4 h as the wind kicked up to 40 knots with little warning from the weather charts. However it soon abated in the morning to a more manageable 20 knots and net sampling operations were resumed. It was then a bit of frustrating day in terms of equipment. The main intended net deployments for today were to be RMT25. Despite successful tests on deck the cogging mechanism which opens and closes the nets did not operate at depth. Peter Enderlein and Jim Fox troubleshooted on this for most of the day. Meanwhile we deployed the Bongo, mini Bongo and FRRF successfully. The freshly modified GoFlo bottles were also deployed but there continued to be snags. The messengers that are sent down to close the bottles became snagged on parts of the wire that were inexplicably thicker than the rest. This required even more milling to add to substantial amount of milling already carried out on the GoFlo bottles yesterday by Simon Wright (the deck engineer). A second deployment with messengers with enlarged grooves proved to be completely successful. While waiting for repairs to the RMT25 net we also trialled a new net, a towed Bongo aimed at obtaining plankton such as pteropods in good condition from the top 50 m of the water column. The ship towed the net at 1 knot and a maximum of 100 m of wire was paid out. A TDR recorder showed that the net almost reached 100 m meaning that a faster speed is probably required. The catch was also small which was probably a result of this slow speed and also possibly the cod end buckets being devoid of any filtering window (which helps flow through the net). Nevertheless, the net did catch small numbers of pteropods in reasonable condition. It is hoped modifications to deployment methods and the cod ends will increase future success.

The RMT25 is presently being deployed having been successfully repaired. A number of hauls will be carried out tonight before we move off station tomorrow morning.

06/01/2008 22:17

The remaining net hauls for station R1 were completed by 7am this morning. All of these involved the deployment of the RMT25 net, firstly to obtain depth stratified nets to determine the depth distribution of the macrozooplankton and micronekton communities and, secondly, to obtain krill by targetting the net at acoustically detected swarms. On the whole, the net operated successfully apart from one deployment where there was an unexplained hitch in the release mechanism. We hope that the teething problems with this device are now behind us.

Once the hauls were completed, we set off for station C2, which is located on the north east shelf of the South Orkneys. Unfortunately this station position is presently occupied by ice, so some relocation will be necessary. This will most likely be northwards, along the line of the main transect. However, we do not wish to go too far north and so get too close to the next station C3.

At present we are currently carrying out a 24 h mesoscale survey of the area around C2 (or as close as we can get to C2, ice depending). The survey involves 5 or 6 60 km transects, spaced 12 km apart. The rationale for these surveys is to characterise the mesoscale variability around core sampling stations with respect to acoustic scattering and physical oceanography. Unfortunately, the undulating oceanographic recorder (UOR) is currently not operational so the survey will only obtain acoustic information and oceanographic properties of the surface water. It is also a good reconnaissance of

what ice there is in this area, which will inform us where to resite C2 so that pelagic sampling can be carried out unhindered.

07/01/2008 20:27

We have completed the mesoscale survey around station C2 and have just commenced the first net tow (MOCNESS). The ice around this area is quite extensive covering the intended location of C2 and also part of the mesoscale survey area. We eventually sited C2 at a CTD station to the north of the intended site, since this was the first available site where the water was clear enough of ice to carry out net sampling. Nevertheless, there is a lot of fast-moving ice pack nearby so whether this area remains clear of ice for the next 48 h remains to be seen.

Further work on the UOR has been promising and the team are ready to do a test deployment. This will probably take place tomorrow. Although too late for the present station the restoration of this device to working order will be a great asset to the remainder of the cruise in terms of gaining physical data through the upper water column during the small scale and mesoscale surveys.

08/01/2008 22:29

Night time hauls went without any major hitches. The towed Bongo caught around 80 adult *Limacina* (Pteropods) over 3 hauls between the surface and 30 m. This capture technique will be used over the next few days to try and build up a stock of these organisms for experiments.

A hydraulics leak during the night covered the starboard deck with oil, including the GoFlo winch and the mini Bongo. Both were cleaned with detergent. The miniBongo was deployed after a superficial wash. The net mesh will probably be washed in a machine after this station is complete. The wire on the winch was cleaned with dry rags as it spooled out for the GoFlo deployment this afternoon.

The newly repaired UOR had a successful trial and is believed to be deployable for the next mesoscale survey in around 5 days.

Tonight there will be a target fish for krill and stratified RMT25 deployments.

09/01/2008 22:26

Night time fishing activities were a limited success. Many krill were caught during target fishing activities with RMT25. However, the towed Bongo proved less effective than the previous night in terms of catching live pteropods. The RMT25 then lost communication with the deck box during further hauls to obtain depth stratified samples. Peter Enderlein and Jim Fix stayed up all night to fix the problem. After encountering a number of broken components they had a working system by around 5 am. A deployment between 700 m and 200 m worked in the most part but communication errors were still apparent. I therefore decided to stop any further fishing with this net, which also meant the end of the station since all other activities were complete.

Our next task is to carry out 6 CTD casts to the SE of the South Orkney Islands. This area is presently strewn the brash ice and ice pack so we are having to pick our way

through it carefully. We have 2 days in which to get this task done. The ice will determine how many of the CTD locations we will get to in that time.

10/01/2008 20:43

Currently heading south, weaving our way through the pack ice. We have just completed our third of the six CTD stations along this section. GoFlo bottles were deployed at 2 of those 3 stations. Our progress through the ice is slow (an average of 6 knots). We have another 20 h to complete the remaining 3 stations before turning around and heading north. It is uncertain whether all 3 are reachable since ice charts from various sources are either conflicting or obscured.

11/01/2008 22:24

We successfully completed the other 3 CTD stations of the southerly transect. Progress through the ice was slow and some contingency time was used up in reaching the remaining 3 stations.

We are now heading back north. Our ideal destination is Signy base although a call there is dependent on the rate of our progress north. If we are held up considerably by ice, then we will head straight to station C3 via station C2 (where we will carry out some deployments that were unsuccessful first time around). If we make good time through the ice fields, we will call into Signy for a 3 h visit before heading to station C3. We will drop off cargo and mail and assist with some engineering problems as part of the call.

12/01/2008 23:01

We made it into Signy base at 6:30am. 22 scientists plus crew launched from the ship in the cargo tender and made the 500 m journey to the jetty. Scientists, crew and the Signy staff combined forces to offload the empty oil drums, provisions and mail from the tender. The scientists then had a wander around the area close to the base taking pictures of the resident elephant and fur seals as well as the spectacular Borges Bay. Hugh Venables went with a member of the Signy staff to a nearby glacier to obtain water for baseline 018 analysis. The JCR party left the base at 09:15 carrying gash and other cargo intended for other bases or UK.

The ship headed through the Weshington Strait in order to get north of the South Orkney Islands and rejoin the main transect. The strait was clear enough for navigation but nevertheless a tremendous spectacle of icebergs and bergy bits with a backdrop of misty glaciated mountains.

We got through the Strait by around 3pm but then hit some brash ice to the north of the Strait that slowed progress. Station C2 (CTD9) was reached by 19:15 this evening. An RMT25 has been just deployed since these deployments were not carried out very satisfactorily at this location ~4 days ago. The towed Bongo net will follow RMT25 deployments in order to obtain live pteropods. Tomorrow, we will proceed to station C3 via CTD 10.

13/01/2008 19:03

Completed two successful RMT25 catches at station C2 last night with few reported technical problems. The deeper catches contained many myctophids (dominated by

Electrona antarctica). The surface catch was filled with krill (300 kg). Subsequent towed Bongo catches caught around 15 *Limicina* pteropods in good condition. The net appears to be working well in terms of keeping these animals in good enough condition to incubate. However, greater numbers are required to perform all planned experiments.

A full depth CTD (5000 m) at CTD position 10 was carried out around 10 am followed by a test deployment of the UOR to establish sensible datastream outputs. We arrived at station C3 just before midday and deployed the upward looking acoustic towfish and the UOR to carry out a 24 mesoscale survey, which is due to finish around midday tomorrow.

14/01/2008 22:42

UOR and upward looking acoustic towfish both failed part way through the mesoscale survey. The survey track was completed nevertheless, with the oceanlogger revealing the surface signal of a warm water filament occupying the northwest sector of the mesoscale grid. Acoustics showed that the transition region into this warmer water contained a lot of targets, probably krill. The station position itself was well away from this transition zone, in colder more productive waters which suits our purpose since we want to characterise just one body of water during core sampling operations. Sampling started around midday with the FRRF, followed by GoFlos and then a MOCNESS net (which had a broken flowmeter). 1 target fishing haul with the RMT8 caught two cod ends full of live krill which are happily fuelling the next set of incubation experiments by Ted Gaten (clock genes and circadian rhythms) and Angus Atkinson (fecal pellet production rates and sinking speeds)

15/01/2008 21:04

Core sampling activities at station C3 continued with most devices performing well. The flow meter problem with the MOCNESS was solved and the deployment between 21:00 and 00:00 last night went without hitch. Unfortunately, the LHPR developed a flow meter problem which was still not fully resolved by the second deployment later that day. CTDs, Bongo and mini Bongos were all carried out without any problems. The towed Bongo was deployed from the forward crane during the second LHPR deployment.

16/01/2008 21:06

Towed Bongo deployments again failed to catch large numbers of pteropods. We conclude these organisms are not very abundant and are patchily distributed in this region. We are expecting them to increase in abundance further north. RMT25 stratified hauls overnight went well with good catches of myctophids in the deeper layers and plenty of krill in the surface layer. The wind picked up overnight, which was just about tolerable for deployment of the Bongos but not the mini Bongos which were postponed. Conditions were nevertheless good enough for the RMT25 daytime deployment, which were again successful in catching myctophids and krill. One unusual species of *Gymnoscopelus* was noted which may require further taxonomic investigation to determine if it has been previously described (a new species perhaps?). The wind died down towards the early afternoon so one mini-Bongo, previously postponed was deployed before leaving the station.

We are now heading to station C4, ticking off a number of CTD stations en route. A failure in the termination meant that the first of these (CTD position 12) has been missed. We expect this problem to be fixed by the time we reach CTD position 13.

18/01/2008 08:24

The retermination of the CTD wire ended up in 200 m of this cable having to be sacrificed. This should not be a major problem since the cable is relatively new and so close to its full length. We completed the remaining CTDs between station C3 and C4 without any problems. A towed Bongo overnight did not catch any *Limacina*. We arrived at the start of the mesoscale survey for station C4 around 1pm yesterday. The survey comprises of 5 parallel lines, each 50 km long and 12 km apart. The aim is to place one of the middle transects through the station location. It is also necessary to ensure that this transect is carried out in daylight. The timing of our arrival has sometimes meant that our first pass of this middle transect is in darkness so we have repeated this transect during daylight. This also makes for an interesting day/night comparison of that stretch of water. The original intention was to tow the UOR along these transects. However an malfunction in this instrument has meant that surveys are now dedicated towards acoustics and predator observations. Surface oceanography collected during the surveys has also been informative. For instance, during C3, we identified a warm body of water to the NW of our station position which we then tried to avoid to minimise any variance between deployments.

18/01/2008 21:15

Completed the 24 h mesoscale survey around 1:30pm today. The survey revealed a great deal of scattering in the water, probably a combination of krill and myctophid fish. It may explain the large numbers of whales (mainly Fin) we have seen in this area over the past 24 h.

After the survey, we held station while a fire drill was carried out involving all scientists and crew. Haimish, the purser, did a thorough demonstration on the correct usage of fire extinguishers and hoses before we all crammed into the lifeboats. Core sampling activities at this station (C4) have just commenced with the MOCNESS net.

19/01/2008 21:25

Continued with core sampling activities at station C4 for the whole of today. Both MOCNESS nests were carried out successfully and sufficient krill was caught between two targeted deployments of the RMT8 nets to supply the incubation experiments and the multitude of requirements for preserved material. No *Limacina* were caught by the towed Bongo. There was a glitch in the software and coms of the LHPR net, which resulted in the depth of the net being lost for a period of time. The net was brought back on deck having reached a maximum depth of 700 m. The cogging device appeared to have carried on working so something may have been salvagable from this deployment. An inspection by Jim Fox revealed little wrong with the device and a subsequent (daytime) deployment worked without a hitch. There were also successful deployments of the CTD, FRRF, Bongos and GoFlo bottles. A targeted haul this evening produced more krill, both in the RMT8 and the RMT25 nets. The two RMT devices were deployed one after the other over the same track to make an intercomparison of their krill catches. Further RMT25 target fishing for myctophid fish is currently taking place.

20/01/2008 21:20

RMT25 deployments overnight were successful in catching good amounts of myctophids, principally *Electrona antarctica* in the deeper layers and *E. carlsbergi* closer to the surface. Daytime deployments of this net were not so smooth with an undiagnosed cogging problem causing 1 depth interval (700 to 400 m) to be missed. We repeated this haul with the consequence of leaving C4 3 h late, at approximately 17:00. We are hoping to make some of this time up as we move to responsive station R2 overnight, carrying out 2 CTD deployments en route.

The location of R2 was deliberately not set at the start of the cruise to allow us to alter it according to the conditions we encountered in the field. As we approached this station, our feelings were that a location with the lowest productivity possible would be the ideal choice as a contrast to the higher productivities already encountered and expected further north. Another factor was that we needed to approach this station in the dark to allow primary productivity bioassays to be carried out (which requires water collected from the towfish at > 6 knots). The location of CTD20 and our expected time of arrival there met both these criteria. We are due to arrive there between 03:00 and 05:00 tomorrow morning where we will commence with a 6 h small scale survey.

21/01/2008 20:58

Weather did not look too promising as we closed in on station R2. We battled our way along the small scale survey achieving two thirds of its intended length before running out of time. We then headed back to the station location. Despite the forecast, the wind started to drop and by the time we arrived at R2, conditions were favourable enough for the deployment of the first instrument on the timetable the LHPR. The deployment was completed without any problems as was the FRRF and the GoFlos that followed. Presently carrying out a MOCNESS deployment. Weather conditions are still favourable and we are hoping they will hold despite the forecast.

22/01/2008 21:11

A strengthening wind and accompanying swells made sampling less and less possible through the night. A bucket was lost from the first MOCNESS deployment, which was indicative of the difficult working conditions. The RMT8 net then encountered some difficulties when being brought back on deck, with the net monitor cross crashing into the deck and bending a number of bolts and bars. No krill were caught by this net. A second (nighttime) MOCNESS deployment was aborted when it reached a maximum depth of 625 m because conditions by that time had become too hazardous to continue working. Further net operations were suspended once this net had been successfully retrieved (with good samples). Conditions were still good enough for CTD and vertical Bongo net work, which continued through the night and morning. By 10 am, a full depth CTD and CTDs for Oithona work and fatty acid/particulate work had been carried out successfully. Four Bongos (2 x main, 2 x mini) were also completed by that time.

At 09:30, I held a meeting with those people who still had deployments outstanding for R2. Beki Korb had not yet carried out an FRRF for nighttime (it was postponed last night because of the swells). Martin Collins had not yet deployed the RMT25. Target fishing had yet to find any krill. The forecast was for the winds to strengthen

over the next 24-48 h. It was felt that remaining on R2 for the remaining allotted time (ie a further 24 h) would not be useful since none of the remaining deployments were likely to take place in that time. It was decided to leave the station at 11am and make to the next CTD station. This is somewhat disappointing, especially for fish/RMT25 work since the very low productivity at R2 is a good contrast to the communities of higher productivity regions elsewhere on the transect. Satellite information informs us that the next 3 CTD stations will similarly be located within this low productivity region and we resolved to consider the suitability of weather conditions when we reach each of these stations to see if RMT25 deployments can be made. The forecast and current weather makes such a prospect remote nevertheless.

23/01/2008 21:16

Wind and swells increased overnight such that we were unable to reach the location of CTD posn 23 and instead headed straight for CTD posn 24. By first light it was apparent that we would not be able to hold position at CTD posn 24 and continued through the position 'hoved to', waiting for an improvement in the weather. A slight improvement by 10am encouraged us to make back to CTD posn 24 to see firstly if position could be held and, secondly, whether deploying a CTD was possible. We found we could just about do both and so a full-depth CTD deployment was made that turned out to be successful. We took a similar approach to CTD, 25 which was successfully completed by 18:00 this evening. We are currently making our way to station P2, where hopefully conditions will still be good enough for another CTD deployment and possibly other deployments besides.

24/01/2008 22:19

Weather unsuitable for any deployments for the entire day - sea state 8 to 9 wind gusting up to 50 knots. Hoved to around station P2 and the mooring, hoping for an improvement tomorrow

26/01/2008 08:09

Weather started to die down at long last. The nighttime of 24th/25th was spent hovering around the mooring site, trying to obtain some good acoustic records to compare to those being collected by the ADCP on the mooring. Our earlier attempts at this were not great with the large swells causing a large amount of drop out in the acoustic traces. However, by that night the swell had died down enough to allow the acoustics to obtain much better records, even recording a diel vertical migration as the night progressed through to dawn. By mid morning, the swell had decreased further and we made our way back to the position of the station (P2), which is 4nm to west of mooring site. There we carried out a CTD followed by a set of Bongos, an FRRF, a CTD for Oithona and GoFlo bottles. These activities finished around 4pm. By then, it was judged that conditions had calmed enough to attempt a retrieval of the mooring. We maintained position 400 m downwind of the designated site of the mooring and sent the acoustic release signal. It dutifully came up, slightly closer to the ship than anticipated, but within a good distance to manoeuvre our way to pick it up on the starboard side of the ship. It was shackled and hauled in, firstly the flotation device containing an ADCP, SeaBird CTD and Argos beacon, then the sediment trap and current meter and finally acoustic releases. All went as planned. The sediment trap appeared to have worked as programmed, which was great news. We will download data from other instruments during the course of today. The mooring was fully retrieved by 20:00. Three towed Bongos were deployed before making our way to the

start of the mesoscale survey, which was started at 00:00. We are now 5 h into this survey and conditions are remain suitable for adequate acoustic and high predator data collection.

26/01/2008 21:55

Continued with 24 h mesoscale survey for rest of the day. Will finish around midnight tonight. Weather currently looks too bad to start other station activities at end of survey period. Hoping that wind will abate overnight as forecast and sampling can recontinue tomorrow

27/01/2008 22:06

Weather calmed down relatively quickly and sampling restarted with a nighttime FRRF, a CTD for Dave Pond, and a series of Bongo nets. We then tried to get the RMT25 deployments underway, but there were some snagging problems, firstly with the depth reading and then with communications. After a few failed deployments, we put it to one side for a thorough check over and deployed the MOCNESS net instead. That deployment was carried out successfully. After identifying and repairing some cracks on the circuit board of the net monitor, we tried the RMT25 again around midday. The deep deployment was carried out successfully and the shallow deployment is now nearing completion. There will then be a spot of target fishing with the RMT25 followed by another depth stratified RMT25 series through the night.

28/01/2008 22:20

RMT25 fishing was successful overnight, as was the LHPR that followed first thing this morning. We failed to find any krill during the target fishing slot during the mid morning. We then began the mooring redeployment by 11am. The equipment was laid out before lunch and then deployed in under 2 h after lunch. The operation was smooth and efficient, with everything going to plan. The good weather was a great help, especially in moving around some of the heavier pieces of kit such as the large weights (welded railway wheels). We looked for krill targets again after the mooring deployment, making our way to CTD 27. Nothing was found, so we arrived at the CTD station in time to make a full depth CTD deployment. This will save us at least 3 h on our passage north, since this station no longer needs ticking off. We will shortly head back to P2 to finish off the last 2 deployments, the nighttime MOCNESS and LHPR

29/01/2008 21:50

Station P2 was finished off by first light this morning with successful MOCNESS and LHPR deployments. We started to make our way to P3 via a number of CTD stations. As we are approaching the area between South Georgia and Shag Rocks, extra time will be spent searching for krill targets. There has been little sign of any krill on the echocharts since leaving P2.

A general meeting was held today to discuss options for science after P3. At present, it appears that retaining the original plan of a station before the Polar Front, transitional area and another in the Polar Front itself at the site of penguin foraging is still optimal to meet the differing needs of various members of the science party.

30/01/2008 21:46

Target fishing for krill overnight was unsuccessful. One target was spotted early morning but it was difficult to catch given its depth of more than 100 m. We missed it twice and then ran out of time. Completed CTD 32 by 11:00 am and also carried out a Bongo net to 200 m. The net contained juvenile pteropods at long last. The mesoscale survey for P3 was brought forward because conditions were too marginal for mooring recovery. The survey started around 12:00 pm and will continue until the same time tomorrow. Weather is forecast to improve and hopefully be good enough for mooring recovery early afternoon.

31/01/2008 21:42

Mesoscale survey was completed by 11:30 today. All 6 transects were run with a towfish deployed throughout. Transect 3 (which runs through the station) was run twice, once in the dark and one during daytime. Underway samples were filtered for pteropods, to compliment the number of other underway measurements made during this survey. The acoustics found plenty of fish marks during the survey but krill marks were quite rare.

Mooring was recovered successfully this afternoon. Again it was a smooth operation. However, the sediment trap did not rotate through the carousel and no sediment was collected over the past 15 month deployment period.

Currently, we are target fishing, hoping for better luck than we have had over the past days. P3 core-sampling activities will start at 21:00 with MOCNESS

01/02/2008 21:24

LHPR and MOCNESS deployments went without hitch last night. Bongo nets CTDs, Go Flos, FRRF and a further a LHPR were all achieved today without any problems. A MOCNESS is presently underway. The CTD for Dave Pond was brought forward to follow the MOCNESS in place of krill target fishing. We have found krill targets to be rare at this region and a 2 h slot both to find and to fish krill targets is insufficient. Therefore this 2 h slot will be consolidated into a longer fishing slot later in the station.

02/02/2008 22:11

A twist in the 17 mm cable, resulting from a length of warp falling off the drum potentially put an end to RMT25 deployments last night before they even started. The wires were quickly swapped over, which at least enabled the RMT8 to be deployed in its place for some target fishing. It was indeed successful, with 500 krill being caught. This now satisfies the krill requirement for the krill clock gene experiments. Angus and his fecal pellet experiments will still require some further catches over the next few days however. While the target fishing was taking place, some quick work by John Summers and a speedy retermination by Peter Enderlein enabled the 17 mm cable to be functioning again. This allowed one of the two planned RMT25 deployments to be carried out overnight. Bongo netting followed in the early morning and then the two daytime RMT25 deployments. The mooring redeployment followed on from the fishing, starting around 3pm. The weather was particularly calm, which helped this operation greatly. The deployment went according to plan, with the final release being made just after 6pm. We must now wait until darkness to carry out the

one RMT25 deployment that was not achieved last night. Until then, we will do some target fishing

03/02/2008 22:14

Target fishing was successful in obtaining sufficient krill for incubations and preservation yesterday evening. Station P3 was then completed with a surface nighttime RMT25. The next two stations are responsive stations, where the exact location are to be defined by the conditions experienced during the cruise. Our remit for the first of these, R3, was to find some of the highest levels of productivity resulting from South Georgia productivity plume. Station P3 was slightly to the west of the main centre of this plume, so we ran a west to east transect with the intention of running across this plume and defining its limits. We entered very high Chla soon after we left P3 at 3am. A large krill swarm was spotted around 5 am, which was successfully fished. Continuing in an easterly direction, we entered colder water with higher levels of silicate around 8:30am, which was taken to be the easterly limit of the plume. We therefore decided to turn around and run a parallel westerly coarse 12km to north of the previous transect, in order to survey the area more fully. This coarse was run until around 12:30pm. It was decided to place R3 3/4 of the way along this transect, in the middle of the high Chla region. We carried out a target fish at the end of the transect which was again successful and completed a series of 4 successful catches at 6 h intervals over the past 24 h (a request of the AFI clock genes project). We then moved to the designated position of R3 and started core-sampling activities around 14:30.

Although meeting the main criteria for R3 (highest Chla downstream of South Georgia), the final location for this station is possibly a bit closer to P3 than ideal. However, a further constraint that forced our hand on this matter is the forecast of bad weather in 36 to 48 h. That bad spell looks like it might last a few days. Given how few days we have left and the need to still complete another responsive station at the Polar Front, the opportunity to find a suitable spot for R3 so quickly was one I readily accepted.

04/02/2008 21:15

The two MOCNESS deployments, CTD for Dave Pond and FRRF were carried out without any problems last night. The nighttime LHPR suffered a problem with the winding on mechanism and the sample was abandoned. The morning was spent carrying out a full depth CTD followed by a series of Bongo net deployments. One of the cod-ends of the mini-Bongo was dropped, so the 3rd mini-Bongo deployment was changed from being a 200 m deployment to a 400 m deployment - Pete Ward received 1 cod-end while Nina was left the other for pteropod experiments. After some attention from Jim Fox, the LHPR was deployed again in the late morning and this time performed without any problems. The afternoon has been spent searching for krill. Nothing had been spotted after around 4 h of searching, but a target has just now been found and is being fished.

05/02/2008 21:55

Although the wind started to pick up overnight, the two nighttime RMT25 deployments were completed successfully. Conditions remained marginal into the morning, but the fact that the wind changed direction by almost 180 degrees stopped any major swells from developing. Four Bongo deployments were made in the early

morning and then the daytime stratified RMT25 nets were carried out during late morning and into the early afternoon. Station R3 was completed by 14:00. Our next intended station is R4, at the Polar Front. The exact site will be determined by the foraging behaviour of king penguins tagged at Hound Bay, South Georgia. It appears that a particular hot spot of foraging is around 50°S 33°W, which is 270 nm from R3. One complication however is that the weather forecasts for that region are ominously bad and it is likely to remain that way for a number of days (up to Sunday 10th). We are currently making our way there hoping to get in a bit of sampling before the bad weather arrives. We have decided not to carry out CTDs en route in order to make as rapid a passage as possible. We expect to arrive at R4 tomorrow afternoon.

06/02/2008 21:39

Made good progress towards station R4 for most of the day, taking advantage of the following wind and the swell. Around 11:00, around 50 nm short of our intended station location, we noticed strong targets on the echosounder, between 100 m and 200 m depth, stronger on 38 kHz than 120 kHz. Such marks are consistent with myctophids even though they were unusually high in the water column for the time of day. Just after spotting the marks, surface temperature rose dramatically to around 5°C. This area is also a site of King penguin foraging as identified by satellite tags recently deployed on individuals at Hound Bay. Combined, these features were consistent with the criteria identified by Martin Collins for the location of R4. Therefore, we decided to halt our journey north and start core-sampling activities. This started with a surface daytime RMT25 around midday. Although flown right through the marks, this net did not catch any fish. We then carried out a small scale survey of the area, which involved parallel transects first running along the warmer surface water and then the colder surface water. As the sun is now setting, it is hoped that a series of RMT25 target hauls will be carried out to try and catch whatever is responsible for the prominent acoustic marks in this area, since these are probably the key prey items of King Penguins. Our hope is that the weather holds sufficiently for safe deployment.

07/02/2008 19:57

The weather managed to hold enough to squeeze in two net tows over night. The first was an RMT25 aimed at the top 200 m. Unfortunately, at the point of deployment, the jaw mechanism was not working and so it was necessary to deploy the net open and carry out an oblique tow. The net caught a significant number of fish, dominated by *Electrona carlsbergi* and *Protomyctophum spp.* The acoustics revealed two main layers of targets in the upper layers and identification of what species occupied which layers was required. The jaw mechanism was operational on the RMT8 net, so this was used in place of the RMT25. Each layer was fished by a separate net (ie the RMTs have two nets that can be opened and closed separately). Myctophid catches with the RMT8 were not as large as with the RMT25, but some distinction between the species composition of each layer was revealed. Nevertheless, neither layer was exclusively inhabited by just one species. By the time the RMT8 had been hauled in (~3am), weather conditions had become too severe to continue. We have been hove to for the rest of the day. As was expected before we even arrived, our short window of opportunity has expired and, according to forecasts, it is unlikely to improve even by Sunday 10th, which is our latest break-off day from this station. It has been necessary therefore to abandon the rest of station activities at R4 and to make the ship head for

South Georgia. At the moment we are heading almost due west and it may be some hours before a more southerly course can be adopted.

08/02/2008 22:01

We were hove to heading west for most of last night but gradually turned south as the wind started to turn northerly. The wind and swell moderated throughout the day and ship's speed gradually increased from 4 to 8 knots through the afternoon and now to above 10 knots this evening. We have an ETA at NW South Georgia of 02:00 tonight. Our first activity will be the deployment of whale buoy moorings.

09/02/2008 23:37

Arrived at the whale buoy moorings site, NW of South Georgia, around 4am. It took around 90 minutes to carry out the deployments - 5 buoys, 4 making the corners of a diamond (around 10 nm apart) and one in the middle. Once deployed, the buoys were synchronised by making a controlled implosion (lowering a light bulb through the water until it imploded). By 07:30 we were ready for our next activity, krill RMT8 fishing. We headed to the shelf edge but had little success, partly through missing a rapidly migrating swarm, partly because the net completely ripped open and lost most of what it caught. We returned to the shelf for the station activities. We chose the core box CTD site 3.2S for these activities since it has a suitable depth and also a legacy of past data. A CTD, some Bongos, a CTD for Oithona, FRRF and GoFlos were carried out. A problem with the stern gantry meant that there was a delay to the start of netting activities. These were resolved by 5pm and a MOCNESS was deployed by 5.30 pm close to the core-box mooring (near to 3.2S). The MOCNESS reached a max depth of 160 m and fished the water column in 20 m increments. We are presently in the middle of more krill target fishing and have had one successful haul already. An RMT25 at Station A (shelf edge) will take place following this and then some more target fishing before heading off to do the pickups at Bird Island first light tomorrow.

11/02/2008 14:13

A successful krill haul and then some RMT25s completed sampling activities for the supplementary South Georgia station (since termed R5) in the early hours of 10th. We then headed in to Bird Island to pick up 3 Pax between 8am and 12pm. We immediately headed for Stromness Harbour on completing the uplift and arrived there around 6pm to commence the acoustic calibration. The ship was anchored and held position by DP for the duration of the calibration. There were a few snags in setting up the calibration, particularly finding the copper sphere under the ship. This may have been due to some modifications to the shape of the ship's hull following an incident earlier in the season. The calibration took a bit longer as a result and was completed by 8am this morning. It is now not possible to fit in any other science activities apart from the 5 CTDs that were previously axed during the race to the Polar Front. After e-mail correspondence with Mike Meredith, alternative locations running offshore direct from Stromness were agreed to be suitable for addressing dynamic height issues. The CTD series will take us to the point where we must break off science in the early hours of 12th.

13/02/2008 00:24

Only 2 CTDs for the DIMES transect were completed last night. A problem with one of the ship's motors meant that the captain requested we break off and head for South

Georgia. We arrived at Hound Bay around 7am. A field party was sent to pick up left baggage at a depot on the beach. In the meantime, the forward hatch was opened and packing boxes were brought out and distributed amongst the labs. The Hound Bay cargo was successfully retrieved around 09:00 and we left for King Edward Point at 09:45, arriving at 14:30. Strong winds prevented the ship from going alongside, so we anchored in the bay. Engineers used this time to look at the problem motor. The science team dismantled net equipment and stowed it in the science hold. We are presently still at anchor, waiting for a window of opportunity to transfer people and cargo with KEP.

13/02/2008 22:55

Stayed at anchor in Cumberland Bay all night. By morning the weather had moderated. The captain felt that the engineers needed more time to clean up the broken motor before heading for Stanley. He therefore berthed at KEP at 09:00. Shore leave was granted until 16:00, which was much appreciated by the science crew. FIDS and Norwegian scientists were taken on board for the journey back to Stanley, Martin Collins disembarked for 2 weeks at KEP. We departed at 17:00 and are now on our way. The clean water towfish is currently deployed. The CPR will be deployed at 08:00 tomorrow.

14/02/2008 12:00

CPR deployed at 11:11. Clearing and packing equipment. Ship running well on the backup engine although speed has been reduced as a precaution.

16/02/2008 12:00

CPR recovered at 11:37. NOC towfish recovered at 11:42. Continued to clear and pack

17/02/2008 12:00

Arrived in Port Stanley during the morning. Packed containers in late morning and afternoon

18/02/2008 11:00

Demobbed from ship and headed into Port Stanley

1.6 Scientific Personnel

| | | |
|-------------------|----------------------|-------------------------|
| Geraint Tarling | BAS | PSO |
| Sophie Fielding | BAS | Deputy PSO |
| Hugh Venables | BAS | Oceanography |
| Mags Wallace | BAS | Oceanography |
| Rebecca Korb | BAS | Phytoplankton |
| Mick Whitehouse | BAS | Nutrients |
| Min Gordon | BAS | Nutrients/Phytoplankton |
| David Pond | BAS | Biochemistry |
| Rachael Shreeve | BAS | Mesozooplankton |
| Peter Ward | BAS | Mesozooplankton |
| Angus Atkinson | BAS | Macrozooplankton |
| Jon Watkins | BAS | Krill |
| Martin Collins | BAS | Nekton |
| Gabby Stowasser | BAS | Nekton |
| Peter Enderlein | BAS | Equipment |
| Nathan Cunningham | BAS | Data Management |
| Andy Black | RSPB | Higher predator obs |
| Dirk Briggs | BAS | Higher predator obs. |
| Maria Nielsdottir | NOC | Iron Work/Oceanography |
| Daria Hinz | NOC | Iron Work |
| Elizabeth Jones | UEA | CO2 work/Oceanography |
| Ted Gaten | Leicester University | Krill clock genes |
| Nina Bednarsek | BAS/UEA | Pteropod ecology |
| Jose Xavier | Univ Algarve | Fish and zooplankton |
| James Fox | BAS | AME |
| Jeremy Robst | BAS | ITS |

1.7 JCR Officers and Crew

CHAPMAN Graham P Master
PATERSON Robert C Chief Officer
LEASK Douglas J 2nd Officer
EVANS Simon D 3rd Officer
WADDICOR Charles A ETO (Comms)
CUTTING David J Chief Engineer
COLLARD, Glynn 2nd Engineer
ELLIOTT Thomas R 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
BLABY Marc A Bosun's Mate
JENKINS Derek G SG1
JOLLY Lester SG1
CAMPBELL Andrew C SG1

MULLANEY Clifford 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
TAME Paul D Engineer
DENMAN John C Engineer
MCKINNON Paul Surveyor

1.8 Acknowledgments

Geraint Tarling PSO

This cruise has built on the achievements of JR161 in making a thorough examination of the physical- and biological oceanic environments of the Scotia Sea, from ice-edge to Polar Front. The achievements of the present cruise are a tribute to the hard work and dedication of Captain Graham Chapman and his crew, who guided and supported us through some of the most treacherous seas in the world. Tribute is also owed to the science support staff, Jim Fox and Jeremy Robst, in keeping our instruments working and making sure our data streamed through consistently and securely. Much hard work and preparation went in to the planning of this cruise before even leaving headquarters and I would like to acknowledge Eugene Murphy and the Programme Advisory Group of Discovery 2010 for facilitating the design and implementation of this science programme. Also, thanks to Chris Hindley and Julia Fear in smoothing out the prickly logistical details of putting such a large science team in the field, and to Kath Nicholson and Mick Cliff ensuring that our equipment arrived safely and in good time. Jeff Benson and the team at NMF provided remote support during our teething problems with the sampling equipment they provided, which was a great help. This cruise was part of the Q4 programme at BAS, with further support from the Antarctic Funding Initiative.

1.9 Recommendations

2.8.4 UOR Recommendations

Invest time and money on the UOR updating the interface and down wire communications. The supporting computing and systems interface is become old and hence very unreliable, it needs to be replaced. This should be done in full consultation with AME.

7.1.5 Iron Work Recommendations

For future work, it would be a wish to bring at least one more person on the cruise to give a hand with the iron work and bioassay. Being just one doing the iron work limits the coverage of underway sampling and having an extra person would mean that a bigger suite of nutrient and light combinations for the bioassay experiments could be done.

10.1.5 Krill Ecology Recommendations

No major problems, although I need a more efficient through-flow method if I do this in future! I am indebted to my fellow scientists for all the gear changeovers, target fishing, filtering and analysing the chl *a* samples and preparing filtered seawater.

I had been hoping to rely on the fluorometer to provide an underway index of the food environment – shame about its non-functionality, as this index is absolutely basic to the food web.

A design issue for future cruises might be to make this target fishing less closely linked to station work and more opportunistic in nature (ie. using transit time between stations as search time and fishing when we run over a swarm). This may help keep the target hauls ticking over at a rate of 1 every day or so rather than having big gaps between big work sessions. We started doing this later in the cruise and it worked out well.

16.1.10 Gear Recommendations

Replacing the old DWNM system is well underway now. The prototype worked very well and the new connectors and sensors a major improvement compared with last season. During the summer hopefully the transition will carry on so that next season the new fully tested DWNM system will replace the old system. Also the aim is to have 3 fully functional systems one for the LHPR, one for the RMT8 and one for the RMT25.

We are only using non-filtering cod-ends in the moment. The new ones were not of the quality expected and have to go back to the net maker for repairs and also to strengthen them.

The connector of the RMT25 release mechanism needs replacing. The connector is old and one pin is corroded and smaller than the other pins, causing problems to make a proper connection.

On a more general note mobilisation and demobilisation again relied on good weather condition during passage from and to the Falklands. Also we benefited from having 3 people on board before we arrived on JCR who unpacked the Containers, giving us a head start. More time should be allocated for future cruises especially if the same amount of gear will be used. **We need 3 days for mobilisation and 2 day for demobilisation.**

16.3.7 ITS Recommendations

The UPS situation in the computer office is very poor and should be the focus of the work done in the summer 2008 refit. A reorganisation of the racks in the computer office should be done at the same time.

The SCS data logging system is struggling to cope with the number of streams being logged, at the least it should be upgraded to the latest version of a new logging system should be installed.

The V240 Sun servers should probably be replaced with Linux servers – the Linux virtual machine JRLC is about twice as fast as a V240 and with the NetApp NAS there is no longer a need for Sun servers.

2 PHYSICAL OCEANOGRAPHY

Hugh Venables & Mags Wallace

2.1 Introduction

Collection of physical oceanographic data throughout JR177 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, Expendable Bathythermographs (XBTs) and an Undulating Oceanographic Recorder (UOR). Locations for water column profiling had generally been selected in advance, although the opportunity for some additional CTDs arose at the end of the cruise. The locations of these were selected once it had been confirmed that time would be available, subject to the success of the acoustics calibrations.

Aim

The purpose of the physical oceanographic program was twofold: firstly, to further the understanding of the physical environment, with a view to planned future projects; and secondly, to support the work of the biologists and chemists aboard the JCR, and aid in the selection of suitable sampling locations.

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 Lowered ADCP (LADCP)
- 2.7 XBT profiles
- 2.8 UOR
- 2.9 Satellite data

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

Mags Wallace

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 $\approx 15\text{m}$)

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_tsshrrp*, which invoke the *listit* command to retrieve 24 hours of gyrocompass, bestnav, Ashtec (ADU2), Ashtec Glonass (GG24), GPS NMEA, Seatex and tsshrrp (heave, pitch and roll) data. Data are saved in subdirectories 'gyro', 'bestnav', 'gpsash', 'gpsglos', 'gpsnmea', 'seatex', and 'tsshrrp' as *gyro.NNN*, *bestnav.NNN*, *gpsash.NNN*, *gpsglos.NNN*, *gpsnmea.NNN*, *seatex.NNN* and *tsshrrp.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 $\neq 50$ 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 $\neq 50$ 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 $\neq 50$ 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 ≤ 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*.
- scatter_depth* Loads *sim500_NNNclean.mat* and calculates 1 minute averages to make plotting easier, then loads 1 minute average latitude and longitude data from *oceanlog_navNNN_1minave.mat* (see Oceanlogger section) and plots 1 minute average depth data. Output is *sim500_NNN_1minave.mat*.

plot_sim500_all Reads in *sim500_NNN_1minave.mat* for all jdays and GEBCO bathymetry data. Plots 1 minute average depth data along entire cruise track.

2.2.3 Problems encountered

A few problems were encountered in the collection of EA600 data: on jday 010, the bottom depth was set to be too shallow, so several hours' worth of data were lost whilst the instrument was searching for the bottom in the wrong place; on jdays 012, 038, 039 and 044, data were lost due to poor sea conditions during stormy weather. No good data were collected on jday 038, whilst only ½ a day's worth of data were good on jday 039. The other two days lost a few hours' worth of data.

2.2.4 Example plots

Plots of the cruise track, extracted from the Seatex GPS, and EA600 depth along the cruise track are shown below in Figures Ocea.1 and Ocea.2.

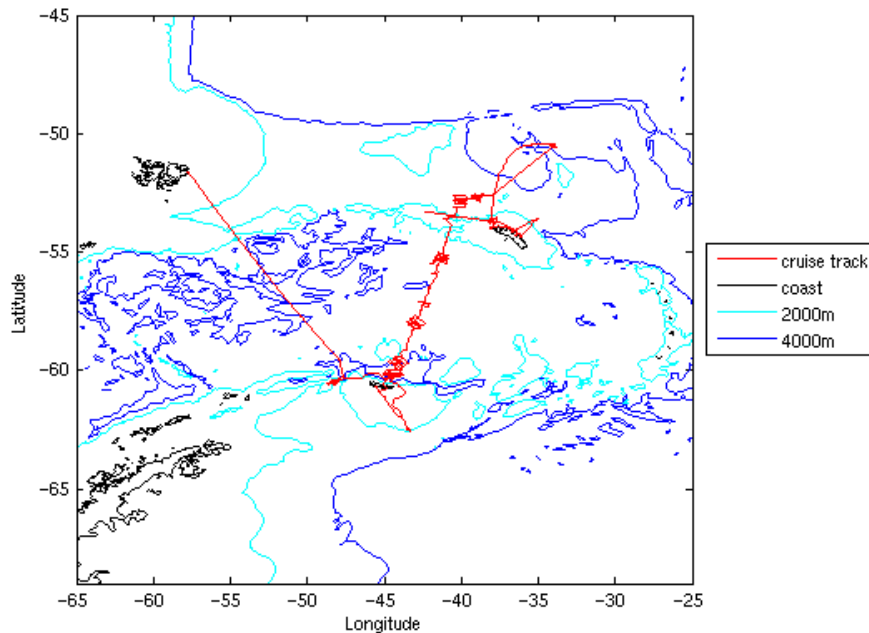


FIGURE OCEA.1: JR177 CRUISE TRACK FOR 31/12/07-14/2/08 FROM SEATEX GPS. COASTLINE AND BATHYMETRY DATA ARE FROM THE GEBCO DATASET.

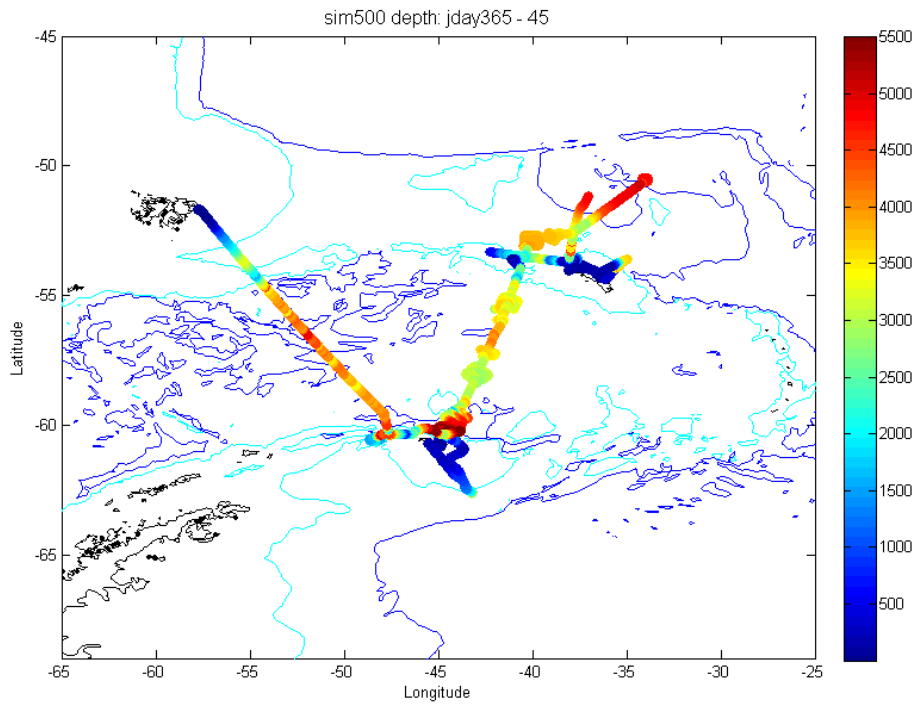


FIGURE OCEA.2: SIMRAD EA600 DEPTH (1 MINUTE AVERAGES) FOR JDAYS 1-45.

2.3 UNDERWAY OCEANLOGGER & METEOROLOGICAL DATA

Mags Wallace

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 the meteorological data were measured by instruments on the forward mast. Instruments were as follows:

Oceanlogger

SeaBird Electronics SBE45 CTD

Turner Designs 10-AU Fluorometer

Meteorological data

Photosynthetically Active Radiation (PAR) 1, Parlite Quantum Sensor, Kipp & Zonen

Photosynthetically Active Radiation (PAR) 2, Parlite Quantum Sensor, Kipp & Zonen

Transmissometer 1, Proto1 SPLite, Kipp & Zonen

Transmissometer 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.

get_select Performs the same functions as *get_underway*, but asks for a file extension, 'ext' and beginning and end times in the format YYDDDHHMMSS, and outputs SST, salinity, fluorescence

and PAR to *oceanlog_ext*. The script also calls *get_seatex* and saves navigational data for the time period of interest as *seatex_ext*.

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*.

load_select

Loads *oceanlog_ext* and *seatex_ext*. Only data that are flagged as 'good' are used but, unlike *loadunderway* (above), no further cleaning is carried out. The script calculates 1 minute averages of SST, salinity, fluorescence and PAR for the time period selected in *get_select* (above). Data are plotted and the figure is saved as *seatexoceanlog_ext*. Data are written to a Matlab file *seatex_oceanlog_ext* and an ascii file *seatex_oceanlog_ext*.

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_jr177.mat*.

2.3.3 Problems encountered

(1) Underway temperatures have previously been observed to be $\approx 0.3^{\circ}\text{C}$ 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 this cruise a concerted effort has been made to monitor the problem, and comparisons have been made between CTD data from 6m and synchronous underway data. *check_oceanlog_ctd* loads

jr177ctdNNN.2db.mat, *jr177ctdNNN.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 plot of CTD temperature minus underway temperature (Figure OCEA.3) yields a scatter of points between -0.2 and 0.9°C. There is a mean offset of 0.37°C (oceanlogger reads too cold) which is not affected by the removal of outlying points. The standard deviation is 0.1 °C. A plot of the change in the temperature difference against time interval between data points shows that the timescale for variability in the temperature is short, <30 minutes (Figure OCEA.4). The intention is to collect underway and CTD data from previous cruises and pool the data, such that an offset can be determined to calibrate the underway temperature data. A request will also be made to replace the underway temperature logger. Underway and CTD salinities show better agreement, with a range of -0.04 to 0.113. If outliers are discarded, CTD salinity – underway salinity has an offset of about 0.01. Similarly to comparison with underway samples (see below) there is greater scatter towards the end of the cruise.

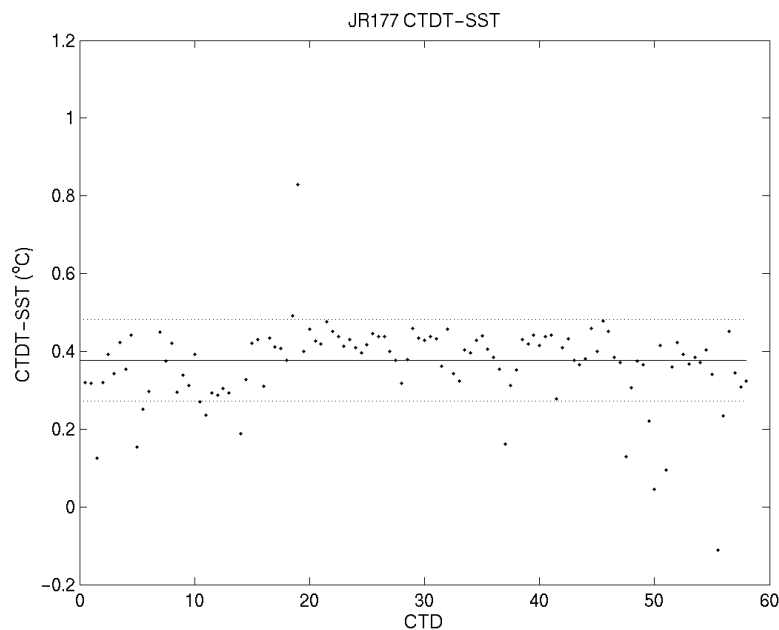


FIGURE OCEA.3: CTD-OCEANLOGGER TEMPERATURE, WITH MEAN AND MEAN +/- STD DEV.

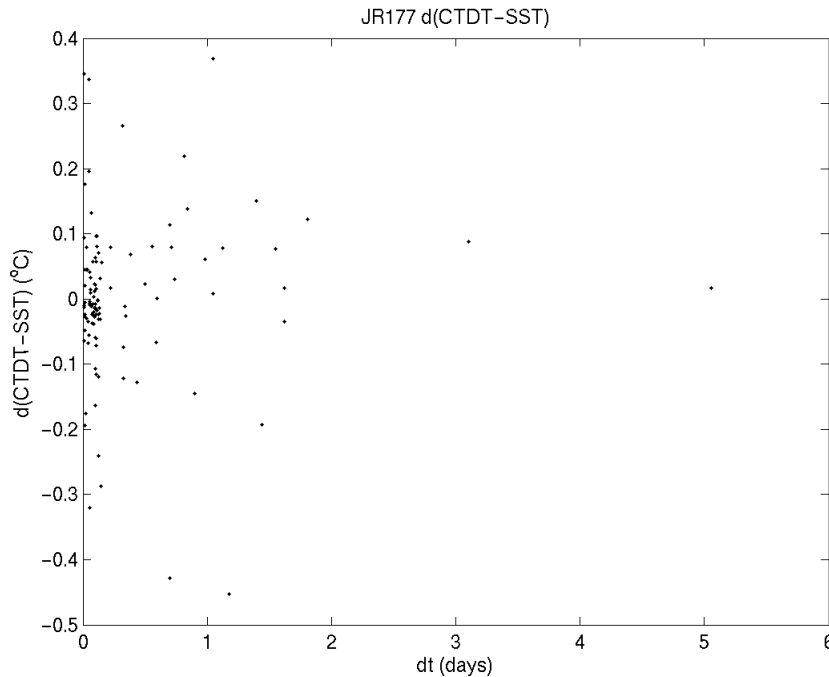


FIGURE OCEA.4: CHANGE IN TEMPERATURE DIFFERENCE AGAINST TIME INTERVAL BETWEEN DATA POINTS.

(2) The bulb in the underway fluorometer was replaced on 03/02/08, leading to an approximately threefold increase in fluorescence readings, and a reduction in noise. It was hoped that the fluorescence data prior to the bulb change could be calibrated by comparison with the 6m CTD data, but a plot of underway fluorescence minus CTD fluorescence produced a scatter of points between -2.3 and +1, following no clear pattern. No further attempt has been made, as yet, to recalibrate those data.

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 Autosol salinometers (s/n 65763), 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 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.

On 19/01/08 internal salinometer pump ceased to work, so a peristaltic pump was set up. This filled the sample cell more quickly, so samples required longer to equilibrate with the ambient water bath temperature. However, the results obtained were suitably stable and this system was used for the remainder of the cruise. On 30/01/08 the readings obtained were found to be very scattered, probably due to the appearance of small bubbles on the third coil of the cell. The cell was filled with a detergent solution and left to soak for ≈ 12 hours, then flushed with milliq for a total of ≈ 1 hour, following the procedure of flushing a few bottles through the cell, leaving it to soak for ≈ 1 hour, then flushing again. This was repeated several times. The next crate of samples yielded stable results.

Once analysed, the conductivity ratios were entered by hand into an Excel spreadsheet, *jr177_master.xls*, converted to salinities and transferred to the Unix system. They were then used to investigate a conductivity offset for the underway sensor.

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_jr177.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 *jr177_master.xls*) and a plot of underway salinity minus sample salinity is plotted to the screen. Outlying points are ignored, yielding an offset of ≈ -0.012 between the two datasets, which is similar to the offset of -0.01 obtained through comparison of the underway and CTD data. However, the data points are relatively scattered, and the offset becomes increasingly negative with time, so no calibration has as yet been applied to the underway conductivity sensor. This will be looked at back in Cambridge.

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. Further freshwater samples were collected from glacial meltwater streams at Signy and South Georgia. 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.

JR177: 2007/08, jday 365:45

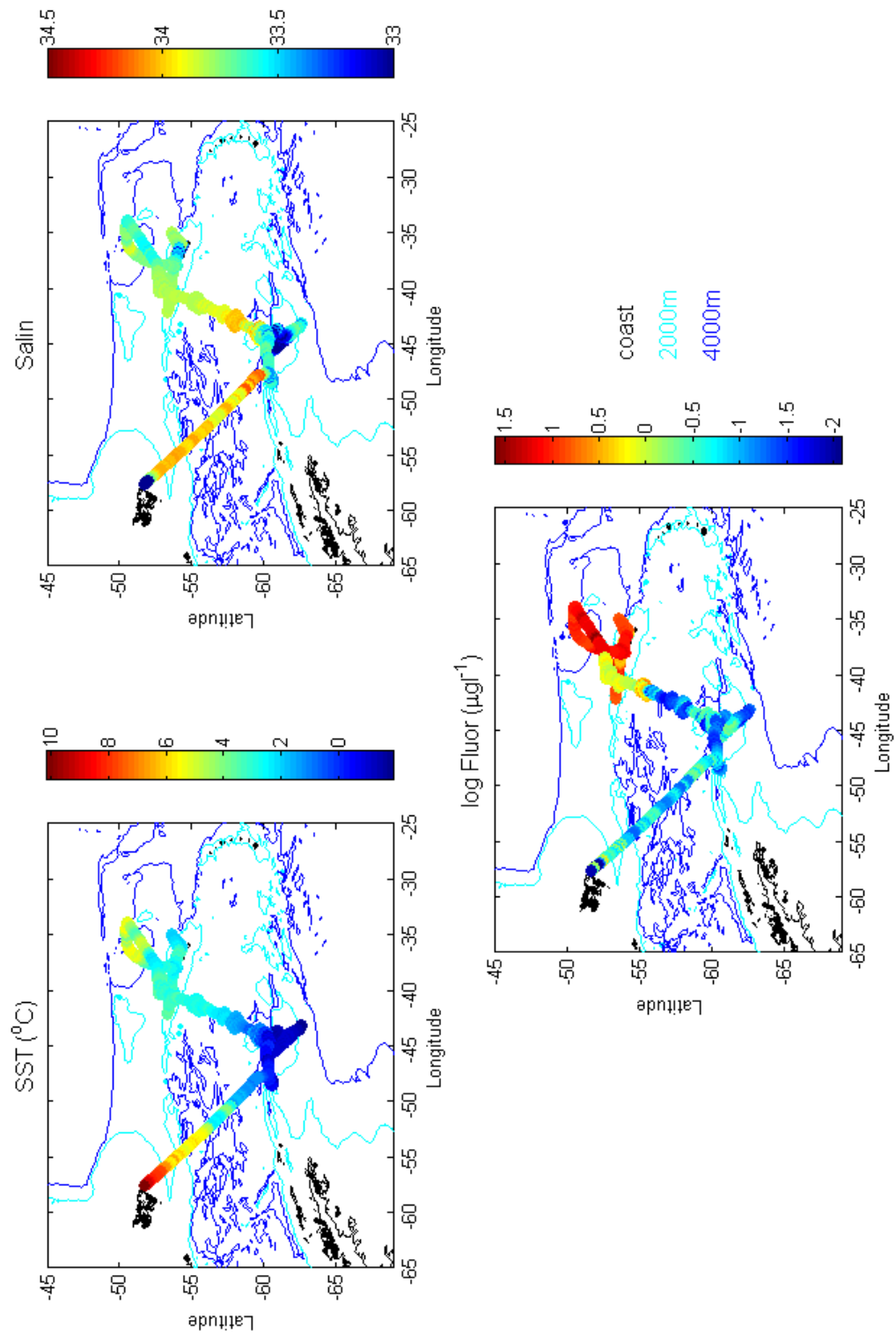


FIGURE OCEA.5: 1 MINUTE AVERAGES OF SST, SALINITY AND LOG FLUORESCENCE FROM THE OCEANLOGGER FOR 31/12/07-14/2/08.

2.4 Vessel-mounted Acoustic Doppler Current Profiler (VM-ADCP)

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) and JR193 (McCarthy and Venables 2007). 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 JR177, 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, however this acts to reduce the pingrate. As noted by Dr. Sophie Fielding, when in deep water the swath can take 20 to 30 seconds from ping to end of listening, as a result this means the ADCP only pings once every 25 or so seconds. A further problem is that the ADCP appears to “time out” every other ping when it has to wait a long time between pings (i.e when running in deep water alongside the EM120). This results in it rebooting and waking the ADCP instrument up every other ping, which simply exacerbates the problem. A fix is promised by BAS AME, but requires a firmware upgrade from RDI which is not presently available. To circumvent these problems, the swath was not used during the cruise. The EK60 was set as master through the SSU and the single-beam echosounder (EA600) and OS75 were set as slaves.

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 was run as a realtime monitor of data but the output bore little resemblance to the processed data so this was discontinued. The OS75 ran in two modes during JR177: narrowband with bottom-tracking on and narrowband with bottom-tracking off. Both modes were enabled with sixty-five 16 meter bins. It is highly desirable for the number of bins to be the same as this allows the data to be processed together in matlab. Narrowband profiling was enabled with an 8 meter 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.

Due to problems noted above with synchronizing the ADCP in bottom tracking mode with the other acoustic instruments, the ADCP was run independently when in bottom tracking. During these periods the ping rate was every 2 seconds. When not in bottom tracking mode (including some shallow areas where good EK60 data was prioritized) the ADCP was run through the SSU, leading to a 4 second ping rate. This is because the EK60 was set as master at 2 second intervals and the ADCP picked up every other signal. This ping rate was occasionally changed slightly to avoid problems with false bottoms.

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 JR177_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 JR177 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_jr177.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. As a carry-over from processing JR161 data, the arrays for water velocity are ‘hard-wired’ to have 65 rows as bottom track and water track configurations had different number of bins on that cruise so the arrays do not otherwise concatenate.

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 is 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 JR177). The version of the function `average_pings.m` was the one modified for JR193 from that used during JR165. These changes were modified on JR177 to cope with a change of year.
- 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 JR177. 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) JR177_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).
- 2) JR177_00A_00000Bd_att.mat, where A and B are as above. This contains the ship’s attitude data.
- 3) JR177_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) JR177_00A_000000_ATT.mat. As (3), but for the whole section of data in the user-incremented series A
- 5) JR177_00A_00000B_bad_heading.mat. Record of the data points removed due to bad heading
- 6) JR177_00A_00000B_bad_nav.mat. Record of the data points removed due to bad navigation.

- 7) jr177_000_000000_A_ave_ping. Two minute averaged data, including ship velocity.
- 8) jr177_000_000000_A_abs. Two minute averaged data, water velocities.
- 9) adcp_vel_contours_A.ps Individual plots of data in jr177_000_000000_A_abs, "A" here is the first in any list of files given to OS75_JCR_jr177.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.

JR177 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 easier processing of the data during the cruise.

There were few issues with the data collection during the section. Some data was lost before reaching Burdwood Bank. The ADCP had been running in bottom track mode and it is believed that the sharp increase in depth before the bank led to the instrument timing out and losing data. On other occasions the instrument and processing failed to recognize the bottom and returned spurious velocities from below the sea floor.

The instrument stopped on occasions due to the buffer filling up. This led to the navigation repeater being swapped to the one that was used on JR165. This has a reduced volume of data, but still sufficient to run the instrument and process the data effectively. This was made the default navigation repeater. Despite this, there were further time-outs where data was lost, but none were over 1 hour due to hourly checks on the instrument, and other checks between. The cause of these time-outs needs to be found, especially if the ADCP is to be run without a specialist, when checks may be less frequent.

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.

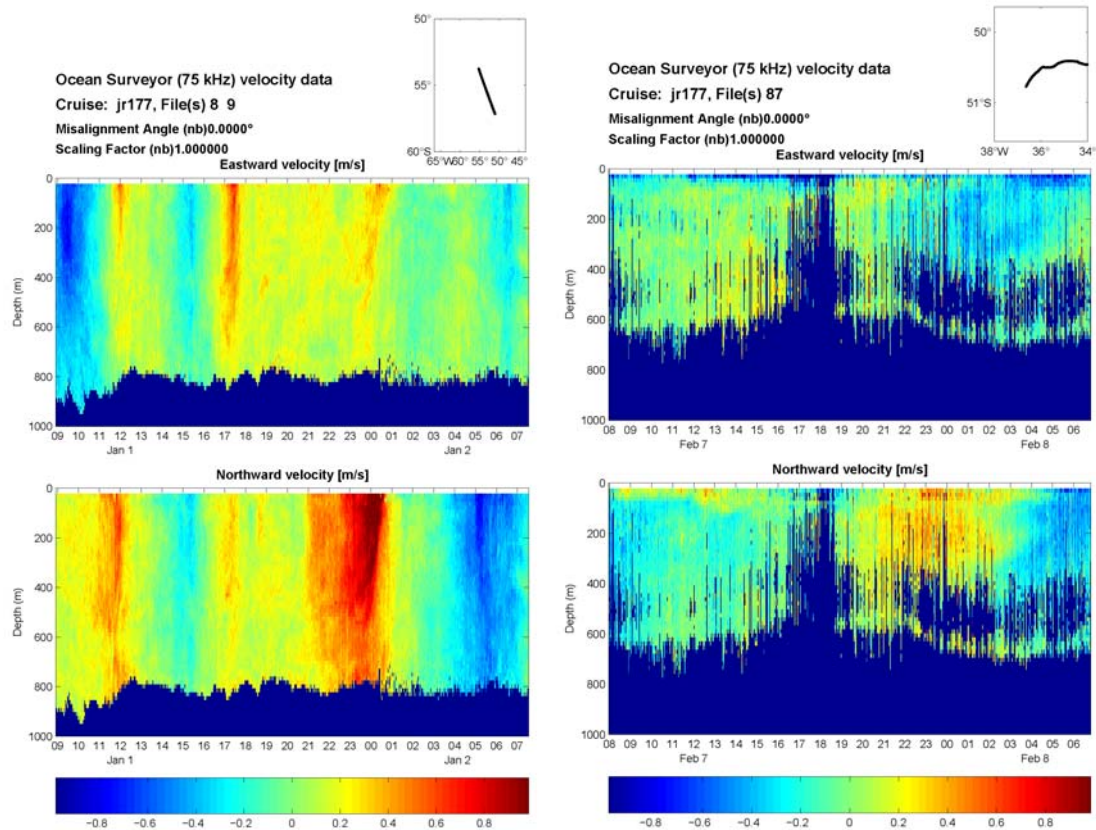


FIGURE OCEA.6. DATA DURING GOOD WEATHER (8 AND 9) AND BAD WEATHER (87)

As noted on JR193, the ADCP velocities can be contaminated by deployed instruments or the cable. This was noted linked to CTD deployments on JR193 and was seen again on JR177 for CTD and Bongo net deployments. The problem is that in medium to strong flows the instrument is 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 30° and the transducer is 23m away from the CTD gantry.

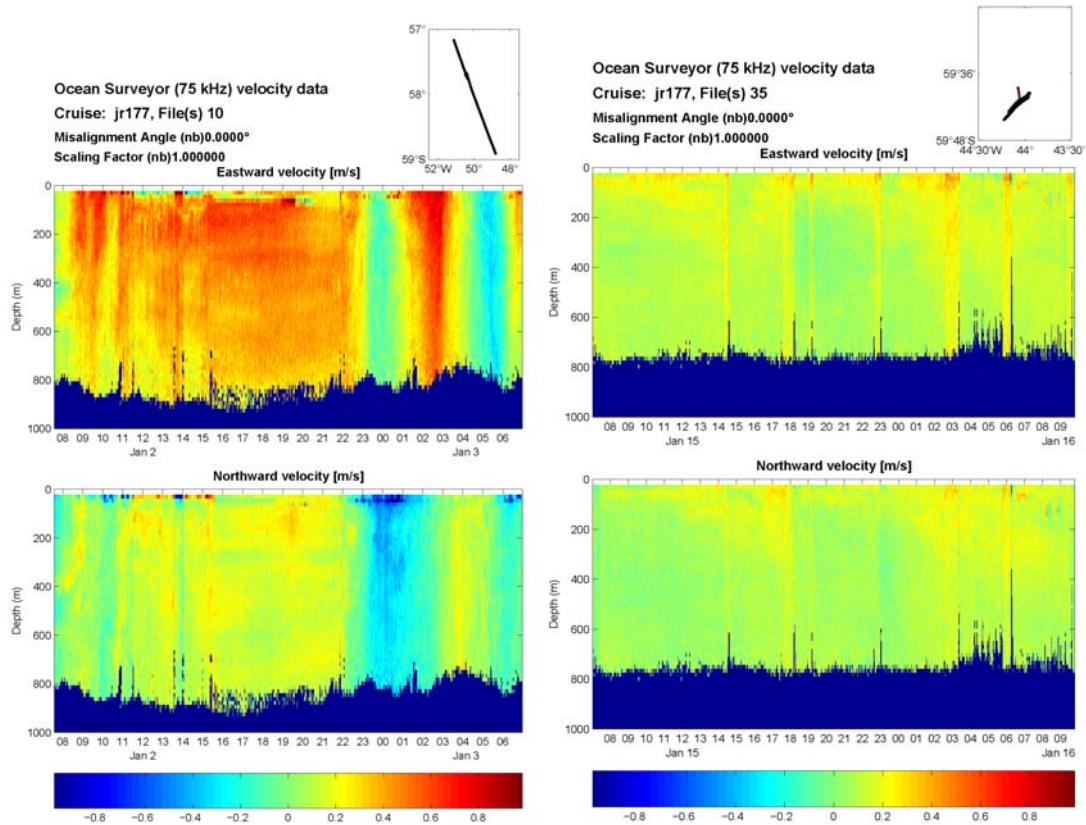


FIGURE OCEA.7. INTERFERENCE FROM DEPLOYED INSTRUMENTS. CTD AT 19.00 ON JAN 2ND (FILE 10) AND BONGO NETS AT 0800 JAN 16TH (FILE 35). BONGO NETS SHOW UP DEEPER AS THEY ARE DRAWN OUT AT A GREATER ANGLE SO THE CABLE AND ADCP BEAM INTERSECT DEEPER. FILE 35 ALSO SHOWS THE STRIPINESS THAT EXISTS IN THE DATA BEFORE AMPLITUDE AND MISALIGNMENT ANGLE CORRECTIONS ARE APPLIED.

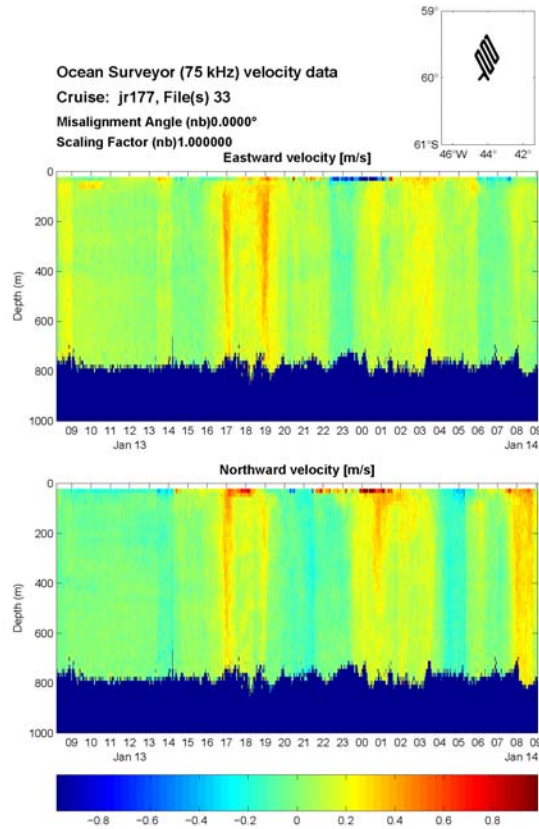


FIGURE OCEA.8. SIGNAL FROM THE PES TOWFISH IN THE SURFACE BIN. THIS HAPPENS WHEN THE FISH IS SWEEPED UNDER THE SHIP.

It is also believed that the ADCP recorded a shoal of fish, swimming away from a shallow net deployed in daylight. This again will be investigated further, but will possibly be in all beams and therefore harder to remove. It is however an interesting feature in its own right.

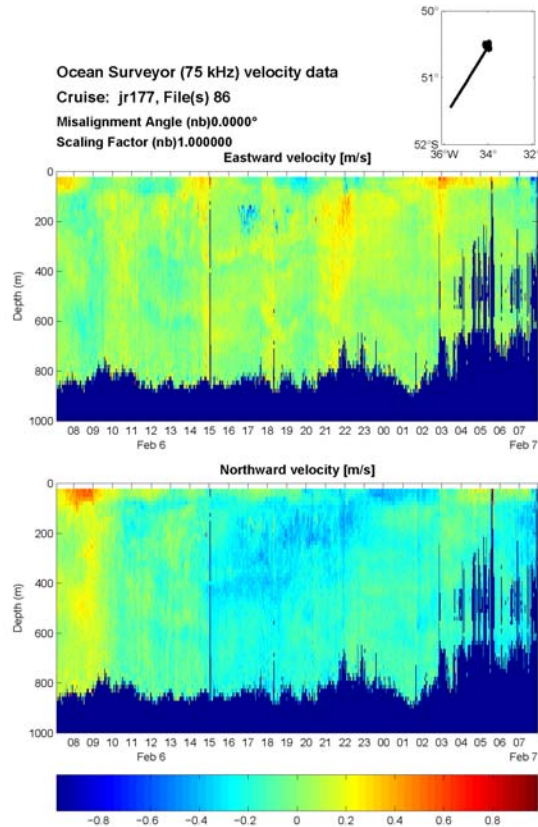


FIGURE OCEA.8. SIGNAL PROBABLY FROM SHOAL OF FISH AVOIDING NET AT 1700 ON FEB 6TH. NEEDS COMPARING AGAINST ACOUSTIC DATA AND ADCP BACKSCATTER STRENGTH.

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 – 1000m or shallower. The ADCP also needs to be able to accurately identify the bottom. This was a problem during JR177.

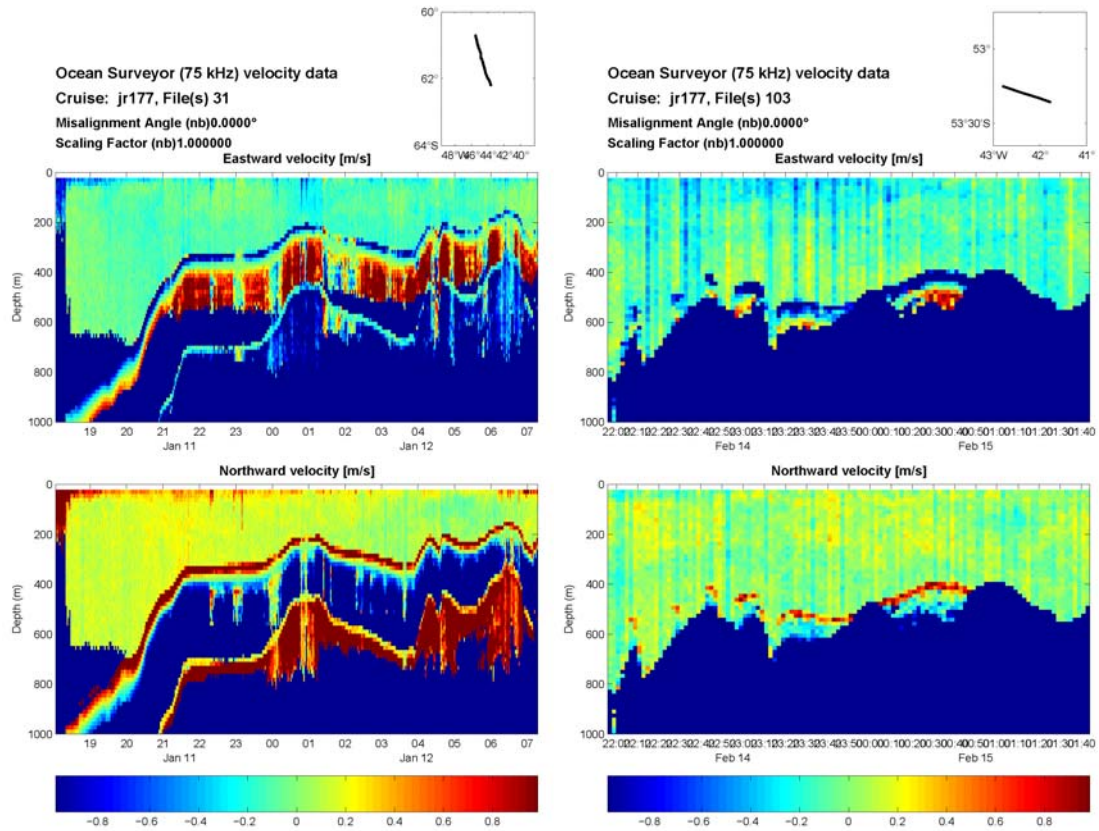


FIGURE OCEA.9. PROBLEMS WERE EXPERIENCED WITH SUB-BOTTOM RETURNS REMAINING IN THE DATA AFTER PROCESSING. THIS NEEDS TO BE ADDRESSED AND MAY EXPLAIN PROBLEMS WITH BOTTOM-TRACK DATA.

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 effect of ‘stripiness’ can be seen visually in the right hand panel of figure Ocea.7. 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. On JR177 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.

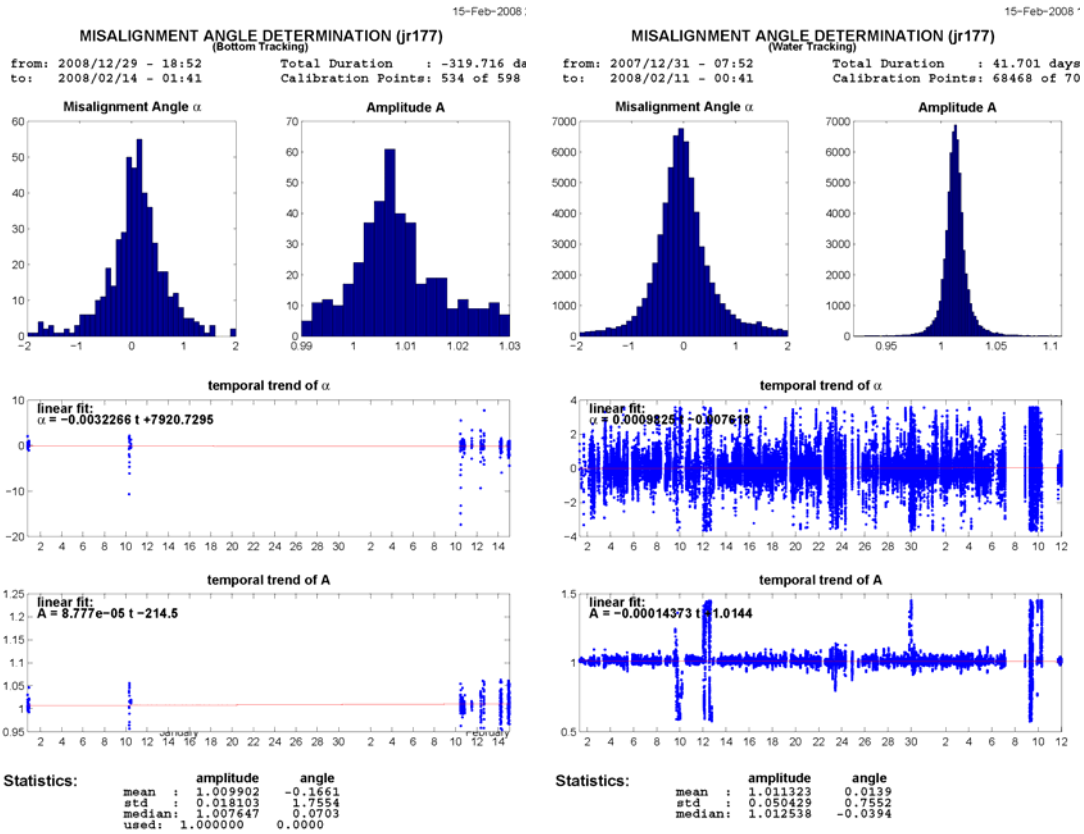


FIGURE OCEA.10. BOTTOM AND WATER TRACK CALIBRATION DATA. THE DIFFERENCES IN THE DATA NEEDS TO BE ASSESSED, WITH REFERENCE TO THE EFFECT ON THE STRIPINESS OF THE DATA NOTED ABOVE.

As seen in Figure Ocea.9, the bottom track calibration numbers show considerably more scatter than the water track calibration. This is contrary to expectations and needs further investigation. The files used for water track calibration include those with sub-bottom returns. These contaminate the data but do not alter the median significantly.

Command Files used:

ADCP bottom track on, not through SSU:

```

;-----\
; ADCP Command File for use with VmDas software.
;
; ADCP type: 75 Khz Ocean Surveyor
; Setup name: default
; Setup type: low resolution, Long range profile(Narrowband) 1000 m
;
; NOTE: Any line beginning with a semicolon in the first
; column is treated as a comment and is ignored by
; the VmDas software.
;
; NOTE: This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 28August2005
;-----/

```

; Restore factory default settings in the ADCP

cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE: VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), sixty five (NN) 16 meter bins (NS),
; 8 meter blanking distance (NF), 390 cm/s ambiguity vel (WV)

; Switch Narrowband ON NP1
NP1
nn65
ns1600
nf0800

; Switch Broadband OFF WP0

WP000
WN065
WS800
WF0200

WV390

; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX) (decimeters)
BP01
BX12000

; output velocity, correlation, echo intensity, percent good
WD111100000

; Two seconds between bottom and water pings
TP000150

; Three seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE00000300

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.3 on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

```

; Set Trigger In/Out [ADCP run through SSU]
;CX1,1

; save this setup to non-volatile memory in the ADCP
CK
ADCP bottom track off, through SSU:

;-----\
; ADCP Command File for use with VmDas software.
;
; ADCP type: 75 Khz Ocean Surveyor
; Setup name: default
; Setup type: low resolution, Long range profile(Narrowband) 1000 m
;
; NOTE: Any line beginning with a semicolon in the first
; column is treated as a comment and is ignored by
; the VmDas software.
;
; NOTE: This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 28August2005
;-----/

; Restore factory default settings in the ADCP
cr1

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE: VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for narrowband single-ping profile mode (NP), sixty five (NN) 16 meter bins (NS),
; 8 meter blanking distance (NF), 390 cm/s ambiguity vel (WV)

; Switch Narrowband ON NP1
NP1
nn65
ns1600
nf0800

; Switch Broadband OFF WP0

WP000
WN065
WS800
WF0200

WV390

; Disable single-ping bottom track (BP),
; Set maximum bottom search depth to 1200 meters (BX) (decimeters)
BP00
BX12000

; output velocity, correlation, echo intensity, percent good
WD111100000

```

; One and a half seconds between bottom and water pings
TP000150

; Two seconds between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE0000200

; Set to calculate speed-of-sound, no depth sensor, external synchro heading
; sensor, no pitch or roll being used, no salinity sensor, use internal transducer
; temperature sensor
EZ1020001

; Output beam data (rotations are done in software)
EX00000

; Set transducer misalignment (hundredths of degrees)
EA6008

; Set transducer depth (decimeters) [= 6.3 on JCR]
ED00063

; Set Salinity (ppt) [salinity in transducer well = 0]
ES0

; Set Trigger In/Out [ADCP run through SSU]
CX1,1

; save this setup to non-volatile memory in the ADCP
CK

2.5 CTD Deployment and Data Acquisition

Mags Wallace

2.5.1 Introduction

A Conductivity-Temperature-Depth (CTD) unit was used to vertically profile the water column. Fifty four casts were carried out in total, including one test station, eight biological stations and thirty two physics CTDs. Additional CTDs were also carried out at mooring recovery/redeployment sites 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). Two of the biological stations also involved mooring recovery and redeployment, and CTD casts to 400m were carried out at the mooring site. CTD positions are included in Table Ocea.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 Ocea.1 when accessing CTD data. In an attempt to avoid confusion, CTDs will generally be referred to as CTD NNN. CTD #N or CTD #NN refers to the station name (i.e. numbered CTD locations in cruise plan). For instance, CTD 009 was carried out at CTD #6 position, and CTD 036 at CTD #25 position.

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 and, in deep water, often returns depths that are several tens of metres deeper than the true bottom location.

Both upward- and downward-looking LADCPs were attached to the CTD frame, but the upward-looking instrument failed to work, so only the downward-looking ADCP was used to collect data. The LADCP collected data for most CTD profiles. 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 5.37b (Sea-Bird Electronics, Inc.), which allows real-time viewing of the data. The procedure was to start data logging, deploy the CTD, then stop the instrument at 10m wireout, where the CTD package was left for at least two

minutes to allow the seawater-activated pumps to switch on and the sensors to equilibrate with ambient conditions. The pumps are typically expected to switch on between 30 and 60 seconds after the instrument is deployed, but during JR177 they could take up to 2 ½ minutes to switch on. Flushing of the pumps with milliq and then uncontaminated seawater following each CTD cast was found to improve this performance.

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, at least 20 seconds had to be left between firings to allow the SBE35 to take readings and recharge. Shorter times between firings led to no SBE35 readings for certain bottles. If the sea state was particularly rough, the CTD package was not raised fully to the surface prior to the downcast and, in certain cases, did not allow the firing of bottles shallower than 10m.

Bottle firing depths were largely determined by water sample and calibration requirements. Four ‘types’ of CTD were carried out during the cruise: semi-bio (SB) CTDs were sampled for physical, chemical and biological parameters; water sample (WS) CTDs were carried out to collect large volumes of water at particular depths; physics (Ph) and mooring recovery/deployment (MR/MD) CTDs were carried out predominantly to measure physical parameters, and to calibrate the CTD and mooring sensors. Bottle firing depths for the SB and WS CTDs were thus strongly controlled by the water sample requirements, whereas the bottle fire depths of the Ph and MR/MD CTDs placed more emphasis upon the choice of depths most appropriate for sensor calibration.

