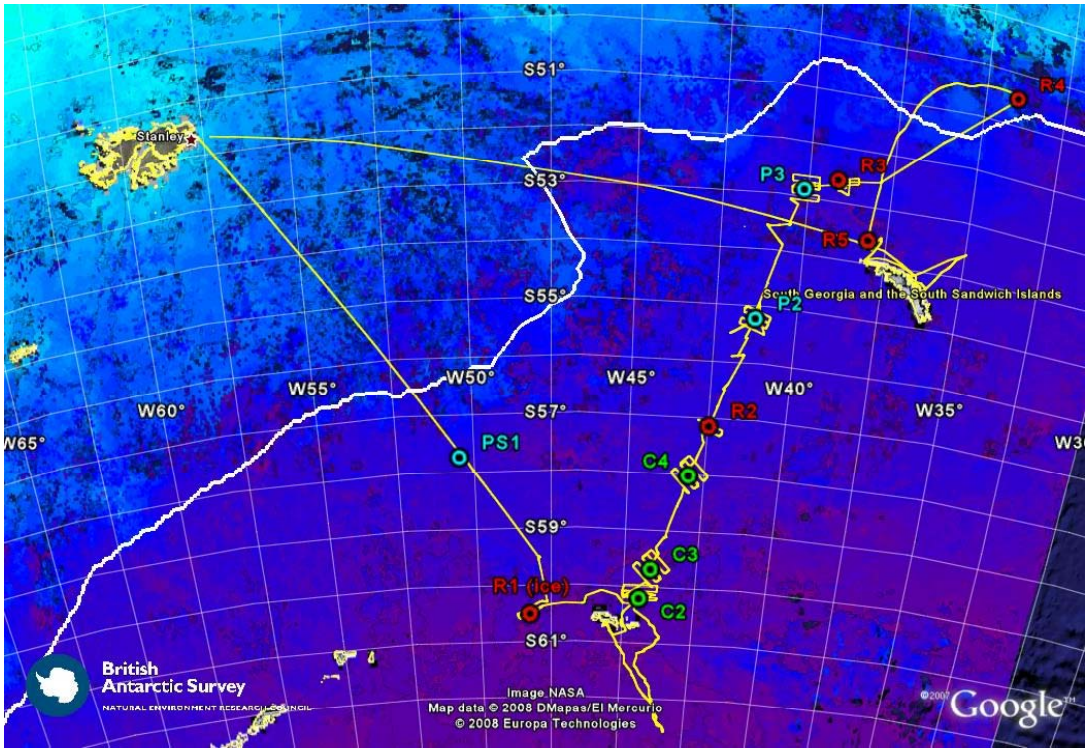
Discovery 2010 - Summer Cruise



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

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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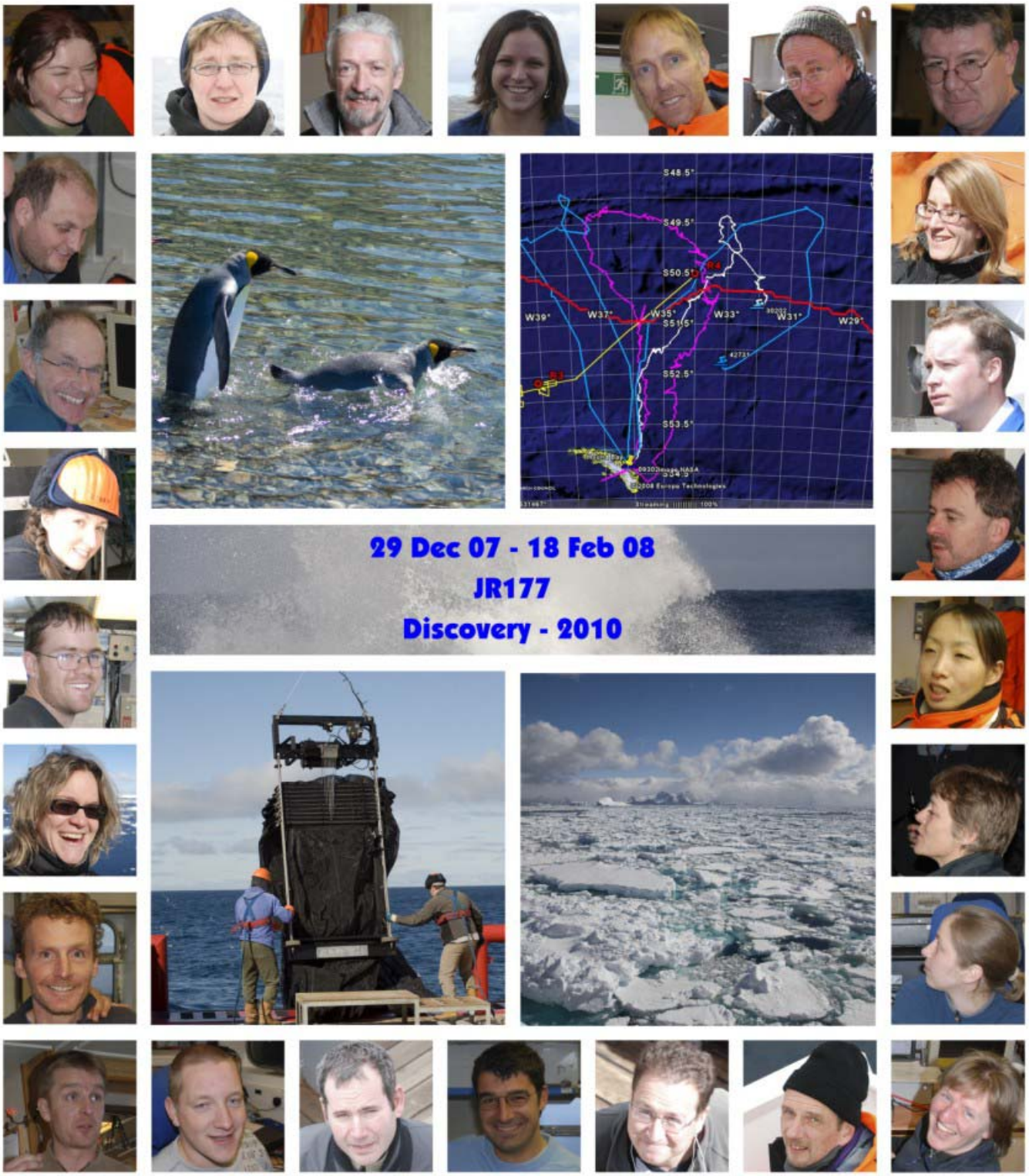
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29 Dec 07 - 18 Feb 08
JR177
Discovery - 2010

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 pCO_2 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 pCO_2.

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 consideration 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 macrozooplanton 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 pCO_2 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