2.5.3 Instrumentation changes and problems encountered with CTD deployments

Details of instrumentation and configuration are included in Table Ocea.2. Some changes were made to the CTD instrumentation throughout the cruise, in most cases in response to failure of instruments. These are summarised in Table Ocea.3. Further problems were encountered that required changes in operational procedures, but no instrumentation changes. These included (1) a software problem with the user-input bottle fire and (2) CTD pumps taking up to 2 ½ minutes to switch on:

1. An attempt to fire bottles out-of-sequence on CTD 012 led to two bottle fires being deleted from the screen, refusal of one bottle to fire at all and an apparent double-firing of one bottle. This necessitated the repeat of the uppermost 160m of the CTD cast (CTD 012a) in order to collect water samples. The solution is to only use the sequential bottle fire option.
2. CTD pumps had been slow to switch on for several casts, and took 2 ½ minutes to switch on at CTD 050. Following the CTD the pumps were flushed repeatedly with milliq, then with uncontaminated seawater, using 60ml syringes with attached plastic tubing. Once flushing had finished the syringes were left attached to the CTD so that the uncontaminated seawater would be

held within the tubes of the instrument. They switched on within 30 seconds on CTD051, so it has become standard practice to flush out the pumps following each CTD.

Also worthy of note are the notes appended to Table Ocea.1, regarding issues associated with individual CTDs that are not included in Table Ocea.3.

2.5.4 Data acquisition and preliminary processing

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

| | |
|--------------------------|---|
| <i>jr177ctd[NNN].dat</i> | binary data file |
| <i>jr177ctd[NNN].con</i> | ascii configuration file containing calibration information |
| <i>jr177ctd[NNN].hdr</i> | ascii header file containing sensor information |
| <i>jr177ctd[NNN].bl</i> | ascii file containing bottle fire information |

where NNN is the CTD number (column 1 in Table Ocea.1). 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 *jr177ctd[NNN].cnv*. The *Data Conversion* module calculates parameters using the coefficients detailed in Table Ocea.2 as follows:

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

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 Ocea.2, where U is the temperature in $^{\circ}\text{C}$.

$$\textbf{Conductivity:} \quad \text{cond} = \frac{(g + hf^2 + if^3 + jf^4)}{10(1 + \delta t + \epsilon p)}$$

where cond is the conductivity in Sm^{-1} , p is pressure, t is temperature, $\delta = \text{CTcor}$ and $\epsilon = \text{CPcor}$. All coefficients are included in Table Ocea.2.

Temperature:

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

Where the temperature, temp , is measured in $^{\circ}\text{C}$, g , h , i and j are coefficients detailed in Table Ocea.2 and f is the frequency output by the sensor.

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

where *oxy* is dissolved oxygen in ml/l, *V* is the voltage output from the SBE43 sensor, *O_{xsat}* is oxygen saturation (ml/l), a function of temperature, *T*, salinity, *S*, and pressure, *P*, and the remaining coefficients are detailed in Table Ocea.2.

$$\text{PAR: } PAR = \left(\frac{\text{multiplier} \cdot 10^9 \cdot 10^{(V-B)/M}}{C} \right) + \text{offset}$$

where *V*, *B*, *M*, *offset*, *multiplier* and *C*, the calibration constant, can be found in Table Ocea.2.

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

Where *flsc* is measured in µg/l, *V* is the fluorometer output voltage and the remaining coefficients can be found in Table Ocea.2.

$$\text{Transmission: } \text{Light transmission} = M \cdot \text{output voltage} + B$$

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 Ocea.2.

The SBE Data Processing *Cell thermal mass* module was then used to remove the conductivity cell thermal mass effects from the measured conductivity. This reads in the *jr177ctd[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 *jr177ctd[NNN]_ctm.cnv*. The correction applied to the CTD data is detailed below:

$$\text{Corrected conductivity} = \text{conductivity} + \text{ctm}$$

where

$$\text{ctm} = -1 \times \left(\frac{1 - 5\alpha}{2s\beta + 4} \right) \times \text{ctm}_0 + \frac{2\alpha}{s\beta + 2} \times 0.1(1 + 0.006[T - 20]) \times \Delta T$$

and *s* is the sample interval, *T* is temperature, *ctm₀* is the uncorrected cell thermal mass,

$\alpha = 0.03$ and $\beta = 7.0$.

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 *jr177sbeNNN.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.

Once all data had been downloaded and the preliminary processing described above carried out, the directory containing all data for that CTD cast was copied to the Unix system for further processing in MatLab.

2.5.6 Salinity samples

At each CTD station 24 niskin bottles were closed at selected depths. In general, eight of these on the semi-bio and physics CTDs were sampled for salinity analysis, although if duplicate water samples were taken from one bottle, only 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 *jr177_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. The majority of samples were collected in close proximity to landmasses, but further samples were collected at the summer and winter mixed layers depths (20m and 120m, respectively) in regions of high productivity. Samples were stored in boxes, along with photocopies of associated CTD logsheets.

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 for this cruise (detailed below). 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 *jr177_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. The second subset was run for those CTDs for which salt samples had been collected, following the salinity analysis. This second subset also processed the SBE35 data for those CTDs. The first subset of Matlab routines applied to the CTD data is as follows:

- *ctdread177* invokes the *cnv2mat* routine written by Rich Signell to read in the *jr177ctdNNN_ctm.cnv* file. Data are stored in Matlab arrays and named accordingly. Start, bottom and end times, latitudes and longitudes are entered manually. The output file is of the form *jr177ctdNNN.cal*.
- *offpress177* reads in *jr177ctdNNN.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 *jr177ctdNNN.wat*.
- *editctd177* reads in *jr177ctdNNN.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 *jr177ctdNNN.edt*.

- *interpol177* reads in *jr177ctdNNN.edt* and uses linear interpolation to fill data gaps generated by *editctd177*. Output is *jr177ctdNNN.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 *jr177ctdNNN.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. Output is *jr177ctdNNN.var*.
- *splitcast* reads in *jr177ctdNNN.var* and splits the downcast and upcast into *jr177ctdNNN.var.dn* and *jr177ctdNNN.var.up*.
- *gridctd* reads in both *jr177ctdNNN.var.dn* and *jr177ctdNNN.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 *jr177ctdNNN.2db.mat* and *jr177ctdNNN.2db.up.mat*.
- *fill_to_surf* reads in *jr177ctdNNN.2db.mat* and *jr177ctdNNN.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.
- *ctdplot177* reads in *jr177ctdNNN.2db.mat* and plots profiles of θ and salinity (both primary and secondary), 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.
- *ctd2asc177* loads *jr177ctdNNN.2db.mat* and writes the data to an ascii file *ctdNNN.asc*. Start, beginning and end times, latitudes and longitudes, and sensor information are included as a footer.

The second subset of Matlab programs is as follows:

- *makebot177* reads in *jr177ctdNNN.ros*, *jr177ctdNNN.BL* and *jr177ctdNNN.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 *jr177botNNN.lst*.
- *readsal177* extracts salinity calibration data from *jr177_master.xls* and reads in *jr177botNNN.lst*. 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 *jr177salNNN.mat*.
- *addsal177* reads in *jr177botNNN.lst* and *jr177salNNN.mat*, and stores all salinity information in *jr177botNNN.sal*.
- *setsalflag177* loads *jr177botNNN.sal* and flags those bottles with high standard deviations for temperature and conductivity. Output is *jr177botNNN.sal*.

- *salplot177* loads *jr177ctdNNN.int* and *jr177botNNN.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.
- *sb35read177* loads *jr177sbeNNN.asc*, *jr177botNNN.1st* and *jr177ctdNNN.cal*, and plots SBE35 temperature minus CTD temperature (1 & 2) for a visual check. The SBE35 data are saved in *jr177botNNN.sb35* and SBE35 temperature minus CTD temperature is saved in *tempcals.all.mat*. This script must be run prior to *salcal177*.
- *salcal177* loads *jr177botNNN.sal*, *jr177ctdNNN.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.
- Once this second subset of programs has been run, *salcalapp* is run again, and this time loads *jr177botNNN.sal*. Any required temperature or conductivity offset is applied here, and salinity, θ , and σ are recalculated. Offset data are saved in *jr177botNNN.cal*. All programs following *salcalapp* must then be re-run.
- *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.

2.5.9 CTD calibration

In total, 1098 SBE35 temperature data points were recorded, and 255 salinity samples analysed. These were compared with CTD data and, excluding a small number of outlying points, yielded temperature offsets for the CTD sensors of $\approx 1 \times 10^{-3} \text{ }^\circ\text{C}$ and conductivity offsets of $< 2 \times 10^{-3} \text{ mS/cm}$, equating to a salinity offset of $< 2.5 \times 10^{-3}$. It was thus decided not to apply any offset to the CTD sensors.

2.5.10 Sample plots

Below are sample plots of the main CTD transect between Signy and the Polar Front, and CTD profiles from CTD #1 (014).

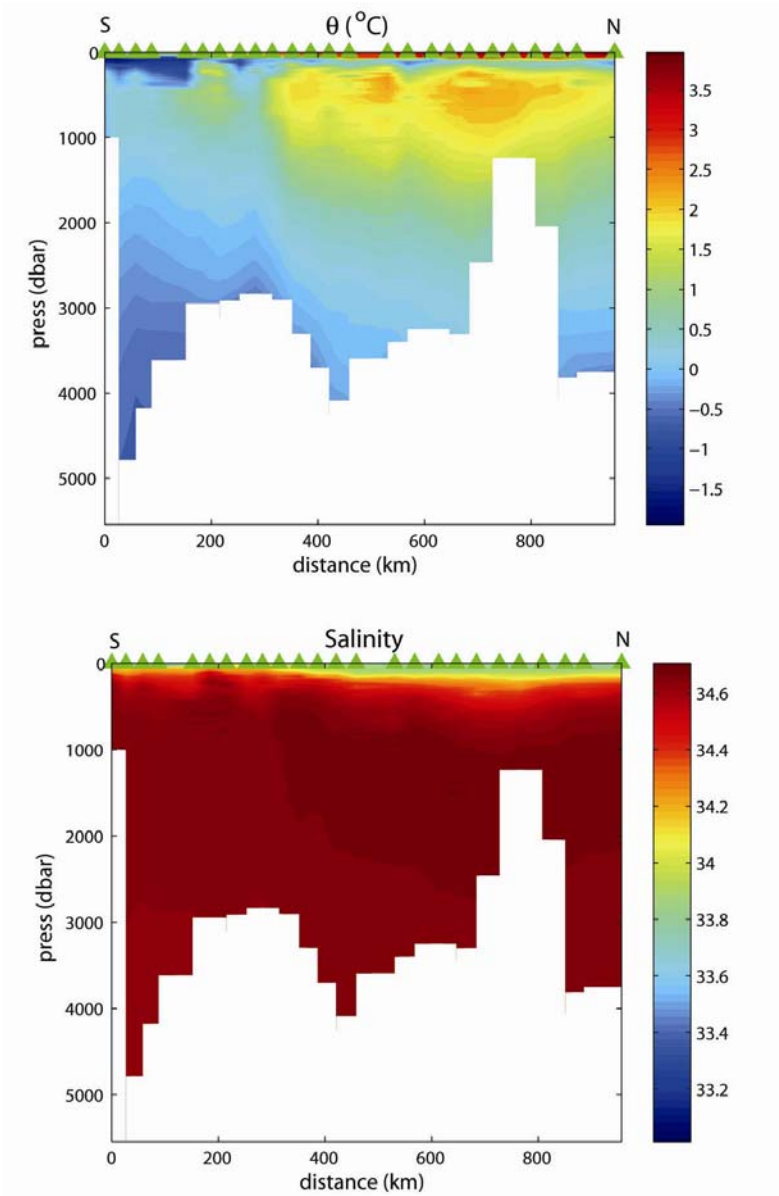


FIGURE OCEA.11: CONTOUR PLOTS OF POTENTIAL TEMPERATURE AND SALINITY BETWEEN SIGNY (S) AND THE POLAR FRONT (N).

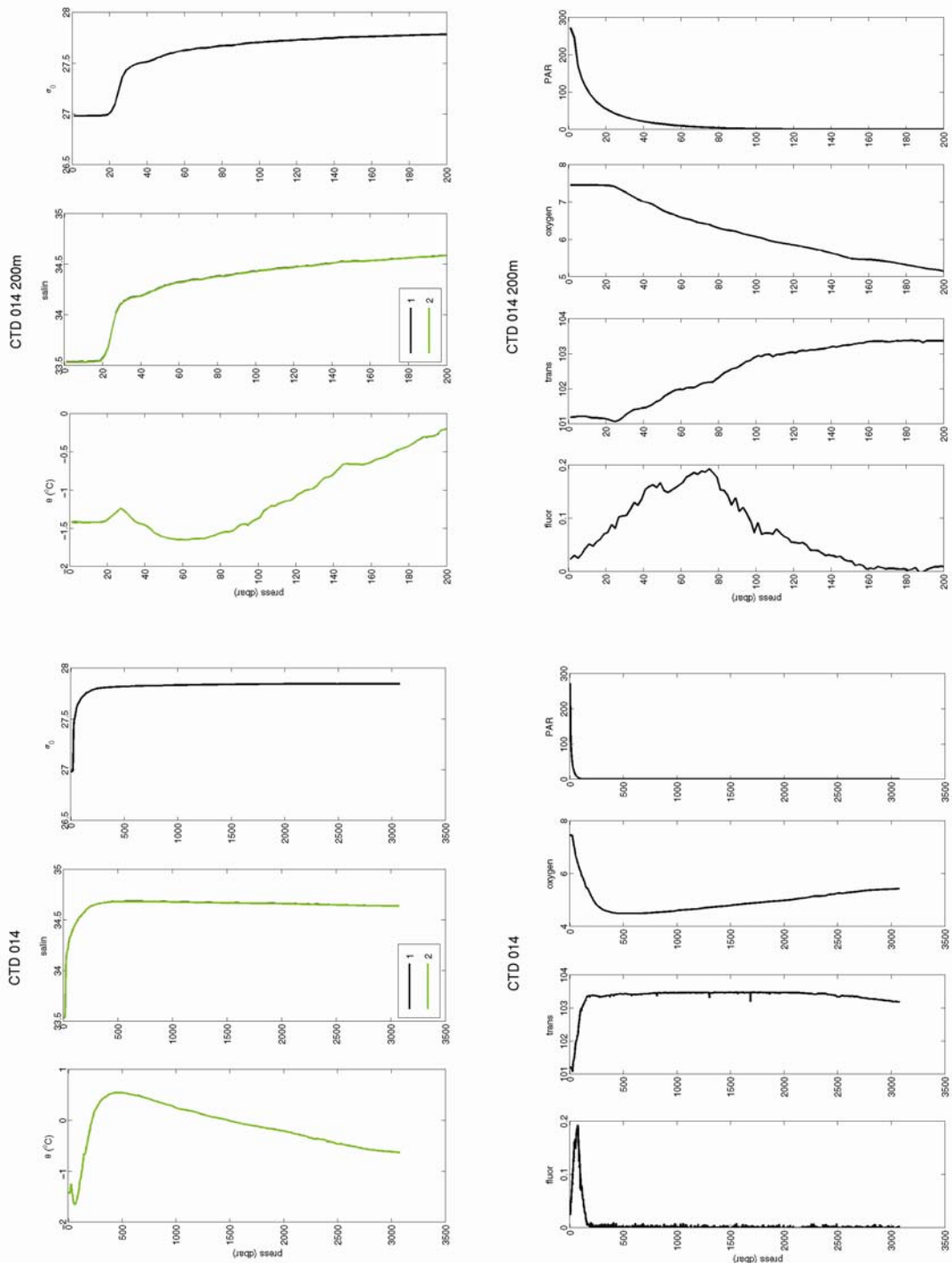


FIGURE OCEA.12: CTD PROFILES OF TEMPERATURE 1 (BLACK) & 2 (GREEN), SALINITY 1 & 2, POTENTIAL DENSITY ANOMALY, FLUORESCENCE, TRANSMISSION, OXYGEN AND PAR FROM STATION 014 (CTD #1). PROFILES ARE INCLUDED FOR BOTH THE FULL WATER DEPTH AND THE TOP 200M.

2.5.10 Further points of note

It has been noted that fluorescence and transmission do not always concur on CTD profiles, as illustrated in Figure Ocea.12, which shows two important effects regarding the interpretation of fluorescence data:

- (1) surface quenching, whereby fluorescence is reduced in the upper $\approx 40\text{m}$, where irradiance is high. This leads to relatively low fluorescence, even though transmission indicates that biomass is at a maximum in this layer. This effect can lead to a misleading indication of the depth of the chlorophyll maximum
- (2) increased fluorescence in the deeper water column ($\approx 80\text{m}$, below the mixed layer). Higher transmission at this depth indicates lower biomass. The high fluorescence is therefore an indication of high chl-a:C in the phytoplankton at this depth, as would be expected through photoacclimation of phytoplankton below the base of the mixed layer. Having the transmissometer together with the fluorometer allows such features to be better understood. The primary data stream used to determine the sampling strategy should depend on the desired outcome of the sampling, and possibly the irradiance levels.

TABLE OCEA.1: CTD SUMMARY

The three lines for each station represent the start, maximum depth and end of the station. 'Wout' is the wireout at the bottom depth of the CTD. 'Type' refers to semi-bio (SB), water sample (WS), physics (Ph), mooring recovery (MR), mooring deployment (MD) and acoustics calibration (AC) CTDs. 'Station name' is the official name/number of the CTD station in the cruise plan and 'event' is the event number in the JR177 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 | 002 | 18:26:18 | 57° 41.11'S | 50° 26.54'W | 4110 | Test | | 32 | |
| | 002 | 19:38:58 | 57° 40.75'S | 50° 25.80'W | | | | | |
| | 002 | 21:20:05 | 57° 40.40'S | 50° 25.01'W | | | | | |
| 002 | 004 | 07:50:26 | 60° 29.89'S | 48° 11.55'W | 1376 | SB | R1 | 49 | |
| | 004 | 08:17:20 | 60° 29.89'S | 48° 11.55'W | | | | | |
| | 004 | 09:05:15 | 60° 29.89'S | 48° 11.55'W | | | | | |
| 003 | 004 | 12:04:18 | 60° 29.89'S | 48° 11.55'W | 398 | WS | R1 | 54 | |
| | 004 | 12:16:30 | 60° 29.89'S | 48° 11.57'W | | | | | |
| | 004 | 12:33:34 | 60° 29.89'S | 48° 11.60'W | | | | | |
| 004 | 005 | 05:38:20 | 60° 29.87'S | 48° 11.66'W | 1354 | WS | R1 | 62 | |
| | 005 | 06:06:55 | 60° 29.87'S | 48° 11.62'W | | | | | |
| | 005 | 06:40:41 | 60° 29.87'S | 48° 11.56'W | | | | | |
| 005 | 008 | 09:07:00 | 60° 12.49'S | 44° 24.47'W | 5407 | SB | C2/ CTD #9 | 88 | |
| | 008 | 10:41:33 | 60° 12.49'S | 44° 24.48'W | | | | | |
| | 008 | 12:42:20 | 60° 12.49'S | 44° 24.50'W | | | | | |
| 006 | 008 | 15:13:30 | 60° 12.52'S | 44° 25.10'W | 398 | WS | C2 | 92 | |
| | 008 | 15:25:00 | 60° 12.52'S | 44° 25.10'W | | | | | |
| | 008 | 15:41:32 | 60° 12.52'S | 44° 25.09'W | | | | | |
| 007 | 009 | 04:36:00 | 60° 12.49'S | 44° 24.50'W | 1989 | WS | C2 | 103 | 1 |
| | 009 | 15:13:40 | 60° 12.49'S | 44° 24.50'W | | | | | |
| | 009 | 06:00:40 | 60° 12.49'S | 44° 24.50'W | | | | | |
| 008 | 009 | 13:41:40 | 60° 25.86'S | 44° 35.55'W | 986 | Ph | CTD #8 | 109 | |
| | 009 | 14:03:00 | 60° 25.86'S | 44° 35.56'W | | | | | |
| | 009 | 14:37:20 | 60° 25.85'S | 44° 35.57'W | | | | | |
| 009 | 010 | 00:56:01 | 61° 11.89'S | 44° 24.50'W | 315 | Ph | CTD #6 | 110 | |
| | 010 | 01:07:40 | 61° 11.89'S | 44° 24.50'W | | | | | |
| | 010 | 01:41:49 | 61° 11.89'S | 44° 24.50'W | | | | | |
| 010 | 010 | 09:54:47 | 61° 39.69'S | 44° 04.05'W | 565 | Ph | CTD #5 | 112 | |
| | 010 | 10:08:37 | 61° 39.79'S | 44° 03.71'W | | | | | |
| | 010 | 10:37:21 | 61° 39.91'S | 44° 03.16'W | | | | | |
| 011 | 010 | 18:21:53 | 62° 09.77'S | 43° 41.65'W | 1053 | Ph | CTD #4 | 114 | 2 |
| | 010 | 18:43:30 | 62° 09.77'S | 43° 41.65'W | | | | | |
| | 010 | 19:26:21 | 62° 09.77'S | 43° 41.65'W | | | | | |
| 012 | 010 | 22:59:58 | 62° 21.27'S | 43° 31.65'W | 1220 | Ph | CTD #3 | 116 | 3 |
| | 010 | 23:24:59 | 62° 21.28'S | 43° 31.68'W | | | | | |
| | 011 | 00:22:36 | 62° 21.30'S | 43° 31.73'W | | | | | |
| 012a | 011 | 00:54:50 | 62° 20.75'S | 43° 31.40'W | 119 | Ph | CTD #3 | 117 | 3 |
| | 011 | 01:03:08 | 62° 20.70'S | 43° 31.35'W | | | | | |
| | 011 | 01:24:00 | 62° 20.64'S | 43° 31.30'W | | | | | |
| 013 | 011 | 05:38:09 | 62° 30.96'S | 43° 18.83'W | 2000 | Ph | CTD #2 | 119 | 4 |
| | 011 | 06:18:45 | 62° 31.07'S | 43° 18.82'W | | | | | |
| | 011 | 07:17:03 | 62° 31.20'S | 43° 18.00'W | | | | | |
| 014 | 011 | 09:30:28 | 62° 36.53'S | 43° 14.69'W | 3015 | Ph | CTD #1 | 120 | |
| | 011 | 10:25:52 | 62° 36.50'S | 43° 14.34'W | | | | | |
| | 011 | 11:42:52 | 62° 36.48'S | 43° 14.08'W | | | | | |

| | | | | | | | | | |
|-----|-------------------|----------------------------------|---|---|------|----|----------------|-----|----|
| 015 | 012 012 012 | 07:46:30 07:54:00 08:08:25 | 60° 39.98'S 60° 39.98'S 60° 39.98'S | 45° 31.15'W 45° 31.15'W 45° 31.15'W | 180 | Ph | CTD #7 | 122 | |
| 016 | 013 013 013 | 09:14:44 10:36:50 12:16:56 | 59° 56.17'S 59° 56.17'S 59° 56.16'S | 44° 14.35'W 44° 14.35'W 44° 14.35'W | 4673 | Ph | CTD #10 | 128 | |
| 017 | 015 015 015 | 07:32:10 08:44:15 10:13:00 | 59° 41.32'S 59° 41.32'S 59° 41.32'S | 44° 03.27'W 44° 03.27'W 44° 03.27'W | 4080 | SB | C3/ CTD #11 | 146 | |
| 018 | 015 015 015 | 12:59:56 13:11:44 14:00:58 | 59° 41.33'S 59° 41.33'S 59° 41.33'S | 44° 03.27'W 44° 03.27'W 44° 03.27'W | 400 | WS | C3 | 151 | |
| 019 | 016 016 016 | 06:29:06 07:06:15 07:46:38 | 59° 40.81'S 59° 40.81'S 59° 40.81'S | 44° 03.40'W 44° 03.42'W 44° 03.43'W | 2000 | WS | C3 | 162 | 5 |
| 020 | 016 | 20:23:28 | 59° 24.94'S | 43° 52.24'W | | Ph | CTD #12 | 169 | 6 |
| 021 | 017 017 017 | 00:25:07 01:30:46 03:04:48 | 59° 08.64'S 59° 08.64'S 59° 08.64'S | 43° 41.62'W 43° 41.62'W 43° 41.62'W | 3540 | Ph | CTD #13 | 170 | |
| 022 | 017 | 06:01:14 06:55:08 08:06:10 | 58° 52.30'S 58° 52.30'S 58° 52.30'S | 43° 30.55'W 43° 30.55'W 43° 30.56'W | 2890 | Ph | CTD #14 | 172 | |
| 023 | 017 017 017 | 10:01:14 10:56:51 12:07:28 | 58° 35.89'S 58° 35.97'S 58° 35.98'S | 43° 30.55'W 43° 30.56'W 43° 30.56'W | 3051 | Ph | CTD #15 | 173 | |
| 024 | 017 017 017 | 14:21:13 15:12:30 16:15:30 | 58° 16.67'S 58° 16.67'S 58° 16.67'S | 43° 08.46'W 43° 08.46'W 43° 08.45'W | 2858 | Ph | CTD #16 | 174 | |
| 025 | 019 019 019 | 07:02:00 07:53:05 08:58:31 | 58° 01.38'S 58° 01.37'S 58° 01.37'S | 42° 59.08'W 42° 58.88'W 42° 58.86'W | 2778 | SB | C4/ CTD #17 | 186 | |
| 026 | 019 019 019 | 12:06:05 12:17:00 12:33:52 | 58° 01.37'S 58° 01.37'S 58° 01.37'S | 42° 58.86'W 42° 58.86'W 42° 58.86'W | 400 | WS | C4 | 191 | |
| 027 | 020 020 020 | 06:08:41 06:46:29 07:30:15 | 58° 01.62'S 58° 01.62'S 58° 01.62'S | 42° 58.32'W 42° 58.32'W 42° 58.32'W | 2000 | WS | C4 | 200 | 7 |
| 028 | 020 020 020 | 21:41:07 22:34:07 23:47:49 | 57° 45.49'S 57° 45.49'S 57° 45.49'S | 42° 48.07'W 42° 48.07'W 42° 48.08'W | 2850 | Ph | CTD #18 | 208 | |
| 029 | 021 021 021 | 02:49:57 03:49:19 05:14:47 | 57° 26.20'S 57° 26.20'S 57° 26.21'S | 42° 36.63'W 42° 36.63'W 42° 36.62'W | 3232 | Ph | CTD #19 | 209 | |
| 030 | 022 022 022 | 04:43:27 06:03:17 07:30:58 | 57° 08.38'S 57° 08.38'S 57° 08.37'S | 42° 25.98'W 42° 25.98'W 42° 25.97'W | 3624 | SB | R2/ CTD #20 | 216 | 8 |
| 031 | 022 022 022 | 10:23:33 10:34:50 10:51:15 | 57° 08.45'S 57° 08.45'S 57° 08.45'S | 42° 25.97'W 42° 25.97'W 42° 25.97'W | 398 | WS | R2 | 221 | 9 |
| 032 | 022 022 022 | 12:11:45 12:50:00 13:30:00 | 57° 08.45'S 57° 08.45'S 57° 08.45'S | 42° 25.97'W 42° 25.97'W 42° 25.97'W | 2000 | WS | R2 | 222 | |
| 033 | 022 022 022 | 15:57:45 17:12:43 18:43:50 | 56° 50.59'S 56° 50.59'S 56° 50.59'S | 42° 15.40'W 42° 15.40'W 42° 15.41'W | 4155 | Ph | CTD #21 | 223 | |
| 034 | 022 022 022 | 21:08:11 22:21:08 23:52:30 | 56° 31.27'S 56° 31.27'S 56° 31.27'S | 42° 04.31'W 42° 04.31'W 42° 04.30'W | 4005 | Ph | CTD #22 | 224 | |
| 035 | 023 | 13:10:15 | 55° 54.11'S | 41° 43.17'W | 3521 | Ph | CTD #24 | 225 | 10 |

| | | | | | | | | | |
|-----|-----|----------|-------------|-------------|------|-----------|----------------|-----|--|
| | 023 | 14:14:50 | 55° 54.11'S | 41° 43.17'W | | | | | |
| | 023 | 15:33:55 | 55° 54.10'S | 41° 43.18'W | | | | | |
| 036 | 023 | 18:48:05 | 55° 34.82'S | 41° 32.07'W | 3332 | Ph | CTD #25 | 226 | |
| | 023 | 19:46:04 | 55° 34.82'S | 41° 32.07'W | | | | | |
| | 023 | 21:01:01 | 55° 34.82'S | 41° 32.06'W | | | | | |
| 037 | 025 | 11:50:53 | 55° 12.42'S | 41° 14.76'W | 3185 | SB | P2/ CTD #26 | 227 | |
| | 025 | 12:50:10 | 55° 12.54'S | 41° 14.68'W | | | | | |
| | 025 | 14:03:43 | 55° 12.60'S | 41° 14.67'W | | | | | |
| 038 | 025 | 17:16:03 | 55° 13.05'S | 41° 14.42'W | 400 | WS | P2 | 233 | |
| | 025 | 17:27:20 | 55° 13.05'S | 41° 14.42'W | | | | | |
| | 025 | 17:44:39 | 55° 13.05'S | 41° 14.42'W | | | | | |
| 039 | 027 | 03:08:16 | 55° 12.41'S | 41° 09.41'W | 2000 | WS | P2 | 240 | |
| | 027 | 03:47:10 | 55° 12.41'S | 41° 09.41'W | | | | | |
| | 027 | 04:32:36 | 55° 12.41'S | 41° 09.41'W | | | | | |
| 040 | 028 | 17:42:50 | 55° 11.82'S | 41° 07.53'W | 400 | MD | P2 | 258 | |
| | 028 | 17:54:00 | 55° 11.82'S | 41° 07.53'W | | | | | |
| | 028 | 18:04:02 | 55° 11.82'S | 41° 07.53'W | | | | | |
| 041 | 028 | 20:11:36 | 54° 54.77'S | 41° 10.40'W | 3374 | Ph | CTD #27 | 259 | |
| | 028 | 21:12:20 | 54° 54.77'S | 41° 10.40'W | | | | | |
| | 028 | 22:32:44 | 54° 54.77'S | 41° 10.40'W | | | | | |
| 042 | 029 | 10:31:23 | 54° 35.45'S | 40° 59.80'W | 3236 | Ph | CTD #28 | 262 | |
| | 029 | 11:29:23 | 54° 35.45'S | 40° 59.80'W | | | | | |
| | 029 | 12:48:00 | 54° 35.45'S | 40° 59.81'W | | | | | |
| 043 | 029 | 15:09:10 | 54° 12.97'S | 40° 48.79'W | 2418 | Ph | CTD #29 | 263 | |
| | 029 | 15:53:21 | 54° 12.97'S | 40° 48.79'W | | | | | |
| | 029 | 16:48:35 | 54° 12.97'S | 40° 48.79'W | | | | | |
| 044 | 029 | 19:06:20 | 53° 53.83'S | 40° 38.67'W | 1214 | Ph | CTD #30 | 264 | |
| | 029 | 19:32:01 | 53° 53.83'S | 40° 38.67'W | | | | | |
| | 029 | 20:16:19 | 53° 53.84'S | 40° 38.67'W | | | | | |
| 045 | 030 | 04:23:00 | 53° 31.57'S | 40° 27.54'W | 2006 | Ph | CTD #31 | 267 | |
| | 030 | 05:02:11 | 53° 31.58'S | 40° 27.56'W | | | | | |
| | 030 | 05:59:20 | 53° 31.59'S | 40° 27.58'W | | | | | |
| 046 | 030 | 11:18:53 | 53° 09.27'S | 40° 16.55'W | 3968 | Ph | CTD #32 | 270 | |
| | 030 | 12:30:15 | 53° 09.27'S | 40° 16.55'W | | | | | |
| | 030 | 13:56:00 | 53° 09.27'S | 40° 16.55'W | | | | | |
| 047 | 031 | 16:50:47 | 52° 43.33'S | 40° 08.36'W | 400 | MR/ WS | P3 | 273 | |
| | 031 | 17:01:55 | 52° 43.33'S | 40° 08.36'W | | | | | |
| | 031 | 17:17:55 | 52° 43.33'S | 40° 08.37'W | | | | | |
| 048 | 032 | 07:24:13 | 52° 51.49'S | 40° 05.84'W | 3736 | SB | P3 | 279 | |
| | 032 | 08:30:00 | 52° 51.49'S | 40° 05.82'W | | | | | |
| | 032 | 09:56:45 | 52° 51.49'S | 40° 05.82'W | | | | | |
| 049 | 032 | 12:58:22 | 52° 51.54'S | 40° 05.82'W | 400 | WS | P3 | 286 | |
| | 032 | 13:07:50 | 52° 51.54'S | 40° 05.82'W | | | | | |
| | 032 | 13:26:11 | 52° 51.54'S | 40° 05.82'W | | | | | |
| 050 | 032 | 22:29:51 | 52° 51.49'S | 40° 05.83'W | 2000 | WS | P3 | 293 | |
| | 032 | 23:09:37 | 52° 51.49'S | 40° 05.83'W | | | | | |
| | 032 | 23:57:58 | 52° 51.50'S | 40° 05.83'W | | | | | |
| 051 | 033 | 21:28:16 | 52° 43.62'S | 40° 08.82'W | 400 | MD | P3 | 303 | |
| | 033 | 21:40:29 | 52° 43.62'S | 40° 08.82'W | | | | | |
| | 033 | 22:03:00 | 52° 43.62'S | 40° 08.82'W | | | | | |
| 052 | 034 | 23:09:30 | 52° 37.61'S | 39° 06.92'W | 2000 | WS | R3 | 313 | |
| | 034 | 23:47:50 | 52° 37.62'S | 39° 06.93'W | | | | | |
| | 035 | 00:33:00 | 52° 37.64'S | 39° 06.95'W | | | | | |
| 053 | 035 | 08:10:01 | 52° 37.60'S | 39° 06.89'W | 3674 | SB | R3 | 317 | |
| | 035 | 09:16:20 | 52° 37.63'S | 39° 06.92'W | | | | | |
| | 035 | 10:39:35 | 52° 37.63'S | 39° 06.91'W | | | | | |
| 054 | 035 | 13:59:34 | 52° 37.63'S | 39° 06.91'W | 400 | WS | R3 | 324 | |
| | 035 | 14:10:30 | 52° 37.63'S | 39° 06.91'W | | | | | |
| | 035 | 14:27:23 | 52° 37.63'S | 39° 06.90'W | | | | | |

| | | | | | | | | | |
|-----|-----|----------|-------------|-------------|------|----|-----------|-----|----|
| 055 | 040 | 15:45:40 | 53° 42.86'S | 37° 57.86'W | 123 | SB | R5 | 368 | |
| | 040 | 15:53:10 | 53° 42.86'S | 37° 57.86'W | | | | | |
| | 040 | 16:08:00 | 53° 42.85'S | 37° 57.86'W | | | | | |
| 056 | 040 | 17:27:56 | 53° 42.90'S | 37° 57.88'W | 119 | WS | R5 | 373 | |
| | 040 | 17:34:29 | 53° 42.90'S | 37° 57.88'W | | | | | |
| | 040 | 17:47:10 | 53° 42.90'S | 37° 57.88'W | | | | | |
| 057 | 041 | 21:58:48 | 54° 09.53'S | 36° 41.75'W | 58 | AC | Stromness | 380 | |
| | 041 | 22:04:43 | 54° 09.53'S | 36° 41.75'W | | | | | |
| | 041 | 22:17:17 | 54° 09.53'S | 36° 41.75'W | | | | | |
| 058 | 042 | 17:45:15 | 53° 34.04'S | 34° 57.74'W | 3450 | Ph | CTD 88 | 381 | |
| | 042 | 18:47:49 | 53° 34.04'S | 34° 57.74'W | | | | | |
| | 042 | 20:08:29 | 53° 34.04'S | 34° 57.74'W | | | | | |
| 059 | 042 | 21:50:12 | 53° 41.46'S | 35° 15.51'W | 3535 | Ph | CTD 94 | 382 | 11 |
| | 042 | 22:55:32 | 53° 41.46'S | 35° 15.51'W | | | | | |
| | 043 | 00:29:01 | 53° 41.46'S | 35° 15.51'W | | | | | |

Notes:

- 1) Pumps switched on during soak of CTD 007, then off at beginning of downcast, so the upper 35m of data from the downcast are unusable. Upcast data are used for this event.
- 2) First attempt at CTD 011 aborted, as settings incorrect on EA600, so water depth appeared <700m, and only a partial profile was collected. EA600 corrected and full cast carried out to 1053m wireout. Data from initial cast discarded.
- 3) Problem with user input bottle fire above 160m on CTD 012: some bottles would not fire, whilst others appeared to fire twice! Repeat cast carried out to 160m (012a) to collect water samples.
- 4) CTD stopped for a few minutes on upcast at 200m wireout due to poor spooling of CTD wire.
- 5) CTD 019 was supposed to be carried out at CTD position #11 but nets were towed through this location for several hours, so relocated to C3 (≈ 1 nm) for CTD.
- 6) CTD 020 aborted at ≈ 200 m due to transmission errors. 200m cut off CTD wire. Location abandoned due to time constraints.
- 7) CTD 027 carried out slightly off intended location due to proximity of iceberg.
- 8) CTD 030 paused at 1268m on downcast due to bowthrustrer problems.
- 9) Initial attempt at CTD 031 aborted due to failure to connect to SBE carousel. Repeat cast successful.
- 10) CTD #23 not carried out due to bad weather.
- 11) CTD transect abandoned due to major engine problems.

TABLE OCEA.2: DETAILS OF INSTRUMENTATION AND CONFIGURATION FOR SBE911PLUS CTD.

| | |
|--|---|
| <p>Frequency channels suppressed: 0 Voltage words suppressed: 0 Computer interface: RS-232C Scans to average: 1 Surface PAR voltage added: No NMEA position data added: No Scan time added: No</p> <p>Channel 1, Temperature 1 s/n: 2366 Calibrated: 18/07/07 G: 4.31954507e-003 H: 6.43784825e-004 I: 2.32310210e-005 J: 2.19209612e-006 F0: 1000.000 Slope: 1.00000000 Offset: 0.0000</p> <p>Channel 2, Conductivity 1 s/n: 2289 Calibrated: 17/07/07 G: -1.04139247e+001 H: 1.38985993e+000 I: -3.17526541e-004 J: 2.88945166e-004 CTcorr: 3.2500e-006 CPcorr: -9.57000000e-008 Slope: 1.00000000 Offset: 0.0000</p> <p>Channel 3, Pressure (Digiquartz with TC) s/n: 0541-75429 Calibrated: 18/07/07 C1: -4.398881e+004 C2: -5.551403e-001 C3: 1.279490e-002 D1: 3.603000e-002 D2: 0.000000e+000 T1: 2.986716e+001 T2: -5.274889e-004 T3: 4.0929000e-006 T4: 1.616590e-009 T5: 0.000000e+000 Slope: 0.9994000 Offset: 0.52570 AD590M: 1.287420e-002 AD590B: -8.79339e+000</p> <p>Channel 8, Fluorometer s/n: 088-249</p> | <p>Channel 4, Temperature 2 s/n: 2307 Calibrated: 20/07/07 G: 4.33439937e-003 H: 6.44608874e-004 I: 2.37793994e-005 J: 2.31412704e-006 F0: 1000.000 Slope: 1.00000000 Offset: 0.00000</p> <p>Channel 5, Conductivity 2 s/n: 2222 Calibrated: 17/07/07 G: -1.01969735e+001 H: 1.42343710e+000 I: 8.77079731e-005 J: 8.50234811e-005 CTcorr: 3.2500e-006 CPcorr: -9.57000000e-008 Slope: 1.00000000 Offset: 0.00000</p> <p>Channel 6, Oxygen (SBE43) s/n: 0245 Calibrated: 12/06/07 Soc: 3.8470e-001 Boc: 0.0000 Voffset: -0.4229 Tcor: 0.001100 Pcor: 1.35e-004 Tau: 0.0</p> <p>Channel 7, Altimeter <i>Altimeter 1</i> (CTD 004-018) s/n: 213026993 Calibrated: unknown Scale factor: 15.000 Offset: 0.000 <i>Altimeter 2</i> (CTD 019-...) s/n: 27001 Calibrated: unknown Scale factor: 15.000 Offset: 0.000</p> <p>Channel 11, Free</p> |
|--|---|

| | |
|---|--|
| Calibrated: 13/09/07 VB: 0.181700 V1: 2.097600 Vacetone: 0.202800 Scale factor: 1.000000 Slope: 1.000000 Offset: 0.000000 Channel 9, Free Channel 10, PAR/Irradiance (Biospherical/Licor) s/n: 7274 Calibrated: 26/07/07 M: 1.00000000 B: 0.00000000 Calibration constant: 56179775281.00000 Multiplier: 1.00000000 Offset: 0.00000000 | Channel 12, Altimeter/Transmissometer (Chelsea/Seatech/Wetlabs/Cstar) <i>Altimeter 1</i> (CTD 001-003), see Channel 7 <i>Transmissometer</i> s/n: CST-846DR Calibrated: 29/03/05 M: 22.6410 B: -1.3360 Path length: 0.250 Channel 13, Free |
|---|--|

TABLE OCEA.3: CTD INSTRUMENTATION ISSUES AND CHANGES:

| Date | Issue/change |
|-------------|---|
| 05/01/08 | Transmissometer added to CTD prior to cast 004. Put in altimeter channel (12) and altimeter moved to channel 7. |
| 11/01/08 | Altimeter moved down on CTD frame, as it was returning poor readings (kept spiking back to default of 99.780 in bottom 100m of cast). |
| 16/01/08 | Continued problems with altimeter. Replaced prior to CTD 019. |
| 16/01/08 | Problem with CTD wire during CTD 020 led to 200m of cable being cut off. Repairs took about 3 hours and CTD 020 was abandoned. |
| 17/01/08 | CTD fluorometer replaced prior to CTD 025 due to broken lens. Data from CTDs 023 and 024 affected. |
| 23/01/08 | CTD bottles 3 and 9 replaced with BAS bottles, as they often did not shut properly on firing. |
| 29/01/08 | CTD bottle 6 replaced with a BAS bottle, as it often did not shut properly. |

2.6 LADCP

Hugh Venables

2.6.1 Introduction

Cruise JR177 initially used two RDI Workhorse WH300 ADCP (WH) units to collect direct current velocity (LADCP) data during CTD casts. A 300 kHz RDI WH unit (*DWH; serial number 4908*) was fixed in a downward facing position mounted off-centre at the bottom of the CTD frame. A second WH unit (serial number 1855) was attached in an upward facing position on the side of the CTD. A fin was added to the CTD frame to reduce spinning.

The LADCP was deployed as in the previous cruises (see Stansfield 2006, Hawker 2006). Between stations, each ADCP was connected to a controlling PC in the Underway Instrument Control (UIC) room through a serial cable for delivery of pre-deployment instructions and post-deployment data retrieval. The battery package was recharged as necessary after each deployment, by connection to a charging unit via a power lead.

The LADCP units were used on the cruise for assessing the currents at depth and to investigate backscatter strength for bio-acoustics. Because of the latter use the units were also activated on 2000m casts made for water sampling, from part way through the cruise. The units were not switched on for 400m casts as data from these depths is acquired via the shipboard acoustic instruments.

2.6.2 Instructions for LADCP deployment and recovery during JR177

This set of instructions is based on the LADCP section of previous NOC cruise reports (including JR139 Stansfield et al., 2006).

JR193 LADCP Deployment

Connect the communications and battery leads for both instruments. Details of the deployment were recorded on logsheets for each cast.

Go to controlling PC:

A) MASTER (downward looking workhorse DWH)

1. Open BBTALK window for COM1
Press <F3> to create log file for all output: filename of the form
c:\ladcp\jr177\log_files\WHM###m.txt
where ### is ctd cast number, and m refers to master status
2. Press <END> or click on the blue 'B' (break) to wake up DWH if it has powered down
3. Type **TS? <ENTER>** to check DWH clock against scientific clock
gives time in form YYMMDDhhmmss

Type **TS YY/MM/DD, hh:mm:ss <ENTER>** if required to reset DWH clock
4. Type **RS? <ENTER>** to check available memory of DWH

If you need to clear memory, type **RE ErAsE <ENTER>**
Only clear if data are transferred to the UNIX drive and processed to check they are not corrupted. Some downloads after casts were not successful on the first attempt. All files are erased at once.
5. Type **PA <ENTER>** to run diagnostic checks. Due to the instruments being in air, some of these are likely to fail and deployment is likely to be successful despite this. Transmit nearly always returned a fail.
6. If batteries were recharged, switch off battery charge unit and check battery voltage.

The master unit is now ready to be started but the slave should be started first to ensure pings start at the same time.

B) SLAVE (upward looking workhorse UWH)

Repeat steps 1 - 6 in adjacent window noting:

1. UWH log file should be called **c:\ladcp\jr177\log_files\WHS####s.txt** (s refers to slave)
7. Press <F2> Select slave UWH configuration file – slave now ready to be told to ping by the master

Master (again)

7. Press <F2> select DWH master configuration file – both instruments should start pinging.

Both

8. Press <F3> to stop log file

Detach communication and charger cables and fit blanks to cable ends. Ensure blanks have sufficient silicon grease to make a complete seal (this needs re-applying about every 20-30 CTD casts).

2.6.3 JR177 LADCP Recovery

Remove Blanks and attach communications and charger cables.

1. Open BBTALK COM1 window (for master) and COM2 window (for slave)

Press <END> or click 'B' (break) in the master window first and then the slave – both instruments then stop at the same time.

2. Check battery voltage and switch on charger if needed.

Reset Baud rate to 115200 to allow for faster recovery of the data by typing **CB811**

To transfer data to PC:

Go to FILE, RECOVER RECORDER

Select c:\ladcp\jr177\master\ for DWH and c:\ladcp\jr177\slave for UWH as destination files

Once data are downloaded, check file size and reset Baud rate by typing **CB411**. File size should be approximately 1Mb per 1000m of depth.

Type **CZ <ENTER>** once data are transferred to power down LADCPs

4. Rename the default filenames to
c:\ladcp\jr193\master\jr177M####.000 and
c:\ladcp\jr193\slave\jr177S####.000

5. Copy data on to Unix disk.

6. Initial processing on Unix to ensure data have been fully downloaded and are not corrupt. Further processing will be carried out in Cambridge for deep velocity estimates and backscatter intensity.

2.6.4 LADCP Problems

Similar problems were encountered initially of JR177 as were found on JR193. These consisted of one or both of the LADCP units going to sleep. The unit would not recognise commands and respond to sending a break by printing a number of ascii characters on the screen. This behaviour was sometimes linked to changing the baud rate, but would also occasionally start spontaneously. Once it started the baud rate would have to be changed on both instruments (using the mouse) and a break sent, searching for a combination that would wake the instrument up. Sometimes the second time a combination was tried it was successful. This problem was normally solved in time, but led to the loss of data on some casts as the units could not be switched on.

On processing the data during JR193 (the Drake Passage crossing preceding JR177) the upward looking workhorse normally returned a warning that it had a weak beam.

This meant its data were probably useless. This, combined with the fact that it was normally the slave that went to sleep (often making the master unavailable in the process) and the fact that we could not download any data from the slave, led us to take the decision to stop running the upward looking workhorse (the slave). Downward looking data are more important so we maintained the positions of the instruments on the frame. Following this we had no further problems with the downward looking instrument going to sleep. Due to this we have no upward looking data from JR177.

On one occasion, CTD 20, the file size for the downward looking instrument was too small and data were useless. It is not clear why this was though it could be linked to a rapid turnaround of the instrument after an aborted CTD cast.

The Wynall charging unit failed during the cruise so a second power pack was installed by Jim Fox. The voltage and current had to be controlled on this unit (the Wynall unit adjusts them itself). After consultation the charging was set at 54V with a current of 0.1 amps, to safely trickle charge the battery. Any voltage above 49V was rapidly lost by the battery but below this it held charge very well and charging was only needed about every 5 casts. The battery unit was vented about every 20 casts.

2.6.5 Data

Data were collected from the downward looking instrument from CTD casts: 1,2,5,9,10,11,14,16,17,20*,21,22,23,24,25,27,28,29,30,32,33,34,35,36,37,39,41,42,43,44,45,46,48,50,52,53,58,59. See CTD section for the times and locations of these casts.

*CTD20 data are bad, but file exists. Initial processing indicates that data from the other deployments are good.

2.7 EXPENDABLE BATHYTHERMOGRAPHS (XBTs)

Hugh Venables and Mags Wallace

With additional support from Nathan Cunningham, Data Manager

2.7.1 Introduction

A sequence of XBT drops were performed from RRS *James Clark Ross* during JR177 during the southbound transect to the ice edge and around R4, the Polar Front station. The details of the XBT drops are listed in Table Ocea.4.

2.7.2 Deployment

Sippican T5 probes were used and launched using a hand held launcher from the rear of the aft deck. The ship decreased its speed to 6 knots for deploying probes. Data were logged by a Viglen IBM-type 486 PC running the Sippican WinMk12 software. Data were written directly to the unix system. The data was also streamed back to Cambridge in real time.

2.7.3 Processing

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

2.7.4 Additional comments

In general the XBT deployments were successful. In some cases excessive spiking or clearly unrealistic values were logged, identified mid-drop, and the drop aborted and restarted with a new probe. On the southbound transect casts were restarted if the data went bad shallower than 1000m. Near the polar front a cast was considered successful if data were good to >500m as the use in this location was to characterize the area being exploited by King Penguins. If the second cast was also bad no further deployments were made in that location.

TABLE OCEA.4: JR177 XBT DEPLOYMENTS

| Time | Latitude | Longitude | Depth | Event number | XBT serial number | Filename | Comment |
|---------------------|----------|-----------|---------|--------------|-------------------|----------|--|
| 03/01/2008 17:39 | -60.287 | -47.6459 | 4510.91 | 44 | 326820 | T5_00035 | Spiky below 500m but cleanable |
| 03/01/2008 16:16 | -60.0351 | -47.7511 | 3371.06 | 43 | 326824 | T5_00034 | Successful |
| 03/01/2008 14:51 | -59.7771 | -47.8435 | N/A | 42 | 326827 | T5_00033 | Successful |
| 03/01/2008 11:12 | -59.5309 | -47.9258 | 4032.25 | 39 | 326823 | T5_00032 | Successful |
| 03/01/2008 09:28 | -59.2756 | -48.2844 | 3889.56 | 38 | 326819 | T5_00031 | Successful |
| 03/01/2008 07:39 | -59.0144 | -48.6525 | 4009.16 | 37 | 326818 | T5_00030 | Successful |
| 03/01/2008 05:47 | -58.7643 | -48.9933 | 4026.22 | 36 | 326822 | T5_00029 | Successful |
| 03/01/2008 03:45 | -58.511 | -49.3422 | 3703.31 | 35 | 326817 | T5_00028 | Successful |
| 03/01/2008 01:34 | -58.2527 | -49.6869 | 3979.12 | 34 | 326821 | T5_00027 | Successful |
| 02/01/2008 23:54 | -58.003 | -50.0297 | 4021.71 | 33 | 326825 | T5_00026 | Successful |
| 02/01/2008 11:19 | -57.7422 | -50.3763 | 3713.06 | 25 | 326826 | T5_00025 | Successful |
| 02/01/2008 09:40 | -57.4883 | -50.7037 | 3557.47 | 24 | 331925 | T5_00024 | Successful |
| 02/01/2008 08:01 | -57.2346 | -51.0292 | 4055.74 | 23 | 331921 | T5_00023 | Successful |
| 02/01/2008 06:22 | -56.9797 | -51.3581 | 4177.03 | 22 | 331917 | T5_00022 | Successful. Output file T5_00022 |
| 02/01/2008 04:50 | -56.7384 | -51.6648 | 4346.62 | 20 | 331919 | T5_00021 | Temperature profile at depth similar to event 19 |
| 02/01/2008 04:42 | -56.7274 | -51.6776 | 4426.25 | 19 | 331918 | T5_00020 | Temperature profile very constant at depth. Cast aborted because thought data might be faulty. Repeat cast revealed same pattern |
| 02/01/2008 03:07 | -56.4817 | -51.9872 | 4238.97 | 18 | 331922 | T5_00019 | Successful. Output file T5_00019 |
| 02/01/2008 03:04 | -56.4785 | -51.9914 | 5021.85 | 17 | 331928 | T5_00018 | Successful. Serial number not in file |
| 02/01/2008 01:17 | -56.2178 | -52.3149 | 3863.76 | 16 | 331920 | T5_00017 | Successful. Output file T5_00017 |
| 01/01/2008 23:30 | -55.9658 | -52.6278 | 4396.19 | No evt# in | 331923 | T5_00016 | Successful repeat XBT for event |

| | | | | | | | |
|---------------------|----------|----------|---------|---------------|--------|----------|---|
| | | | | bridge log | | | 15. |
| 01/01/2008 23:26 | -55.9605 | -52.6327 | 4213.31 | 15 | 331924 | T5_00015 | Aborted. Output file T5_00015 |
| 01/01/2008 21:37 | -55.7047 | -52.949 | 4086.96 | 14 | 331927 | T5_00014 | Top 1000 m good data. Below this depth data were spiky so broke wire and terminated cast. |
| 01/01/2008 19:56 | -55.4541 | -53.2579 | 3873.26 | 13 | 331928 | T5_00013 | Successful. Output file T5_00013 |
| 01/01/2008 18:16 | -55.194 | -53.5725 | 3904.77 | 12 | 332036 | T5_00012 | Successful. Output file T5_00012 |
| 01/01/2008 16:39 | -54.9377 | -53.8775 | 3795.97 | 11 | 332032 | T5_00011 | Successful. Output file T5_00011 |
| 01/01/2008 15:01 | -54.6876 | -54.1836 | 4495.59 | 10 | 332028 | T5_00010 | Successful. Output file T5_00010 |
| 01/01/2008 13:23 | -54.4321 | -54.4921 | 2109.67 | 9 | 332035 | T5_00009 | Successful. Output file T5_00009 |
| 01/01/2008 11:44 | -54.1778 | -54.7884 | 1444.32 | 8 | 332031 | T5_00008 | Successful. Output file T5_00008 |
| 01/01/2008 09:59 | -53.9198 | -55.0951 | 2318.87 | 7 | 332027 | T5_00007 | Successful. Output file T5_00007 |
| 01/01/2008 08:05 | -53.6455 | -55.4201 | 3263.59 | 6 | 332034 | T5_00006 | Successful. Output file T5_00006 |
| 01/01/2008 06:33 | -53.4125 | -55.69 | 2874.58 | 5 | 332030 | T5_00005 | Manually incremented file number but shouldn't have |
| 01/01/2008 04:53 | -53.1608 | -55.972 | 2186.17 | 4 | 332026 | T5_00003 | Successful. Output file T5_00003 |
| 01/01/2008 04:45 | -53.1496 | -55.9865 | 2161.09 | 3 | 332033 | T5_00002 | Failed - readings of 18degC at depth. |
| 31/12/2007 22:34 | -52.1674 | -57.1043 | 278 | 2 | 332029 | T5_00001 | Test XBT. Output file T5_00001 |

2.8 UOR

Nathan Cunningham, Hugh Venables, Mags Wallace

2.8.1 Introduction

The UOR used on JR177 was a Chelsea Technologies Group NuShuttle vehicle (s/n **029**). It is fitted with a Minipack CTD, PAR sensor, fluorometer, and 6 wavelengths of SeaWiifs sensors for radiance and irradiance.

Operation of the UOR requires two PCs: one to control the vehicle, and the other to control the data logging.

2.8.2 Aim

The cruise plan for JR177 included mesoscale surveys around each station, of 6 or 24 hours. These were to characterise the area around the station in terms of the physics and bio-acoustics, to assess how representative the station location was and to avoid any sharp gradients into different water masses. The UOR was to be towed to measure the physical parameters (temperature, conductivity, PAR) and fluorescence from the surface to 140m.

2.8.3 Reality

Unfortunately, if not unexpectedly, the UOR failed to work reliably. After some testing and fixing of the modem it was deployed and successfully undulated and collected data for approximately 5 hours. It then lost communications and was recovered. In the process all settings were lost and it was not possible to reset the instrument to undulate again, though it would collect data. After this it was not deployed again.

2.8.4 Recommendation

Invest time and money on the UOR updating the interface and down wire communications. The supporting computing and systems interface is become old and hence very unreliable, it needs to be replaced. This should be done in full consultation with AME.

2.9 Satellite data

Hugh Venables

2.9.1 Introduction

Each day during JR177 ocean colour (chl-a) and Sea Surface Temperature (SST) data were downloaded from <http://oceancolor.gsfc.nasa.gov/cgi/level3.pl> or <ftp://oceans.gsfc.nasa.gov/MODISA/Mapped/Daily/9/PPPP> where PPPP=CHLO or SST. These two sources were used as occasionally data would appear on one before the other. Data are delayed by two days from collection. 9km data were downloaded to reduce the file sizes being downloaded ($\approx 1.2\text{Mb}$ for chl-a, $\approx 3\text{Mb}$ for SST). Normally the daily data were downloaded but due to power problems at NASA some files from late January do not exist. During this period three-day data files were downloaded.

Absolute dynamic height data were also downloaded from ftp://ftp.cls.fr/pub/oceano/dua_antarctic_5789gfj25/maps/rt_abs/merged/h These data were delayed 7 days, after a request was put in to get data more rapidly for cruise support. The data are otherwise available after 30 days. There was no charge for the more rapid data – it was granted after writing to AVISO giving a very brief science case – see http://www.jason.oceanobs.com/html/donnees/produits/hauteurs/global/madt_uk.html

2.9.2 Processing

These data were processed in matlab, using modiscomp.m, a script written by Hugh Venables. The script allows consecutive images (one or three day) to be composited together, the upper colourbar limit to be defined and the dynamic height contours from the closest available image to be overlain. Locations defined in a separate script are also shown on the image as coloured markers. The images are then saved as png

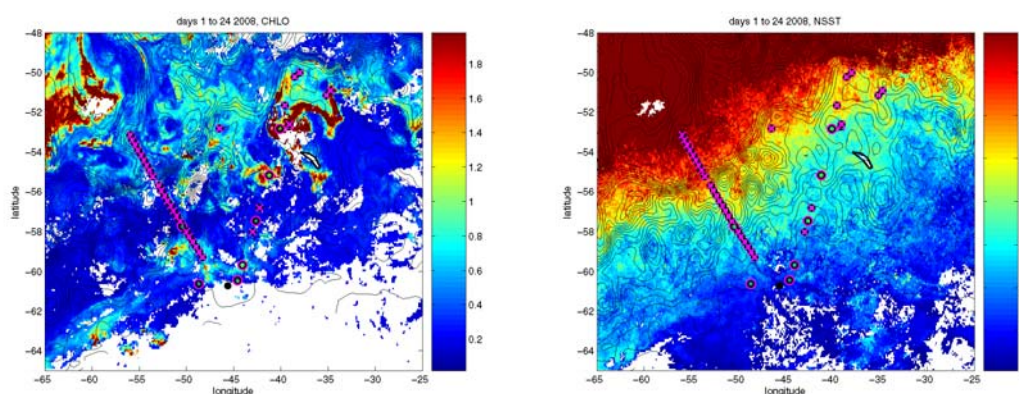


FIGURE OCEA.13: CHLOROPHYLL AND SST IMAGES FROM 1ST-24TH JANUARY, WITH OVERLAIN DYNAMIC HEIGHT CONTOURS AND PROPOSED OR ACTUAL CRUISE TRACK LOCATIONS. SOUTH GEORGIA IS INDICATED BY A BLACK OUTLINE, SIGNY BY A BLACK SPOT AND FALKLANDS BY THE WHITE AREA WITH NO DATA.

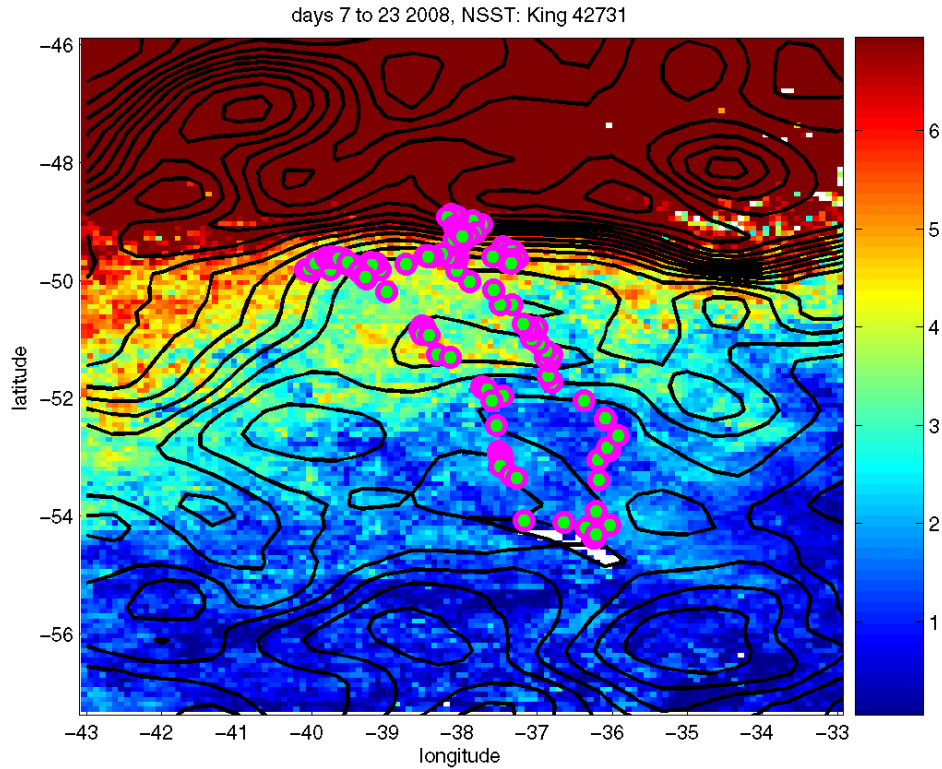


FIGURE OCEA.14: LOCATIONS OF A SATELLITE TRACKED KING PENGUIN OVERLAIN ON SST AND DYNAMIC HEIGHT CONTOURS. SOUTH GEORGIA IS INDICATED BY A BLACK OUTLINE.

files. A derivative of this program, `modis penguinPlot.m`, was used to plot the locations of satellite tracked penguins over the data.

Satellite data were used to decide on the location of the responsive stations R2 (low chl-a), R3 (high chl-a) and R4 (King Penguin foraging location); R1 was responsive to the sea ice). They were also used to assist in underway sampling, through giving an indication of the conditions that we likely to encounter along the cruise track.

These images are archived in the following, off JR177 directory on the SAN

`..\pstar\satellite\images`

3 MOORINGS AND ARPS

3.1 Moorings

Peter Enderlein, David Pond, Hugh Venables & Sophie Fielding

3.1.1 Recovery and redeployment during JR 177

During JR177 both Discovery2010 sediment trap moorings were successfully recovered and redeployed.

The 3200 m mooring was recovered on 25.01.08. The weather was fine with good visibility. The releases were activated at 20:30 GMT and just 5 minutes later the mooring was sighted on the port side of the ship. After hooking the main buoy, the mooring was recovered from top to bottom. The releases were finally recovered at 22:37. After the required data download and the necessary maintenance the mooring was redeployed on 28.01.08 @ 14:57 GMT with the weight first. After the deployment of all the equipment the main buoy was finally released at 17:04 in 3150 m of water depth at 55 11:99S and 41 07:42W. To release the main buoy a quick release hook was used successfully.

The 3700 m mooring was recovered on 31.01.08. The weather was good again with good visibility. The releases were activated at 17:30 and just 5 minutes later the mooring was sighted on the starboard side of the ship. After hooking the main buoy, the mooring was recovered from top to bottom. The releases were finally recovered at 19:49. After the required data download and the necessary maintenance the mooring was redeployed on 02.02.08 @ 18:30 GMT with the weight first. After the deployment of all the equipment the main buoy was finally released at 20:48 in 3780 m of water depth at 52 43:40S and 40 08:83W. To release the main buoy a quick release hook was used successfully.

Overall the mooring recoveries and redeployments were all very smooth operations so they took far less time than expected. For the next recoveries and redeployments however **12 hours for each operation** should be allowed to cover for any unexpected problems, which could easily occur as it has happened before.

3.1.2 Data verification

Apart from one sediment trap all instruments worked fine and collected a huge amount of data.

3200 m Discovery2010 sediment trap mooring

CTD

The CTD unit on the acoustic buoy worked well. The pressure trace initially looked bad but the pressure reverted to ???-17 when it exceeded ???386. It then logged correctly from this new baseline. After correcting for this, the data all look good. The smallest pressure was 238db. The pressure was consistently at approximately this value for periods while at other times the mooring experienced significant knock-down, with a maximum pressure recorded of 526db. Temperature and salinity data

were stable and within expected bounds. These will be compared to other data in Cambridge. The high pressures coincide between the CTD units and with periods of increased flow, giving confidence in the pressure and the current data.

ADCP

The ADCP data were converted to Matlab (using *rdradcp*, from Rich Pawlowicz), then the percent good fields checked in order to ensure high data quality. Contour plots of east, north and vertical velocities were then generated. Note that these were generated on a uniform pressure grid - i.e. assuming that each bin remained at a particular depth throughout the deployment. Given the large amount of knock-down experienced by the mooring, this was certainly not the case, but the approach was suitable for a quick check of the data. Currents were generally of the order of <20cm/s, although brief periods of flow as strong as 50cm/s were experienced. These coincided with the large knockdown observed in the CTD data. Good data were obtained for approximately 100-200m of the water column throughout the deployment.

Sediment trap

The sediment trap at PS2 had functioned correctly and a time series of sediment samples in excellent condition were recovered. Sub-samples of the sediment material were preserved for analysis of biogenic silica, POC, PON and lugols. Photographs were also taken of recognisable remains in the trap material.

Current meter

The current meter rigged immediately below the trap operated perfectly and confirmed that the sediment trap was deployed in a suitable location with mean current speeds of < 10 cm sec⁻¹. Battery life and memory usage of the current meter was minimal but it was decided not to up the sampling rate and increase battery usage since it is to an extent unpredictable when the trap will be recovered.

3700 m Discovery2010 sediment trap mooring

CTD

The CTD unit on the rope below the acoustic buoy worked well. The smallest pressure was 353dbar. The pressure was consistently at approximately this value for periods while at other times the mooring experienced significant knock-down, with a maximum pressure recorded of 598dbar. The CTD unit on the buoy also performed well. The minimum pressure was 103dbar and maximum 349dbar. Temperature and salinity data were stable and within expected bounds. These will be compared to other data in Cambridge. The high pressures coincide between the CTD units and with periods of increased flow, giving confidence in the pressure and the current data.

ADCP

No processing has been carried out on the ADCP data.

Sediment trap

Unfortunately due to an unfortunate hardware problem the sediment trap at PS3 did not function. Correspondence with the manufacturers (McLane, Canada) indicated that if after programming the trap time series, the cable is disconnected from the computer before the sediment trap controller unit, the EPROM memory cache crashes

and the trap subsequently fails to rotate the carousel. Onboard tests of the sediment trap confirmed that this was the cause of why the trap failed to operate. The controller on the PS3 sediment trap has been labelled to make this clear for future deployments.

Current meter

The current meter rigged immediately below the trap operated perfectly and confirmed that the sediment trap was deployed in a suitable location with mean current speeds of $< 10 \text{ cm sec}^{-1}$. Battery life and memory usage of the current meter was minimal but it was decided not to up the sampling rate and increase battery usage since it is to an extent unpredictable when the trap will be recovered.

3.1.3 Work carried out and setup 3200m Discovery2010 sediment trap mooring

- Deployed at: 28.01.2008
- Mooring position: 55 11:99S 41 07:42W
- Water depth: 3150 meters
- NOVATEC beacon: R09, Ch B, 159.48 MHz

Acoustic Releases

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

Codes:

Release No: 92 release code: **0483 + 0455**

Release No: 217 release code: **A274**

Acoustic releases: 92 + 217

- new batteries

ARGOS beacon: 35519

- new batteries

NOVATEC Combo beacon: R09-020

- new batteries

CTD 37 SMP 29579: 2462 on main buoy

- data downloaded
- new batteries

Set-up instrument for re-deployment

- Set real time clock to PC clock (p. 28)
- Check instruments is ok and clock is set properly by using “DS”command (p. 27)

- Set-up instrument for “Autonomous Sampling” following the instructions on page 24
- Samplenum=0 automatically makes entire memory available for recording
- Sample interval: 900 sec

ADCP WHS300 - I - UG26: 2965

- Data downloaded
- New batteries
- Set-up instrument for re-deployment
- Erase data (p.16 WinSC)
- Start WinSC for set up instrument
- Set-up instrument
 - Number of bins: 30 (1-128)
 - Bin size (m): 8 (0.2-16)
 - Pings per Ensemble: 10
 - Interval: 15 min
 - Duration: 550 days
 - Transducer depth: 200 m
- Save deployment settings in prepared folder
- Set up ADCP real time clock to PC clock
- Don't verify the compass (needless on a ship)
- Run pre-deployment tests to check instrument
- Check if instrument is working (you can hear it pinging)

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!!

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.

TABLE 3.1.2 AQUADOPP CURRENT METER DEPLOYMENT SETTINGS

```
=====
Deployment      : dstm47
Current time    : 22/04/2007 20:51:35
Start at       : 24/04/2007
Comment:
deep water sediment trap mooring, deployed 23.04.2007 south west of SG
at 55.12.373 and 41.14.784
-----
Measurement interval (s) : 900
Average interval (s) : 60
Blanking distance (m) : 0.35
Diagnostics interval(min) : N/A
Diagnostics samples : N/A
Measurement load (%) : 4
Power level : HIGH
Compass upd. rate (s) : 900
Coordinate System : ENU
Speed of sound (m/s) : MEASURED
Salinity (ppt) : 34
File wrapping : OFF
-----
Assumed duration (days) : 430.0
Battery utilization (%) : 190.0
Battery level (V) : 15.7
Recorder size (MB) : 89
Recorder free space (MB) : 88.970
Memory required (MB) : 1.7
Vertical vel. prec (cm/s) : 1.4
Horizon. vel. prec (cm/s) : 0.9
-----
Aquadopp Version 1.28
Copyright (C) 1997-2004 Nortek AS
=====
```

Sediment trap mooring (3200m water depth)

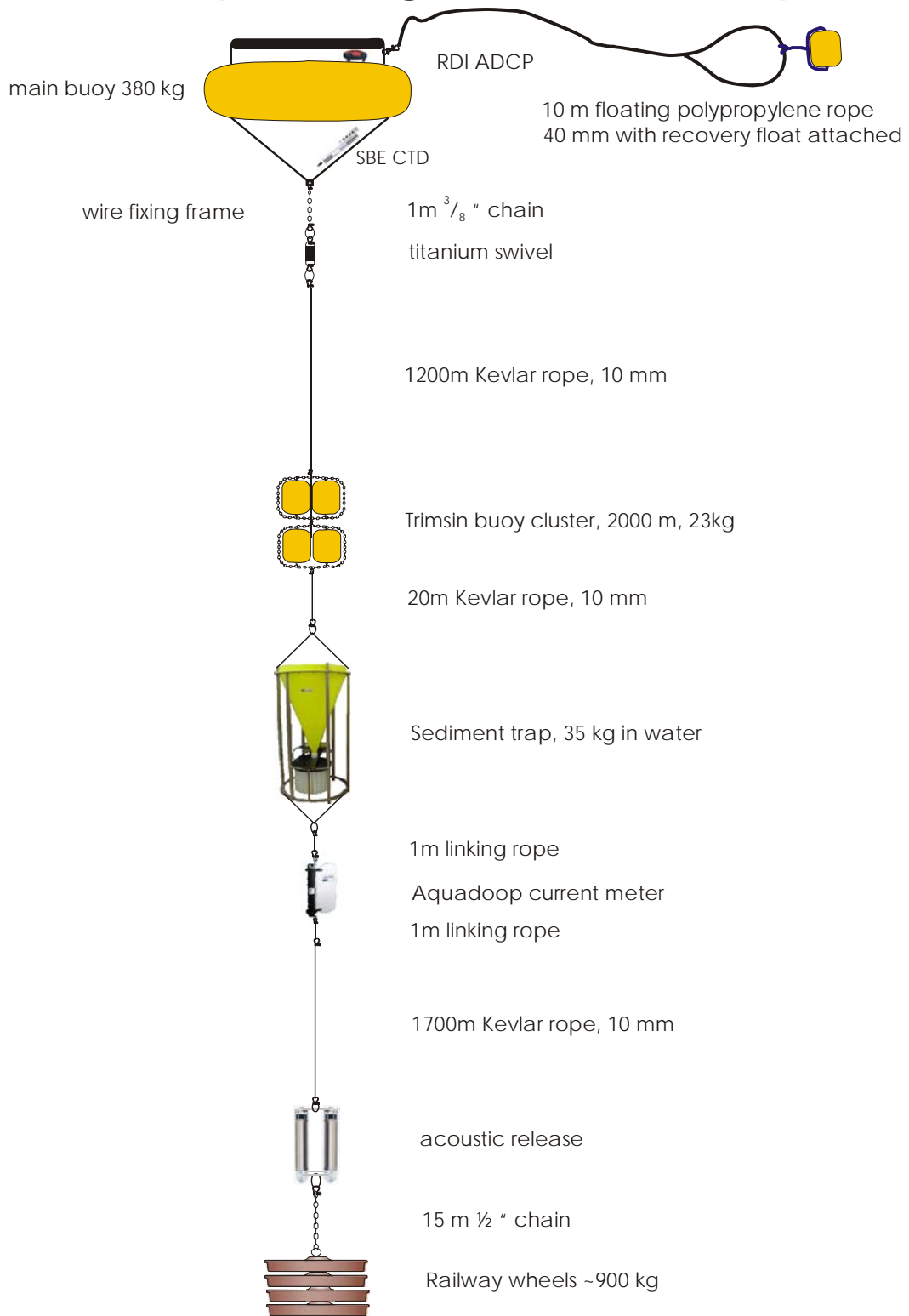


FIGURE 3.1.1 DIAGRAM OF 3200M MOORING

3.1.4 Work carried out and setup 3200m Discovery2010 sediment trap mooring

- Deployed at: 02.02.2008
- mooring position: 52 43:40S 40 08:83W
- water depth: 3780 meter
- NOVATEC beacon: U07-029, Ch A, 154.585 MHz

Acoustic Releases

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

Codes

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

Acoustic releases: 572 + 573

ARGOS beacon: SN 280, ID 60210

- New batteries

NOVATEC Combo beacon: *U07-029*

- New batteries

CTD 37 SMP 43742: *4852 on main buoy*

- Data downloaded
- New batteries

Set-up instrument for re-deployment

- Set real time clock to PC clock (p. 28)
- Check instruments is ok and clock is set properly by using “DS”command (p. 27)
- Set-up instrument for “Autonomous Sampling” following the instructions on page 24
- Samplenum=0 automatically makes entire memory available for recording
- Sample interval: 900 sec
- Create a .txt file with instrument settings and save file in correct folder

CTD 37 SMP 43742: 4855 at estimated 500 m

- Data downloaded
- New batteries

Set-up instrument for re-deployment

- set real time clock to PC clock (p. 28)
- check instruments is ok and clock is set properly by using “DS”command (p. 27)

- set-up instrument for “Autonomous Sampling” following the instructions on page 24
- samplenum=0 automatically makes entire memory available for recording
- sample interval: 900 sec
- create a .txt file with instrument settings and save file in correct folder

ADCP WHS300 - I - UG26: 7522

- Data downloaded
- New batteries

Set-up instrument for re-deployment

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

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!!

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

- Deployment → planning
- Measurement intervals (s) 900
- Average interval (s) 60
- Measurement load (%) 4 tick in auto box
- Blanking distance 0.35
- Compass 900
- Speed sound, measured 34 (appro salinity at 2000m)
- Coordinate system ENU
- Diagnostics do not tick enable
- Deployment planning assumed duration 430 days
- Battery utilisation approx 200 % (can use up to 400% for Lithium battery).

Sediment trap mooring (3700m water depth)

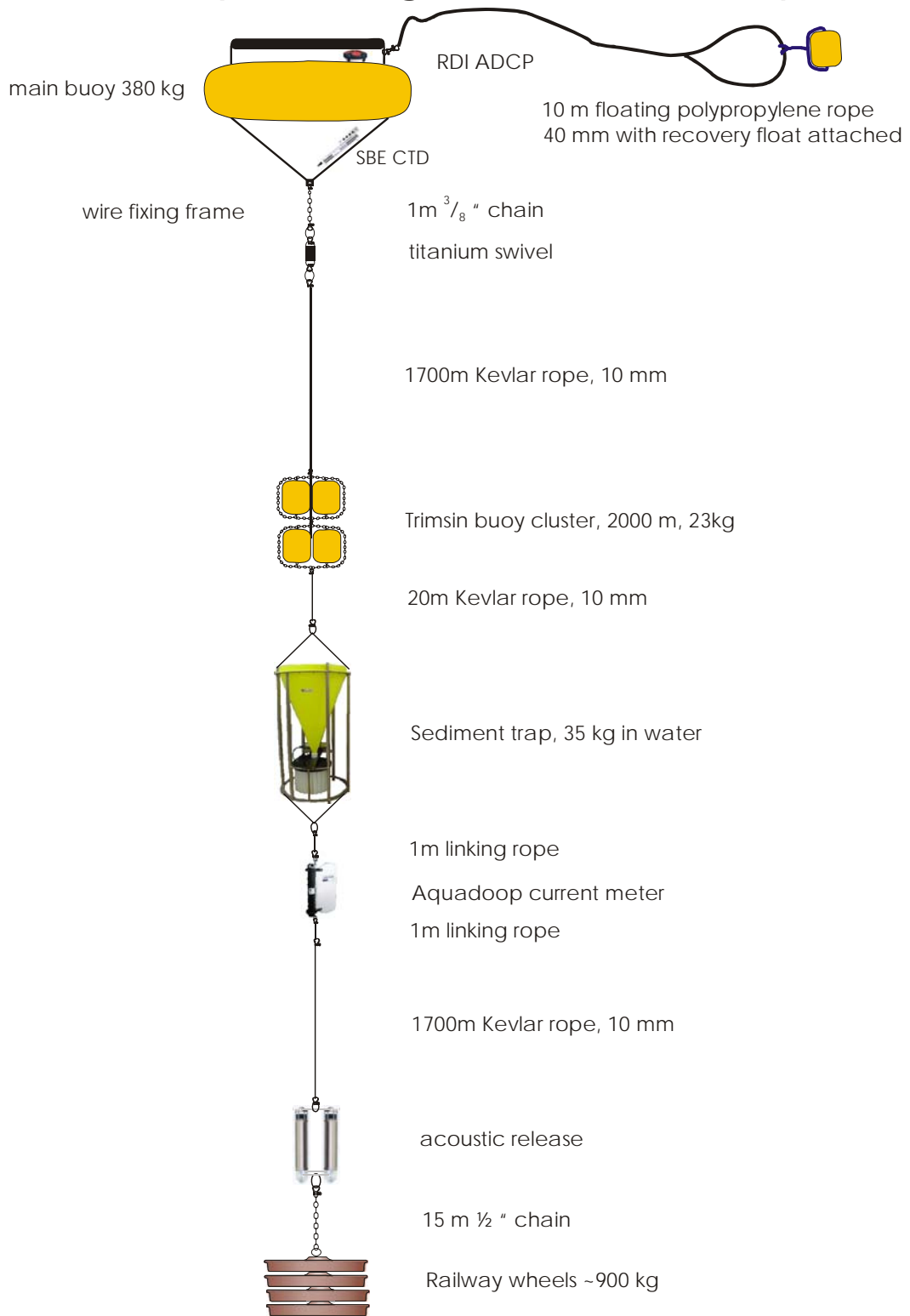


FIGURE 3.1.2 DIAGRAM OF 3700M MOORING

3.2 Acoustic Recording Package

Peter Enderlein, & James Fox

General overview

During JR177 two ARPs on the sediment trap mooring were recovered, five stand alone units deployed as well as 2 unit refurbishments.

3.2.1 Refurbishment

A total of 2 units were refurbished during JR177. We encountered no problems, now familiar with the process the refurbishment is straight forward including the sealing of the unit and creating the vacuum. Nevertheless unit 76 had a slight increase in its pressure when tested just before the deployment. This may have been due to multiple chips found on one half of the sphere.

3.2.2 Report on the two units on sediment trap moorings

During the cruise the two sediment trap moorings with the PopUps 54 and 76 were recovered. Both units seen to have worked fine. The hard drives were full of data and were taken out and backed up to go back to CB. The units were taken out of their stainless steel frames and modified for a stand alone deployment.

3.2.3 Report on the five stand alone units

The deployment took place in the same way as during JR 159. The buoy was lowered by hand to the water, the weight was taken by the Effer crane and lowered down. When the buoy was sitting on the surface the toggle of the weight was pulled - pulling the buoy under water. The units were deployed according to the instructions given by Tanja Pangerc (FAASIS PhD student) in a diamond shape with the fifth unit in the middle, all deployed in a depression in the WCB of SG. The exact deployment positions are given in the table below. A swath map of that area was used to determine the deployment sites (see Attachment)

3.2.4 Synchronisation of units

All 5 units were synchronized following the procedure outlined by Tanja. Before synchronization all 5 units were programmed and switched on. Thereafter all 5 units were put in a circle on the afterdeck and in a series of bangs with a metal stick on a metal shifter were performed as follows:

1. 1* bang @ 06:53:32 GMT, 09.02.2008
2. 2* bangs @ 06:54:00
3. 3* bangs @ 06:54:30
4. 4* bangs @ 06:55:00
5. 5* bangs @ 06:55:30

After deployment of unit 75 a light bulb attached to a shackle of 1.35 kg using Gaffa Tape was released at 09:13:18 GMT, and after the deployment of unit 73 a second light bulb again attached to a shackle of 1.35 kg was released at 10:22:09 GMT.

TABLE 3.2.1 WHALE POP-UP INFORMATION OF RECOVERED STAND ALONE UNITS:

| | Recovered | |
|-----------|------------|----------------|
| Pop-up ID | Date | HDD serial no. |
| 54 | 31.01.2008 | 361 |
| 76 | 25.01.2008 | 379 |

TABLE 3.2.2 WHALE POP-UP INFORMATION OF ALL DEPLOYED UNITS:

| Pop-up ID | Deployment (09.02.2008) | | | Sonardyne | HDD no. |
|-----------|-------------------------|-------|-----------------------|--------------|---------|
| | Time (GMT) | Depth | Position | Release code | |
| 54 | 07:09:10 | 343 m | 53 47.50 S 38 06.99 W | 005.1 | 622 |
| 80 | 07:58:16 | 250 m | 53 45.49 S 38 12.49 W | 003.1 | 623 |
| 76 | 08:30:30 | 377 m | 53 44.25 S 38 11.24 W | 004.1 | 383 |
| 75 | 09:01:21 | 328 m | 53 43.00 S 38 09.98 W | 001.1 | 621 |
| 73 | 10:07:55 | 330 m | 53 41.50 S 38 16.99 W | 002.1 | 620 |

3.2.5 Setup of the PopUp units:

Pop Up 26 (in hard hat 80) - stand alone unit

Sample rate: 2000 Hz

Qualified DSM drive ID 623

Drive has been used since last prefill.