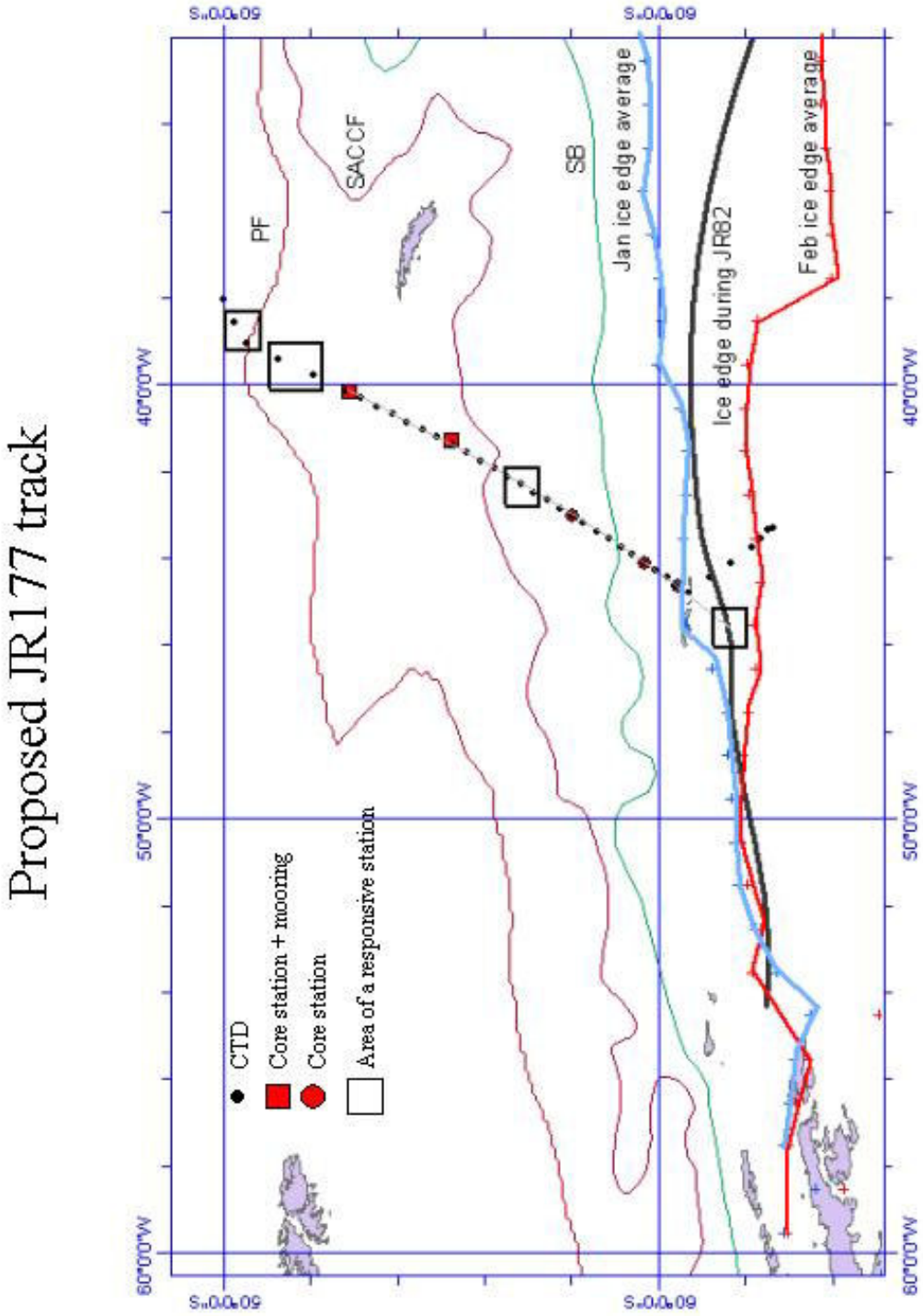


FIGURE 1.2 JR177 48HR SAMPLING PLAN

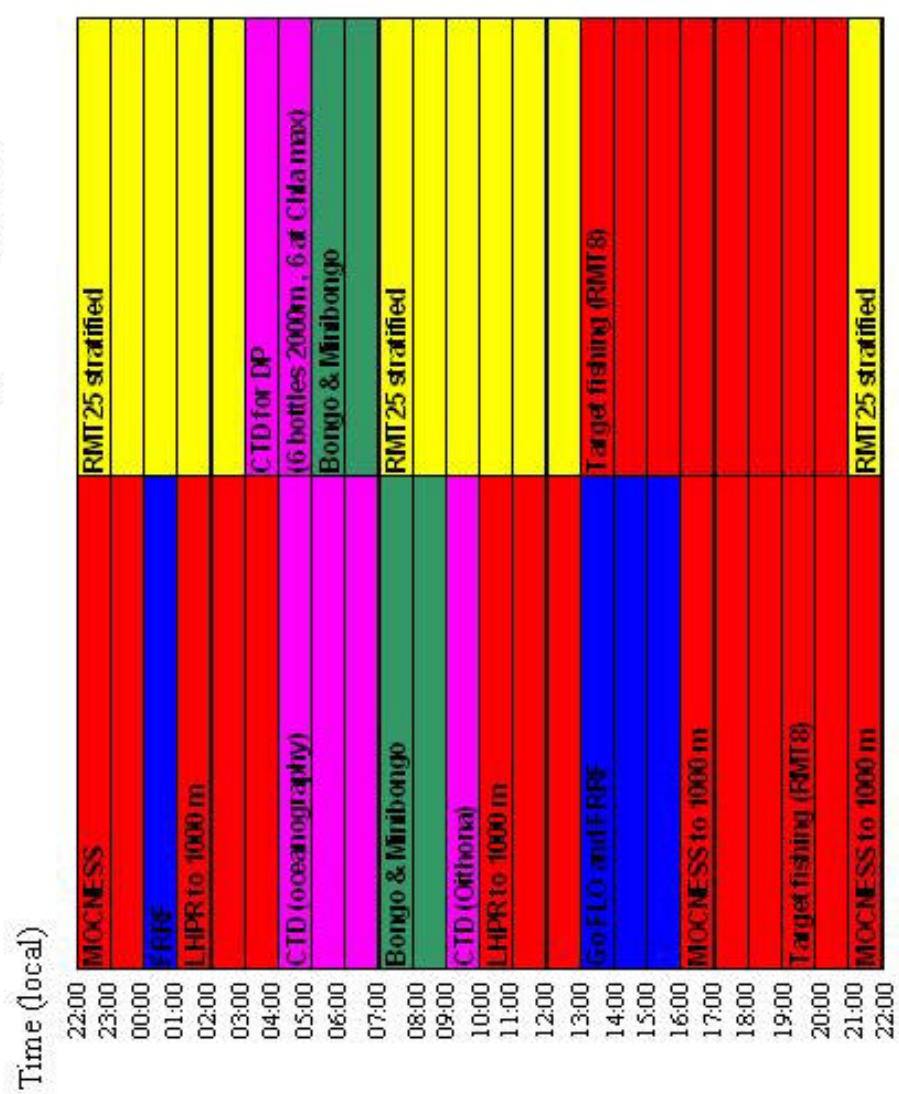
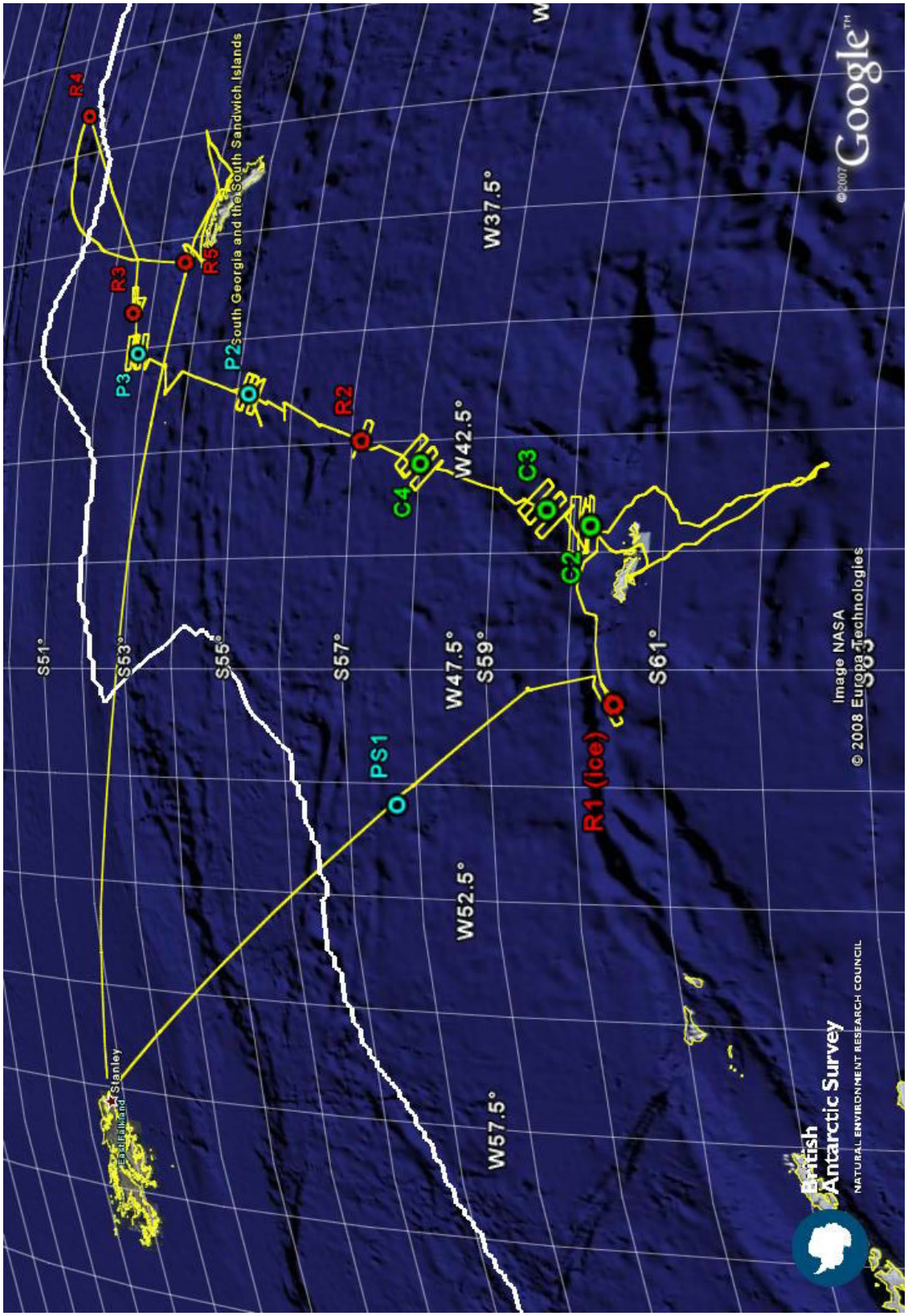


FIGURE 1.3 ACTUAL CRUISE TRACK



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'etre' 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 stirling 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 stirling 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 shorty 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 is 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 scatterrers 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 prooved 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 communcation 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 an 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 statons. 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. Ourideal 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 forard crane during the second LHPR deployment.

16/01/2008 21:06

Towed Bongo deployments again failed to catch large numbers of pterpods. 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 sacraficed. 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 mescoscale 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 and 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 nest were carried out successfully and sufficient krill was caught between two targetted 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 targetted 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 restared 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 silcate 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 50oS 33oW, 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 dramtically to around 5oC. 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 coarse 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 activties 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 offshelf direct from Stromness were agreed to be suitable for addressing dynamic height issues. The CTD series will take up 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 in 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 once where 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 then 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 ≈15m)

Sperry Mk 37 Model D Gyrocompass

Seatex GPS (Seapath 200)

GPS NMEA

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

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

2.2.2 Processing

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

Unix

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

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

Matlab

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

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

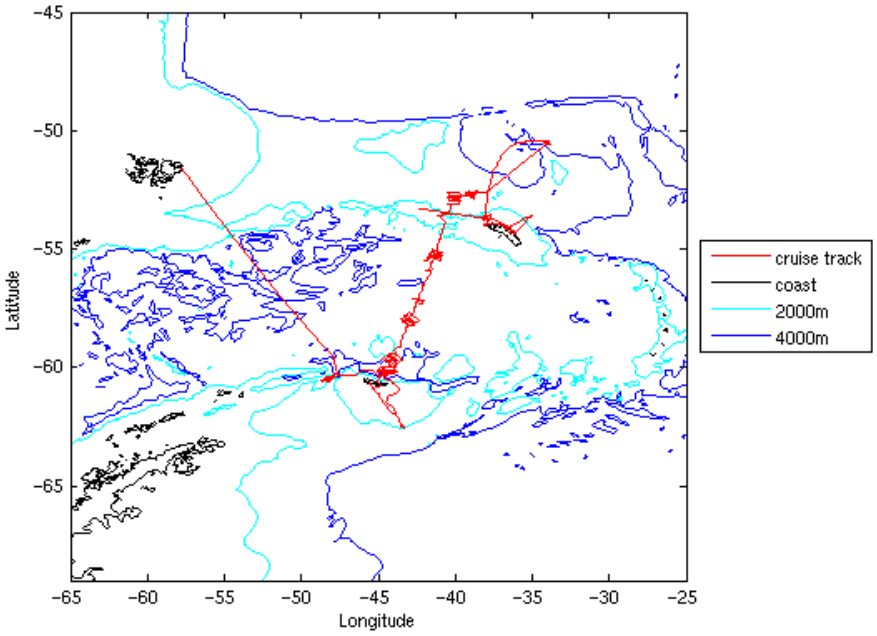


FIGURE OCEA.1: JR177 CRUISE TRACK FOR 31/12/07-14/2/08 FROM SEATEX GPS. COASTLINE AND BATHYMETRY DATA ARE FROM THE GEBCO DATASET.

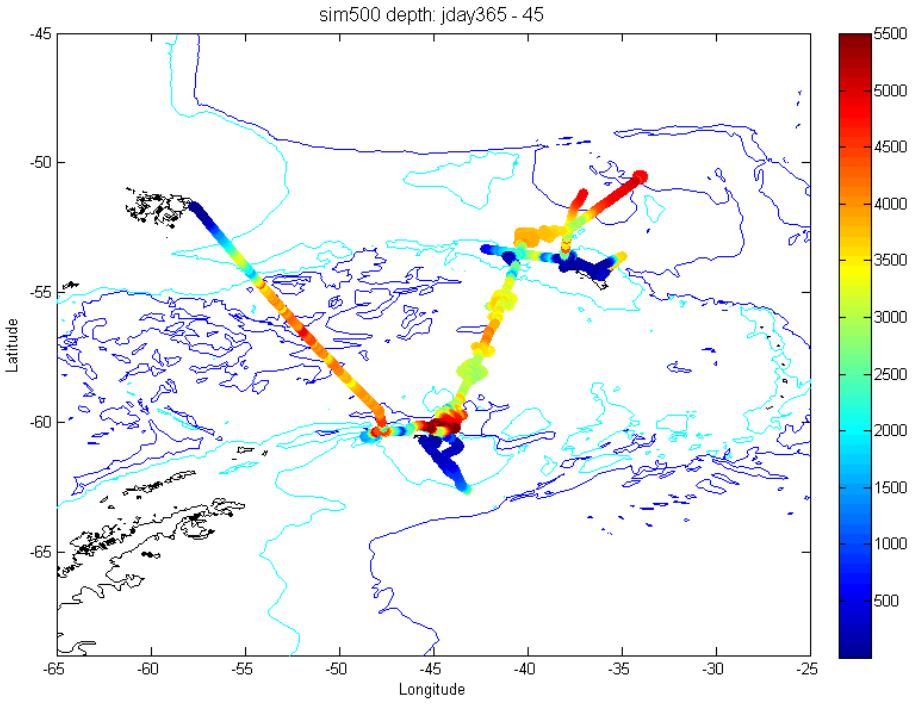


FIGURE OCEA.2: SIMRAD EA600 DEPTH (1 MINUTE AVERAGES) FOR JDAYS 1-45.

2.3 UNDERWAY OCEANLOGGER & METEOROGICAL 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 Quanum Sensor, Kipp & Zonen

Photosynthetically Active Radiation (PAR) 2, Parlite Quanum 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 ≈0.3ºC too low. This was noted during JR165 (Feb-Apr 2007) and an attempt was made to fix the problem during that summer's refit period. However, the same problem was encountered on JR171 and JR193 (Nov-Dec 2007). During 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 0.9ºC. There is a mean offset of 0.37ºC (oceanlogger reads too cold) which is not affected by the removal of outlying points. The standard deviation is 0.1 ºC. 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.

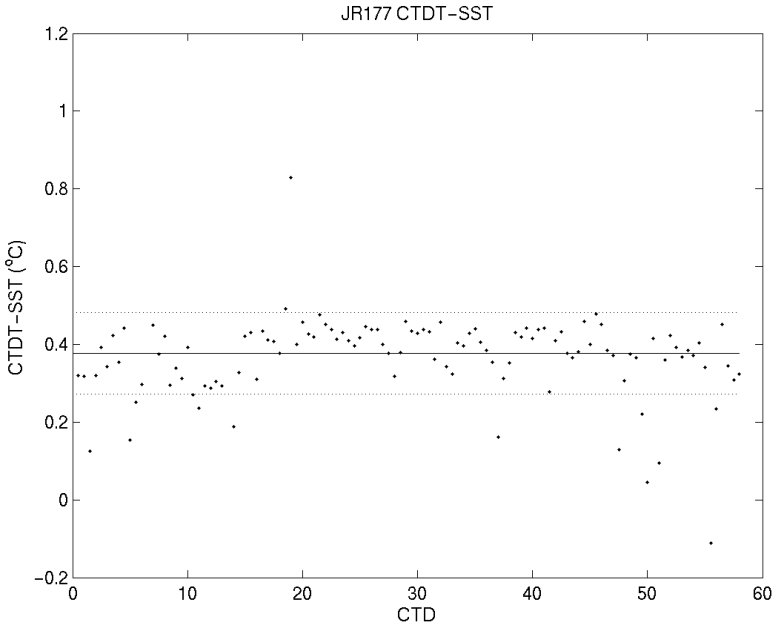


FIGURE OCEA.3: CTD-OCEANLOGGER TEMPERATURE, WITH MEAN AND MEAN +/- STD DEV.