HDD model number: HTS421280H9AT00

HDD serial number: 540AMCJ011L

Firmware revision: HA30A70S

Total user-addressable sectors: 156235952

Next recording begins at sector 2

Remaining recording time: 231.461 days

Start time: 21:52:43 08.02.2008

Year set to 2004, which could not be changed, MM,DD, HH, MM, SS set correct

Stand alone Sonardyne release

Release: 240 841 – 001

Batteries: 16 V

Release code: 003.1

Pop Up 75 (in hard hat 73) - stand alone unit

Sample rate: 2000 Hz

Qualified DSM drive ID 620.

Drive has been used since last prefill

HDD model number: HTS421280H9AT00

HDD serial number: 540AMCHU3VL

Firmware revision: HA30A70S

Total user-addressable sectors: 156235952

Next recording begins at sector 2

Remaining recording time: 231.461 days
Start time: 22:16:40 08.02.2008

Stand alone Sonardyne release

Release: 240 841 – 005
Batteries: 15.99 V
Release code: 002.1

Pop Up 80 (in hard had 75) - stand alone unit

Sample rate: 2000 Hz
Qualified DSM drive ID 621.
Drive has been used since last prefill
HDD model number: HTS421280H9AT00
HDD serial number: 540AMCJ05XL
Firmware revision: HA3OA70S
Total user-addressable sectors: 156235952
Next recording begins at sector 2
Remaining recording time: 231.461 days

Starting time: 22:38:30 08.02.2008
Year set to 2004, which could not be changed, MM,DD, HH, MM, SS set correct

Stand alone Sonardyne release

Release: 240 841 – 002
Batteries: 16 V
Release code: 001.1

Pop Up 76 (in hard hat 76) - stand alone unit

Sample rate: 2000 Hz
Qualified DSM drive ID 283.
Drive has been used since last prefill.
HDD model number: HTS421280H9AT00
HDD serial number: 540AMH5LJYF
Firmware revision: HA3OA70G
Total user-addressable sectors: 156235952
Next recording begins at sector 2
Remaining recording time: 231.461 days

Starting time: 23:03:40 08.02.2008
Year set to 2004, which could not be changed, MM,DD, HH, MM, SS set correct

Stand alone Sonardyne release

Release: 240 841 – 003
Batteries: 16 V
Release code: 004.1

Pop Up 54 (in hard hat 54) - stand alone unit

Sample rate: 2000 Hz

Qualified DSM drive ID 622

Drive has been used since last prefill.

HDD model number: HTS421280H9AT00

HDD serial number: 540AMCHYWKL

Firmware revision: HA3OA70S

Total user-addressable sectors: 156235952

Next recording begins at sector 2

Remaining recording time: 231.461 days

Starting time: 22:50:40 08.02.2008

Year set to 2004, which could not be changed, MM,DD, HH, MM, SS set correct

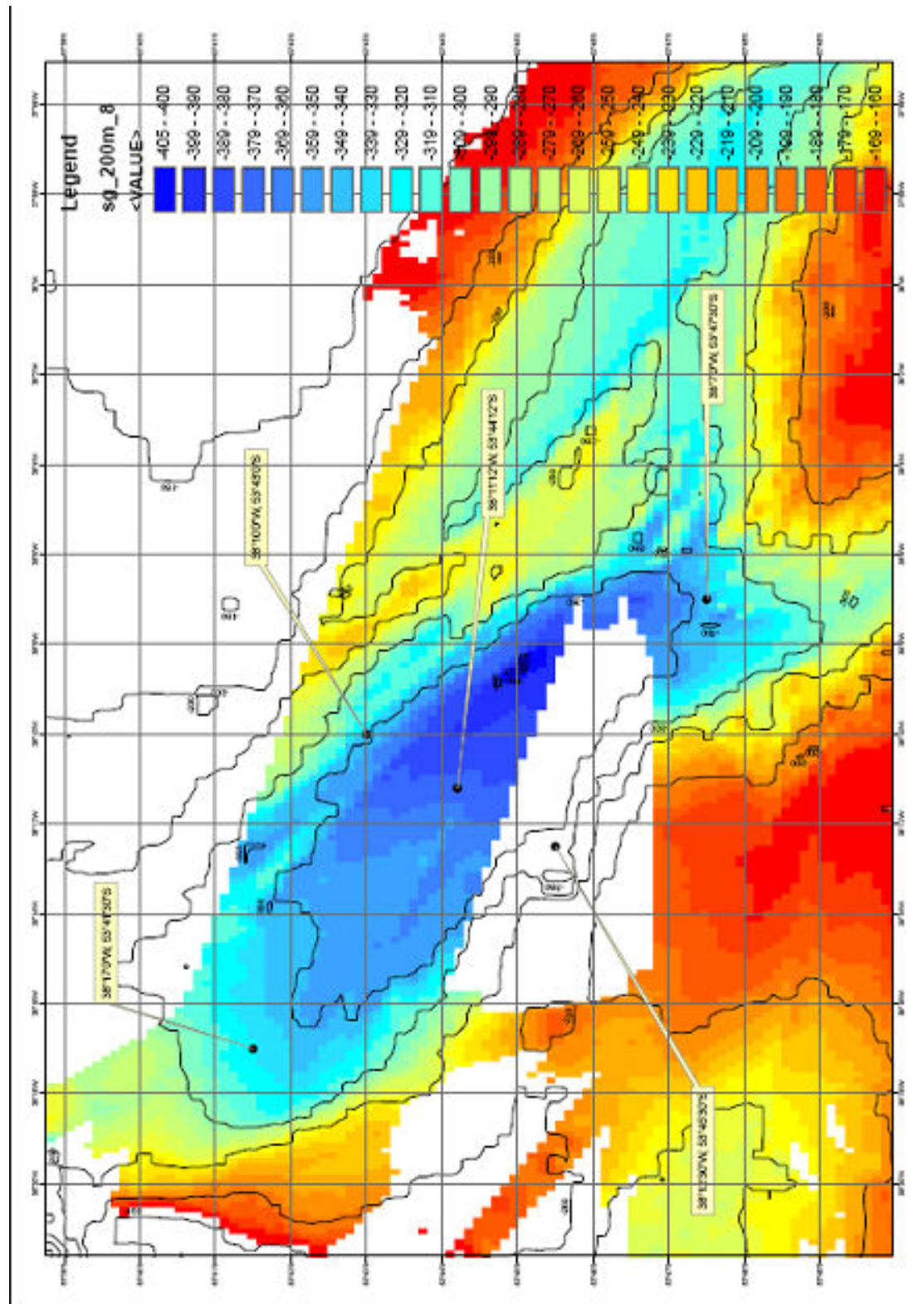
Stand alone Sonardyne release

Release: 240 841 – 004

Batteries: 16 V

Release code: 005.1

SWATH MAP OF THE DEPLOYMENT SITE OF THE 5 STAND ALONE POPUPS. PLEASE NOTE THE POSITIONS IN HERE ARE GIVEN IN DEGREE, MINUTES AND SECONDS, WHEREAS THE POSITIONS GIVEN IN THE TABLE ARE IN DEGREE, MINUTES AND DECIMALS!



4 Cruise JR177 Macronutrient Analysis

Mick Whitehouse and Min Gordon

4.1 Introduction

The Southern Ocean is generally regarded as being rich in macronutrients that are underutilized by phytoplankton. Regions where phytoplankton growth and abundance remain low throughout the year are generally described with the much-used expression “High-Nutrient, Low-Chlorophyll”. In such regions, low phytoplankton growth is attributed to factors such as a scarcity of micronutrients such as iron, inadequate light or grazing. However, there are exceptions to this “high-macronutrient, low-chlorophyll” phenomenon, especially in the Scotia Sea. Among the explanations for the Scotia Sea’s relatively high phytoplankton growth is the relief from iron-stress brought about by natural iron fertilization from sources at the Antarctic Peninsula and at oceanic islands such as South Georgia. An adequate supply of iron facilitates the uptake of nitrate-nitrogen that is abundant in the Southern Ocean. However, due to the Southern Ocean’s latitudinal silicic acid gradient, limited abundance in northern Scotia Sea waters potentially imposes silica-stress on diatom growth downstream of iron sources such as South Georgia. Notwithstanding, South Georgia’s blooms regularly comprise chlorophyll *a* concentrations $>10 \text{ mg m}^{-3}$ and may be sustained for four months or more (Korb and Whitehouse 2004). They seed the ocean for hundreds of kilometers downstream and are associated with the strongest predicted carbon sink in the Southern Ocean (Schlitzer 2002). Furthermore, the island’s enhanced primary production supports a rich food web (Atkinson et al. 2001). To sustain such substantial blooms, iron is likely to be supplied continuously to the euphotic layer throughout the growing season. The availability of silicic acid in the surface waters will determine whether the bloom is dominated by diatoms or whether a seasonal succession of other phytoplankton species occurs. Although our understanding of the dynamics of South Georgia’s phytoplankton has improved considerably with the advent of satellite imagery (Korb et al. 2004), much has still to be learnt of its seasonality, speciation and its fate downstream.

4.2 Aims

Three cruises are planned to examine seasonality across the Scotia Sea: the spring cruise JR161 was completed during 2006 while the present summer cruise is due to be followed with autumn measurements in 2009. Macronutrient measurements are a component part of the examination of phytoplankton dynamics and will complement micronutrient and phytoplankton growth measurements (detailed elsewhere in this report).

Stations sited in the vicinity of South Georgia present an opportunity to make phytoplankton growth rate measurements in iron-poor, silicic acid-rich waters (upstream of the island) and iron-rich, seasonally silicic acid-poor waters downstream of the island. Lugols-fixed samples will be examined to ascertain the seasonal taxonomic composition of the phytoplankton. Macronutrients were measured at other stations along the major transect so as to help characterize these other localities. Macronutrient concentrations south of the Southern Antarctic Circumpolar Current Front are never likely to be depleted to concentrations that limit phytoplankton growth. However, iron limitation is likely to occur in parts of the Scotia Sea which

presents the opportunity to examine phytoplankton response to iron additions made in bioassays conducted aboard ship (detailed elsewhere).

4.3 Sample collection and analytical methods

Full depth profiles of macronutrient distribution were measured at all major stations where samples were taken from the main CTD cast (see physical oceanography section for depths). Additionally, samples were taken opportunistically from “physics” CTDs made at locations between the major stations. Samples were also taken from all Go-flo bottle casts made to obtain “clean” water for iron analysis (see iron analysis section for details). Along the major transects and during mesoscale surveys, near-surface waters (7 m depth) pumped through the ship’s non-toxic seawater supply were monitored continuously for macronutrient levels. For bioassays, macronutrients were measured at intervals over the course of the experiments.

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 ($\text{NO}_3+\text{NO}_2\text{-N}$), ammonium ($\text{NH}_4\text{-N}$), silicic acid ($\text{Si(OH)}_4\text{-Si}$) and phosphate ($\text{PO}_4\text{-P}$) using a Technicon-based segmented-flow analyser (Whitehouse 1997). Data were logged to a PC once every ten seconds using a LabVIEW 6i (National instruments) acquisition programme and to a Kipp and Zonen BD300 data acquisition recorder.

In addition, particulate samples were taken for biogenic-silica analysis from three CTD casts near South Georgia and the sediment samples retrieved from station P2. CTD sub-samples (250 ml) and sediment samples (3 x 10 or 5 ml) were filtered onto a 0.45 μm polycarbonate membrane, rinsed, dried and stored at 4°C for analysis back in Cambridge.

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

No logistical, analytical or ship-side problems were encountered on this cruise.

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5 Carbon Cycling in the Scotia Sea

Elizabeth Jones, Dorothee Bakker and Andy Watson

5.1 Rationale

Present atmospheric concentrations of carbon dioxide (CO₂) have reached a level not exceeded during at least the past 650,000 years (Cicerone et al. 2004, Siegenthaler et al. 2005). The ocean is one of the largest natural reservoirs of carbon and has buffered the increase in atmospheric CO₂ by absorbing about half of the CO₂ released from anthropogenic activities since 1800 (Sabine et al., 2004). The future rate of the oceanic CO₂ uptake is unknown and is determined by physical and biological processes. The difference in the partial pressure of CO₂ (pCO₂) between the ocean and the atmosphere is the driving force for oceanic CO₂ uptake. Changes in Southern Ocean circulation have been implicated in increased uptake of atmospheric CO₂ during the last four glacial cycles (Watson and Naveira Garabato, 2006). It has been shown that south of 50°S the Southern Ocean represents a sizeable sink for CO₂ of around 0.4 Pg y⁻¹ (Takahashi et al., 2002). It is estimated that the efficiency of this sink has decreased by 10% per decade since 1981 in response to increased Southern Ocean winds (Le Quéré et al. 2007). Future changes in climate and ocean circulation could potentially lead to a slowdown of CO₂ uptake in the Southern Ocean. Given the paucity of surface water pCO₂ data in the Southern Ocean, we clearly need to increase our effort to better quantify the current CO₂ sink and to predict the future carbon cycle.

5.2 Objectives

- To quantify the accuracy and precision of a new CASIX pCO₂ instrument, previously installed on James Clark Ross (JCR), by running a UEA pCO₂ instrument in parallel.
- To make a seasonal comparison of the magnitude of the oceanic CO₂ sink.
- To quantify the summertime biological carbon uptake across a major productivity gradient.

5.3 Methods

Underway pCO₂ and O₂

Continuous measurements of pCO₂ in surface water and marine air were made throughout the cruise with two underway CO₂ systems. The CASIX system has been running continuously on JCR since October 2006 and the UEA system, designed by Ute Schuster (CAVASSOO, 2004), was running for the duration of JR177 as part of the instrument inter-comparison exercise.

Atmospheric CO₂

A ¼" Dekabon tubing air line is run from the pCO₂ instrument to the bridge wing to sample marine air. The tube opening is finished with a Swagelok filter to remove solid particulates and a plastic funnel to ensure that any moisture that collects drips off a larger area preventing the line from becoming frozen. It is important to record the relative wind speed and direction to confirm that the air being sampled is not contaminated by ship exhaust gases.

Seawater CO₂

Determination of the partial pressure of carbon dioxide (pCO₂) in seawater is achieved by measuring the pCO₂ from a fixed volume of air that is in equilibrium with a flowing stream of seawater. Seawater from the ship's surface water supply was introduced at a rate of 3 l min⁻¹ into a fast response equilibrator filled with glass Rachig rings. The system is maintained at ambient atmospheric pressure through a vent and the CO₂ and moisture content of the headspace is determined every minute during a 30 minute cycle. The analysis of the CO₂ content in the headspace was interrupted for that of the CO₂ content in marine air (4 × 30 minutes per 8 hours) and in four CO₂ standards (1 × 30 minutes per 8 hours each).

The pCO₂ is dependent on water temperature so it is important that the water in the equilibrator be as close to sea surface temperature as possible. This is achieved by using a high flow rate of sea water to reduce the extent to which the water is warmed during its passage from the ships intake to the equilibrator. Two PT100 probes accurately determined the temperature of the water in the equilibrator. Sea water temperature was measured at the water intake at 6.5 m depth in the ship's bow and the salinity was measured in the preparation laboratory. It is important to have accurate underway measurements of sea water temperature and salinity at the ships sea water inlet. Unfortunately there were problems with the oceanlogger hull temperature sensor (SST) and when compared with CTD data a mean offset of 0.37 °C (oceanlogger too cold) and a standard deviation of 0.1 °C, as shown below.

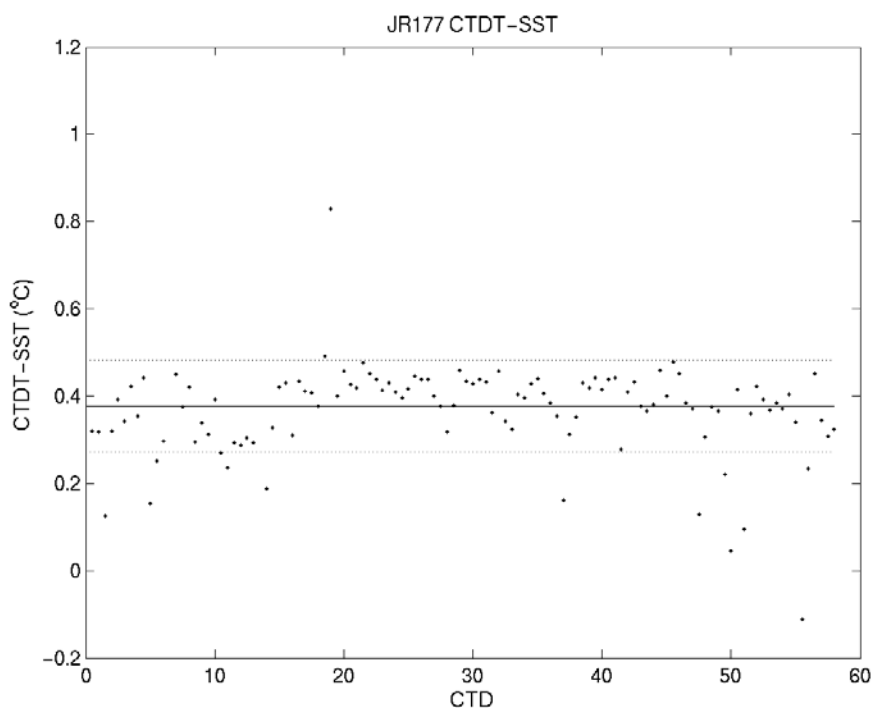


FIGURE 5.1 CARBON 1. DIFFERENCE BETWEEN SURFACE CTD TEMPERATURE AND OCEANLOGGER SST.

This is described in more detail in the oceanlogger section of the oceanography chapter of this report.

The air from the equilibrator head space is recirculated through a non-dispersive infrared analyser, LI-COR 7000, to measure the CO_{2(g)} and H₂O_(g) content. The LI-COR is calibrated using four gas standards of known CO₂ concentrations of 0, 250, 350 and 450 μmol mol⁻¹ (mole fraction), previously calibrated at UEA against certified, high precision gases from NOAA. Analyses of all parameters were carried out at a flow of 100 ml min⁻¹ through the LI-COR at a slight overpressure. Samples from the equilibrator headspace and marine air were partly dried to 10°C below the ambient temperature in an electric cool-box before being passed through the LI-COR. Drying the air eliminates the possibility of condensation in the tubing and improves the accuracy of the LI-COR measurements. The air is cooled to a specified dew point and hence the water traps in the cool box need to be regularly checked and emptied. A final analysis for each parameter was made at atmospheric pressure with no flow. The flow and overpressure did not have a discernable effect on the CO₂ and moisture measurements, once the pressure had been corrected for. The pCO₂ is calculated from the product of the mole fraction of carbon dioxide (xCO₂) and the atmospheric pressure, P, (pressure of equilibration):

$$p\text{CO}_2 = x\text{CO}_2 \cdot P$$

Values for pCO₂ are then corrected for water vapour pressure and to the measured sea surface temperature (DOE, 1994). The pCO₂ measurements were time stamped by a Garmin GPS unit mounted starboard side of the ship.

Seawater O₂

Oxygen (O₂) concentration is measured with an optode (Aanderaa model 3930) using the property of dynamic luminescence quenching of luminophore molecules embedded in a sensing foil exposed to the surrounding water (Aanderaa, 2003). The intensity of fluorescent light incident on the photo-diode detector decreases with the oxygen concentration. The optode was connected to the temperature and oxygen channels on a datalogger (Aanderaa model 3660). The O₂ data will be corrected for sea water temperature and salinity and CASIX O₂ readings will be checked against equivalent O₂ concentrations determined by the Winkler method from samples taken during JR165 in early 2007.

Gaps in the data are due to when the sea water supply was turned off due to the ship being in ice; a loose connection in power to the cool box; replacement and 'resting' of the equilibrator circuit pump and pressure leak testing or calibrations.

Dissolved Inorganic Carbon and Total Alkalinity

Sea water samples were taken from the 10 l Niskin bottles on the CTD rosette and the ships uncontaminated supply for analysis of dissolved inorganic carbon (DIC) and total alkalinity (TA). Glass reagent bottles (Schott Duran, 250 or 500 ml) were used to collect the sample either from Tygon® tubing connected to the Niskin bottle or from a bypass pipe from the ships underway supply.

Sample bottles were filled smoothly from the bottom and the water was allowed to overflow by at least half of the bottle volume. A head-space of 1% of the bottle volume was achieved by removing excess water with a plastic Pasteur pipette. The samples were then poisoned with 0.02% by volume of a saturated aqueous solution of mercuric chloride i.e. 50 μ L for a 250 ml sample. The bottles were then sealed using a greased (Apiezon® grease) ground glass stopper to provide an air tight seal and shaken thoroughly to disperse the mercuric chloride. 360 CTD samples and 60 underway samples were taken in total. The samples were stored in a cool, dark location for DIC and TA analysis back at UEA.

Table Carbon 1: The three lines for each station represent the start, maximum depth and end of the station. 'Station name' is the official name/number of the CTD station in the cruise plan and 'event' is the event number in the JR177 bridge science log. 'Depths sampled' is the total number of samples taken from the CTD at the following respective depths (m):

10 × depths: 5 10 30 50 80 120 160 200 400 600

20 × depths: 5 10 20 30 40 50 60 80 100 120 140 160 180 200 400 600 800 1000
1500 2000

Numbered notes are found at the end of the table. Full details of CTD deployments can be found in the oceanography chapter of this report.

| CTD # | Jday | Time (GMT) | Latitude | Longitude | Station Name | Event | Depths Sampled | Note |
|-------|------|------------|-------------|-------------|--------------|-------|----------------|------|
| 002 | 004 | 07:50:26 | 60° 29.89'S | 48° 11.55'W | R1 | 49 | 20 | 1 |
| 005 | 008 | 09:07:00 | 60° 12.49'S | 44° 24.47'W | C2 CTD 9 | 88 | 20 | 2 |
| 008 | 009 | 13:41:40 | 60° 25.86'S | 44° 35.55'W | CTD 8 | 109 | 10 | |
| 010 | 010 | 09:54:47 | 61° 39.69'S | 44° 04.05'W | CTD 5 | 112 | 10 | |
| 012 | 010 | 22:59:58 | 62° 21.27'S | 43° 31.65'W | CTD 3 | 116 | 5 | 3 |
| 012a | 011 | 00:54:50 | 62° 20.75'S | 43° 31.40'W | CTD 3 | 117 | 5 | 3 |
| 014 | 011 | 09:30:28 | 62° 36.53'S | 43° 14.69'W | CTD 1 | 120 | 10 | |
| 015 | 012 | 07:46:30 | 60° 39.98'S | 45° 31.15'W | CTD 7 | 122 | 5 | 4 |
| 016 | 013 | 09:14:44 | 59° 56.17'S | 44° 14.35'W | CTD 10 | 128 | 10 | |
| 017 | 015 | 07:32:10 | 59° 41.32'S | 44° 03.27'W | C3 CTD 11 | 146 | 20 | |
| 021 | 017 | 00:25:07 | 59° 08.64'S | 43° 41.62'W | CTD 13 | 170 | 10 | |
| 023 | 017 | 10:01:14 | 58° 35.89'S | 43° 30.55'W | CTD 15 | 173 | 5 | 5 |
| 025 | 019 | 07:02:00 | 58° 01.38'S | 42° 59.08'W | C4 CTD 17 | 186 | 20 | |
| 028 | 020 | 21:41:07 | 57° 45.49'S | 42° 48.07'W | CTD 18 | 208 | 10 | |
| 030 | 022 | 04:43:27 | 57° 08.38'S | 42° 25.98'W | R2 CTD 20 | 216 | 10 | |
| 033 | 022 | 15:57:45 | 56° 50.59'S | 42° 15.40'W | CTD 21 | 223 | 20 | 6 |
| 035 | 023 | 13:10:15 | 55° 54.11'S | 41° 43.17'W | CTD 24 | 225 | 10 | 7 |
| 037 | 025 | 11:50:53 | 55° 12.42'S | 41° 14.76'W | P2 CTD 26 | 227 | 20 | |
| 041 | 028 | 20:11:36 | 54° 54.77'S | 41° 10.40'W | CTD 27 | 259 | 10 | 8 |
| 042 | 029 | 10:31:23 | 54° 35.45'S | 40° 59.80'W | CTD 28 | 262 | 10 | |
| 043 | 029 | 15:09:10 | 54° 12.97'S | 40° 48.79'W | CTD 29 | 263 | 10 | |
| 044 | 029 | 19:06:20 | 53° 53.83'S | 40° 38.67'W | CTD 30 | 264 | 10 | |
| 045 | 030 | 04:23:00 | 53° 31.57'S | 40° 27.54'W | CTD 31 | 267 | 10 | |
| 046 | 030 | 11:18:53 | 53° 09.27'S | 40° 16.55'W | CTD 32 | 270 | 10 | |
| 048 | 032 | 07:24:13 | 52° 51.49'S | 40° 05.84'W | P3 | 279 | 20 | |
| 051 | 033 | 21:28:16 | 52° 43.62'S | 40° 08.82'W | P3 | 303 | 10 | 9 |
| 053 | | 08:10:01 | 52° 37.60'S | 39° 06.09'W | R3 | 317 | 20 | |
| 055 | 040 | 15:45:40 | 53° 42.86'S | 37° 57.86'W | R5 | 368 | 10 | |
| 058 | 042 | 17:45:15 | 53° 34.04'S | 34° 57.74'W | CTD 88 | 381 | 10 | |
| 059 | 042 | 21:50:12 | 53° 41.46'S | 35° 15.51'W | CTD 94 | 382 | 10 | |

Notes:

- 1 Changed deeper samples to 2 × 1000 m and 1 × 1200 m due to maximum depth.
- 2 Bottles 4 (2000 m), 5 (1500 m) and 6 (1000 m) had loose caps.
- 3 2 casts covering all depths at the same location due to a malfunction in user input firing.
- 4 Just sampled first 5 depths (5 10 30 50 80 m) as a part set.
- 5 Just sampled 5 30 50 and 120 m as 2nd of part set.
- 6 Identified deep Chla maximum therefore increased sampling frequency around this depth; 5 10 20 30 40 50 60 70 80 90 100 120 140 160 180 200 400 600 800 1000 m.
- 7 Fired 5 m bottle at 10 m due to rough weather.
- 8 Bottle 24 (5 m) was leaking slightly.
- 9 Changed deeper samples to 2 × 400 m due to maximum depth.

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5.5 Acknowledgements

I would like to thank the Captain, officers and crew for their full support during JR177 and to Geraint Tarling and Sophie Fielding for their enthusiasm, support and humour throughout the cruise. Special thanks to Simon Wright, Doug Trevett, Mark Preston and Jim Fox for their continued ship side support for the CASIX pCO₂ instrument since October 2006. My supervisors and colleagues Dorothee Bakker, Andy Watson, Ute Schuster and Nick Hardman-Mountford have given me much of their time and expertise in order to prepare me for CO₂ work at sea. Finally, Gareth Lee, Andy MacDonald, Dave Blomfield and Alex Etchells have contributed in many ways to the recent refurbishment of the UEA instrument and cruise preparations.

This work was funded by a CGS grant from the Antarctic Funding Initiative in collaboration with Angus Atkinson.

6 BIOGEOCHEMISTRY

6.1 Tissue sampling for stable isotope analysis. Trophic relationships and carbon flow in the Scotia Sea food web

Gabriele Stowasser

6.2 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 of 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.

6.3 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, labelled and frozen at -80°C (species catalogue see Table biog1). 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 sampled from shallow CTDs at all stations and from depth (100m, 300m, 600m and 1000m) at process and condensed stations by filtering water samples onto ashed glass fibre filters. 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, will be collected at Bird Island, Signy and

South Georgia 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 6.1 BIOG1: SPECIES COLLECTED FOR STABLE ISOTOPE ANALYSIS AT PROCESS (P), CONDENSED (C) AND RESPONSIVE (R) STATIONS DURING CRUISE JR 177. SD = SHAKEDOWN STATION), SH = SHELF STATION.

| <i>Species</i> | R1 | C2 | C3 | C4 | R2 | P2 | P3 | R3 | R4 | Sd and sh* |
|------------------------------|----|----|----|----|----|----|----|----|----|------------|
| POM | x | x | x | x | x | x | x | x | x | |
| <i>Calycopsis</i> | | | | | | | | | | |
| <i>borchgrevinki</i> | x | x | x | x | | x | x | x | | |
| <i>Diphyes</i> sp.1 | x | x | x | x | | x | x | x | | |
| <i>Diphyes</i> sp.2 | x | x | x | x | | | | | | |
| <i>Atolla</i> sp. | x | x | x | x | | x | x | | | |
| <i>Paraphyllina ransonii</i> | | x | x | x | | | | | | |
| <i>Periphylla periphylla</i> | x | | x | | | x | x | | | |
| <i>Stygiomedusa gigantea</i> | | x | | | | | | | | x (sh) |
| <i>Metridia</i> sp. | | x | x | x | x | x | x | | | |
| <i>Calanoides acutus</i> | x | x | x | x | x | x | x | | | |
| <i>Calanus propinquus</i> | | | | | x | x | x | | | |
| <i>Calanus simillimus</i> | | | | | | x | | | | |
| <i>Pareuchaeta</i> sp. | | | | | x | x | x | | | |
| <i>Rhincalanus gigas</i> | x | x | x | x | x | x | x | x | | |
| <i>Themisto gaudichaudi</i> | | | | x | x | x | x | x | x | |
| <i>Euphausia frigida</i> | | | | | x | | x | x | | |
| <i>Euphausia triacantha</i> | | x | x | x | | x | x | | x | |
| <i>Euphausia superba</i> | x | x | x | x | | | x | x | | x (sd) |
| <i>Thysanoessa</i> sp. | | x | x | x | x | x | x | | | x (sd) |
| <i>Galiteuthis glacialis</i> | | x | x | | | x | | | | |
| <i>Sagitta</i> sp. | x | x | x | x | | x | x | x | | |
| <i>Salpa</i> sp. | x | x | x | x | | x | x | | x | x (sd) |

7 Iron Chemistry

7.1 A study of the iron biogeochemistry in the Scotia Sea

Maria C. Nielsdóttir, Daria Hinz, Tom Bibby and Eric Achterberg

The work carried out on the cruise was funded by an AFI-CGS collaboration awarded to Dr. Rebecca Korb.

7.1.1 Introduction

Iron is an essential element for all living organisms and is of major importance for aquatic photosynthetic organisms. Due to the insolubility of Fe(III) the concentration of iron in oxygenated seawater is extremely low (<0.5 nM in the open ocean). Iron is supplied to the surface ocean via atmospheric transport of dust and its deposition (Jickells 2005), as well as by upwelling, entrainment, or mixing of deeper waters relatively rich in nutrients and metals (Johnson 1997, Bowie 2005). Furthermore a runoff effect supplying iron from ice, sea ice and brine has been found to contribute to the iron budget in higher latitudes (Lanzuel 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)

7.1.2 Sample Methods

Underway

Samples were taken from a metal towfish that was towed at the stern on the starboard side of the ship. Tubing went from the fish into the container where it was pumped with a peristaltic pump. See figure 7.1.1.

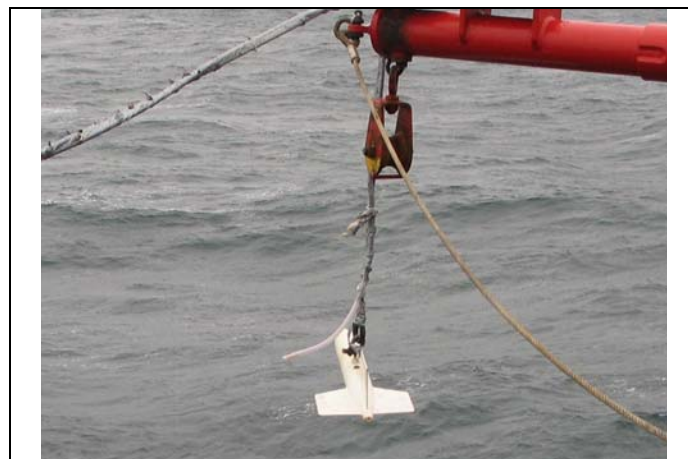


FIGURE 7.1.1, TORPEDO TOWFISH

Underway samples were filtered online through a 0.2 um Sartobran filter. All underway samples were acidified to a pH~1.8 with ultra pure HCl from Fisher.

Profiles

Water samples from six different depth horizons were obtained at each biostation and an additional 4 casts were carried out on the hydrographic transect into the ice. Samples were taken with 6 General Oceanic (GO-FLO) bottles. The bottles were attached to a plastic coated metal wire and the bottles were released with Teflon messengers.

All six go-flo bottles were acid washed with 10% HCl 6 times. However, this did not seem to help the contamination problem. This problem will have to be taken into account during the analysis phase.

All samples were acidified to a pH~2 with ultra pure HCl from Fisher for subsequent analysis for metals some time in the future.

In addition to dissolved iron samples and samples for iron speciation, additional samples were taken for Heme to be analysed back at NOC.

7.1.3 Method of analysis

Dissolved iron was measured using the flow-injection chemiluminescence method by Obata (1993). Samples were buffered with ammonium acetate to a pH=4 and pre-concentrated on a resin column during analysis. The samples were then eluted off the column by HCl and mixed with Luminol, H₂O₂ and NH₄OH to create a blue light detected by a photomultiplier. Concentrations were determined according to standard addition calibration carried out before analysis and comparison with SAFE and IRONAGES samples.

7.1.4 Results

13 Go-Flo profiles were sampled and 152 underway samples with the towfish. The majority of the samples were analysed onboard and the remaining samples will be analysed at NOC. The strategy for underway sampling was on the mesoscale surveys and the transects between the stations.

Preliminary data suggest low Fe south of S. Georgia and higher Fe north of S. Georgia

7.1.5 Recommendations and future work

For future work, it would be a wish to bring at least one more person on the cruise to give a hand with the iron work and bioassay. Being just one doing the iron work limits the coverage of underway sampling and having an extra person would mean that a bigger suite of nutrient and light combinations for the bioassay experiments could be done.

7.1.6 Equipment

The clean container: The UKORS clean container was used as a lab. The back door had visual gaps. The door was sealed using silicon gel to avoid water, air and other contaminants to enter the clean space. The MQ system in the clean

container worked well and was set up with the help of the deck engineer Simon Wright.

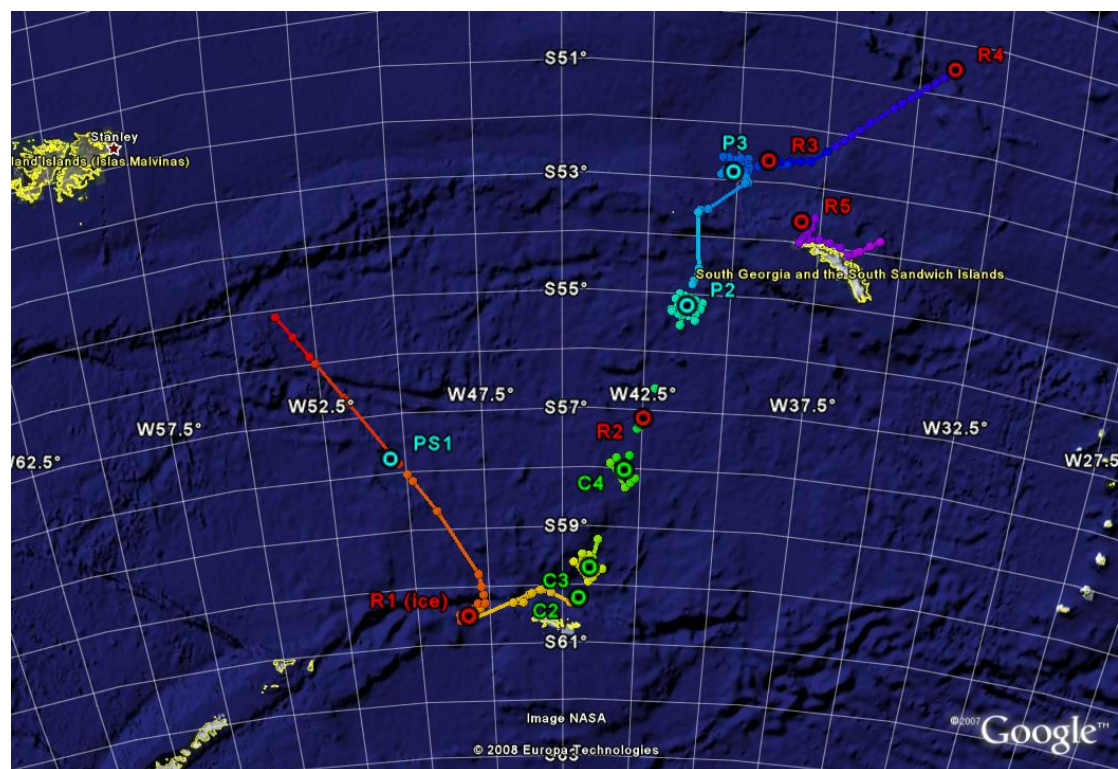


FIGURE 7.1.2 UNDERWAY SAMPLING COLOURED BY DAY.

The Go-Flos: The provided wire for the go-flos was too thick so Simon Wright had to cut out deeper grooves in to the plastic holders.

Several of the bottles leaked badly and some were unable to close properly. The wire rusted during the cruise hence making it swell and stopping the Teflon messengers to slide down.

7.1.7 Acknowledgements

I would like to thank Dr. Dave Pond for the amazing help with the go-flos. Also, I would like to thank the captain, officers and crew for all their help and patience.

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

Daria Hinz, Maria Nielsdóttir, Tom Bibby, Eric Achterberg

7.2.1 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 JR177, is to correlate natural iron abundance with phytoplankton abundance, speciation and productivity with respect to the rest of the Scotia Sea food chain.

7.2.2 *Phytoplankton physiology*

Introduction

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 JR177, two different Fast Repetition Rate (FRR) fluorometers were used to record continuous underway measurements from the non-toxic supply, discrete measurements from CTD casts, and discrete measurements from bioassay experiments. The two instruments were used in tandem as often as possible, allowing comparisons to be made between the two data sets (analysis to be performed later). Both the FASTtracka™ I, manufactured by Chelsea Technologies Group (CTG) (UK), and the bench top FIRE™ system (Fluorescence Induction and Relaxation of Emission Spectrometer), manufactured by, Satlantic (Canada) performed well, although the first CTG instrument was switched out after the first week to be used for FRRf casts. The point at which the replacement CTG came into use is noted on the data tables.

7.2.3 *Underway measurements on ships non-toxic supply*

Daria Hinz, Rebecca Korb

Both the CTG FASTtracka™ I FRRf and the bench top FIRE™ FRRf were connected to the ships 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.

CTG FAST *tracka*TM I

Saturation of variable chlorophyll fluorescence was performed using 100 flashlets of 1.1 μ s duration with a 2.3 μ s repetition rate. Subsequent relaxation of fluorescence was monitored using flashlets provided at 98.8 μ s spacing, giving a total relaxation protocol length of around 2ms. Fouling of the optics was prevented by daily cleaning of the optical surfaces. The data were stored internally on the instrument and downloaded every few days (Table frf1).

| | Start date | Start time | End date | End time | Gain | Comments |
|-------|------------|------------|----------|----------|------|--|
| UW1 | 01/01/08 | 20:43 | 02/01/08 | 16:45 | 1 | Used BAS machine S/N 182048 at start |
| UW2 | 02/01/08 | 23:11 | 03/01/08 | 1:06 | 1 | Gain too low at end |
| UW3 | 03/01/08 | 1:07 | 03/01/08 | 4:30 | 4 | Gain too high at end |
| UW4 | 03/01/08 | 4:30 | 03/01/08 | 13:06 | 1 | |
| UW5 | 04/01/08 | 3:00 | 04/01/08 | 11:38 | 1 | Gain still too low at 64, machine error? |
| UW6 | 05/01/08 | 0:19 | 04/01/08 | 4:09 | 4 | |
| UW7 | 05/01/08 | 8:08 | 05/01/08 | 14:08 | 1 | |
| UW8 | 06/01/08 | 21:46 | 07/01/08 | 16:19 | Auto | Used UKORS machine S/N 182039 until end |
| UW9 | 07/01/08 | 18:45 | 08/01/08 | 6:16 | Auto | Lots of bubbles in tubing |
| UW10 | 08/01/08 | 7:41 | 08/01/08 | 13:53 | Auto | Lots of bubbles in tubing |
| UW10b | 08/01/08 | 14:07 | 09/01/08 | 6:01 | Auto | Lots of bubbles in tubing |
| UW11 | 09/01/08 | 7:11 | 10/01/08 | 6:05 | Auto | Lots of bubbles in tubing, underway supply down at 17:30 for ½ hour |
| UW12 | 10/01/08 | 7:46 | 10/01/08 | 14:23 | Auto | Lots of bubbles in tubing |
| UW13 | 10/01/08 | 15:40 | 11/01/08 | 9:10 | Auto | Lots of bubbles in tubing |
| UW14 | 11/01/08 | 12:43 | 11/01/08 | 18:22 | Auto | Bubble-free after fitting a tap to the end of the outlet tube which reduced the flow |
| UW15 | 11/01/08 | 19:18 | 12/01/08 | 5:50 | Auto | |
| UW16 | 12/01/08 | 18:52 | 13/01/08 | 15:29 | Auto | |
| UW17 | 13/01/08 | 16:01 | 13/01/08 | 19:45 | Auto | |
| UW18 | 13/01/08 | 20:04 | 15/01/08 | 13:14 | Auto | |
| UW19 | 15/01/08 | 15:19 | 16/01/08 | 18:17 | Auto | |
| UW20 | 16/01/08 | 19:07 | 17/01/08 | 5:16 | Auto | |
| UW21 | 17/01/08 | 6:34 | 17/01/08 | 15:41 | Auto | |
| UW22 | 17/01/08 | 16:00 | 19/01/08 | 11:41 | Auto | |
| UW23 | 19/01/08 | 13:11 | 19/01/08 | 15:38 | Auto | |
| UW24 | 19/01/08 | 21:53 | 21/01/08 | 8:15 | Auto | |
| UW25 | 21/01/08 | 9:42 | 22/01/08 | 5:41 | Auto | |
| UW26 | 22/01/08 | 7:01 | 22/01/08 | 2:02 | Auto | |
| UW27 | 23/01/08 | 4:55 | 23/01/08 | 11:59 | Auto | |
| UW28 | 23/01/08 | 12:43 | 24/01/08 | 4:59 | Auto | |
| UW29 | 24/01/08 | 7:08 | 25/01/08 | 16:28 | Auto | |
| UW30 | 25/01/08 | 18:02 | 26/01/08 | 8:26 | Auto | |
| UW31 | 26/01/08 | 10:32 | 27/01/08 | 7:26 | Auto | |
| UW32 | 27/01/08 | 11:17 | 27/01/08 | 12:55 | Auto | |
| UW33 | 27/01/08 | 13:54 | 28/01/08 | 6:26 | Auto | |
| UW34 | 28/01/08 | 8:20 | 29/01/08 | 15:39 | Auto | |
| UW35 | 29/01/08 | 19:27 | 30/01/08 | 5:57 | Auto | |
| UW36 | 30/01/08 | 7:41 | 31/01/08 | 8:00 | Auto | |
| UW37 | 31/01/08 | 12:29 | 31/01/08 | 17:12 | Auto | |
| UW38 | 01/02/08 | 1:52 | 01/02/08 | 11:10 | Auto | |
| UW39 | 01/02/08 | 12:55 | 02/02/08 | 5:55 | Auto | |

| | | | | | | |
|-------------|----------|-------|----------|--------|------|-------------------------------------|
| UW40 | 02/02/08 | 6:54 | 04/02/08 | 8:12 | Auto | |
| UW41 | 04/02/08 | 14:38 | 05/02/08 | 16:05 | Auto | |
| UW42 | 05/02/08 | 17:03 | 09/02/08 | 18:53 | Auto | |
| UW43 | 09/02/08 | 19:02 | 10/02/08 | 12:41 | Auto | |
| UW44 | 10/02/08 | 15:55 | 11/02/08 | 21:50 | Auto | |
| UW45 | 11/02/08 | 21:58 | unknown | | Auto | Underway supply off from 9:30-12:30 |
| UW46 | 14/02/08 | 12:06 | 14/02/08 | 14:02 | Auto | |
| UW47 | 14/02/08 | 14:06 | 15/02/08 | ~16:00 | Auto | |

TABLE 7.2.1 FRRF1. UNDERWAY SAMPLING FILES, DATES AND TIMES FOR CTG FASTTRACKA™ I INSTRUMENT.

Data will be analyzed at a later date using custom software in a Matlab™ environment.

Satlantic FIRE

Underway sampling was carried out using a flow-through cuvette, which was cleaned daily. The data were stored internally on the instrument and downloaded every few days (Table frf2).

| | Start date | Start time | End date | End time | Comments |
|---------------|------------|------------|----------|----------|---|
| UW.000 | 21/01/08 | 19:41 | 22/01/08 | 4:51 | |
| UW.001 | 22/01/08 | 10:41 | 22/01/08 | unknown | |
| UW.002 | 23/01/08 | 4:25 | 23/01/08 | 16:20 | |
| UW.003 | 24/01/08 | 7:52 | 25/01/08 | 14:01 | |
| UW.004 | 25/01/08 | 17:21 | 26/01/08 | 7:02 | |
| UW.005 | 26/01/08 | 9:23 | 27/01/08 | 6:46 | blank .000 taken |
| UW.006 | 27/01/08 | 10:45 | 28/01/08 | 5:46 | blank .001 taken |
| UW.007 | 28/01/08 | 8:28 | 29/01/08 | 12:47 | |
| UW.008 | 29/01/08 | 16:25 | unknown | | blank .002 taken |
| UW.010 | 01/02/08 | 12:54 | 02/02/08 | 4:44 | UW.009 overflowed, not recorded, blank .003 taken |
| UW.011 | 02/02/08 | 6:47 | 04/02/08 | 7:07 | blank .004 taken |
| UW.012 | 04/02/08 | 14:54 | 06/02/08 | 18:46 | flow stopped several times |
| UW.013 | 06/02/08 | 20:06 | 07/02/08 | 9:29 | flow stopped several times |
| UW.014 | 09/02/08 | 21:01 | 12/02/08 | 15:33 | flow stopped several times |

TABLE 7.2.2 FRRF2. UNDERWAY SAMPLING FILES, DATES AND TIMES FOR FIRE™ INSTRUMENT.

Data will be analyzed at a later date using manufacturer-provided software.

7.2.4. Discrete measurements of samples from bioassays

Daria Hinz, Maria Nielsdóttir

A series of on-deck bioassay incubation experiments were conducted at five stations (Table frf3). The aim of these experiments is to identify the factors limiting phytoplankton growth. Trace metal clean surface water was collected using the Tow-Fish at the start of each station, or during the station's mesoscale survey. Samples (2 l) were subjected to varying nutrient and light conditions (Table frf4). These experiments will be important demonstrations of conclusions drawn from the sampling of the natural phytoplankton community and nutrient availability in the Scotia Sea.

Samples from the five Fe addition bioassays were collected in dark 500 ml bottles, at one or two day intervals. The samples were run first through the FIRE™ FRRf and then the FASTtracka™ I after being allowed to relax in the dark for >30 minutes both before and between analyses (Table 2). Data will be analyzed later using custom codes within Matlab™ (FASTtracka™ I) or manufacturer-provided software (FIRE™).

| | Sampling location | Sampling method | Start date | End date | FASTtracka™ I instrument used | Notes |
|-------------|-------------------|-----------------|------------|----------|-------------------------------|--|
| BIO1 | P1 | Tow Fish | 02/01/08 | 11/01/08 | BAS S/N 182048 | Low initial Fv/Fm, large changes observed |
| BIO2 | R1 | Tow Fish | 03/01/08 | 12/01/08 | BAS S/N 182048 | High initial Fv/Fm, small changes observed |
| BIO3 | R2 | Tow Fish | 21/1/08 | 27/01/08 | UKORS S/N 182039 | Moderately high initial Fv/Fm, moderate changes observed |
| BIO4 | P2 | Tow Fish | 26/01/08 | 31/1/08 | UKORS S/N 182039 | Low initial Fv/Fm, large changes observed |
| BIO5 | P3 | Tow Fish | 31/1/08 | 04/02/08 | UKORS S/N 182039 | Very high initial Fv/Fm, very small changes observed |

TABLE 7.2.3 FRRF3. SAMPLING METHOD, LOCATION, AND DATES FOR BIOASSAY EXPERIMENT.

| | 40% of Surface PAR | 40% of Surface PAR + Fe addition | 22% of Surface PAR | 22% of Surface PAR + Fe addition |
|----------------------|--------------------|----------------------------------|--------------------|---|
| Bottle Number | 1-5 | 6-10 | 11-15 | 16-20 |

TABLE 7.2.4 FRRF4. CONDITIONS FOR BIOASSAY EXPERIMENTS.

7.2.5 CTD casts

Daria Hinz

Discrete samples were collected from the niskin rosette during full-depth station casts and semi-bio transect casts in dark 500 ml bottles and analyzed using both the CTG FASTtracka™ I FRRf and the bench top FIRE™ FRRf (Table frf5). Samples were taken from 10 shallow depths (Table frf6) 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 | FASTtracka™ I | FIRE™ |
|----------|--------------|---------|--------------------------------------|-------|
| 02/01/08 | 32 | PS1 | | Y |
| 04/01/08 | 63 | R1 | Y (BAS S/N 182048) | Y |
| 08/01/08 | 88 | C2 | | Y |
| 10/01/08 | 112 | 5 | | Y |
| 11/01/08 | 120 | 1 | | Y |
| 15/01/08 | 146 | C3 | Y (UKORS S/N 182039 until end) | Y |
| 17/01/08 | 170 | 13 | Y | Y |
| 17/01/08 | 173 | 15 | | Y |
| 19/01/08 | 185 | C4 | Y | Y |
| 22/01/08 | 216 | R2 | | Y |
| 22/02/08 | 224 | 22 | Y | |
| 23/01/08 | 225 | 24 | | Y |
| 25/01/08 | 227 | P2 | Y | Y |
| 29/01/08 | 262 | 28 | Y | Y |
| 29/01/08 | 264 | 30 | | Y |
| 30/01/08 | 270 | 32 | | Y |
| 01/02/08 | 279 | P3 | Y | Y |
| 04/02/08 | 317 | R3 | | Y |

TABLE 7.2.5 FRRF5. RECORD OF CTD CASTS AND INSTRUMENTS USED FOR ANALYSIS. A “Y” IN THE TWO FINAL COLUMNS INDICATES THAT ANALYSIS WAS PERFORMED USING THAT INSTRUMENT.

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

TABLE 7.2.6 FRRF6. DEPTHS SAMPLED ON CTD CASTS

7.2.6 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.

7.2.7 References

Greene, R.M., Kolber, Z., Swift, D.G., Tindale, N.W. and Falkowski, P.G. (1994) Physiological limitation of phytoplankton photosynthesis in the eastern equatorial Pacific determined from variability in the quantum yield of fluorescence. *Limnol. Oceanogr.* 39 1061-1074

Kolber, Z., Prasil, O. and Falkowski P. G. (1998) Measurements of variable chlorophyll fluorescence using fast repetition rate techniques: Defining methodology and experimental protocols. *Biochim Biophys Acta* 1367: 88–106.

8 Phytoplankton biomass, productivity & photosynthetic physiology

RECECCA KORB

8.1 Introduction

Iron (Fe) is a key factor limiting phytoplankton production in HNLC waters of the Southern Ocean. Whilst much of the Southern Ocean is characterized as HNLC type water, there are areas naturally enriched in Fe and highly productive. Within the Scotia Sea the generally easterly flowing ACC crosses a large number of ridges, plateaus and oceanic islands. These bathymetric features may introduce Fe into surface waters through upwelling or mixing with shelf sediments. Indeed some of the most spatially and temporally intense phytoplankton blooms in the Southern Ocean are found in the waters downstream of the island of South Georgia. These blooms are largely comprised of diatoms, which in addition to Fe also require silicic acid for growth. During the austral summer, this macronutrient can become limiting near to South Georgia. Light is another important factor controlling phytoplankton growth. To date few direct measurements of Fe have been made in the Scotia Sea. Thus the exact role of Fe and/or the interactive effects with silicic acid concentrations and light in promoting or preventing primary production in this region is unclear.

8.2 Aim

Through a collaborative research effort with NOC, funded by an AFI-CGS bid awarded to R. Korb, we aim to examine the effect that iron, light and silicic acid have on natural phytoplankton populations in the Scotia Sea. We will measure ambient iron, light and silicic acid across a latitudinal gradient covering both areas of open ocean and shelf waters and relate these environmental parameters to differences in primary production rates, phytoplankton biomass, and photosynthetic efficiency. In addition, on deck experiments will be conducted (bioassays) with controlled additions of Fe and light.

8.3 Methods and data coverage

The iron/bioassay component of this work is covered by the reports of Maria Nielsdottir and Daria Hinz, the macronutrient component, including silicic acid measurements, by Mick Whitehouse. This cruise report will concentrate on primary production, chlorophyll a (biomass) and photosynthetic physiology (as measured by the FRRF).

Primary production

Primary production was measured using the radioisotope ^{14}C 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 with 100, 77, 54, 30, 10, 6, 1, and 0% surface irradiance. Trace metal clean techniques were followed. 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 rad lab and not in the clean container.

Measurements of primary production were also measured as PvsE curves (14C), using the photosynthetron in the rad lab. Incubations lasted for 2 hours.

Primary production rates using the on deck incubators were measured at all the major biology stations (see Table 1a) and at a few of the physics CTD stations. At stations near to South Georgia, primary production was measured using water collected from both the NOC towfish and the CTD. However, it is unlikely that the results will be directly comparable between the 2 methods due to differences in sampling times.

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 1b). When a full profile was not measured, a sample was collected for surface and 20 m Chl a. 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 100 m were measured at the main biology stations, and from 20 m only at all CTD stations. (Table 1b) Chlorophyll samples were also taken from the ships non-toxic seawater supply when the ship was approaching a station, during the mesoscale surveys and whilst carrying out logistics runs near South Georgia. These samples will be used to calibrate the Oceanlogger fluorescence.

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

Species composition

Lugols samples were collected at most stations at a depth of 20 m and also from 100 m at the biology stations.

8.4 Photosynthetic physiology

Two Chelsea FRRF's were used during the cruise. The BAS FRRF was deployed on a frame at each main biology station at approx. midday and midnight. The UKORS FRRF was connected to the ships underway seawater supply. Blanks were performed on both instruments at sea using bucket blanks. An instrument response function was carried out on both FRRF's using a chl a standard of $0.034 \mu\text{g}\cdot\text{ml}^{-1}$ in 90% acetone.

Additional

At various time points in the bioassay, water was collected from the incubation bottles by Bibby and samples taken for chlorophyll a, POC and Lugols.

At some stations (Table 1) water samples were taken from the 100 μm bongo net. The water was added to filtered seawater containing *f/2* and cultures were placed in the incubator on the aft deck. When the Polar Front was crossed on the return to the Falklands, the cultures were removed to the cold room. The cultures will be returned

to the CCAP in Oban for the potential isolation of new phytoplankton species into culture. Samples for Si isotope analysis were also collected for Kate Hendry, University of Oxford.

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. However, from Figure 8.1 we can see that a fairly intense phytoplankton bloom is located near the north side of the South Orkneys and to the north of South Georgia. A full evaluation of all the data should be completed during summer 2008.

8.5 Problems

We had some initial teething problem with the NOC FRRF. When it was first switched on, the date/time was set correctly. However, the date kept reverting back to some very odd dates. Pre-1950 seemed to be a popular date! Also the FRRF did not want to switch on when swiped with the magnet. The machine seemed to be in a deep sleep mode saying that it was waking up and giving a date, for example Wed.20th Nov 1940, then it would say False Alarm going back to sleep and that it was programmed to wake up in 1945. The machine was reset and reprogrammed, and reformatted as suggested by Chelsea Instruments. It was then hooked up to the underway supply and worked fine for the rest of the cruise.

However, whilst trying to get the NOC FRRF working, we mixed up battery packs between the NOC and BAS FRRF's. We used BAS FRRF with the NOC battery, for water column profiles. The battery cap was not replaced after charging with the result that the battery case flooded (interestingly the instrument continued to work and stored the data). Jim Fox cleaned up the flooded battery casing and disposed of the dead batteries. As the casing looks fine it was agreed with UKORS to hand carry the battery pack back to the UK for them to repair.

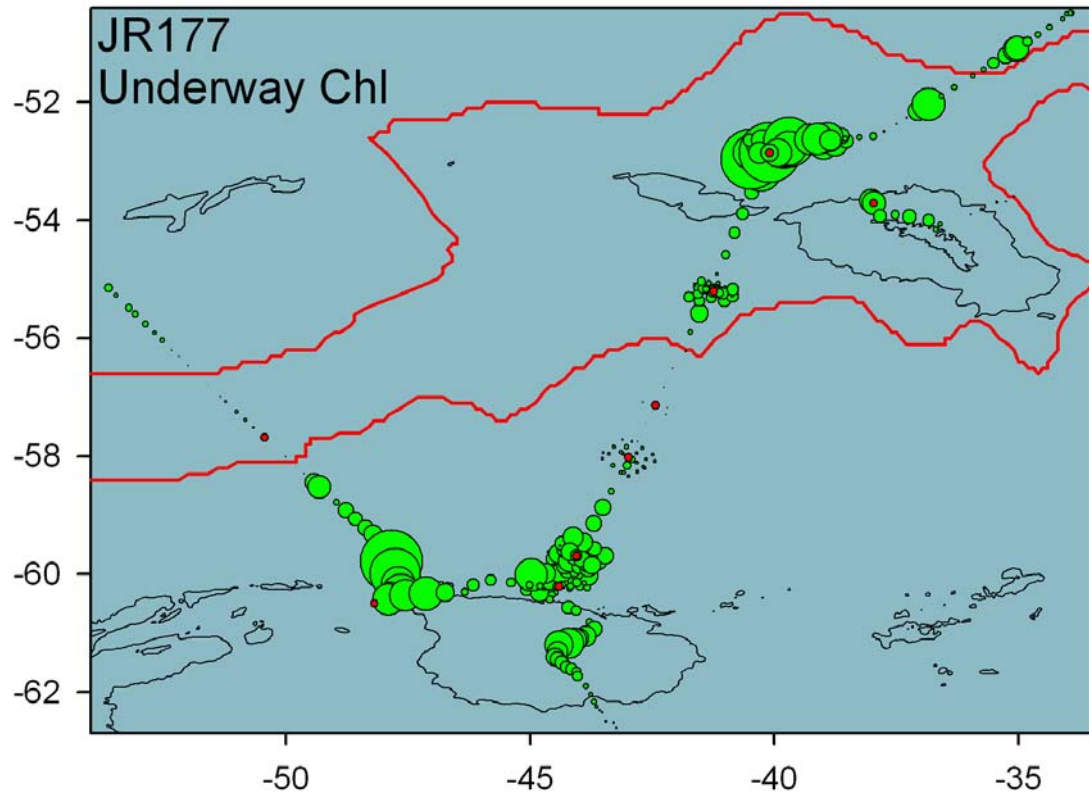


FIGURE 8.1. UNDERWAY CHL *A* CONCENTRATIONS DURING JR177. THE LARGEST BUBBLES REPRESENT VALUES OVER 7 MG M⁻³, THE SMALLEST, VALUES < 0.5 MG M⁻³

| Experiment/ sample | Source | Test | R1 | C2 | C3 | C4 | R2 | P2 | P3 | R3 | R5 |
|-----------------------|---------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 14C - PE curve | Towfish | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| 14C - on deck | Towfish | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Chl profile | CTD | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Chl 20 m only | CTD | No | No | No | No | No | No | No | No | No | No |
| SF Chl 20 m | CTD | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| SF Chl 100 m | CTD | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Lugols 20 m | CTD | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Lugols 100 m | CTD | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bioassay | Towfish | Yes | Yes | Yes | No | No | Yes | Yes | Yes | No | No |
| Si isotopes | CTD | Yes | No | Yes | No | No | Yes | Yes | Yes | No | Yes |
| CCAP culture | Bongo | No | Yes | Yes | No | No | No | Yes | Yes | No | No |

TABLE 8.1A. BAS SAMPLES COLLECTED AT MAIN BIOLOGY STATIONS.

| Experiment/ sample | 8 | 6 | 5 | 4 | 3 | 2 | 1 | 10 | 13 | 14 | 15 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 27 | 28 | 29 | 30 | 31 | 32 | |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 14C - PE curve | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | Yes | No | No | No | No |
| 14C - on deck | No | No | No | No | No | No | No | No | Yes | No | No | No | No | No | No | No | No | No | No | No | Yes | No | Yes | No | Yes |
| Chl profile | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | No | No | No | Yes | Yes | No | No | Yes | No | Yes | No | Yes | Yes |
| Chl 20 m only | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | Yes | Yes | Yes | Yes | No | No | Yes | Yes | No | Yes | No | Yes | No | Yes | No |
| SF Chl 20 m | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | No | No | No | No | Yes | Yes | No | No | Yes | No | Yes | No | Yes | No | Yes |
| SF Chl 100 m | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Lugols 20 m | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Lugols 100 m | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Bioassay | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| Si isotopes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| CCAP culture | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |
| GoFlo POC | No | No | Yes | No | No | Yes | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No | No |

TABLE 8.1B. BAS SAMPLES COLLECTED AT MAIN PHYSICS CTD STATIONS.

Prior to JR177 a series of microplankton samples were taken from the ships pumped seawater supply for a variety of biochemical analyses. Sampling locations are specified in the table below and ranged from Rothera to the Falklands, via the Bransfield Strait, the South Orkneys and South Georgia (Table 8.2). Complementary samples were collected during JR177 although most of these samples were collected from the CTD (Table 8.3)

TABLE 8.2. UNDERWAY PARTICULATE SAMPLES TAKEN FROM THE NON-TOXIC SEA WATER SUPPLY.

| Sample number | Date | Time | Lat | Long | Fatty acid litres | POC litres | Stable isotopes litres | PCB carbouys | Spare litres |
|---------------|------------|-------|----------|----------|----------------------|---------------|---------------------------|-----------------|-----------------|
| 1 | 12/12/2007 | 10:50 | 67 37.98 | 68 17.89 | 6 | 2 | 2 | 4 | 6 |
| 2 | 12/12/2007 | 18:00 | 66 37.43 | 68 35.75 | 6 | 2 | 2 | 4 | 6 |
| 3 | 13/12/2007 | 00:10 | 65 42.82 | 67 19.65 | 3 | 1.5 | 1.5 | 4 | 3 |
| 4 | 03/12/2007 | 08:20 | 64 28.11 | 64 29.14 | 6 | 2 | 2 | 4 | 6 |
| 5 | 13/12/2007 | 15:5 | 63 29.20 | 61 39.16 | 3 | 1.5 | 1.5 | 4 | 3.75 |
| 6 | 13/12/2007 | 11:10 | 62 36.35 | 58 41.51 | 6 | 2 | 2 | 4 | 6 |
| 7 | 14/12/2007 | 08:00 | 61 9.70 | 55 30.38 | 6 | 2 | 2 | 4 | 6 |
| 8 | 14/12/2007 | 15:50 | 61 09.31 | 52 15.81 | 6 | 2 | 2 | 4 | 6 |
| 9 | 14/12/2007 | 23:50 | 60 29.83 | 49 09.45 | 6 | 2 | 2 | 0 | 6 |
| 10 | 15/12/2007 | 08:15 | 60 29.86 | 46 45.03 | 6 | 2.5 | 2.5 | 4 | 6 |
| 11 | 16/12/2007 | 17:40 | 60 42.0 | 45 34.73 | 4.5 | 0.3 | 1.3 | 3 | 4.5 |
| 12 | 18/12/2007 | 09:15 | 59 16.86 | 45 2.58 | 6 | 2 | 2 | 4 | 6 |
| 13 | 18/12/2007 | 17:30 | 58 01.01 | 43 59.20 | 6 | 1.9 | 1.9 | 3 | 6 |
| 14 | 19/12/2007 | 00:15 | 56 58.19 | 42 22.32 | 6 | 2 | 2 | 3 | 6 |
| 15 | 19/12/2007 | 08:30 | 55 42.92 | 40 32.13 | 6 | 2 | 2 | 4 | 6 |
| 16 | 19/12/2007 | 15:45 | 54 34.22 | 38 49.89 | 3 | 1 | 1 | 4 | 3 |
| 17 | 20/12/2007 | 14:00 | 53 48.02 | 37 56.19 | 6 | 2 | 2 | 3 | 6 |
| 18 | 21/12/2007 | 10:20 | 54 02.44 | 36 45.01 | 3 | 1 | 1 | 2 | 3 |
| 19 | 23/12/2007 | 11:00 | 54 04.58 | 36 35.06 | 3 | 1.5 | 1.5 | 2 | 3 |
| 20 | 23/12/2007 | 17:00 | 53 57.74 | 38 35.47 | 6 | 1.5 | 1.5 | 2 | 6 |
| 21 | 23/12/2007 | 22:30 | 53 55.95 | 40 25.11 | 6 | 2 | 2 | 2 | 6 |
| 22 | 24/12/2007 | 08:15 | 53 47.28 | 43 29.17 | 6 | 2 | 2 | 4 | 6 |
| 23 | 24/12/2007 | 22:10 | 53 36.26 | 47 10.55 | 3 | 1.5 | 1.5 | 0 | 3 |
| 24 | 25/12/2007 | 08:15 | 52 47.57 | 50 07.93 | 6 | 1.5 | 1.5 | 4 | 6 |
| 25 | 26/12/2007 | 08:15 | 52 24.93 | 55 22.38 | 6 | 2 | 2 | 4 | 6 |
| 26 | 26/12/2007 | 16:30 | 51 42.69 | 57 25.41 | 4.5 | 1.5 | 1.5 | 3 | 4.5 |
| 27 | 31/12/2007 | 19:12 | 52 07.98 | 57 09.61 | 9 | 3 | 3 | 4 | 9 |
| 28 | 01/01/2008 | 06:10 | 53.47.97 | 55 14.09 | 6 | 2 | 2 | 0 | 6 |
| 29 | 01/01/2008 | 15:00 | 55 09.56 | 53 36.87 | 6 | 2 | 2 | 4 | 6 |
| 30 | 02/01/2008 | 04:20 | 57 07.16 | 51 10.50 | 9 | 3 | 3 | 4.5 | 9 |
| 31 | 03/01/2008 | 04:20 | 58 58.09 | 48 43.01 | 4.5 | 1.8 | 1.8 | 4 | 4.5 |
| 32 | 03/01/2008 | 15:05 | 60.18.79 | 47 41.09 | 3 | 1 | 1 | 4 | 3 |
| 33 | 04/01/2008 | 05:00 | 60 29.89 | 48 11.56 | 3.5 | 1.2 | 1.2 | 4 | 3.5 |
| 34 | 07/01/2008 | 16:00 | 60 09.91 | 44 17.35 | 6 | 2 | 2 | 4 | 6 |

TABLE 8.3. MICROPLANTON SAMPLES TAKEN FROM THE CTD.

| Event | Date | bottle depth | Fatty acid | POC | Stable isotope | PCB Spare | Comments |
|-------|------------|--------------|------------|-----|----------------|-----------|---|
| 49 | 04/01/2008 | 24 80 | 3 | 1 | 1.5 | | |
| 62 | 05/01/2008 | 0-14 1357 | | | | 6 | contains sediment which was also visible on the transmissometer |
| 88 | 08/01/2008 | 24 20 | 4 | 2 | 2 | | |
| 103 | 09/01/2008 | 2000 | | | | 6 | |
| 103 | 09/01/2008 | 20 | 3 | 1 | | | |
| 109 | 09/01/2008 | 20 | 6 | 2 | | | |
| 112 | 10/01/2001 | 40 | 5.2 | 2 | | | |
| 114 | 10/01/2008 | 5 5 | 4.2 | 2 | | | |
| 114 | 10/01/2008 | 19 38 | 5.5 | 2 | | | |
| 120 | 11/01/2008 | 17 70 | 4.2 | 2 | | | |
| 146 | 15/01/2008 | 23 10 | 3 | 1 | 1.5 | | |
| 162 | 16/01/2008 | 2000 | | | | 5 | |
| 162 | 16/01/2008 | 10 | | | | 3 | |
| 173 | 17/01/2008 | 22 20 | 4.2 | 2 | 2 | | |
| 174 | 17/01/2008 | 19 20 | 4.2 | 2 | | | |
| 185 | 19/01/2008 | 22 20 | 3 | 2 | 2 | | |
| 200 | 20/01/2008 | 2000 | | | | 5 | |
| 200 | 20/01/2008 | 20 | | | | 3 | |
| 216 | 22/01/2008 | 17 70 | 4.5 | 2 | 2 | | |
| 222 | 22/01/2008 | 2000 | | | | 6 | |
| 222 | 22/01/2008 | 70 | | | | 3 | |
| 225 | 23/01/2008 | 21 30 | 4.2 | 2 | | | |

| | | | | | | | | |
|-----|------------|----|------|-----|-----|-----|---|---|
| 227 | 25/01/2008 | 22 | 20 | 3 | 1.5 | 1.5 | | C |
| 240 | 27/01/2008 | | 2000 | | | | 6 | 2000, 1000, 600, 300 100 in Iugols for Claire Allen |
| 240 | 27/01/2008 | | 30 | | | | 3 | |
| 259 | 28/01/2008 | | 3382 | | | | | 1 litre in Iugols for Claire Allen |
| 259 | 28/01/2008 | | 3007 | | | | | 1 litre in Iugols for Claire Allen |
| 262 | 29/01/2008 | | ? | 5 | 2 | 2 | | chlorophyll max? |
| 279 | 01/02/2008 | | 3744 | | | | | 1 litre in Iugols for Claire Allen |
| 279 | 01/02/2008 | | 3000 | | | | | 1 litre in Iugols for Claire Allen |
| 279 | 01/02/2008 | | ? | 4.2 | 2 | 2 | | chl max |
| 293 | 01/02/2008 | | 2000 | | | | 5 | 2000, 1000, 600, 300 100 in Iugols for Claire Allen |
| 393 | 10/02/2008 | | ? | | | | 3 | chl max |

9 Mesozooplankton Sampling

9.1 Longhurst Hardy Plankton Recorder (LHPR) studies

Peter Ward, Geraint Tarling

9.1.1 Background

As last year LHPR sampling was undertaken at each station to describe the fine scale (~25 m resolution) of mesozooplankton within the top 1000 m. However, unlike last year (cruise JR161), when the sampler was plagued by persistent electronic problems, the LHPR has performed much more reliably this season. The reason for this improved performance appears to be the upgraded net monitor that Jim Fox and Peter Enderlein have worked hard to ready for this cruise. Consequently the majority of deployments have worked properly and for those that didn't the poor communication problems invariably lay with faulty connectors and not with the gear itself. Many thanks to both of the above-mentioned for ensuring that a quality product was ready in time for this cruise.

9.1.2 Method

We wished to undertake 2 deployments at each station; a nighttime and a daytime haul to 1000 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 m per minute at a ship's speed of 2.5 kts, 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 1000 m 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 5 m³ 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 15 hauls were undertaken at 8 stations (Table 9.1). At 5 stations both hauls were successfully carried out although at CS3 flow data was disrupted. At a further 2 stations only 1 haul was taken. No sampling was undertaken at the Polar Front station (R4) due to poor weather conditions.

Damage to the sampler frame occurred during bad weather experienced at station R2. Welds were broken where the runners are attached to the main frame. Thanks to Steve Eadie (4th Engineer) and Peter Enderlein for fabricating brackets to strengthen the runners and which allowed the samplers continued use.

TABLE 9.1 LHPR TAB1. SUMMARY OF HAULS

| Station | Event number | Patches | Comments |
|---------|--------------|---------|--|
| R1 | E48 | 44 | OK |
| | E55 | 40 | OK |
| CS2 | E87 | 48 | OK Comms problem but worked |
| | E96 | 42 | OK |
| CS3 | E145 | 44 | OK but no flow data |
| | E152 | 46 | OK but flow only worked to 700 m and then stopped |
| CS4 | E183 | 28 | Comms out at 700 m on descent. Hauled to surface . |
| | E194 | 35 | OK |
| R2 | E210 | 40 | OK but nighttime LHPR cancelled due to bad weather |
| P2 | E256 | 47 | OK |
| | E261 | 44 | OK |
| P3 | E278 | 45 | OK |
| | E287 | 42 | OK |
| R3 | E316 | | Malfunctioned. Traced to bent and corroded connections |
| | E325 | 44 | OK |

9.2 *Oithona similis* (Copepoda:Cyclopoida): lifecycles and population dynamics

Peter Ward and Andrew Hirst

(Queen Mary College, University of London)

9.2.1 Introduction

Work has continued throughout JR177 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 submitted).

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.

9.2.2 Method

At all stations, with the exception of R4 at the Polar Front, where poor weather precluded sampling, 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 53 micron 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 lifestages of this and its less abundant congener *Oithona frigida* in relation to physical and environmental variation.

9.2.3 Carbon analysis

Five hundred adult female *O.similis* were picked from samples obtained at 5 of the stations 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°C to await carbon analysis. At two of the stations *O. frigida* was also sufficiently abundant to allow the same procedure to take place.

9.2.4 Lipid analysis

Again at 5 of the stations, 3 replicate samples of 20 *O. similis* females, 20 stage CV and where sufficiently abundant *O. frigida* females were picked out and placed in a chloroform/methanol mixture for lipid analysis in the UK.

9.2.5 References

Gallienne CP, Robins DB (2001) Is *Oithona* the most important copepod in the world's oceans? J Plankton Res 23: 1421-143.

Hirst AG, Ward P (submitted) Mortality of the cyclopoid copepod *Oithona similis* in polar waters during spring. Submitted to Marine Ecology Progress Series.

Ward P, Hirst AG (2007) *Oithona similis* in a high latitude ecosystem: abundance, distribution and temperature limitation of fecundity rates in a sac spawning copepod. Mar Biol 151: 1099-1110.

FIGURE 9.2 OITHONA FRIGIDA FEMALES. NOTE FEMALE BEARING EGGSAC



9.3 Condition factors of *Calanoides acutus*

RACHAEL SHREEVE, DAVID POND and GERAINT TARLING

Individuals of Stage CV *Calanoides acutus* were picked from the MOCNESS nets and preserved individually in pre-weighed tin foil capsules.

The aim was to get 12 individuals from each of the 8 depth horizons during the daytime haul. These were dried onboard ship at 60 degrees C, and returned to

| Depth/station | R1 (E57) | C2 (85) | C3 (137) | C4 (177) | R2 (213) | P2 (249) | P3 (292) | R3 (312) |
|---------------|-------------|---------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1000 – 875 | 12 | 12 | 6 | 3 | 0 | 12 | 12 | 12 |
| 875 – 750 | 12 | 12 | 8 | 6 | 3 | 12 | 12 | 12 |
| 750 – 625 | 12 | 12 | 12 | 4 | 0 | 12 | 12 | 12 |
| 625 – 500 | 6 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 500 – 375 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 375 – 250 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 250 – 125 | 12 | 12 | 12 | 12 | 1 | 12 | 12 | 12 |
| 125 - 0 | 12 | 12 | 12 | 0 | 8 | 12 | 12 | 12 |

Cambridge in the minus 80 freezer for later CHN analysis in the UK. Number actually taken are recorded in Table 9.3 MOCNESS

TABLE 9.3.1 MOCNESS NUMBER OF INDIVIDUALS OF *CALANOIDES ACUTUS* STAGE CV FROM EACH DEPTH AND STATION.

Additional samples of *C. acutus* were frozen in solvent (chloroform:methanol) and will be analysed individually for their total lipid, lipid class, fatty acid and fatty alcohol contents. Each copepod was measured and a digital image taken.

TABLE 9.3.2. *C. ACUTUS* SAMPLES FROZEN FOR LIPID ANALYSIS.

| Event | Stage | | |
|-------|-------|----|----|
| | CIV | CV | F |
| 50 | 0 | 10 | 10 |
| 57 | 0 | 24 | 16 |
| 81 | 0 | 9 | 17 |
| 89 | 0 | 6 | 10 |
| 104 | 0 | 5 | 0 |
| 137 | 0 | 22 | 19 |
| 148 | 0 | 8 | 10 |
| 177 | 0 | 8 | 18 |
| 187 | 0 | 5 | 8 |
| 213 | 0 | 8 | 7 |
| 218 | 0 | 10 | 7 |
| 229 | 7 | 10 | 0 |
| 249 | 0 | 50 | 0 |
| 281 | 0 | 10 | 0 |
| 292 | 0 | 32 | 0 |
| 312 | 0 | 25 | 15 |
| 321 | 0 | 16 | 0 |

10 Krill Ecology

10.1 Feeding Ecology of Antarctic krill

Angus Atkinson

10.1.1 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.

10.1.2 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 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,N (?and possibly Silica?) as a proportion of dry mass in pellets from freshly caught krill
2. Do the same in krill maintained in a flow-through incubator (pumped seawater supply) for 1 month, sampling pellets every 12h

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.

10.1.3 Methods

Objective A: 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°C for laboratory determination of gut fullness and diet back in Cambridge. Undamaged animals in good condition were then transferred to two replicate 10L buckets of filtered seawater (fsw), provided by the one and only Dave Pond. At hourly intervals for the first 3h after capture the krill were transferred to fresh 10L buckets of fsw. This allowed all pellets 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°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 Gordon and Beki Korb. 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 B: pellet sinking rates

Concurrently with the krill incubated for fecal egestion rate measurements, I also incubated larger numbers, where available, in two 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 Mags Wallace 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 C: pellet composition.

I attacked this objective in two ways.

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 after about 2-4 h, rinsed in fsw and cleaned carefully of any debris, before a brief final rinse in deionised water and transfer to 2ml micro-centrifuge tubes. These larger volume samples were frozen (-80°C) for later analysis of dry mass and elemental content.

2. Secondly I incubated 30 krill in a through flow system, a 20L bucket, plumbed into the non-toxic seawater supply in the cold room. Flow rate was maintained at $\sim 1\text{L min}^{-1}$, via a 10L settling tank to first remove any larger debris. This water was further screened at the inflow to the incubation bucket by a large area 750 micron sieve, which also served as a baffle to help prevent turbulence. A mesh grid at the bottom of the 20L incubation bucket prevented krill from potentially re-ingesting their fecal pellets. This set-up was run for nearly 1 month, from 14 Jan to 12 Feb, with fecal pellets harvested and treated (as C.1 above) every ~ 12 h. This provided 56 pellet samples for chemical analysis and comparison with the ambient chl *a* samples.

For both approaches, pellets were photographed to record dimensions and overall quantities.

10.1.4 Data coverage and Preliminary Results

Table 10.1 ***Krill Trophic Ecology*** shows the experiments and preservation of freshly caught krill completed for Objectives A, B and C.1.

Objective A: fecal egestion rates

Krill were caught mainly by RMT8 but also by RMT25, providing 22 catches with freshly frozen krill for gut contents analysis. Of these, 19 hauls provided krill in good enough condition to measure fecal egestion. These were caught throughout the cruise from a variety of conditions, spanning a range of krill sizes, swarm depths and times of day. I incubated variable numbers of krill per timepoint, 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.

Overall, fecal egestion rate was highly variable, reflecting the complex feeding behaviour of this species. There was no noticeable day-night difference in egestion rates, although several swarms sampled below 100 m depth (e.g. event 308) had low 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, and often little decrease after the first 3h, in contrast to some earlier studies.

With 19 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 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. The results will probably need to be combined with data from the autumn cruise to say something sensible on the causes of this variability.

Objective B: pellet sinking rates

I determined the sinking rate of 714 individual pellets across 16 experiments (see Table *Krill Trophic Ecology I*). The sinking rate of the fecal pellets varied nearly 30-fold, from 0.051 cm s^{-1} to 1.41 cm s^{-1} (corresponding to an equivalent theoretical sinking rate of 44 to 1218 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 C: pellet composition

There were sufficient krill caught to obtain bulk samples of fecal pellets from 15 of the catches (Table *Krill Trophic Ecology I*). This will be augmented by the 56 timepoints from the through-flow (I consider that the latter was definitely a “Plan B” approach, which I started during the cruise to keep the work ticking over. However, 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.

10.1.5 Problems encountered/recommendations

No major problems, although I need a more efficient through-flow method if I do this in future! I am indebted to my fellow scientists for all the gear changeovers, target fishing, filtering and analysing the chl *a* samples and preparing filtered seawater.

I had been hoping to rely on the fluorometer to provide an underway index of the food environment – shame about its non-functionality, as this index is absolutely basic to the food web.

A design issue for future cruises might be to make this target fishing less closely linked to station work and more opportunistic in nature (ie. using transit time between

stations as search time and fishing when we run over a swarm). This may help keep the target hauls ticking over at a rate of 1 every day or so rather than having big gaps between big work sessions. We started doing this later in the cruise and it worked out well.

10.1.6 References

Clarke A, Quetin LB, Ross RM (1988) Laboratory and field estimates of the rate of faecal pellet production by Antarctic krill, *Euphausia superba*. Mar Biol 98: 557-563.