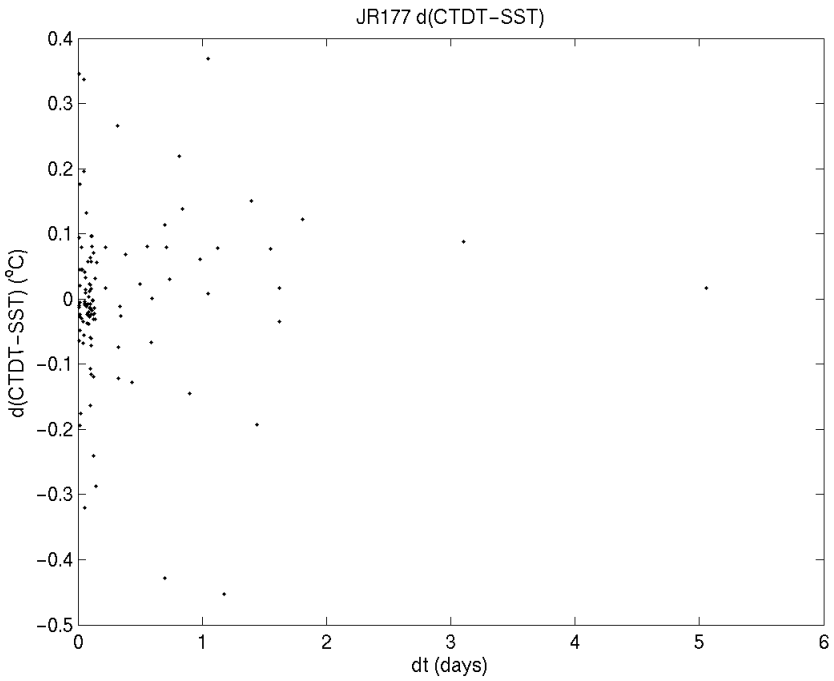


FIGURE OCEA.4: CHANGE IN TEMPERATURE DIFFERENCE AGAINST TIME INTERVAL BETWEEN DATA POINTS.

(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 Autosal 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 ≈ 1hour, 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.

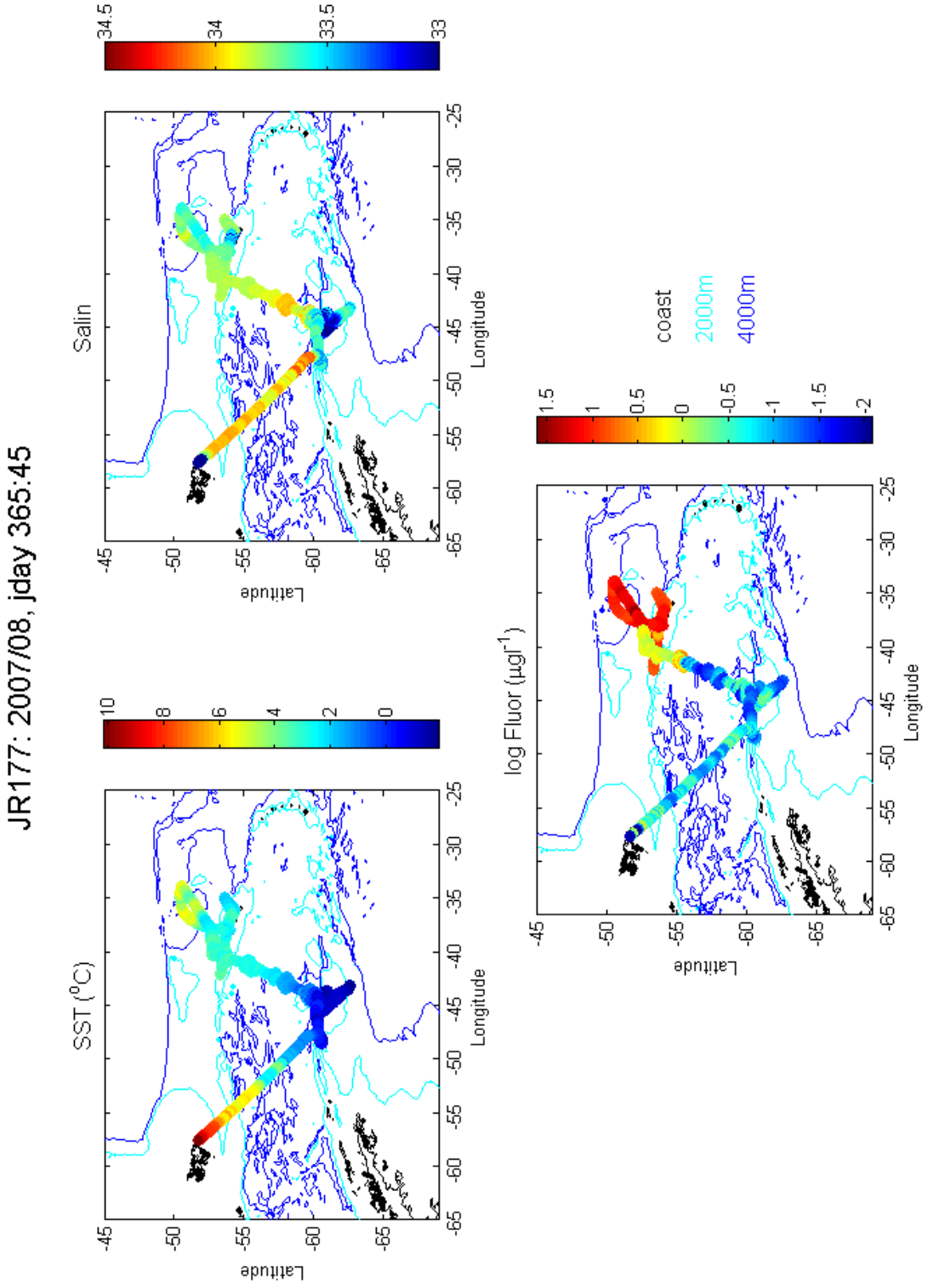


FIGURE OCEA.5: 1 MINUTE AVERAGES OF SST, SALINITY AND LOG FLUORESCENCE FROM THE OCEANLOGGER FOR 31/12/07-14/2/08.

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.

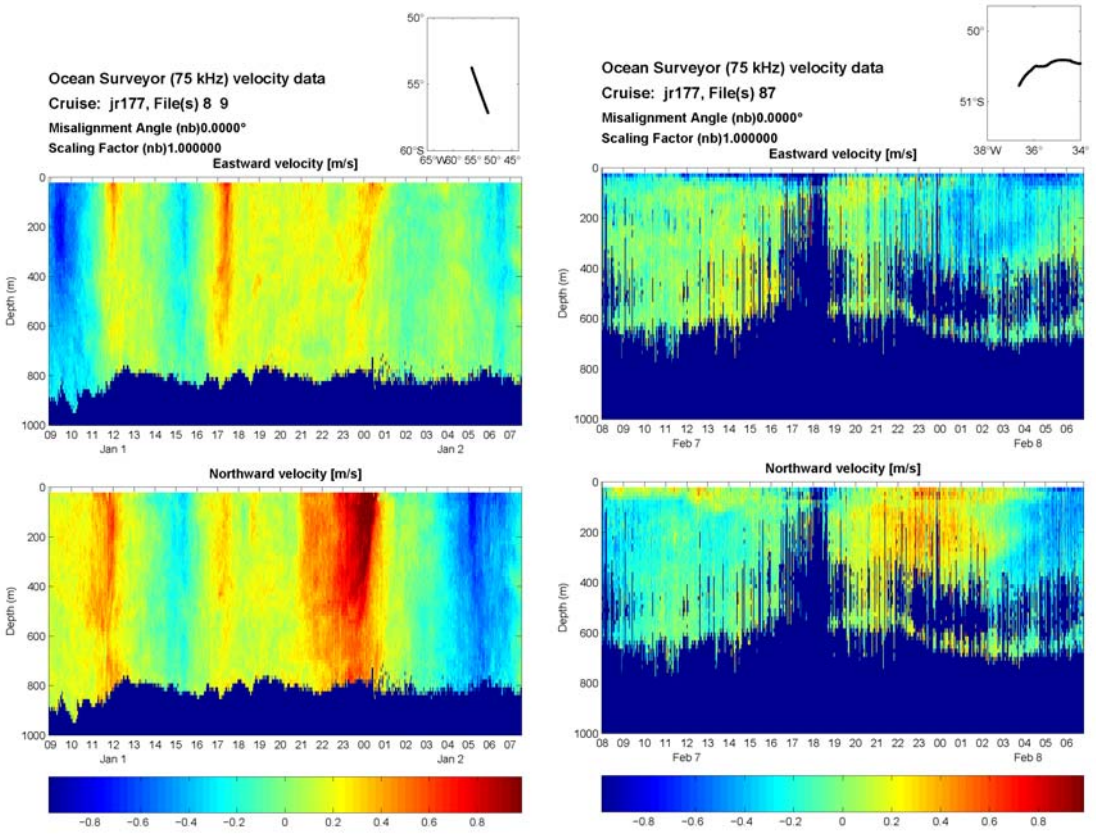


FIGURE OCEA.6. DATA DURING GOOD WEATHER (8 AND 9) AND BAD WEATHER (87)

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 30º and the transducer is 23m away from the CTD gantry.

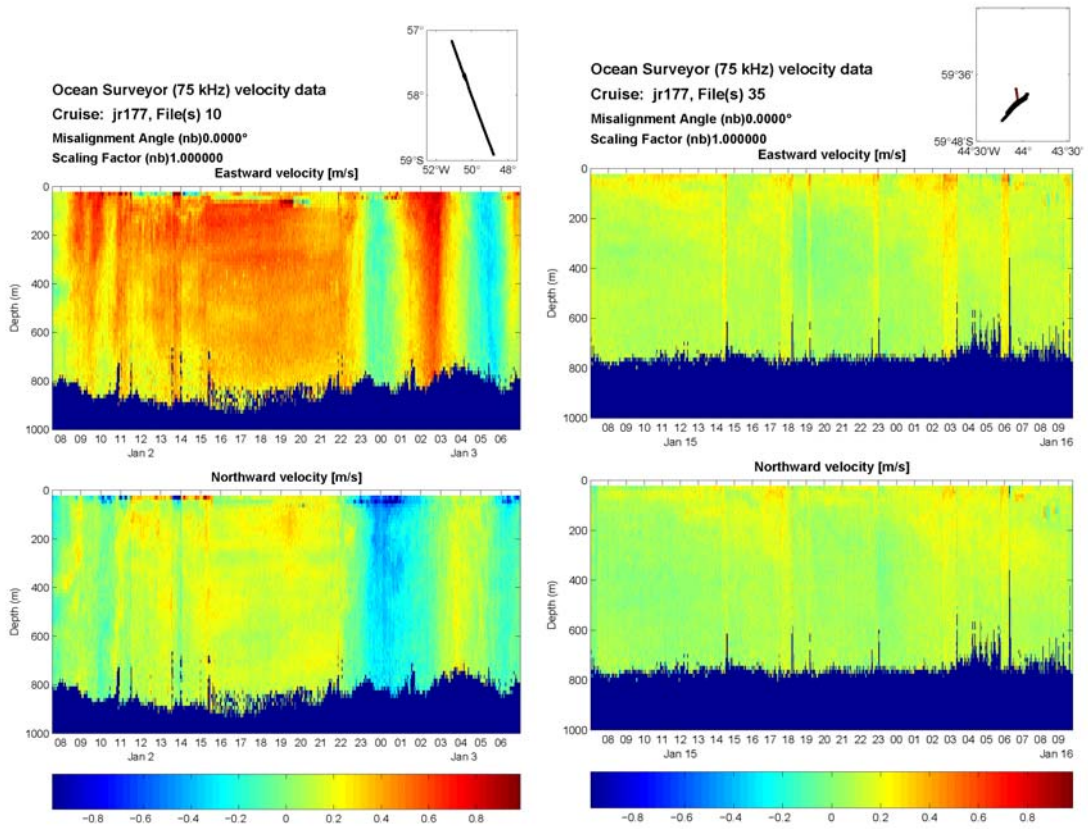


FIGURE OCEA.7. INTERFERENCE FROM DEPLOYED INSTRUMENTS. CTD AT 19.00 ON JAN 2ND (FILE 10) AND BONGO NETS AT 0800 JAN 16TH (FILE 35). BONGO NETS SHOW UP DEEPER AS THEY ARE DRAWN OUT AT A GREATER ANGLE SO THE CABLE AND ADCP BEAM INTERSECT DEEPER. FILE 35 ALSO SHOWS THE STRIPINESS THAT EXISTS IN THE DATA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

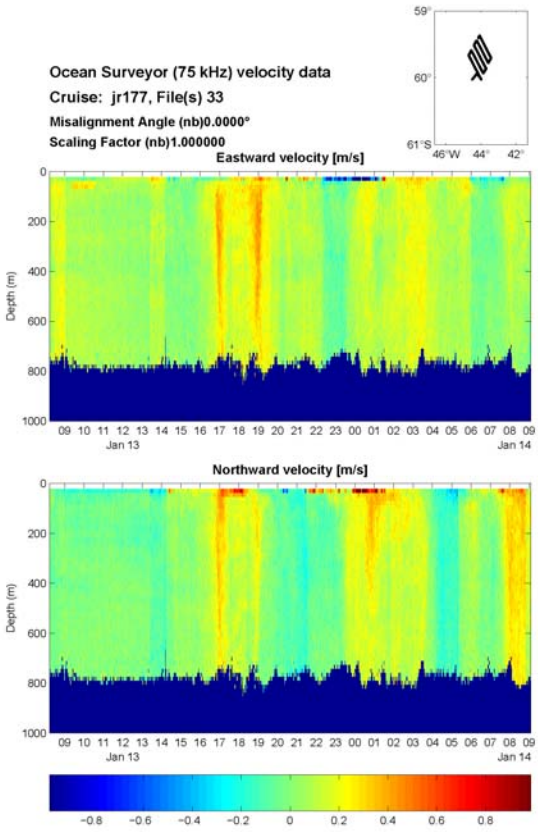


FIGURE OCEA.8. SIGNAL FROM THE PES TOWFISH IN THE SURFACE BIN. THIS HAPPENS WHEN THE FISH IS SWEPT UNDER THE SHIP.

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.

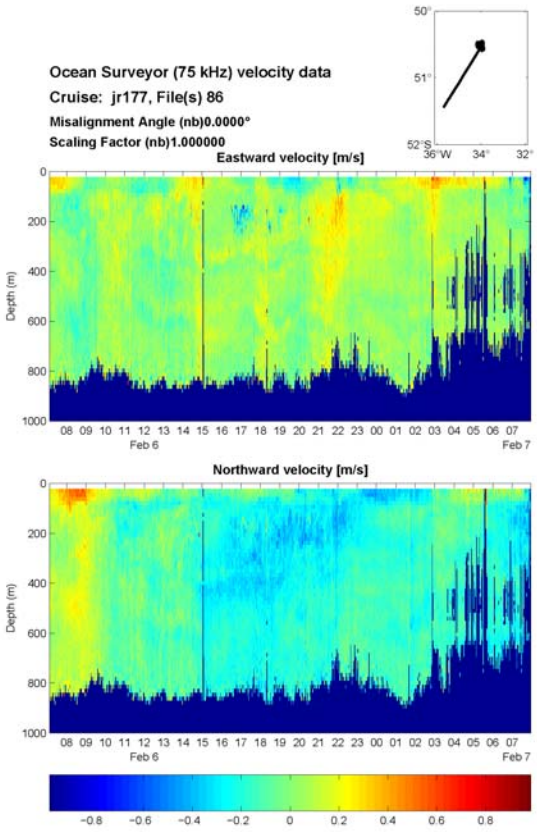


FIGURE OCEA.8. SIGNAL PROBABLY FROM SHOAL OF FISH AVOIDING NET AT 1700 ON FEB 6TH. NEEDS COMPARING AGAINST ACOUSTIC DATA AND ADCP BACKSCATTER STRENGTH.

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.