Quetin LB, Ross RM, Clarke A (1994) Krill energetics: seasonal and environmental aspects of the physiology of *Euphausia superba*. in: El Sayed SZ (ed) Southern Ocean ecology: the BIOMASS perspective. Cambridge University Press, Cambridge, UK. p 165-184

TABLE 10.1 *KRILL TROPHIC ECOLOGY I*. A SUMMARY OF RMT 8 AND RMT25 NET CATCHES USED FOR KRILL FECAL PELLET EXPERIMENTS

| Event | Date (2008) | Net no. | Freshly frozen (t_0) krill | | Fecal egestion measurement | | | Bulk pellets (no. h after t_0) | Incubation Temp (°C) | No. of pellets settled | Approx mean krill size (mm) |
|-------|-------------|---------|--------------------------------|-------------------|----------------------------|-----------------|----------------------|-----------------------------------|----------------------|------------------------|-----------------------------|
| | | | Time frozen (GMT) | Approx no. frozen | No. replicate buckets | No. time-points | No. krill per bucket | | | | |
| 29 | 2 Jan | 1+2 | 15:00 | 44 | None | None | None | 5 | None | 10 | ~45 |
| 40 | 3 Jan | 2 | 12:00 | 20 | 2 | 5 | 15 | 3 | 2.2 | 42 | 30 |
| 47 | 4 Jan | 2 | 02:55 | 40 | 2 | 4 | 40 | 1.5 | 1.8 | 46 | 40 |
| 56 | 4 Jan | 2 | 17:32 | 60 | 2 | 4 | 19 | 2.5 | 1.2 | 51 | 42 |
| 79 | 6 Jan | 2 | 10:00 | 40 | 1 | 3 | 34 | 3 | 0.5 | 50 | 37 |
| 97 | 8 Jan | 1 | 22:50 | 60 | 2 | 2 | 75 | 3 | -0.25 | 65 | 44 |
| 123 | 13 Jan | 1 | 04:32 | 60 | None | None | None | None | None | None | ~45 |
| 138 | 14 Jan | 2 | 20:50 | 60 | 2 | 3 | 50 | 2 | 0.5 | 50 | 40 |
| 154 | 15 Jan | 2 | 18:49 | 60 | 2 | 3 | 27 | 2.5 | 1.0 | 50 | 46 |
| 178 | 18 Jan | 2 | 23:05 | 25 | 2 | 2 | 34 | None | 1.9 | None | ~50 |
| 179 | 18 Jan | 2 | 23:33 | 41 | 1 | 2 | 45 | 2.5 | 1.9 | 51 | 50 |
| 195 | 19 Jan | 2 | 18:25 | 40 | 2 | 3 | 40 | 2.5 | 1.8 | 51 | 50 |
| 199 | 20 Jan | 2 | 04:35 | 30 | None | None | None | None | None | None | ? |
| 275 | 31 Jan | 1 | 21:55 | 30 | 1 | 3 | 26 | None | 2.5 | 20 | 55 |
| 294 | 2 Feb | 2 | 03:50 | 30 | 1 | 3 | 164 | None | 2.5 | None | 51 |
| 304 | 2 Feb | 1+2 | 23:59 | 18 | 2 | 4 | 32 | 4 | 2.5 | 50 | 53 |
| 306 | 3 Feb | 1 | 09:10 | 40 | 2 | 3 | 43 | 4 | 2.5 | 33 | 50 |
| 308 | 3 Feb | 1 | 16:30 | 50 | 1 | 2 | 50 | 3.5 | 2.5 | 35 | 48 |
| 327 | 4 Feb | 2 | 22:31 | 40 | 2 | 3 | 44 | 3 | 2.5 | 60 | 45 |
| 365 | 9 Feb | 1 | 13:20 | 1 | 1 | 1 | 13 | None | 2.5 | None | 45 |
| 376 | 9 Feb | 2 | 23:30 | 50 | 2 | 4 | 48 | 3 | 2.7 | 50 | 45 |
| 378 | 10 Feb | 2 | 05:43 | 30 | 1 | 2 | 26 | None | 2.7 | None | 53 |

10.2 Krill length-frequency and maturity stage

Jon Watkins and Sophie Fielding

10.2.1 Introduction

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

10.2.2 Methods

Samples were taken from RMT8 and RMT25 net hauls that were either directed at acoustic targets or hauled obliquely through set depth horizons at a station.

For oblique station hauls all krill were sorted from the nets and then a random sample of 100 krill taken for krill length measurement and maturity stage analysis. For targeted hauls, 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 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).

Once measured, animals from station-based hauls were preserved in formalin with the general zooplankton catch. Samples of krill from target-directed hauls were not preserved.

Watkins et al. (1986) points out that measurer variation can bias krill length measurements. On this cruise two scientists measured krill (Jon Watkins and Sophie Fielding). To assess the effect of measurement bias two experiments were carried out. First, different samples of krill from the same net were measured by both scientists. Second, the same krill were measured by both scientists.

10.2.3 Data coverage

A summary of net hauls in which krill were measured is given in Table_krill/f_1. Krill length and maturity stage data were entered into the spreadsheet:

L:\science\krill_ecology\length_frequency\jr177_krill_length_frequency.xls

From there the data were entered into the RMT25/Lower trophic level database.

Net hauls where krill were measured by both Jon Watkins and Sophie Fielding are identified in Table_krill/f_2 and the resulting length frequency distributions are shown in Figure_krill/f_1. An ANOVA (Table_krill/f_3) shows that there was no significant difference between the two krill measurers. We therefore conclude that krill measurer can be ignored as a measurement bias for this cruise.

Significant numbers of krill were taken from both RMT8 and RMT25 nets. There have been concerns expressed that these two nets might show different levels of

selection for different sizes of krill; with RMT8's under-sampling large krill and RMT25's under-sampling small krill. Comparison of the overall size distribution of krill caught by these net types indicates that there is a significant difference between these nets (Table 10.2.1_krill/f_3 and Figure 10.2.1_krill/f_2).

TABLE 10.2.1_KRILL/F_1: NUMBER OF NETS WHERE KRILL LENGTH FREQUENCY MEASURED, GROUPED BY NET TYPES AND MEASURERS

| Net type | Total no of net hauls in cruise | Total no of net hauls where krill measured | Number of net samples processed by each krill measurer | | |
|----------|---------------------------------|--|--|-----------------|-----------------|
| | | | Jon Watkins | Sophie Fielding | Rachael Shreeve |
| RMT25 | 43 | 15 | 18 | 12 | 1 |
| RMT8 | 24 | 15 | 12 | 3 | - |
| LHPR | | 1 | 1 | - | - |

TABLE 10.2.2_KRILL/F_2: NUMBER OF NETS WHERE KRILL MEASURED BY BOTH JON WATKINS (JLW) and Sophie Fielding (SOF) to allow detection and correction of any measurement bias. * signifies that krill measured are not the same animals, \$ signifies that same krill measured and used in ANOVA to test measurer differences and shown in Figure_krill/f_1.

| Event number | Net number | Net type | First measurer | Second measurer |
|--------------|------------|----------|----------------|-----------------|
| 47 | 2 | RMT8 | JLW | SOF* |
| 155 | 1 | RMT25 | JLW | SOF* |
| 155 | 2 | RMT25 | JLW | SOF* |
| 294 | 2 | RMT8 | JLW | SOF\$ |
| 306 | 1 | RMT8 | JLW | SOF\$ |
| 308 | 1 | RMT8 | SOF | SOF\$ |
| 326 | 1 | RMT8 | SOF | JLW\$ |
| 327 | 2 | RMT8 | SOF | JLW\$ |

TABLE 10.2.3_KRILL/F_3: RESULTS FROM ANOVA TO TEST DIFFERENCES BETWEEN KRILL MEASURERS (JLW & SOF). KRILL MEASUREMENTS TAKEN FROM NETS IDENTIFIED BY \$ IN TABLE_KRILL/F_2.

| | Degrees of freedom | Sum Sq | Mean Sq | F value | Pr(>F) |
|-----------|--------------------|---------|---------|---------|--------|
| Measurer | 1 | 38.6 | 38.6 | 2.5951 | 0.1076 |
| Residuals | 826 | 12285.6 | 14.9 | | |

TABLE 10.2.4_KRILL/F_4: RESULTS FROM ANOVA TO TEST DIFFERENCES BETWEEN RMT8 AND RMT25 (NET.TYPE).

| | Degrees of freedomf | Sum Sq | Mean Sq | F value | Pr(>F) |
|------------------|---------------------|--------|---------|---------|--------------|
| Station | 8 | 76003 | 9500 | 449.480 | <2.2e-16 *** |
| Net.type | 1 | 2804 | 2804 | 132.642 | <2.2e-16 *** |
| Station:Net.type | 5 | 2082 | 416 | 19.704 | <2.2e-16 *** |
| Residuals | 3721 | 78648 | 21 | | |

FIGURE 10.2.1_KRILL/F_1: OVERALL LENGTH DISTRIBUTIONS FOR KRILL MEASURED BY JON WATKINS AND SOPHIE FIELDING IN KRILL MEASUREMENT COMPARISON.

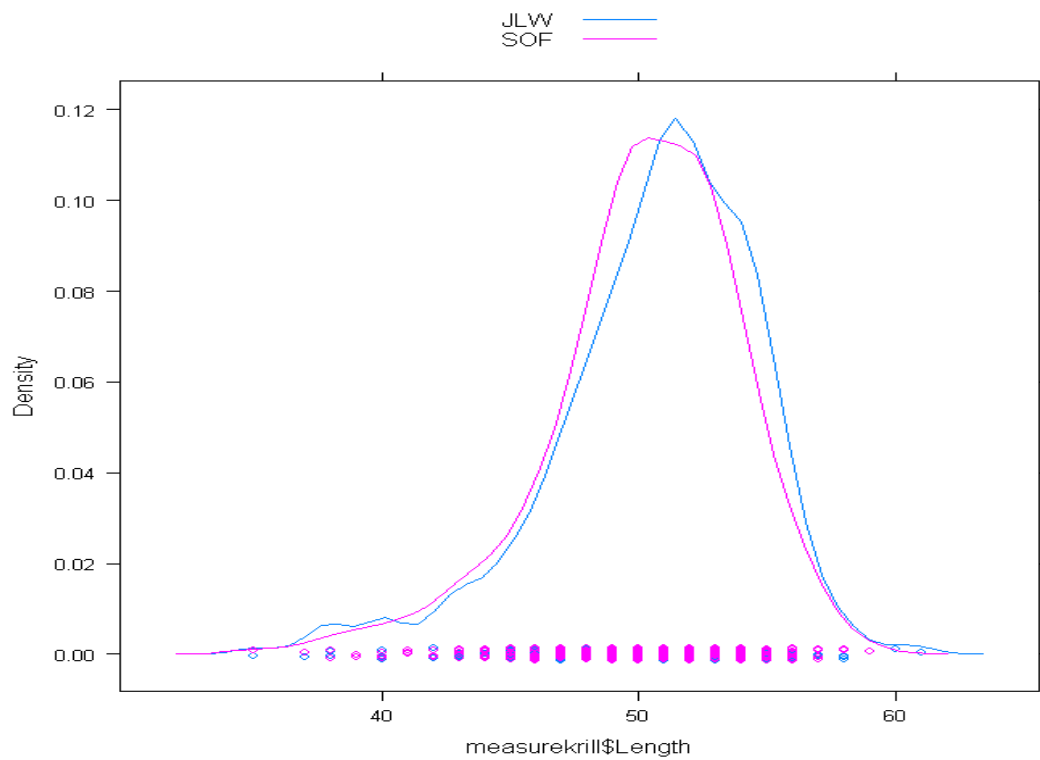
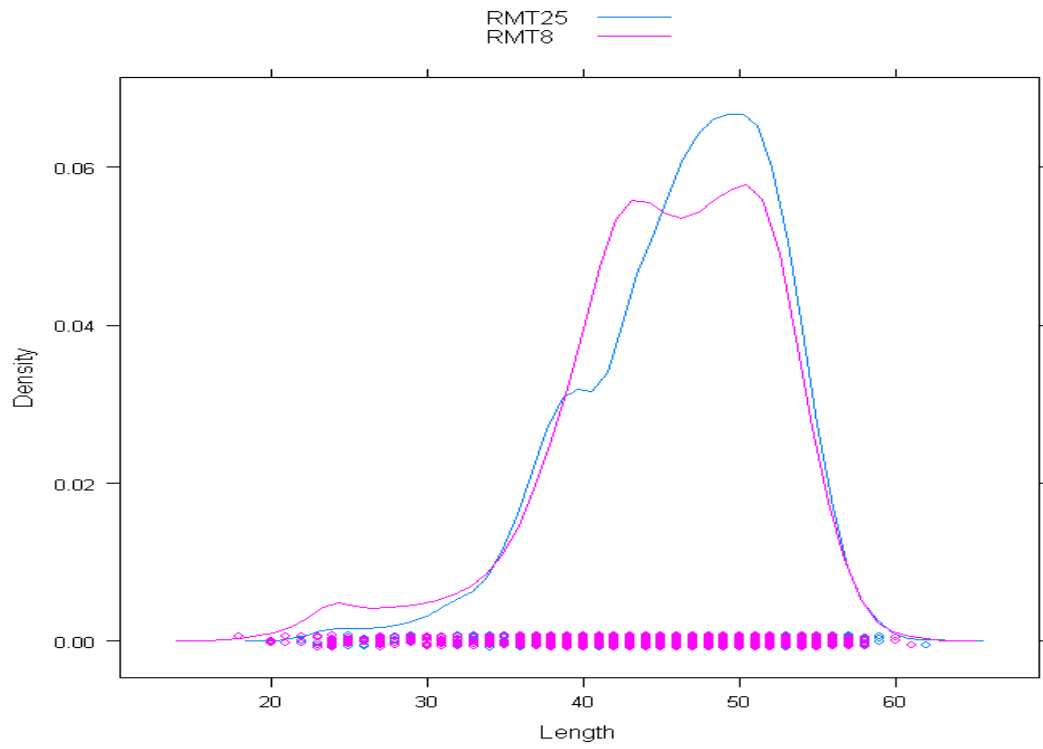


FIGURE 10.2.2_KRILL/F_2: OVERALL LENGTH DISTRIBUTIONS FOR KRILL SAMPLED FROM RMT25 AND RMT8 NETS.



11 Gene function in Antarctic krill

Determining the role of clock-genes in synchronised behavioural patterns (Ref.: AFI Nov 2004 OB7/06)

Ted Gaten

11.1 Introduction

Antarctic krill (*Euphausia superba*) are the key species in the Southern Ocean, acting as both the main consumer of phytoplankton and the principal food source of many of the animals that define that ecosystem. This AFI-funded project (AFI 7/06; see Appendix) examines rhythmic behaviour patterns in this species and the functioning of the genes that underly these behaviours.

The two behavioural rhythms being investigated are diel vertical migration and the moult cycle. Vertical migration occurs in many species of krill, with the animals moving towards the surface at night to feed on phytoplankton and into deeper water during the daytime to avoid visually-guided predators. The extent of vertical migration in Antarctic krill is unclear. The moult cycle in this species is around 20 days long, depending on the temperature.

11.2 Aims

1. To record vertical migration patterns of individual krill in an activity monitor, based on the design of apparatus used in the study of northern krill (*Meganyctiphanes norvegica*) (Velsch & Champalbert, 1994).
2. To preserve krill samples from nets taken at key points throughout the day and night for the isolation of canonical circadian clock genes.
3. To maintain a population of krill in an entrainment tank (with the light environment strictly controlled) and to collect these krill at key times of the day for subsequent analysis of the temporal and spatial expression of the clock genes.
4. To maintain a population of krill in an entrainment tank (with the light environment strictly controlled) and to collect these krill at the same time each day over a period of 23 days for subsequent gene expression studies. Microarray technology will be used to isolate those genes showing evidence of cyclical expression over a period of around 20 days.
5. All of these experiments to be carried out on two groups of krill: one from around 60° South from the vicinity of Signy, and a second group from the South Georgia area at around 52° South.

11.3 Methods

Specimen capture

All of the krill were taken by target fishing mainly using the RMT8 net, based largely on observations of swarms using the EK60 echosounder (table 11.1). The nets were towed for only a short time and, after hauling, the krill were transferred as quickly as possible to the cold room for sorting.

TABLE 11.1. NETS FROM WHICH KRILL WERE TAKEN

| Date | event | time | latitude | depth range |
|------------|-----------|------|----------|-------------|
| 03/01/2008 | 40 net 2 | 1000 | 59.5 | 34-12m |
| 03/01/2008 | 41 net 1 | 1100 | 59.5 | 33-39m |
| 03/01/2008 | 47 net 2 | 2400 | 60.45 | 9-4m |
| 04/01/2008 | 56 net 1 | 1400 | 60.43 | 65-17m |
| 06/01/2008 | 79 Net 1 | 0700 | 60.53 | 59-64m |
| 08/01/2008 | 97 net 1 | 2000 | 60.26 | 1m |
| 14/01/2008 | 138 net 1 | 1800 | 60 | 22-18m |
| 15/01/2008 | 154 net 1 | 1545 | 59.66 | 63-60m |
| 18/01/2008 | 178 net 1 | 2000 | | |
| 19/01/2008 | 195 net 1 | 1500 | 58 | 2m |
| 31/01/2008 | 275 net 1 | 1900 | 52.7 | 60-58m |
| 02/02/2008 | 294 net 1 | 0050 | 52.89 | 26-22 |
| 02/02/2008 | 304 net 1 | 2100 | 52.77 | 13-12m |
| 03/02/2008 | 306 net 1 | 0600 | 52.72 | 83-82m |
| 03/02/2008 | 308 net 1 | 1330 | | |
| 04/02/2008 | 327 net 2 | 1930 | 52.82 | 61-30m |
| 09/02/2008 | 376 net 1 | 2030 | | |

Activity monitor

The activity monitor is a purpose-built apparatus comprising 12 vertical tubes, each containing 5 l of seawater, retained upright in a light-tight box. Each tube has infra-red barriers 5 cm from the top and bottom of each tube and the output from these barriers is recorded continuously via a datalogger to a laptop computer running Spike2 software. The lighting within the apparatus is adjusted to that experienced by the krill at normal daytime depths and the temperature in the cool-room kept at the level of the seawater supply. Krill are loaded individually into 11 of the tubes containing filtered seawater, with the other tube containing a datalogger recording the light and temperature. The computer is programmed to record the movements of the krill over a 10-day period. The krill spend the first 5 days under a light/dark cycle matching that of the region from which they were taken in order to record their vertical migration patterns under normal lighting conditions. This is followed by 5 days in total darkness to see whether the activity pattern is maintained in total darkness, indicating control by an endogenous circadian rhythm. After 10 days, the animals were measured, the moult stage assessed, and the heads fixed in paraformaldehyde for 2 hours. The brain and optic tracts were dissected from each

specimen and stored in methanol at -80° for later analysis. When not required for krill, the activity monitor was used to assess its suitability for monitoring copepod activity. Specimens of *Rhincalanus gigas* were used, either singly in each tube or in groups.

1. Canonical clock genes. A sample of krill (usually 30 animals) was taken from each net and stored in RNAlater (a commercially available solution for long term storage without deterioration of RNA). These were left in the cool room (around 3° C) overnight and then stored at -20° C for subsequent analysis. A sample of krill (usually 10 animals) was also taken from each net and the heads fixed in paraformaldehyde (PFA) for 2 hours. The brain and optic tracts were dissected from each specimen and stored in methanol at -80° for later analysis using in-situ hybridization and immuno-chemical cytochemistry. Where abundant krill were taken in the net, up to 200 animals were rapidly frozen in a methanol freezing mixture at -80° and then stored in the -80° freezer for further clock gene studies.
2. Spatial and temporal expression of clock genes. An entrainment tank containing around 250 l of flowing seawater was loaded with up to 700 krill. These animals were maintained under a controlled light regime that mimicked that normally experienced by swarms at the latitude from which they were taken. After 2 days entrainment, a sample of krill (usually 10 animals) was taken at 3-hourly intervals over a period of 48 hours; these were either preserved in RNAlater or were frozen directly at -80° as detailed above. During the next 24 hours samples were taken at 6-hourly intervals and fixed in PFA as above. The lights were switched off and on the 2nd, 3rd and 4th day in total darkness, the above sampling regime was repeated. The specimens were returned to the UK for subsequent analysis.
3. Moulting cycle. A second entrainment tank was loaded with around 350 krill and maintained under the conditions given above. Either 10 or 20 animals were removed each day at the same time, measured, maturity- and moult-staged and the heads preserved in RNAlater for subsequent use in the microarray studies to isolate the genes involved in the moult cycle.

11.4 Data

1. Activity monitor. Three runs were carried out, using animals from nets 56 (60.44° S), 154 (59.66° S) and 275 (52.75° S). The first two runs consisted of 5 days light/dark (dawn = 03.00, dusk = 21.30), followed by 2 days of complete darkness. The third run consisted of 5 days light/dark (dawn = 04.00, dusk = 20.00), followed by 5 days of complete darkness. The effectiveness of the monitor for assessing copepod activity was investigated over a 2-day period under a light/dark cycle. All of the resulting Spike2 traces were saved for later periodogram analysis.
2. A total of 1,820 krill were preserved from 16 net hauls for clock gene identification. This included 1,210 frozen dry at -80° , 490 preserved in RNAlater, and 120 fixed in PFA.
3. The circadian entrainment experiment was carried out twice, using animals from net 41 at a latitude of 60° S, and from net 294 at a latitude of 52° S. During these experiments, krill were preserved by freezing at -80° during the

first experiment (540 krill) and by immersion in RNAlater (stored at -20°) for the second experiment (300 krill). For both experiments, PFA was used for fixation of the dissected brains (100 krill).

4. The moult cycle entrainment experiment was also carried out twice, using animals from net 40 (60° South) and net 138 (60° South). The ambient water temperatures at these latitudes, taken from CTD data were around 1°C for net 40 and 3°C for net 138. A total of 590 krill in RNAlater were returned to the UK at -20° for further analysis.

11.5 Preliminary results

The first two runs in the activity monitor did not reveal any obvious sign of vertical migration within the tubes, although extraction of the data and a more detailed analysis will be necessary before any conclusions can be drawn. Polar animals (van Oort et al., 2005) often show differences in the extent of their circadian activity profiles dependent on the latitude from which the animals are taken. Animals from higher latitudes experience shorter nights during the summer and diel variations in activity are not normally apparent. The same species at lower latitudes experience a significant period of dark and usually show circadian variations in activity. Only a more detailed analysis will show whether or not this is the case in Antarctic krill.

All of the other experiments rely on molecular analysis at the home laboratories, either at the University of Leicester or at BAS, Cambridge. However, all of the experiments requested by the molecular biologists have been carried out and sufficient specimens have been preserved so it is reasonable to assume that at least some of the molecular questions will be answered in the fullness of time.

11.6 References

Van Oort et al. (2005) *Nature* **438**, 1095-1096.

Velsch & Champalbert (1994). *C. R. Acad. Sci. Paris/ Life Sciences* **317**: 857-62.

12 Acoustics Reports

12.1 EK60

Sophie Fielding, Jon Watkins, Peter Enderlein, Geraint Tarling

12.1.1 Introduction

JR177 is the second 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). Dedicated acoustic transects were run within mesoscale surveys (of two different styles depending on station) at each station, although acoustic data were collected continuously during the cruise. Acoustic data were of high quality throughout the cruise: a result of correct interfacing with other acoustic instruments through the SSU, the Doppler logger being turned off for nearly the whole duration, ADCP bottom tracking was not used during all surveying periods and nail gunning in the engineering space was controlled.

12.1.2 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

12.1.3 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 - 300 m (38 kHz), 0 – 300 (120 kHz) and 0 – 300 (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

Compression settings were changed on 06/02/08 to allow for deeper detection of myctophid fish at the polar front stations. Range was extended to 500 m for 38 kHz and 120 kHz. Settings were returned to the shallower during calibration 10/02/08.

An additional set of compressed files (.EK60) were created for all RMT hauls, where 38 and 120 kHz data were compressed over a 1000 m range to cover the full extent of the net hauls, otherwise all settings were the same. Raw file were transferred into a “holding” folder on the L drive and compressed using the following command in a dos prompt (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 JR177, all echolog data were saved in the folder JR177 \echolog. All files were prefixed with JR177. Calibration data were saved to the calibration folder.

EK60 (ER60) settings

The EK60 was only calibrated at the end of the cruise; hence it was run with the same settings as JR161. Table 12.1 Acoustics_1 lists the settings the EK60 was run with during JR177. The EK60 settings were not updated following calibration – it is assumed that calibrated settings will be used in post-processing only.

TABLE 12.1 ACOUSTICS 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) | 1453 | 1453 | 1453 |
| 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) | 10.07 | 26.27 | 39.8 |
| Pulse length (ms) | 1.024 | 1.024 | 1.024 |
| Max Power (W) | 2000 | 500 | 300 |
| 2-way beam angle (dB) | -20.70 | -20.70 | -19.60 |
| Sv transducer gain (dB) | 24.07 | 21.38 | 22.03 |
| Sa correction (dB) | -0.63 | -0.39 | -0.31 |
| Angle sensitivity along | 22 | 21 | 23 |
| Angle sensitivity athwart | 22 | 21 | 23 |
| 3 dB Beam along | -0.02 | -0.12 | 0.17 |
| 3 dB Beam athwart | 0 | -0.07 | -0.24 |
| Along offset | 6.96 | 7.48 | 6.44 |
| Athwart offset | 6.88 | 7.48 | 6.43 |

The EK60 was controlled through the SSU, under a group EK60, EA600 and 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. Therefore at times when the EK60 data would not be used and during periods of shallow water (<800 m) the ADCP was run external to the SSU, with only the EA600 and EK60 synchronised. Unsurprisingly there is interference in the EK60 data during these periods.

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) |

EK60 Calibration

Stromness Harbour. 22:00 (GMT) 10-11/02/2008

An acoustic calibration was carried out in Stromness, South Georgia on 11/02/2008. The ship was anchored, its movement balanced by minimal DP usage. All water discharges from the ship were stopped. The EK60 was allowed to trigger itself (i.e. not controlled by 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 (event 380) was undertaken immediately prior to calibration. 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 33.43 PSU resulting in a speed of sound constant of 1462 m/s (Francois and Garrison, 1982). This value was only used in the Echoview calibration, the speed of sound constant was NOT updated on the EK60.

Although the calibration itself went smoothly, the initial detection of the sphere under the ship was delayed. Between JR159 and JR177 the fishing lines to the winches had been replaced. These were found to be different to the expected lengths required as calculated by Doug Bone. The lines were re-measured and new positions marked. Even then the sphere did not appear – it only eventually turned up by chance when the slack on the port forward winch was taken up. [It is possible that a dent in the ship’s hull caused by a minor grounding event prior to JR177 may have snagged these lines]

Parameters following two different procedures for calibrating are given in Table 12.2 Acoustics_2 and Table 12.3 Acoustics_3.

TABLE 12.2 ACOUSTICS_2 ECHOVIEW CALIBRATION

| Parameter | 38 kHz | 120 kHz | 200 kHz |
|---------------------|--------|---------|---------|
| Alpha (dB/km) | 10.33 | 29.416 | 42.635 |
| Theoretical TS (dB) | -33.70 | -40.3 | -44.85 |
| TS gain | 23.88 | 21.70 | 22.50 |
| Sa correction | -0.02 | 0.02 | 0.05 |

TABLE 12.3 ACOUSTICS 3 ER60 CALIBRATION

| Date | 11/02/2008 | 11/02/2008 | 11/02/2008 |
|---------------------------------------|--------------------|--------------------|--------------------|
| Location | Stromness | Stromness | Stromness |
| Time | 02:00 | 04:50 | 03:35 |
| Cruise ID | JR177 | JR177 | JR177 |
| Calibrators | sof/jlwa/pend | sof/jlwa/pend | sof/jlwa/pend |
| Frequency | 38 | ES120-7 | ES200-7 |
| Transducer type | ES38 | | |
| Transducer serial no | 23080 | | 24574 |
| GPT serial no | 009072033fa5 | 00907203422d | 9072033191 |
| Comments | All transducers on | All transducers on | All transducers on |
| Environmental parameters | | | |
| Water temperature | 3.52 | 3.52 | 3.52 |
| Salinity | 33.43 | 33.43 | 33.43 |
| Sound velocity* | 1453 | 1453 | 1453 |
| Absorption coefficient* | 10.1 | 26.3 | 39.8 |
| Echosounder parameters | | | |
| Ping rate | 1 | 1 | 1 |
| Transmit power | 2000 | 500 | 300 |
| Pulse length | 1.024 | 1.024 | 1.024 |
| Bandwidth | 2.43 | 3.03 | 3.09 |
| Sample interval | 0.186 | 0.186 | 0.186 |
| Original gain | 24.07 | 21.38 | 22.03 |
| Original Sa correction | -0.63 | -0.39 | -0.31 |
| Background noise | -126 | | |
| Reference target | | | |
| Theoretical TS of sphere | -33.7 | -40.3 | -44.85 |
| TS deviation allowed | 3 | 3 | 4.5 |
| Depth of target | 24.9 | 26.5 | 26.6 |
| Min distance layer | 24 | 25.5 | 25 |
| Max distance layer | 28 | 28.5 | 28.5 |
| TS detection parameters | | | |
| Min value | -50 | -50 | -50 |
| Max Beam compensation | 6 | 6 | 6 |
| Max phase deviation | 8 | 8 | 8 |
| Min echolength | 80 | 80 | 80 |
| Max echolength | 180 | 180 | 180 |
| Calibration/Beam model results | | | |
| Transducer gain | 23.94 | 21.59 | 22.33 |
| Sa Correction | -0.59 | -0.41 | -0.32 |
| Athwart Beam Angle | 6.94 | 7.47 | 6.45 |
| Along Beam Angle | 6.95 | 7.49 | 6.42 |
| Athw offset angle | 0 | -0.06 | -0.22 |
| Along offset angle | -0.03 | -0.15 | 0.03 |
| RMS of beam model | 0.17 | 0.21 | 0.32 |
| Max model result | 0.6 | 0.43 | 0.74 |
| Max no. of points | 19 | 199 | 56 |
| Min model result | -0.63 | -1.16 | -1.19 |
| Min no. of points | 75 | 346 | 197 |
| Calibration applied | no | no | no |

12.1.4 Data processing in echoview

Post-processing was undertaken in Echoview. Two template EV files were set up, one for use with the net data (1000 m), the other for use with the acoustic transects (300 m) – although both had a similar format and the main difference was the depth of data used. The following virtual variables were created, where Freq represents both 38 and 120 kHz data. Dropout removal and spike detect was not used on the 200 kHz data.

| Variable 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 | |
| 120-38 | Minus | 120-500m | 38-500m |
| 200-38 | Minus | 200-500m | 38-500m |
| 200-120 | Minus | 200-500m | 120-500m |
| Fish -10-0.5 | Data range bitmap | 120-38 | |
| 38 fish | Mask | 38-500m | fish -10-0.5 |
| CCAMLR krill 2-16 | Data range bitmap | 120-38 | |
| 120 CCAMLR krill | Mask | 120-500m | CCAMLR krill 2-16 |
| Demer krill range | Data range bitmap | 120-38 | |

12.1.5 Data coverage

Acoustic transects (Mesoscale survey)

Acoustic transects were run at each station as part of the “mesoscale survey”. A full 24 hours was dedicated to all permanent stations (identified as C and P stations) and a smaller time (6 hours) at the responsive stations (R stations). The shape of the survey was discussed in detail in Cambridge, although the direction in which it would be run on board was dependant on weather, sun and current conditions. Six transects (in the large surveys) were identified initially as 60 km in length with 12 km spacing. However, due to time constraints and the need to run a daytime transect through the station position (to maintain commonality with last year’s data) only a maximum five transects were run for spatial resolution, 50 km in length and 12 km spacing. A sixth transect was used to re-run, typically, the middle transect (through the station) to ensure daytime coverage. Predator observations were undertaken concurrently. In addition at various times the UOR was deployed (with several working problems) and also the EK500 acoustic towfish. Transect times and names are given in Table 12. 4 Acoustics_4.

TABLE 12.4 ACOUSTICS_4 TRANSECT TIMES, DIRECTIONS AND SPEEDS.

| Date | Transect | Start | End | Bearing | Speed | Comments | EV file | Towfish | UOR |
|---------------|----------|----------|----------|---------|-------|--|---------|---------|-----|
| 03/01/2008 | R1.1 | 18:57:00 | 21:40:00 | 240 | 10 | Deviation at end of transect due to iceberg | R1_1.ev | No | No |
| 03/01/2008 | R1.2 | 22:12:00 | 0:55:00 | 60 | 10 | Heading in to dusk at end | R1_2.ev | No | No |
| 06/01/2008 | C2.1 | 19:31:00 | 22:54:00 | 90 | 10 | Deviation due to pack ice | C2_1.ev | No | No |
| 06-07/01/2008 | C2.2 | 23:36:00 | 2:53:00 | 270 | 10 | | C2_2.ev | Yes | No |
| 07/01/2008 | C2.3 | 4:03:00 | 7:26:00 | 94 | 10 | | C2_3.ev | Yes | No |
| 07/01/2008 | C2.4 | 8:26:00 | 11:42:00 | 270 | 10 | | C2_4.ev | Yes | No |
| 07/01/2008 | C2.5 | 13:27:00 | 17:05:00 | 90 | 10 | Towfish recovered, dogleg due to ice, repeat of transect C2.1 | C2_5.ev | No | No |
| 13/01/2008 | C3.1 | 14:44:00 | 17:24:00 | 315 | 10 | | C3_1.ev | Yes | Yes |
| 13/01/2008 | C3.2 | 18:29:00 | 21:21:00 | 135 | 10 | UOR failed halfway through, had to slow to 5 knots for recovery | C3_2.ev | Yes | Yes |
| 13-14/01/2008 | C3.3 | 22:29:00 | 1:14:00 | 315 | 10 | UOR failed at beginning, recovery at 5 knots | C3_3.ev | Yes | No |
| 14/01/2008 | C3.4 | 2:31:00 | 5:16:00 | 135 | 10 | UOR failed at beginning, recovery at 5 knots, towfish going under hull | C3_4.ev | No | No |
| 14/01/2008 | C3.5 | 6:01:00 | 8:45:00 | 315 | 10 | | C3_5.ev | No | No |
| 14/01/2008 | C3.6 | 10:01:00 | 12:44:00 | 135 | 10 | Repeat of transect C3.3 | C3_6.ev | No | No |
| 17/01/2008 | C4.1 | 17:25:00 | 20:08:00 | 315 | 10 | Strong fish marks half way through | C4_1.ev | Yes | No |
| 17/01/2008 | C4.2 | 21:31:41 | 23:57:08 | 135 | 10 | | C4_2.ev | Yes | No |
| 18/01/2008 | C4.3 | 1:09:18 | 3:50:22 | 315 | 10 | | C4_3.ev | No | No |
| 18/01/2008 | C4.4 | 4:38:10 | 7:21:35 | 135 | 10 | Krill in middle, strong fish in western third | C4_4.ev | No | No |
| 18/01/2008 | C4.5 | 8:38:15 | 11:22:00 | 315 | 10 | | C4_5.ev | Yes | No |
| 18/01/2008 | C4.6 | 13:14:00 | 15:54:00 | 135 | 10 | Strong fish marks in western half, plus dense krill layer | C4_6.ev | Yes | No |
| 21/01/2008 | R2.1 | 6:59:00 | 8:20:00 | 115 | 10 | | R2_1.ev | No | No |
| 21/01/2008 | R2.2 | 9:10:00 | 12:26:00 | 290 | 7.5 | Acoustics good at slow speeds | R2_2.ev | No | No |
| 26/01/2008 | P2.1 | 3:00:00 | 5:50:00 | 290 | 10 | Wand around 30 knots | P2_1.ev | No | No |
| 26/01/2008 | P2.2 | 6:34:00 | 9:16:00 | 110 | 10 | | P2_2.ev | No | No |
| 26/01/2008 | P2.3 | 10:06:00 | 13:59:00 | 290 | 7.5 | Wind above 30 knots, bad quality data | P2_3.ev | No | No |
| 26/01/2008 | P2.4 | 14:15:00 | 16:57:00 | 110 | 10 | Repeat of transect P2.3 downwind for better predator obs | P2_4.ev | No | No |
| 26/01/2008 | P2.5 | 17:43:00 | 22:14:00 | 290 | 7.5 | Variable speed due to weather | P2_5.ev | No | No |
| 26/01/2008 | P2.6 | 23:03:00 | 1:30:00 | 110 | 10 | Repeat of P2.3 nighttime, ended early | P2_6.ev | No | No |
| 30/01/2008 | P3.1 | 16:01:00 | 18:42:00 | 90 | 10 | Power set to 2 KW | P3_1.ev | Yes | No |
| 30/01/2008 | P3.2 | 19:47:00 | 22:45:00 | 265 | 10 | | P3_2.ev | Yes | No |
| 30/01/2008 | P3.3 | 23:42:00 | 2:24:00 | 90 | 10 | | P3_3.ev | Yes | No |
| 31/01/2008 | P3.4 | 3:29:00 | 6:22:00 | 270 | 10 | Krill swarms in transect | P3_4.ev | Yes | No |
| 31/01/2008 | P3.5 | 7:17:00 | 9:59:00 | 90 | 10 | Most northerly transect | P3_5.ev | Yes | No |
| 31/01/2008 | P3.6 | 11:45:00 | 14:33:00 | 270 | 10 | Repeat of P3.3 | P3_6.ev | Yes | No |
| | | | | | | | | | |
| 06/02/2008 | R4.1 | 18:25:00 | 19:37:00 | 270 | 10 | Polar front survey | R4_1.ev | No | No |
| 06/02/2008 | R4.2 | 20:24:00 | 21:31:00 | 90 | 10 | | R4_2.ev | No | No |
| 06/02/2008 | R4.3 | 22:03:00 | 22:33:00 | 275 | 10 | | R4_3.ev | No | No |
| 07/02/2008 | R4.4 | 1:43:00 | 2:48:00 | 140 | 10 | New survey at the polar front, same pattern as before | R4_4.ev | No | No |

The acoustic biomass of fish and krill was calculated along each transect and overlaid on either sea surface temperature or salinity (from EK60 data). Separate ev files were created for each transect and listed sequentially (e.g. P1_1.ev, P1_2.ev etc).

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. 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. This can be a very frustrating task, to maximise opportunity for krill catching it is important that this surface net is undertaken in darkness with time allocated for its undertaking. Ev files were created for each target net and a line file of net position in the water added. Each ev file is listed with event number.ev (e.g. ev1.ev).

TABLE 12.5 ACOUSTICS_5 RMT TARGET HAULS TIMES AND COMMENTS.

| Event | Net | Type | Date open | Time in | Time open | Depth open | Date closed | Time closed | Depth closed | Time out | Comment |
|-------|-----|--------|------------|---------|-----------|------------|-------------|-------------|--------------|----------|--|
| 40 | 1 | Target | 03/01/2008 | 11:45 | 11:55 | 75 | 03/01/2008 | 12:07 | 74 | 12:22 | RMT 8 target |
| | 2 | | 03/01/2008 | | 12:13 | 33 | 03/01/2008 | 12:16 | 12 | | |
| 41 | 1 | Target | 03/01/2008 | 12:48 | 12:49 | 32 | 03/01/2008 | 12:59 | 37 | 13:20 | RMT 8 target |
| | 2 | | 03/01/2008 | | 13:08 | 39 | 03/01/2008 | 13:13 | 19 | | |
| 47 | 1 | Target | 04/01/2008 | 02:21 | 02:31 | 48 | 04/01/2008 | 02:39 | 10 | 02:51 | RMT 8 target |
| | 2 | | 04/01/2008 | | 02:39 | 8 | 04/01/2008 | 02:44 | 3 | | |
| 56 | 1 | Target | 04/01/2008 | 16:49 | 17:14 | 64 | 04/01/2008 | 17:20 | 20 | 17:31 | RMT 8 target |
| | 2 | | 04/01/2008 | | 17:20 | 20 | 04/01/2008 | 17:24 | 14 | | |
| 79 | 1 | Target | 06/01/2008 | 09:32 | 09:35 | 58 | 06/01/2008 | 09:40 | 63 | 09:56 | RMT 25 Krill |
| | 2 | | 06/01/2008 | | 09:40 | 68 | 06/01/2008 | 09:44 | 68 | | Krill |
| 97 | 1 | Target | 08/01/2008 | 22:16 | 22:20 | 70 | 08/01/2008 | 22:25 | 55 | 22:47 | RMT 25 Krill mark at 55 m |
| | 2 | | 08/01/2008 | | 22:27 | 47.5 | 08/01/2008 | 22:32 | 42 | | |
| 138 | 1 | Target | 14/01/2008 | 20:25 | 20:27 | 21 | 14/01/2008 | 20:32 | 18 | 20:47 | RMT 8 target |
| | 2 | | 14/01/2008 | | 20:33 | 22 | 14/01/2008 | 20:39 | 20 | | |
| 154 | 1 | Target | 15/01/2008 | 18:20 | 18:24 | 63 | 15/01/2008 | 18:29 | 59 | 18:44 | RMT8 krill layer between 60 - 70m |
| | 2 | | 15/01/2008 | | 18:30 | 68 | 15/01/2008 | 18:35 | 68 | | |
| 155 | 1 | Target | 15/01/2008 | 19:30 | 19:34 | 80 | 15/01/2008 | 19:39 | 60 | 20:01 | RMT25 krill layer between 60 - 70m repeat of 154 |
| | 2 | | 15/01/2008 | | 19:40 | 70 | 15/01/2008 | 19:45 | 65 | | |
| 195 | 1 | Target | 19/01/2008 | 17:48 | 16:07 | 138 | 19/01/2008 | 16:13 | 140 | 18:23 | RMT8 target |
| | 2 | | 19/01/2008 | | 16:13 | 141 | 19/01/2008 | 16:14 | 143 | | |
| 196 | 1 | Target | 19/01/2008 | 19:18 | 19:23 | 50 | 19/01/2008 | 19:30 | 55 | 19:49 | RMT25 target on same RMT8 krill layer |
| | 2 | | 19/01/2008 | | 19:32 | 40 | 19/01/2008 | 19:38 | 20 | | |
| 197 | 1 | Target | 19/01/2008 | 20:32 | 20:44 | 257 | 19/01/2008 | 21:14 | 153 | 21:53 | RMT25 target on fish at 250 m |
| | 2 | | 19/01/2008 | | 21:14 | 157 | 19/01/2008 | 21:29 | 146 | | |
| 214 | 1 | Target | 21/01/2008 | 22:47 | 22:56 | 44 | 21/01/2008 | 23:05 | 32 | 23:25 | RMT8 missed mark |
| | 2 | | 21/01/2008 | | 23:05 | 33 | 21/01/2008 | 23:15 | 31 | | |
| 252 | 1 | Target | 27/01/2008 | 23:20 | 23:26 | 53 | 27/01/2008 | 23:31 | 63 | 23:46 | RMT25 Target - caught fish not krill |
| | 2 | | 27/01/2008 | | 23:32 | 71 | 27/01/2008 | 23:38 | 66 | | |
| 253 | 1 | Target | 28/01/2008 | 00:22 | 00:27 | 29 | 28/01/2008 | 00:38 | 14 | 00:51 | RMT25 Target |
| | 2 | | 28/01/2008 | | 00:38 | 16 | 28/01/2008 | 00:49 | 18 | | |
| 265 | 1 | Target | 30/01/2008 | 00:09 | 00:16 | 51 | 30/01/2008 | 00:26 | 37 | 00:45 | RMT8 target caught themisto |
| | 2 | | 30/01/2008 | | 00:27 | 39 | 30/01/2008 | 00:37 | 28 | | |
| 266 | 1 | Target | 30/01/2008 | 02:23 | 02:27 | 23 | 30/01/2008 | 02:31 | 25 | 02:40 | RMT8 weather dodgy no catch |
| | 2 | | 30/01/2008 | | 02:32 | 27 | 30/01/2008 | 02:32 | 28 | | |
| 268 | 1 | Target | 30/01/2008 | 07:00 | 07:06 | 63 | 30/01/2008 | 07:11 | 74 | 07:31 | RMT8 no target, catch not caught |
| | 2 | | 30/01/2008 | | 07:16 | 28 | 30/01/2008 | 07:21 | 19 | | |
| 269 | 1 | Target | 30/01/2008 | 07:57 | 08:27 | 35 | 30/01/2008 | 08:37 | 22 | 08:57 | RMT8 net 2 caught krill |
| | 2 | | 30/01/2008 | | 08:38 | 23 | 30/01/2008 | 08:48 | 24 | | |
| 275 | 1 | Target | 31/01/2008 | 21:00 | 21:16 | 60 | 31/01/2008 | 21:21 | 57 | 21:52 | RMT8 |
| | 2 | | 31/01/2008 | | 21:38 | 74 | 31/01/2008 | 21:43 | 54 | | |
| 294 | 1 | Target | 02/02/2008 | 03:10 | 03:14 | 25 | 02/02/2008 | 03:25 | 22 | 03:42 | RMT8 krill mark disappeared |
| | 2 | | 02/02/2008 | | 03:26 | 26 | 02/02/2008 | 03:36 | 14 | | Caught krill |
| 304 | 1 | Target | 02/02/2008 | 23:33 | 23:37 | 13 | 02/02/2008 | 23:42 | 12 | 23:56 | RMT8 target |
| | 2 | | 02/02/2008 | | 23:43 | 19 | 02/02/2008 | 23:49 | 9 | | |
| 306 | 1 | Target | 03/02/2008 | 08:43 | 08:53 | 83 | 03/02/2008 | 08:57 | 81 | 09:11 | RMT8 target |
| | 2 | | 03/02/2008 | | 08:57 | 84 | 03/02/2008 | 09:01 | 67 | | |
| 308 | 1 | Target | 03/02/2008 | 16:00 | 16:07 | 138 | 03/02/2008 | 16:13 | 140 | 16:29 | RMT8 target |
| | 2 | | 03/02/2008 | | 16:13 | 141 | 03/02/2008 | 16:14 | 143 | | |
| 326 | 1 | Target | 04/02/2008 | 21:08 | 21:13 | 105 | 04/02/2008 | 21:18 | 61 | 21:35 | RMT8 target fishing missed. Net 1 has krill though |
| | 2 | | 04/02/2008 | | 21:23 | 24 | 04/02/2008 | 21:29 | 11 | | |
| 327 | 1 | Target | 04/02/2008 | 22:07 | 22:12 | 76 | 04/02/2008 | 22:15 | 60 | 22:28 | RMT8 target - caught krill |
| | 2 | | 04/02/2008 | | 22:16 | 60 | 04/02/2008 | 22:20 | 29 | | Only in net 2! |
| 358 | 1 | Target | 07/02/2008 | 04:17 | 04:22 | 67 | 07/02/2008 | 04:42 | 68 | 05:12 | RMT8 target 50 - 60 m |
| | 2 | | 07/02/2008 | | 04:43 | 67 | 07/02/2008 | 04:59 | 55 | | |
| 365 | 1 | Target | 09/02/2008 | 12:46 | 13:01 | 64 | 09/02/2008 | 13:05 | 58 | 13:18 | RMT8 target |
| | 2 | | 09/02/2008 | | 13:07 | 72 | 09/02/2008 | 13:11 | 65 | | |
| 376 | 1 | Target | 09/02/2008 | 23:07 | 23:14 | 30 | 09/02/2008 | 23:16 | 22 | 23:27 | RMT8 target |
| | 2 | | 09/02/2008 | | 23:16 | 23 | 09/02/2008 | 23:19 | 36 | | |

12.1.6 Problems encountered

No problems were encountered with the EK60. It was rebooted once when settings had been changed on the ER60 software (bottom detection range had been extended beyond what it could possibly detect) and the ping rate became erratic. Interference was rare due to the Doppler logger being switched off and all instrumentation 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. Another noise source was nail gunning by the engineers near the transducers. Once identified this was kept to a minimum.

12.2 EK500

Sophie Fielding, Jon Watkins and Peter Enderlein

12.2.1 Introduction

The EK500 towfish was deployed to obtain acoustic data from the surface 30 m of the water column, the depth typically missed by the hull-mounted EK60. The idea is to collect krill abundance data from the surface both day and night to investigate migration above the ships transducers. The towfish was deployed during all mesoscale surveys (weather and technical hitches permitting). After initial problems the instrument itself worked well, although the calibration of the transducer implied a fault with the transducer that needs investigating in Cambridge.

12.2.2 Aim

To collect acoustic data from the surface 30 m at 200 kHz.

12.2.3 Method/System specification

Hardware setup

The EK500 towfish and cradle are installed on the PES winch, located on the starboard side of the ship forward of the accommodation. Wooden spacers are tied to the PES winch drum and the tow cable (UOR cable and fairing) wound onto the drum. The slip-ring and step-down transformer are installed on the aft end of the drum. Attached on the EK500 towfish is a depth sensor. The deck cable (to connect the towfish to the transceiver) and depth sensor cable were run from the PES winch to the UIC through a gland located to the left and above the EK60 PC, cable tied along the way.

A 200 kHz single-beam transducer was installed in the towfish (Serial No: 26623, ES200-28-E), mounted at an angle of 32° off vertical (looking up). Stainless steel support bars within the towfish prevent the transducer being turned to other angles during towing.

An EK500 transceiver, screen, logging PC and depth sensor display were installed in the UIC immediately above the EK60 GPTs. The acoustic data were broadcast on the AUI network connection from the EK500 transceiver, converted to BNC and stored on the U:\data drive by the logging PC using Sonardata echolog500 running under Windows NT.

EK500 settings

The towfish was only calibrated at the end of the cruise. All EK500 settings were recorded in a text file using the echoconfig programme and are given below.

```
/OPERATION MENU/Ping Mode=Off  
/OPERATION MENU/Ping Mode=Off  
/OPERATION MENU/Ping Auto Start=Off  
/OPERATION MENU/Ping Auto Start=Off
```

/OPERATION MENU/Ping Interval=2.0 sec
/OPERATION MENU/Ping Interval=2.0 sec
/OPERATION MENU/Transmit Power=Normal
/OPERATION MENU/Transmit Power=Normal
/OPERATION MENU/Noise Margin=0 dB
/OPERATION MENU/Noise Margin=0 dB
/OPERATION MENU/Ping Mode=Off
/OPERATION MENU/Ping Mode=Off
/OPERATION MENU/Ping Auto Start=Off
/OPERATION MENU/Ping Auto Start=Off
/OPERATION MENU/Ping Interval=2.0 sec
/OPERATION MENU/Ping Interval=2.0 sec
/OPERATION MENU/Transmit Power=Normal
/OPERATION MENU/Transmit Power=Normal
/OPERATION MENU/Noise Margin=0 dB
/OPERATION MENU/Noise Margin=0 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Mode=Active
/TRANSCEIVER MENU/Transceiver-3 Menu/Mode=Active
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Type=200-28
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Type=200-28
/TRANSCEIVER MENU/Transceiver-3 Menu/Transd. Sequence=Off
/TRANSCEIVER MENU/Transceiver-3 Menu/Transd. Sequence=Off
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-3 Menu/Absorption Coef.=40 dBkm
/TRANSCEIVER MENU/Transceiver-3 Menu/Absorption Coef.=40 dBkm
/TRANSCEIVER MENU/Transceiver-3 Menu/Pulse Length=Long
/TRANSCEIVER MENU/Transceiver-3 Menu/Pulse Length=Long
/TRANSCEIVER MENU/Transceiver-3 Menu/Bandwidth=Narrow
/TRANSCEIVER MENU/Transceiver-3 Menu/Bandwidth=Narrow
/TRANSCEIVER MENU/Transceiver-3 Menu/Max. Power=250 W
/TRANSCEIVER MENU/Transceiver-3 Menu/Max. Power=250 W
/TRANSCEIVER MENU/Transceiver-3 Menu/2-Way Beam Angle=-20.5 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/2-Way Beam Angle=-20.5 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Sv Transd. Gain=26.30 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Sv Transd. Gain=26.30 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/TS Transd. Gain=26.30 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/TS Transd. Gain=26.30 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Along=15.0
/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Along=15.0
/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Athw.=15.0
/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Athw.=15.0
/TRANSCEIVER MENU/Transceiver-3 Menu/3 dB Beamw.Along=7.0 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/3 dB Beamw.Along=7.0 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/3 dB Beamw.Athw.=7.0 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/3 dB Beamw.Athw.=7.0 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/Alongship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/Alongship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/Athw.ship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/Athw.ship Offset=0.00 dg

Sound velocity = 1452

It was noted that the EK500 clock, echolog clock and ships clock were not synchronised. During the cruise these clock differences were noted once this had been identified.

| Date | EK500 clock | Echolog clock | Ships clock |
|------------|-------------|---------------|-------------|
| 31/01/08 | 07:09:07 | | 09:00:00 |
| 31/01/08 | 12:30:00 | | 14:20:53 |
| 31/01/08 | | 09:06:16 | 09:06:00 |
| 03/02/2008 | 07:32:00 | 09:22:55 | 09:23:41 |
| 11/02/2008 | 09:09:00 | 10:59:52 | 11:01:10 |

12.2.4 Calibration

The 200 kHz single beam transducer was calibrated in Stromness Harbour 07:00 GMT 11/02/2008. The transducer was mounted pointing vertically downwards and the calibration frame was mounted on the tow fish. A standard 200 kHz copper sphere was used and a CTD (event 380) was taken prior to the calibration. Several problems were encountered with the calibration. In particular the motors on the rig winches did not operate for much of the calibration. It was therefore impossible to get sufficient movement to swing the sphere through the beam to locate the peak signal return signifying on-axis location. In an effort to achieve the peak value with minimal sphere movement we set the sphere to the position in which maximum signal return had been obtained during the JR140 towfish calibration. On that occasion the sphere was set up with the calibration lines extended until the first tape mark was approximately 1 m from the electric winch along the extension pole. The winches were then driven from the initial 000 setting to achieve the on-axis position at the following settings on the winches - starboard=968, port=976, nose=977.

Once the sphere was in position as well as could be done it became apparent that the transducer was working sub optimally. The target strength of the sphere should have been -44.85 dB, yet only showed up as a target of ~-60 dB at its highest. Since nothing could be done to rectify this (apart from setting the gain to near 10 – a 16 dB change from its previous setting), it was decided to suspend the sphere under the towfish at this time for 20 minutes, collect the data and investigate possible causes back in Cambridge. On return to Cambridge either or both the transducer and the transceiver need to be examined.

12.2.5 Data coverage

The towfish was deployed during the mesoscale surveys. Table 12.6 EK500_2 contains the times of the towfish deployment which was dependent on technical problems and weather.

TABLE 12. 6 EK500 2

| Event number | Station | Date deployed | Time deployed | Date recovered | Time recovered | Comments |
|--------------|-------------|---------------|---------------|----------------|----------------|--|
| 30 | Test | 02/01/2008 | 15:01 | 02/01/2008 | 20:36 | Test deployment, motor failed stretched termination |
| 45 | R1 | 03/01/2008 | 18:36 | 03/01/2008 | 18:49 | R1 towfish deployed but no signal received |
| 46 | Test | 04/01/2008 | 01:07 | 04/01/2008 | 01:11 | Test deployment to ensure termination working |
| 80 | C2 | 06/01/2008 | 23:25 | 07/01/2008 | 16:16 | Towfish recovered due to worsening weather |
| 131 | C3 | 13/01/2008 | 14:18 | 14/01/2008 | 01:39 | Towfish showing up in hull acoustics due to current, recovered early |
| 175 | C4 | 17/01/2008 | 17:06 | 18/01/2008 | 00:47 | Towfish recovered due to worsening weather |
| 176 | C4 | 18/01/2008 | 07:35 | 18/01/2008 | 16:06 | Towfish redeployed for last transects |
| 272 | P3 | 30/01/2008 | 15:39 | 31/01/2008 | 14:42 | First survey with towfish all the time |
| 307 | R3 | 03/02/2008 | 09:27 | 03/02/2008 | 15:37 | Worked okay |
| 381 | Calibration | 11/02/2008 | 07:55 | 11/02/2008 | 10:17 | Could not calibrate satisfactorily |

12.2.6 Problems encountered

Several problems were encountered.

- 1) The motor failed on the PES winch, resulting in the cable spooling out to its limit. This broke the mechanical termination linking cable to drum, but fortunately did not affect electrical termination and so the data recording capability remained the same.
- 2) The EK500, Echolog PC and ships clock were all out of sync. This could easily be rectified in the future using the software that updates PCs to ships time (K9T).
- 3) The calibration sphere rig winches did not work. The gears on the winches had seized such that moving the sphere was not always possible. Maintenance of this equipment back in Cambridge is essential if this rig is to be used in subsequent years.
- 4) The 200 kHz transducer did not behave optimally. This requires investigation in Cambridge to determine the underlying causes. These could be: a problem with the transducers, the wrong transceiver card.

13 Pteropod Ecology

Nina Bednarsek

13.1 Introduction

Pteropod samples on JCR 177 were collected for two reasons:

As part of a longer term data set on which the life cycle of the Southern Ocean pteropods will be established

For ocean acidification experiments conducted on the ship

13.2 Methods

Sampling methods

Pteropods were obtained from a variety of the nets used during JR177, including RMT25, RMT8, MOCNESS, bongo's, mini-bongo's and towed bongo's.

23 Towed Bongos net hauls were completed, each haul comprising a 300 µm and 600 µm net sample fitted with a solid cod end. Nets were deployed to different depths (from 25 m to 120m), hauled horizontally at 2 kts, and brought up on the water surface as gently as possible. The detailed bongo logs with locations, times, sampled depth and notes can be found in the general event log.

(http://eventlog.jcr.nercbas.ac.uk/eventlog/analyst/list_recs/175)

In the first event at least 45 undamaged pteropods were caught, but in all subsequent events the number of individuals decreased and the shells were completely broken or partly damaged. The decrease in numbers might be due to:

- Patchiness of pteropods
- Adult population die-off in the summer time
- Deployment of bongos to the different depths and times of where pteropods were located
- Insufficient numbers of deployment of nets in the water

The weather conditions were most probably the reasons for the damaged shells of pteropods as it experienced flushing when at the surface. Efforts to mitigate the effects of flushing were tried by hauling the net at lower speeds and using plastic strips in the cod ends did not succeed. Once the pteropods shell is damaged, animals are not suitable for live experimental set-up as they are unable to swim and the survival of these animals declines rapidly.

Bongo and Mini Bongo nets were used to obtain juvenile forms of *Limacina helicina* but did not catch any adults; either because the adults escaped from these vertical nets or they were not present.

The RMT25 collected pteropods from greater depths. In a number of events (329, 300, 295, 250, 74) bathypelagic *Clio recurva* was caught with intact shells, but animals were not alive any more.

RMT8 and MOCNESS nets gave a constant supply of Gymnosomes (*Clione limacina* and *Spongiobranchaea australis*). MOCNESS also collected *Clio pyramidata*. The catches of MOCNESS and LHPR nets were the indicators of the presence of pteropods and decisions on deployment of towed bongos were based on those catches.

Sample handling

All pteropods were picked out from the net catch and placed in the filtered seawater.

Spongiobranchaea australis and *Clione limacina* were either immediately frozen (for stable isotope analysis or CHN) or dabbed dry and placed in to pre-weighed ultra-light weight tin foil capsules for dry mass and elemental composition analysis back in the UK. Samples were immediately stored at -80°C .

Limacina helicina (adults and juveniles) were transferred to seawater with predetermined CO_2 concentration as part of acidification experiments. Additionally, juveniles were collected on filters (ashed) for dry mass and elemental composition analysis back in the UK.

If the shell was intact, *Clio pyramidata* was also used in the same type of the experiment.

Samples from the MOCNESS, where juvenile *Limacina helicina* were expected, were also preserved intact in Steedmans solution (a formalin based fixative and preservative). These samples will be used for community composition analysis back in the UK.

Table chart with all event and preserved samples is at the end of this document.

13.3 Experiments

Ocean acidification experiment

The acidification experiment was set up to observe the changes in the shell structure of shelled pteropods under different future CO_2 (and hence ocean acidification) environments. Four different gases: 375ppm (control), 500ppm, 750ppm and 1200 ppm were pumped through filtered sea water contained in either 20L carboys or 2L glass bottles. The aim is to equilibrate the cylinder gas concentration with the dissolved CO_2 concentration in the water. In order to establish whether the water was at a similar concentration to the cylinder gas a LICOR was used to measure the CO_2 concentrations in the headspace. Because the equilibrium in CO_2 concentrations between the headspace and the water is established, it is presumed that the reading of CO_2 concentration in the headspace reflects the dissolved CO_2 in the water.

Measurements are only possible at the same time as gas is bubbled through the incubators because a through-flow of gas is required by the LICOR). CO_2 doesn't dissolve immediately but escapes in the headspace from where it slowly dissolves in the water. By bubbling and at the same time measuring the CO_2 in the headspace it is possible that LICOR measurements would not really reflect the proper CO_2 concentration in the liquid. In order to avoid potential mistakes, a Charles Austin

pump with equilibrators circuits was installed to suck the air out of the carboys instead of using the gas from the cylinder.

The CO₂ concentration measurements were confirmed using a pH meter (2 decimal points) and sys CO₂ computer programme.

With the increasing concentration of CO₂ in the gas cylinders, it takes much more time to reach the determined concentration point in the carboys or 2 L bottles. The latter ones were more straightforward to work with since it requires much less time of bubbling and increases the certainty that the CO₂ concentrations in the carboys are correct.

In order to establish 500ppm in the filtered seawater, 3-4 intervals of 2h bubbling were needed. For the 1200ppm, at least 7-10 intervals were needed, and the amount of gas required triples. More gas and bubbling time was required when using the 20 L carboys than with the 2 L bottles.

The acidification experiments were conducted with:

Limacina helicina (adults) in Experiment I which was set up to observe the morphological changes of the shell due to the own respiration of the organisms (repeating the Orr's experiment (Orr et al., 2005). Animals were kept in the vials as long as they were alive after which the experiment stopped and the samples got preserved. pH measurements were taken regularly to record the changes in pH seawater due to respiration. The experiment lasted for 6 days and 28 different samples are now to be analyzed using the SEM back in the UK

Limacina helicina (adults) in Experiment II when exposed to predetermined concentration of CO₂ in the seawater. These include: 375ppm, 500ppm, 750ppm and 1200ppm. All the animals were initially alive at the start of the experiment and were taken out of their vials on the 2nd and 4th day of experiment. The experiment had to be stopped on the 4th day because majority of animals were dead. At the end of the experiment it was recorded if the animal was alive or dead when it was taken out for a sample. 48 samples were obtained.

Limacina helicina (juv.) Experiment III focused on the effect of high CO₂ waters on juveniles. Juveniles were caught with MOCNESS and Bongo nets (200 µm), picked from the samples and placed in the glass parfait jars with pre-acclimatized water (375, 500, 750 and 1200 ppm). Three experiments were setup, starting on 2/2/08, 4/2/08 and 7/2/08, in 2 parallels and undertaken for 4, 8 and 12 days. After the completion of the experiment, animals were picked out the jar and placed either in 90% EtOH or frozen for biochemical analysis or put in the RNA later for genetic analyses. A 250 ml sample of the water in which the animals were cultivated was taken at the start and the end of the experiment and fixed with mercuric chloride. These water samples will be analysed at UEA for TA and DIC. From this p CO₂ and pH values will be obtained.

Clio recurva in Experiment IV were exposed to the same setting as *Limacina helicina* in Experiment II. Only one animal was put in each jar with acclimatized water due to limited numbers. The animals were stored in 90% ethanol. The water in which the animals were cultivated was fixed with mercuric chloride at the end of the experiment for TA and DIC from which p CO₂ and pH values will be obtained.

Spongiobranchea australis (Experiment V) was used to observe the high CO₂ concentration on swimming reactions. 5 animals were placed in 2 L of pre-acclimatized filtered sea water. They were observed daily on 8 hours intervals. The experiment had to be stopped after 2 days when the animals became inactive or died. Once the experiment was stopped all the animals were frozen for subsequent elemental or biochemical analysis.

All together 60 samples of CO₂ enriched seawater were collected from the experiments to which HgCl₂ was added to prevent any form of biological contamination. These samples will be freighted back to UEA for analysis.

Feeding (grazing) experiment with *Spongiobranchea* and *Oithona*

To test either Gymnosomes exclusively feed on euthecosomes, an experiment with 30 *Oithona*s and 2 (or 1) *Spongiobranchea* were set up for 5 days after which the number of remaining *Oithona* were counted. The control contained just *Oithona* and served as an indicator how good was the picking and transferring the *Oithona* in the experiment was.

| | | | | |
|------|--------------------|----------------|--------------------|------------------|
| Exp1 | Oithona in control | Oithona in exp | Oithone at the end | Spongiobrancahea |
| | 24 | 30? | 5 | 2 |
| Exp2 | Oithona in control | Oithona in exp | Oithonaat the end | Spongiobrancahea |
| | 22 | 30? | 12 | 1 |

13.4 Mesoscale distribution of pteropods in surface waters

Underway water samples were filtered during (i) the mesoscale survey around P3 (ii) the transit between station R3 and R4 and the small scale survey at R4 (iii) part of the transit from R4 to South Georgia. The aim was to examine mesoscale variability in the distribution of juvenile *Limacina helicina* in surface waters

Pilot study

Water from the underway water supply (water taken from 6.5 m below surface and coarsely filtered) was filtered through 100um mesh filtering bucket for approximately 2 h between 10:00 and 12:00 local on 30 Jan 2008. The sample was examined and approximately 5 juvenile *L. helicina* were spotted on a superficial examination of the sample. It was concluded that this was a means of collecting this species for semi-quantitative distributional analysis

General protocol

The 100um mesh bucket filter was cleaned prior to the start of the sample. The underway water supply was then continuously passed through this filter. The sample was collected 2 h later and preserved. This was repeated every 2 h.

Flow rate

The flow rate was measured by pouring water from this supply into a graduated measuring cylinder. It took approximately 1 minute to fill the 2 l cylinder – hence 2 l per minute flow rate. For a 2 h period, this would result in 240 l being filtered through the mesh.

The flow rate was measured at a number of times throughout the surveys and some variability was evident. For instance, at 05:00 on 31st Jan, the flow rate had dropped to

1 l per minute. Some minor adjustments were made to try and maintain a flow rate of 2 l per minute, but a factor of 2 variability in volume filtered must be factored in to any comparison of abundance between samples.

Preservation

All samples were condensed in a smaller 100um mesh cylinder and then washed into a polypropylene screw top jar and topped up with formalin (4% formaldehyde)

13.5 Survey Design

(i) P3 mesoscale survey design

The mesoscale survey carried out 6 parallel transects, 60km long and 12 km apart. The design was such that the middle transect (3) went through the location of the core-sampling station. Two passes were made of this middle transect, one during the night, the other the day.

(ii) R3 to R4 and R4 small scale survey design

The transit between R3 and R4 was continuous since there was a pressing need to arrive at R4 before the available weather window closed. On arrival at R4, there was an immediate RMT25 deployment and then a small scale survey. That consisted of 3 parallel transects, 10 km long and 5 km apart. The design was such that the upper transect was in warmer surface waters (>5oC) and the lower two were in gradually colder surface waters (<5oC). This survey took place between ~15:00 and ~19:00.

(iii) R4 to South Georgia

After sampling operations at R4 had to be halted, the ship moved westwards, hove to for 24 h. It then gradually turned southwards, in the direction of South Georgia. Samples were taken after the ship was part way into its southern trajectory. Samples were stopped at the point where the first deployments at South Georgia were made (whale buoy deployments on the NW South Georgia shelf).

13.6 Samples

The collected samples were as follows:

P3

- 1) 30 Jan 13:00-15:00 local
- 2) 30 Jan 15:00-17:00
- 3) 30 Jan 17:00-19:00
- 3) 30 Jan 19:00-21:00
- 5) 30 Jan 21:00-23:00
- 6) 30/31 Jan 23:00-01:00
- 7) 31 Jan 01:00-03:00
- 8) 31 Jan 03:00-05:00
- 9) 31 Jan 05:00-07:00
- 10) 31 Jan 07:00-09:00
- 11) 31 Jan 09:00-11:30 End of survey

R3 to R4

- 1) 5 Jan 13:00-15:00 local
- 2) 5 Jan 15:00-17:00
- 3) 5 Jan 17:00-19:00
- 3) 5 Jan 19:00-21:00
- 5) 5 Jan 21:00-23:00
- 6) 5/6 Jan 23:00-01:00
-) 6 Jan 01:00-03:00 – sample not taken
- 7) 6 Jan 03:00-05:00 – flow rate problems
- 8) 6 Jan 05:00-07:00
- 9) 6 Jan 07:00-09:00
- 10) 6 Jan 09:00-11:00
- 11) 6 Jan 11:00-13:00
- 12) 6 Jan 13:00-15:00
- 13) 6 Jan 15:00-17:00
- 14) 6 Jan 17:00-19:00 ???

R4 to South Georgia

- 1) 8 Jan 10:00-12:00 (local)
- 2) 8 Jan 12:00-14:00
- 3) 8 Jan 14:00-16:00
- 4) 8 Jan 16:00-18:00
- 5) 8 Jan 18:00-20:00
- 6) 8 Jan 20:00-22:00
- 7) 8/9 Jan 22:00-00:00
- 8) 9 Jan 00:00-02:00
- 9) 9 Jan 02:00-04:00

13.7 Supplementary measurements made during the transects

Oceanlogger – which measures the same water supply used for filtering the pteropods. Measurements made include temperature, salinity, fluorescence, oxygen.

Acoustics – Simrad EK60 38 kHz, 120 kHz and 200 kHz were operational for the entire transect

Observations - Higher predator observations were made during daylight hours

Other potential measurements of underway water

- **ppCO₂** measurements? Libby
- **FRRF** measurements of phytoplankton? Daria/Maria
- **Iron?** Daria/Maria
- **Macronutrients?** Mick
- **Chla pigment analysis?** Beki/Min

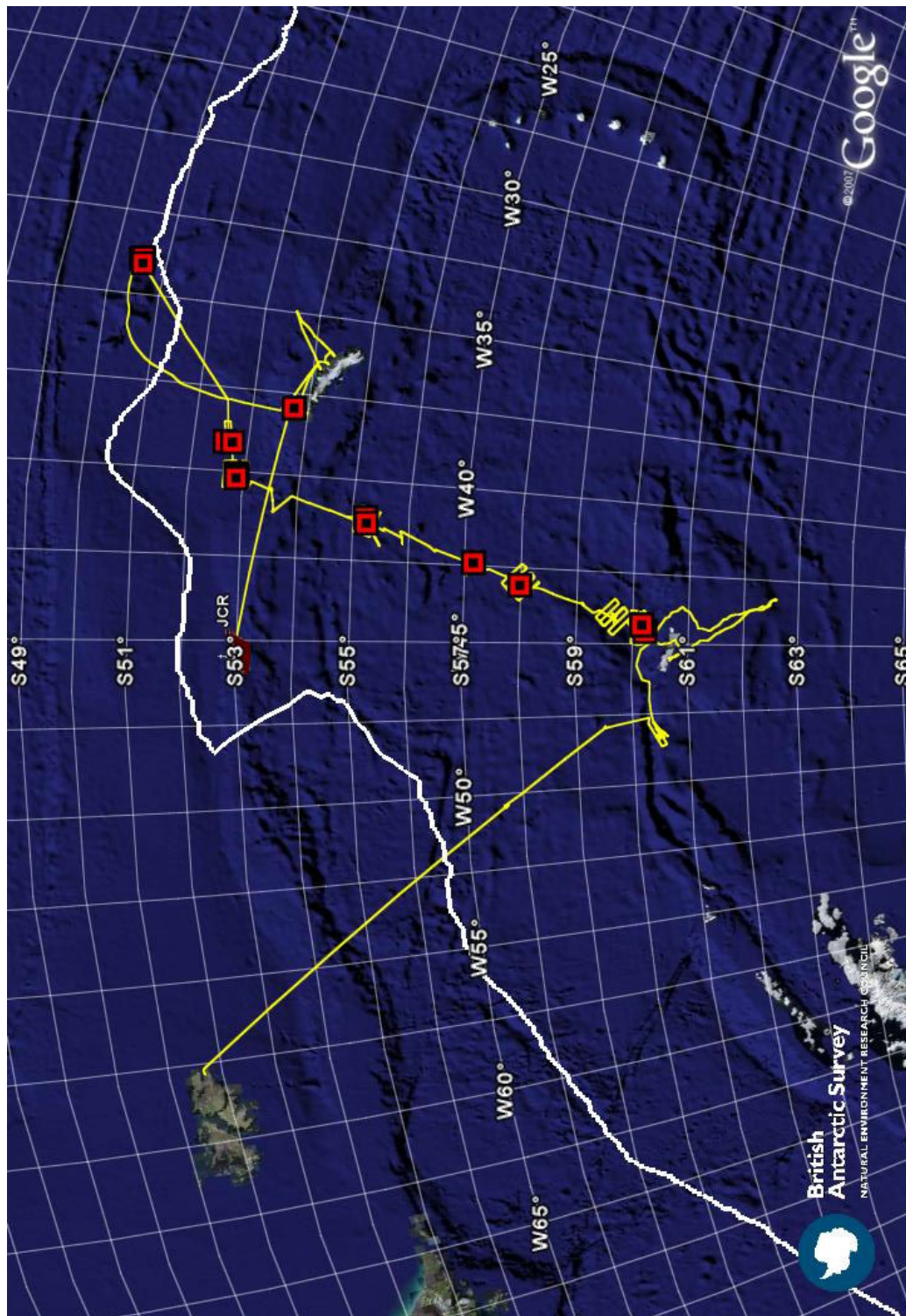
TABLE 13.1: ALL THE EVENTS WHERE PTEROPODS WERE CAUGHT

| species | Event | number of animals | type of net | nets | date | freezer | ethanol | formalin | tins | LAT//LONG |
|------------------------------|-------|-------------------------|----------------|------|--------|-------------|---------|----------|---------------------------------|----------------------|
| Spongiobranchia australis | 359 | 8 | RMT8 | 1 | 07-Feb | x | | | | -52.5824 -39.0894 |
| | 329 | 2 | RMT25 | 2 | 05-Feb | x | | | | -52.5824 -39.0894 |
| | 312 | 12 | MOCNESS | all | 03-Feb | x | | | | -52.5824 -39.0894 |
| | 300 | 9 | RMT25 | | 02-Feb | x | | | | -52.5824 -39.0894 |
| | 292 | 16 | MOCNESS | 9 | 01-Feb | x | | | | -52.8571 -40.0208 |
| | 281 | 1 | Bongo | | 01-Feb | x | | | | -52.8571 -40.0208 |
| | 375 | 7 | MOCNESS | | 09-Feb | x | | | | -53.7493 -37.9192 |
| | 295 | 4 | RMT25 | 2 | 02-Feb | x | | | | -52.8571 -40.0208 |
| | 249 | 11 | MOCNESS | 1 | 27-Jan | x | | | x (tray2:C1- C11) | -55.2296 -41.2858 |
| | 276 | 12 | MOCNESS | | 01-Feb | x | | | | -52.8571 -40.0208 |
| | 177 | 6 | MOCNESS | 1 | 18-Jan | x | | | | -57.9835 -43.0377 |
| | 237 | 13 | towed Bongo | | 26-Jan | x | | | | -55.2058 -41.1176 |
| | 85 | 2 | MOCNESS | | 08-Jan | x | | | | -60.2203 -44.5074 |
| | 81 | 4 | MOCNESS | | 06-Jan | x | | | x(tray5:8 animals) | -60.161 -44.2726 |
| | 346 | 4 | RMT25 | 2 | 06-Feb | | | | x (tray2:B8- B12) | -52.5824 -39.089 |
| | 213 | 1 | MOCNESS | all | 21-Jan | | | | x (tray2:F1) | -57.1554 -42.3492 |
| | 215 | 12 | MOCNESS | all | 21-Jan | | | | x (tray2:G1- G12) | -57.1554 -42.3492 |
| | 357 | | RMT25 | 1 | 06-Jan | | | | x(tray9:F1- F12 & G4- G7) | -60.161 -44.2726 |
| | 81 | 8 | MOCNESS | | 06-Jan | | | | x(tray 5:8 animals) | -60.161 -44.2726 |
| | 355 | 1 | RMT25 | 1 | 07-Feb | | | x | | -50.5448 -33.8868 |
| Clione limacina | 312 | 14 | MOCNESS | all | 03-Feb | x | | | | -52.5824 -39.0894 |
| | 292 | 8 | MOCNESS | all | 01-Feb | x | | | | -52.8571 -40.0208 |
| | 276 | 2 | MOCNESS | 8 | 01-Feb | x | | | | -52.8571 -40.0208 |
| | 177 | 15 (?) | MOCNESS | 1 | 18-Jan | x (appr nb) | | | | -57.9835 -43.0377 |
| | 276 | 2 | MOCNESS | | 01-Feb | x | | | | -52.8571 -40.0208 |
| | 237 | 12 | towed Bongo | | 26-Jan | x | | | | -55.2058 -41.1176 |
| | 82 | 15 | towed Bongo | | 07-Jan | x | | | | -60.161 -44.2726 |
| | 85 | 8 | MOCNESS | | 08-Jan | x | | | x(tray2:B1- B8) | -60.2203 -44.5074 |

| | | | | | | | | | | |
|----------------------|--------------------|---------|----------------|--------|---|------------------------------------|--|---|--|----------------------|
| | | | | | | | | | x(tray9:D1- D12, E1- E12 & G1- G3) | -52.5824 -39.0894 |
| | 312 | 27 | MOCNESS all | 03-Feb | | | | | | |
| | | | | | x(3) (the body of one animal from the treatment added) | | | | | |
| Clio recurva | 329 | 10 | RMT25 | 1 | 05-Feb | | | | x(8) (3/2- 15/2 treatment) | -52.7164 -39.1028 |
| | 329 | 6 | RMT25 | 2 | 05-Feb | x(2) | | | x(4) (3/2- 7/2 treatment) | -52.7164 -39.1028 |
| | 295 | 3 | RMT25 | 2 | 02-Feb | x | | | | -53.7493 -37.9192 |
| | 300 | 1 | RMT25 | | 02-Feb | x | | | | -53.7493 -37.9192 |
| | 250 | 1 | RMT25 | | 1000- 700m 27-Jan | | | x | | -55.2296 -41.2858 |
| | 250 | 2 | RMT25 | | 700- 400 27-Jan | | | x | | -55.2296 -41.2858 |
| | 74 | 2 | RMT25 | 1 | 05-Jan | | | x | | -60.161 -44.2726 |
| Limacina helicina | 297 | 400 | Bongo | | 02-Feb | x(filterPOC) | | | | -52.8571 -40.0208 |
| | 314 | 400 | MOCNESS | | 04-Feb | x(filterPOC) | | | | -52.5824 -39.0894 |
| | 314 | 400 | MOCNESS | | 04-Feb | x(filterPOC) | | | | -52.5824 -39.0894 |
| | 85 | 4 | MOCNESS 9 | | 08-Jan | x | | | | -60.2203 -44.5074 |
| | 177 | 2 | MOCNESS 9 | | 18-Jan | x | | | | -57.9835 -43.0377 |
| | 139,140,141 | 8 | Towed Bongo | | 14-Jan | x(tray2:H1- H8) | | | | |
| | 73,82,83,98,140 76 | | Towed Bongo | | 05/01/- 14/1 | x(tray5:A1- A10) | | | x(48vials in Exp2 and 28 vials in Exp1) x(17 vials for 4 days 7/2-10/2 each with 30 animals) | |
| | 297 | cca 800 | Bongo | | 02-Feb | x(3 vials) | | | | -52.8571 -40.0208 |
| | 314 | cca 800 | Bongo | | 04-Feb | x(4 vials) x (smashed vials) | | | | -52.5824 -39.0894 |
| Clio pyramidata | 329 | 2 | RMT25 | 2 | 05-Feb | shell) | | | | -52.5824 -39.0894 |
| | 85 | 11 | MOCNESS | | 08-Jan | shell) | | | x(tray2:A1- A11) | -60.2203 -44.5074 |
| | 81 | 4 | MOCNESS | | 07-Jan | shell) | | | x(3) | -60.2203 -44.5074 |

| | | | | | | | |
|----------------------|-----|---|---------|---|--------|---|----------------------|
| unknown species:1 | 328 | 1 | RMT25 | 2 | 04-Feb | x | -52.8571 -40.0208 |
| unknown species:2 | 375 | 1 | MOCNESS | | 09-Feb | x | -52.8571 -40.0208 |
| unknown species:3 | ? | 2 | | | | x | |

FIGURE 13.1: OCCURRENCE OF *SPONGIOBRANCHAEA AUSTRALIS* THROUGHOUT THE SCOTIA SEA



14 Predator Obs

Andrew Black and Dirk Briggs

14.1 Introduction

The predator recording methodologies used throughout JR177 are taken from the JR161 Predator Observations cruise report (Wakefield 2007). We present recommendations for future observers and analysis as well as a brief summary of our achievements.

14.2 Aims

The principal aim of this study was to record air breathing predators (seabirds, seals and cetaceans) for estimates of relative abundance both at and between mesoscale process stations during daylight hours in January and February, 2008. These critical records were then supplemented with additional observations along most of the ships track whilst steaming, commencing and ending near the Falkland Islands. Assemblages of predators will be analysed for spatial cross correlation with acoustically detected prey aggregations from fixed and towed sonar transponders.

14.3 Method

The earlier JR161 cruise report provides background and detailed instructions for applying the distance sampling with strip-transect methodology used by Andy Black and Dirk Briggs (observers 1 and 2 respectively) throughout JR177.

At the commencement of the JR177 cruise track (figure Pred1), observer 2 attempted to code and enter data in real time using the Itronix GO book III touch screen laptop provided, whilst observer 1 called out species names and numbers, activity attributes, headings and surface locations (as applied). Though the touch screen interface is nicely presented, where the countdown clock is an especially useful visual aid, we found that recording was a slow process for novice users and that in our hands the computer was prone to crashing. Therefore we decided not to use the laptop whilst observing and entered the data retrospectively from hand written sheets instead. This also meant that we could observe independently and seamlessly (on short watches to reduce fatigue) for as many as 18 hours in a day. We also simplified and otherwise altered the prescribed list of codes (appendix pred1b) so that they were easier to use and remember whilst recording.

Position and speed of the vessel were taken from the ships log and our watches were synchronised to the ships UTC chronometer. Weather, visibility and sea ice conditions were assessed by eye and recorded at the time of a change. Recording usually ceased in poor weather (wind with excessive spray, too much sun glare, poor light and less than 100m visibility) except during the mesoscale surveys when we continued for as long as possible.

All observations were carried out from the port or starboard bridge wing deck, depending on the wind and sun position. A one second recording accuracy was achieved in “snapshots” and a 5 second accuracy was used at all other times. Priority was accorded to recording predators within the survey transect. Only cetaceans and

note worthy aggregations of other predators were recorded beyond the survey transect when seen ahead of, or perpendicular to, and on the same side of the vessel as the observer. Two observers were generally available when whales were seen to reduce the likelihood of misidentification.

As during JR161, we had similar concerns about according most effort to the continuous recording of birds flying. We also thought that some of the behavioural codes are confusing or ambiguous (e.g. is it not reasonable to assume that all predators are “apparently foraging” unless clearly doing something else?). Because of the recording difficulties that ship followers cause, we did not routinely undertake observations when the vessel was stationary or moving slowly.

14.4 Recommendations for analysis

Intuitively, the accuracy of recording will be influenced by the experience and ability of each observer, weather conditions (particularly sea state) and visibility (including poor light). In sea state 4 or above and in less than excellent visibility, observer 2 had difficulty seeing predators at (or very close to) the surface, particularly penguins (especially when they were more or less stationary and only their heads were visible), and diving petrels. Whilst the recording method should take into account differences in composition and abundance at increasing distances from the ship, impaired detection when compounded by the effect of sea state and visibility is likely to be more problematic. Therefore in a worst case we recommend selective use of the data after rigorous testing for inter-observer biases.

Because the method prescribes that ship following predators are not recorded by the observer, an analysis of predator composition and relative abundance along the survey track should be fairly robust. But we would urge caution when interpreting the penguin data subset as it was generally impossible to tell if birds were within or between foraging areas. Assumptions from other spatial interactions are discussed in the JR161 cruise report.