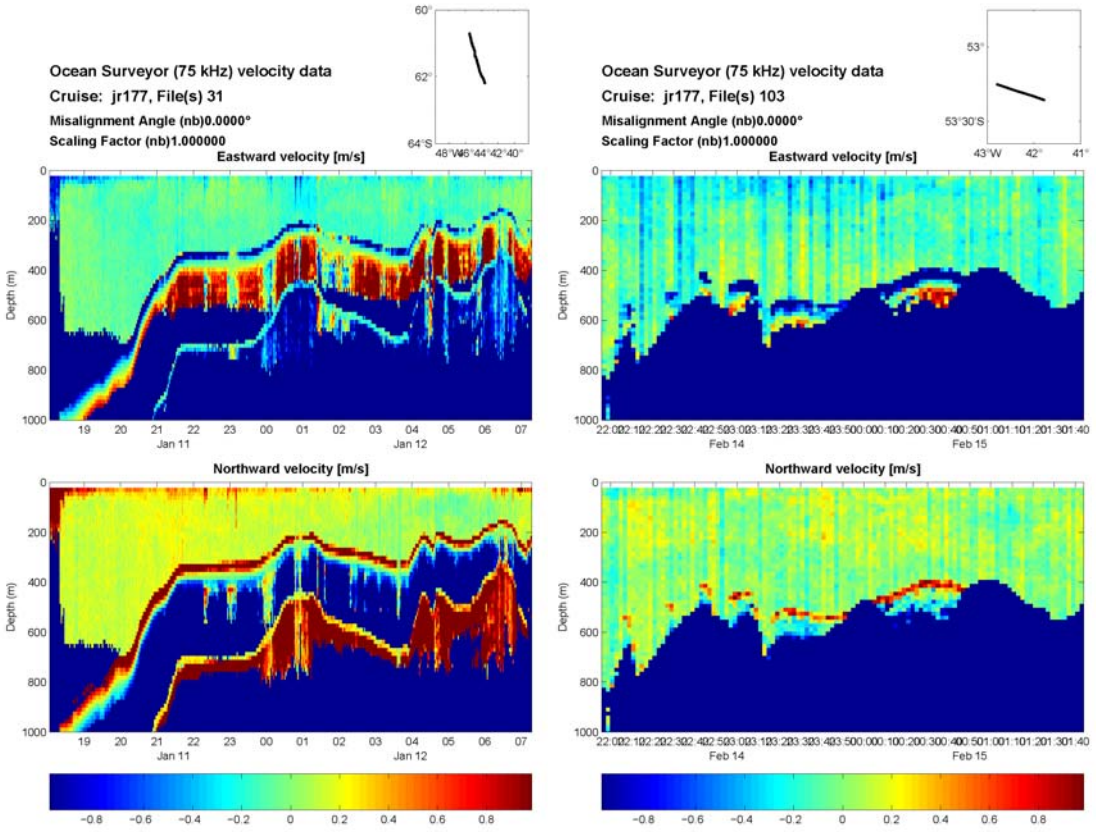


FIGURE OCEA.9. PROBLEMS WERE EXPERIENCED WITH SUB-BOTTOM RETURNS REMAINING IN THE DATA AFTER PROCESSING. THIS NEEDS TO BE ADDRESSED AND MAY EXPLAIN PROBLEMS WITH BOTTOM-TRACK DATA.

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 is 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.

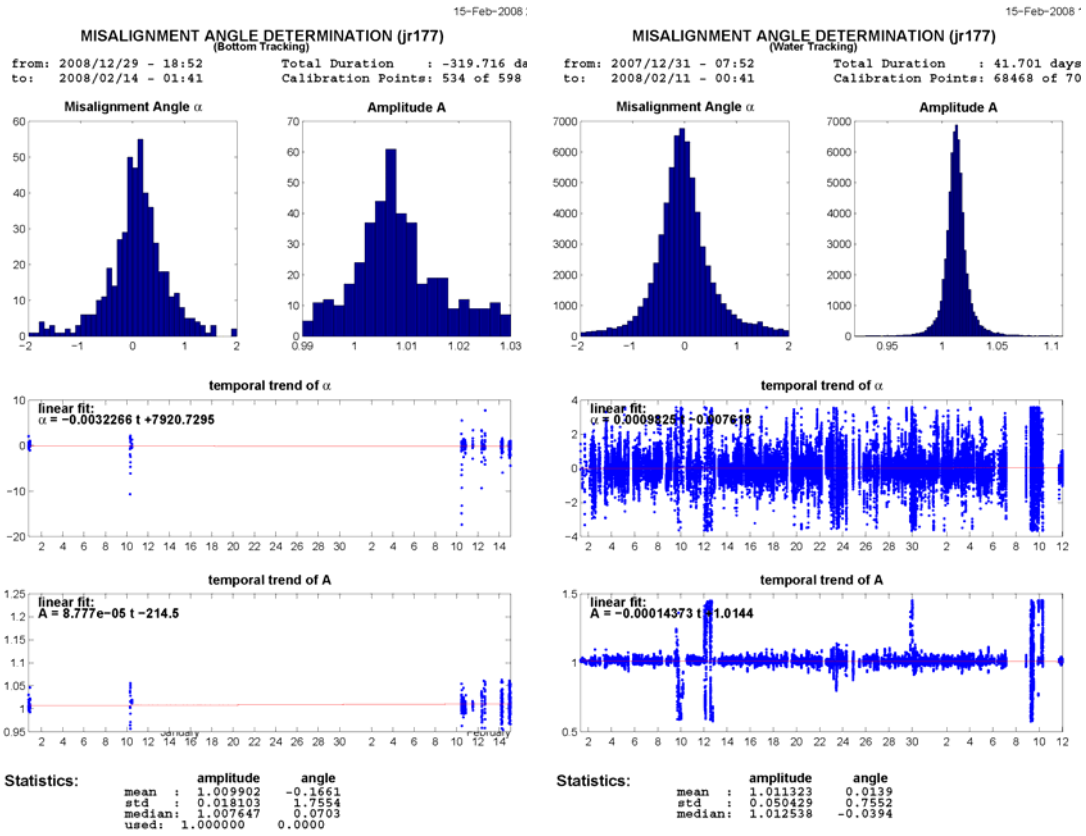


FIGURE OCEA.10. BOTTOM AND WATER TRACK CALIBRATION DATA. THE DIFFERENCES IN THE DATA NEEDS TO BE ASSESSED, WITH REFERENCE TO THE EFFECT ON THE STRIPINESS OF THE DATA NOTED ABOVE.

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
TE00000200

; 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:

jr177ctd[NNN].dat	binary data file
jr177ctd[NNN].con	ascii configuration file containing calibration information
jr177ctd[NNN].hdr	ascii header file containing sensor information
jr177ctd[NNN].bl	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:

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

where P is the pressure (dbar), T is the pressure period in μsec, $D = D_1 + D_2U$, $C = C_1 + C_2U + C_3U$ and $T_0 = T_1 + T_2U + T_3U_2 + T_4U_3 + T_5U_4$ are calculated from the coefficients detailed in Table Ocea.2, where U is the temperature in ˚C.

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

where *cond* is the conductivity in Sm^{-1}, p is pressure, t is temperature, δ = CTcor and ε = CPcor. All coefficients are included in Table Ocea.2.

Temperature:

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

Where the temperature, *temp*, is measured in ˚C, g, h, i and j are coefficients detailed in Table Ocea.2 and f is the frequency output by the sensor.

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

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

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

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

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

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

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

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

$$Corrected\ conductivity = conductivity + ctm$$

where

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

and *s* is the sample interval, *T* is temperature, ctm_0 is the uncorrected cell thermal mass,
$\alpha = 0.03$ and $\beta = 7.0$.

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 secdondary), σ_θ, fluorescence, transmission, oxygen and PAR. Plots are output for the entire CTD depth and for only the upper 200m of the cast. These plots are saved as png files and printed.
- *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.1st*.
- *readsal177* extracts salinity calibration data from *jr177_master.xls* and reads in *jr177botNNN.1st*. Data from duplicate salinity samples are stored in *niskinsalts.mat*, and if the standard deviation of these samples is >0.002, a warning is written to the screen. Output is *jr177salNNN.mat*.
- *addsal177* reads in *jr177botNNN.1st* 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 $\approx 1\times10^{-3}$°C and conductivity offsets of $<2\times10^{-3}$mS/cm, equating to a salinity offset of $<2.5\times10^{-3}$. 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).

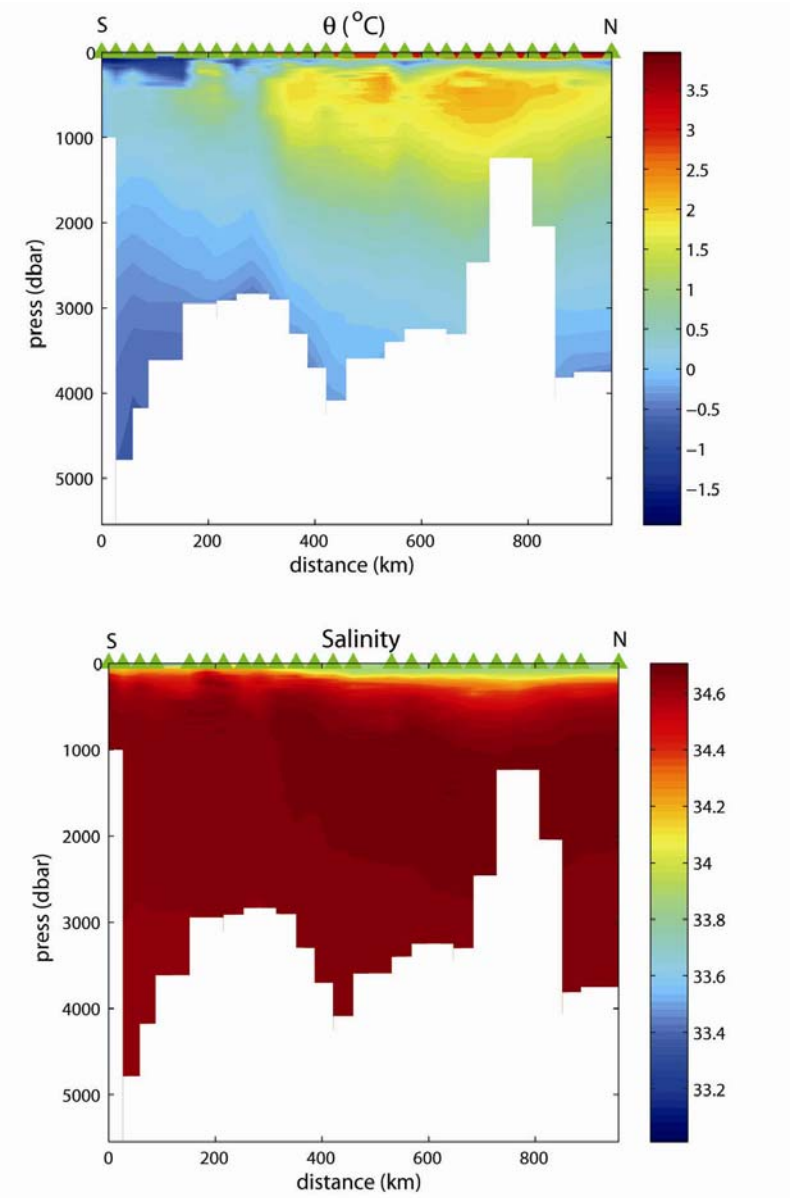


FIGURE OCEA.11: CONTOUR PLOTS OF POTENTIAL TEMPERATURE AND SALINITY BETWEEN SIGNY (S) AND THE POLAR FRONT (N).

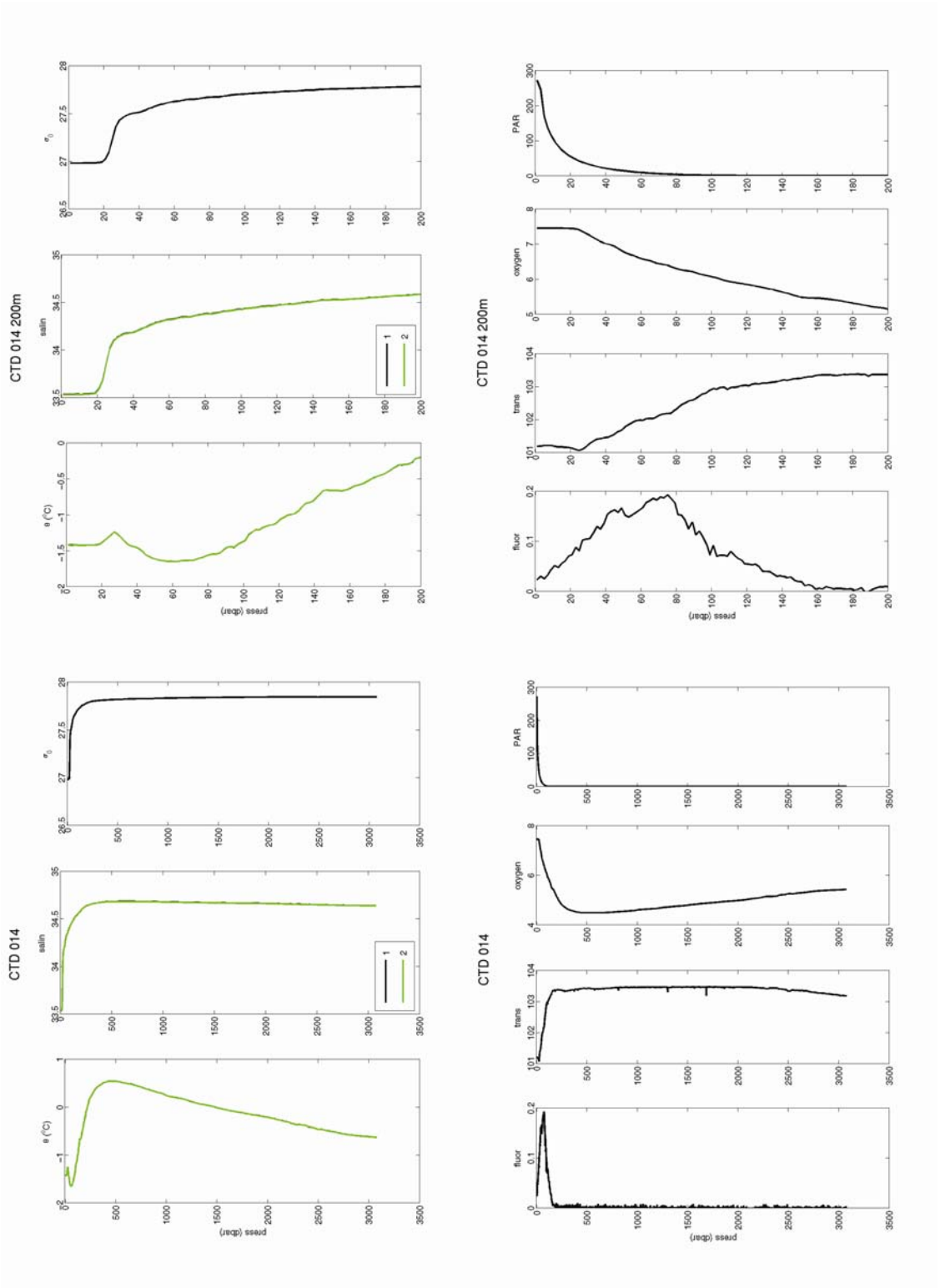


FIGURE OCEA.12: CTD PROFILES OF TEMPERATURE 1 (BLACK) & 2 (GREEN), SALINITY 1 & 2, POTENTIAL DENSITY ANOMALY, FLUORESCENCE, TRANSMISSION, OXYGEN AND PAR FROM STATION 014 (CTD #1). PROFILES ARE INCLUDED FOR BOTH THE FULL WATER DEPTH AND THE TOP 200M.