14.5 Achievements

Predator observations were carried out in the mesoscale process stations, in the pack ice and at most other times except when the ship was stationary or moving slowly. We achieved a total of 8837 individual records, (5573 on 32 different days by observer 1, and 3264 on 25 different days by observer 2).

Data from the observers field sheets were then typed into EXCEL spreadsheets and checked manually before bulk uploading into an ACCESS database together with additional data from the ships log files. The database has the same table and field format used for entering JR161 data, but incorporates the code changes listed in appendix pred1b.

14.6 Acknowledgements

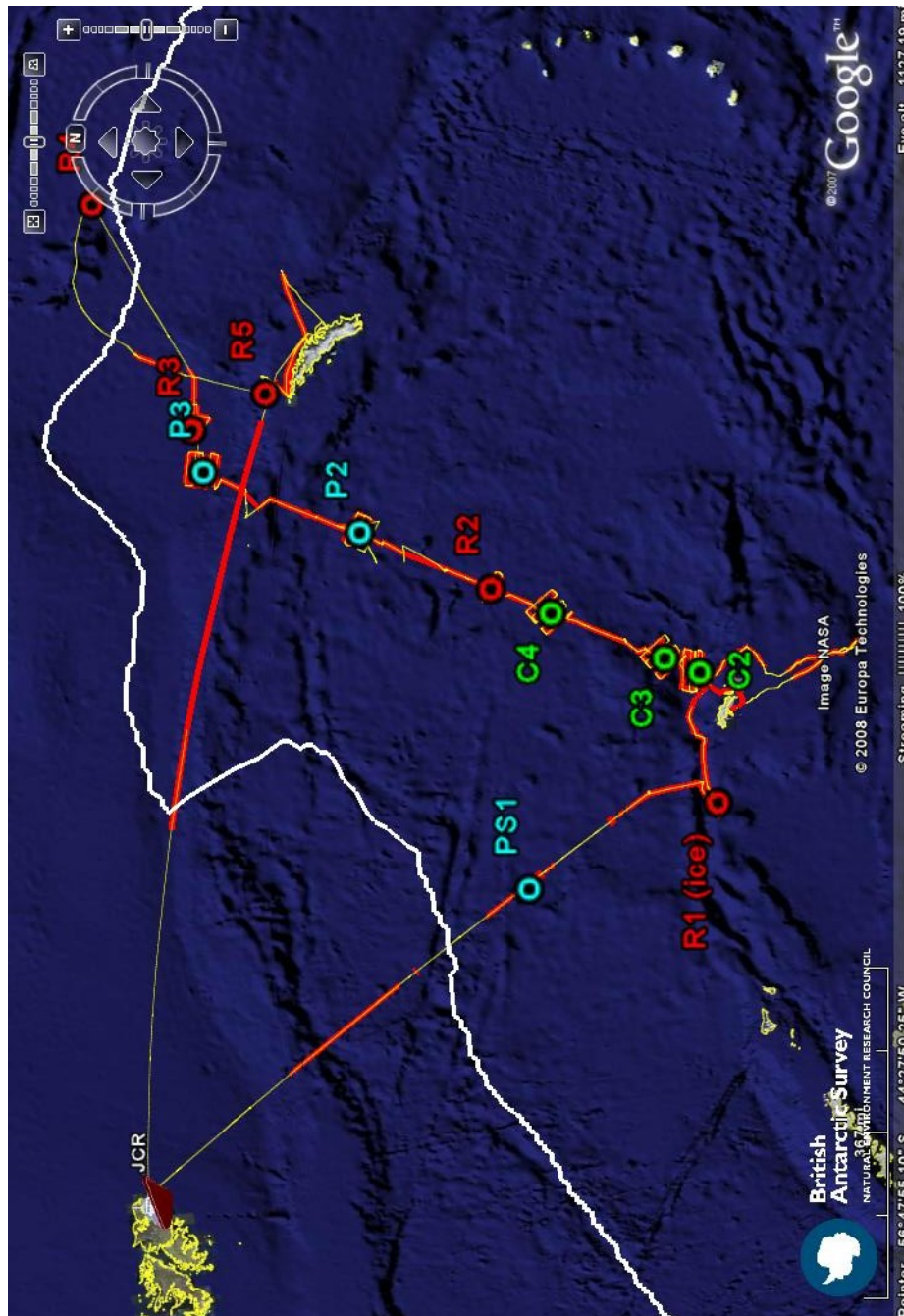
For their assistance, patience, understanding and interest, and for providing cups of tea and coffee, we would especially like to thank Captain Graham Chapman, Chief Officer Robert Patterson, the officers of the watch and watch keepers. We would also like to thank Sophie Fielding and Jon Watkins for coordinating our predator

observations with their mesoscale survey work, Helen Peat and Nathan Cunningham for their ACCESS expertise and Hugh Venables for being an extra “pair of eyes”.

14.7 References

Harrison PH Seabirds an identification guide (Helm, ISBN 0-7470-1410-8, 1983)
Wakefield E JR161 Predator Observations (in JR161 Cruise Report, 2007)

Fig Pred1



Predator observations (red) along JR177 cruise track

NB. White line shows the position of the Mean Polar Front

14.8 Appendix Pred1b

Access database field values are as described in the JR166 cruise report except for the following:

| Table | Field | Description |
|-----------|--------------------------|--|
| CountData | pl | Stage classes for great albatrosses are from Harrison (1983) |
| | band | Used "W" (Water) for in-transect penguins and seals when the band position was not recorded or unknown. This was generally used when animals were heard and not seen |
| | dir | N, NE, E, SE, S, SW, W, NW |
| | <i>Movement:</i> | |
| | FDD | Flying direction ("dir") was recorded in "snapshot" or otherwise at the time a bird left the counting box |
| | FT1 | Not used |
| | FT2 | Not used |
| | FT3 | Flying birds circling >180 deg: generally applied to birds circling in "snapshot" or otherwise if circling and not seen leaving the counting box |
| | SOW | All stationary animals at the surface |
| | SOD | Sitting on driftwood or kelp |
| | SSD | Cetaceans, seals and penguins moving slowly |
| | SUR | Not used |
| | SF1 | Not used |
| | SF2 | Not used |
| | SF3 | Not used |
| | SS1 | Not used |
| | SS2 | Not used |
| | SS3 | Not used |
| | SFD | Cetaceans, seals and penguins moving quickly |
| | <i>Feeding:</i> | |
| | F | Not used (used surface feeding codes instead) |
| | 0 | Not used |
| | 1 | Not used |
| | <i>Foraging:</i> | |
| | DDD | Used when potentially diving to locate prey (but not plunging) |
| | FPT | Not used (used "SFP" instead) |
| | FDP | Used if not hydroplaning ("SHY") |
| | <i>General foraging:</i> | |
| | 2 | Not used |

Associating:

Ass

Predators associating with:

Predators (2 or more animals clearly together)

Kelp

Ice

None (default)

METO:

wind_dir

N, NE, E, SE, S, SW, W, NW

swell_direction

N, NE, E, SE, S, SW, W, NW

vis

1; <100m, 2; 100 – 200m, 3; 201 – 300m, 4; 301
- 500m, 5; 501 - 1000m, 6; 1001 – 3000m,
7; > 3000m

temperature

Categories used are appropriate for the Southern
Ocean (e.g. “Mild” = approx +4 deg C).

15 Fish and Macroplankton

Martin Collins

15.1 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 JR177 there were three key objectives associated with the Scotia Sea Foodwebs project:

1. To investigate the distribution of the mesopelagic fish community from the ice-edge 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 fish eaters, undertake long (16-30 day) foraging trips to the Polar Front, but the target of these foraging trips is unknown. Penguins were satellite-tracked prior to and during the cruise to identify key foraging locations and time-depth recorders provided information about diving depth. By fishing in the foraging areas, with opening and closing nets, it should be possible to determine the composition of the king's diet and understand why they undertake such long foraging trips.

15.2 Gear

During the cruise the RMT25 was used to characterise the fish and macro-zooplankton community at each station from the surface to 1000 m during day and night. The RMT25 was rigged with 2 new nets, with the release mechanism and downwire net-monitor with flow, temperature, salinity and PAR sensors. There were a number of technical problems with the RMT25 release gear that will need to be addressed before the next cruise.

15.3 Catch sorting and processing

Depth stratified hauls (1000-700; 700-400; 400-200 & 200-surface) were conducted day and night at most of the stations (33 hauls) (see Table X1), with each net open for 35-45 minutes. In addition 8 hauls were undertaken at stations either targeting krill or fish marks identified on the EK60 echosounder or to catch krill in surface waters.

For the stratified hauls 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. Samples were collected from key species for stable isotope analysis and the remainder of the catch, with the exception of the large jellies, was preserved in formalin or ethanol (pteropods and some amphipods only). All data were recorded in an MS Access relational database.

Fish were separated from the rest of the catch and were measured and sexed (using external sexual characters when possible). The majority of fish were measured, sexed (externally if possible) and frozen whole. Specimens of *Cyclothone* and *Notolepis* larvae were preserved in ethanol or formalin. Unusual specimens were fixed in formalin.

15.4 Preliminary results

In general sufficient data was collected to achieve objectives 1 & 2 above, although no samples were obtained from one of the key stations in the central Scotia Sea, due to poor weather. Unfortunately objective 3 was not achieved due to poor weather and late changes to the cruise strategy that reduced the number of Polar Front stations from 2 to 1 and required work on the South Georgia shelf.

Over 3700 fish, belonging to 30 species were caught during the cruise (Table X2) 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*, *Electrona carlsbergi*, *Protomyctophum bolini*, and *Cyclothone* sp.

Few fish were caught during daylight hauls in the top 400 m, indicating that the fish are able to avoid the net during daylight. Daylight target hauls on clear fish marks caught either few or no fish.

Whilst all fish and euphausiids were identified to the species level, it was not possible to identify other faunal groups to the species level. A photographic guide is being developed to make identification easier and provide consistency between cruises and catch sorters.

15.5 Recommendations for future cruises

It is essential to carry a full set of spares for the RMT 25 release mechanism and net monitors. In particular there were problems with the batteries on the release unit and a number of instances where the release failed to work for no apparent reason. The new net monitor worked well during most of the cruise.

The RMT25 is clearly unable to catch fish in the surface waters during daylight, so to get any idea of fish abundance night time hauls must be used.

The work at the Polar Front is a key part of the Scotia Sea Foodwebs project, linking oceanography, acoustics, fish distribution and higher predators. For the second cruise in a row, this work was not accomplished. It is essential that this work be given a higher priority in the final cruise, possibly having dedicated time outside of the main cruise to ensure that it happens.

TABLE X1. DETAILS OF RMT25 STATIONS DURING JR177.

| Event | Targetype | Net | Date | Time | Duration | Lat | Long | Depth | Net Depth |
|-------|------------|-----|-----------|----------|----------|--------|--------|-------|--------------|
| 29 | Test | 1 | 02-Jan-08 | 14:24:00 | 0:07:00 | -57.74 | -50.38 | 4160 | 89-173.5 |
| 29 | Test | 2 | 02-Jan-08 | 14:32:00 | 0:07:00 | -57.74 | -50.39 | 4163 | 15.6-77.6 |
| 64 | Stratified | 1 | 05-Jan-08 | 9:01:00 | 0:46:00 | -60.49 | -48.32 | 1748 | 401.7-1004.9 |
| 74 | Stratified | 1 | 05-Jan-08 | 20:12:00 | 0:40:00 | -60.50 | -48.26 | 1744 | 206.5-400.4 |
| 74 | Stratified | 2 | 05-Jan-08 | 20:53:00 | 0:39:00 | -60.50 | -48.33 | 1851 | 13.3-203 |
| 75 | Stratified | 1 | 05-Jan-08 | 23:27:00 | 0:47:00 | -60.52 | -48.24 | 1901 | 403.9-700.1 |
| 76 | Stratified | 1 | 06-Jan-08 | 2:42:00 | 0:40:00 | -60.52 | -48.20 | 1838 | 204.4-401.5 |
| 76 | Stratified | 2 | 06-Jan-08 | 3:23:00 | 0:34:00 | -60.56 | -48.20 | 2064 | 14.1-206.8 |
| 78 | Stratified | 1 | 06-Jan-08 | 6:33:00 | 0:20:00 | -60.58 | -48.23 | 2161 | 845.1-996 |
| 78 | Stratified | 2 | 06-Jan-08 | 6:55:00 | 0:22:00 | -60.59 | -48.24 | 2189 | 700.1-850 |
| 79 | Target | 1 | 06-Jan-08 | 9:35:00 | 0:05:00 | -60.53 | -48.12 | 1398 | 47.5-69 |
| 79 | Target | 2 | 06-Jan-08 | 9:40:00 | 0:04:00 | -60.53 | -48.13 | 1401 | 54.9-73 |
| 97 | Target | 1 | 08-Jan-08 | 22:20:00 | 0:05:00 | -60.25 | -44.47 | 5390 | 47.8-64.4 |
| 97 | Target | 2 | 08-Jan-08 | 22:27:00 | 0:05:00 | -60.25 | -44.46 | 5429 | 41.3-48.9 |
| 102 | Stratified | 1 | 09-Jan-08 | 2:34:00 | 0:10:00 | -60.18 | -44.38 | 5400 | 168.6-203.6 |
| 102 | Stratified | 2 | 09-Jan-08 | 2:47:00 | 0:43:00 | -60.18 | -44.38 | 5334 | -1.6-201.9 |
| 108 | Stratified | 1 | 09-Jan-08 | 9:31:00 | 0:21:00 | -60.18 | -44.36 | 5384 | 407.7-703.4 |
| 108 | Stratified | 2 | 09-Jan-08 | 9:53:00 | 0:19:00 | -60.17 | -44.34 | 5336 | 197.9-409.1 |
| 123 | Stratified | 1 | 12-Jan-08 | 23:25:00 | 0:51:00 | -60.20 | -44.44 | 5447 | 698-997.9 |
| 123 | Stratified | 2 | 13-Jan-08 | 0:17:00 | 0:48:00 | -60.20 | -44.51 | 5453 | 400.1-709.6 |
| 124 | Stratified | 1 | 13-Jan-08 | 2:31:00 | 0:40:00 | -60.19 | -44.72 | 5252 | 193.8-406.3 |
| 124 | Stratified | 2 | 13-Jan-08 | 3:12:00 | 0:40:00 | -60.18 | -44.78 | 5042 | 7.6-207.1 |
| 155 | Target | 1 | 15-Jan-08 | 19:34:00 | 0:05:00 | -59.66 | -43.96 | 4105 | 58.4-80.6 |
| 155 | Target | 2 | 15-Jan-08 | 19:40:00 | 0:05:00 | -59.66 | -43.97 | 4115 | 58.4-70.9 |
| 158 | Stratified | 1 | 16-Jan-08 | 0:03:00 | 0:46:00 | -59.68 | -44.04 | 4156 | 701.2-998.1 |
| 158 | Stratified | 2 | 16-Jan-08 | 0:55:00 | 0:47:00 | -59.70 | -44.10 | 4213 | 402.8-704.5 |
| 161 | Stratified | 1 | 16-Jan-08 | 3:50:00 | 0:46:00 | -59.68 | -44.03 | 4260 | 203.3-403.6 |
| 161 | Stratified | 2 | 16-Jan-08 | 4:37:00 | 0:47:00 | -59.69 | -44.09 | 4386 | 11.4-209 |
| 165 | Stratified | 1 | 16-Jan-08 | 10:55:00 | 0:49:00 | -59.67 | -44.06 | 4151 | 699.9-1000.6 |
| 165 | Stratified | 2 | 16-Jan-08 | 11:49:00 | 0:46:00 | -59.68 | -44.14 | 3839 | 400.4-698.8 |
| 166 | Stratified | 1 | 16-Jan-08 | 15:11:00 | 0:44:00 | -59.67 | -43.99 | 4235 | 201.9-400.9 |
| 166 | Stratified | 2 | 16-Jan-08 | 15:59:00 | 0:42:00 | -59.68 | -44.06 | 4157 | 12-202.7 |
| 196 | Target | 1 | 19-Jan-08 | 19:23:00 | 0:07:00 | -58.02 | -42.97 | 2839 | 42.9-53.2 |
| 196 | Target | 2 | 19-Jan-08 | 19:32:00 | 0:06:00 | -58.02 | -42.98 | 2846 | 19.8-53 |
| 197 | Target | 1 | 19-Jan-08 | 20:44:00 | 0:30:00 | -58.02 | -42.98 | 2854 | 150.4-258.6 |
| 197 | Target | 2 | 19-Jan-08 | 21:14:00 | 0:15:00 | -58.02 | -43.02 | 2878 | 146-162 |
| 198 | Stratified | 1 | 19-Jan-08 | 23:36:00 | 0:46:00 | -58.03 | -42.93 | 2823 | 697.7-1010 |
| 198 | Stratified | 2 | 20-Jan-08 | 0:24:00 | 0:50:00 | -58.02 | -42.98 | 2862 | 399.3-705.3 |
| 199 | Stratified | 1 | 20-Jan-08 | 3:03:00 | 0:47:00 | -58.01 | -43.05 | 2899 | 204.4-414.5 |
| 199 | Stratified | 2 | 20-Jan-08 | 3:57:00 | 0:38:00 | -58.01 | -43.12 | 2940 | 43.2-190 |
| 205 | Stratified | 1 | 20-Jan-08 | 11:45:00 | 0:48:00 | -58.02 | -42.97 | 2857 | 704.2-1003 |
| 205 | Stratified | 2 | 20-Jan-08 | 12:39:00 | 0:45:00 | -58.02 | -43.04 | 2897 | 408-709.6 |
| 206 | Stratified | 1 | 20-Jan-08 | 16:02:00 | 0:46:00 | -58.03 | -42.96 | 2844 | 397.9-695.8 |
| 206 | Stratified | 2 | 20-Jan-08 | 16:49:00 | 0:45:00 | -58.03 | -43.02 | 2883 | 202.7-413.4 |
| 207 | Stratified | 1 | 20-Jan-08 | 18:27:00 | 0:31:00 | -58.02 | -43.14 | 2955 | 10.3-208.7 |

| | | | | | | | | |
|-----|------------|---|-----------|----------|---------|--------|--------|------------------|
| 207 | Target | 2 | 20-Jan-08 | 18:59:00 | 0:05:00 | -58.02 | -43.18 | 29932.5-18.2 |
| 250 | Stratified | 1 | 27-Jan-08 | 16:38:00 | 0:46:00 | -55.20 | -41.24 | 3278701.8-999.8 |
| 250 | Stratified | 2 | 27-Jan-08 | 17:31:00 | 0:45:00 | -55.22 | -41.30 | 3397399.6-703.7 |
| 251 | Stratified | 1 | 27-Jan-08 | 20:39:00 | 0:45:00 | -55.20 | -41.20 | 3231201.7-400.9 |
| 251 | Stratified | 2 | 27-Jan-08 | 21:25:00 | 0:48:00 | -55.21 | -41.26 | 333811.4-214.1 |
| 252 | Target | 1 | 27-Jan-08 | 23:26:00 | 0:05:00 | -55.20 | -41.20 | 319849.7-63.8 |
| 252 | Target | 2 | 27-Jan-08 | 23:32:00 | 0:06:00 | -55.20 | -41.20 | 321253.5-75.8 |
| 253 | Target | 1 | 28-Jan-08 | 0:27:00 | 0:11:00 | -55.19 | -41.19 | 31905.2-32.9 |
| 253 | Target | 2 | 28-Jan-08 | 0:38:00 | 0:11:00 | -55.20 | -41.20 | 32136-20.9 |
| 254 | Stratified | 1 | 28-Jan-08 | 1:44:00 | 0:46:00 | -55.19 | -41.22 | 3227190.8-402.3 |
| 254 | Stratified | 2 | 28-Jan-08 | 2:30:00 | 0:46:00 | -55.21 | -41.25 | 32988.4-201.4 |
| 255 | Stratified | 1 | 28-Jan-08 | 5:09:00 | 0:45:00 | -55.19 | -41.23 | 3248702.3-1006 |
| 255 | Stratified | 2 | 28-Jan-08 | 5:55:00 | 0:45:00 | -55.22 | -41.26 | 3357399.8-707.5 |
| 295 | Stratified | 1 | 02-Feb-08 | 5:56:00 | 0:45:00 | -52.86 | -40.11 | 3793700.4-999.5 |
| 295 | Stratified | 2 | 02-Feb-08 | 6:45:00 | 0:48:00 | -52.87 | -40.05 | 3796407.2-702.9 |
| 300 | Stratified | 1 | 02-Feb-08 | 12:49:00 | 0:45:00 | -52.85 | -40.09 | 3792707.5-1002.2 |
| 300 | Stratified | 2 | 02-Feb-08 | 13:38:00 | 0:46:00 | -52.87 | -40.13 | 3795401.2-705.6 |
| 301 | Stratified | 1 | 02-Feb-08 | 15:43:00 | 0:46:00 | -52.90 | -40.21 | 3797203-402 |
| 301 | Stratified | 2 | 02-Feb-08 | 16:35:00 | 0:44:00 | -52.88 | -40.15 | 37941.6-201.4 |
| 305 | Stratified | 1 | 03-Feb-08 | 1:10:00 | 0:46:00 | -52.83 | -40.12 | 3789200-401.2 |
| 305 | Stratified | 2 | 03-Feb-08 | 2:02:00 | 0:45:00 | -52.86 | -40.10 | 379415.5-206 |
| 328 | Stratified | 1 | 05-Feb-08 | 0:05:00 | 0:45:00 | -52.72 | -39.08 | 3725204.1-405 |
| 328 | Stratified | 2 | 05-Feb-08 | 0:54:00 | 0:46:00 | -52.73 | -39.03 | 371912-205.4 |
| 329 | Stratified | 1 | 05-Feb-08 | 3:27:00 | 0:46:00 | -52.72 | -39.05 | 3723703.7-1001.9 |
| 329 | Stratified | 2 | 05-Feb-08 | 4:15:00 | 0:49:00 | -52.74 | -39.01 | 3716401.2-701 |
| 334 | Stratified | 1 | 05-Feb-08 | 11:19:00 | 0:45:00 | -52.62 | -39.12 | 3730703.4-1007.3 |
| 334 | Stratified | 2 | 05-Feb-08 | 12:05:00 | 0:47:00 | -52.64 | -39.09 | 3725406.9-719.6 |
| 335 | Stratified | 1 | 05-Feb-08 | 15:10:00 | 0:45:00 | -52.61 | -39.15 | 3728198.9-400.1 |
| 335 | Stratified | 2 | 05-Feb-08 | 15:55:00 | 0:44:00 | -52.63 | -39.11 | 37273-208.7 |
| 346 | Stratified | 1 | 06-Feb-08 | 15:49:00 | 0:45:00 | -50.49 | -33.93 | 4752198.7-400.9 |
| 346 | Stratified | 2 | 06-Feb-08 | 16:38:00 | 0:35:00 | -50.50 | -33.99 | 475910.3-201.4 |
| 357 | Stratified | 1 | 06-Feb-08 | 23:29:00 | 1:41:00 | -50.55 | -34.05 | 4767-3.8-206.8 |
| 378 | Stratified | 1 | 10-Feb-08 | 3:56:00 | 0:45:00 | -53.57 | -37.66 | 1098199.2-400.4 |
| 379 | Stratified | 1 | 10-Feb-08 | 6:21:00 | 0:36:00 | -53.58 | -37.66 | 107526.3-211.4 |
| 379 | Stratified | 2 | 10-Feb-08 | 7:02:00 | 0:01:00 | -53.61 | -37.66 | 79655.9-63.8 |

TABLE X2 FISH CAUGHT IN RMT25 NET HAULS DURING JR177

| Family | Species Name | Count |
|------------------|------------------------------------|-------|
| Myctophidae | <i>Electrona carlsbergi</i> | 271 |
| Myctophidae | <i>Electrona antarctica</i> | 1083 |
| Myctophidae | <i>Electrona subaspera</i> | 1 |
| Myctophidae | <i>Gymnoscopelus bolini</i> | 2 |
| Myctophidae | <i>Gymnoscopelus fraseri</i> | 95 |
| Myctophidae | <i>Gymnoscopelus nicholsi</i> | 23 |
| Myctophidae | <i>Gymnoscopelus opisthopterus</i> | 36 |
| Myctophidae | <i>Gymnoscopelus braueri</i> | 590 |
| Myctophidae | <i>Gymnoscopelus</i> sp. | 5 |
| Myctophidae | <i>Krefflichthys anderssoni</i> | 192 |
| Myctophidae | <i>Lampanyctus achirus</i> | 11 |
| Myctophidae | <i>Protomyctophum andreyeshevi</i> | 1 |
| Myctophidae | <i>Protomyctophum gemmatum</i> | 1 |
| Myctophidae | <i>Protomyctophum bolini</i> | 202 |
| Myctophidae | <i>Protomyctophum tenisoni</i> | 103 |
| Myctophidae | <i>Protomyctophum choriodon</i> | 54 |
| Bathylagidae | <i>Bathylagus antarcticus</i> | 544 |
| Bathylagidae | <i>Bathylagus</i> sp. | 128 |
| Channichthyidae | <i>Champscephalus gunnari</i> | 2 |
| Chiasmondontidae | <i>Chiasmondontidae</i> sp. | 1 |
| Gempylidae | <i>Paradiplospinus gracilis</i> | 7 |
| Gonostomatidae | <i>Cyclothone</i> sp. | 255 |
| Macrouridae | <i>Cynomacrurus piriei</i> | 13 |
| Melamphidae | <i>Poromitra crassiceps</i> | 8 |
| Microstomatidae | <i>Nansenia antarctica</i> | 8 |
| Muraenolepidae | <i>Muraenolepis microps</i> | 1 |
| Paralepididae | <i>Notolepis coatsi</i> | 33 |
| Paralepididae | <i>Notolepis</i> sp. | 95 |
| Scopelarchidae | <i>Benthalbella elongata</i> | 4 |
| Scopelarchidae | <i>Benthalbella macropinna</i> | 2 |
| Stomiidae | <i>Stomias gracilis</i> | 2 |
| Stomiidae | <i>Stomias</i> sp. | 2 |
| Stomiidae | <i>Borostomias antarcticus</i> | 11 |
| Zoarcidae | <i>Melanostigma gelatinosum</i> | 6 |
| | Fish larvae (unidentified) | 1 |

16 Technical Support

16.1 Gear Report

Peter Enderlein

16.1.1 General

This was an other cruise with a high number of deployments of towed gear. There were over 80 deployments over the stern and more than 90 deployments over the side. Because of the number of different towed gears and their different requirements the cables and the DWNM and its sensors needed lots of swapping over. This always causes certain wear and tear to the equipment and reduces its reliability. But overall it worked very well with a problem rate over ~ 10 %. All equipment was deployed to the maximum depth of 1000 m. At one point the '17 mm wire' was reterminated because the cable came of the drum and got caught and jammed.

16.1.2 Down Wire Net Monitor

During this cruise the DWNM has 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. Considering that this was the first test of the new developed system in a prototype stage, it did very well. There where a few problems in the beginning but after the initial problems where solved it worked reliably. The new improved electronics, deck unit, connectors, cables, sensors, and the new software interface are a huge improvement compared to the old system. For this cruise we still had only one system with one set of sensors available, which meant lots of swapping over of the DWNM and its sensors, reducing its reliability. We still managed to do 82 deployments. For next year it is planned to have 3 fully independent systems, to minimize the swapping over to increase the reliability even further. Also it is planned to move the batteries from the RMT25 release into the DWNM housing so charging these batteries will be done automatically by the system. So far this project has been a full success and should be finalized with the implementation of the three new DWNM systems by next season.

16.1.3 RMT25

This net was used to make 38 hauls, for stratified hauls and for target fishing. Initially there was a problem with the release gear, after that everything worked fine apart from a few times, when the release cable did not made a proper connection. , when the cable came loose. Due to the number of deployments and the wear and tear in sometimes not ideal conditions the side wires were worn out and needed replacing with the spares. After a certain amount of deployments the side wires experienced a good amount of twisting and, in the future, swivels should be put on the top of the side wires so they can turn freely.

Also the nets suffered from the number of deployments and the use in sometimes not ideal conditions. The age of the nets is showing now. The nets need good refurbishing by the net maker. On one occasions a big krill swarm was caught (up to 150 kg) and to get the net in the support of the Gilson winch was required. On several of the

recoveries the non-filtering cod-ends were ripped partly or completely. They will have to go back to the net maker and need major repair work and redesign to make them more robust.

This season the new net was used and it worked very well. It is far heavier than the old net and it needs 4 people pulling it in.

16.1.4 RMT8

The RMT8 was used 25 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.

16.1.5 LHPR

The LHPR was used 19 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 were no mismatches between the Gauze advances and the advances given by the software.

16.1.6 Acoustic Towfish

The Acoustic Towfish was deployed when ever sea conditions allowed during the mesoscale surveys. At one point the winch motor broke, causing all the wire to come off the drum rapidly. The wire was stopped by the termination block which broke the electrical termination. After replacing the motor and reterminating the electrical termination everything worked fine again. With the system given, the Towfish flies at about 30 m water depth at 10 kn. This season it was used with a 200 kHz transducer using the old EK500 system.

16.1.6 UOR

The idea was to fly the UOR together with the Towfish during the mesoscale surveys. This was started successfully with the UOR undulating between 148.8 m and 7.5 m water depth. Then the UOR stopped undulating and had to be recovered. After getting in contact with Chelsea, further test deployments revealed that the UOR motor suffered an internal EPROM failure preventing the UOR from executing any flying instructions. Therefore it has to go back to Chelsea for repairs.

16.1.7 MOCNESS Net

The new 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, but overall, it worked fine. The new system is reliable and needs only minor adjustments for future work.

16.1.8 Bongo and Mini-Bongo Net

The Bongo and Mini-Bongo net were deployed about 70 times and worked very well. The new bars, and cod-ends were used on the old spring mechanism and the old top and bottom ring frame. The cod-ends are a clear improvement to the old ones.

16.1.9 Towed Bongo

The Towed Bongo was deployed 23 times over the stern and from the crane starboard forward. It needed very good sea conditions and a very slow ship speed to catch live Pteropods, therefore the net was always paid out and hauled in very slow. Also the time in the water was minimized to increase the chance for the animals to survive. Weights of between 20 to 40 kg were used depending on the weather conditions to get the net to descend. The net really needs a depressor to reach depths deeper than 30 m.

16.1.10 Recommendation

Replacing the old DWNM system is well underway now. The prototype worked very well and the new connectors and sensors a major improvement compared with last season. During the summer hopefully the transition will carry on so that next season the new fully tested DWNM system will replace the old system. Also the aim is to have 3 fully functional systems one for the LHPR, one for the RMT8 and one for the RMT25.

We are only using non-filtering cod-ends at the moment. The new ones were not of the quality expected and have to go back to the net maker for repairs and also to strengthen them.

The connector of the RMT25 release mechanism needs replacing. The connector is old and one pin is corroded and smaller than the other pins, causing problems to make a proper connection.

On a more general note mobilisation and demobilisation again relied on good weather condition during passage from and to the Falklands. Also we benefited from having 3 people on board before we arrived on JCR who unpacked the Containers, giving us a head start. More time should be allocated for future cruises especially if the same amount of gear will be used. **We need 3 days for mobilisation and 2 day for demobilisation.**

16.2 AME

Jim Fox

16.2.1 AME Standard Report

Cruise: JR177 Start date: 30/12/07 Finish date: 16/02/08

Name of AME engineer: Jim Fox

Name of principle scientist (PSO): Geraint Tarling

| Instrument | Used? | Comments |
|--|-------|--|
| XBT (aft UIC) (PC, I/F box, handgun) | Y | White gun used ok – left in place on aft port bulwark for next cruise. Orange gun in workshop under bench. |
| Scintillation counter (prep lab) | Y | Ok |
| AutoSal (labs on upper deck) S/N 63360 | | |
| AutoSal (labs on upper deck) S/N 65763 | Y | Ok – old style peristaltic pump used |
| AutoSal (labs on upper deck) S/N 68533 | Y | Ok |
| Portasal S/N 68164 | | |
| Magnetometer STCM1 (aft UIC) | Y | Monitor not showing any data for first part of cruise. Rebooted and all ok. |
| | | |
| AME workshop PC | Y | Ok |

GPS, MRU, Gyro

| | | |
|---|--|--|
| GPS Furuno GP32 (bridge – port side) | | |
| DGPS Ashtec ADU5 (bridge – port side) | | |
| DGPS, MRU Seatex Seapath (UIC – swath suite) | | |
| DGPS Ashtec Glonass GG24 (bridge – starboard side) | | |
| Gyro synchro to RS232 Navitron NT925HDI (UIC – aft) | | |

| | | |
|---------------------------|--|--|
| TSS HRP (UIC repeater) | | |
|---------------------------|--|--|

ACOUSTIC

| Instrument | Used? | Comments |
|--|-------|--|
| ADCP (aft UIC) | Y | Oceanographers left to control. Occasional 'hanging' of data throughput. No definite info. Contact Hugh Venables. |
| PES (aft UIC) | | |
| EM120 (for'd UIC) | | |
| TOPAS (for'd UIC) | | |
| EPC plotter (used with TOPAS) | | |
| EK60 (mid UIC) | Y | Ok – Usual interference from Doppler log (esp. shallow water) and metalwork cleaning/ needle gunning when used. |
| HP deskjet 1 (used with EK) | | |
| HP deskjet 2 (used with EK) | | |
| SSU (for'd UIC) | Y | EK60 given priority set on 2sec ping interval on EK60 machine. ADCP and EA600 set to TX pulse i.e. all echosounders transmit simultaneously. |
| 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) | | Usage attempted with transponder on towed body. Average angle probably about 45 degrees. Very disappointing performance – see Peter Enderlein. |

OCEANLOGGER

| Instrument | Used? | Comments |
|---|-------|----------|
| Main logging PC hardware and software | Y | Ok |
| Barometer (back of logger rack) #V145002 (7/03) | Y | Ok |
| Barometer #V145003 (7/03) | Y | Ok |
| Barometer #Y2610005 | | |
| Barometer | | |

| | | |
|---|---|--|
| #W4620001 | | |
| Air humidity & temp (for'd mast) #15619015 | | Still only one in place. See previous report for attempt at replacement. Spare on bench in workshop. |
| Air humidity & temp #15619025 | | |
| Air humidity & temp #28552023 (HT1, 7/03) | | |
| Air humidity & temp #18109036 (HT2, 7/03) | | |
| Thermosalinograph SBE45 (prep lab) #0130 | Y | Ok |
| Thermosalinograph SBE45 # 4532920-0072 | | |
| Thermosalinograph SBE45 #4524698-0018 (7/04) | | |
| Fluorometer (prep lab) | Y | Lamp failing – very noisy and poor data for first part of cruise – not sure how long this had been faulty. Lamp replaced 3/2/08. All ok now. |
| TIR sensor (pyranometer) (for'd mast) #990684 | | TIR sensors in place unknown but ok. |
| TIR sensor #32374 (TIR1, 7/03) | | |
| TIR sensor #990685 | | |
| TIR sensor #011403 (TIR2, 7/03) | | |
| PAR sensor (for'd mast) #990069 | | PAR sensors in place unknown but ok. |
| PAR sensor #990070 | | |
| PAR sensor #30335 (PAR1, 7/03) | | |
| PAR sensor # 010224 (PAR2, 7/03) | | |
| Flow meter (prep room) #45/59462 | Y | Ok |
| Uncontaminated seawater temp (transducer space) | Y | Concerns expressed from oceanographers again regarding offset and calibration. Hugh Venables advised to contact Richard Bridgeman. |

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 | Ok |

| | | |
|--|---|--|
| Underwater unit SBE9plus #09P15759-0480 Press #67241 | | |
| Underwater unit SBE9plus #09P20391-0541 Press #75429 | Y | Ok |
| Underwater unit SBE9plus #09P30856-0707 Press #89973 | | Returning to Cambridge - airfreight |
| Underwater unit SBE9plus #09P35716-0771 Press #93686 | | |
| Carousel & pylon SBE32 #3215759-0173 | | 24-bottle carousel and frame used from NOC |
| Carousel & pylon SBE32 #0248 | | |
| CTD swivel linkage | Y | Ok |
| CTD swivel S/N196115 | Y | Ok |
| CTD swivel S/N196111 | | |

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

| | | |
|----------------------------------|---|-----------|
| Temp sensor SBE3plus #03P2191 | | |
| Temp sensor SBE3plus #03P2307 | Y | Secondary |
| Temp sensor SBE3plus #03P2366 | Y | Primary |
| Temp sensor SBE3plus #03P2679 | | |
| Temp sensor SBE3plus #03P2705 | | |
| Temp sensor SBE3plus #03P2709 | | |
| Temp sensor SBE3plus #03P4235 | | |
| Temp sensor SBE3plus #03P4302 | | |
| Cond sensor SBE4C #041912 | | |
| Cond sensor SBE4C #041913 | | |
| Cond sensor SBE4C #042222 | Y | Secondary |
| Cond sensor SBE4C #042248 | | |
| Cond sensor SBE4C #042255 | | |
| Cond sensor SBE4C #042289 | Y | Primary |

| | | |
|------------------------------|---|-----------|
| Cond sensor SBE4C #042813 | | |
| Cond sensor SBE4C #042875 | | |
| Pump SBE5T # 54488 | Y | Primary |
| Pump SBE5T # 54458 | Y | Secondary |
| Pump SBE5T # 52371 | | |
| Pump SBE5T # 52395 | | |
| Pump SBE5T # 52400 | | |
| Pump SBE5T # 53415 | | |

CTD contd

| Instrument | Used? | Comments |
|--|-------|--|
| Fluorometer Aquatracka MkIII #088216 | Y | Water ingress in optical section. Returning to Cambridge - airfreight. |
| Fluorometer Aquatracka MkIII #088249 | Y | Replaced #216 on 17/1/08. Ok |
| Standards Thermometer SBE35 #3515759-0005 | | |
| Standards Thermometer SBE35 # 3527735-0024 | Y | Ok |
| Standards Thermometer SBE35 # 3535231-0047 | | |
| Altimeter PA200 #2130.26993 | Y | Noisy – poor performance. Needs to be repaired. |
| Altimeter PA200 #2130.27001 | Y | Replaced #26993 on 16/1/08. Ok |
| Transmissometer C-Star #CST-396DR | | |
| Transmissometer C-Star #CST-527DR | | |
| Transmissometer C-Star CST 846DR | Y | Ok but difficulty in measuring a static Vair. |
| Oxygen sensor SBE43 #0242 | | |
| Oxygen sensor SBE43 #0245 | Y | Ok |
| Oxygen sensor SBE43 #0620 | | |
| Oxygen sensor SBE43 #0676 | | |
| PAR sensor | | |

| | | |
|---------------------|---|----|
| #7235 | | |
| PAR sensor #7252 | | |
| PAR sensor #7274 | Y | Ok |
| PAR sensor #7275 | | |

| | | |
|---|--|--|
| Notes on any other part of CTD e.g. faulty cables, wire drum slip ring, bottles, swivel, frame, tubing etc. | | 24-bottle NOC frame and carousel used along with two LADCP units. Fault in wire occurred 16/1/08 – 200m removed from wire and then reterminated. Undetermined whether fault was due to manufacturing fault or spooling gear fault. |
|---|--|--|

AME UNSUPPORTED INSTRUMENTS BUT LOGGED

| Instrument | Used? | Comments |
|----------------------------------|-------|----------|
| EA600 (bridge and UIC remote) | Y | Ok |
| Anemometer | | |
| Gyro | | |
| DopplerLog | | |
| EMLog | | |
| CLAM winch monitoring system | Y | Ok |

| Instrument | Cleaned? |
|----------------------------|----------|
| Oceanlogger | Y |
| EM120, TOPAS, NEPTUNE UPSs | Y |
| Seatex Seapath | N |
| | |
| | |

16.2.1 Down wire net monitor

Although this is not JCR ships fit, it would be prudent to mention it here due its development by AME. The DWNM version 3 prototype developed during the latter half of 2007 was used for JR177. It has performed well considering the limited time resources. Problems encountered were due to two reasons: faulty underwater connectors and shock from two accidental drops to the deck. The latter caused breaks on the stripboard used for the prototype electronics, and component disconnections. The underwater connection problems were due to old, damaged or worn out

connectors for which there were no spares as well as a few new connectors which suffered from the frequent disconnection and reconnection they were subjected to by moving the DWNM between three pieces of equipment.

Many improvements have been noted and will be implemented in time for next year. More than one DWNM unit will be made so that swapping will not be necessary. Spare cables will be made or purchased, as well as spare connectors and new connectors for those already worn.

A number of slight changes with the electronics and software will be made from the results of this cruise. The main intended change is to fit a battery into the DWNM housing to supply power to the motor actuators, specifically to overcome the problem of the RMT25 being used on the much higher resistance 17mm wire. The poorly chosen nickel batteries can then be removed from the RMT25 release mechanism. Additional notes and recommendations for change / future work

16.3 Items to be purchased/added to database:

Previously not on database

Large scissors x 2 (+1 for immediate use in workshop)

Solder flux pen x 1 (+1 for immediate use in workshop)

Desolder braid x 1 (+1 for immediate use in workshop)

IC test clips (8,14,20 way) x 1 of each (+1 of each for immediate use in workshop)

Belt strap (for opening cylindrical underwater housings) x 1 (+1 for immediate use in workshop)

Approx 30cm circumference stainless steel jubilee clips (hose clamp) x 5

On database

Medium adjustable spanner 8" x 2 (increase database stock level) (+2 for immediate use in workshop)

Large adjustable spanner 12" x 2 (increase database stock level) (+2 for immediate use in workshop)

Suggestions for additional items

Portable phone for workshop (current phone muffled)

0-2000m archival depth logger (to attach to confirm depth sensor operation)

16.3 ICT Report

Jeremy Robst

16.3.1 Personal Computers

JCR-DPREP-D4's power supply died and was replaced. JCR-DPREP-D3 refused to power on a few times, but currently appears to be working.

16.3.2 Netware

There were no problems with Netware during this cruise.

16.3.3 Unix

There were no problems with the unix systems during the cruise. A new virtual machine JRLC was created for linux development work and was connected to the data network.

16.3.4 SCS Logging System

Data Acquisition Events

| Date / Time (GMT) | Event / Reason |
|--------------------------|--|
| 14:00 28/12/2007 | New Leg - acquisition Started |
| 21:00 – 21:30 31/12/2007 | Logging restarted 3 times to get new Netmonitor stream in scs.cfg & definition correct. |
| 02/01/2008 | JCR-SCS-S2 setup and used to log minipack stream as JCR-SCS-S1 did not have enough spare variables to log the stream. |
| 19:01 06/01/2008 | Logging restarted twice attempting to get Truewind to work but was unsuccessful. |
| 11:16 08/01/2008 | JCR-SCS-S2 tardis time sync changed to use JCR-SCS-S1 as JCR-SCS-S2 doesn't have GPS input when being used as secondary SCS. |
| 16:09 08/01/2008 | Restarted JCR-SCS-S2 logging to correct minipack variable names. |
| 14:32 13/01/2008 | JCR-SCS-S2 logging restarted to correct minipack variable names. |
| 16:23 15/02/2008 | JCR-SCS-S1 logging restarted to fix corruption in the Ashtech ACO file. |
| 20:51 16/02/2008 | JCR-SCS-S1 locked up – all streams red. Restarting logging fixed problem. |

16.3.5 Network

Both CODIS routers had memory, flash and OS upgrades during the cruise.

16.3.6 Other

Two UPSes died during the trip and there are no spares left.

16.3.7 Work to be done/Recommendations

The UPS situation in the computer office is very poor and should be the focus of the work done in the summer 2008 refit. A reorganisation of the racks in the computer office should be done at the same time.

The SCS data logging system is struggling to cope with the number of streams being logged, at the least it should be upgraded to the latest version of a new logging system should be installed.

The V240 Sun servers should probably be replaced with Linux servers – the Linux virtual machine JRLC is about twice as fast as a V240 and with the NetApp NAS there is no longer a need for Sun servers.

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 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 acknowledgement for doing so. I cannot emphasise enough how this technology will 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 processed data, especially if the specialist scientist is not on that particular cruise; for example, an oceanographer 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 back

immediately as a low priority process over BASnet.

A proof of concept, targeting instrumentation used 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 provide
 - a. a succinct overview,
 - b. enough detail to perform initial analysis and suggest alteration to the collection parameters
 - c. an improvement to the turn around time of the raw data and the overall scientific output. It is important to emphasise 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 several 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.

17 Appendices

17.1 Iron availability and effects on phytoplankton communities in contrasting production regimes of the Scotia Sea: a seasonal perspective.

Rebecca Korb¹, Eric Achterberg², Tom Bibby², Christopher Moore², Maria Nielsdottir², Mick Whitehouse¹ (¹British Antarctic Survey, ²National Oceanography Centre Southampton).

Objectives: We propose to make high resolution measurements of dissolved iron (Fe) and Fe speciation in the Scotia Sea during the austral summer of 2008. In addition, we will establish the photosynthetic response of natural phytoplankton communities to gradients in Fe availability. The fieldwork will be sited in areas of contrasting primary productivity; the high nutrient, low chlorophyll waters (HNLC; low productivity) typical of the central Scotia Sea to bloom conditions (high productivity) near to the island of South Georgia. A sound understanding of the role of Fe availability throughout the growing season and its control on primary production are key requirements for modelling the dynamics of Southern Ocean ecosystems and assessing their significance for biogeochemical cycles on a global scale. This proposal complements the BAS science programme, Discovery 2010, (Southern Ocean Ecosystem Processes).

Underlying rationale: Fe is a key factor limiting phytoplankton production in HNLC waters of the Southern Ocean and thus plays a critical role in carbon cycling and potentially climate modification. *In situ* Fe-addition experiments have been important in confirming the control of Fe on primary productivity [1]. However, there are a number of artefacts associated with such experiments and the blooms produced are relatively short term events [2]. Recently there has been a move by the scientific community to examine systems that are naturally enriched with a continual supply of Fe resulting in blooms lasting in the order of months. Although much of the Southern Ocean is characterized as HNLC type water, there are areas naturally enriched in Fe and highly productive. For example, enhanced chlorophyll and dissolved Fe concentrations have been reported in the wake of the Kerguelen archipelago [3]. Another candidate area is the Scotia Sea. Along the Scotia Arc it is likely that complex local bathymetry introduces Fe into the euphotic zone [4]. The island of South Georgia regularly supports spatially and temporally intense phytoplankton blooms [5]. In addition, nitrate and ammonium depletion in this region point to high nitrate utilisation indicative of an Fe replete system [6]. While the BAS science has highlighted the likely role of Fe at South Georgia, there are few direct measurements of Fe in the Scotia Sea. Key questions remain as to how and where Fe reaches surface waters, its availability throughout the growing season and how it might affect the phytoplankton community. It is possible that Fe is not uniformly available to phytoplankton throughout the year and that high diatom-dominated growth during the summer leads to Fe depletion in surface waters. In this case a shift in community composition might be anticipated and picoplankton could dominate the system. Such a switch in the phytoplankton community would have major biogeochemical

consequences as far as food availability for grazers and ultimately carbon export to the deep ocean.

The first of the Discovery 2010 cruises (JR161) took place during the austral spring of 2006. Part of this cruise involved a highly successful collaborative project with NOC to map concentrations of Fe across the Scotia Sea and to investigate effects on phytoplankton communities. Continuation of this work over the next field season, in the austral summer of 2008, will provide a unique seasonal aspect to understanding the role of Fe in shaping phytoplankton communities. The work will provide important information to the BAS FOODWEBS hypothesis that “the HNLC and productive parts of the Antarctic Zone waters support fundamentally different types of food web” and which aims to examine food web structure and controlling influences throughout the seasons.

Methods: At stations, Fe profiles of the water column will be sampled by deploying trace metal clean GoFlo bottles to 1000 m depths. Deployments will be made from the midships gantry. Bottles will be removed from the deployment wire and transported to a clean chemistry container for analysis. When the ship is transecting between stations, surface waters will be collected using a trace metal clean towed fish (towfish) supply at a depth of ~5m. The instrument will be deployed from a davit on the aft starboard quarter. The towfish itself is non-mechanical and a Teflon diaphragm pump will be used to pump water from the towfish into a clean chemistry container sited on the aft deck of the ship. All Fe measurements will take place inside the clean chemistry container. Dissolved Fe (<0.2 µm fraction) analyses will be determined on-board ship as Fe(III). In addition, samples will be filtered using 0.02 µm pore size membrane filters, with subsequent dissolved Fe analysis in the UK at NOC. The concentration of dissolved Fe binding ligands (<0.2 µm), with their conditional stability constants, Fe(III)' and free Fe(III) concentrations will be determined using cathodic stripping voltammetry.

Variable fluorescence (FRRF) techniques, using water collected with the GoFlos, will be used to measure the physiological status of the phytoplankton community and will be directly comparable to measured, ambient Fe availability. In addition, on-deck bioassay incubation experiments will be conducted at stations. Water collected with the towfish will be dispensed into trace metal clean bottles and differing concentrations of the potentially limiting nutrients Fe and silicic acid will be added. The bottles will be placed in incubators sited on the aft deck and cooled with running seawater. During the course of the experiment (~15 days), changes in nutrient concentrations, phytoplankton taxonomy, primary productivity, photo-physiology, pigments, carbon and nitrogen content of the phytoplankton communities will be assessed.

Resources: Financial support is required for travel, training and field clothing to enable two researchers to participate in cruise JR177. The work will require a UKORS trace metal clean container to be sited on the aft deck, and a UKORS GoFlo system to be deployed from the midships gantry. The towfish and equipment for the Fe analysis are the personal equipment of Dr. Achterberg.

Presentation and stewardship of results: Results will be presented at international conferences and published in peer-reviewed journals. The data acquired during the

cruise will be archived at the British Antarctic Survey and a copy lodged with the British Oceanographic Data Centre.

References :

de Baar & others, 2005. Synthesis of iron fertilization experiments: From the iron age in the age of enlightenment. *Journal of Geophysical Research-Oceans* 110, doi: 10.1029/2004JC002601.

Boyd PW & others, 2007. Mesoscale iron enrichment experiments 1993-2005: Synthesis and future directions. *Science* 315: 612-617.

Blain S & others, 2007. Effect of natural iron fertilization on carbon sequestration in the Southern Ocean. *Nature*. 446:1070-1074.

Holm-Hansen O & others, 2005. Deep chlorophyll a maxima (DCMs) in pelagic Antarctic waters. II. Relation to bathymetric features and dissolved iron concentrations. *Marine Ecology-Progress Series* 297: 71-81

Korb & others, 2004. SeaWiFS in the southern ocean: spatial and temporal variability in phytoplankton biomass around South Georgia. *Deep Sea Res. Part II*. 51 (1-3): 99-116.

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17.2 AFI_CGS_pCO2_case for support

IN CONFIDENCE

NATURAL ENVIRONMENT RESEARCH COUNCIL, POLARIS HOUSE,
NORTH STAR AVENUE, SWINDON SN2 1EU

Tel: 01793 411500 Fax: 01793 411616

BRITISH ANTARCTIC SURVEY, HIGH CROSS, MADINGLEY ROAD,
CAMBRIDGE CB3 0ET

Tel. (AFI Coordinator, direct line): 01223 221537 Fax: 01223 221330

ANTARCTIC FUNDING INITIATIVE – COLLABORATIVE GEARING SCHEME (CGS) PROPOSAL

Please follow the instructions on this form carefully, as failure to do so may disqualify your bid. One signed copy of the completed form should be sent to the AFI Coordinator at BAS, and an electronic version e-mailed to afibas@bas.ac.uk. Bids must be accompanied by a supporting, signed statement from the Principal Investigator of the associated BAS core programme project. For further information, please refer to: <http://www.antarctica.ac.uk/afi/cgs.php>. Information about the BAS core programme is provided at: http://www.antarctica.ac.uk/BAS_Science/programmes2005-2010.

Bids may be submitted at any time of year, but **names of proposed field personnel must be submitted to the AFI Coordinator no later than 30th June preceding the intended field season.**

Reference: **CGS-8/** (for AFI Office use only)

| | | | |
|--|---|--|--|
| 1. Investigators: | Principal Investigator Dorothee Bakker | Co-Investigator 1 Angus Atkinson | Co-Investigator 2 Nick Hardman-Mountford |
| 2. Current post & period held: | Research Officer, 01/01/2006 to date; at UEA since 08/1998 | Marine Ecologist 1984 to present | CASIX Project Scientist, 2003-date |
| 3. Department / Institution Address: | School of Environmental Sciences University of East Anglia Norwich NR4 7TJ | British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 0ET | Plymouth Marine Laboratory, Prospect Place, Plymouth, PL1 3DH |
| 4. Telephone number: Fax number: E-mail address: | 01603-592648 d.bakker@uea.ac.uk | 01223 221306 aat@bas.ac.uk | 01752 633429 nhmo@pml.ac.uk |

5. TITLE OF RESEARCH PROJECT (Do not exceed 200 characters)

Quantifying carbon drawdown and seasonal uptake across a major Southern Ocean carbon sink

6. ABSTRACT The Southern Ocean is important for the earth's climate, but lack of sampling here means that we know little of its role in mitigating the buildup of atmospheric CO₂. Drawdown of CO₂ into the ocean is driven by the difference in the partial pressure of CO₂ (pCO₂) between the atmosphere and the ocean. Novel pCO₂ instruments have recently been fitted to the NERC fleet to measure this. After a first and successful CGS-funded field season (2006/2007) to tailor the system for use aboard *James Clark Ross*, we apply here to send Elizabeth Jones from the University of East Anglia (UEA) down south again, on cruise JR177. This is the main Discovery 2010 summer cruise, in Jan-Feb2008. We aim to a) compare the *JCR* pCO₂ system against an established UEA sensor, and b) collect vertical profile data to quantify mechanisms of biological C uptake, thus supporting BAS core science objectives for this process cruise.

7. ACCESS TO BAS LOGISTIC SUPPORT

Please indicate *likely requirements* of access to BAS logistical support. Note that requests for logistical resources significantly in excess of those already committed to the BAS Core Programme cannot be considered.

This proposal is to link to and to complement BAS core science aboard *James Clark Ross* (JCR) without requiring additional ship time or significant extra logistical support (see MOU section below).

The bid is only for flights, transit and accommodation on cruise JR177 for 1 scientist: Elizabeth Jones (University of East Anglia) plus costs for associated training and clothing/PPE required for Antarctic fieldwork.

Two pCO₂ sensors will be inter-calibrated on JR 177. These will be housed side by side in the main lab. The JCR's sensor was used last year and will require the same level of logistical support (see MOU section). The UEA system is self-contained and will not need BAS logistical support, except advice on the best location for the installation of UEA sensors and calibration of the ship's sea surface temperature sensor.

MOU issues

The pCO₂ system for use aboard *JCR* is from CASIX, the Centre for observation of Air-Sea Interactions and Fluxes, Plymouth. BAS support of this CASIX pCO₂ system on the last Antarctic field season (and the CGS bid) was agreed by Directorate on a one-season only basis, with further support pending successful completion of the field season. With the recent return of the *JCR* to the UK this MOU has expired. Angus Atkinson, Steve Bremner, Richard Bridgeman (AME), and Johnnie Edmonston (ICT) are presently assessing the likely future impacts on their resources of the pCO₂ sensor. This is to negotiate BAS's future longer term support during the whole of the *JCR*'s voyages south. However, whatever the outcome of this, it has been agreed that they will give full support to the CASIX instrument for cruise JR177 - whether in its present configuration or in an improved (more ICT-friendly) configuration. This will be covered by a MOU once these issues are resolved with CASIX.

8. ASSOCIATED PROJECT OF THE BAS CORE SCIENCE PROGRAMME

Please indicate which project of the BAS Core Programme the proposed research is intended to enhance.

In summary the benefits to BAS are:

1. Enhancement of BAS core science within Foodwebs project of DISCOVERY 2010
 2. Strategic improvement of *JCR* as a state-of-the-art research platform.
 3. Providing the longer term monitoring pCO₂ data needed to quantify CO₂ air-sea fluxes and validate large scale biogeochemical models.
-

The BAS Foodwebs project addresses the energy flows in probably the largest single carbon sink in the open Southern Ocean. However while this project examines the controls on net community / primary production (including iron, in a collaboration with the National Oceanography Centre Southampton, NOC) and its export to the deep ocean, it lacks measurements of inorganic carbon drawdown. By adding this component, the BAS cruises will be ideal opportunities to gain a more complete understanding of the carbon flow through the system. UEA is internationally renowned in the study of air-sea CO₂ fluxes and part of a strategic alliance with BAS. It is a partner in the Centre for observation of Air-Sea Interactions and Fluxes (CASIX), a NERC Centre of Excellence for studying the exchange of CO₂ between the ocean and the atmosphere.

9. BRIEF SCIENTIFIC CASE

Present atmospheric concentrations of carbon dioxide (CO₂) have reached a level not exceeded during at least the past 650,000 years (Cicerone et al. 2004, Siegenthaler et al. 2005). The ocean is one of the largest natural reservoirs of carbon and has buffered the increase in atmospheric CO₂ by absorbing about half of the CO₂ released from all human activities since 1800 (Sabine et al., 2004). The future rate of the oceanic CO₂ uptake is unknown and is determined by physical and biological processes. The difference in the partial pressure of CO₂ (pCO₂) between the ocean and the atmosphere is the driving force for oceanic CO₂ uptake. The Southern Ocean (SO) is a critical region for our understanding of the global C cycle. First it is plausible that changes in Southern Ocean circulation were an important driver in the large drawdown in atmospheric CO₂ observed during the last four glacial cycles (Watson and Naveira Garabato, 2006). Second, the role of the modern Southern Ocean south of 50°S as a sizeable sink for CO₂ of around 0.4 Pg y⁻¹ (Takahashi et al., 2002) is under revision (Takahashi et al., in preparation). Furthermore it is estimated that the efficiency of the Southern Ocean CO₂ sink has decreased by 10% per decade since 1981 in response to an increase in Southern Ocean winds (Le Quéré et al. 2007). Future changes in climate and ocean circulation could potentially lead to a slowdown of anthropogenic CO₂ uptake in the Southern Ocean. Given the paucity of surface water pCO₂ data in the SO, we clearly need to increase our effort to better quantify the current CO₂ sink and to predict the future C cycle.

The Project

The largest predicted CO₂ sink in the SO is in the SW Atlantic sector, where the Antarctic Circumpolar Current (ACC) crosses the Scotia Ridge (Schlitzer 2002; Takahashi et al., 2002). This region, despite having by far the largest blooms in the ACC, has few pCO₂ measurements. The BAS Foodwebs Project of the DISCOVERY 2010 is targeting this area to understand mechanisms for its intense productivity (Korb et al., 2004). Elsewhere in the SO, iron-fueled diatom blooms promote significant (2-3 fold greater) CO₂ uptake compared to the iron-deficient surrounding waters (Bakker et al. 2005, 2007). Therefore collaboration between BAS and UEA/PML is a perfect way to quantify the impacts of the food web enhancement on surface pCO₂ and the overall C budget in the SW Atlantic sector.

BAS is comparing the predicted pCO₂ sink near South Georgia with adjacent regions of low productivity during cruises in austral spring, summer and autumn. CGS-

supported a successful initial season (austral spring) to troubleshoot initial operation of the state-of-the art CASIX pCO₂ sensor aboard JCR and collect additional measurements (Hardman-Mountford et al. 2007; Jones et al. 2007). This bid is to continue and strengthen this initiative by expanding the seasonal picture. It will support a pCO₂ instrument inter-calibration and the collection of vertical profiles of dissolved inorganic carbon and alkalinity to quantify the seasonal sink of CO₂ and the biological uptake of inorganic C across this area.

Objectives

- 1) *To quantify the accuracy and precision of the JCR's pCO₂ instrument from CASIX, by running a UEA pCO₂ instrument in parallel.*
- 2) *To make a seasonal comparison of the magnitude of the oceanic CO₂ sink.*
- 3) *To quantify the summertime biological carbon uptake across a major productivity gradient.*

Methods

Objective 1. Since the JCR's (CASIX) pCO₂ instrument is new and of novel design, it is essential to assess the accuracy and precision of the data at an early stage. This must be done *in situ* for this specific instrument, rather than for a sister instrument on another ship, as some aspects are ship- and SO-specific, for example accurate analysis of the warming between the seawater inlet and the equilibrator of the instrument is needed for accurate pCO₂. We have noticed a worrying temperature offset in the sea surface temperature of 0.3-0.5°C (Jones and Bakker, preliminary results; Kaiser, personal communication). There are also a few outliers in the atmospheric CO₂ data, probably due to the ship's stack. This CGS allows identification, quantification and rectification of these issues at an early stage of the instrument's deployment to allow proper quality control of previous and future data.

Objective 2. The underway surface water pCO₂ data will allow quantification of the oceanic CO₂ sink in summer. In addition, discrete samples will be taken from the CTD rosette for the analysis of DIC (total dissolved inorganic carbon, or TCO₂) and alkalinity. These analyses will allow calculation of pCO₂ in the winter mixed layer south of the Polar Front, where remnant winter water (with its remnant pCO₂ signal) persists below the summertime mixed layer. This will allow quantification of the summer and previous winter's CO₂ sink.

Objective 3 The design of JR177 is similar to that of the spring cruise, with transecting from the ice edge in the south, across low productive (iron-deficient) waters upstream of South Georgia to the massive bloom downstream of the island. Quantification of the DIC deficit at CTD stations during the summer cruise will enable testing the factor 2-3 difference between DIC uptake in productive and unproductive waters in one of the most productive and dynamic areas of the Southern Ocean. These measurements will be an integral part of our interpretation of food web enhancement of nutrient and energy fluxes across this area, the largest natural iron fertilization experiment in the ACC.

Personnel

The CGS bid is to fund participation of Elizabeth Jones, a PhD student from UEA

who was a successful recipient of the CGS bid on the preceding Discovery 2010 Process cruise (Jones et al., 2007). This proposed work will form part of her PhD, in an ongoing collaboration between BAS and the University of East Anglia She has a working knowledge of both the CASIX and the UEA pCO₂ instruments. BAS AME and IT support have benefited from knowledge gained on the previous field season. The work proposed is realistic and is within the scope of a PhD student. Objective 1 will be addressed throughout the cruise, in particular during transects without CTD stations. Objectives 2 and 3 require sampling from selected CTD casts at different sites. Sampling and fixing the samples will take approximately 1 hour per CTD cast. Collaboration with Co-PI, Angus Atkinson, will facilitate 24 h coverage of CTD sampling. In addition, Angus Atkinson will offer general help and guidance.

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10. SIGNATURES

| To be signed by: | Signature: | Date: |
|---|-------------------|--------------|
| Principal Investigator (project proposer): | | |
| BAS Head of Science Division (if the proposal is led by a Principal Investigator from BAS): | | |

The proposal must be accompanied by a signed letter of support from the Principal Investigator of the associated core programme project at BAS.

17. 3 Part 1. Gene function in Antarctic krill: determining the role of clock-genes in synchronised behavioural patterns (Ref.: AFI Nov 2004 OB7/06)

PREVIOUS TRACK RECORDS.

Dr E Rosato (ER) and **Prof CP Kyriacou (CPK)** have collaborated on several aspects of circadian molecular biology providing a number of significant contributions to the development of this area. For over a decade they have been studying the implications of natural variation in circadian clock genes in *D. melanogaster*. They have examined the spatial patterning in Europe of the Thr-Gly repeat variants encoded within *period* (Rosato et al. 1997 *Genet. Res.*, 69, 89-99; Peixoto et al. 1998, *PNAS*, 95, 4475-4480; Sawyer et al. 1997, *Science*, 278, 2117-2120) and the polymorphism that generates two length isoforms of TIMELESS protein via alternative methionine initiators (Rosato et al. 1997, *NAR*, 25, 455-457; Tauber et al. & Sandrelli et al., submitted to *Nature*). This work was performed with EC (CPK, R Costa), BBSRC (CPK) and NERC (CPK, ER) grants. Furthermore, Rosato and Kyriacou have studied the evolution of circadian gene regulation using the housefly *Musca domestica* as a comparative model species (Piccin et al. 2000 *Genetics*, 154, 747-758; Donzel et al., in prep), with funding from BBSRC (David Phillips Fellowship to ER), EC (CPK, R Costa) and the Wellcome Trust (CPK, ER).

Rosato and Kyriacou have also contributed to more general aspects of the field with a particular interest in entrainment. They have studied the molecular biology of cryptochrome, the dedicated blue-light circadian photoreceptor (Rosato et al. 2001, *Curr. Biol.*, 11, 909-917) and were able to discriminate functional differences between the subsets of circadian pacemaker cells in the fly brain (Dissel et al. 2004, *Nature Neurosci.* 7, 834-840). They have also shown that a novel extraocular light-pathway, independent from CRY, is operating in flies and were among the first to demonstrate that the eyes and the underlying optic lobes are the primary structures responsible for normal masking behaviour and for the morning peak of locomotor activity (Zordan M et al. 2001 *J. Neurogenet.*, 15, 97-116). Finally they have examined the input of light and temperature to the *per* splicing mechanism that provides seasonal changes to the circadian behaviour of *Drosophila* (Collins et al., 2004, *PNAS*, 101, 1945-1950). This work was supported by a David Phillips Fellowship to ER and a BBSRC grant to ER and CPK.

Rosato and Kyriacou are currently investigating the circadian, tidal and reproductive biology of two intertidal organisms, the King ragworm, *Nereis virens*, with Prof P Olive (Newcastle), and the marine woodlouse, *Eurydice pulchra*, with S. Webster (Bangor) and M Hastings (Cambridge). Transcriptomic as well as conventional approach have been used to the analysis of these rhythmic phenotypes. The work is funded by a NERC (*Nereis*) grant to PO, CPK and ER and a BBSRC (*Eurydice*) grant to CPK and SW. Both projects are about two years into their tenure. Pivotal to this study has been a BBSRC funded project to Prof Kyriacou and Dr M Hastings (Cambridge), which resulted in the first comprehensive transcriptome study of the mouse circadian clock (Akhtar et al. 2002 *Curr. Biol.*, 12, 540-550).

Dr T Gaten has been studying the structure and function of the eyes and peripheral nervous systems of crustaceans for over 20 years. In particular he has investigated morphological and physiological adaptation to light in the deep-sea environment. This has included work on benthic lobsters (Chapman et al., 2000 *Mar Biol*, 136, 233-241; Johnson et al., 2000 *Mar. Biol.*, 136, 243-248), hydrothermal vent shrimps (Herring et al., 1999 *Nature*, 398, 116) and mesopelagic decapods (Johnson et al., 2000 *Biological Bulletin*, 199, 6-13; Shelton et al., 2000 *Crustacean Issues*, 12, 253-260; Johnson et al., 2002 *J. Mar. Biol. Ass.*, 82, 835-842; Gaten et al., 2002 *Acta Zool.*, 83, 221-230; Gaten et al., 2003 *J of Morph.*, 257, 87-95; Gaten et al., 2004 *Mar. Biol.*, 145, 499-504) including krill (Thomasson et al., 2003 *Mar. Ecol. Prog. Series*, 250, 205-213). This work has involved a combination of laboratory-based research at Leicester, and fieldwork off the West coast of Scotland, in Swedish fjords and in the eastern Atlantic Ocean (aboard *RRV Discovery*).

Recently Dr Gaten became interested in circadian biology and he is collaborating with Dr Rosato on aspects of the functioning of the circadian clock using various approaches including immunocytochemistry and immunoelectron microscopy. Although most of the work has been carried out on *Drosophila*, Dr Gaten has performed some preliminary investigations into northern krill, *Meganyctiphanes norvegica*.

Dr G Tarling is a joint-coordinator of the future British Antarctic Survey project FLEXICON, which will parameterise and model life-history strategies of Antarctic marine organisms. He has built up vast expertise in plankton ecology during his doctoral and post-doctoral studies, participating in the highly rated EU MAST III project PEP on the physiological ecology of Northern krill, and being awarded a prestigious NERC Fellowship to investigate the biophysical interactions of a Scottish fjord (completed in 2002). Relevant recent publications include: Tarling et al., 2004. *Mar. Ecol. Prog. Ser.*, 272, 165-181; Schmidt et al., 2004 *Mar. Ecol. Prog. Ser.*, 281, 131-143; Cuzin-Roudy et al., 2004 *ICES J. Mar. Sci.*, 61, 721-737; Burrows & Tarling 2004 *Mar. Ecol. Prog. Ser.*, 277, 209-220; Tarling et al., 2003 *Mar. Ecol. Prog. Ser.*, 252, 307-310; Tarling 2003 *Mar. Ecol. Prog. Ser.*, 260, 173-188; Tarling & Cuzin-Roudy 2003 *Limnol. Oceanogr.*, 48, 2020-2033

Dr Tarling is currently part of the organising committee for the 6th International Crustacean Congress for which he will co-ordinate a symposium on Ecophysiology.

Dr. RS Shreeve is a marine ecologist in the current DYNAMOE Programme, (Dynamics and Management of Ocean Ecosystems), primarily working on two key zooplankton groups, krill (Arnold et al., 2004 *Limnol. Oceanogr.*, 49, 2152-2161) and copepods (Shreeve et al., 2002 *Mar. Ecol. Prog. Ser.*, 233, 169-183; Irigoien et al., 2002 *Nature*, 419, 387-389; Tarling et al., 2004 *Mar Ecol Prog Ser*, 272, 165-181) and their interactions (Ward et al., 2002 *Deep Sea Res.*, 49, 2183-2202; Priddle et al., 2003 *J. Geophys. Res.*, 108(C4), 8082; Ward et al., 2003 *Mar. Biol.*, 143, 121-130). She has extensive experience as a marine biologist, especially designing and running shipboard experiments, and microanalytical work. Dr Shreeve is on the council of the Challenger Society for Marine Science, and is a coordinator for a biophysical interactions special interest group.

Dr A Rogers is the Programme Leader for the current ABPPF Programme (Antarctic Biodiversity; Past, Present and Future) and the future BIOFLAME Programme

(Biodiversity; Functions, Limits and Ecology from Molecules to Ecosystems). He has extensive experience in marine biology, especially of nearshore marine and deep-sea environments and molecular biology. Relevant recent publications include: Rogers & Lambhead 2004 In: Cook & Hunt (Eds), *Proc. IV Int. Cong. Nematology*, pp. 761-774; Francisco et al., 2004 *J. Mar. Biol. Ass.*, 84, 1077-1084; Howell et al., 2004 *Mar. Biol.*, 144, 977-984; Clark et al., 2004 *Comp. & Funct. Genom.* 5, 230-238; Le Goff-Vitry et al. 2004 *Mol. Ecol.*, 13, 537-549; Le Goff-Vitry et al., 2004 *Mol. Phylog. & Evol.*, 30, 167-177. Dr Rogers has also published major works for the World Conservation Union, World Wildlife Fund for Nature and Greenpeace. Dr Rogers is on the Council of the Linnean Society of London, the Committee for Environmental Sustainability for the Biosciences Federation, is a High Seas Advisor for the WCPA Task Force on Marine Protected Areas in the High Seas and is on the Steering Committee of the recently funded Framework 6 Marine Genomics Network of Excellence.

Competitiveness and expertise

Our work is internationally competitive, we publish in the top general magazines (*Nature*, *Science*, *PNAS* and *Curr Biol.*) as well as in good specialised journals. This reflects not only the quality of the research groups, but also the environment in which they operate. The Biology and Genetics Departments at the University of Leicester (LU) have scored full marks (5 and 5*, respectively) at the last RAE. Through our work, and that of other colleagues, Leicester is internationally recognised as a centre for chronobiology and photoreceptor research and enjoys a long-established reputation in these fields. BAS has a long and distinguished history of carrying out research and surveys in the Antarctic and is a world-leader in Southern Ocean ecology. In addition to its traditional role, BAS has recognised the importance of genetics and genomics research to tackle ecological problems that have worldwide implications. The Angel laboratory at BAS, with state-of-the-art facilities for functional genomics, is a clear signal of this new direction. Both teams, at LU and BAS, have extensive experience in ecology, evolutionary biology, molecular genetics and transcriptomics analysis, although each of them contributes a specific set of expertise. We envisage a very fruitful collaboration.

17.4 Part 2. Gene function in Antarctic krill: determining the role of clock-genes in synchronised behavioural patterns (Ref.: AFI Nov 2004 OB7/06)

RATIONALE

Introduction.

Antarctic krill (*Euphausia superba*) participate in the largest daily migration on earth, the swimming of billions of organisms from the interior of the ocean, where they have spent the day, to the ocean's surface for the duration of the night. Both food and predators are most abundant at the surface, so migrating to the surface at night allows these organisms to eat their daily requirement of food at a time when the predatory risk is lowest. Although the functional significance of diel vertical migration (DVM) is clear and its modulation by light has been described^{1,2}, the underlying mechanisms are yet to be fully resolved. The involvement of an endogenous circadian clock is extremely likely, as almost all organisms, from bacteria to humans, have the ability to predict and anticipate the daily variation in light, temperature and other variables. Endogenous rhythms play an important role in segregating non-compatible and physiological processes. Experimental evidence suggests the existence of such a rhythm in krill³.

The molecular dissection of circadian clocks reveals that they are generated from proteins that are able to feedback and inhibit their own transcription⁴. A molecular framework describing the circadian clock can be exemplified for the fruit fly *Drosophila melanogaster*. In flies, clock function is achieved by delaying the periodic expression of a set of negative autoregulators and of their corresponding positive activators. The key positive components are the protein products of the *Clock* (*Clk*) and *cycle* (*cyc*) genes that drive the rhythmic transcription of the *period* (*per*) and *timeless* (*tim*) genes. The kinases DOUBLETIME (DBT, also known as CASEIN KINASE I ϵ)⁵, CASEIN KINASE II (CKII)^{6,7} and SHAGGY (SGG, also known as GLYCOGEN SYNTHASE KINASE 3)⁸ introduce the necessary delay between the expression of positive and negative components by promoting degradation of the clock proteins. In the nucleus, PER and TIM form a negative feedback loop by directly interacting with CLK/CYC to inhibit their own transcription. As CLK/CYC can inhibit rhythmic *Clk* transcription but PER and TIM can repress the dimer, ultimately PER and TIM also act as positive elements in a second negative feedback loop which also includes the products of the *vri* (*vri*)⁹ and *Par Domain Protein 1* (*Pdp1*)¹⁰ genes. The molecular oscillators are synchronised with external environmental signals, primarily the light-dark cycle, and this entrainment is mediated by the blue light sensitive photoreceptor, cryptochrome (CRY)¹¹.

There is a homologous circadian clock in higher eukaryotes. Despite some divergence in structure and functions of individual molecular components, the two main genetic model organisms, the fly and the mouse, show striking similarities in their circadian mechanisms⁴. Moreover, in both model organisms, these genes are involved in the photoperiodic components of seasonal reproduction¹² and, at least in flies, provide a mechanism for latitudinal adaptation to changing light and temperature regimes¹³. The expression of clock genes establishes the pace of the oscillation, whilst clock-controlled genes (*ccgs*) bring about rhythmic changes in physiology and behaviour.

Microarray analyses have revealed hundreds of *ccgs* transcripts that cycle with circadian periods in flies^{14,15} and mammals^{16,17}, reflecting the output of the circadian oscillator to the tissues and organs.

Antarctic krill as a strategically important species

Antarctic krill is a keystone species in the Southern Ocean ecosystem, being the principal food item of many higher predators such as whales, seals, sea-birds and a major consumer of phytoplankton. Its success in the Antarctic is reflected in the large biomass levels, unparalleled anywhere else in the World's oceans. It has been commercially harvested since the 1960s and today is the subject of an active fishery by several nations¹⁸. The Commission for the Conservation of Marine Living Resources (CCAMLR), which came into force in 1982 to conserve marine life in Antarctica and monitor and advise on the harvesting of biological resources, manages the harvesting of krill stocks. The commission takes an ecosystem-based approach to managing the fisheries, and looks at the implications of harvesting on the populations of the numerous predators that depend on krill. Recent reports on the decline of Antarctic krill stocks²² have brought the importance of this managerial role into focus.

A major candidate for the observed decline in krill is the rapid changes that are underway in some parts of the Antarctic ecosystem. The speed of this change has been recognised by BAS and its impact on the Antarctic ecosystem will be a key research theme for the rest of this decade¹⁹ as well as a major focus for the International Polar Year (2007). The Antarctic Peninsular region is an area where changes have been particularly pronounced, with air-temperature increasing by 2.5°C over the past decade²⁰. The climatic change has coincided with a significant reduction in the amount of sea-ice in this region, which provides an important nursery for larval krill²¹. The 80% decrease in krill stocks over the past 80 years may be a direct result of these changes²² but the behavioural interaction between krill and its environment remains unclear.

The capacity of a species to adapt its behaviour to changing circumstances depends on its genetic variability. Although there have been several studies into this aspect in krill^{23,24}, our insight into relating this variability to behaviour has been limited. This proposal will use some of the latest advances in genomics to link krill behaviour with gene function. In particular, it will characterise the role of clock and clock-related genes, which are likely to dictate many of the synchronised behavioural patterns exhibited by krill.

Relating behaviour to gene expression is a new, rapidly emerging area of biological science. The task is demanding because it requires the behavioural ecology and molecular biology of a species to be investigated simultaneously. The University of Leicester is internationally recognised for its molecular studies on clocks whilst the British Antarctic Survey is a world-leader in Southern Ocean ecology. Combining the expertise of these two institutes will create a team capable of making important progress in this dynamic research area. In investigating the potential of an Antarctic krill to adapt to change, the research not only presents a valuable biological case study but also provides information that could be useful to the management of a commercially important stock.

The importance of synchronisation to krill

Krill is one of the largest holoplanktonic crustaceans. Its body size and constant need to keep swimming places a large demand on its energy intake and makes it particularly vulnerable to visual predation. Krill can increase their swimming efficiency and avoidance of predators through forming swarms^{25,26} but this strategy also has its costs, because swarming decreases the rate of feeding²⁷. The daily vertical migration (DVM) of krill from the ocean's interior in the day to the surface layers at night is possibly a more effective means of trading-off the need to eat with the avoidance of predators. When combined, swarming and DVM result in large numbers of krill moving upwards at dusk and downwards at dawn in a highly synchronised manner. Synchronisation between individuals may also be evident in physiological functions, such as moulting and spawning²⁸. However, it remains unclear how these different types of synchronisation are initiated and maintained.

A number of studies have suggested that the synchronisation of DVM between individuals is environmentally driven². Given that all metazoans contain circadian clocks⁴, it is likely that endogenous rhythms also play a synchronising role. It is known, for instance, that northern krill (*Meganyctiphanes norvegica*) shows an endogenous rhythm in locomotor activity in constant darkness. Once a light/dark cycle is introduced, the krill develop a marked preference for the bottom of the tank during the day and for the top of the tank during the night³. This suggests that the interplay of internal and external cues is an important process in controlling the timing of DVM and in synchronising the response of individuals.

Synchronisation with longer periodicities is evident in the moulting and spawning cycles of krill. Krill are obligate moulters and shed their exoskeleton every 2-3 weeks in the summer, increasing to a month or more in winter. Buchholz²⁸ found that Antarctic krill in the same swarm synchronised their moult cycles. This means that, if a swarm were followed through time, the majority of krill would moult within 1 or 2 days of each other. The pattern was also found in northern krill, where the concept could be extended to female spawning activity²⁹. Females of northern krill co-ordinate their moult and spawn cycles such that spawning only takes place at a certain phase of the moult cycle, just before moulting. Spawning occurs every other moult cycle, with reserves of new oocytes being built up in the intervening period³⁰. Tarling & Cuzin-Roudy²⁹ found that the synchronisation between individuals was such that eggs were released into the environment in regular pulses, with a periodicity of 20 to 26 days (Fig. 1). The initial trigger for this synchronisation was possibly the rapid onset of the spring phytoplankton bloom and the population remained synchronised for the rest of the summer. Ongoing research suggests that a synchronised pulsing of egg production may be common within swarms of Antarctic krill also (Fig. 1; ref.31). Synchronising the release of eggs will satiate predators, reducing the fraction that is preyed upon³². Moulting synchronisation could reduce the cannibalism of soft, newly moulted individuals by those that are still hard³³. Therefore, the process may be an adaptive strategy for a number of different reasons.

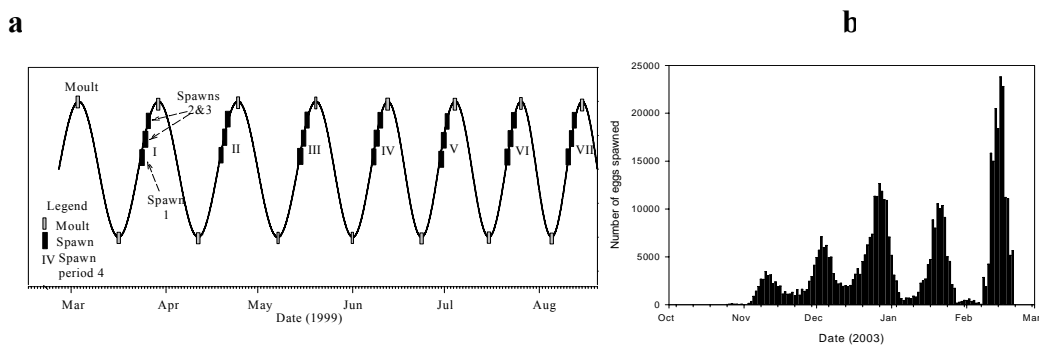


Fig. 1. (a) *Meganyctiphanes norvegica* reproductive cycles in the Clyde Sea during 1999, with a periodicity of around 20 to 26 days²⁹. (b) Estimated number of eggs released per day by 55 females of *Euphausia superba* at South Georgia in 2003, showing a periodicity of around 23 to 26 days³¹.

The periodicity of egg pulses is suggestive of a lunar influence³². Biological processes can entrain to a wide variety of periodicities, and lunar components are particularly important for marine organisms³⁴, especially for the synchronisation of reproduction^{35,36}. Synchronised behavioural patterns are ultimately governed by molecular mechanisms with an intrinsic rhythmicity but entrainable by external elements. They are extremely sensitive to environmental perturbations, leading to a complex set of consequences that would be difficult to predict. Knowing the fundamental mechanisms that govern krill behaviours enables a much better prediction of how they will respond if the environment changes.

OBJECTIVES AND METHODOLOGY

Aims and Objectives

The primary aim of the research is to identify rhythmic genes in Antarctic krill and answer fundamental questions regarding the function of these genes in circadian and moulting-spawning cycles. Specifically, our objectives are:

1. To identify the canonical circadian genes in Antarctic krill using conventional methods of screening.
2. To describe the temporal and spatial expression patterns of these genes.
3. To investigate circadian behaviour at the whole organism level.
4. To identify genes controlling moulting-spawning rhythmicity.

Proposed work and methodology

1. Identification of the canonical circadian genes in Antarctic krill

The group in Leicester University (LU) will use a degenerate-PCR approach to identify the canonical clock gene homologues in Antarctic krill, particularly *period* (*per*), *Clock* (*Clk*), *cycle* (*cyc*), *doubletime* (*dbt*), *vri* (*vri*) and *cryptochrome* (*cry*). This group has already identified almost all the canonical clock components in another crustacean, the sea louse, *Eurydice pulchra*, and so we shall have a flying start. We will design degenerate oligoprimers based on the most conserved regions of these genes and then use cDNA, produced from a pool of krill-heads collected at different time of day, to amplify PCR fragments. The true nature of these fragments will be established by sequencing and by “Blast” analysis. Concurrently, using the same pool of cDNA, the group based at the British Antarctic Survey (BAS) will produce a full-length transcript phage cDNA library. The PCR fragments identified as

part of circadian genes will be used to screen the library (BAS, LU), thus recovering the full sequence of these genes.

2. Description of the temporal and spatial pattern of expression of clock genes.

Temporal and spatial expression patterns of Antarctic krill clock genes will be studied using a combination of molecular and cellular approaches. Rhythms of transcription will be investigated using Quantitative Real Time PCR (Q-PCR, BAS) and *in situ* hybridisation (LU), the latter also reporting on the anatomical localisation of the brain pacemaker. Krill will be sampled during a cruise in October/November 2006.

Animals will be collected at different times of the day and either immediately frozen for Q-PCR analysis, or dissected, fixed and stored in methanol at -20°C , for *in situ* studies. We will use confocal imaging either with a fluorescent whole mount procedure or, if the brain is too large, on sections from paraffin-embedded brains. Only a selection of circadian genes will be investigated at the cellular level since we anticipate that it will be difficult to process many samples on board ship.

Whilst at sea, we will also entrain a large sample of freshly caught krill by maintaining them under constant temperature and light-dark (LD) regime to mimic the temperature and photoperiod in the natural environment. We will apply appropriate experimental light levels by monitoring DVM patterns (using on-board multi-frequency acoustics; EK60) and matching times and depths against atmospheric and downwelling irradiance profiles. Variable LED light sources will be used to simulate these changing light conditions. Catches will be entrained for about a week, after which time animals will be collected at regular intervals over the 24 h cycle. Thus, we will establish, in a controlled environment, the phase relationship between endogenous and external rhythms and provide a baseline for the experiments under constant conditions. After entrainment, krill will be subject to constant darkness (DD) which will allow us to study the free running properties of the molecular cycles and to distinguish between self-sustained and driven rhythmicity in different clusters of neurons, analogous to what has been reported for *Drosophila*³⁷. Some animals will be immediately frozen; others will be dissected and fixed for *in situ* studies. Some of the frozen and fixed specimens will also be used for protein expression studies. As soon as some circadian genes have been sequenced, we will produce antibodies to analyse cycling, phosphorylation and subcellular localisation of clock proteins at the molecular (Western blot) and cellular (immunohistochemistry and confocal imaging) level (Fig. 2).

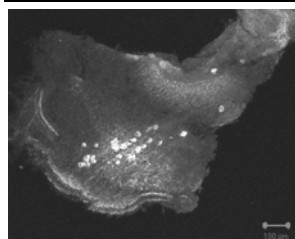


Fig. 2. Projection from 50 confocal sections of the optic lobe of northern krill, *Meganyctiphanes norvegica*, immunostained with anti-PDH antibodies. In crustaceans, the hormone PDH (Pigment Dispersing Hormone) affects body colour changes. However, its homologue in flies has a role as a circadian neuro-regulator necessary for rhythmic behaviour. This function might have been conserved in the central nervous system of Crustacea.

3. Investigation of circadian behaviour at the whole organism level.

It is likely that in Antarctic krill DVM is partly driven by external cues (negative phototaxis) and partly by endogenous changes. To investigate the contribution of the circadian clock to the control of DVM, we need to establish, under free running conditions, whether krill show an endogenous rhythm of locomotor activity and how the activity is expressed over time (periods of high and low activity) and space (the top or bottom of an experimental tank). These data need to be compared with similar experiments performed under LD cycles to distinguish between the influence of internal rhythms and external cues. Animals will be collected and initially maintained in conditions that reflect the natural environment with respect to temperature, photoperiod and light intensity. After this period of entrainment, we will measure locomotor activity initially under LD and then under DD for at least 10 days. This will determine whether there is a rhythm in locomotor activity (as expected) and enable us to calculate its period. For this purpose, we will use a locomotor activity monitor, built by the LU electronic workshop, based on a similar apparatus that is routinely used in our laboratory (ER, CPK) for studying the circadian activity of *Drosophila*. Briefly, a small acrylic tank, in which several animals may be maintained separately using partitions, will be fitted with infra-red (IR) emitter-receiver couples, one for each individual animal. The swimming of an organism across the IR beam will generate a signal that is recorded by a computer, resulting in the continuous and automated monitoring of the activity of each animal for the full duration of the experiment. The apparatus will be able to monitor about 60 animals simultaneously. These experiments will allow us to calculate the rhythm and the temporal profile of activity. To measure spatial distribution, we will use IR cameras, aided by IR LED illumination. We plan to use 4 tanks and 4 cameras simultaneously; a splitter will allocate a quadrant to each of the cameras on a screen and we will record the data either with a time lapse video, to be digitised subsequently, or immediately on a computer (using a digitizer). As before, experiments will be performed under LD and DD conditions.

Separately funded work on Northern krill, *Meganyctiphanes norvegica*, at Kristineberg Marine Station (Sweden) will take place prior to the Antarctic experiments, allowing procedures to be firmly established and providing comparative data.

4. Identification of genes controlling the moulting-spawning rhythmicity.

During the reproductive season, spawning and moulting are continuous and inter-related processes in krill, with periodicities of 20-30 days. Such events are commonly synchronised between individuals within populations, particularly females^{29,31}. We will investigate which genes have a role in the control of the physiological state changes responsible for cyclic variations in reproductive and moulting activity by producing subtractive-hybridisation libraries from appropriate temporally defined females. In the wild, the moulting-spawning cycle runs at different phases in different swarms³⁸. As it will be impossible to sample the same population repeatedly during the experimental cruise, we will capture a large number of individuals and keep them under entrainment conditions, as described above, for the full length of the moult cycle (between 10 and 20 days in females³⁹). Initially, we will assess the dominant moulting and spawning stage of the captured swarm. Then, we will sub-sample the incubated population every four days until incubation-day 20. The sub-samples will always be collected at the same time of day to avoid circadian effects. We will select for individuals showing clear signs of synchronisation. From each of these samples,

we will produce cDNA and, using a stringent subtractive-hybridisation protocol, we will subtract samples 0-12, 4-16, 8-20. This method will produce three libraries comprised of genes (probably only a few hundred for each library) that are differentially regulated during the moulting-spawning cycle. The three different subtractions will ensure that most of the relevant genes will be collected, as this procedure accounts for three potential phase relationships between the expression of the rhythmic genes and the physiological cycle. Sequencing will uniquely identify these genes and PCR copies will be spotted onto glass slides to produce a mini-microarray. Gene-spots will be replicated within the array to account for variation in hybridisation within slides. We will also include spots for external controls into the array design to allow using “spike-in” controls, i.e. adding for example bacterial cDNAs with known concentrations to the cDNAs isolated from the animals⁴⁰. We will then hybridise Cy₃/Cy₅ fluorophore-labelled cDNAs from different time points of the moulting/spawning cycle to characterise the temporal profile of the differentially expressed genes. All experiments will be replicated at least 5 times. In addition, at least two experimental treatments will include dye-swap experiments to account for experimental variation. The microarray will be available for future experiments to study the extent to which regional differences in reproductive periodicity involves differential regulation in these genes, which may reflect natural selection. Finally, this study will create the background for repeating the whole procedure with *Meganyctiphanes norvegica* providing a unique opportunity to investigate whether evolution has found one or multiple ways to establish the moulting-spawning cycle in krill.

Data Analysis

The array design and microarray data will be annotated according to the MIAME standard⁴¹. For the normalization of the microarray we will use external (“spike-in”) controls as well as endogenous transcript levels. This is because, if normalization is only based on endogenous genes, potential global shifts in messenger RNA populations can cause a deterioration of the results. This situation can occur especially if microarrays with small numbers of genes are used. External RNA controls will allow us to monitor such global changes and to determine changes in gene expression accurately⁴⁰. After normalisation the microarray data will be analysed using GeneSpring (SiliconGenetics, Redwood City, CA) and/or R/Bioconductor⁴² for genes, which are differentially expressed at one or more time points.

Choice of methodology

Our investigation is based on a combination of standard and state of the art methodologies, although all techniques outlined above are well developed. We believe that this combination of investigative tools will prove very powerful, providing a solid backbone of novel exciting data and the potential of extraordinary findings. The behavioural, cytological, and molecular analyses are routine within the LU laboratories. Genomic analysis will utilise the state of the art facilities held at the AnGel laboratory at BAS HQ

Management of project and resources and career development opportunities.

The overall project manager will be E. Rosato. The molecular aspects will be directed by E. Rosato and CP. Kyriacou at LU and by A. Rogers at BAS. G. Tarling and RS. Shreeve will direct the collection of krill. T. Gaten will lead the behavioural experiments and the anatomical dissections. G. Tarling will supervise the

identification, entrainment and sampling of the moulting-spawning cycles. However, the three scientists at sea will assist in all the various aspects of research. Finally, cellular and microscopy studies will be directed by T Gaten and E Rosato at LU.

The Leicester team have been successful in using cDNA microarray technology to investigate cycling gene expression in the mouse and in the marine organisms *Nereis viriens* and *Eurydice pulchra*, besides having a long-established reputation in the evolutionary/ecological analysis of clock genes in various dipteran species and in the morpho-physiological study of the visual system of crustaceans. The group in BAS has extensive experience on the ecology and physiology of krill and a keen interest in marine genomics. The work of the two research teams will be highly integrated and we plan frequent visits between the two centres. We will use these for transferring research material, for monitoring the development of the project and for providing an additional forum for the post-doctoral research assistants (PDRAs) to learn new skills. Exceptional training opportunities for all staff involved in this project (both at LU and BAS) will result from integrating their diversity of expertise.

Timetable and milestones

Objective 1. Years 1&2.

Degenerate PCR, cloning & sequencing (LU). cDNA library production, screening & sequencing (BAS)

Objectives 2-4. Year 1.

Cruise: Behavioural experiments. Collection of material for *in situ*, Q-PCR, ICC, Western. Collection, entrainment & sampling of moulting-spawning cycles (LU, BAS).

Objective 2. Years 2&3.

In situ hybridisation, antibodies production, Westerns & ICC (LU). Q-PCR (BAS).

Objective 4. Years 2&3.

Production of subtractive libraries & sequencing (LU, BAS). Spotting of mini-microarray (BAS). RNA preparation from samples & labelling (LU). Microarray hybridisations (BAS). Q-PCR validation of data (LU, BAS).

stewardship of data AND dissemination of results

The materials to be generated, such as sequences, libraries, clones and microarrays, once published will be available for any other scientist to be use in their research (but taking precautions to ensure IP protection in the case of a commercially valuable discovery should arise). We will keep collections of libraries, clones and microarrays at LU and BAS and deposit sequences in appropriate databases. Data will be managed in accordance with the directions of the *Environmental Genomics Thematic Programme Data Centre* (EGTDC) and the *Antarctic Environmental Data Centre* (AEDC). These centres will also act as our main repository.

We aim to communicate our results to the widest possible audience through generating primary science papers, attending international scientific meetings and interacting with the public through science festivals and media. We will ensure that we play a full and active role in supporting AFI initiatives and attending the various

workshops that are organised. The media sections at BAS and LU will release key findings and ensure a high profile.

JUSTIFICATION OF RESOURCES

Personnel: We require two PDRAs, one based at LU, the other at BAS, to carry out the bulk of the molecular and expression work. We also ask for 20% of the salary for a technician (J. Horner-grade B, LU) who offer basic support to the group at LU, and 4% for a technician (E Fitzcharles, BAS) who will assist in the preparation of the mini-microarray.

Consumables.

General Molecular Biology: To cover the costs of PCR, cloning, general molecular biology kits, RNase later, RNA extraction, cDNA production, RACE, phage-library production, subtractive-hybridisation libraries, SDS-PAGE. Costs are based on previous experience - £30,000 LU; £30,000 BAS. *DNA sequencing:* The nature of the project will require extensive sequencing to validate the degenerate-PCR fragments, to characterise full-length sequences and to recognize the differentially expressed clones produced by the subtractive-hybridisation approach. Costs are based on £6/sequence - £5,000 (LU), £8,000 (BAS). *Q-PCR kits and special plasticware:* Q-PCR will be used to characterise the transcriptional cycling of rhythmic genes, identified as part of the circadian clock or the moulting-spawning cycles. It will also be used to validate the mini-microarray experiments. Costs are based on £0.70/25 µl reaction, taking into account the appropriate controls (triplicate and standard curves) - £1,000 (LU), £7,000 (BAS). *Cy3/Cy5 probe-labelling kits* will be used for preparation of labelled probes for microarray hybridisation. Costs are based on £30/hybridisation - £2,000 (LU). *Oligoes:* Degenerate oligoprimers will be required for the identification of clock genes *via* PCR. Gene-specific primers will be required to speed-up full-length sequencing of relevant genes. Large amount of primers will be required for the production of microarrays. Costs are based on previous experience - £1,500 (LU), £1,500 (BAS). *Microarray.* Additional investment is required given the vast amounts of Taq polymerase and special plasticware that will be used. Costs are based on previous experience - £6,000 (BAS).

Small items of equipment, molecular biology. We require £3,800 (LU + BAS) for each PDRA to purchase standard laboratory equipment in their 1st year:- Gilson pipettes, microcentrifuge, vortex-mixer, powerpack agarose electrophoresis tanks, PAGE system.

Small items of equipment and Antarctic work: Work on the experimental ship will require the following:- Fibre optic lights Schott (2x £600, 1 LU, 1 BAS); LED illumination for entrainment tanks (Visible + IR) and power supplies (£1,000, LU); Neutral density filters (£200, LU); CCD infrared (IR) high definition camera (4x £750, 2 LU, 2 BAS); pinnacle Digitizer (£50, LU); Image splitter (£1000, LU); Video recorder (Hitachi) for time lapse (£300, LU); Computers for i) data acquisition for activity monitor ii) data acquisition for cameras, iii) and iv) data analysis (4 x £1,200, 3 LU, 1 BAS); Dry ICE maker, snowpack (£200, BAS); Aluminium boxes to use for transport (4x £150, 2 LU, 2 BAS); Water filtering apparatus (£200, LU). *Antibodies production:* Three rabbit antigens (Neosystem, Strasbourg) - £4,000 (LU). *Confocal charges:* cost of £30/h - £6,000 (LU), based on previous experience.

Stationary/Computing: General costs based on previous experience - £1,500 (LU),

£1,500 (BAS). *Consumables for Antarctic work*: Dissecting tool (£100, LU); “Ethovision” software for tracking (£5,000, LU); 10 CO₂ cylinders (£1,000, BAS); Chemicals for dissection (£100, BAS); Antarctic clothing for summer work (£531, LU); STCW95 training costs (£100, LU); Medical examination (£60, LU). **Total cost for consumables: £73,341 (LU); £62,700 (BAS).**

Equipment (Antarctic work). Dissecting microscope with dark field base, Nikon SMZ10000 - 2 x £7000 (1LU, 1 BAS); Activity monitor, built at LU, 60 channels - £10,000 (LU). Total cost for equipment: £ 17,000 (LU); £ 7,000 (BAS).

Travel. i) *International Chronobiology conferences (SRBR & Gordon, alternating, USA various venues) for 2 PDRAs annually: £1,500x2x3 - £4,500 (LU), £4,500 (BAS).* ii) *UK Clock club (various venues) for 2 PDRAs every 6 months based on trainfares: £50x2x2x3 - £300 (LU), £300 (BAS).* iii) *Workshops at Leicester or Cambridge (8 people every 2 months) based on 6 one-day trip/year by car: £70x6x3; + subsistence: £60x6x3 - £1,170 (LU), £1,170 (BAS).* iv) *1 RTN flight to Falkland - £1,800 (LU).* v) *Travel to/from Brize Norton - £70 (LU).* vi) *Transport material to/from BAS - £200 (LU).* **Total cost for travel: £8,040 (LU); £5,970 (BAS).**

LINKS TO BAS SCIENCE AND OTHER PROGRAMMES.

Two biological programmes were funded by BAS for the period 2005 to 2010 to examine the dynamics of ocean ecosystems (DISCOVERY 2010) and patterns of biodiversity (BIOFLAME). Although our proposal is outside the remit of these programmes, our findings will have the potential to enhance the scientific output of both. FLEXICON, a major project within the DISCOVERY 2010, aims to “quantify behavioural responses to different environmental regimes” through a process of parameterisation, modelling and validation. It links with a sister project, CEMI, that will “develop models...[to] investigate future change scenarios”. Our results will show how a particular behavioural pattern is controlled at the genetic level, which is a good case study for these approaches. For instance, models of this behaviour may be validated in a “quantitative” way through examining levels of expression in different genes. The impact of “future change” on this behaviour will be gauged through examining the diversity of these genes and their capacity for differential expression in various environmental conditions.

The BIOFLAME programme will be studying the biodiversity of benthic species, including an examination of genetic diversity in non-coding parts of genomes. Since our own studies will be (i) on a pelagic organism and (ii) from a part of the genome that is under natural selection, we will be providing different types of information that will supplement their biodiversity database. Clock and rhythmic genes are common to the vast majority of organisms so our findings are likely to be more widely applicable. This will be particularly true of benthic organisms that share with krill many of the problems of surviving in the marine environment.

The remit of our proposal falls within the NERC priority areas in climate change and earth’s life support systems, examining the effects of environmental perturbation on species composition. The work is also relevant to GLOBEC, a core project of the International Geosphere-Biosphere programme (IGBP) responsible for understanding how global change will affect marine populations. International Polar Year (IPY) falls within the period of this proposal and we would welcome our research being used to enhance IPY initiatives.

WIDER IMPLICATIONS

The study of gene expression with microarray technology is now widespread and particularly prevalent in the pharmaceutical industry for the development of drugs and pre-diagnosis of diseases. The development of microarrays is in increasing demand and the microarray products of this proposal may well have commercial potential, particularly in drug development screening. Our microarrays may also have a more specific use in the crustacean farming industry. The guidelines to scientific proposals issued by the Australian Prawn Farm Association states that methods are required that 'improve selective breeding' and achieve 'greater production [growth] efficiency'. Microarray technology is likely to become increasingly important in achieving this aim and our microarrays will probably be of great relevance given that they will contain genes involved in behavioural activity levels, metabolic demand and growth. Genetics has mainly been used in marine ecology to determine levels of diversity in different environments as a means of separating populations. Our proposal goes a stage further to examine how genes may be differentially expressed in different environments, according to prevailing conditions. Clock and clock-related genes are good case studies for this type of investigation because they are fundamental to the success of krill and are also likely to be common to a wide range of other organisms. The outputs of the study will highlight the potential for a new level of ecological investigation in the marine environment.

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17.5 DIMES project outline

DIMES, the Diapycnal and Isopycnal Mixing Experiment in the Southern Ocean, is a major UK/US joint project that seeks to quantify and understanding the mixing and upwelling processes that are responsible for the southern closure of the global Meridional Overturning Circulation (MOC). This is a critical regulator of the Earth's climate processes, and climate models are highly sensitive to the representation of mixing processes in the southern limb of the MOC, however the lack of extensive in situ observations of Southern Ocean processes has made evaluation of mixing challenging. During a 5-year window, DIMES will deploy an unprecedented array of oceanographic equipment in the Southeast Pacific, Drake Passage and the Scotia Sea. Central to DIMES will be the purposeful release of a passive tracer, which will be tracked by several cruises as it advects, spreads and mixes through into the Scotia Sea. A large number of acoustically-tracked floats will also track dispersion of the tagged water, and arrays of moorings will elucidate the mixing processes responsible for the evolution of the tracer patch. BAS's role in DIMES focusses on inverse modelling base on large-scale section data (box inversions), and randomly-spaced hydrographic and float data (Bernoulli inversions). For the former of the these, synergies with the BAS Discovery 2010 programme will prove invaluable, in particular the long high-quality hydrographic section data collected across the Scotia Sea from cruises such as JR177.

<http://dimes.ucsd.edu/index.html>

17.6 PRELIMINARY ENVIRONMENTAL ASSESSMENT

The Environmental Protocol (1996) requires the prior assessment of all activities in the Antarctic Treaty Area. In the absence of relevant environmental legislation for South Georgia, BAS extends these high standards to its activities there as well.

The purpose of this Preliminary Assessment is to identify any likely environmental impacts of your proposed project. The BAS Environmental Office will then work with you to instigate any measures to mitigate likely impacts, or where necessary, undertake further evaluation (Initial Environmental Evaluation or Comprehensive Environmental Evaluation).

Please submit this form electronically to the BAS Environmental Office, who will then arrange a meeting to review it with you.

2. Description of project

| |
|--|
| Title of project: |
| Discovery 2010 |
| Principal Investigator and external collaborators/contractors: |
| Geraint Tarling |
| Location(s) (include a description of the area - e.g. coastal, ice-free , access to protected areas): |
| The ship will be passing to the Scotia Sea region between the longitudes 60°W and 40°W and latitudes 53°S and 61°S. This area will be mainly ice free towards the north and may have some pack-ice towards towards the south during the time of passage (Jan/Feb 2008) |
| Duration and intensity (person days) of proposed activity: |
| There will be 46 science days during the trip (30 th Dec – 16 th Feb 2008) |
| Brief description of proposed activity: |
| Main sampling will be for krill and zooplankton. Water samples will also be taken for micronutrient analysis. |

3. Identification of potential impacts

| |
|---|
| List any hazardous substances to be used (include hazard class and quantity): |
| Carbon 14 (all will be retained on board ship; any waste taken to UK) Formalin (all use retained on board ship; any waste taken to UK) |
| For field parties, will the project involve the storage of fuel (include quantity): |
| NO |
| Estimate the quantity of hazardous and non-hazardous waste that you expect to produce: |
| None |
| Will you take, capture, kill or harmfully interfere with any flora or fauna: |
| Yes, we will collect planktonic/nektonic animals (mainly krill, copepods and myctophids) with a variety of nets (LHPR; BONGO; RMT 8; RMT 25; MOCNESS) |
| Will you remove rock, soil or fossil samples: |
| NO |
| Will you deliberately bring any non-native animal, plant, seed, micro-organism or non-sterile soil: |
| NO |

| |
|---|
| Will you install any equipment (such as data loggers or markers) - if so include a planned date for removal: |
| Service and redeploy 2 moorings to monitor water column: 1) 57.5°S 41°W 2) 40°W 53°S. |
| For building projects, will the work require concrete mixing on site: |
| NO |
| Will you visit any previously undisturbed sites: |
| NO |

4. Simple Impact Matrix (including mitigating measures)

Consider, for example, likely impact on flora or fauna, waste, fuel or chemical handling, storage and possible release into the environment.

| Activity | Possible impact | Mitigating measures |
|-----------------------|--|------------------------------------|
| RMT 8 trawling | very small, very local impact to the pelagic fauna | Very minor but unavoidable impact. |
| RMT 25 trawling | very small, very local impact to the pelagic fauna | Very minor but unavoidable impact. |
| MOCNESS trawling | very small, very local impact to the pelagic fauna | Very minor but unavoidable impact. |
| LHPR trawling | very small, very local impact to the pelagic fauna | Very minor but unavoidable impact. |
| Bongo netting | very small, very local impact to the pelagic fauna | Very minor but unavoidable impact. |
| Mooring redeployment | minor local impact to the benthic fauna | Very minor but unavoidable impact. |
| CTD water collections | No impact to the environment | - |

e-signature : *Geraint Tarling*

Date: 15th August 2007

5. Assessment

(This section to be completed by the Environmental Office)

Project to proceed with mitigating measures in place

or

An Initial Environmental Evaluation is required

17.7 JCR Equipment List

RRS JAMES CLARK ROSS – SHIP MOUNTED SCIENCE CRUISES INFORMATION TECHNOLOGY, ENGINEERING AND INSTRUMENTATION REQUIREMENT FORM

This form must be completed and returned to the Ship Operations Manager the by 1 June preceding the Antarctic season in which the cruise is planned. Where northern summer cruises are planned, the form is required in the preceding year. The form must be sent electronically to Cjh@bas.ac.uk

| PART 1 | | | |
|---|---|--|--|
| CRUISE NUMBER JR177 | CRUISE TITLE Discovery 2010 Summer cruise | DATES Jan-Feb 2008 | PRINCIPAL SCIENTIST Geraint Taring |
| ADDRESS BAS | TELEPHONE NUMBER 01223 221596 | FAX NUMBER 01223 221259 | EMAIL gart@bas.ac.uk |
| BRIEF OUTLINE OF CRUISE OBJECTIVES | | | |
| | | | |
| PART 2 INSTRUMENTATION FIT – BAS SUPPLIED INSTRUMENTATION | | | |
| Tick if required. | | | |
| MISC SYSTEMS | | | |
| WINCH SYSTEMS (CLAM WINCH MONITORING) | <input checked="" type="checkbox"/> | XBT | <input checked="" type="checkbox"/> |
| SCINTILLATION COUNTER | <input checked="" type="checkbox"/> | AUTOSAL SALINOMETER | <input checked="" type="checkbox"/> |
| MAGNETOMETERS (STCM1 AND STCM2) | <input type="checkbox"/> | | |
| ACOUSTIC SYSTEMS | | | |
| VESSEL MOUNTED ADCP | <input checked="" type="checkbox"/> | PRECISION ECHOSOUNDER (PES) | <input type="checkbox"/> |
| EM120 MULTIBEAM | <input checked="" type="checkbox"/> | EM120 ALDEN BACKSCATTER PLOTTER | <input type="checkbox"/> |
| TOPAS SUB-BOTTOM PROFILER | <input type="checkbox"/> | EPC PLOTTER FOR USE WITH TOPAS | <input type="checkbox"/> |
| EK60 FISHERIES ECHOSOUNDER | <input checked="" type="checkbox"/> | EK60 HP DESKJET PRINTERS | <input type="checkbox"/> |
| SOUND VELOCITY PROFILER (SVP) | <input type="checkbox"/> | 10k Hz PINGER | <input type="checkbox"/> |
| 12k Hz PINGER | <input type="checkbox"/> | | |
| GPS SYSTEMS | | | |
| TRIMBLE 4000DS DGPS | <input checked="" type="checkbox"/> | ASHTEC ADU2 DGPS | <input checked="" type="checkbox"/> |
| ASHTEC GLONASS GG24 | <input checked="" type="checkbox"/> | | |
| OCEANLOGGER | | | |
| BAROMETER (AIR PRESSURE) | <input checked="" type="checkbox"/> | AIR HUMIDITY AND TEMPERATURE | <input checked="" type="checkbox"/> |
| THERMOSALINOGRAPH (UNCONTAMINATED WATER FLOW) | <input checked="" type="checkbox"/> | FLUOROMETER (UNCONTAMINATED WATER FLOW) | <input checked="" type="checkbox"/> |
| TIR SENSOR (PYRANOMETER) | <input checked="" type="checkbox"/> | PAR SENSOR | <input checked="" type="checkbox"/> |
| FLOW METER (UNCONTAMINATED WATER FLOW) | <input checked="" type="checkbox"/> | SEAWATER TEMPERATURE (AT UNCONTAMINATED WATER INLET) | <input checked="" type="checkbox"/> |
| CTD | | | |
| DECK CONTROL SBE11 PLUS UNIT | <input checked="" type="checkbox"/> | UNDERWATER SBE9 PLUS UNIT | <input checked="" type="checkbox"/> |
| 12 BOTTLE CAROUSEL, PYLON AND FRAME | <input checked="" type="checkbox"/> | C.T. AND PRESSURE SENSORS | <input checked="" type="checkbox"/> |
| FLUOROMETER | <input checked="" type="checkbox"/> | STANDARDS THERMOMETER (SBE35) | <input checked="" type="checkbox"/> |
| ALTIMETER (FOR USE NEAR SEA BED) | <input checked="" type="checkbox"/> | TRANSMISSOMETER | <input checked="" type="checkbox"/> |
| DISSOLVED OXYGEN SENSOR | <input checked="" type="checkbox"/> | PAR SENSOR | <input checked="" type="checkbox"/> |
| NAVIGATIONAL INSTRUMENTS LOGGED | | | |
| EA600 DEPTH | <input checked="" type="checkbox"/> | HEAVE, ROLL, PITCH (TSS HRP) | <input checked="" type="checkbox"/> |
| ANEMOMETER | <input checked="" type="checkbox"/> | GYRO | <input checked="" type="checkbox"/> |
| DOPPLER LOG | <input checked="" type="checkbox"/> | EMLOG | <input checked="" type="checkbox"/> |
| COMMENTS: | | | |
| NB> there is a requirement for the SEATEC differential GPS in addition to the other GPS systems | | | |
| | | | |

PART 6 SHIP SYSTEMS AND EQUIPMENT FIT BAS SUPPLIED SYSTEMS

| | | | |
|-----------------------|-------------------------------------|----------------------------|-------------------------------------|
| Tick if required | | | |
| WINCHES | <input checked="" type="checkbox"/> | HYDRAULICS | <input checked="" type="checkbox"/> |
| ELECTRICAL SUPPLIES | <input checked="" type="checkbox"/> | WATER SUPPLIES | <input checked="" type="checkbox"/> |
| FUME CUPBOARDS | <input checked="" type="checkbox"/> | RADIO CHEMICAL FACILITIES | <input checked="" type="checkbox"/> |
| COLD ROOMS / FREEZERS | <input checked="" type="checkbox"/> | DYNAMIC POSITIONING SYSTEM | <input checked="" type="checkbox"/> |
| BAS LOGGING SYTEM | <input checked="" type="checkbox"/> | | |

COMMENTS:

PART 7 ADDITIONAL EQUIPMENT FIT NON-BAS EQUIPMENT

Please identify below equipment to be used during the cruise that will be supplied by agencies other than BAS. Items to include special winches and deck fit equipment.

| EQUIPMENT DETAILS | EQUIPMENT OWNER |
|--|-----------------|
| Clean chemistry laboratory container | UKORS |
| Gas bottle storage racks | UKORS |
| Laboratory laminar flow hoods | UKORS |
| Laboratory pure water system (Millipore) | UKORS |
| Trace metal clear underway sampling system | Adtberg AFL-CGS |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

PART 8 STAFF AND CONSUMABLES PROVISION

Under the one-stop shop approach, BAS will provide:

One Electronics and one IT Engineer to support BAS instrumentation and IT infrastructure. The Engineers will each normally operate a 12-hour shift to ensure the on-board equipment is kept operational. The priority will be given to maintenance of BAS equipment but the Engineers will assist with routine operation if circumstances permit. Should additional Engineers be needed for the cruise, they can be requested and a charge will be made for their services.

Spares and consumables will be provided by BAS to keep on-board equipment operational. The Principal Scientist is responsible for the provision of consumables needed for acquisition of scientific data e.g. XBTs, standard seawater, salinity bottle inserts, scintillation counter vials.

DLTs and CD ROMS will be provided to record data from on-board instrumentation. A copy and back-up of recorded data will be provided on DLT or CD ROM at the end of a cruise. The Principal Scientist is responsible for providing media and IT Consumables for :

- Additional computers brought onto the ship for a cruise
- Copies of cruise data in addition the original and backup.
- Personal use.

STAFF REQUIREMENTS

| | | | |
|----------------------------------|-------------------------------------|-------------------------|-------------------------------------|
| ELECTRONICS ENGINEER (NO CHARGE) | <input checked="" type="checkbox"/> | IT ENGINEER (NO CHARGE) | <input checked="" type="checkbox"/> |
|----------------------------------|-------------------------------------|-------------------------|-------------------------------------|

ADDITIONAL STAFF:

| | | | |
|--|--------------------------|--|--------------------------|
| | <input type="checkbox"/> | | <input type="checkbox"/> |
| | <input type="checkbox"/> | | <input type="checkbox"/> |
| | <input type="checkbox"/> | | <input type="checkbox"/> |
| | <input type="checkbox"/> | | <input type="checkbox"/> |

PART 9 NOTES AND ADVICE

NON BAS EQUIPMENT

Equipment not provided by BAS should be installed and operated by customer supplied staff. BAS Staff will assist with interfacing the equipment to ship's systems where appropriate.

ACOUSTIC SYSTEMS

Many of the acoustic instruments incur mutual interference if they all ping at once – hence the synchronisation unit (SSU) is fitted. Even with the SSU it is not prudent for all systems to operate concurrently or generally, when the SSU is used, the more instruments on then the lower the maximum ping rates (i.e. the lower the data rate and spatial resolution). This becomes very apparent in very deep water where return times are longer. Also, the more acoustics systems that are used concurrently, the greater the chance of interference and decreasing data quality.

It is important that the customer representative decides on prioritisation of instruments in relation to optimisation of ping rates.

EM120 SWATHBATHYMETRY MULTIBEAM

- 1) The customer should provide trained operators and watch keepers if consistent data is to be ensured.
- 2) The customer must provide operators for the post processing Neptune software if anything other than the raw data files are required.
- 3) Sound velocity profiles are needed at regular intervals. The most accurate method is with the winched Sound Velocity Profiler (SVP) but this involves stopping the ship for about 30 minutes. XBT's provide a less accurate alternative and can be used on passage.
- 4) The Multibeam manufacturer recommends that a pitch/roll/yaw calibration should be carried out at the start of a swath cruise – trained operators are required to do this (instructions in manual). This takes approximately half a day and should be scheduled into the cruise bid.
- 5) Experience has shown that conditions producing more than 10 degrees of leeway (angle between the direction the bow is pointing and the direction the ship is moving) make the performance of the multibeam unreliable (usually happens only in rough seas). Towing seismic gear beam on to the wind at slow speed is not compatible with collecting swath data.

TOPAS SUB-BOTTOM PROFILER

- 1) The customer should provide trained operators and watch keepers if good, consistent data is to be ensured.
- 2) Although TOPAS uses the same frequencies as the EM120, interference is usually minimal. However, the user should be prepared to prioritise one or the other of these instruments, as interference may be a problem under certain circumstances.

EK60 FISHERIES RESEARCH ECHO SOUNDER

- 1) The customer should supply trained operators.
- 2) The system should be calibrated using calibration spheres and rods at the start of any cruise – customers must provide these. Calibration has to be completed in quiet water. This is a complex procedure and may take a day to complete. This time must be included in the cruise bid.

ADCP

- 1) The customer should provide trained operators if good, consistent data is to be ensured.
- 2) Note that Transect software does not work with the installed data acquisition PC.

XBT

- 1) Customers to supply their own XBTs.

CTD

- 1) Customers to provide personnel to collect and analyse water samples.
- 2) All customers to provide sample bottle top inserts.
- 3) BAS cannot guarantee the provision of staff for CTD cast control at the deck unit PC, but will help wherever possible.

SCINTILLATION COUNTER

- 1) BAS customers should provide a trained operator for this instrument.
- 2) Customers must provide own scintillation sample vials.

AUTOSAL SALINOMETER

- 1) The customer should provide trained operators.
- 2) All customers must supply their own standard water. Estimated about 2 bottles per batch (e.g. a day) of sampling – samples can be stored up so that a big batch can be done at once). See CTD for bottle top inserts.

IT INSTALLATIONS

- 1) Any computer that controls scientific hardware will not be installed with BAS applications such as Groupwise or the Novell client.
- 2) A machine which controls scientific hardware must be correctly configured before the cruise begins and an image backup taken of the hard drive.
- 3) All drivers and recovery disks provided when the machine was purchased should be brought onboard.
- 4) Data backup via the ships LAN is possible, but not recommended (because of the novell client software and network configuration changes required); either backup locally or use the underway SCS logging system which requires NMEA standard data from an RS232 serial port or TCP/IP sockets.

SUPPORT LIMITATION

BAS support staff will endeavour to maintain and repair the BAS systems onboard the RRS James Clark Ross. Technical data and spares are available for most devices - but not all. Due to the remote nature of BAS operations this may lead to a situation whereby:

- 1) A system cannot be repaired
- 2) A system is not operational until further information is sought from the manufacturer.

BAS will use best endeavours to ensure all equipment is operational and data is acquired.

UNSCHEDULED USE OF OTHER BAS EQUIPMENT

The range of BAS instrumentation required for a cruise will be finalised during the cruise planning meeting(s). On occasions, additional BAS equipment has been requested, due to the customer's own system malfunctioning during a cruise.

This has implications for future cruises, insurance, wear & tear and possible damage. Requests to use such equipment must be made via the Instrumentation Manager who will assess any risks and advise.

WATCH KEEPING

Although BAS support staff generally work a 12 hours shift, they should not normally be included in any routine watch keeping. This enables them to concentrate their efforts on the repair and maintenance of equipment when problems occur. If circumstances permit, the support engineers will assist with routine operation but may not be able to interpret data and advise customers on science options.

PART 10 POINTS OF CONTACT

PRIMARY CONTACT AND PERSON TO WHOM COMPLETED FORM IS SENT.

BAS Ships Operations Manager

Chris Hindley

cjh@bas.ac.uk

Tel: 01223 221497

Scientific Instrumentation

Jim Fox

jvf@bas.ac.uk

Tel: 01223 221446

IT and Computing

Jeremy Armitage

jsar@bas.ac.uk

Tel: 01223 221408

Ships Systems and Equipment Fit

David Blake

dmb@bas.ac.uk

Tel: 01223 221477



**British
Antarctic Survey**
NATURAL ENVIRONMENT RESEARCH COUNCIL

For details of fitted equipment and technology on RRS James Clark Ross go to:

Instrumentation: http://www.antarctica.ac.uk/About_BAS/Cambridge/Divisions/ALD/Engineering/support/jcr/jcrinst.html

IT: <http://www.antarctica.ac.uk/Resources/Computing/jcr.html>

Ship's Fit: <http://www.antarctica.ac.uk/About-bas/Living-and-Working/Virtua/James-Clark-Ross/index.html>

17.8 Krill Requirements Per Catch

Event

Net number

| Requirement | Preservation method | Minimum state of krill | Tick |
|---|------------------------------|---------------------------------|------|
| 100 krill for faecal pellet experiments (Angus) | Live | Lively | |
| 400+ krill for clock gene incubation (Ted) | Live | Lively | |
| 30 krill for RNA extraction (Ted/GT) | RNA later | Lively | |
| 10 krill for brain dissection (Ted) | Paraformaldehyde | Lively | |
| 200 for population genetics analysis (GT) | 95% ethanol | Alive | |
| 10 krill for isotope ratios (Dave) | -80°C | Alive | |
| 20 isotope ratios (Gabby) | -80°C | Alive | |
| 30-50 for gut contents (Angus) | -80°C | Alive | |
| 200 krill for LF analysis and subsequent morphology analysis (Sophie/Jon) | To be put aside in cool room | Recently dead | |
| 100 krill for ovarian analysis (GT) Aquarium (Min) | Buffered Formalin -20oC | Recently dead Not decomposed | |

Net type

17.9 Post-Cruise Assessment Form

Principal Scientists should complete this form. This will enable NERC to monitor the performance of its research ship and/or technician/equipment support operations. *[Completed forms should be sent via email to Dr Mike Webb (mweb@nerc.ac.uk), Chris Hindley (cjhh@bas.ac.uk) and to NMF-SS Heads of Groups (nmfss-heads@noc.soton.ac.uk)]*

| | | |
|-----------------------------|--|---|
| Ship:RRS James Clark Ross | Cruise no.JR177 | Dates: Dec 31 st to Feb 16th |
| PS name: Geraint Tarling | Institution & position: British Antarctic Survey; Project leader | Email:gant@bas.ac.uk |
| Work type: Pelagic sampling | Area of operation: Scotia Sea | |
| Master: Graham Chapman | Technical Liaison Officer: Jeff Benson (NMF) | |

Please tick the appropriate box A to E and add comments if required.
(A = Excellent; B = Good; C = Average; D = Poor; E = Unacceptable)

| | A | B | C | D | E | Comments |
|---|---|---|---|---|---|---|
| Pre-cruise planning | | x | | | | Pre-cruise meetings between BAS and NMF particularly useful. Also there were good lines of communication during the cruise |
| Mobilisation support | | x | | | | |
| Onboard marine support | x | | | | | Provided by Bas Personnel only |
| Onboard technical support | x | | | | | Provided by Bas Personnel only |
| Ship/technical/scientific staff interface | | X | | | | |
| Demobilisation support | | X | | | | |
| Suitability of "pool" equipment | | | X | | | Some equipment (L-ADCP) not working on receipt. Other gear (winch and GoFlo) incompatible and requiring modification. Clean chemistry container doors not water tight |
| Facilities in laboratories | | X | | | | |
| Fixed scientific facilities | | X | | | | |
| Safety instruction | | X | | | | |
| Onboard safety practices | | X | | | | |
| Onboard hotel facilities | | x | | | | |
| Onboard catering service | | X | | | | |
| Cleanliness of ship | | X | | | | |
| Other – Please specify | | | | | | |

Are there any Safety Points which were raised during the cruise/charter still “open”? **No**
If so detail (on separate page if necessary).
Do you wish to be informed of “actions and closure” after leaving the ship? **Yes**

Please provide the following information on attached sheets.

1. Were the science objectives of this cruise met? Please explain, especially if the objectives were not met
2. The number of lost days and the reason for lost days
3. Are there any changes that you recommend to improve results and/or safety before the ship is used again for this or similar projects?
4. Please make suggestions for improving the pre-cruise planning and co-ordination, logistics, shore support or living conditions on the ship
5. Please make any comments regarding the ship’s operation, equipment, ship’s personnel, technicians, shore support or science party

1. The objectives of the cruise were to transit between the ice-edge and Polar Front carrying out CTD every 25 nm and pelagic sampling stations (2-4 d duration) every ~100 nm. Moorings were to be retrieved and redeployed and 2 of those stations.
A total of 10 stations were sampled interspersed by a further ~30 CTDs. Around 90% of all scheduled deployments were achieved. Both moorings were successfully retrieved and redeployed. % other whale buoy moorings were deployed close to South Georgia
2. 4 science days lost to weather
3. Some pool equipment was either not working on receipt or incompatible with other supplied equipment. A double-checking procedure would be one means of picking up such problem before shipment
4. Pre-cruise planning was a great improvement to our previous experience (JR161). Lines of communication were clear. The procedure particularly benefited from pre-cruise meetings where NMF representatives visited BAS or vice versa. There were also good lines of communication during the cruise which helped us solve snagging problems quickly
5. No further comments

17.10 Plan of Events

08:00 (local) 3 Jan to 08:00 (local) 4 Jan

General plan: Steam to ice edge, target fishing on the way. Then carry out a small survey over approximate R1 location. This will inform the final decision on the precise location of R1. R1 activities then start

| Date | Start | End | Activity |
|-------------|-------|-------|--|
| 3 Jan | 08:00 | 16:00 | Searching for krill targets on way to ice edge using RMT 8 net if any suitable targets found |
| 3 Jan | 16:00 | 22:00 | Small scale survey over approximate R1 location (Sophie to draw up transect plan) |
| 3 Jan | 22:00 | 00:00 | Target fishing with RMT 8 |
| Start of R1 | | | |
| 4 Jan | 00:00 | 01:00 | FRRF |
| 4 Jan | 01:00 | 04:00 | LHPR |
| 4 Jan | 04:00 | 07:00 | CTD (full depth) |
| 4 Jan | 07:00 | 09:00 | Bongo and mini-bongo |

07:00 (local) 4 Jan to 13:00 (local) 5 Jan

General plan: To continue with R1 core-sampling activities. Note there are rearrangements to the standard schedule to accommodate equipment problems and past fishing activities

| Date | Start (local) | End (local) | Activity |
|-------|---------------|-------------|------------------------------------|
| 4 Jan | 07:00 | 09:00 | Bongo and mini-bongo |
| 4 Jan | 09:00 | 10:00 | CTD (for Peter Ward – Oithona) |
| 4 Jan | 10:00 | 13:00 | LHPR |
| 4 Jan | 13:00 | 16:00 | Target fishing |
| 4 Jan | 16:00 | 19:00 | MOCNESS |
| 4 Jan | 19:00 | 21:00 | Bongo and mini-Bongo (for Nina) |
| 4 Jan | 21:00 | 00:00 | MOCNESS |
| 5 Jan | 00:00 | 03:00 | RMT25 (Deep haul) |
| 5 Jan | 03:00 | 05:00 | CTD (for Dave Pond – particulates) |
| 5 Jan | 05:00 | 07:00 | Bongo and mini-Bongo |
| 5 Jan | 07:00 | 13:00 | RMT25 (Shallow and Deep) |

05:20 (local) 5 Jan to 05:30 (local) 6 Jan

General plan: To complete R1 core-sampling activities. Note there are rearrangements to the standard schedule to accommodate previous bad weather and equipment problems

| Date | Start (local) | End (local) | Activity |
|-------|---------------|-------------|------------------------|
| 5 Jan | 05:20 | 08:20 | RMT25 (Deep) |
| 5 Jan | 08:20 | 10:20 | RMT25 (Shallow) |
| 5 Jan | 10:20 | 13:20 | GoFlo bottles |
| 5 Jan | 13:20 | 14:20 | Towed Bongo (trial) |
| 5 Jan | 14:20 | 15:00 | Bongo |
| 5 Jan | 15:00 | 15:40 | Bongo |
| 5 Jan | 15:40 | 16:20 | Mini-Bongo |
| 5 Jan | 16:20 | 17:00 | Mini- Bongo |
| 5 Jan | 17:00 | 19:00 | Towed Bongo (for Nina) |
| 5 Jan | 19:00 | 22:00 | Target Fish (RMT25) |
| 5 Jan | 22:00 | 00:00 | RMT25 (Shallow) |
| 6 Jan | 00:00 | 00:30 | FRRF |
| 6 Jan | 00:30 | 03:30 | RMT25 (Deep) |
| 6 Jan | 03:30 | 05:30 | Target fish (RMT25) |
| 6 Jan | 05:30 | | Move off R1 |

08:00 (local) 6 Jan to 16:00 (local) 7 Jan

General plan: To steam to the next core sampling station and carry out a 24 h mesoscale survey around the station (acoustic towfish to be deployed during survey)

| Date | Start (local) | End (local) | Activity |
|-----------------|---------------|-------------|---|
| 6 Jan | 08:00 | 16:00 | Steaming to station C2 |
| 6 Jan/ 7 Jan | 16:00 | 16:00 | 24 h mesoscale survey around station C2 |

16:00 (local) 7 Jan to 09:00 (local) 8 Jan

General plan: To start core sampling activities at Station C2

| Date | Start (local) | End (local) | Activity |
|-------|---------------|-------------|---|
| 7 Jan | 16:00 | 19:00 | MOCNESS |
| 7 Jan | 19:00 | 21:00 | Towed Bongo deployments (between 2 and 4 in total, to different depths) |
| 7 Jan | 21:00 | 00:00 | MOCNESS |
| 8 Jan | 00:00 | 01:00 | FRRF |
| 8 Jan | 01:00 | 04:00 | LHPR |
| 8 Jan | 04:00 | 07:00 | CTD (full depth) |
| 8 Jan | 07:00 | 09:00 | Bongo and mini Bongo |

08:00 (local) 8 Jan to 07:00 (local) 9 Jan

General plan: To continue core sampling activities at Station C2

| Date | Start (local) | End (local) | Activity |
|---------|---------------|-------------|--|
| 8 Jan | 05:00 | 09:30 | CTD (full depth) |
| 8 Jan | 09:30 | 10:10 | Bongo |
| 8 Jan | 10:10 | 10:50 | Bongo |
| 8 Jan | 10:50 | 11:30 | Mini Bongo |
| 8 Jan | 11:30 | 12:30 | CTD (Oithona) |
| 8 Jan | 12:30 | 13:00 | FRRF |
| 8 Jan | 13:00 | 14:00 | GoFlo bottles |
| 8 Jan | 14:00 | 14:30 | Trial of UOR on way to start point of next haul |
| 8 Jan | 14:30 | 17:00 | LHPR |
| 8 Jan | 17:00 | 21:00 | Target fishing (with RMT25) (+ Towed Bongo if any time remaining) |
| 8 Jan | 21:00 | 23:30 | RMT25 (shallow) |
| 8-9 Jan | 23:30 | 03:00 | RMT25 (deep) |
| 9 Jan | 03:00 | 05:00 | CTD (for Dave Pond) |
| 9 Jan | 05:00 | 05:40 | Bongo |
| 9 Jan | 05:40 | 06:20 | Bongo |
| 9 Jan | 06:20 | 07:00 | Mini Bongo |

10:00 (local) 9 Jan to 14:00 (local) 11 Jan

General plan: To carry out CTD stations to the SE of Signy. CTDs will be carried out from north to south. Conditions may be icy so passage times may be longer than estimated. The ship must head north again by 14:00 on 11th Jan

| Date | Start (local) | End (local) | Activity |
|--------|---------------|--|--|
| 9 Jan | 10:30 | 12:00 | Full depth CTD at posn. 8 |
| 10 Jan | ~00:00 | ~02:00 | Full depth CTD at posn. 6 |
| 10 Jan | ~02:00 | ~03:00 | GoFlos at posn. 5 (to be verified with Maria and Daria in advance) |
| 10 Jan | ~09:00 | ~11:00 | Full depth CTD at posn. 5 |
| 10 Jan | ~11:00 | ~12:00 | GoFlos at posn. 5 (to be verified with Maria and Daria in advance) |
| 10 Jan | ~18:00 | ~20:00 | Full depth CTD at posn. 4 |
| 10 Jan | ~20:00 | ~21:00 | GoFlos at posn. 4 (to be verified with Maria and Daria in advance) |
| 11 Jan | ~00:00 | ~02:00 | Full depth CTD at posn. 3 |
| 11 Jan | ~02:00 | ~03:00 | GoFlos at posn. 3 (to be verified with Maria and Daria in advance) |
| 11 Jan | ~06:00 | ~08:00 | Full depth CTD at posn. 2 |
| 11 Jan | ~08:00 | ~09:00 | GoFlos at posn. 2 (to be verified with Maria and Daria in advance) |
| 11 Jan | ~10:30 | ~12:30 | Full depth CTD at posn. 1 |
| 11 Jan | ~12:30 | ~13:30 | GoFlos at posn. 1 (to be verified with Maria and Daria in advance) |
| 11 Jan | 14:00 | Latest possible time that can be spent on this southerly section before turning around | |

10:00 (local) 12 Jan to 12:00 (local) 14 Jan

General plan: to leave Signy base and head up main transect to station C3, stopping en route at station C2 for net deployments and at CTD 10 for a full depth CTD

| Date | Start (local) | End (local) | Activity |
|-------------------|---------------|-------------|--|
| 12 Jan | 10:00 | 21:00 | Passage from Signy to station C2 (CTD 9) |
| 12 Jan/ 13 Jan | 21:00 | 02:00 | RMT25 deployment (deep) |
| 13 Jan | 02:00 | 03:00 | Towed Bongo deployments |
| 13 Jan | 03:00 | 05:00 | Passage to CTD 10 |
| 13 Jan | 05:00 | 09:30 | Full depth CTD (~5000 m) |
| 13 Jan | 09:30 | 10:00 | UOR test deployment |
| 13 Jan | 10:00 | 12:00 | Passage to station C3 |
| 13 Jan/ 14 Jan | 12:00 | 12:00 | Mesoscale survey |

11:30 (local) 14 Jan to 13:00 (local) 15 Jan

General plan: to start core sampling activities at station C3

| Date | Start (local) | End (local) | Activity |
|--------|---------------|-------------|-----------------------------|
| 14 Jan | 11:45 | 12:15 | FRRF |
| 14 Jan | 12:15 | 14:00 | GoFlo |
| 14 Jan | 14:30 | 17:00 | MOCNESS * |
| 14 Jan | 17:00 | 18:45 | Target fishing (RMT8) |
| 14 Jan | 18:45 | 20:30 | Towed Bongo |
| 14 Jan | 21:00 | 00:00 | MOCNESS * |
| 15 Jan | 00:00 | 00:30 | FRRF |
| 15 Jan | 01:00 | 04:00 | LHPR * |
| 15 Jan | 04:00 | 07:00 | CTD (Full depth) |
| 15 Jan | 07:00 | 07:40 | Bongo |
| 15 Jan | 07:40 | 08:20 | Bongo |
| 15 Jan | 08:20 | 09:00 | Mini Bongo |
| 15 Jan | 09:00 | 09:40 | Mini Bongo |
| 15 Jan | 09:45 | 10:15 | CTD (Oithona for Pete Ward) |
| 15 Jan | 10:30 | 13:00 | LHPR * |

* - ship needs to be 3 nm downwind of waypoint at start of haul

13:00 (local) 15 Jan to 14:00 (local) 16 Jan

General plan: finish core sampling activities at station C3

| Date | Start (local) | End (local) | Activity |
|-------------------|---------------|-------------|---|
| 15 Jan | 13:00 | 19:00 | Target fishing RMT8 then change to RMT25 |
| 15 Jan | 19:00 | 20:00 | Towed Bongo (over stern) |
| 15 Jan/ 16 Jan | 20:00 | 00:30 | RMT25 (Deep) * Towed Bongo from forard crane - when dark |
| 16 Jan | 00:30 | 02:00 | RMT25 (Shallow) * Towed Bongo from forard crane |
| 16 Jan | 02:00 | 04:00 | CTD for Dave Pond |
| 16 Jan | 04:00 | 04:40 | Bongo |
| 16 Jan | 04:40 | 05:20 | Bongo |
| 16 Jan | 05:20 | 06:00 | Mini Bongo |
| 16 Jan | 06:00 | 06:40 | Mini Bongo |
| 16 Jan | 07:00 | 11:30 | RMT25 (Deep) * |
| 16 Jan | 11:30 | 14:00 | RMT25 (Shallow) * |
| 16 Jan | 14:00 | | Make to next CTD location |

* - ship needs to be 3 nm downwind of waypoint at start of haul

14:00 (local) 16 Jan to 20:00 (local) 18 Jan

General plan: Carry out CTD transect between station C3 and C4. Then 24 h mesoscale survey at C4

| Date | Start (local) | End (local) | Activity |
|-------------------|---------------|-------------|---|
| 16 Jan | 14:00 | 16:00 | UOR trial en route to CTD 12 |
| 16 Jan | 16:00 | 19:00 | CTD 12 |
| 16 Jan | 21:00 | 00:00 | CTD13 |
| 17 Jan | 00:00 | 01:00 | Towed Bongo over stern (depending on weather conditions) then passage to CTD14 |
| 17 Jan | 03:00 | 06:00 | CTD 14 |
| 17 Jan | 18:00 | 11:00 | CTD15 |
| 17 Jan | 13:20 | 16:20 | CTD16 |
| 17 Jan/ 18 Jan | 20:00 | 20:00 | 24 h Mesoscale survey of station C4 |

16:00 (local) 18 Jan to 20:00 (local) 19 Jan

General plan: To start core sampling activities at station C4

| Date | Start (local) | End (local) | Activity |
|--------|---------------|-------------|--|
| 18 Jan | 16:00 | 19:00 | MOCNESS * |
| 18 Jan | 19:00 | 20:00 | Target fishing (RMT 8) |
| 18 Jan | 20:00 | 21:00 | Towed Bongo |
| 18 Jan | 21:30 | 00:30 | MOCNESS * |
| 19 Jan | 00:30 | 01:00 | FRRF |
| 19 Jan | 01:00 | 04:00 | LHPR * Towed Bongos from front of ship if conditions suitable |
| 19 Jan | 04:00 | 07:00 | CTD |
| 19 Jan | 07:00 | 07:40 | Bongo |
| 19 Jan | 07:40 | 08:20 | Bongo |
| 19 Jan | 08:20 | 09:00 | Mini Bongo |
| 19 Jan | 09:00 | 09:40 | Mini Bongo |
| 19 Jan | 09:40 | 10:10 | CTD Pete Ward (Oithona) |
| 19 Jan | 10:30 | 13:00 | LHPR * |
| 19 Jan | 13:00 | 13:30 | FRRF |
| 19 Jan | 13:30 | 15:00 | GoFlos |
| 19 Jan | 15:00 | 18:30 | Target fishing (RMT8 then RMT25) |
| 19 Jan | 18:30 | 20:00 | Towed Bongos |

* - ship needs to be 3 nm downwind of waypoint at start of haul

14:00 (local) 19 Jan to 14:00 (local) 20 Jan

General plan: To complete core sampling activities at station C4

| Date | Start (local) | End (local) | Activity |
|-------------------|---------------|-------------|--|
| 19 Jan | 14:00 | 20:00 | Target fishing (RMT 8 then RMT25) |
| 19 Jan | 20:00 | 00:30 | RMT25 (Deep) * Towed Bongo from forard crane - when dark if requested |
| 19 Jan/ 20 Jan | 00:30 | 02:00 | RMT25 (Shallow) * Towed Bongo from forard crane – if requested |
| 20 Jan | 02:00 | 04:00 | CTD for Dave Pond |
| 20 Jan | 04:00 | 04:40 | Bongo |
| 20 Jan | 04:40 | 05:20 | Bongo |
| 20 Jan | 05:20 | 06:00 | Mini Bongo |
| 20 Jan | 06:00 | 06:40 | Mini Bongo |
| 20 Jan | 07:00 | 11:30 | RMT25 (Deep) * |
| 20 Jan | 11:30 | 14:00 | RMT25 (Shallow) * |
| 20 Jan | 14:00 | | Make to next CTD location |

* - ship needs to be 3 nm downwind of waypoint at start of haul

14:00 (local) 20 Jan to 13:00 (local) 21 Jan

General plan: Carry out CTD transect between stations C4 and R2. Then 6 h small-scale survey at R2 before starting core sampling activities at station R2

| Date | Start (local) | End (local) | Activity |
|--------|------------------|----------------|--|
| 20 Jan | 14:00 | 16:00 | Passage to CTD posn. 18 |
| 20 Jan | 16:00 | 19:00 | CTD 18 |
| 20 Jan | 19:00 | 21:00 | Passage to CTD posn. 19 |
| 20 Jan | 21:00 | 00:00 | CTD 19 |
| 21 Jan | 00:00 | 01:00 | Towed Bongo over stern (depending on weather conditions) |
| 21 Jan | 01:00 | 03:00 | Passage to R2 (CTD posn. 20) |
| 21 Jan | 03:00 | 04:00 | Towed Bongo over stern (depending on weather conditions) |
| 21 Jan | 04:00 | 10:00 | 6 h small scale survey |
| 21 Jan | 10:00 | 13:00 | LHPR |

13:00 (local) 21 Jan to 10:15 (local) 22 Jan

General plan: Continue with core-sampling activities at station R2

| Date | Start (local) | End (local) | Activity |
|--------|------------------|----------------|-----------------------------|
| 21 Jan | 13:00 | 13:30 | FRRF |
| 21 Jan | 13:30 | 15:00 | GoFlos |
| 21 Jan | 15:30 | 18:00 | MOCNESS |
| 21 Jan | 18:00 | 20:00 | Target fishing (RMT8) |
| 21 Jan | 20:00 | 21:00 | Towed Bongo (over stern) |
| 21 Jan | 21:00 | 00:00 | MOCNESS |
| 22 Jan | 00:00 | 00:30 | FRRF |
| 22 Jan | 01:00 | 04:00 | LHPR |
| 22 Jan | 04:00 | 07:00 | Full depth CTD |
| 22 Jan | 07:00 | 07:40 | Bongo |
| 22 Jan | 07:40 | 08:20 | Bongo |
| 22 Jan | 08:20 | 09:00 | Mini-Bongo |
| 22 Jan | 09:00 | 09:40 | Mini-Bongo |
| 22 Jan | 09:40 | 10:15 | CTD for Pete Ward (Oithona) |

11:00 (local) 22 Jan to 07:00 (local) 23 Jan

General plan: To carry out CTDs along transect towards station P2, assessing the suitability of conditions for RMT25 deployments at each station (subsequent timings will change if a decision is made to carry out RMT25 deployments)

| Date | Start (local) | End (local) | Activity |
|-------------------|---------------|-------------|--|
| 22 Jan | 11:00 | 13:00 | Passage to CTD posn. 21 |
| 22 Jan | 13:00 | 16:00 | CTD posn. 21 (then conditions to be assessed for suitability of RMT25 deployments; move on if unsuitable) |
| 22 Jan | 16:00 | 18:00 | Passage to CTD posn. 22 |
| 22 Jan | 18:00 | 21:00 | CTD posn. 22 (then conditions to be assessed for suitability of RMT25 deployments; move on if unsuitable) |
| 22 Jan | 21:00 | 23:00 | Passage to CTD posn. 23 |
| 22 Jan/ 23 Jan | 23:00 | 02:00 | CTD posn. 23 (then conditions to be assessed for suitability of RMT25 deployments; move on if unsuitable) |
| 23 Jan | 02:00 | 04:00 | Passage to CTD posn. 24 |
| 23 Jan | 04:00 | 07:00 | CTD posn. 24 (then conditions to be assessed for suitability of RMT25 deployments; move on if unsuitable) |

16:00 (local) 23 Jan to 08:00 (local) 24 Jan

General plan: Arrive at station P2, carry out CTDs and other activities as dictated by weather conditions. Assess suitability of mooring retrieval at first light, else start mesoscale survey

| Date | Start (local) | End (local) | Activity |
|--------|---------------|-------------|---|
| 23 Jan | 16:00 | 19:00 | Full depth CTD at CTD posn 25 |
| 23 Jan | 19:00 | 21:00 | Passage to station P2 |
| 23 Jan | 21:00 | 00:00 | Full depth CTD |
| 24 Jan | 00:00 | 00:30 | FRRF (weather permitting) |
| 24 Jan | 00:30 | 02:00 | Sit over mooring for acoustic data collection |
| 24 Jan | 02:00 | 04:00 | CTD for Dave Pond |
| 24 Jan | 04:00 | 06:40 | Bongos and mini Bongos (weather permitting, else sit over mooring for acoustic data collection) |
| 24 Jan | 06:40 | 07:20 | CTD for Pete Ward (not to be carried out unless Bongos go ahead) |
| 24 Jan | 08:00 | | Assess weather conditions for either (i) mooring retrieval or (ii) mesoscale survey |

08:45 (local) 25 Jan to 16:00 (local) 25 Jan

General plan: Start sampling activities at station P2 before retrieving mooring

| Date | Start (local) | End (local) | Activity |
|--------|---------------|---|-----------------------------|
| 25 Jan | 08:45 | 11:00 | Full depth CTD |
| 25 Jan | 11:15 | 11:55 | Bongo |
| 25 Jan | 11:55 | 12:35 | Bongo |
| 25 Jan | 12:35 | 13:15 | Mini-Bongo |
| 25 Jan | 13:15 | 13:55 | Mini Bongo |
| 25 Jan | 14:00 | 14:30 | FRRF |
| 25 Jan | 14:30 | 15:00 | CTD for Pete Ward (Oithona) |
| 25 Jan | 15:00 | 16:00 | GoFlos |
| 25 Jan | 16:00 | Assess conditions for mooring retrieval | |

16:00 (local) 25 Jan to 00:30 (local) 28 Jan

General plan: Mooring recovery, mesoscale survey then start sampling activities at station P2

| Date | Start (local) | End (local) | Activity |
|-------------------|---------------|-------------|---|
| 25 Jan | 16:00 | 20:00 | Mooring recovery |
| 25 Jan | 20:00 | 22:00 | Towed Bongos |
| 25 Jan | 22:00 | 00:00 | Relocation to start of mesoscale survey |
| 26 Jan/ 27 Jan | 00:00 | 00:00 | Mesoscale survey (ending 3nm downwind of P2) |
| 27 Jan | 00:00 | 00:30 | FRRF (at 3nm downwind of P2) |
| 27 Jan | 00:30 | 05:00 | RMT25 (Deep) <i>(else LHPR if conditions marginal)</i> |
| 27 Jan | 05:00 | 07:00 | CTD for Dave Pond (2000 m) |
| 27 Jan | 07:00 | 07:40 | Bongo |
| 27 Jan | 07:40 | 08:20 | Bongo |
| 27 Jan | 08:20 | 09:00 | Bongo (for Nina) |
| 27 Jan | 09:00 | 09:40 | Mini Bongo |
| 27 Jan | 09:40 | 10:20 | Mini Bongo |
| 27 Jan | 10:20 | 11:00 | Mini Bongo (for Nina) |
| 27 Jan | 11:00 | 15:30 | RMT25 (Deep) <i>(else LHPR if conditions marginal)</i> |
| 27 Jan | 15:30 | 18:00 | RMT25 (Shallow) <i>(else MOCNESS if conditions marginal)</i> |
| 27 Jan | 18:00 | 22:00 | Target fishing (RMT8 then RMT25) |
| 27 Jan/ 28 Jan | 22:00 | 00:30 | RMT25 (shallow) <i>(else MOCNESS if conditions marginal)</i> |

12:00 (local) 27 Jan to 04:00 (local) 29 Jan

General plan: Complete station activities for P2 and redeploy mooring

| Date | Start (local) | End (local) | Activity |
|----------------------|------------------|--|------------------------|
| 27 Jan | 12:30 | 17:00 | RMT25 (Deep) |
| 27 Jan | 17:00 | 19:30 | RMT25 (Shallow) |
| 27 Jan | 19:30 | 22:00 | Target fishing (RMT25) |
| 27 Jan/ 28 Jan | 22:00 | 02:30 | RMT25 (Deep) |
| 28 Jan | 02:30 | 05:00 | RMT25 (Shallow) |
| 28 Jan | 05:00 | 08:00 | LHPR |
| 28 Jan | 08:00 | 11:00 | Target fishing (RMT8) |
| 28 Jan | 11:00 | 19:00 | Mooring redeployment |
| 28 Jan | 19:00 | 22:00 | Target fishing (RMT8) |
| 28 Jan/ 29 Jan | 22:00 | 01:30 | MOCNESS |
| 29 Jan | 01:45 | 04:00 | LHPR |
| 29 Jan | 04:00 | Transit to CTD station 27 looking for krill targets en route (RMT8 set up on back deck) | |

04:00 (local) 29 Jan to 18:00 (local) 31 Jan

General plan: Transit to station P3, pick up mooring, carry out mesoscale survey.
Note there will potentially be stops for krill target fishing between CTD stations

| Date | Start (local) | End (local) | Activity |
|----------------------|------------------|----------------|--|
| 29 Jan | 04:00 | 08:00 | Transit to CTD posn 28 |
| 29 Jan | 08:00 | 11:00 | CTD 28 (full depth) |
| 29 Jan | 11:00 | 13:00 | Transit to CTD posn 29 |
| 29 Jan | 13:00 | 15:00 | CTD 29 (full depth) |
| 29 Jan | 15:00 | 17:00 | Transit to CTD posn 30 |
| 29 Jan | 17:00 | 17:30 | Bongo (vertical, 200 m) at posn 30 |
| 29 Jan | 17:30 | 18:30 | CTD 30 (full depth) |
| 29 Jan/ 30 Jan | 18:30 | 02:30 | Transit to CTD posn 31, with krill survey and fishing en route |
| 30 Jan | 02:30 | 03:00 | Bongo (vertical, 200 m) at posn 31 |
| 30 Jan | 03:00 | 05:00 | CTD 31 (full depth) |
| 30 Jan | 05:00 | 07:00 | Transit to CTD posn 32 |
| 30 Jan | 07:00 | 09:00 | CTD 32 (full depth) |
| 30 Jan | 09:00 | 11:00 | Transit to mooring at P3 |
| 30 Jan | 11:00 | 12:00 | Locate mooring then CTD to 400 m at mooring site |
| 30 Jan | 12:00 | ~18:00 | Mooring recovery |
| 30 Jan/ 31 Jan | ~18:00 | ~18:00 | Mesoscale survey (Note: mesoscale survey to start as soon as mooring recovered) |

12:30 (local) 31 Jan to 11:00 (local) 01 Feb

General plan: Pick up mooring and start core-sampling activities at station P3

| Date | Start (local) | End (local) | Activity |
|--------|---------------|-------------|--|
| 31 Jan | 12:30 | ~18:00 | Mooring recovery |
| 31 Jan | ~18:00 | 21:00 | Target fishing for krill RMT8 Note: this will start as soon as practicable after mooring recovery |
| 31 Jan | 21:00 | 00:00 | MOCNESS |
| 1 Feb | 00:00 | 01:00 | FRRF |
| 1 Feb | 01:00 | 04:00 | LHPR |
| 1 Feb | 04:00 | 07:00 | CTD (full depth) |
| 1 Feb | 07:00 | 07:40 | Bongo (400 m) |
| 1 Feb | 07:40 | 08:20 | Bongo (400 m) |
| 1 Feb | 08:20 | 08:40 | Bongo (200 m) |
| 1 Feb | 08:40 | 09:20 | Mini Bongo (400 m) |
| 1 Feb | 09:20 | 10:00 | Mini Bongo (400 m) |
| 1 Feb | 10:00 | 10:20 | Mini Bongo (200 m) |
| 1 Feb | 10:20 | 11:00 | CTD Oithona |

11:00 (local) 1 Feb to 13:00 (local) 02 Feb

General plan: Continue core-sampling activities at station P3

| Date | Start (local) | End (local) | Activity |
|-----------------|------------------|----------------|----------------------------|
| 1 Feb | 11:00 | 13:30 | LHPR + Towed Bongo |
| 1 Feb | 14:00 | 14:30 | FRRF |
| 1 Feb | 14:30 | 15:30 | GoFlo bottles |
| 1 Feb | 15:30 | 18:00 | MOCNESS |
| 1 Feb | 18:00 | 20:00 | CTD for Dave Pond (2000 m) |
| 1 Feb/ 2 Feb | 20:00 | 00:30 | RMT25 (Deep) |
| 2 Feb | 00:30 | 03:00 | RMT25 (Shallow) |
| 2 Feb | 03:00 | 03:40 | Bongo (400 m) |
| 2 Feb | 03:40 | 04:20 | Bongo (400 m) |
| 2 Feb | 04:20 | 05:00 | Mini-Bongo (400 m) |
| 2 Feb | 05:00 | 05:40 | Mini-Bongo (400 m) |
| 2 Feb | 06:00 | 10:30 | RMT25 (Deep) |
| 2 Feb | 10:30 | 13:00 | RMT25 (Shallow) |

09:00 (local) 2 Feb to 00:15 (local) 03 Feb

General plan: Complete core-sampling activities at P3 and redeploy mooring

| Date | Start (local) | End (local) | Activity |
|-------|------------------|---|----------------------|
| 2 Feb | 09:00 | 13:30 | RMT25 (Deep) |
| 2 Feb | 14:00 | 16:30 | RMT25 (Shallow) |
| 2 Feb | 17:00 | 21:00 | Mooring redeployment |
| 2 Feb | 21:30 | 00:00 | RMT25 (Shallow) |
| 3 Feb | 00:15 | Target fishing en route to R3 (Exact location of R3 to be determined depending on latest satellite info) | |

06:00 (local) 03 Feb to 11:15 (local) 04 Feb

General plan: Start small-scale survey and then core-sampling activities at station R3

| Date | Start (local) | End (local) | Activity |
|-------|---------------|-------------|---|
| 3 Feb | 06:00 | 12:30 | Small scale survey around R3 (including acoustic towfish) |
| 3 Feb | 12:30 | 14:00 | Krill target fishing (RMT8) |
| 3 Feb | 14:00 | 14:30 | FRRF |
| 3 Feb | 14:30 | 16:00 | GoFlos |
| 3 Feb | 16:00 | 18:30 | MOCNESS |
| 3 Feb | 18:30 | 21:00 | RMT8 Target fishing |
| 3 Feb | 21:00 | 00:00 | MOCNESS |
| 4 Feb | 00:00 | 00:30 | FRRF |
| 4 Feb | 01:00 | 04:00 | LHPR |
| 4 Feb | 04:00 | 07:00 | CTD (Full depth) |
| 4 Feb | 07:00 | 07:40 | Bongo (400 m) |
| 4 Feb | 07:40 | 08:20 | Bongo (400 m) |
| 4 Feb | 08:20 | 08:40 | Bongo (200 m) |
| 4 Feb | 08:40 | 09:20 | Mini Bongo (400 m) |
| 4 Feb | 09:20 | 10:00 | Mini Bongo (400 m) |
| 4 Feb | 10:00 | 10:20 | Mini Bongo (200 m) |
| 4 Feb | 10:30 | 11:00 | CTD (Oithona; 400 m) |

11:30 (local) 04 Feb to ~12:00 (local) 05 Feb

General plan: Complete core-sampling activities at Station R3

| Date | Start (local) | End (local) | Activity |
|-----------------|---------------|------------------|--|
| 4 Feb | 11:30 | 13:00 | LHPR |
| 4 Feb | 13:00 | 20:00 | Krill target fishing (RMT 8) RMT25 stratified hauls may take up the remainder of this slot if needs for krill have first been satisfied |
| 4 Feb/ 5 Feb | 20:00 | 00:30 | RMT25 (Deep) |
| 5 Feb | 00:30 | 03:00 | RMT25 (Shallow) |
| 5 Feb | 03:00 | 03:40 | Bongo (400 m) |
| 5 Feb | 03:40 | 04:20 | Bongo (400 m) |
| 5 Feb | 04:20 | 05:00 | Mini Bongo (400 m) |
| 5 Feb | 05:00 | 05:40 | Mini Bongo (400 m) |
| 5 Feb | 06:00 | Until completion | Remaining RMT25 daytime hauls |

14:00 (local) 05 Feb to 11:00 (local) 07 Feb

General plan: Transit to R4, commence sampling activities with RMT25 netting

| Date | Start (local) | End (local) | Activity |
|-----------------|------------------|----------------|---|
| 5 Feb/ 6 Feb | 14:00 | 14:30 | Transit to R4 (XBTs en route) |
| 6 Feb | 15:00 | 18:30 | RMT25 (Deep) |
| 6 Feb | 19:00 | 21:30 | RMT25 (Shallow) |
| 6 Feb/ 7 Feb | 21:30 | 05:00 | Target fishing for myctophids (RMT25 or RMT8, depending on conditions) |
| 7 Feb | 05:00 | 08:00 | LHPR |
| 7 Feb | 08:00 | 11:00 | CTD (full depth) |

04:00 (local) 09 Feb to 04:00 (local) 10 Feb

General plan: Carry out deployments in NW South Georgia area

| Date | Start (local) | End (local) | Activity |
|---------------------|------------------|----------------|---------------------------|
| 9 Feb | 04:00 | 07:30 | Deploy whale moorings |
| 9 Feb | 07:30 | 10:00 | RMT8 krill fishing |
| 9 Feb | 10:00 | 11:00 | CTD (full depth) |
| 9 Feb | 11:00 | 11:30 | Bongo |
| 9 Feb | 11:30 | 12:00 | Bongo |
| 9 Feb | 12:00 | 12:30 | Mini Bongo |
| 9 Feb | 12:30 | 13:00 | Mini Bongo |
| 9 Feb | 13:00 | 13:30 | FRRF |
| 9 Feb | 13:30 | 14:00 | CTD Oithona |
| 9 Feb | 14:00 | 15:00 | Go-Flos |
| 9 Feb | 15:30 | 18:00 | MOCNESS above WCB mooring |
| 9 Feb | 18:00 | 21:00 | RMT8 krill fishing |
| 9 Feb/ 10 Feb | 21:30 | 00:00 | RMT25 at Station A |
| 10 Feb | 00:30 | 01:00 | FRRF |
| 10 Feb | 01:00 | 04:00 | RMT8 krill fishing |

04:00 (local) 10 Feb to 06:00 (local) 12 Feb

General plan: Carry out PAX uplifts, acoustic calibration and DIMES series CTDs

| Date | Start (local) | End (local) | Activity |
|-------------------------|------------------|----------------|---|
| 10 Feb | 04:00 | 08:00 | Transit to Bird Island |
| 10 Feb | 08:00 | 12:00 | Uplift of PAX |
| 10 Feb | 12:00 | 18:00 | Transit to Stromness Harbour |
| 10 Feb/ 11 Feb | 18:00 | 09:00 | Acoustic calibration |
| 11 Feb | 09:00 | 15:00 | Transit to CTD posn SG_5 |
| 11 Feb | 15:00 | 18:00 | CTD posn SG_5 (full depth) |
| 11 Feb | 18:00 | 19:00 | Transit to CTD Posn SG_4 |
| 11 Feb | 19:00 | 22:00 | CTD posn SG_4 (full depth) |
| 11 Feb | 22:00 | 23:00 | Transit to CTD Posn SG_3 |
| 11 Feb/ 12 Feb | 23:00 | 01:00 | CTD posn SG_3 (full depth) |
| 12 Feb | 01:00 | 02:00 | Transit to CTD Posn SG_2 |
| 12 Feb | 02:00 | 03:30 | CTD posn SG_2 (full depth) |
| 12 Feb | 03:30 | 04:30 | Transit to CTD Posn SG_1 |
| 12 Feb | 04:30 | 06:00 | CTD posn SG_1 (full depth) |
| 12 Feb | 06:00 | | Break off for Hound Bay and KEP logistics |

17.11 JR177 strategy for mesoscale surveys 19/03/2007

Present: Keith Reid (KR), Mike Meredith (MM), Jon Watkins (JW) and Sophie Fielding (SF)

This meeting was conducted to devise the mesoscale survey design around each station.

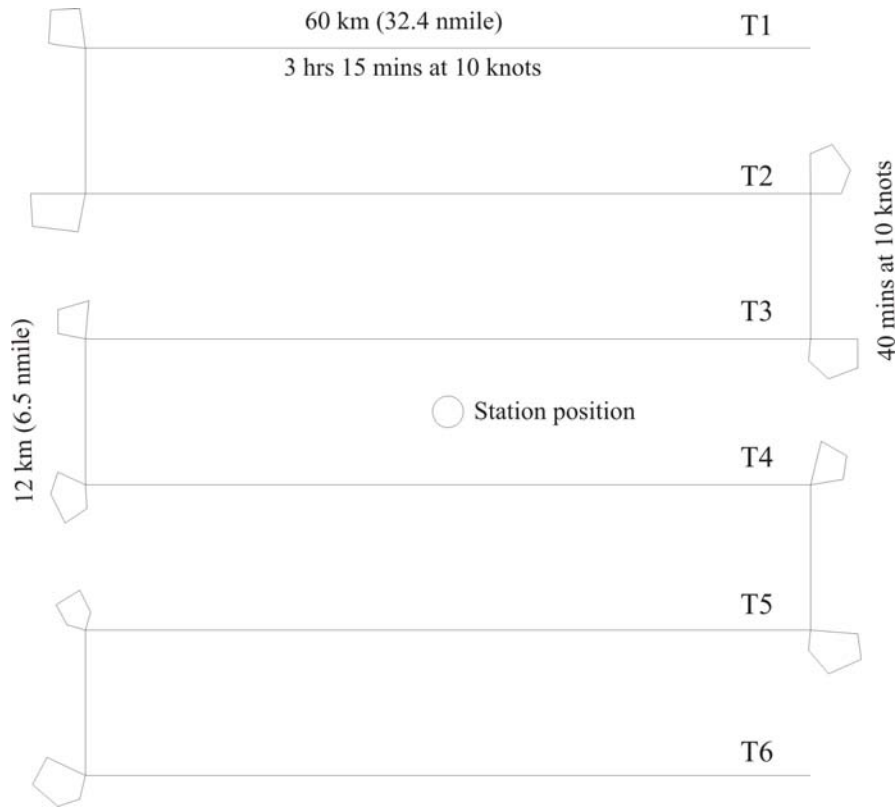
The actual design of the mesoscale survey

The following factors were considered when devising the strategy.

- 1) The MVP will not be used – rather the UOR will be. This results in shallower profiles of CTD and fluorometer information. The speed of the ship towing the UOR is limited to 10 knots. It was decided that additional depth could be added to the data by undertaking XBTs at judicious (i.e. points where they were likely to succeed) locations during the survey. In particular the loops undertaken at the end of each transect would force the UOR to the side of the ship probably permitting a full depth XBT to be undertaken without shorting on the towed body.
- 2) The resolution of the survey was discussed. Eventually it was decided that to resolve the physical environment surrounding each process station a mesoscale survey would be preferred. That is, given that the occupation of a station took a few days this scale was equal to the mesoscale spatial scale of 10's of km. Ultimately transects of at least 50 km were requested with a space of ~10 km between. Predator observations requested that any transects were spaced at greater than ~ 5km intervals (i.e. beyond eye sight) so that repeat observations were not undertaken. Acoustic observations requested that a repeat of some of JR161s transects was undertaken – this is simple, given that it mostly consisted of one 50 km transect through the station.
- 3) The orientation of the survey could be considered from various angles (cross front, cross transect etc). However, it was decided that the strategy adopted in JR161 (to head in the direction that creates the best quality data set) was as good as any other.
- 4) Predator observations are limited to the day time – likewise consistent acoustic observations. However core transects to be undertaken during the day could be identified.
- 5) The total duration of these surveys was likely to be a 24 hour period. A minimum of 20 hours at each station

The below was devised based on the factors above. Initially 10 km resolution was suggested for between transects. 12 km resolution would permit a larger area to be surveyed within an acceptable amount of time. The below survey would take approximately 28 hours (5 hours of which is transit time to the start and from the end to the station position). A similar survey box of six 50 km transects with a spacing of 10 km between would take approximately 23 hours to complete, this does not include the time required to undertake the turns at each end of the transects.

The orientation would be to undertake the long transects up or downwind. Given that there is not a 24 hour period of daylight during this 24 hours, it would be expected/hoped that the survey would start at a time that would ensure the commencement of transect T2 or T3 at dawn so that acoustic and predator observations in the core area of the survey could be undertaken in daylight.



A long transect versus more in-depth survey around each station

The depth of information collected by the UOR is limited to 140 m. It was decided that this was too shallow to provide a useful long transect for JR177. It was therefore decided that increased time at the stations undertaking mesoscale surveys around would be more beneficial to providing data that would set the physical variability around each station.

It was hoped that, if the P1 transect was deemed unnecessary, the XBTs from this transect would be used during the mesoscale surveys.

Creation of a “UOR action group”

The UOR will require some spin-up time for its use on JR177. The last use of the UOR, it is thought, was on JR116 and there are questions regarding certain components of the instrument and whether these need additional work on. SF will progress with this action. *It is suggested that UOR team consists of Pete Enderlein, Nathan Cunningham, Jon Watkins, Physical Oceanographer (new person?), Sophie Fielding.*

Additional points

KR suggested that at least two predator observers (or one dedicated and one very capable helper) would be required to undertake the surveys as described above in addition to the observations undertaken during the nets.

17.12 Cruise Planning Questionnaire Form



[Return] [Showing : Completed fields only] [Goto : Show Complete Form] [Goto : Empty Form All Fields]

| | |
|--|--|
| | NATURAL ENVIRONMENT RESEARCH COUNCIL |
| | Profile ID : 240 PS : Geraint Tarling Questionnaire Submission Date : |

Cruise Planning Questionnaire Form (Questionnaire or QUE)

| | |
|------------------------------|----------------------|
| Cruise Number : | JR177 |
| Institution : | BAS |
| PI Last Name : | Tarling |
| Vessel : | RRS James Clark Ross |
| Sail date : | 30-12-2007 |
| Dock date : | 14-02-2008 |
| Cruise working area : | S Atlantic |

| TABLE : CRUISE ITINERARY - for PROFILE 240 | | | | | |
|--|-----------------|------------------|----------------------|------------------|-------------------|
| JR177 RRS James Clark Ross 46Days S Atlantic Profile (240) View SME Tarling BAS | Mob Date | Sail Date | Mid Port Date | Dock Date | DeMob Date |
| | 28-12-2007 | 30-12-2007 | | 14-02-2008 | 14-02-2008 |
| | MobPort | Sail Port | Mid Port | Dock Port | DeMob Port |
| | Stanley | Stanley | | Stanley | Stanley |

PART 1 : Equipment Pool SECTION A : Portable Equipment

| 1. Chemistry | | QUE PART 1 : Equipment Pool SECTION A : Portable Equipment |
|--|--|---|
| 1.1 Clean chemistry laboratory container. | | Yes |
| 1.6 Underway water sampling system (Trace Metal Spec). | | Yes |

| 4. Sensors and Moorings. | | <small>QUE PART 1 : Equipment Pool SECTION A : Portable Equipment</small> |
|---|--|---|
| 4.1 Moorings & mooring instrumentation. | | Yes |
| 4.3 CTD / rosette sampler systems (Stainless steel). | | Yes |
| 4.3 CTD / rosette sampler systems (Titanium). | | Yes |
| 4.5 Moving vessel profiler (MVP300). | | Yes |
| 4.6 CI FASTRACKA FRRF. | | Yes |
| 4.11 SC ADCP RDI WH sentinel 300 kHz (6000m depth rating - 2 off). | | Yes |
| 4.11 L ADCP RDI WH monitor 300kHz (6000m depth rating - 2 off). | | Yes |
| 5. Miscellaneous | | <small>QUE PART 1 : Equipment Pool SECTION A : Portable Equipment</small> |
| 5.2 Gas bottle storage racks. | | Yes |

PART 1 : Equipment Pool SECTION B : Ship Fitted Equipment

| 4. RRS James Clark Ross | | <small>QUE PART 1 : Equipment Pool SECTION B : Ship Fitted Equipment</small> |
|--|--|--|
| Seismic Air Compressor / Delivery Systems is required. | | |
| Computing Systems [scientific data acquisition] are required. | | Yes |
| Pumped Sea Water Sampling System [from 6m depth] is required. | | Yes |
| Sea Surface Monitoring System [salinity, temperature, transmissometer, fluorimeter] are required. | | Yes |
| Meteorology Monitoring Package is required. | | Yes |
| 150 kHz Hull Mounted ADCP System is required. | | Yes |
| SIMRAD EM120 Swath Bathymetry System is required. | | Yes |
| SIMRAD EK500 Echo Sounder is required. | | Yes |
| SIMRAD EK60 Echo Sounder is required. | | Yes |
| DPS is required. | | Yes |

PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions

| | | |
|--|-----|--|
| 1.1 Clean Chemistry Containers | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
| Do you require a Laminar Flow Hood. | Yes | |
| Do you require a container Millipore. | Yes | |
| Do you require compressed air/other gas. | | |
| Please state below any specific container layout/requirements, and preference of deck installation i.e. Aft deck, upper deck etc: | | |
| We request a rack in the clean container for OTE bottles | | |
| How many UKORS alarm boards required. UKORS use only. | | |
| Deck bed plates/deck shoes required. UKORS use only. | | |
| State location of containers on deck. UKORS use only. | | |
| | | |
| Please give additional details on the use of the Clean Chemistry Container. | | |
| Underway sampling system deployed on the JCR starboard quarter is to pump water to the clean container | | |
| 1.6 Underway Water Sampling System (Trace Metal Spec.) | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
| What equipment do you require to use the Underway Water Sampling System with. | | |
| Underway sampling system deployed on the JCR starboard quarter is to pump water to the clean container for trace metal analysis | | |

| 4.1 Sensors and Moorings | | QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions |
|---|-------------------|--|
| Uploaded file containing a mooring map. | No files uploaded | |
| List type and number of sensors requested from UKORS equipment pool. | | |
| We would like 2 x 300 kHz sentinel ADCPs to mount on existing moorings that are currently deployed in the survey area and will be recovered and redeployed on this cruise. The moorings are designed and constructed by BAS who are also responsible for their deployment and recovery. | | |
| Give details of sensor ranges/resolutions (in meters). | | |
| 200m range, 4m bin depths | | |
| State sensor depths (in meters, from surface, or heights off bottom). | | |
| 3500m water depth, sensor depths within this range | | |
| State the duration of mooring deployment. | | |
| 12months | | |
| Geographical location of mooring deployment. | | |
| 54degS, 39degW 53degS, 39degW | | |
| Details of topography at mooring site. | | |
| Flat | | |
| Details of current profile extremes. | | |
| N/A | | |
| Is Argos mooring monitoring required | | |
| BAS will monitor this | | |
| Are budgetary constraints to be applied to mooring design. | | |
| N/A | | |
| Please state proposed recovery ship. | | |
| JCR | | |
| Please add any further comments as required. | | |
| | | |

| 4.3 CTD Systems (Stainless Steel) | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
|---|---|--|
| Do you require a 12 or 24 bottle frame/rosette. | 24 | |
| Do you wish to carry out trace metal work. | | |
| Do you wish to carry out CFC work. | | |
| Do you require 10Ltr or 20Ltr bottles for the CTD frame. | 20 | |
| Do you require GOFLO bottles to be fitted to the CTD frame. | | |
| 1. Seabird 911 CTD : | Yes | |
| 2. Transmissometer : | Yes | |
| 3. Fluorimeter : | Yes | |
| 4. Oxygen sensor : | Yes | |
| 5. Light scatter sensor : | Yes | |
| 6. PAR sensor ; | Yes | |
| 7. Pinger : | Yes | |
| 8. Altimeter : | Yes | |
| 9. Other : | | |
| Estimate the maximum number of deployments. | 40 | |
| Estimate the minimum depth for casts (in meters). | 200 | |
| Estimate the maximum depth for casts (in meters). | 3500 | |
| Estimate the salinity samples numbers per casts. | 10 | |
| Do you require UKORS to supply salinity bottles and caps. | | |
| Estimate salinity samples to be taken per day from online sea water supply. | | |
| Specify what level of support you want from UKORS staff for salinity sampling. | None - BAS will undertake salinity analyses | |
| Do you require UKORS to supply standard sea-water for salinity sampling. | | |
| Do you anticipate continuous 24hr CTD operations. | | |
| Specify any additional requirements for the CTD system. | | |
| <p>We require both the stainless steel CTD system and the titanium CTD system with the following requirements: Stainless steel system: We require a 24 bottle rosette, CTD system and frame that is additionally able to house upward and downward looking 300 kHz LADCPs (supplied as part of this agreement). This would include all required mounting brackets and battery packs. Titanium system: We require a 24 bottle (OTE) titanium CTD frame, rosette and associated bottles and sensors compatible with sampling trace metals (in particular iron) - including OTE bottles and a cover for the CTD to keep it clean. We request 6 GOFLO bottles to use as an alternative for collecting "clean" water, plus messengers, deck winch, weight, 1000m kevlar or plastic coated rope and meter sheave. Please note that the CTD annex on the JCR is not large enough to house 2 CTD rosettes, hence the CTD track system is additionally requested.</p> <p>PI will investigate a method for measuring depth during the go-flo bottle deployments e.g. BAS SVP, microcat, pressure sensor, CTD etc.</p> | | |

| 4.3 CTD Systems (Titanium) | | QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions |
|---|------|--|
| Do you require a 12 or 24 bottle frame/rosette. | 24 | |
| Do you wish to carry out trace metal work. | Yes | |
| Do you wish to carry out CFC work. | | |
| Do you require GOFLO bottles to be fitted to the CTD frame. | | |
| 1. Seabird 911 CTD : | Yes | |
| 2. Transmissometer : | Yes | |
| 3. Fluorimeter : | Yes | |
| 4. Oxygen sensor : | Yes | |
| 5. Light scatter sensor : | Yes | |
| 6. PAR sensor ; | Yes | |
| 7. Pinger : | Yes | |
| 8. Altimeter : | Yes | |
| 9. Other : | | |
| Estimate the maximum number of deployments. | 40 | |
| Estimate the minimum depth for casts (in meters). | 200 | |
| Estimate the maximum depth for casts (in meters). | 3500 | |
| Estimate the salinity samples numbers per casts. | | |
| Do you require UKORS to supply salinity bottles and caps. | | |
| Do you require any support from UKORS staff for salinity sampling. | | |
| Do you require UKORS to supply standard sea-water for salinity sampling. | | |
| Do you anticipate continuous 24hr CTD operations. | | |
| Specify any additional requirements for the CTD system. | | |
| <p>We require both the stainless steel CTD system and the titanium CTD system with the following requirements: Stainless steel system: We require a 24 bottle rosette, CTD system and frame that is additionally able to house upward and downward looking 300 kHz LADCPS (supplied as part of this agreement). This would include all required mounting brackets and battery packs. Titanium system: We require a 24 bottle (OTE) titanium CTD frame, rosette and associated bottles and sensors compatible with sampling trace metals (in particular iron) - including OTE bottles and a cover for the CTD to keep it clean. We request 6 GOFLO bottles to use as an alternative for collecting "clean" water, plus messengers, deck winch, weight, 1000m kevlar or plastic coated rope and meter sheave. Please note that the CTD annex on the JCR is not large enough to house 2 CTD rosettes, hence the CTD track system is additionally requested.</p> <p>PI will investigate a method for measuring depth during the go-flo bottle deployments e.g. BAS SVP, microcat, pressure sensor, CTD etc.</p> | | |

| | | |
|--|---------|--|
| 4.5 Moving Vessel Profiler (MVP) | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
| 1. AML CTD : | Yes | |
| 2. Oxygen sensor : | Yes | |
| 3. Fluorometer : | Yes | |
| 4. Up and downward TIR : | Yes | |
| 5. Tilt & roll : | Yes | |
| 1. AML CTD : | | |
| 2. Satlantic nutrient sensor : | | |
| 3. Up and downward TIR : | | |
| 4. Tilt & roll : | | |
| 5. Flourometer : | | |
| 6. Oxygen : | | |
| Estimate length of survey line(s) (in nautical miles). | 750 | |
| Estimate number of deployments. | 13 | |
| Please give any additional details of your required use of this equipment. | | |
| 1 long transect of 750 nm and up to 12 shorter transects of ~200 nm | | |
| 4.6 CI FASTRACKA FRRF | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
| How many FRRF's do you require. | 1 | |
| Do you plan to use an FRRF deployed on a frame. | Yes | |
| Do you plan to use an FRRF vehicle mounted. | | |
| Do you plan to use an FRRF bench mounted. | | |
| Please give any additional details of your required use of this equipment. | | |
| We require a frame for FRRF deployment and associated weights | | |
| 4.11 SC ADCP / L ADCP option - SC ADCP RDI WH Sentinel 300 kHz | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
| How many requested. | 2 | |
| How do you wish to deploy the instruments. | Mooring | |
| Please give additional details about the use of the SC ADCP / L ADCP. | | |
| These ADCPs are to be placed on BAS moorings that will be deployed for a 14 month period | | |

| | | |
|--|------------------|--|
| 4.11 SC ADCP / L ADCP option - L ADCP RDI WH Monitor 300kHz | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
| How many requested. | 2 | |
| How do you wish to deploy the instruments. | Fixed to a frame | |
| Please give additional details about the use of the SC ADCP / L ADCP. | | |
| We require the brackets and batteries for an upward and downward looking 300 kHz monitor LADCP to be fitted to the stainless steel 24 bottle frame | | |
| 5.2 Compressed Gas Bottle Storage Racks | | <small>QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions</small> |
| Estimate numbers gas bottles to be stored. | | |
| Please indicate the sizes of gas bottles to be stored. | | |
| | | |

PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions

| | | |
|---|-----|--|
| Surface Pumped Sea-water Sampling System | | <small>QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions</small> |
| Is the requirement for continuous use throughout the cruise. | Yes | |
| What equipment is to be used with this water supply. | | |
| Underway sampling will be undertaken by BAS | | |

| | | |
|---|-----|--|
| Sea Surface Monitoring System | | <small>QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions</small> |
| Salinity : | Yes | |
| Surface Temp : | Yes | |
| Transmission : | Yes | |
| Fluorescence : | Yes | |
| Please give additional details about the use of the Sea Surface Monitoring System. | | |
| | | |

| | | |
|--|-----|--|
| Meteorology Monitoring Package | | <small>QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions</small> |
| Wind direction/speed : | Yes | |
| Barometric pressure : | Yes | |
| Air temp/humidity : | Yes | |
| Light meters : TIR - Total irradiance | Yes | |
| Light meters : PAR - Photo synthetic radiation | Yes | |
| Please give additional details about the use of the Meteorology Monitoring Package. | | |
| | | |

| | | |
|--|--|--|
| 150kHz Acoustic Doppler Current Profiler (ADCP) | | <small>QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions</small> |
| Bin numbers : | | |
| BAS scientists will manage this instrument | | |
| Preferred Software : | | |

| | | |
|--|--|--|
| SIMRAD EK60 - Fisheries Echo Sounder (18,38,70,120 & 200 kHz) | | <small>QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions</small> |
| Please add any additional details concerning the use of the SIMRAD EK60 - Fisheries Echo Sounder. | | |
| BAS scientists will manage this instrument | | |

| | | |
|--|---|--|
| Ship Fitted Systems - SIMRAD EM120 System | | <small>QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions</small> |
| How many days do you wish to use the SIMRAD EM120 System during the cruise | 1 | |
| Is the survey to be one continuous operation or broken into specific blocks | | |
| Do you require UKORS staff to process the data on board | | |
| Specify any additional requirements for the EM120 system. | | |
| BAS scientists will manage this instrument | | |

PART 1 : Equipment Pool SECTION E : Shipboard Fitted Computing

| | | |
|---|--------------------------------|---|
| Shipboard Fitted Computing Systems | | <small>QUE PART 1 : Equipment Pool SECTION E : Shipboard Fitted Computing</small> |
| Do you require user supplied equipment to be interfaced to the ships computing system (for data logging). | Yes | |
| Do you require data outputs from the ships computing systems to be connected to your equipment. E.g. Gyro, EM Log, GPS, ships clock etc. | Yes | |
| Specify data format for archive : | User Defined ASCII | |
| To what extent will you want any Seabird CTD data post-processed. | User to support own processing | |
| Please give additional details about the use of the Shipboard Fitted Computing Systems. | | |
| BAS will take charge of computer support and data management | | |

| | | |
|--|--|---|
| Data Logging Requirements | | <small>QUE PART 1 : Equipment Pool SECTION E : Shipboard Fitted Computing</small> |
| Please identify other sources to be logged. | | |
| BAS will log these variables as appropriate | | |

PART 2 : User Supplied Equipment SECTION A : User Supplied Equipment

PART 3 : Laboratory Space SECTION A : Laboratory Space

| | | |
|--|--|---|
| Laboratory Space | | <small>QUE PART 3 : Laboratory Space SECTION A : Laboratory Space</small> |
| Main Laboratory | | |
| BAS will take charge of allocation of equipment to areas on board. Provision of space to NMF instruments will be part of process | | |

PART 4 : Hazardous Substances SECTION A : Hazardous Substances

| | |
|--|---|
| 3. Compressed Gas | QUE PART 4 : Hazardous Substances SECTION A : Hazardous Substances |
| Please give additional details about the use of Compressed Gas. | |
| To be addressed during the meeting with NMF in March/April | |

PART 5 : Form Completion SECTION A : Freight Table

| TABLE : FREIGHT REQUIREMENTS - for PROFILE 240 | | | | | |
|--|-----------------------|-------------------|---------------|-------------|--------------|
| Transport type | Transport description | Dispatch location | Dispatch date | Destination | Arrival date |
| No freight information has been input. | | | | | |

PART 5 : Form Completion SECTION B : Mobilisation Table

| TABLE : STAFF MOBILISATION - for PROFILE 240 | | | | |
|--|------|-----------|--|-------------------|
| Technical support : | | | | |
| Mobilisation officers : | | | | |
| Mobilise | Date | Personnel | | Personnel Numbers |
| No mobilisation information has been input. | | | | |

PART 5 : Form Completion SECTION C : Outstanding Matters Relating to the Questionnaire

PART 5 : Form Completion SECTION D : Additional Uploads

PART 5 : Form Completion SECTION E : Progress form

[Return] [[Goto : Show complete form](#)]

Coversheet for FORM : QUE PROFILE : 240

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17.13 LHPR Deployment Log Sheet

| JR177 | Event number | Date | Station name |
|-------|-----------------|----------------------|-----------------|
| | Start latitude | End latitude | Water depth (m) |
| | Start longitude | End longitude | Wind strength |
| | Time (local) | Number of increments | Veer/Haul rate |
| | | | Comments |
| | Surface | | |
| | 1000 m | | |
| | 900 m | | |
| | 800 m | | |
| | 700 m | | |
| | 600 m | | |
| | 500 m | | |
| | 400 m | | |
| | 300 m | | |
| | 200 m | | |
| | 100 m | | |
| | Surface | | |

Ship's speed.....

Total number of increments at end of haul.....

17.14 MOCNESS Deployment Log Sheet

| | | | | | | |
|-----------------------|--------------------------------|-------------------------|-------------------------|--------------|-----------------|-----------------|
| JR177 | Event number | | Date | | Station name | |
| | Start latitude | | End latitude | | Water depth (m) | |
| | Start longitude | | End longitude | | Wind strength | |
| | Time at opening (local) | Depth opened (m) | Depth closed (m) | Catch | Fate | Comments |
| Net 1 | | | | | | |
| Net 2 | | | | | | |
| Net 3 | | | | | | |
| Net 4 | | | | | | |
| Net 5 | | | | | | |
| Net 6 | | | | | | |
| Net 7 | | | | | | |
| Net 8 | | | | | | |
| Net 9 | | | | | | |
| Time of closing Net 9 | | | | | | |

Haul rate on descent.....

Haul rate on ascent.....

Ship's speed.....

| |
|----------------|
| Other comments |
|----------------|

17.15 MOCNESS deployment protocol

Setting up in the UIC

Ship speed to be 2 knots, heading into wind

To pull up screen for MOCNESS, press SCROLL twice then 'down arrow' once

Double click "Shortcut to MOCNESS.EXE" icon

Make sure Biowire cable is connected to the back of the Deckbox then turn on

Go into "Acquisition setup", then "Real time Acquisition" then "Processed Filename". Find the appropriate folder (U:\DATA). Give an appropriate filename (eg R1DAY.PRO; C2NIGHT.PRO etc)

Go into "Select Environmental Sensors". Check that numbers of sensors are as follows: Temperature = 4620; Conductivity = 3244; Pressure = 166

Then go to set up sea cable

Go into "Plot Setup" then "Net trajectory plot". Change maximum time to present time + 4 h. Change minimum time to present time

Go into "Runtime options" then "Acquire Data (Run)" then "Start". The software will try to connect firstly to the Deckbox then to the net. Normally it establishes a 600 Baud communication rate

Press "Increment Net" button so that the net number goes from 0 to 1

You are now ready to deploy

Deployment

Send net down at 30 m/min

Stop net at 1000 m (if bathymetry allows). Press the "Step Net" button. The software should say "Step 1", "Step 2", "Step 3" in one of the white boxes. The computer will then make a loud extended noise indicating that the bar has fallen successfully and the next net is open. The parameter values will reset once this occurs (see troubleshooting if this does not happen)

Haul in at 20 m/min

| | |
|--------------------|-------|
| Close next nets at | 875 m |
| | 750 m |
| | 625 m |
| | 500 m |
| | 375 m |

250 m

125 m

5 m

Press the “End acquisition” button when net is at the surface (It may say it has lost communication at this point – Press “NO”, you do not want to restore communication)

Then turn off Deckbox before leaving to sort out the net (VERY IMPORTANT)

Remove sea cable

Troubleshooting

Could not connect to net –

Check that the tow cable coming from the net is connected up to the biowire

Check that the Biowire is connected to back of Deckbox (turn off Deckbox before doing this because it may be live)

No loud noise and increment after Stepping the net -

The net may have snagged or the response lever may have lost connection (it is often flakey). Carry on as normal but press the “Increment Net” button to reset parameters for the next net. Note this in the comments on the paper log

17.16 Uncontaminated Sea Water Log for JR177

| Date | Time (GMT) | Pump | Filter (In Use) | Probe Position | EVENT | REMARKS | Location/ Cruise No. |
|--------|------------|------|-----------------|----------------|----------------------------------|------------------------------------|-------------------------|
| 31-Dec | 19:05 | 1 | 1 | Mid | System On | Depart Stanley | JR177 |
| 01-Jan | | | | | | | JR177 |
| 2 | | | | | | | JR177 |
| 3 | 12:10 | 2 | 2 | Mid | Filters Changed over and Cleaned | 5 Krill ~ ¼ Full Of | JR177 |
| 4 | 23:25 | 2 | 1 | Mid | Filters Changed over and Cleaned | Krill | JR177 |
| 5 | 23:50 | 2 | 2 | Mid | Filters Changed over and Cleaned | ~ 30 Krill | JR177 |
| 6 | | | | | | | JR177 |
| 7 | 11:25 | 2 | 1 | Mid | Filters Changed over and Cleaned | ~ 1/8 Full Of Krill | JR177 |
| 8 | 20:57 | 2 | 2 | Mid | Filters Changed over and Cleaned | 6 Krill | JR177 |
| 9 | 17:30 | 2 | 2 | Mid | System Tripped Air/Ice | Approx time | JR177 |
| 9 | 17:45 | 2 | 2 | Mid | Filters Changed over and Cleaned | ~ 20 Krill | JR177 |
| 9 | 17:53 | 2 | 2 | Mid | System On | | JR177 |
| 10 | 18:44 | 2 | 1 | Mid | Filters Changed over and Cleaned | 6 Small Krill | JR177 |
| 11 | 9:10 | 2 | 1 | Mid | System Tripped | Ice | JR177 |
| 11 | 11:24 | 2 | 2 | Mid | Filters Changed over and Cleaned | Ice | JR177 |
| 11 | 11:24 | 2 | 2 | Mid | System On | | JR177 |
| 12 | | | | | | | JR177 |
| | 11:35 | 2 | 1 | Mid | Filters Changed over and Cleaned | ~ 40 Krill (mostly alive) | JR177 |
| 13 | | | | | | | JR177 |
| 14 | 11:22 | 2 | 2 | Mid | Filters Changed over and Cleaned | ~ 40 Krill | JR177 |
| | 18:38 | 2 | 1 | Mid | Filters Changed over and Cleaned | Filter surface full of Krill | JR177 |
| 15 | | | | | | | JR177 |
| 16 | 12:16 | 2 | 2 | Mid | Filters Changed over and Cleaned | ~ 1/8 Full Of Krill | JR177 |
| 17 | 13:53 | 2 | 1 | Mid | Filters Changed over and Cleaned | ~ 1/8 Full Of Krill | JR177 |
| 18 | 12:29 | 2 | 2 | Mid | Filters Changed over and Cleaned | 4 Krill | JR177 |
| 19 | 11:53 | 2 | 1 | Mid | Filters Changed over and Cleaned | 4 Krill & 6 Salps | JR177 |
| 20 | 19:42 | 2 | 2 | Mid | Filters Changed over and Cleaned | Clean | JR177 |
| 21 | 13:51 | 2 | 1 | Mid | Filters Changed over and Cleaned | Clean | JR177 |
| 22 | 18:53 | 2 | 2 | Mid | Filters Changed over and Cleaned | Clean | JR177 |
| | 4:12 | 2 | 2 | Mid | System Tripped | Gassed Up - Rough Seas | JR177 |
| 23 | | | | | | | JR177 |
| 23 | 4:33 | 2 | 2 | Mid | Filter Cleaned | Clean | JR177 |
| | 4:33 | 1 | 2 | Down | System Back On | Pumps Changed Over | JR177 |
| 23 | | | | | | | JR177 |
| 23 | 18:53 | 1 | 1 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 24 | 11:52 | 1 | 2 | Down | Filters Changed over and Cleaned | Clean | JR177 |

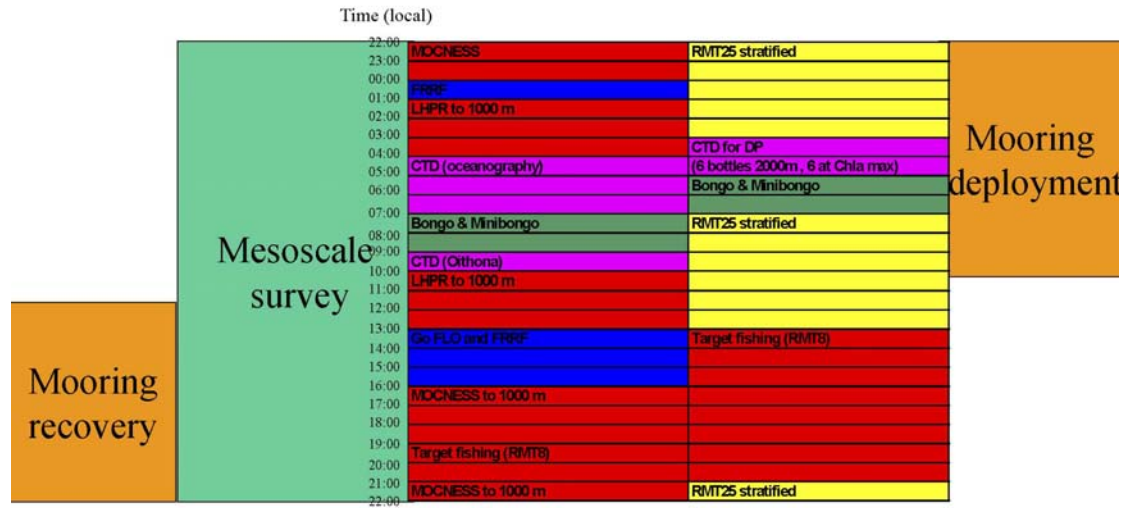
| | | | | | | | |
|--------|-------|---|---|------|----------------------------------|---------------------------|-------|
| 25 | 18:53 | 1 | 1 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 26 | 11:45 | 1 | 2 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 27 | 11:17 | 1 | 1 | Down | Filters Changed over and Cleaned | One Thermisto | JR177 |
| 28 | 17:35 | 1 | 2 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 29 | 19:00 | 1 | 1 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 30 | 11:34 | 1 | 2 | Down | Filters Changed over and Cleaned | One Krill | JR177 |
| 31 | 21:17 | 1 | 1 | Down | Filters Changed over and Cleaned | Two Krill | JR177 |
| 01-Feb | 12:07 | 1 | 2 | Down | Filters Changed over and Cleaned | One Thermisto | JR177 |
| 2 | 16:35 | 1 | 1 | Down | Filters Changed over and Cleaned | Two Krill | JR177 |
| 3 | 12:37 | 1 | 2 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 4 | 11:45 | 1 | 1 | Down | Filters Changed over and Cleaned | Almost Clean | JR177 |
| 4 | 23:55 | 1 | 1 | Mid | Probe Raised | Request Bridge | JR177 |
| 5 | 11:31 | 1 | 2 | Mid | Filters Changed over and Cleaned | Six Krill | JR177 |
| 6 | 18:46 | 1 | 1 | Mid | Filters Changed over and Cleaned | Clean | JR177 |
| 6 | 20:00 | 1 | 1 | Down | Probe Lowered | Worsening Weather | JR177 |
| 6 | 23:00 | 1 | 1 | Mid | Probe Raised | Approx Time From Bridge | JR177 |
| 7 | 8:00 | 1 | 1 | Down | Probe Lowered | Approx Time From Bridge | JR177 |
| 7 | 23:00 | 1 | 1 | Mid | Probe Raised | Approx Time From Bridge | JR177 |
| 8 | 7:00 | 1 | 1 | Down | Probe Lowered | Approx Time From Bridge | JR177 |
| 8 | 17:25 | 1 | 2 | Down | Filters Changed over and Cleaned | One Krill | JR177 |
| 8 | 23:00 | 1 | 2 | Mid | Probe Raised | From Bridge | JR177 |
| 9 | 10:13 | 1 | 2 | Down | Probe Lowered | From Bridge | JR177 |
| 9 | 11:33 | 1 | 1 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 9 | 20:00 | 1 | 1 | Mid | Probe Raised | From Bridge | JR177 |
| 10 | 7:00 | 1 | 1 | Down | Probe Lowered | From Bridge | JR177 |
| 10 | 16:30 | 1 | 1 | Mid | Probe Raised | From Bridge | JR177 |
| 11 | 11:37 | 1 | 2 | Mid | Filters Changed over and Cleaned | Two Fish | JR177 |
| 12 | 9:34 | 1 | 2 | Mid | System Off | Boat Operations | JR177 |
| 12 | 12:05 | 1 | 2 | Mid | System On | Depart Hound Bay | JR177 |
| 13 | 14:30 | 1 | 1 | Mid | Filters Changed over and Cleaned | One Fish & A Few Feathers | JR177 |
| 14 | 9:30 | 1 | 1 | Down | Probe Lowered | Approx Time From Bridge | JR177 |
| 14 | 12:33 | 1 | 2 | Down | Filters Changed over and Cleaned | Clean | JR177 |
| 15 | 16:38 | 1 | 1 | Down | Filters Changed over and Cleaned | Three | JR177 |

| | | | | | | | |
|----|-------|---|---|------|----------------------------------|--------------------------|-------|
| | | | | | | Thermisto | |
| | | | | | | Mesh ¼ | |
| 16 | 11:05 | 1 | 2 | Down | Filters Changed over and Cleaned | covered in salps, etc | JR177 |
| 17 | 9:04 | | | | Filters Changed over and Cleaned | Almost Clean | JR177 |
| 17 | 9:04 | | | Up | System Shutdown | Arrival Stanley | JR177 |

17.17 Sampling Station
Plan

Core station (+ moorings)

Stations P2 and P3



Core station

Stations C2, C3, C4

Time (local)

| | | |
|-------|-----------------------|----------------------------------|
| 22:00 | MOCNESS | RMT25 stratified |
| 23:00 | | |
| 00:00 | FRAP | |
| 01:00 | LHPR to 1000 m | |
| 02:00 | | |
| 03:00 | | |
| 04:00 | | CTD for DP |
| 05:00 | CTD (oceanography) | (6 bottles 2000m, 6 at Chla max) |
| 06:00 | | Bongo & Minibongo |
| 07:00 | Bongo & Minibongo | RMT25 stratified |
| 08:00 | | |
| 09:00 | CTD (Oithona) | |
| 10:00 | LHPR to 1000 m | |
| 11:00 | | |
| 12:00 | | |
| 13:00 | Go FLO and FRAP | Target fishing (RMTB) |
| 14:00 | | |
| 15:00 | | |
| 16:00 | MOCNESS to 1000 m | |
| 17:00 | | |
| 18:00 | | |
| 19:00 | Target fishing (RMTB) | |
| 20:00 | | |
| 21:00 | MOCNESS to 1000 m | RMT25 stratified |
| 22:00 | | |

Mesoscale survey

Responsive station

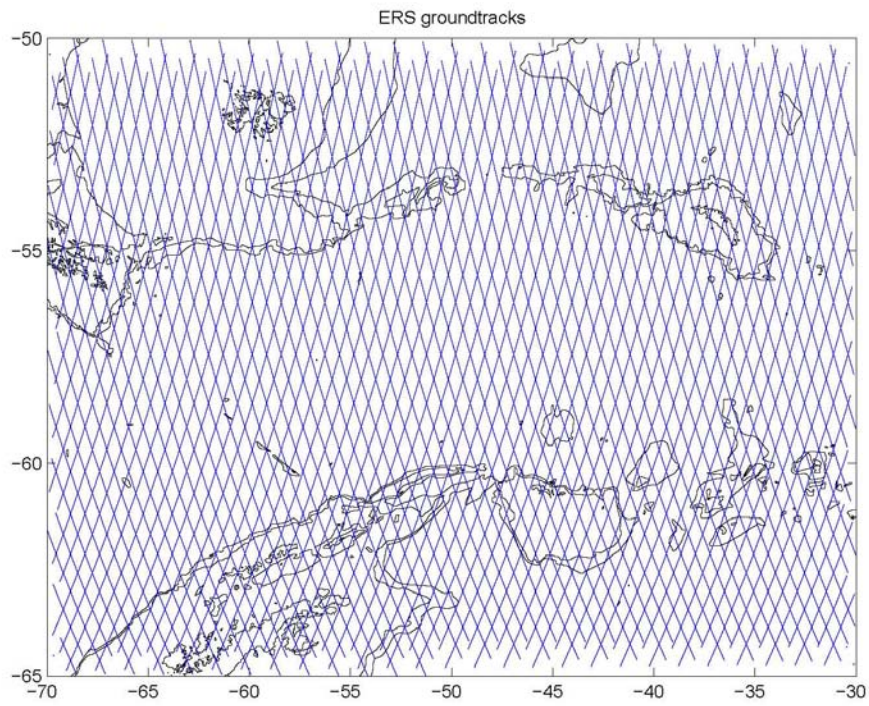
Stations R1, R2, R3, R4

Time (local)

| | | |
|-------|-----------------------|----------------------------------|
| 22:00 | MOCNESS | RMT25 stratified |
| 23:00 | | |
| 00:00 | FRAP | |
| 01:00 | LHPR to 1000 m | |
| 02:00 | | |
| 03:00 | | |
| 04:00 | | CTD for DP |
| 05:00 | CTD (oceanography) | (6 bottles 2000m, 6 at Chla max) |
| 06:00 | | Bongo & Minibongo |
| 07:00 | Bongo & Minibongo | RMT25 stratified |
| 08:00 | | |
| 09:00 | CTD (Oithona) | |
| 10:00 | LHPR to 1000 m | |
| 11:00 | | |
| 12:00 | | |
| 13:00 | Go FLO and FRAP | Target fishing (RMTB) |
| 14:00 | | |
| 15:00 | | |
| 16:00 | MOCNESS to 1000 m | |
| 17:00 | | |
| 18:00 | | |
| 19:00 | Target fishing (RMTB) | |
| 20:00 | | |
| 21:00 | MOCNESS to 1000 m | RMT25 stratified |
| 22:00 | | |

Small survey

17.18 ERS satellite tracks across Scotia Sea



17.19 Cruise Summary Form

| CRUISE SUMMARY REPORT | | <i>FOR COLLATING CENTRE USE</i> |
|--|---|--|
| | | Centre: BODC Ref. No.: |
| | | Is data exchange <input type="checkbox"/> Yes <input type="checkbox"/> In part <input type="checkbox"/> No |
| SHIP enter the full name and international radio call sign of the ship from which the data were collected, and indicate the type of ship, for example, research ship; ship of opportunity, naval survey vessel; etc. | | |
| Name: RRS James Clark Ross | | Call Sign: ZDLP |
| Type of ship: Research Ship | | |
| CRUISE NO. / NAME | JR 177 Discovery 2010 Summer cruise | enter the unique number, name or acronym assigned to the cruise (or cruise leg, if appropriate). |
| CRUISE PERIOD | start 31/12/2007 to 16/02/2008 end | |
| | (set sail) day/ month/ year day/ month/ year (return to port) | |
| PORT OF DEPARTURE (enter name and country) Stanley, Falkland Islands | | |
| PORT OF RETURN (enter name and country) Stanley, Falkland Islands | | |
| RESPONSIBLE LABORATORY enter name and address of the laboratory responsible for coordinating the scientific planning of the cruise | | |
| Name: British Antarctic Survey | | |
| Address: High Cross, Madingley Road, Cambridge. CB3 0ET | | |
| Country: UK | | |
| CHIEF SCIENTIST(S) enter name and laboratory of the person(s) in charge of the scientific work (chief of mission) during the cruise. | | |
| Dr. Geraint A. Tarling, British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, UK. | | |
| OBJECTIVES AND BRIEF NARRATIVE OF CRUISE enter sufficient information about the purpose and nature of the cruise so as to provide the context in which the report data were collected. | | |
| Cruise JR 177 was conducted within the Scotia Sea, Southern Ocean. Three transects were run as follows: - 1. from Port Stanley (Falkland Islands) to the ice edge, close to South Orkneys Islands, 2. from the ice edge to the Polar Front, north of South Georgia, and 3. from South Georgia to Port Stanley. A few days were spent in the vicinity of South Georgia before undertaking transect 3 | | |
| There were nine main sampling stations along transect 2. Supplementary sampling was carried out at 2 further stations, 1 on transect 1 and 1 in the vicinity of South Georgia. The time spent at each station varied between 1 and 4 days depending on scheduled activities, which was a mixture of CTD, netting, acoustic surveying and mooring deployments. At each station we took samples and measurements to characterise the oceanography, micro- and macronutrients, phytoplankton, zooplankton, krill and myctophid fish. Observations for higher predators were maintained for the majority of daytime hours throughout the cruise. Moorings were recovered and redeployed at 2 stations and contained oceanographic and acoustic instruments and a sediment trap. Whale acoustic buoys were deployed at a supplementary station in vicinity of South Georgia | | |
| The sampling was undertaken as part of the DISCOVERY 2010 BAS programme, with its remit to investigate and describe the response of the Southern Ocean ecosystem to climate variability, climate change and commercial exploitation. | | |
| PROJECT (IF APPLICABLE) if the cruise is designated as part of a larger scale cooperative project (or expedition), then enter the name of the project, and of organisation responsible for co-ordinating the project. | | |
| Project name: DISCOVERY 2010. | | |
| Coordinating body: British Antarctic Survey, High Cross, Madingley Road, Cambridge, CB3 0ET. | | |

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Except for the data already described on page 2 under 'Moorings, Bottom Mounted Gear and Drifting Systems', this section should include a summary of all data collected on the cruise, whether they be measurements (e.g. temperature, salinity values) or samples (e.g. cores, net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished, as should measurements/sampling techniques that imply distinctly different accuracy's or spatial/temporal resolutions. Thus, for example, separate entries would be created for i) BT drops, ii) water bottle stations, iii) CTD casts, iv) towed CTD, v) towed undulating CTD profiler, vi) surface water intake measurements, etc.

Each data set entry should start on a new line – it's description may extend over several lines if necessary.

NO, UNITS : for each data set, enter the estimated amount of data collected expressed in terms of the number of 'stations'; miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

| PI | NO | UNITS | DATA TYPE | DESCRIPTION |
|------------|-----------|-----------|--------------------------------------|---|
| see page 2 | see above | see above | Enter code(s) from list on last page | Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e. g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken. |
| A | | | H10 | CTD |
| A | | | H13 | XBT |
| B | | | H22-26 | CTD |
| H | | | B71 | CTD |
| D | | | B09 | CTD |
| C | | | B08 | CTD |
| K | | | H30 | Go flo bottles (clean water) |
| B | | | H22-26 | Underway - ships non toxic pumped sea water supply |
| C | | | B02 | Underway - ships non toxic pumped sea water supply |
| E | | | B09 | Underway - ships non toxic pumped sea water supply |
| K | | | H30 | Underway – clean water supply from tow fish |
| D | | | B09 | Bongo net – vertically hauled |
| E | | | B09 | Bongo net – obliquely hauled |
| D | | | B09 | LHPR - towed |
| E | | | B09 | MOCNESS |
| E | | | B09, B11 | RMT 8. Krill |
| F | | | B11, B14 | RMT 25. Fish |
| G | | | B25, B26 | Higher Predator observations |
| C | | | B01 | Primary productivity bioassays |
| L | | | B09 | Krill feeding and egestion incubations |
| E | | | B09 | Krill behaviour incubations |

TRACK CHART: You are strongly encouraged to submit, with the completed report, an annotated track chart illustrating the route followed and the points where measurements were taken.

Insert a tick(✓) in this box if a track chart is supplied



GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise – please use commonly recognised names (see, for example, International Hydrographic Bureau Special Publication No. 23, 'Limits of Oceans and Seas').

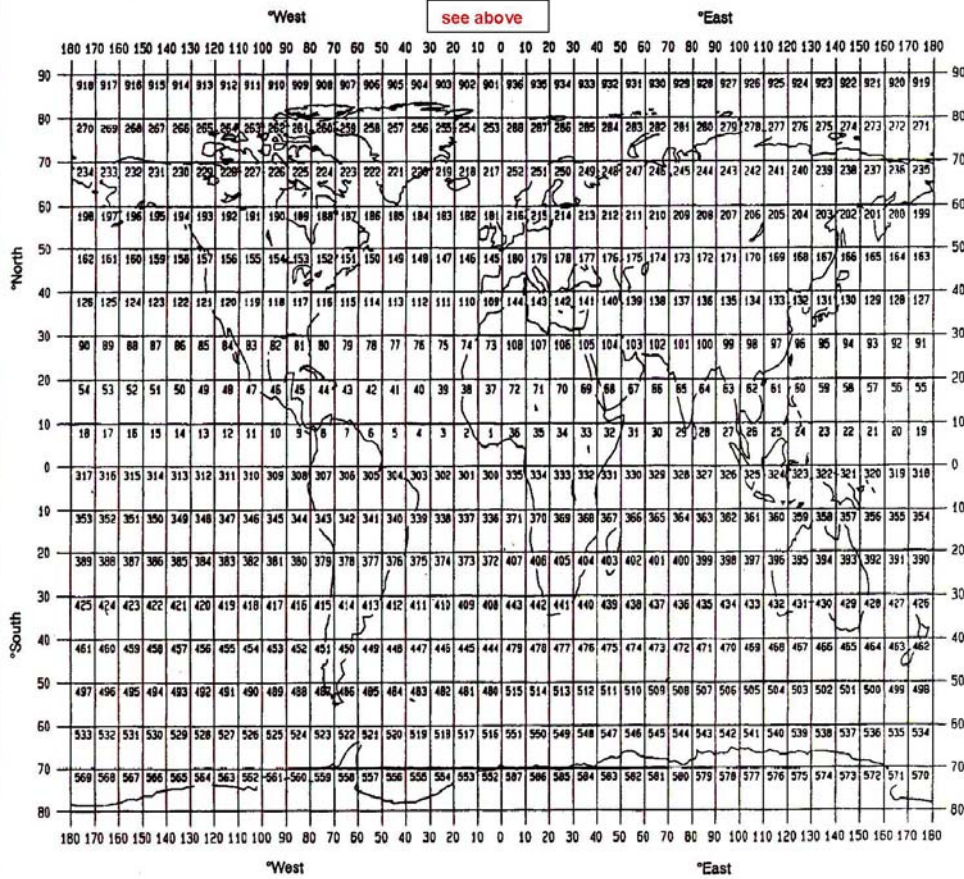
Scotia Sea. Atlantic Sector of the Southern Ocean

SPECIFIC AREAS: If the cruise activities were concentrated in a specific area(s) of an ocean or sea, then enter a description of the area(s). Such descriptions may include references to local geographic areas, to sea floor features, or to geographic coordinates.

Please insert here the number of each square in which data were collected from the below given chart

520, 484, 483, 447

GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED



THANK YOU FOR YOUR COOPERATION

Please send your completed report without delay to the collating centre indicated on the cover page

PARAMETER CODES**METEOROLOGY**

| | |
|-----|-----------------------------------|
| M01 | Upper air observations |
| M02 | Incident radiation |
| M05 | Occasional standard measurements |
| M06 | Routine standard measurements |
| M71 | Atmospheric chemistry |
| M90 | Other meteorological measurements |

PHYSICAL OCEANOGRAPHY

| | |
|-----|--|
| H71 | Surface measurements underway (T,S) |
| H13 | Bathythermograph |
| H09 | Water bottle stations |
| H10 | CTD stations |
| H11 | Subsurface measurements underway (T,S) |
| H72 | Thermistor chain |
| H16 | Transparency (eg transmissometer) |
| H17 | Optics (eg underwater light levels) |
| H73 | Geochemical tracers (eg freons) |
| D01 | Current meters |
| D71 | Current profiler (eg ADCP) |
| D03 | Currents measured from ship drift |
| D04 | GEK |
| D05 | Surface drifters/drifted buoys |
| D06 | Neutrally buoyant floats |
| D09 | Sea level (incl. Bottom pressure & inverted echosounder) |
| D72 | Instrumented wave measurements |
| D90 | Other physical oceanographic measurements |

CHEMICAL OCEANOGRAPHY

| | |
|-----|---|
| H21 | Oxygen |
| H74 | Carbon dioxide |
| H33 | Other dissolved gases |
| H22 | Phosphate |
| H23 | Total - P |
| H24 | Nitrate |
| H25 | Nitrite |
| H75 | Total - N |
| H76 | Ammonia |
| H26 | Silicate |
| H27 | Alkalinity |
| H28 | PH |
| H30 | Trace elements |
| H31 | Radioactivity |
| H32 | Isotopes |
| H90 | Other chemical oceanographic measurements |

MARINE CONTAMINANTS/POLLUTION

| | |
|-----|--------------------------------|
| P01 | Suspended matter |
| P02 | Trace metals |
| P03 | Petroleum residues |
| P04 | Chlorinated hydrocarbons |
| P05 | Other dissolved substances |
| P12 | Bottom deposits |
| P13 | Contaminants in organisms |
| P90 | Other contaminant measurements |

MARINE BIOLOGY/FISHERIES

| | |
|-----|---|
| B01 | Primary productivity |
| B02 | Phytoplankton pigments (eg chlorophyll, fluorescence) |
| B71 | Particulate organic matter (inc POC, PON) |
| B06 | Dissolved organic matter (inc DOC) |
| B72 | Biochemical measurements (eg lipids, amino acids) |
| B73 | Sediment traps |
| B08 | Phytoplankton |
| B09 | Zooplankton |
| B03 | Seston |
| B10 | Neuston |
| B11 | Nekton |
| B13 | Eggs & larvae |
| B07 | Pelagic bacteria/micro-organisms |
| B16 | Benthic bacteria/micro-organisms |
| B17 | Phytoenthos |
| B18 | Zoobenthos |
| B25 | Birds |
| B26 | Mammals & reptiles |
| B14 | Pelagic fish |
| B19 | Demersal fish |
| B20 | Molluscs |
| B21 | Crustaceans |
| B28 | Acoustic reflection on marine organisms |
| B37 | Taggings |
| B64 | Gear research |
| B65 | Exploratory fishing |
| B90 | Other biological/fisheries measurements |

MARINE GEOLOGY/GEOPHYSICS

| | |
|-----|---|
| G01 | Dredge |
| G02 | Grab |
| G03 | Core - rock |
| G04 | Core - soft bottom |
| G08 | Bottom photography |
| G71 | In-situ seafloor measurement/sampling |
| G72 | Geophysical measurements made at depth |
| G73 | Single-beam echosounding |
| G74 | Multi-beam echosounding |
| G24 | Long/short range side scan sonar |
| G75 | Single channel seismic reflection |
| G76 | Multichannel seismic reflection |
| G26 | Seismic refraction |
| G27 | Gravity measurements |
| G28 | Magnetic measurements |
| G90 | Other geological/geophysical measurements |

17.20 Event Log

| Event Code | Station Code | Time | Lat | Lon | Comment |
|------------|--------------|------------------|----------|----------|---|
| 1NTOW | | 31/12/2007 20:33 | -51.8503 | -57.4609 | NOC towfish deployed at 4 knots. |
| 1NTOW | | 09/01/2008 14:48 | -60.4309 | -44.5929 | NOC towfish recovered |
| 2XBT | | 31/12/2007 22:37 | -52.1712 | -57.0999 | XBT completed. |
| 3XBT | | 01/01/2008 04:45 | -53.1492 | -55.9871 | XBT DEPLOYED @ 6 KNOTS/ FAILED |
| 4XBT | | 01/01/2008 04:54 | -53.1609 | -55.9719 | XBT DEPLOYED @ 6 KNOTS |
| 4XBT | | 01/01/2008 05:02 | -53.1721 | -55.9592 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 5XBT | | 01/01/2008 06:33 | -53.4116 | -55.6909 | XBT DEPLOYED @ 6 KNOTS |
| 5XBT | | 01/01/2008 06:42 | -53.425 | -55.6758 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 6XBT | | 01/01/2008 08:04 | -53.6427 | -55.4237 | Speed reduced to 6kts for XBT |
| 6XBT | | 01/01/2008 08:11 | -53.6522 | -55.4116 | XBT deployment completed. Increasing speed. |
| 7XBT | | 01/01/2008 09:51 | -53.9055 | -55.112 | Reducing speed for XBT. |
| 7XBT | | 01/01/2008 10:05 | -53.928 | -55.0858 | XBT deployment completed. |
| 8XBT | | 01/01/2008 11:46 | -54.1795 | -54.7864 | XBT DEPLOYED @ 6 KNOTS |
| 8XBT | | 01/01/2008 11:50 | -54.1847 | -54.7793 | XBT Completed Increasing Speed |
| 9XBT | | 01/01/2008 13:22 | -54.43 | -54.4944 | XBT DEPLOYED @ 6 KNOTS |
| 9XBT | | 01/01/2008 13:27 | -54.4373 | -54.486 | XBT Completed Increasing Speed |
| 10XBT | | 01/01/2008 15:00 | -54.6854 | -54.1869 | XBT DEPLOYED @ 6 KNOTS |
| 10XBT | | 01/01/2008 15:06 | -54.694 | -54.1758 | XBT Completed Increasing Speed |
| 11XBT | | 01/01/2008 16:39 | -54.9377 | -53.8776 | XBT DEPLOYED @ 6 KNOTS |
| 11XBT | | 01/01/2008 16:46 | -54.9497 | -53.863 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 12XBT | | 01/01/2008 18:16 | -55.1932 | -53.5737 | XBT DEPLOYED @ 6 KNOTS |
| 12XBT | | 01/01/2008 18:24 | -55.2059 | -53.5578 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 13XBT | | 01/01/2008 19:55 | -55.4518 | -53.2615 | Speed reduced to 6 knots for XBT. |
| 13XBT | | 01/01/2008 20:01 | -55.4598 | -53.2505 | XBT completed. Increasing speed. |
| 14XBT | | 01/01/2008 21:32 | -55.6958 | -52.9601 | Reducing speed to 6 knots for XBT. |
| 14XBT | | 01/01/2008 21:42 | -55.7109 | -52.9409 | XBT completed. |
| 15XBT | | 01/01/2008 23:30 | -55.9646 | -52.6289 | XBT DEPLOYED @ 6 KNOTS |
| 15XBT | | 01/01/2008 23:37 | -55.9739 | -52.6183 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 16XBT | | 02/01/2008 01:16 | -56.2158 | -52.3174 | XBT DEPLOYED @ 6 KNOTS |
| 16XBT | | 02/01/2008 01:23 | -56.2258 | -52.3048 | XBT Completed Increasing Speed |
| 17XBT | | 02/01/2008 02:59 | -56.4705 | -52.0013 | XBT DEPLOYED @ 6 KNOTS/ FAILED |
| 18XBT | | 02/01/2008 03:07 | -56.4814 | -51.9876 | XBT DEPLOYED @ 6 KNOTS |
| 18XBT | | 02/01/2008 03:19 | -56.5012 | -51.9625 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 19XBT | | 02/01/2008 04:44 | -56.729 | -51.6758 | XBT DEPLOYED @ 6 KNOTS/ FAILED |
| 20XBT | | 02/01/2008 04:49 | -56.7362 | -51.6673 | XBT DEPLOYED @ 6 KNOTS |
| 21XBT | | 02/01/2008 05:00 | -56.7558 | -51.6441 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 22XBT | | 02/01/2008 06:17 | -56.9686 | -51.3705 | COMMENCE SLOWING FOR XBT |
| 22XBT | | 02/01/2008 06:22 | -56.9783 | -51.3596 | XBT DEPLOYED @ 6 KNOTS |
| 23XBT | | 02/01/2008 08:06 | -57.2411 | -51.0196 | XBT deployed at 6 knots. |
| 24XBT | | 02/01/2008 09:36 | -57.4794 | -50.7156 | Reducing speed for XBT. |
| 24XBT | | 02/01/2008 09:46 | -57.495 | -50.6937 | XBT deployment completed. |
| 25XBT | PS1 | 02/01/2008 11:19 | -57.7415 | -50.377 | XBT DEPLOYED @ 6 KNOTS |
| 25XBT | PS1 | 02/01/2008 11:27 | -57.752 | -50.3641 | XBT Completed |
| 26MOC | PS1 | 02/01/2008 11:47 | -57.7468 | -50.3647 | Mocness deployed @ 2.0kts |
| 26MOC | PS1 | 02/01/2008 12:23 | -57.736 | -50.3919 | Mocness on deck. |
| 27LHPR | PS1 | 02/01/2008 12:53 | -57.7231 | -50.4189 | LHPR Deployed |
| 27LHPR | PS1 | 02/01/2008 13:00 | -57.7182 | -50.4278 | LHPR Recovered |
| 28LHPR | PS1 | 02/01/2008 13:01 | -57.7175 | -50.4291 | LHPR Deployed |

| | | | | | |
|---------|-----|------------------|----------|----------|---|
| 28LHPR | PS1 | 02/01/2008 13:25 | -57.7016 | -50.4596 | LHPR Recovered |
| 29RMT25 | PS1 | 02/01/2008 14:11 | -57.7447 | -50.3683 | RMT 25 deployed. |
| 29RMT25 | PS1 | 02/01/2008 14:46 | -57.7305 | -50.4059 | RMT Recovered |
| 30ATOW | PS1 | 02/01/2008 15:01 | -57.7206 | -50.4206 | PES Fish deployed |
| 30ATOW | PS1 | 02/01/2008 15:06 | -57.7189 | -50.4201 | increase speed to 10 kts |
| 30ATOW | PS1 | 02/01/2008 15:13 | -57.7073 | -50.4297 | Vessel at 10 knots |
| 30ATOW | PS1 | 02/01/2008 15:16 | -57.6999 | -50.4364 | Slow down for PES tow fish recovery |
| 30ATOW | PS1 | 02/01/2008 15:22 | -57.6906 | -50.443 | Vessel at 2 knots |
| 30ATOW | PS1 | 02/01/2008 15:23 | -57.69 | -50.443 | Motor blows on PES gantry. Recovery suspended while problem is investigated |
| 30ATOW | PS1 | 02/01/2008 15:38 | -57.6852 | -50.4425 | Vessel stopped on DP to ease load on tow fish cable |
| 30ATOW | PS1 | 02/01/2008 15:48 | -57.6852 | -50.4423 | Fish secured |
| 30ATOW | PS1 | 02/01/2008 20:36 | -57.6741 | -50.4228 | PES fish recovered inboard. |
| 31FRRF | PS1 | 02/01/2008 17:34 | -57.6852 | -50.4423 | FRRF deployed |
| 31FRRF | PS1 | 02/01/2008 17:47 | -57.6852 | -50.4424 | FRRF @ 150m |
| 31FRRF | PS1 | 02/01/2008 18:05 | -57.6852 | -50.4423 | FRRF recovered |
| 32CTD | PS1 | 02/01/2008 18:25 | -57.6851 | -50.4423 | CTD deployed |
| 32CTD | PS1 | 02/01/2008 19:39 | -57.6789 | -50.4296 | CTD held at 4110m |
| 32CTD | PS1 | 02/01/2008 21:23 | -57.6733 | -50.4169 | CTD recovered to deck and gantry secured. |
| 33XBT | | 02/01/2008 23:52 | -57.9999 | -50.0337 | XBT DEPLOYED @ 6 KNOTS |
| 33XBT | | 03/01/2008 00:01 | -58.0117 | -50.0176 | XBT Completed Increasing Speed |
| 34XBT | | 03/01/2008 01:33 | -58.2505 | -49.6906 | XBT DEPLOYED @ 6 KNOTS |
| 34XBT | | 03/01/2008 01:40 | -58.2593 | -49.678 | XBT COMPLETE. |
| 35XBT | | 03/01/2008 03:44 | -58.5086 | -49.346 | XBT DEPLOYED @ 6 KNOTS |
| 36XBT | | 03/01/2008 05:47 | -58.7638 | -48.994 | XBT DEPLOYED @ 6 KNOTS |
| 37XBT | | 03/01/2008 07:45 | -59.0213 | -48.6433 | XBT deployed at 6 knots |
| 38XBT | | 03/01/2008 09:34 | -59.2819 | -48.2743 | XBT deployed at 6 knots |
| 39XBT | | 03/01/2008 11:11 | -59.5295 | -47.9281 | XBT DEPLOYED @ 6 KNOTS |
| 39XBT | N1 | 03/01/2008 11:17 | -59.5369 | -47.9161 | XBT COMPLETE. |
| 40RMT8 | N1 | 03/01/2008 11:45 | -59.5199 | -47.8925 | RMT 8 deployed |
| 40RMT8 | N1 | 03/01/2008 12:22 | -59.5346 | -47.9351 | RMT 8 recovered |
| 41RMT8 | N1 | 03/01/2008 12:48 | -59.5213 | -47.8966 | RMT 8 deployed |
| 41RMT8 | N1 | 03/01/2008 13:20 | -59.5362 | -47.9405 | RMT 8 recovered |
| 42XBT | | 03/01/2008 14:51 | -59.7758 | -47.844 | XBT DEPLOYED @ 6 KNOTS |
| 42XBT | | 03/01/2008 14:57 | -59.7844 | -47.8395 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 43XBT | | 03/01/2008 16:16 | -60.0349 | -47.7512 | XBT DEPLOYED @ 6 KNOTS |
| 43XBT | | 03/01/2008 16:25 | -60.0524 | -47.7435 | XBT COMPLETE. VESSEL BACK TO 12 KNOTS |
| 44XBT | | 03/01/2008 17:34 | -60.2767 | -47.6499 | COMMENCE SLOWING FOR XBT |
| 44XBT | | 03/01/2008 17:39 | -60.2869 | -47.6459 | XBT DEPLOYED @ 6 KNOTS |
| 45ATOW | R1 | 03/01/2008 18:36 | -60.3008 | -47.8568 | Deploy PES fish |
| 45ATOW | R1 | 03/01/2008 18:44 | -60.3024 | -47.8623 | PES fish not working |
| 45ATOW | R1 | 03/01/2008 18:49 | -60.3032 | -47.8648 | TowFish recovered |
| 46ATOW | R1 | 04/01/2008 01:07 | -60.3902 | -47.7959 | deployed towfish |
| 46ATOW | R1 | 04/01/2008 01:11 | -60.391 | -47.7955 | TowFish recovered |
| 47RMT8 | R1 | 04/01/2008 02:21 | -60.4512 | -48.0293 | RMT 8 deployed |
| 47RMT8 | R1 | 04/01/2008 02:51 | -60.4621 | -48.0645 | RMT 8 recovered |
| 48LHPR | R1 | 04/01/2008 04:12 | -60.4669 | -48.089 | LHPR deployed. |
| 48LHPR | R1 | 04/01/2008 07:09 | -60.527 | -48.3007 | LHPR recovered. |
| 49CTD | R1 | 04/01/2008 07:49 | -60.4982 | -48.1924 | CTD deployed (1416 metres EA 600) |
| 49CTD | R1 | 04/01/2008 08:17 | -60.4982 | -48.1924 | CTD held at 1376m wire out. |
| 49CTD | R1 | 04/01/2008 09:09 | -60.4982 | -48.1924 | CTD recovered. |
| 50BON | R1 | 04/01/2008 09:25 | -60.4982 | -48.1924 | Bongo nets deployed from midships gantry. 400 metres. |
| 50BON | R1 | 04/01/2008 09:44 | -60.4982 | -48.1924 | Commence recovering bongo nets. |

| | | | | | |
|---------|----|------------------|----------|----------|---|
| 50BON | R1 | 04/01/2008 10:01 | -60.4982 | -48.1924 | Bongo nets recovered to deck. |
| 51BON | R1 | 04/01/2008 10:03 | -60.4982 | -48.1924 | Bongo nets deployed. |
| 51BON | R1 | 04/01/2008 10:34 | -60.4982 | -48.1924 | Bongo nets recovered to deck. |
| 52MON | R1 | 04/01/2008 10:45 | -60.4982 | -48.1924 | Mini bongos deployed. |
| 52MON | R1 | 04/01/2008 11:14 | -60.4982 | -48.1924 | Mini Bongos Recovered |
| 53MON | R1 | 04/01/2008 11:16 | -60.4982 | -48.1924 | Mini Bongo Deployed |
| 53MON | R1 | 04/01/2008 11:50 | -60.4982 | -48.1927 | Minibongo Recovered |
| 54CTD | R1 | 04/01/2008 12:05 | -60.4983 | -48.1928 | CTD deployed 1415m |
| 54CTD | R1 | 04/01/2008 12:16 | -60.4983 | -48.1934 | CTD stopped @ 400m |
| 54CTD | R1 | 04/01/2008 12:34 | -60.4983 | -48.1934 | CTD recoverd to deck |
| 55LHPR | R1 | 04/01/2008 13:26 | -60.4667 | -48.0847 | LHPR Deployed |
| 55LHPR | R1 | 04/01/2008 15:23 | -60.5115 | -48.2399 | LHPR recovered |
| 56RMT8 | R1 | 04/01/2008 16:44 | -60.4428 | -47.9635 | Commence deployment of RMT 8 |
| 56RMT8 | R1 | 04/01/2008 16:49 | -60.4418 | -47.9704 | RMT 8 deployed |
| 56RMT8 | R1 | 04/01/2008 17:31 | -60.4313 | -48.0319 | RMT 8 recovered |
| 57MOC | R1 | 04/01/2008 18:42 | -60.5101 | -48.1133 | Commence mocness deployment |
| 57MOC | R1 | 04/01/2008 18:44 | -60.5097 | -48.1154 | Mocness deployed |
| 57MOC | R1 | 04/01/2008 21:29 | -60.4817 | -48.2939 | Mocness recovered to deck |
| 58BON | R1 | 04/01/2008 22:05 | -60.4981 | -48.192 | Bongo nets deployed |
| 58BON | R1 | 04/01/2008 22:34 | -60.4981 | -48.192 | Bongo nets recovered |
| 59BON | R1 | 04/01/2008 22:35 | -60.4982 | -48.192 | Bongo nets redeployed |
| 59BON | R1 | 04/01/2008 23:04 | -60.4981 | -48.192 | Bongo nets recovered |
| 60MON | R1 | 04/01/2008 23:21 | -60.4981 | -48.192 | Mini Bongos Deployed |
| 60MON | R1 | 04/01/2008 23:52 | -60.4982 | -48.192 | Mini Bongos Recovered |
| 61MOC | R1 | 05/01/2008 00:16 | -60.4934 | -48.2052 | Mocness deployed |
| 61MOC | R1 | 05/01/2008 02:31 | -60.4469 | -48.3158 | Mocness recovered |
| 62CTD | R1 | 05/01/2008 05:18 | -60.4983 | -48.1912 | CTD deployed (water depth 1415m) |
| 62CTD | R1 | 05/01/2008 05:23 | -60.4982 | -48.1911 | Problem with CTD |
| 62CTD | R1 | 05/01/2008 05:28 | -60.4982 | -48.1911 | CTD recovered |
| 62CTD | R1 | 05/01/2008 05:38 | -60.4982 | -48.191 | CTD redeployed |
| 62CTD | R1 | 05/01/2008 06:07 | -60.4983 | -48.1905 | CTD @ depth 1354m |
| 62CTD | R1 | 05/01/2008 06:42 | -60.4982 | -48.1906 | CTD recovered |
| 63RMT25 | R1 | 05/01/2008 07:36 | -60.4983 | -48.1924 | Commence deployment of RMT 25. |
| 63RMT25 | R1 | 05/01/2008 07:44 | -60.4978 | -48.2041 | RMT 25 deployed. Course over ground approx. 276T. |
| 63RMT25 | R1 | 05/01/2008 08:06 | -60.4958 | -48.2368 | Net recovered to deck for maintenance. |
| 64RMT25 | R1 | 05/01/2008 08:18 | -60.4932 | -48.2544 | RMT redeployed. |
| 64RMT25 | R1 | 05/01/2008 09:12 | -60.4877 | -48.3365 | RMT 25 at 1676m wire out. Hauling. |
| 64RMT25 | R1 | 05/01/2008 10:27 | -60.4824 | -48.4521 | RMT 25 recovered. |
| 65BON | R1 | 05/01/2008 11:34 | -60.498 | -48.1922 | V/L on Station Deploying Bongos net |
| 65BON | R1 | 05/01/2008 12:04 | -60.498 | -48.1922 | bongos net recovered |
| 66BON | R1 | 05/01/2008 12:07 | -60.498 | -48.1922 | Bongo nets deployed. |
| 66BON | R1 | 05/01/2008 12:34 | -60.498 | -48.1922 | Bongo Nets on board. |
| 67MON | R1 | 05/01/2008 12:39 | -60.498 | -48.1922 | Mini Bongos Deployed |
| 67MON | R1 | 05/01/2008 13:07 | -60.498 | -48.1922 | Mini Bongos Recovered |
| 68MON | R1 | 05/01/2008 13:14 | -60.4982 | -48.1923 | Mini Bongos Deployed |
| 68MON | R1 | 05/01/2008 13:39 | -60.4982 | -48.1923 | Mini Bongos Recovered |
| 69FRRF | R1 | 05/01/2008 13:49 | -60.4982 | -48.1923 | FRRF dep |
| 69FRRF | R1 | 05/01/2008 14:18 | -60.4982 | -48.1923 | FRRF on deck. |
| 70GOF | R1 | 05/01/2008 14:35 | -60.4982 | -48.1923 | Go Flo deployed |
| 70GOF | R1 | 05/01/2008 14:43 | -60.4982 | -48.1923 | Go Flo recovered |
| 71GOF | R1 | 05/01/2008 14:58 | -60.4982 | -48.1923 | Go Flo deployed |
| 71GOF | R1 | 05/01/2008 15:22 | -60.4982 | -48.1923 | Go Flo wire at 1000m Trigger weight deployed. |

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| 71 GOF | R1 | 05/01/2008 15:41 | -60.4982 | -48.1924 | commence recovery of go-flo |
| 71 GOF | R1 | 05/01/2008 16:15 | -60.4982 | -48.1925 | Go Flo recovered |
| 72 GOF | R1 | 05/01/2008 17:14 | -60.4981 | -48.1925 | Go Flo deployed |
| 72 GOF | R1 | 05/01/2008 17:36 | -60.4981 | -48.1925 | Go Flo wire at 1000m Trigger weight deployed. |
| 72 GOF | R1 | 05/01/2008 17:54 | -60.4981 | -48.1924 | commence recovery of go-flo |
| 72 GOF | R1 | 05/01/2008 18:15 | -60.4981 | -48.1925 | Go Flo recovered |
| 73 TON | R1 | 05/01/2008 18:43 | -60.4984 | -48.1932 | Towed bongo deployed at 0.5 knots. |
| 73 TON | R1 | 05/01/2008 18:45 | -60.4986 | -48.1938 | Increase speed to 1 knot |
| 73 TON | R1 | 05/01/2008 19:23 | -60.5008 | -48.2128 | Towed bongo recovered to deck. RMT 25 deployed. Course over ground approx. 270T. |
| 74 RMT25 | R1 | 05/01/2008 19:51 | -60.5012 | -48.2316 | Later adjusted to 250T. |
| 74 RMT25 | R1 | 05/01/2008 20:23 | -60.5005 | -48.2805 | RMT 25 @ 770m cable out. Hauling in. |
| 74 RMT25 | R1 | 05/01/2008 21:43 | -60.5087 | -48.3899 | RMT recovered. |
| 75 RMT25 | R1 | 05/01/2008 22:52 | -60.5034 | -48.2004 | RMT 25 deployed. Course over ground approx. 215(T). |
| 75 RMT25 | R1 | 06/01/2008 01:05 | -60.5683 | -48.363 | RMT 25 recovered |
| 76 RMT25 | R1 | 06/01/2008 02:18 | -60.5042 | -48.2067 | RMT 25 Deployed @ 2.5kts |
| 76 RMT25 | R1 | 06/01/2008 04:09 | -60.5919 | -48.1912 | RMT recovered |
| 77 FRRF | R1 | 06/01/2008 04:27 | -60.5946 | -48.1908 | FRRF deployed |
| 77 FRRF | R1 | 06/01/2008 04:55 | -60.5946 | -48.1908 | FRRF recovered |
| 78 RMT25 | R1 | 06/01/2008 05:31 | -60.5393 | -48.1905 | Commence deployment of RMT 25 |
| 78 RMT25 | R1 | 06/01/2008 05:38 | -60.5438 | -48.1956 | RMT 25 deployed. |
| 78 RMT25 | R1 | 06/01/2008 07:00 | -60.5962 | -48.2478 | 1967 metres wire out. Commence hauling net. |
| 78 RMT25 | R1 | 06/01/2008 08:16 | -60.6397 | -48.3232 | RMT 25 recovered. |
| 79 RMT25 | R1 | 06/01/2008 09:32 | -60.5257 | -48.1189 | RMT 25 deployed for target fishing. Heading South West |
| 79 RMT25 | R1 | 06/01/2008 09:45 | -60.5317 | -48.1332 | RMT 25 @ 143m (cable out). Hauling in. |
| 79 RMT25 | R1 | 06/01/2008 09:56 | -60.537 | -48.1463 | RMT 25 recovered. |
| 80 ATOW | C2 | 06/01/2008 23:25 | -60.2075 | -43.8207 | PES Fish deployed |
| 80 ATOW | C2 | 07/01/2008 16:16 | -60.2083 | -44.0537 | PES fish recovered |
| 81 MOC | C2 | 07/01/2008 19:05 | -60.161 | -44.2726 | Mocness deployed |
| 81 MOC | C2 | 07/01/2008 20:06 | -60.1767 | -44.3326 | 1740 metres wire out. Hauling. |
| 81 MOC | C2 | 07/01/2008 21:36 | -60.1971 | -44.4234 | Mocness recovered. |
| 82 TON | C2 | 07/01/2008 22:09 | -60.2083 | -44.4107 | Towed bongo deployed. 1.5kts requested |
| 82 TON | C2 | 07/01/2008 22:34 | -60.2104 | -44.431 | Towed bongo recovered. |
| 83 TON | C2 | 07/01/2008 22:37 | -60.2107 | -44.4334 | Towed bongo redeployed. |
| 83 TON | C2 | 07/01/2008 22:59 | -60.2127 | -44.4516 | Towed bongo recovered. |
| 84 TON | C2 | 07/01/2008 23:09 | -60.2136 | -44.4599 | Towed bongo deployed. |
| 84 TON | C2 | 08/01/2008 00:16 | -60.2207 | -44.4974 | Towed bongo net recovered. |
| 85 MOC | C2 | 08/01/2008 00:57 | -60.2203 | -44.5074 | Mocness deployed |
| 85 MOC | C2 | 08/01/2008 03:36 | -60.2358 | -44.6851 | Mocness recovered |
| 86 FRRF | C2 | 08/01/2008 03:46 | -60.2359 | -44.6865 | FRRF deployed |
| 86 FRRF | C2 | 08/01/2008 04:15 | -60.2359 | -44.6865 | FRRF recovered |
| 87 LHPR | C2 | 08/01/2008 05:16 | -60.2071 | -44.4062 | Commence LHPR deployment |
| 87 LHPR | C2 | 08/01/2008 05:23 | -60.2093 | -44.4194 | Suspend deployment of LHPR - Equipment problem |
| 87 LHPR | C2 | 08/01/2008 05:26 | -60.2099 | -44.4251 | Resume LHPR deployment |
| 87 LHPR | C2 | 08/01/2008 05:31 | -60.2108 | -44.4344 | LHPR deployed. |
| 87 LHPR | C2 | 08/01/2008 08:03 | -60.2212 | -44.6533 | LHPR recovered |
| 88 CTD | C2 | 08/01/2008 09:06 | -60.2082 | -44.4077 | CTD deployed. EA 600 depth 5450 metres. |
| 88 CTD | C2 | 08/01/2008 10:41 | -60.2082 | -44.4077 | CTD stopped at 5407 metres wire out. |
| 88 CTD | C2 | 08/01/2008 12:36 | -60.2091 | -44.4107 | CTD recovered |
| 89 BON | C2 | 08/01/2008 13:22 | -60.2088 | -44.4184 | Bongo deployed |
| 89 BON | C2 | 08/01/2008 13:52 | -60.2088 | -44.4183 | Bongo nets recovered |
| 90 BON | C2 | 08/01/2008 13:53 | -60.2088 | -44.4183 | Bongo deployed |
| 90 BON | C2 | 08/01/2008 14:24 | -60.2088 | -44.4183 | Bongo nets recovered |

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| 91 MON | C2 | 08/01/2008 14:30 | -60.2088 | -44.4183 | Mini Bongos Deployed |
| 91 MON | C2 | 08/01/2008 15:00 | -60.2088 | -44.4183 | Mini Bongos Recovered |
| 92 CTD | C2 | 08/01/2008 15:13 | -60.2088 | -44.4183 | CTD deployed |
| 92 CTD | C2 | 08/01/2008 15:24 | -60.2088 | -44.4183 | CTD @ depth 400m |
| 92 CTD | C2 | 08/01/2008 15:43 | -60.2088 | -44.4183 | CTD recovered |
| 93 FRRF | C2 | 08/01/2008 15:49 | -60.2088 | -44.4183 | FRRF deployed |
| 93 FRRF | C2 | 08/01/2008 16:07 | -60.2088 | -44.4183 | FRRF @ 150m |
| 93 FRRF | C2 | 08/01/2008 16:24 | -60.2088 | -44.4183 | FRRF recovered |
| 94 GOF | C2 | 08/01/2008 16:35 | -60.2088 | -44.4183 | Go Flo deployed |
| 94 GOF | C2 | 08/01/2008 17:25 | -60.2088 | -44.4183 | Go flo @ 1004m |
| 94 GOF | C2 | 08/01/2008 17:25 | -60.2088 | -44.4183 | Go flo @ 1004m |
| 94 GOF | C2 | 08/01/2008 17:42 | -60.2088 | -44.4183 | commence recovery of go-flo |
| 94 GOF | C2 | 08/01/2008 18:07 | -60.2088 | -44.4183 | Go flo recovered |
| 95 UOR | C2 | 08/01/2008 18:25 | -60.2165 | -44.4235 | UOR deployed - Increase to 10 knots |
| 95 UOR | C2 | 08/01/2008 18:55 | -60.2862 | -44.4683 | UOR recovered. Turning and steaming on course 013T |
| 96 LHPR | C2 | 08/01/2008 19:18 | -60.2524 | -44.4574 | towards LHPR deployment position. |
| 96 LHPR | C2 | 08/01/2008 19:58 | -60.2286 | -44.4296 | LHPR deployed @ 2.5 knots. |
| 96 LHPR | C2 | 08/01/2008 21:24 | -60.1765 | -44.3712 | LHPR recovered. Ship turned and steaming downwind on |
| 97 RMT25 | C2 | 08/01/2008 22:16 | -60.257 | -44.4724 | course 213T. |
| 97 RMT25 | C2 | 08/01/2008 22:47 | -60.2383 | -44.4444 | RMT 25 deployed. Course over ground 035T. |
| 98 TON | C2 | 08/01/2008 23:22 | -60.2619 | -44.4824 | RMT 25 recovered. Ship steaming downwind at 6 knots |
| 98 TON | C2 | 08/01/2008 23:45 | -60.256 | -44.471 | while changing deck for towed bongo. |
| 99 TON | C2 | 08/01/2008 23:50 | -60.2545 | -44.4683 | Towed Bongo deployed. 1.0kts requested |
| 99 TON | C2 | 09/01/2008 00:11 | -60.2481 | -44.457 | Towed bongo net recovered. |
| 100 TON | C2 | 09/01/2008 00:20 | -60.2448 | -44.452 | Towed bongo net recovered. |
| 100 TON | C2 | 09/01/2008 00:34 | -60.2418 | -44.4462 | Towed bongo deployed. |
| 101 TON | C2 | 09/01/2008 00:40 | -60.2408 | -44.4437 | Towed bongo net recovered. |
| 101 TON | C2 | 09/01/2008 00:51 | -60.2378 | -44.4403 | Towed bongo deployed. |
| 102 RMT25 | C2 | 09/01/2008 01:29 | -60.2235 | -44.4244 | Towed bongo net recovered. |
| 102 RMT25 | C2 | 09/01/2008 03:43 | -60.1408 | -44.3475 | RMT 25 deployed. |
| 103 CTD | C2 | 09/01/2008 04:36 | -60.2092 | -44.4089 | RMT 25 recovered |
| 103 CTD | C2 | 09/01/2008 05:13 | -60.2092 | -44.4089 | CTD deployed |
| 103 CTD | C2 | 09/01/2008 06:02 | -60.2092 | -44.4089 | CTD @depth 1989m |
| 104 BON | C2 | 09/01/2008 06:14 | -60.2092 | -44.4089 | CTD recovered |
| 104 BON | C2 | 09/01/2008 06:46 | -60.2093 | -44.4088 | Bongo deployed |
| 105 BON | C2 | 09/01/2008 06:47 | -60.2092 | -44.4088 | Bongo recovered |
| 105 BON | C2 | 09/01/2008 07:18 | -60.2092 | -44.4089 | Bongo redeployed |
| 106 MON | C2 | 09/01/2008 07:24 | -60.2092 | -44.4089 | Bongo nets recovered. |
| 106 MON | C2 | 09/01/2008 07:54 | -60.2092 | -44.4089 | Mini bongo nets deployed. |
| 107 MON | C2 | 09/01/2008 07:58 | -60.2093 | -44.4089 | Mini bongo nets recovered. |
| 107 MON | C2 | 09/01/2008 08:28 | -60.2092 | -44.4089 | Mini bongo redeployed. |
| 108 RMT25 | C2 | 09/01/2008 08:47 | -60.2048 | -44.4024 | Mini bongo recovered. |
| 108 RMT25 | C2 | 09/01/2008 08:52 | -60.2019 | -44.3978 | Commence RMT 25 deployment. |
| 108 RMT25 | C2 | 09/01/2008 09:35 | -60.1768 | -44.357 | RMT 25 deployed. |
| 108 RMT25 | C2 | 09/01/2008 10:46 | -60.1342 | -44.2941 | RMT 25 @ 1344m cable out. Hauling in. |
| 109 CTD | | 09/01/2008 13:42 | -60.4309 | -44.593 | RMT 25 recovered. Holding station. |
| 109 CTD | | 09/01/2008 14:03 | -60.4309 | -44.5929 | CTD deployed |
| 109 CTD | | 09/01/2008 14:37 | -60.4309 | -44.5929 | CTD @ 986m |
| 110 CTD | N2 | 10/01/2008 00:57 | -61.1981 | -44.4081 | CTD recovered to deck |
| 110 CTD | N2 | 10/01/2008 01:08 | -61.1981 | -44.4082 | CTD deployed 329m |
| 110 CTD | N2 | 10/01/2008 01:41 | -61.1981 | -44.4081 | CTD @ depth 315m |
| | | | | | CTD recovered |

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| 111GOF | N2 | 10/01/2008 02:04 | -61.1981 | -44.4082 | Go Flo deployed |
| 111GOF | N2 | 10/01/2008 02:39 | -61.1981 | -44.4082 | Go Flo recovered |
| 112CTD | N3 | 10/01/2008 09:54 | -61.6619 | -44.0665 | with pack ice to stay in pool of clear water. |
| 112CTD | N3 | 10/01/2008 10:09 | -61.6632 | -44.0617 | CTD all stopped at 565 metres wire out. |
| 112CTD | N3 | 10/01/2008 10:40 | -61.6654 | -44.0516 | CTD recovered to deck. |
| 113GOF | N3 | 10/01/2008 10:55 | -61.6671 | -44.0449 | Go Flo deployed. 104m |
| 113GOF | N3 | 10/01/2008 11:13 | -61.6691 | -44.0401 | Go Flo recovered. |
| 114CTD | N4 | 10/01/2008 17:33 | -62.1629 | -43.6941 | CTD deployed |
| 114CTD | N4 | 10/01/2008 17:50 | -62.1629 | -43.6941 | CTD @ 674m |
| 114CTD | N4 | 10/01/2008 18:14 | -62.1629 | -43.6941 | CTD recovered |
| 115CTD | N4 | 10/01/2008 18:22 | -62.1629 | -43.6941 | CTD redeployed |
| 115CTD | N4 | 10/01/2008 18:43 | -62.1629 | -43.6941 | CTD @ 1053m |
| 116CTD | N5 | 10/01/2008 23:04 | -62.3545 | -43.5277 | CTD deployed (EA 600 water depth 1266 metres). |
| 116CTD | N5 | 10/01/2008 23:25 | -62.3529 | -43.5275 | CTD at depth (cable out 1220m) |
| 116CTD | N5 | 11/01/2008 00:21 | -62.3484 | -43.5249 | CTD recovered to deck |
| 117CTD | N5 | 11/01/2008 00:56 | -62.3457 | -43.523 | CTD deployed 1263m |
| 117CTD | N5 | 11/01/2008 01:03 | -62.3451 | -43.5226 | CTD @ 120m |
| 117CTD | N5 | 11/01/2008 01:24 | -62.344 | -43.5217 | CTD recovered |
| 118GOF | N5 | 11/01/2008 01:31 | -62.344 | -43.5215 | Go Flo deployed |
| 118GOF | N5 | 11/01/2008 01:59 | -62.344 | -43.5198 | Go Flo recovered |
| 119CTD | | 11/01/2008 05:38 | -62.5161 | -43.3132 | CTD deployed |
| 119CTD | | 11/01/2008 06:19 | -62.5179 | -43.3079 | CTD @ 2000m |
| 119CTD | | 11/01/2008 07:19 | -62.52 | -43.2993 | CTD recovered. |
| 120CTD | N6 | 11/01/2008 09:30 | -62.6089 | -43.2444 | CTD deployed. EA 600 depth 3078 metres. |
| 120CTD | N6 | 11/01/2008 10:25 | -62.6078 | -43.239 | CTD stopped at 3015 metres wire out. |
| 120CTD | N6 | 11/01/2008 11:45 | -62.608 | -43.2344 | CTD recovered to deck. |
| 121GOF | N6 | 11/01/2008 11:50 | -62.608 | -43.2341 | Go Flo deployed. 104m. |
| 121GOF | N6 | 11/01/2008 12:24 | -62.608 | -43.232 | Go Flo recovered to deck. |
| 122CTD | | 12/01/2008 07:46 | -60.6662 | -45.519 | CTD deployed. EA 600 depth 192 metres. |
| 122CTD | | 12/01/2008 07:53 | -60.6662 | -45.519 | CTD stopped at 180 metres. |
| 122CTD | | 12/01/2008 08:12 | -60.6662 | -45.519 | CTD recovered. |
| 123RMT25 | C2 | 12/01/2008 22:39 | -60.2018 | -44.3696 | RMT 25 deployed. |
| 123RMT25 | C2 | 13/01/2008 01:40 | -60.1936 | -44.6428 | RMT 25 recovered. |
| 124RMT25 | C2 | 13/01/2008 02:06 | -60.1911 | -44.6844 | RMT 25 Deployed |
| 124RMT25 | C2 | 13/01/2008 04:00 | -60.1855 | -44.8557 | Commence recovery of RMT 25 |
| 124RMT25 | C2 | 13/01/2008 04:23 | -60.1852 | -44.8844 | RMT 25 recovered |
| 125TON | C2 | 13/01/2008 04:56 | -60.1853 | -44.9035 | Towed bongo deployed @ 1 knot |
| 125TON | C2 | 13/01/2008 05:12 | -60.1853 | -44.9124 | Towed bongo recovered |
| 126TON | C2 | 13/01/2008 05:17 | -60.1851 | -44.9151 | Towed bongo redeployed |
| 126TON | C2 | 13/01/2008 05:43 | -60.1845 | -44.9317 | Towed bongo recovered |
| 127TON | C2 | 13/01/2008 05:51 | -60.1841 | -44.9367 | Towed bongo redeployed |
| 127TON | C2 | 13/01/2008 06:31 | -60.1861 | -44.9609 | Towed bongo recovered |
| 128CTD | | 13/01/2008 09:15 | -59.9362 | -44.239 | CTD deployed. EA 600 depth 4731 metres. |
| 128CTD | | 13/01/2008 10:37 | -59.9362 | -44.239 | CTD stopped at 4673 metres wire out. |
| 128CTD | | 13/01/2008 12:18 | -59.9361 | -44.239 | CTD recovered to deck |
| 129UOR | | 13/01/2008 12:39 | -59.9362 | -44.239 | UOR Deployed |
| 129UOR | | 13/01/2008 13:10 | -59.9362 | -44.239 | UOR recovered |
| 130NTOW | | 13/01/2008 12:52 | -59.9362 | -44.239 | NOC towfish deployed |
| 130NTOW | | 25/01/2008 19:05 | -55.2218 | -41.2402 | NOC towfish recovered (to allow mooring deployment). |
| 131ATOW | | 13/01/2008 14:18 | -60.0248 | -43.995 | PES Fish deployed |
| 131ATOW | | 14/01/2008 01:39 | -59.5086 | -44.3841 | PES fish recovered inboard. |
| 132UOR | | 13/01/2008 14:30 | -60.0185 | -44.0082 | UOR Deployed |

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| 132UOR | | 13/01/2008 20:21 | -59.8082 | -44.1241 | UOR recovered |
| 133UOR | | 13/01/2008 22:22 | -59.8575 | -43.7186 | UOR deployed and at depth. Increasing speed. |
| 133UOR | | 13/01/2008 22:48 | -59.8101 | -43.8167 | Reducing speed for UOR recovery. |
| 133UOR | | 13/01/2008 22:52 | -59.804 | -43.8286 | UOR recovered. Increasing to 10 knots. |
| 134UOR | | 14/01/2008 02:29 | -59.4505 | -44.2266 | UOR Deployed |
| 134UOR | | 14/01/2008 03:06 | -59.5153 | -44.0995 | UOR recovered due to technical problems |
| 135FRRF | C3 | 14/01/2008 14:33 | -59.6886 | -44.055 | FRRF deployed |
| 135FRRF | C3 | 14/01/2008 15:07 | -59.6886 | -44.0549 | FRRF recovered |
| 136GOF | C3 | 14/01/2008 15:17 | -59.6886 | -44.055 | Go Flo deployed |
| 136GOF | C3 | 14/01/2008 15:42 | -59.6886 | -44.0549 | go flo @ 1004m trigger weight deployed |
| 136GOF | C3 | 14/01/2008 16:23 | -59.6886 | -44.0549 | Go flo recovered |
| 137MOC | C3 | 14/01/2008 17:02 | -59.7289 | -43.9978 | Mocness deployed |
| 137MOC | C3 | 14/01/2008 18:02 | -59.7015 | -44.0361 | Mocness @ 1723m Mocness recovered. Ship turned downwind and steaming |
| 137MOC | C3 | 14/01/2008 19:33 | -59.6603 | -44.0985 | back while RMT net is made ready. |
| 138RMT8 | C3 | 14/01/2008 20:25 | -59.7345 | -43.9975 | RMT 8 deployed. |
| 138RMT8 | C3 | 14/01/2008 20:47 | -59.725 | -44.0134 | RMT 8 recovered. |
| 139TON | C3 | 14/01/2008 21:00 | -59.7212 | -44.0183 | Towed Bongo deployed from scientific crane forward. |
| 139TON | C3 | 14/01/2008 21:19 | -59.7186 | -44.0256 | Towed bongo recovered |
| 140TON | C3 | 14/01/2008 21:35 | -59.7165 | -44.0315 | Towed bongo redeployed |
| 140TON | C3 | 14/01/2008 21:45 | -59.7153 | -44.0343 | Towed bongo recovered |
| 141TON | C3 | 14/01/2008 21:52 | -59.7143 | -44.0367 | Towed bongo redeployed. |
| 141TON | C3 | 14/01/2008 22:17 | -59.7106 | -44.045 | Towed bongo recovered. |
| 142TON | C3 | 14/01/2008 22:40 | -59.7068 | -44.0515 | Towed Bongo deployed from aft gantry |
| 142TON | C3 | 14/01/2008 22:51 | -59.7051 | -44.0549 | Towed Bongo @ 120m wire out. |
| 142TON | C3 | 14/01/2008 23:32 | -59.698 | -44.0706 | Towed bongo recovered |
| 143MOC | C3 | 15/01/2008 00:00 | -59.7246 | -44.0072 | Mocness deployed @ 2.0kts |
| 143MOC | C3 | 15/01/2008 02:44 | -59.6497 | -44.1192 | Mocness recovered. |
| 144FRRF | C3 | 15/01/2008 03:36 | -59.6882 | -44.0546 | FRRF deployed |
| 144FRRF | C3 | 15/01/2008 04:08 | -59.6882 | -44.0546 | FRRF recovered |
| 145LHPR | C3 | 15/01/2008 04:38 | -59.7193 | -44.0337 | LHPR Deployed @ 2.0kts |
| 145LHPR | C3 | 15/01/2008 05:35 | -59.6889 | -44.0554 | LHPR @ 1770m cable out |
| 145LHPR | C3 | 15/01/2008 06:57 | -59.6441 | -44.0819 | LHPR recovered |
| 146CTD | C3 | 15/01/2008 07:32 | -59.6887 | -44.0544 | CTD deployed. EA600 depth 4143 metres. |
| 146CTD | C3 | 15/01/2008 08:44 | -59.6887 | -44.0543 | CTD @ 4080m. Recovery commences. |
| 146CTD | C3 | 15/01/2008 10:15 | -59.6887 | -44.0544 | CTD recovered. |
| 147BON | C3 | 15/01/2008 10:22 | -59.6887 | -44.0544 | Bongo nets deployed. |
| 147BON | C3 | 15/01/2008 10:55 | -59.6888 | -44.0544 | Bongo nets recovered. |
| 148BON | C3 | 15/01/2008 11:08 | -59.6887 | -44.0544 | Bongo deployed |
| 148BON | C3 | 15/01/2008 11:41 | -59.6887 | -44.0544 | Bongo nets recovered |
| 149MON | C3 | 15/01/2008 11:45 | -59.6888 | -44.0544 | Mini Bongos Deployed |
| 149MON | C3 | 15/01/2008 12:16 | -59.6887 | -44.0544 | Mini Bongos Recovered |
| 150MON | C3 | 15/01/2008 12:19 | -59.6887 | -44.0544 | Mini Bongos Deployed |
| 150MON | C3 | 15/01/2008 12:51 | -59.6887 | -44.0544 | Mini Bongos Recovered |
| 151CTD | C3 | 15/01/2008 12:59 | -59.6887 | -44.0544 | CTD Deployed |
| 151CTD | C3 | 15/01/2008 13:13 | -59.6887 | -44.0544 | CTD @ 400m |
| 151CTD | C3 | 15/01/2008 14:02 | -59.6887 | -44.0544 | CTD recovered to deck |
| 152LHPR | C3 | 15/01/2008 14:39 | -59.6728 | -43.9677 | LHPR Deployed |
| 152LHPR | C3 | 15/01/2008 15:41 | -59.6848 | -44.0377 | Commence hauling LHPR |
| 152LHPR | C3 | 15/01/2008 17:06 | -59.7021 | -44.1283 | LHPR recovered |
| 153TON | C3 | 15/01/2008 14:47 | -59.6743 | -43.9776 | Towed Bongo deployed from scientific crane forward. |
| 153TON | C3 | 15/01/2008 15:09 | -59.6788 | -44.0032 | Towed bongo recovered |
| 154RMT8 | C3 | 15/01/2008 18:20 | -59.6614 | -43.9548 | RMT 8 deployed |

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| 154RMT8 | C3 | 15/01/2008 18:44 | -59.6684 | -43.9845 | RMT 8 recovered |
| 155RMT25 | C3 | 15/01/2008 19:30 | -59.6617 | -43.9552 | RMT 25 deployed. |
| 155RMT25 | C3 | 15/01/2008 19:47 | -59.6672 | -43.9765 | RMT 25 @ 190m cable out. Hauling in. |
| 155RMT25 | C3 | 15/01/2008 20:01 | -59.672 | -43.9956 | RMT 25 recovered |
| 156TON | C3 | 15/01/2008 20:21 | -59.6742 | -44.0028 | Towed Bongo deployed from aft gantry |
| 156TON | C3 | 15/01/2008 21:03 | -59.6754 | -44.0224 | Towed Bongo @ 100m wire out |
| 156TON | C3 | 15/01/2008 21:33 | -59.679 | -44.0333 | Towed Bongo recovered |
| 157TON | C3 | 15/01/2008 21:39 | -59.6797 | -44.0356 | Towed bongo redeployed |
| 157TON | C3 | 15/01/2008 21:51 | -59.6807 | -44.0409 | Towed Bongo @ 120m wire out. Hauling in |
| 157TON | C3 | 15/01/2008 22:37 | -59.6864 | -44.0619 | Towed bongo recovered. Ship turned and steaming downwind towards RMT deployment position. |
| 158RMT25 | C3 | 15/01/2008 23:10 | -59.6706 | -43.9696 | RMT 25 deployed. |
| 158RMT25 | C3 | 16/01/2008 02:16 | -59.7313 | -44.2091 | RMT 25 recovered. |
| 159TON | C3 | 15/01/2008 23:25 | -59.675 | -43.9901 | Towed Bongo deployed from scientific crane forward. |
| 159TON | C3 | 15/01/2008 23:50 | -59.6815 | -44.0213 | Towed bongo net recovered. |
| 160TON | C3 | 15/01/2008 23:51 | -59.6818 | -44.0226 | Deployed Towed Bongo |
| 160TON | C3 | 16/01/2008 00:02 | -59.6847 | -44.0376 | Recovered towed bongo |
| 161RMT25 | C3 | 16/01/2008 03:29 | -59.6727 | -44.0019 | RMT 25 deployed |
| 161RMT25 | C3 | 16/01/2008 05:36 | -59.7133 | -44.1681 | RMT recovered |
| 162CTD | C3 | 16/01/2008 06:29 | -59.6801 | -44.0565 | CTD deployed |
| 162CTD | C3 | 16/01/2008 07:07 | -59.6801 | -44.0571 | CTD stopped at 2000 metres wire out. |
| 162CTD | C3 | 16/01/2008 07:49 | -59.6801 | -44.0571 | CTD recovered. |
| 163BON | C3 | 16/01/2008 08:05 | -59.6801 | -44.0571 | Bongo nets deployed. |
| 163BON | C3 | 16/01/2008 08:34 | -59.6801 | -44.0571 | Bongo nets recovered. |
| 164BON | C3 | 16/01/2008 08:36 | -59.6801 | -44.0571 | Bongo nets redeployed. |
| 164BON | C3 | 16/01/2008 09:07 | -59.6801 | -44.0571 | Bongo nets recovered. Mini bongos cancelled because of sea state. Ship steaming downwind on course of 075T towards RMT 25 deployment position. |
| 165RMT25 | C3 | 16/01/2008 09:46 | -59.6582 | -43.9617 | RMT 25 deployed. |
| 165RMT25 | C3 | 16/01/2008 10:50 | -59.6723 | -44.052 | Wire held at 2230 metres. |
| 165RMT25 | C3 | 16/01/2008 13:16 | -59.6892 | -44.2716 | RMT 25 recovered |
| 166RMT25 | C3 | 16/01/2008 14:44 | -59.6693 | -43.9572 | RMT 25 deployed. |
| 166RMT25 | C3 | 16/01/2008 16:51 | -59.6969 | -44.1243 | RMT Recovered |
| 167MON | C3 | 16/01/2008 17:21 | -59.6978 | -44.1277 | Mini bongo deployed |
| 167MON | C3 | 16/01/2008 17:52 | -59.6977 | -44.1278 | Mini bongo recovered |
| 168UOR | | 16/01/2008 18:06 | -59.6911 | -44.1296 | UOR deployed |
| 168UOR | | 16/01/2008 19:51 | -59.448 | -43.8637 | UOR recovered due to technical issues |
| 169CTD | | 16/01/2008 20:24 | -59.4152 | -43.8705 | CTD deployed. EA600 depth 3093 metres. |
| 169CTD | | 16/01/2008 20:33 | -59.4152 | -43.8705 | CTD returning to surface. Problem with underwater unit. |
| 169CTD | | 16/01/2008 20:55 | -59.4147 | -43.87 | CTD Cancelled due to technical problems. V/L off DP and heading for next CTD. |
| 170CTD | N7 | 17/01/2008 00:26 | -59.144 | -43.6935 | CTD Deployed |
| 170CTD | N7 | 17/01/2008 01:31 | -59.1441 | -43.6935 | CTD stopped @ 3540m |
| 170CTD | N7 | 17/01/2008 03:07 | -59.1441 | -43.6934 | CTD recovered |
| 171TON | N7 | 17/01/2008 03:34 | -59.145 | -43.6881 | Towed bongo deployed |
| 171TON | N7 | 17/01/2008 04:05 | -59.1517 | -43.6723 | Towed bongo recovered |
| 172CTD | | 17/01/2008 06:01 | -58.8716 | -43.5094 | CTD 14 deployed |
| 172CTD | | 17/01/2008 06:55 | -58.8716 | -43.5093 | CTD @ depth 2890m |
| 172CTD | | 17/01/2008 08:10 | -58.8716 | -43.5093 | CTD recovered. |
| 173CTD | | 17/01/2008 10:01 | -58.5982 | -43.3309 | CTD deployed. EA 600 depth 3112 metres. |
| 173CTD | | 17/01/2008 10:57 | -58.5996 | -43.3329 | CTD stopped at 3051 metres wire out. |
| 173CTD | | 17/01/2008 12:08 | -58.5996 | -43.3329 | CTD recovered and gantry secured |
| 174CTD | | 17/01/2008 14:23 | -58.2778 | -43.141 | CTD Deployed (water depth 2907m) |
| 174CTD | | 17/01/2008 15:13 | -58.2778 | -43.1409 | CTD @ 2858m |

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| 174CTD | | 17/01/2008 16:15 | -58.2778 | -43.141 | CTD recovered |
| 175ATOW | | 17/01/2008 17:06 | -58.3498 | -42.9718 | PES Fish deployed |
| 175ATOW | | 18/01/2008 00:47 | -58.2205 | -42.6928 | PES fish recovered inboard. |
| 176ATOW | | 18/01/2008 07:35 | -58.1175 | -42.5126 | PES fish deployed. |
| 176ATOW | | 18/01/2008 16:06 | -58.1891 | -42.6706 | PES fish recovered |
| 177MOC | C4 | 18/01/2008 19:14 | -57.9835 | -43.0377 | Mocness net deployed Mocness recovered. Ship turned and steaming downwind |
| 177MOC | C4 | 18/01/2008 21:50 | -58.0507 | -42.9388 | at 6 knots. |
| 178RMT8 | C4 | 18/01/2008 22:38 | -57.9986 | -42.9764 | RMT 8 net deployed. |
| 178RMT8 | C4 | 18/01/2008 22:53 | -58.0068 | -42.9715 | 55 metres wire out |
| 179RMT8 | C4 | 18/01/2008 23:10 | -58.019 | -42.9652 | RMT 8 net deployed. |
| 179RMT8 | C4 | 18/01/2008 23:30 | -58.0317 | -42.9583 | RMT 8 net recovered |
| 180TON | C4 | 18/01/2008 23:51 | -58.0463 | -42.9496 | deployed towed bongo |
| 180TON | C4 | 19/01/2008 00:25 | -58.051 | -42.941 | towed bongo recovered |
| 181MOC | C4 | 19/01/2008 01:03 | -57.9729 | -42.9669 | Mocness net deployed |
| 181MOC | C4 | 19/01/2008 03:45 | -58.0597 | -42.9946 | Mocness recovered |
| 182FRRF | C4 | 19/01/2008 04:15 | -58.0227 | -42.9804 | FRRF deployed |
| 182FRRF | C4 | 19/01/2008 04:40 | -58.0227 | -42.9804 | FRRF recovered |
| 183LHPR | C4 | 19/01/2008 05:16 | -57.9868 | -42.9234 | LHPR deployed |
| 183LHPR | C4 | 19/01/2008 06:48 | -58.0258 | -42.9864 | LHPR recovered |
| 184TON | C4 | 19/01/2008 05:23 | -57.9899 | -42.9283 | Towed bongo deployed from scientific crane |
| 184TON | C4 | 19/01/2008 06:04 | -58.0071 | -42.956 | Towed bongo recovered |
| 185CTD | C4 | 19/01/2008 07:02 | -58.0229 | -42.9843 | CTD deployed. EA600 depth 2842 metres. |
| 185CTD | C4 | 19/01/2008 07:53 | -58.0228 | -42.9813 | CTD stopped at 2778 metres wire out. |
| 185CTD | C4 | 19/01/2008 09:00 | -58.0228 | -42.9809 | CTD recovered. |
| 186BON | C4 | 19/01/2008 09:06 | -58.0228 | -42.9809 | Bongo nets deployed. |
| 186BON | C4 | 19/01/2008 09:35 | -58.0228 | -42.9809 | Bongo nets recovered. |
| 187BON | C4 | 19/01/2008 09:38 | -58.0228 | -42.9809 | Bongo nets redeployed. |
| 187BON | C4 | 19/01/2008 10:08 | -58.0228 | -42.9809 | Bongo nets recovered. |
| 188MON | C4 | 19/01/2008 10:13 | -58.0228 | -42.9809 | Mini bongo deployed. |
| 188MON | C4 | 19/01/2008 10:44 | -58.0228 | -42.9809 | Mini bongo recovered. |
| 189MON | C4 | 19/01/2008 10:48 | -58.0228 | -42.9809 | Mini bongo redeployed. |
| 189MON | C4 | 19/01/2008 11:19 | -58.0228 | -42.9809 | Mini bongo recovered. |
| 190MON | C4 | 19/01/2008 11:27 | -58.0228 | -42.981 | Mini bongo redeployed. |
| 190MON | C4 | 19/01/2008 11:57 | -58.0228 | -42.9809 | Mini bongo recovered. |
| 191CTD | C4 | 19/01/2008 12:11 | -58.0228 | -42.9809 | CTD deployed. EA600 depth 2840 metres. |
| 191CTD | C4 | 19/01/2008 12:34 | -58.0228 | -42.9809 | CTD recovered. |
| 192GOF | C4 | 19/01/2008 12:42 | -58.0228 | -42.9809 | Go-Flo Deployed |
| 192GOF | C4 | 19/01/2008 13:55 | -58.0228 | -42.9809 | Go-Flo Recovered |
| 193FRRF | C4 | 19/01/2008 14:06 | -58.0228 | -42.9809 | FRRF Deployed |
| 193FRRF | C4 | 19/01/2008 14:37 | -58.0228 | -42.9809 | FRRF recovered |
| 194LHPR | C4 | 19/01/2008 15:17 | -58.0223 | -42.887 | LHPR deployed |
| 194LHPR | C4 | 19/01/2008 16:05 | -58.0228 | -42.9361 | LHPR @ 1728m |
| 194LHPR | C4 | 19/01/2008 17:14 | -58.0194 | -43.0079 | LHPR recovered |
| 195RMT8 | C4 | 19/01/2008 17:48 | -58.0223 | -42.9633 | RMT 8 deployed |
| 195RMT8 | C4 | 19/01/2008 18:23 | -58.023 | -43.0089 | RMT8 recovered |
| 196RMT25 | C4 | 19/01/2008 19:18 | -58.0229 | -42.9647 | RMT 25 deployed RMT 25 recovered. Ship turned downwind and steaming |
| 196RMT25 | C4 | 19/01/2008 19:49 | -58.0233 | -43.0093 | back for redeployment. |
| 197RMT25 | C4 | 19/01/2008 20:32 | -58.0224 | -42.9634 | RMT 25 deployed. |
| 197RMT25 | C4 | 19/01/2008 20:56 | -58.023 | -42.9966 | 445 metres wire out. |
| 197RMT25 | C4 | 19/01/2008 21:31 | -58.0232 | -43.0455 | Commence hauling. RMT 25 recovered. Turning and steaming 4 miles |
| 197RMT25 | C4 | 19/01/2008 21:53 | -58.023 | -43.0741 | downwind of station. |

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| 198RMT25 | C4 | 19/01/2008 22:47 | -58.0325 | -42.8573 | RMT 25 deployed. |
| 198RMT25 | C4 | 20/01/2008 01:42 | -58.0168 | -43.0801 | RMT 25 recovered |
| 199RMT25 | C4 | 20/01/2008 02:41 | -58.0169 | -43.0228 | RMT 25 deployed |
| 199RMT25 | C4 | 20/01/2008 04:50 | -58.0082 | -43.1843 | RMT recovered |
| 200CTD | C4 | 20/01/2008 06:09 | -58.0271 | -42.9718 | CTD deployed |
| 200CTD | C4 | 20/01/2008 06:46 | -58.0271 | -42.9718 | CTD @ 2000m |
| 200CTD | C4 | 20/01/2008 07:34 | -58.0271 | -42.9719 | CTD recovered. |
| 201BON | C4 | 20/01/2008 07:40 | -58.0271 | -42.9718 | Bongo nets deployed. |
| 201BON | C4 | 20/01/2008 08:08 | -58.0271 | -42.9719 | Bongo nets recovered. |
| 202BON | C4 | 20/01/2008 08:10 | -58.0271 | -42.9718 | Bongo nets redeployed. |
| 202BON | C4 | 20/01/2008 08:40 | -58.0271 | -42.9719 | Bongo nets recovered. |
| 203MON | C4 | 20/01/2008 08:46 | -58.0271 | -42.9719 | Mini bongo nets deployed. |
| 203MON | C4 | 20/01/2008 09:18 | -58.0271 | -42.9718 | Mini bongo nets recovered. |
| 204MON | C4 | 20/01/2008 09:20 | -58.0271 | -42.9718 | Mini bongo nets redeployed. |
| 204MON | C4 | 20/01/2008 09:49 | -58.0271 | -42.9718 | Mini bongo nets recovered. |
| 205RMT25 | C4 | 20/01/2008 10:46 | -58.0232 | -42.8893 | RMT 25 deployed. |
| 205RMT25 | C4 | 20/01/2008 13:48 | -58.0191 | -43.1309 | RMT 25 recovered |
| 206RMT25 | C4 | 20/01/2008 15:18 | -58.0261 | -42.8974 | RMT deployed |
| 206RMT25 | C4 | 20/01/2008 18:00 | -58.0216 | -43.1089 | RMT recovered |
| 207RMT25 | C4 | 20/01/2008 18:15 | -58.0212 | -43.1252 | RMT 25 deployed |
| 207RMT25 | C4 | 20/01/2008 19:15 | -58.0216 | -43.2005 | RMT 25 recovered. Ship steaming head to wind for net stowage |
| 208CTD | | 20/01/2008 21:40 | -57.7583 | -42.8011 | CTD deployed . EA600 depth 2913 metres. |
| 208CTD | | 20/01/2008 22:35 | -57.7582 | -42.8011 | CTD stopped at 2850 metres wire out. |
| 208CTD | | 20/01/2008 23:49 | -57.7582 | -42.8013 | CTD recovered. |
| 209CTD | | 21/01/2008 02:50 | -57.4368 | -42.6104 | ctd deployed |
| 209CTD | | 21/01/2008 03:49 | -57.4368 | -42.6103 | CTD @ 3232m |
| 209CTD | | 21/01/2008 05:16 | -57.4368 | -42.6102 | CTD recovered |
| 210LHPR | R2 | 21/01/2008 14:07 | -57.1562 | -42.3407 | LHPR Deployed |
| 210LHPR | R2 | 21/01/2008 16:15 | -57.1321 | -42.4818 | LHPR recovered |
| 211FRRF | R2 | 21/01/2008 16:55 | -57.1397 | -42.4337 | FRRF deployed |
| 211FRRF | R2 | 21/01/2008 17:27 | -57.1396 | -42.4337 | FRRF recovered |
| 212GOF | R2 | 21/01/2008 17:35 | -57.1396 | -42.4337 | Go flo deployed |
| 212GOF | R2 | 21/01/2008 18:01 | -57.1396 | -42.4337 | Go flo @ 1004m |
| 212GOF | R2 | 21/01/2008 18:43 | -57.1396 | -42.4337 | Go flo recovered |
| 213MOC | R2 | 21/01/2008 19:24 | -57.1554 | -42.3492 | Mocness deployed |
| 213MOC | R2 | 21/01/2008 20:25 | -57.145 | -42.4074 | 1794 metres wire out. Commence hauling. |
| 213MOC | R2 | 21/01/2008 20:57 | -57.1395 | -42.4382 | Mocness recovered. |
| 214RMT8 | R2 | 21/01/2008 22:47 | -57.1318 | -42.4602 | RMT 8 deployed. |
| 214RMT8 | R2 | 21/01/2008 23:25 | -57.1241 | -42.5109 | RMT 8 Recovered |
| 215MOC | R2 | 22/01/2008 01:09 | -57.1506 | -42.3636 | Mocness deployed |
| 215MOC | R2 | 22/01/2008 03:40 | -57.1324 | -42.547 | Mocness recovered. |
| 216CTD | R2 | 22/01/2008 04:43 | -57.1396 | -42.4329 | CTD deployed |
| 216CTD | R2 | 22/01/2008 06:03 | -57.1396 | -42.4328 | CTD @ 3624m |
| 216CTD | R2 | 22/01/2008 07:32 | -57.1396 | -42.4326 | CTD recovered. |
| 217BON | R2 | 22/01/2008 07:39 | -57.1396 | -42.4327 | Bongo nets deployed. |
| 217BON | R2 | 22/01/2008 08:09 | -57.1408 | -42.4327 | Bongo nets recovered. |
| 218BON | R2 | 22/01/2008 08:10 | -57.1408 | -42.4327 | Bongo nets redeployed. |
| 218BON | R2 | 22/01/2008 08:41 | -57.1408 | -42.4327 | Bongo nets recovered. |
| 219MON | R2 | 22/01/2008 08:44 | -57.1408 | -42.4327 | Mini bongos deployed. |
| 219MON | R2 | 22/01/2008 09:13 | -57.1408 | -42.4327 | Mini bongos recovered. |
| 220MON | R2 | 22/01/2008 09:17 | -57.1408 | -42.4327 | Mini bongos redployed. |
| 221CTD | R2 | 22/01/2008 09:56 | -57.1408 | -42.4327 | CTD deployed. |

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| 221CTD | R2 | 22/01/2008 10:01 | -57.1408 | -42.4327 | CTD recovered to investigate fault. |
| 221CTD | R2 | 22/01/2008 10:24 | -57.1408 | -42.4327 | CTD deployed. |
| 221CTD | R2 | 22/01/2008 10:35 | -57.1408 | -42.4327 | CTD stopped at 398 metres wire out. |
| 221CTD | R2 | 22/01/2008 10:53 | -57.1408 | -42.4327 | CTD recovered. |
| 222CTD | R2 | 22/01/2008 12:12 | -57.1408 | -42.4326 | CTD deployed . EA600 depth 2000 metres. |
| 222CTD | R2 | 22/01/2008 12:51 | -57.1408 | -42.4326 | CTD @ 2000m |
| 222CTD | R2 | 22/01/2008 13:34 | -57.1408 | -42.4327 | CTD recovered |
| 223CTD | | 22/01/2008 15:57 | -56.8432 | -42.2566 | CTD deployed . EA600 depth 4199 metres. |
| 223CTD | | 22/01/2008 17:13 | -56.8432 | -42.2566 | CTD @ 4155m |
| 223CTD | | 22/01/2008 18:46 | -56.8432 | -42.2566 | CTD recovered |
| 224CTD | | 22/01/2008 21:08 | -56.5212 | -42.0717 | CTD deployed. EA600 depth 4042 metres. |
| 224CTD | | 22/01/2008 22:21 | -56.5212 | -42.0715 | CTD @ 4005m |
| 224CTD | | 22/01/2008 23:55 | -56.5211 | -42.0715 | CTD recovered. |
| 225CTD | | 23/01/2008 13:14 | -55.9018 | -41.7195 | CTD deployed |
| 225CTD | | 23/01/2008 14:15 | -55.9017 | -41.7195 | CTD @ 3521m |
| 225CTD | | 23/01/2008 15:36 | -55.9017 | -41.7194 | CTD recovered |
| 226CTD | | 23/01/2008 18:46 | -55.5804 | -41.5343 | CTD deployed |
| 226CTD | | 23/01/2008 19:46 | -55.5803 | -41.5343 | CTD @ 3332m cable out. |
| 226CTD | | 23/01/2008 21:04 | -55.5803 | -41.5343 | CTD recovered. |
| 227CTD | P2 | 25/01/2008 11:52 | -55.2064 | -41.2465 | CTD deployed . EA600 depth 3240 metres. |
| 227CTD | P2 | 25/01/2008 12:50 | -55.209 | -41.2447 | CTD @ 3185m |
| 227CTD | P2 | 25/01/2008 14:04 | -55.21 | -41.2444 | CTD recovered |
| 228BON | P2 | 25/01/2008 14:18 | -55.2101 | -41.2444 | Bongo nets deployed. |
| 228BON | P2 | 25/01/2008 14:48 | -55.2121 | -41.2439 | Bongo nets recovered. |
| 229BON | P2 | 25/01/2008 14:50 | -55.2123 | -41.2439 | Bongo nets redeployed. |
| 229BON | P2 | 25/01/2008 15:21 | -55.2136 | -41.244 | Bongo nets recovered |
| 230MON | P2 | 25/01/2008 15:26 | -55.2136 | -41.244 | Mini bongo deployed |
| 230MON | P2 | 25/01/2008 15:56 | -55.2156 | -41.2421 | Mini bongo recovered |
| 231MON | P2 | 25/01/2008 16:00 | -55.2159 | -41.2418 | Mini bongo nets redeployed. |
| 231MON | P2 | 25/01/2008 16:30 | -55.2175 | -41.2403 | Mini bongo recovered |
| 232FRRF | P2 | 25/01/2008 16:35 | -55.2175 | -41.2402 | FRRF deployed |
| 232FRRF | P2 | 25/01/2008 17:05 | -55.2175 | -41.2402 | FRRF recovered |
| 233CTD | P2 | 25/01/2008 17:16 | -55.2175 | -41.2402 | CTD deployed |
| 233CTD | P2 | 25/01/2008 17:27 | -55.2175 | -41.2402 | CTD @ 400m |
| 233CTD | P2 | 25/01/2008 17:45 | -55.2175 | -41.2402 | CTD recovered |
| 234GOF | P2 | 25/01/2008 17:55 | -55.2175 | -41.2402 | Go flo deployed |
| 234GOF | P2 | 25/01/2008 18:23 | -55.2188 | -41.2402 | Go flo @ 1004m |
| 234GOF | P2 | 25/01/2008 18:45 | -55.2204 | -41.2402 | 1st bottle not fired. Trigger weight redeployed at 970m. |
| 234GOF | P2 | 25/01/2008 19:35 | -55.225 | -41.2402 | Go Flo recovered. |
| 235MOO | P2 | 25/01/2008 20:26 | -55.2035 | -41.1162 | On station for mooring release. |
| 235MOO | P2 | 25/01/2008 20:28 | -55.2036 | -41.1162 | Hydrophone deployed. |
| 235MOO | P2 | 25/01/2008 20:30 | -55.2035 | -41.1162 | Mooring released. |
| 235MOO | P2 | 25/01/2008 20:57 | -55.2065 | -41.1137 | Mooring buoy recovered to deck. |
| 235MOO | P2 | 25/01/2008 21:41 | -55.2064 | -41.1137 | Trimsin buoy cluster on deck. |
| 235MOO | P2 | 25/01/2008 21:48 | -55.2065 | -41.1137 | Sediment trap on deck. |
| 235MOO | P2 | 25/01/2008 22:37 | -55.2065 | -41.1137 | Acoustic release on deck. Completed mooring recovery. |
| 236NTOW | P2 | 25/01/2008 23:01 | -55.2065 | -41.1137 | NOC towfish deployed |
| 236NTOW | P2 | 31/01/2008 16:57 | -52.7222 | -40.1393 | NOC tow fish recovered |
| 237TON | P2 | 25/01/2008 23:13 | -55.2058 | -41.1176 | Towed bongo deployed |
| 237TON | P2 | 26/01/2008 00:56 | -55.2003 | -41.1599 | Towed bongo recovered |
| 240CTD | P2 | 27/01/2008 03:08 | -55.2069 | -41.1567 | CTD deployed (238 |
| 240CTD | P2 | 27/01/2008 03:47 | -55.2069 | -41.1567 | CTD @ 2000m |

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| 240CTD | P2 | 27/01/2008 04:34 | -55.2069 | -41.1567 | CTD recovered |
| 241FRRF | P2 | 27/01/2008 04:41 | -55.2069 | -41.1567 | FRRF deployed |
| 241FRRF | P2 | 27/01/2008 05:13 | -55.2072 | -41.1566 | FRRF recovered |
| 242BON | P2 | 27/01/2008 05:20 | -55.2072 | -41.1566 | Bongo deployed |
| 242BON | P2 | 27/01/2008 05:51 | -55.2112 | -41.1558 | Bongo nets recovered |
| 243BON | P2 | 27/01/2008 05:53 | -55.2114 | -41.1558 | Bongo nets redeployed |
| 243BON | P2 | 27/01/2008 06:23 | -55.2168 | -41.1543 | Bongo nets recovered |
| 244BON | P2 | 27/01/2008 06:24 | -55.2169 | -41.1542 | Bongo nets redeployed |
| 244BON | P2 | 27/01/2008 06:54 | -55.2206 | -41.1537 | Bongo nets recovered. |
| 245MON | P2 | 27/01/2008 07:00 | -55.2215 | -41.1538 | Mini bongos deployed. |
| 245MON | P2 | 27/01/2008 07:32 | -55.2247 | -41.1536 | Mini bongos recovered. |
| 246MON | P2 | 27/01/2008 07:33 | -55.2248 | -41.1536 | Mini bongos redeployed. |
| 246MON | P2 | 27/01/2008 08:03 | -55.2276 | -41.1536 | Mini bongos recovered. |
| 247MON | P2 | 27/01/2008 08:07 | -55.2282 | -41.1536 | Mini bongos redeployed. |
| 247MON | P2 | 27/01/2008 08:36 | -55.2317 | -41.1535 | Mini bongos recovered. |
| 248RMT25 | P2 | 27/01/2008 09:21 | -55.1702 | -41.193 | Commence deployment of RMT 25 |
| 248RMT25 | P2 | 27/01/2008 09:27 | -55.172 | -41.1999 | RMT 25 deployed |
| 248RMT25 | P2 | 27/01/2008 09:45 | -55.1825 | -41.2134 | RMT 25 @ 610m cable out. |
| 248RMT25 | P2 | 27/01/2008 10:27 | -55.2042 | -41.2491 | RMT 25 recovered. |
| 249MOC | P2 | 27/01/2008 12:05 | -55.2296 | -41.2858 | Mocness deployed |
| 249MOC | P2 | 27/01/2008 14:37 | -55.2824 | -41.3912 | Mocness recovered |
| 250RMT25 | P2 | 27/01/2008 15:41 | -55.1883 | -41.1684 | RMT 25 deployed |
| 250RMT25 | P2 | 27/01/2008 18:56 | -55.2508 | -41.3939 | RMT 25 recovered. Ship steaming to redeployment position. |
| 251RMT25 | P2 | 27/01/2008 20:14 | -55.1898 | -41.1746 | RMT 25 deployed |
| 251RMT25 | P2 | 27/01/2008 20:55 | -55.2038 | -41.2224 | 770 metres wire out. Commence hauling. |
| 251RMT25 | P2 | 27/01/2008 22:24 | -55.2394 | -41.3203 | RMT 25 recovered |
| 252RMT25 | P2 | 27/01/2008 23:20 | -55.1951 | -41.1917 | RMT 25 deployed. |
| 252RMT25 | P2 | 27/01/2008 23:46 | -55.2017 | -41.2167 | RMT recovered. |
| 253RMT25 | P2 | 28/01/2008 00:22 | -55.1937 | -41.1893 | RMT 25 deployed. |
| 253RMT25 | P2 | 28/01/2008 00:51 | -55.2009 | -41.2148 | RMT 25 recovered. |
| 254RMT25 | P2 | 28/01/2008 01:22 | -55.1757 | -41.1998 | RMT 25 deployed. |
| 254RMT25 | P2 | 28/01/2008 03:26 | -55.2344 | -41.2946 | RMT 25 recovered |
| 255RMT25 | P2 | 28/01/2008 04:18 | -55.1656 | -41.1862 | RMT 25 deployed. |
| 255RMT25 | P2 | 28/01/2008 07:18 | -55.2684 | -41.3301 | RMT 25 recovered. Changing over to LHPR. |
| 256LHPR | P2 | 28/01/2008 08:16 | -55.2405 | -41.2847 | LHPR deployed. |
| 256LHPR | P2 | 28/01/2008 10:54 | -55.1529 | -41.185 | LHPR recovered. |
| 257MOO | M1 | 28/01/2008 14:11 | -55.2 | -41.1231 | V/L on DP for mooring deployment |
| 257MOO | M1 | 28/01/2008 14:57 | -55.1999 | -41.1237 | Commenced mooring Deployment |
| 257MOO | M1 | 28/01/2008 15:05 | -55.1999 | -41.1237 | Accoustic release deployed |
| 257MOO | M1 | 28/01/2008 16:06 | -55.1999 | -41.1237 | Sediment trap and current meter deployed |
| 257MOO | M1 | 28/01/2008 16:12 | -55.1999 | -41.1237 | Trimsin buoy cluster deployed |
| 257MOO | M1 | 28/01/2008 17:04 | -55.1999 | -41.1236 | Main buoy released. Mooring deployment complete |
| 258CTD | M1 | 28/01/2008 17:43 | -55.1971 | -41.1254 | CTD deployed |
| 258CTD | M1 | 28/01/2008 17:54 | -55.1971 | -41.1254 | CTD @ 400m |
| 258CTD | M1 | 28/01/2008 18:05 | -55.1971 | -41.1254 | CTD recovered |
| 259CTD | | 28/01/2008 20:12 | -54.9128 | -41.1732 | CTD deployed. EA 600 depth 3413 metres. |
| 259CTD | | 28/01/2008 21:12 | -54.9128 | -41.1733 | CTD stopped at 3374 metres wire out. |
| 259CTD | | 28/01/2008 22:36 | -54.9128 | -41.1732 | CTD recovered. |
| 260MOC | P2 | 29/01/2008 00:36 | -55.1782 | -41.1785 | Mocness deployed |
| 260MOC | P2 | 29/01/2008 03:07 | -55.2316 | -41.295 | Mocness recovered. |
| 261LHPR | P2 | 29/01/2008 04:04 | -55.2107 | -41.1814 | LHPR Deployed |
| 261LHPR | P2 | 29/01/2008 06:32 | -55.1975 | -41.3296 | LHPR recovered |

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| 262CTD | | 29/01/2008 10:31 | -54.5908 | -40.9966 | CTD deployed. EA 600 depth 3285 metres. |
| 262CTD | | 29/01/2008 11:29 | -54.5909 | -40.9966 | CTD @ 3236m |
| 262CTD | | 29/01/2008 12:45 | -54.5909 | -40.9966 | CTD recovered |
| 263CTD | | 29/01/2008 15:09 | -54.2162 | -40.813 | CTD deployed . EA600 depth 2424 metres. |
| 263CTD | | 29/01/2008 15:53 | -54.2162 | -40.813 | CTD @ 2418m |
| 263CTD | | 29/01/2008 16:49 | -54.2162 | -40.8131 | CTD recovered |
| 264CTD | | 29/01/2008 19:06 | -53.8972 | -40.6444 | CTD deployed. EA 600 depth 1185 metres. |
| 264CTD | | 29/01/2008 19:32 | -53.8972 | -40.6444 | CTD held at 1214m cable out CTD recovered. Ship proceeding to Shag Rocks shelf for |
| 264CTD | | 29/01/2008 20:19 | -53.8972 | -40.6445 | target fishing. |
| 265RMT8 | | 30/01/2008 00:09 | -53.5806 | -41.0304 | RMT 8 deployed |
| 265RMT8 | | 30/01/2008 00:45 | -53.5917 | -41.0672 | RMT 8 Recovered |
| 266RMT8 | | 30/01/2008 02:23 | -53.5606 | -40.7945 | RMT 8 deployed |
| 266RMT8 | | 30/01/2008 02:40 | -53.5663 | -40.8131 | RMT 8 Recovered |
| 267CTD | N8 | 30/01/2008 04:23 | -53.5261 | -40.4588 | CTD deployed. EA 600 depth 2057 metres. |
| 267CTD | N8 | 30/01/2008 05:02 | -53.5263 | -40.4595 | CTD @ 2006m |
| 267CTD | N8 | 30/01/2008 06:00 | -53.5264 | -40.4594 | CTD recovered |
| 268RMT8 | N8 | 30/01/2008 07:00 | -53.5233 | -40.461 | RMT 8 deployed |
| 268RMT8 | N8 | 30/01/2008 07:31 | -53.54 | -40.4878 | RMT 8 recovered |
| 269RMT8 | N8 | 30/01/2008 07:57 | -53.5163 | -40.4503 | RMT 8 deployed. |
| 269RMT8 | N8 | 30/01/2008 08:57 | -53.5472 | -40.505 | RMT 8 recovered. Ship steaming to CTD position 32. |
| 270CTD | N9 | 30/01/2008 11:20 | -53.1547 | -40.2755 | CTD deployed |
| 270CTD | N9 | 30/01/2008 12:30 | -53.1551 | -40.2752 | CTD @ 3968m |
| 270CTD | N9 | 30/01/2008 13:56 | -53.1551 | -40.2753 | CTD recovered |
| 271BON | N9 | 30/01/2008 14:09 | -53.1552 | -40.2753 | Bongo nets deployed. |
| 271BON | N9 | 30/01/2008 14:23 | -53.155 | -40.2755 | Bongo nets recovered |
| 272ATOW | | 30/01/2008 15:39 | -53.0882 | -40.5103 | PES fish deployed |
| 272ATOW | | 31/01/2008 14:42 | -52.8587 | -40.487 | PES towfish recovered |
| 273CTD | M2 | 31/01/2008 16:51 | -52.7222 | -40.1392 | CTD deployed |
| 273CTD | M2 | 31/01/2008 17:01 | -52.7222 | -40.1393 | CTD @ 400m |
| 273CTD | M2 | 31/01/2008 17:19 | -52.7222 | -40.1393 | CTD recovered |
| 274MOO | M2 | 31/01/2008 17:28 | -52.7222 | -40.1393 | Hydrophone deployed. |
| 274MOO | M2 | 31/01/2008 17:30 | -52.7223 | -40.1393 | Mooring released |
| 274MOO | M2 | 31/01/2008 17:32 | -52.7223 | -40.1393 | Mooring sighted. Off DP proceeding for recovery |
| 274MOO | M2 | 31/01/2008 17:53 | -52.7237 | -40.1477 | Commence recovery of mooring |
| 274MOO | M2 | 31/01/2008 17:55 | -52.7237 | -40.1477 | Main buoy and whale buoy recovered |
| 274MOO | M2 | 31/01/2008 18:58 | -52.7237 | -40.1477 | Trimsin buoy cluster recovered. |
| 274MOO | M2 | 31/01/2008 19:06 | -52.7236 | -40.1477 | Sediment trap recovered. |
| 274MOO | M2 | 31/01/2008 19:49 | -52.7236 | -40.1477 | Acoustic release on deck. Completed mooring recovery. |
| 275RMT8 | P3 | 31/01/2008 21:00 | -52.751 | -40.0696 | RMT 8 deployed. Heading west. |
| 275RMT8 | P3 | 31/01/2008 21:52 | -52.751 | -40.1295 | RMT recovered. |
| 276MOC | P3 | 01/02/2008 00:12 | -52.8571 | -40.0208 | Mocness deployed |
| 276MOC | P3 | 01/02/2008 02:43 | -52.8573 | -40.1596 | Mocness recovered. |
| 277FRRF | P3 | 01/02/2008 03:31 | -52.859 | -40.0961 | FRRF deployed |
| 277FRRF | P3 | 01/02/2008 04:01 | -52.859 | -40.0961 | FRRF recovered |
| 278LHPR | P3 | 01/02/2008 04:30 | -52.848 | -40.0471 | LHPR deployed |
| 278LHPR | P3 | 01/02/2008 06:48 | -52.8811 | -40.1633 | LHPR recovered |
| 279CTD | P3 | 01/02/2008 07:25 | -52.8583 | -40.0971 | CTD deployed. EA 600 depth 3791 metres. |
| 279CTD | P3 | 01/02/2008 08:32 | -52.8589 | -40.0969 | CTD stopped at 3736 metres wire out. |
| 279CTD | P3 | 01/02/2008 09:59 | -52.859 | -40.0969 | CTD recovered. |
| 280BON | P3 | 01/02/2008 10:06 | -52.859 | -40.0969 | Bongo nets deployed. |
| 280BON | P3 | 01/02/2008 10:35 | -52.859 | -40.0969 | Bongo nets recovered. |
| 281BON | P3 | 01/02/2008 10:38 | -52.859 | -40.0968 | Bongo nets redeployed. |

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| 281 BON | P3 | 01/02/2008 11:05 | -52.8589 | -40.0968 | Bongo nets recovered |
| 282 BON | P3 | 01/02/2008 11:08 | -52.8589 | -40.0968 | Bongo nets deployed. |
| 282 BON | P3 | 01/02/2008 11:23 | -52.8589 | -40.0968 | Bongo nets recovered |
| 283 MON | P3 | 01/02/2008 11:30 | -52.8589 | -40.0969 | Mini bongo nets deployed. |
| 283 MON | P3 | 01/02/2008 12:00 | -52.859 | -40.0968 | Mini bongo nets recovered. |
| 284 MON | P3 | 01/02/2008 12:03 | -52.859 | -40.0968 | Mini bongo nets redeployed. |
| 284 MON | P3 | 01/02/2008 12:33 | -52.859 | -40.0968 | Mini bongo recovered |
| 285 MON | P3 | 01/02/2008 12:36 | -52.859 | -40.0968 | Mini bongo nets deployed. |
| 285 MON | P3 | 01/02/2008 12:50 | -52.859 | -40.0968 | Mini bongo nets recovered. |
| 286 CTD | P3 | 01/02/2008 12:59 | -52.859 | -40.0968 | CTD deployed |
| 286 CTD | P3 | 01/02/2008 13:09 | -52.859 | -40.0968 | CTD @ 400m |
| 286 CTD | P3 | 01/02/2008 13:28 | -52.8589 | -40.0968 | CTD recovered. |
| 287 LHPR | P3 | 01/02/2008 14:08 | -52.8586 | -40.0137 | LHPR Deployed |
| 287 LHPR | P3 | 01/02/2008 16:17 | -52.8595 | -40.1541 | LHPR recovered |
| 288 TON | P3 | 01/02/2008 14:12 | -52.8587 | -40.0178 | Towed bongo deployed fwd |
| 288 TON | P3 | 01/02/2008 14:21 | -52.859 | -40.0279 | Towed bongo recovered fwd |
| 289 TON | P3 | 01/02/2008 14:25 | -52.8592 | -40.0324 | Towed bongo deployed fwd |
| 289 TON | P3 | 01/02/2008 14:37 | -52.8595 | -40.0463 | Towed bongo recovered |
| 290 FRRF | P3 | 01/02/2008 16:57 | -52.8588 | -40.0964 | FRRF deployed |
| 290 FRRF | P3 | 01/02/2008 17:30 | -52.8589 | -40.0965 | FRRF recovered |
| 291 GOF | P3 | 01/02/2008 17:42 | -52.8589 | -40.0964 | Go flo deployed |
| 291 GOF | P3 | 01/02/2008 18:07 | -52.859 | -40.0968 | Go flo @ 904m |
| 291 GOF | P3 | 01/02/2008 18:44 | -52.859 | -40.0968 | Go Flo recovered. |
| 292 MOC | P3 | 01/02/2008 19:21 | -52.8756 | -40.0177 | Mocness deployed. |
| 292 MOC | P3 | 01/02/2008 20:22 | -52.865 | -40.0706 | Mocness @ 1757m cable out. Hauling in. |
| 292 MOC | P3 | 01/02/2008 21:57 | -52.8465 | -40.1593 | Mocness recovered. Proceeding to station position. |
| 293 CTD | P3 | 01/02/2008 22:30 | -52.8583 | -40.0973 | CTD deployed. |
| 293 CTD | P3 | 01/02/2008 23:10 | -52.8582 | -40.0974 | CTD @ 2000m |
| 293 CTD | P3 | 01/02/2008 23:59 | -52.8583 | -40.0974 | CTD recovered |
| 294 RMT8 | P3 | 02/02/2008 03:10 | -52.8957 | -40.0267 | RMT 8 deployed |
| 294 RMT8 | P3 | 02/02/2008 03:42 | -52.896 | -40.0657 | RMT 8 net recovered |
| 295 RMT25 | P3 | 02/02/2008 05:04 | -52.8424 | -40.1649 | RMT25 deployed for deep tow |
| 295 RMT25 | P3 | 02/02/2008 08:10 | -52.889 | -39.9539 | RMT 25 recovered. |
| 296 BON | P3 | 02/02/2008 09:11 | -52.8591 | -40.0964 | Bongo nets deployed. |
| 296 BON | P3 | 02/02/2008 09:40 | -52.8592 | -40.0964 | Bongo nets recovered. |
| 297 BON | P3 | 02/02/2008 09:42 | -52.8592 | -40.0964 | Bongo nets redeployed. |
| 297 BON | P3 | 02/02/2008 10:13 | -52.8592 | -40.0964 | Bongo nets recovered. |
| 298 MON | P3 | 02/02/2008 10:17 | -52.8592 | -40.0964 | Mini bongos deployed. |
| 298 MON | P3 | 02/02/2008 10:48 | -52.8591 | -40.0964 | Mini bongos recovered. |
| 299 MON | P3 | 02/02/2008 10:52 | -52.8591 | -40.0964 | Mini bongos redployed. |
| 299 MON | P3 | 02/02/2008 11:20 | -52.8591 | -40.0964 | Mini bongo recovered |
| 300 RMT25 | P3 | 02/02/2008 11:51 | -52.836 | -40.0312 | RMT 25 deployed. |
| 300 RMT25 | P3 | 02/02/2008 14:57 | -52.9009 | -40.2132 | RMT 25 recovered |
| 301 RMT25 | P3 | 02/02/2008 15:25 | -52.9021 | -40.2233 | RMT 25 deployed |
| 301 RMT25 | P3 | 02/02/2008 17:27 | -52.8593 | -40.099 | RMT 25 recovered |
| 302 MOO | M2 | 02/02/2008 18:30 | -52.7234 | -40.1472 | Commence mooring deployment. Railway wheels deployed |
| 302 MOO | M2 | 02/02/2008 18:34 | -52.7234 | -40.1472 | Acoustic release deployed |
| 302 MOO | M2 | 02/02/2008 19:28 | -52.7234 | -40.1472 | Sediment trap and current meter attached. |
| 302 MOO | M2 | 02/02/2008 19:35 | -52.7234 | -40.1472 | Trimsin cluster attached. |
| 302 MOO | M2 | 02/02/2008 20:22 | -52.7234 | -40.1472 | SBE CTD attached. |
| 302 MOO | M2 | 02/02/2008 20:48 | -52.7234 | -40.1472 | Mooring buoy released. |
| 303 CTD | M2 | 02/02/2008 21:28 | -52.7269 | -40.1471 | CTD deployed. |

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| 303CTD | M2 | 02/02/2008 21:40 | -52.7269 | -40.1471 | CTD at 400 metres depth. |
| 303CTD | M2 | 02/02/2008 22:05 | -52.7269 | -40.1471 | CTD recovered. |
| 304RMT8 | P3 | 02/02/2008 23:33 | -52.7707 | -39.9295 | RMT 8 deployed. |
| 304RMT8 | P3 | 02/02/2008 23:56 | -52.7657 | -39.955 | RMT 8 Recovered |
| 305RMT25 | P3 | 03/02/2008 00:49 | -52.8192 | -40.134 | RMT 25 deployed |
| 305RMT25 | P3 | 03/02/2008 02:57 | -52.8888 | -40.0654 | RMT 25 recovered |
| 306RMT8 | R3 | 03/02/2008 08:43 | -52.7147 | -39.168 | Target fishing |
| 306RMT8 | R3 | 03/02/2008 09:11 | -52.7354 | -39.1742 | RMT 8 recovered. |
| 307ATOW | R3 | 03/02/2008 09:27 | -52.7421 | -39.1627 | PES fish deployed |
| 307ATOW | R3 | 03/02/2008 15:37 | -52.6515 | -39.2906 | PES and NOC towfish recovered |
| 308RMT8 | R3 | 03/02/2008 16:00 | -52.6384 | -39.2774 | RMT 8 deployed for target fishing |
| 308RMT | R3 | 03/02/2008 16:29 | -52.6583 | -39.2903 | RMT 8 Recovered |
| 309NTOW | R3 | 03/02/2008 16:24 | -52.6548 | -39.2882 | NOC towfish redeployed |
| 309NTOW | R3 | 11/02/2008 23:57 | -53.6911 | -35.2584 | NOC tow fish recovered |
| 310FRRF | R3 | 03/02/2008 17:21 | -52.627 | -39.1155 | FRRF deployed |
| 310FRRF | R3 | 03/02/2008 17:52 | -52.627 | -39.1155 | FRRF recovered |
| 311GOF | R3 | 03/02/2008 18:00 | -52.627 | -39.1155 | Go flo deployed |
| 311GOF | R3 | 03/02/2008 18:24 | -52.627 | -39.1156 | Go flo @ 904m Go Flo recovered. Moving 3 miles downwind for |
| 311GOF | R3 | 03/02/2008 19:06 | -52.6269 | -39.1155 | Mocness. |
| 312MOC | R3 | 03/02/2008 19:43 | -52.5824 | -39.0894 | Mocness deployed. |
| 312MOC | R3 | 03/02/2008 20:52 | -52.6194 | -39.1125 | 2000 metres wire out. Commence hauling. |
| 312MOC | R3 | 03/02/2008 22:34 | -52.6764 | -39.149 | Mocness recovered. Proceeding to station position. |
| 313CTD | R3 | 03/02/2008 23:10 | -52.6268 | -39.1153 | CTD deployed in 3730m water depth |
| 313CTD | R3 | 03/02/2008 23:48 | -52.6273 | -39.1157 | CTD at depth 2000m |
| 313CTD | R3 | 04/02/2008 00:34 | -52.6273 | -39.1157 | CTD recovered. |
| 314MOC | R3 | 04/02/2008 01:12 | -52.5796 | -39.1032 | Mocness deployed |
| 314MOC | R3 | 04/02/2008 02:23 | -52.6205 | -39.1143 | 2040m wire out |
| 314MOC | R3 | 04/02/2008 02:35 | -52.6276 | -39.116 | Vessel passed through R3 station |
| 314MOC | R3 | 04/02/2008 04:05 | -52.68 | -39.126 | Mocness recovered |
| 315FRRF | R3 | 04/02/2008 04:09 | -52.6809 | -39.1263 | V/L on DP for FRRF - FRRF deployed |
| 315FRRF | R3 | 04/02/2008 04:38 | -52.6808 | -39.1263 | FRRF recovered |
| 316LHPR | R3 | 04/02/2008 05:20 | -52.6145 | -39.0681 | LHPR deployed |
| 316LHPR | R3 | 04/02/2008 07:33 | -52.6395 | -39.1851 | LHPR recovered. Proceeding to station for CTD. |
| 317CTD | R3 | 04/02/2008 08:10 | -52.6267 | -39.1148 | CTD deployed. EA600 depth 3730 metres. |
| 317CTD | R3 | 04/02/2008 09:17 | -52.6273 | -39.1153 | CTD at depth. Commence hauling. |
| 317CTD | R3 | 04/02/2008 10:41 | -52.6272 | -39.1152 | CTD recovered. |
| 318BON | R3 | 04/02/2008 10:47 | -52.6272 | -39.1152 | Bongo nets deployed. |
| 318BON | R3 | 04/02/2008 11:16 | -52.6272 | -39.1152 | Bongo nets recovered |
| 319BON | R3 | 04/02/2008 11:18 | -52.6272 | -39.1152 | Bongo nets deployed. |
| 319BON | R3 | 04/02/2008 11:51 | -52.6272 | -39.1152 | Bongo nets recovered |
| 320BON | R3 | 04/02/2008 11:56 | -52.6272 | -39.1152 | Bongo nets deployed. |
| 320BON | R3 | 04/02/2008 12:06 | -52.6272 | -39.1152 | Bongo nets recovered |
| 321MON | R3 | 04/02/2008 12:14 | -52.6272 | -39.1152 | Mini bongo deployed |
| 321MON | R3 | 04/02/2008 12:41 | -52.6272 | -39.1152 | Mini bongo nets recovered. |
| 322MON | R3 | 04/02/2008 12:45 | -52.6272 | -39.1152 | Mini bongo nets deployed. |
| 322MON | R3 | 04/02/2008 13:19 | -52.6272 | -39.1152 | Mini bongo nets recovered. |
| 323MON | R3 | 04/02/2008 13:22 | -52.6272 | -39.1152 | Mini bongo nets deployed. |
| 323MON | R3 | 04/02/2008 13:51 | -52.6272 | -39.1153 | Mini bongo nets recovered. |
| 324CTD | R3 | 04/02/2008 14:02 | -52.6272 | -39.1152 | CTD deployed to 400m |
| 324CTD | R3 | 04/02/2008 14:10 | -52.6272 | -39.1152 | CTD @ 400m |
| 324CTD | R3 | 04/02/2008 14:29 | -52.6272 | -39.1152 | CTD recovered |
| 325LHPR | R3 | 04/02/2008 14:59 | -52.6626 | -39.174 | LHPR Deployed |

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| 325 LHPR | R3 | 04/02/2008 17:00 | -52.6101 | -39.0852 | LHPR recovered. |
| 325 RMT8 | R3 | 04/02/2008 17:00 | -52.6101 | -39.0852 | RMT 8 deployed for target fishing |
| 326 RMT8 | R3 | 04/02/2008 21:08 | -52.8186 | -39.0987 | RMT 8 recovered. |
| 326 RMT8 | R3 | 04/02/2008 21:35 | -52.8055 | -39.0854 | RMT 8 redeployed |
| 327 RMT8 | R3 | 04/02/2008 22:07 | -52.8204 | -39.0992 | RMT 8 recovered. |
| 327 RMT25 | R3 | 04/02/2008 22:28 | -52.8225 | -39.0802 | RMT 25 deployed |
| 328 RMT25 | R3 | 04/02/2008 23:39 | -52.721 | -39.1073 | RMT 25 recovered |
| 328 RMT25 | R3 | 05/02/2008 01:51 | -52.7327 | -38.9599 | RMT 25 deployed. |
| 329 RMT25 | R3 | 05/02/2008 02:41 | -52.7164 | -39.1028 | RMT 25 recovered |
| 329 BON | R3 | 05/02/2008 05:40 | -52.7665 | -38.9104 | Bongo nets deployed. |
| 330 BON | R3 | 05/02/2008 07:26 | -52.6275 | -39.1164 | Bongo nets recovered. |
| 330 BON | R3 | 05/02/2008 07:55 | -52.6275 | -39.1165 | Bongo nets redeployed. |
| 331 BON | R3 | 05/02/2008 07:58 | -52.6275 | -39.1164 | Bongo nets recovered. |
| 331 MON | R3 | 05/02/2008 08:28 | -52.6275 | -39.1163 | Mini bongos deployed. |
| 332 MON | R3 | 05/02/2008 08:32 | -52.6275 | -39.1163 | Mini bongos recovered. |
| 332 MON | R3 | 05/02/2008 09:01 | -52.6275 | -39.1164 | Mini bongos redeployed. Mini bongos recovered. Ship proceeding 3 miles |
| 333 MON | R3 | 05/02/2008 09:05 | -52.6275 | -39.1164 | downwind for RMT. |
| 333 RMT25 | R3 | 05/02/2008 09:37 | -52.6276 | -39.1165 | RMT 25 deployed. |
| 334 RMT25 | R3 | 05/02/2008 10:27 | -52.5925 | -39.1634 | RMT 25 recovered |
| 334 RMT25 | R3 | 05/02/2008 13:37 | -52.695 | -38.9971 | RMT 25 deployed |
| 335 RMT25 | R3 | 05/02/2008 14:51 | -52.6033 | -39.1682 | RMT 25 recovered |
| 335 XBT | | 05/02/2008 16:49 | -52.6607 | -39.0581 | XBT deployed. |
| 336 XBT | | 05/02/2008 21:23 | -52.5594 | -37.8567 | XBT deployed. |
| 337 XBT | | 05/02/2008 23:23 | -52.3221 | -37.3944 | XBT deployed. |
| 338 XBT | | 06/02/2008 01:32 | -52.0826 | -36.9332 | XBT deployed @ 6 knots |
| 339 XBT | | 06/02/2008 03:23 | -51.8597 | -36.4992 | XBT deployed @ 6 knots |
| 340 XBT | | 06/02/2008 05:21 | -51.6297 | -36.0946 | XBT deployed @ 6 knots |
| 341 XBT | | 06/02/2008 07:25 | -51.4018 | -35.627 | XBT deployed @ 6 knots |
| 342 XBT | | 06/02/2008 09:29 | -51.156 | -35.1602 | XBT deployed @ 6 knots |
| 343 XBT | | 06/02/2008 11:30 | -50.9114 | -34.7032 | XBT deployed @ 6 knots |
| 344 XBT | | 06/02/2008 13:27 | -50.6686 | -34.244 | XBT deployed @ 6 knots |
| 345 RMT25 | R4 | 06/02/2008 14:25 | -50.5541 | -34.0283 | RMT 25 deployed |
| 346 RMT25 | R4 | 06/02/2008 15:29 | -50.4891 | -33.9116 | RMT 25 recovered |
| 346 XBT | R4 | 06/02/2008 17:21 | -50.5014 | -34.0437 | XBT deployed |
| 347 XBT | R4 | 06/02/2008 17:25 | -50.5012 | -34.048 | XBT deployed @ 6 knots |
| 348 XBT | R4 | 06/02/2008 18:25 | -50.4668 | -33.8923 | XBT deployed (mid transect). |
| 349 XBT | R4 | 06/02/2008 19:07 | -50.4669 | -34.0397 | End of 1st. transect line. XBT deployed. XBT deployed at beginning of second transect. Course |
| 350 XBT | R4 | 06/02/2008 19:37 | -50.4664 | -34.1562 | 090T. |
| 351 XBT | R4 | 06/02/2008 20:29 | -50.5502 | -34.1428 | XBT deployed (mid transect). |
| 352 ACO | R4 | 06/02/2008 21:04 | -50.5503 | -34.0069 | Complete second transect. Slowing for XBT. |
| 353 XBT | R4 | 06/02/2008 21:31 | -50.55 | -33.8953 | XBT completed. |
| 354 XBT | R4 | 06/02/2008 21:39 | -50.5501 | -33.8744 | XBT deployment completed @ 6 knots. Complete XBT deployment. Turning head to wind for |
| 355 XBT | R4 | 06/02/2008 22:11 | -50.5832 | -33.9097 | fishing. |
| 356 RMT25 | R4 | 06/02/2008 22:40 | -50.5836 | -34.012 | RMT 25 deployed |
| 357 RMT25 | R4 | 06/02/2008 23:29 | -50.5497 | -34.0479 | RMT 25 recovered. |
| 357 XBT | R4 | 07/02/2008 01:10 | -50.4895 | -34.1148 | XBT deployed @ 6 knots |
| 358 RMT8 | R4 | 07/02/2008 02:14 | -50.5306 | -34.055 | RMT 8 deployed |
| 359 RMT8 | R4 | 07/02/2008 04:17 | -50.5448 | -33.8868 | RMT 8 recovered |
| 359 ARP | R4 | 07/02/2008 05:12 | -50.5146 | -33.888 | Whale buoy released [unit #54] |
| 360 ARP | R5 | 09/02/2008 07:08 | -53.7916 | -38.1165 | Pop-up released (EA depth 250m) [unit #80] |
| 361 ARP | R5 | 09/02/2008 07:58 | -53.7583 | -38.2082 | Pop-up released (EA depth 377m) [unit #76] |

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| 362 ARP | R5 | 09/02/2008 08:30 | -53.7375 | -38.1873 | Pop-up released (EA depth 328m) [unit #75] |
| 363 ARP | R5 | 09/02/2008 09:01 | -53.7167 | -38.1663 | Light bulb deployed (EA depth 328m). |
| 363 ARP | R5 | 09/02/2008 09:13 | -53.7167 | -38.1664 | Pop-up released (EA depth 330m) [unit #73] |
| 364 ARP | R5 | 09/02/2008 10:08 | -53.6917 | -38.2832 | Light bulb deployed (EA depth 330m) |
| 365 RMT8 | R5 | 09/02/2008 12:46 | -53.6249 | -38.067 | RMT 8 deployed |
| 365 RMT8 | R5 | 09/02/2008 13:18 | -53.6103 | -38.094 | RMT 8 Recovered |
| 366 ACO | R5 | 09/02/2008 13:53 | -53.6682 | -38.0226 | commenced Maria's Transect |
| 366 ACO | R5 | 09/02/2008 14:33 | -53.7609 | -37.9064 | completed Maria's Transect |
| 367 FRRF | R5 | 09/02/2008 15:12 | -53.7144 | -37.9642 | FRRF deployed |
| 367 FRRF | R5 | 09/02/2008 15:36 | -53.7144 | -37.9642 | FRRF recovered |
| 368 CTD | R5 | 09/02/2008 15:45 | -53.7144 | -37.9641 | CTD deployed. EA depth 132m |
| 368 CTD | R5 | 09/02/2008 15:55 | -53.7144 | -37.9641 | CTD @ 118m |
| 368 CTD | R5 | 09/02/2008 16:09 | -53.7144 | -37.9642 | CTD recovered |
| 369 BON | R5 | 09/02/2008 16:27 | -53.7144 | -37.9641 | Bongo nets deployed. |
| 369 BON | R5 | 09/02/2008 16:39 | -53.7147 | -37.9643 | Bongo nets recovered |
| 370 BON | R5 | 09/02/2008 16:40 | -53.7147 | -37.9644 | Bongo nets redeployed. |
| 370 BON | R5 | 09/02/2008 16:49 | -53.715 | -37.9645 | Bongo nets recovered |
| 371 MON | R5 | 09/02/2008 16:57 | -53.715 | -37.9645 | Mini bongo deployed |
| 371 MON | R5 | 09/02/2008 17:05 | -53.715 | -37.9645 | Mini bongo recovered |
| 372 MON | R5 | 09/02/2008 17:08 | -53.715 | -37.9645 | Mini bongo nets redeployed. |
| 372 MON | R5 | 09/02/2008 17:17 | -53.7151 | -37.9645 | Mini bongo nets recovered. |
| 373 CTD | R5 | 09/02/2008 17:27 | -53.7151 | -37.9645 | CTD deployed |
| 373 CTD | R5 | 09/02/2008 17:34 | -53.7151 | -37.9645 | CTD @ 119m |
| 373 CTD | R5 | 09/02/2008 17:48 | -53.7151 | -37.9645 | CTD recovered |
| 374 GOF | R5 | 09/02/2008 18:00 | -53.7151 | -37.9645 | Go flo deployed |
| 374 FRRF | R5 | 09/02/2008 18:14 | -53.7151 | -37.9645 | go flo @ 125m |
| 374 FRRF | R5 | 09/02/2008 18:24 | -53.7151 | -37.9645 | Go Flo recovered. |
| 375 MOC | R5 | 09/02/2008 20:37 | -53.7493 | -37.9192 | Mocness deployed. |
| 375 MOC | R5 | 09/02/2008 22:11 | -53.801 | -37.9235 | Mocness recovered. |
| 376 RMT8 | R5 | 09/02/2008 23:07 | -53.6843 | -38.0163 | RMT 8 deployed |
| 376 RMT8 | R5 | 09/02/2008 23:27 | -53.6984 | -38.0185 | RMT 8 Recovered |
| 377 FRRF | R5 | 10/02/2008 00:59 | -53.7139 | -37.965 | FRRF deployed |
| 377 FRRF | R5 | 10/02/2008 01:32 | -53.7138 | -37.965 | FRRF recovered |
| 378 RMT25 | R5 | 10/02/2008 03:22 | -53.5478 | -37.6533 | RMT 25 deployed |
| 378 RMT25 | R5 | 10/02/2008 05:29 | -53.6378 | -37.6719 | RMT 25 recovered |
| 379 RMT25 | R5 | 10/02/2008 06:09 | -53.5696 | -37.6561 | RMT 25 deployed |
| 379 RMT25 | R5 | 10/02/2008 07:18 | -53.618 | -37.6633 | RMT 25 recovered. Ship proceeding to Bird Island for pick up |
| 380 CTD | | 10/02/2008 21:59 | -54.1588 | -36.6958 | CTD deployed for calibration. |
| 380 CTD | | 10/02/2008 22:22 | -54.1588 | -36.6958 | CTD recovered. |
| 381 ATOW | | 11/02/2008 07:55 | -54.1589 | -36.6958 | PES fish overside for calibration. |
| 381 ATOW | | 11/02/2008 10:17 | -54.1589 | -36.6958 | PES fish onboard. |
| 382 CTD | | 11/02/2008 17:45 | -53.5674 | -34.9622 | CTD deployed |
| 382 CTD | | 11/02/2008 18:47 | -53.5674 | -34.9622 | CTD @ depth 3540m |
| 382 CTD | | 11/02/2008 20:12 | -53.5674 | -34.9622 | CTD recovered. |
| 383 CTD | | 11/02/2008 21:50 | -53.6911 | -35.2584 | CTD deployed. EA 600 depth 3578 metres. |
| 383 CTD | | 11/02/2008 22:55 | -53.6911 | -35.2584 | CTD @ 3535m. Hauling in. |
| 383 CTD | | 12/02/2008 00:31 | -53.6911 | -35.2584 | CTD recovered |
| 384 NTOW | | 13/02/2008 20:53 | -54.2779 | -36.4642 | Towfish deployed. |
| 384 NTOW | | 16/02/2008 11:42 | -52.146 | -53.1791 | NOC tow fish recovered |
| 385 CPR | | 14/02/2008 11:11 | -53.5775 | -39.4883 | CPR Deployed |
| 385 CPR | | 16/02/2008 11:37 | -52.1474 | -53.1695 | CPR Recovered |
| 386 ACO | | 03/01/2008 18:57 | -60.3094 | -47.8952 | Begin transect |

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| 386ACO | 03/01/2008 21:40 | -60.5332 | -48.6812 | End of transect |
| 386ACO | 03/01/2008 22:11 | -60.612 | -48.5951 | Begin second leg of transect along course 060(T) |
| 386ACO | 04/01/2008 00:55 | -60.3881 | -47.8082 | Complete Transect |
| 387ACO | 06/01/2008 19:31 | -60.3158 | -44.9517 | V/l passes waypoint 1 of C2 on course 090 at 10.0kts |
| 387ACO | 06/01/2008 21:16 | -60.3152 | -44.3661 | Course altered to approx. 055T for pack to the east. |
| 387ACO | 06/01/2008 21:56 | -60.2538 | -44.1867 | Resume transect along course 090 at 10.0kts |
| 387ACO | 06/01/2008 22:54 | -60.253 | -43.863 | End of transect |
| 388ACO | 06/01/2008 23:37 | -60.2084 | -43.8629 | Commence Acoustic transect @ 10.0kts |
| 388ACO | 07/01/2008 02:53 | -60.2081 | -44.9481 | Complete Transect |
| 388ACO | 07/01/2008 03:02 | -60.208 | -44.9825 | A/C to 360degrees @ 5 knots |
| 388ACO | 07/01/2008 03:07 | -60.2053 | -44.9944 | Turn complete |
| 388ACO | 07/01/2008 03:42 | -60.1171 | -45.0081 | Reduce to 5 knots |
| 388ACO | 07/01/2008 03:48 | -60.106 | -45.0076 | A/C to 090 degrees |
| 388ACO | 07/01/2008 04:03 | -60.0989 | -44.9488 | Commence transect 3 of mesoscale survey at 10 knots |
| 388ACO | 07/01/2008 07:17 | -60.1004 | -43.8666 | End of transect 3. Reducing speed to 5kts for turn. |
| 388ACO | 07/01/2008 07:24 | -60.1003 | -43.8404 | Commence turn to the north at 5 knots |
| 388ACO | 07/01/2008 07:33 | -60.0916 | -43.8279 | Complete turn. Increasing speed to 10 knots. |
| 388ACO | 07/01/2008 08:11 | -59.9984 | -43.8111 | Commence turn at 5 knots towards next transect. |
| 388ACO | 07/01/2008 08:27 | -59.9928 | -43.8717 | 10 knots. Commence transect 4 at waypoint 7. Course 270T. Speed |
| 388ACO | 07/01/2008 11:43 | -59.9929 | -44.9489 | Complete Transect |
| 388ACO | 07/01/2008 13:30 | -60.2081 | -44.9498 | Commence Acoustic transect @ 10.0kts |
| 388ACO | 07/01/2008 16:05 | -60.208 | -44.0807 | V/l nearing ice edge. Slow to 2 knots for recovery of PES tow fish |
| 388ACO | 07/01/2008 17:05 | -60.1589 | -43.8605 | End of mesoscale survey |
| 389ACO | 13/01/2008 14:43 | -59.9994 | -44.0448 | commenced transect |
| 389ACO | 13/01/2008 17:24 | -59.6833 | -44.6724 | End of transect 1 |
| 389ACO | 13/01/2008 17:27 | -59.6774 | -44.6845 | UOR @ 30m flight |
| 389ACO | 13/01/2008 17:32 | -59.6703 | -44.6979 | V/L @ 5 knots |
| 389ACO | 13/01/2008 18:16 | -59.5931 | -44.5644 | Commence turn to starboard @ 5 knots for transect leg 2 |
| 389ACO | 13/01/2008 18:29 | -59.6055 | -44.5249 | Commence leg 2 of acoustic transect @ 10 knots |
| 389ACO | 13/01/2008 21:22 | -59.924 | -43.8935 | Ship passes waypoint 4. End of second transect. Reducing speed to 5 knots for turn. |
| 389ACO | 13/01/2008 21:33 | -59.929 | -43.8687 | Turn completed. Increasing to 10 knots. |
| 389ACO | 13/01/2008 22:11 | -59.8675 | -43.7152 | Commence turn towards transect 3 |
| 389ACO | 13/01/2008 22:29 | -59.8475 | -43.7428 | Commence 3rd. transect. Course 315T. Speed 10 knots. |
| 389ACO | 14/01/2008 01:15 | -59.5287 | -44.3732 | Transect Complete |
| 389ACO | 14/01/2008 02:32 | -59.4536 | -44.2203 | Commenced acoustic transect |
| 389ACO | 14/01/2008 05:16 | -59.7705 | -43.5971 | Complete transect leg 4/ A/C to 045degrees |
| 389ACO | 14/01/2008 06:00 | -59.6976 | -43.4378 | Commence transect leg 5 |
| 389ACO | 14/01/2008 08:43 | -59.3786 | -44.067 | End of transect. Course altered to 227T. Commence repeat of middle transect in south easterly |
| 389ACO | 14/01/2008 10:01 | -59.5307 | -44.3687 | direction. |
| 389ACO | 14/01/2008 12:45 | -59.8476 | -43.7423 | Complete Transect |
| 390ACO | 17/01/2008 17:25 | -58.3358 | -42.9673 | Commence leg 1 of mesoscale survey |
| 390ACO | 17/01/2008 20:08 | -58.0171 | -43.5699 | Complete first transect. Reduce speed to 5 knots for turn. |
| 390ACO | 17/01/2008 20:17 | -58.0053 | -43.592 | Course altered to 045T. |
| 390ACO | 17/01/2008 21:00 | -57.9285 | -43.4622 | Commence course alteration to 135T. |
| 390ACO | 17/01/2008 21:13 | -57.9407 | -43.427 | Commence second transect. Course 135T. Speed 10 knots. |
| 390ACO | 17/01/2008 23:56 | -58.2562 | -42.8311 | Completed transect. |
| 390ACO | 18/01/2008 01:09 | -58.1855 | -42.6773 | Commenced transect. |
| 390ACO | 18/01/2008 03:50 | -57.8648 | -43.2811 | Complete transect leg 3 |
| 390ACO | 18/01/2008 04:38 | -57.7874 | -43.1401 | Commence transect leg 4 |
| 390ACO | 18/01/2008 07:20 | -58.1053 | -42.5424 | End of transect. Reducing speed for PES fish deployment. |

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| 390 ACO | 18/01/2008 07:38 | -58.1191 | -42.5099 | Speed increased to 5kts. Commence turn towards next transect. |
| 390 ACO | 18/01/2008 08:25 | -58.045 | -42.3818 | Speed reduced to 5kts |
| 390 ACO | 18/01/2008 08:38 | -58.0297 | -42.3978 | Commence transect leg 5 |
| 390 ACO | 18/01/2008 11:20 | -57.7123 | -42.9938 | transect completed |
| 390 ACO | 18/01/2008 13:13 | -57.8625 | -43.2855 | Commenced transect |
| 390 ACO | 18/01/2008 15:54 | -58.18 | -42.6867 | Complete mesoscale survey |
| 391 ACO | 21/01/2008 06:59 | -57.2405 | -42.5028 | Start small scale survey of R2. Course 110T. |
| 391 ACO | 21/01/2008 08:20 | -57.3168 | -42.1152 | End of first transect line. |
| 391 ACO | 21/01/2008 09:10 | -57.2167 | -42.043 | Commence second transect line on course 290T. |
| 391 ACO | 21/01/2008 12:27 | -57.063 | -42.8226 | completed transect |
| 392 ACO | 26/01/2008 03:02 | -55.4859 | -41.0033 | Commenced mesoscale survey transect. |
| 392 ACO | 26/01/2008 05:49 | -55.3324 | -41.743 | Complete leg 1 of mesoscale survey |
| 392 ACO | 26/01/2008 06:34 | -55.2303 | -41.6823 | Commence second transect line on course 110T. |
| 392 ACO | 26/01/2008 09:17 | -55.3846 | -40.9393 | Completed second leg of mesoscale survey. |
| 392 ACO | 26/01/2008 10:06 | -55.2831 | -40.8766 | Commence 3rd. transect of mesoscale survey. |
| 392 ACO | 26/01/2008 14:00 | -55.129 | -41.6137 | Completed transect |
| 392 ACO | 26/01/2008 14:16 | -55.1299 | -41.612 | Commenced repeat of 3Transect |
| 392 ACO | 26/01/2008 16:57 | -55.2828 | -40.8772 | Complete leg 3 of transect |
| 392 ACO | 26/01/2008 17:42 | -55.1816 | -40.8149 | Commence leg 4 of transect |
| 392 ACO | 26/01/2008 22:13 | -55.0282 | -41.5506 | End of transect 4. |
| 392 ACO | 26/01/2008 23:03 | -55.1286 | -41.619 | Commenced repeat 3 Transect |
| 392 ACO | 27/01/2008 03:00 | -55.2069 | -41.1566 | V/L on D.P. for CTD |
| 393 ACO | 30/01/2008 16:00 | -53.0746 | -40.4724 | Commence mesoscale survey of P3 |
| 393 ACO | 30/01/2008 18:43 | -53.0747 | -39.721 | Complete leg 1 of mesoscale survey |
| 393 ACO | 30/01/2008 19:47 | -52.9672 | -39.7241 | Commence second transect line on course 270T. |
| 393 ACO | 30/01/2008 22:45 | -52.9673 | -40.4661 | Complete leg 2 of mesoscale survey |
| 393 ACO | 30/01/2008 23:43 | -52.8586 | -40.4606 | Commence 3rd. transect of mesoscale survey. |
| 393 ACO | 31/01/2008 02:27 | -52.8581 | -39.718 | Complete leg 3 of mesoscale survey |
| 393 ACO | 31/01/2008 03:29 | -52.7512 | -39.7242 | Commence 4th transect of mesoscale survey. |
| 393 ACO | 31/01/2008 06:22 | -52.7512 | -40.4632 | Complete leg 4 of mesoscale survey |
| 393 ACO | 31/01/2008 07:17 | -52.6433 | -40.4657 | Commence 5th transect of mesoscale survey |
| 393 ACO | 31/01/2008 09:59 | -52.6436 | -39.7298 | Complete leg 5 of mesoscale survey. Reducing speed to 5 kts for alteration to rerun leg 3. |
| 393 ACO | 31/01/2008 11:45 | -52.8585 | -39.7268 | Commence the resurvey of the 3th transect of mesoscale survey |
| 393 ACO | 31/01/2008 14:34 | -52.8588 | -40.4743 | Complete leg 3 of mesoscale survey |
| 394 ACO | 03/02/2008 12:48 | -52.5687 | -38.5637 | Commence small mesoscale survey |
| 394 ACO | 03/02/2008 15:26 | -52.6457 | -39.2849 | End of small scale survey of R3. Slow for recovery of tow fish |