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 ≈40m, 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 (≈80m, 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	57º 41.11'S	50º 26.54'W	4110	Test		32	
	002	19:38:58	57º 40.75'S	50º 25.80'W					
	002	21:20:05	57º 40.40'S	50º 25.01'W					
002	004	07:50:26	60º 29.89'S	48º 11.55'W	1376	SB	R1	49	
	004	08:17:20	60º 29.89'S	48º 11.55'W					
	004	09:05:15	60º 29.89'S	48º 11.55'W					
003	004	12:04:18	60º 29.89'S	48º 11.55'W	398	WS	R1	54	
	004	12:16:30	60º 29.89'S	48º 11.57'W					
	004	12:33:34	60º 29.89'S	48º 11.60'W					
004	005	05:38:20	60º 29.87'S	48º 11.66'W	1354	WS	R1	62	
	005	06:06:55	60º 29.87'S	48º 11.62'W					
	005	06:40:41	60º 29.87'S	48º 11.56'W					
005	008	09:07:00	60º 12.49'S	44º 24.47'W	5407	SB	C2/ CTD #9	88	
	008	10:41:33	60º 12.49'S	44º 24.48'W					
	008	12:42:20	60º 12.49'S	44º 24.50'W					
006	008	15:13:30	60º 12.52'S	44º 25.10'W	398	WS	C2	92	
	008	15:25:00	60º 12.52'S	44º 25.10'W					
	008	15:41:32	60º 12.52'S	44º 25.09'W					
007	009	04:36:00	60º 12.49'S	44º 24.50'W	1989	WS	C2	103	1
	009	15:13:40	60º 12.49'S	44º 24.50'W					
	009	06:00:40	60º 12.49'S	44º 24.50'W					
008	009	13:41:40	60º 25.86'S	44º 35.55'W	986	Ph	CTD #8	109	
	009	14:03:00	60º 25.86'S	44º 35.56'W					
	009	14:37:20	60º 25.85'S	44º 35.57'W					
009	010	00:56:01	61º 11.89'S	44º 24.50'W	315	Ph	CTD #6	110	
	010	01:07:40	61º 11.89'S	44º 24.50'W					
	010	01:41:49	61º 11.89'S	44º 24.50'W					
010	010	09:54:47	61º 39.69'S	44º 04.05'W	565	Ph	CTD #5	112	
	010	10:08:37	61º 39.79'S	44º 03.71'W					
	010	10:37:21	61º 39.91'S	44º 03.16'W					
011	010	18:21:53	62º 09.77'S	43º 41.65'W	1053	Ph	CTD #4	114	2
	010	18:43:30	62º 09.77'S	43º 41.65'W					
	010	19:26:21	62º 09.77'S	43º 41.65'W					
012	010	22:59:58	62º 21.27'S	43º 31.65'W	1220	Ph	CTD #3	116	3
	010	23:24:59	62º 21.28'S	43º 31.68'W					
	011	00:22:36	62º 21.30'S	43º 31.73'W					
012a	011	00:54:50	62º 20.75'S	43º 31.40'W	119	Ph	CTD #3	117	3
	011	01:03:08	62º 20.70'S	43º 31.35'W					
	011	01:24:00	62º 20.64'S	43º 31.30'W					
013	011	05:38:09	62º 30.96'S	43º 18.83'W	2000	Ph	CTD #2	119	4
	011	06:18:45	62º 31.07'S	43º 18.82'W					
	011	07:17:03	62º 31.20'S	43º 18.00'W					
014	011	09:30:28	62º 36.53'S	43º 14.69'W	3015	Ph	CTD #1	120	
	011	10:25:52	62º 36.50'S	43º 14.34'W					
	011	11:42:52	62º 36.48'S	43º 14.08'W					

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

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

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

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 ≈200m 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 bowthruster 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.

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 **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 **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: 0.00000 **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 **Channel 8, Fluorometer** s/n: 088-249	**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 **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 **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 **Channel 7, Altimeter** *Altimeter 1*(CTD 004-018) s/n: 213026993 Calibrated: unknown Scale factor: 15.000 Offset: 0.000 *Altimeter 2* (CTD 019-…) s/n: 27001 Calibrated: unknown Scale factor: 15.000 Offset: 0.000 **Channel 11, Free**

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)** *Altimeter 1*(CTD 001-003), see Channel 7 *Transmissometer* 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).

2.6.3JR177 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 shoulf 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 SeaWifs 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 (≈1.2Mb for chl-a, ≈3Mb 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

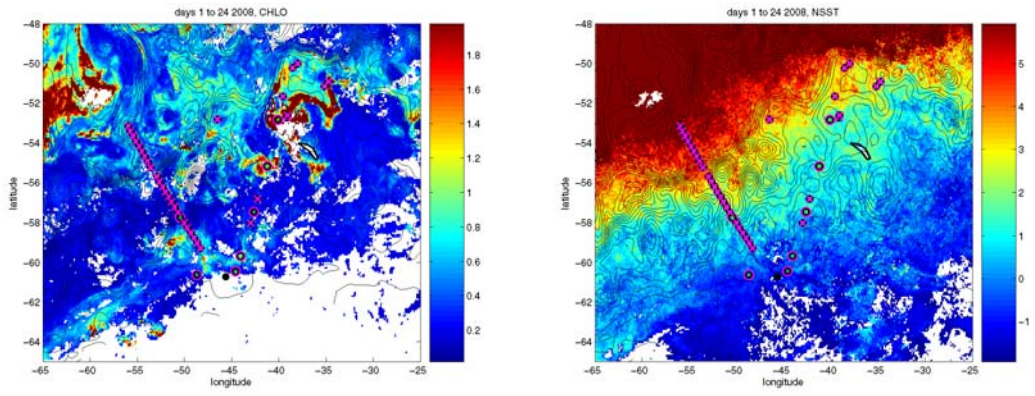


FIGURE OCEA.13: CHLOROPHYLL AND SST IMAGES FROM 1ST-24TH JANUARY, WITH OVERLAIN DYNAMIC HEIGHT CONTOURS AND PROPOSED OR ACTUAL CRUISE TRACK LOCATIONS. SOUTH GEORGIA IS INDICATED BY A BLACK OUTLINE, SIGNY BY A BLACK SPOT AND FALKLANDS BY THE WHITE AREA WITH NO DATA.

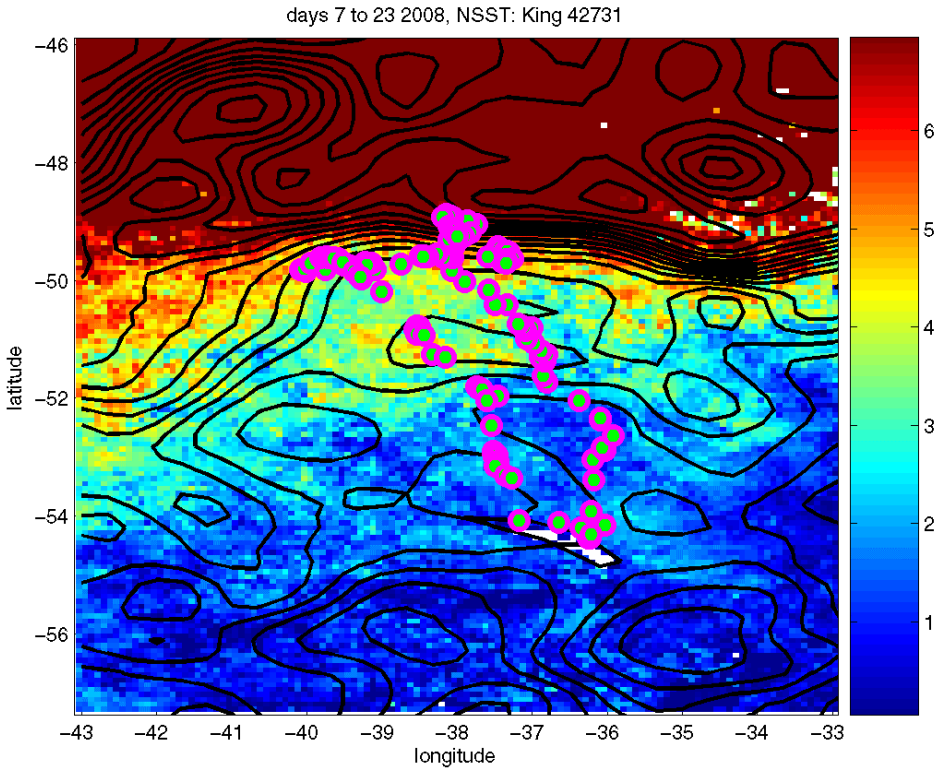


FIGURE OCEA.14: LOCATIONS OF A SATELLITE TRACKED KING PENGUIN OVERLAIN ON SST AND DYNAMIC HEIGHT CONTOURS. SOUTH GEORGIA IS INDICATED BY A BLACK OUTLINE.

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 where 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 where 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 then 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 form 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 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!!

FIGURE 3.1.1 PARFLUX SEDIMENT TRAP DEPLOYMENT SETTINGS (21 CUPS)

```
         McLane Research Laboratories, USA
           ParFlux 21-Cup Sediment Trap
              Version: pst-21_1.c   S/N: ML11966-02

        É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
        º            Main Menu            º
        È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
             Sun Apr 22 20:20:15 2007

       <1> Set Time             <5> Create Schedule
       <2> Diagnostics          <6> Deploy System
       <3> Fill Containers      <7> Offload Data
       <4> Sleep                <8> Contacting McLane

         Selection  ? 6

 Is the rotator aligned to the
 open hole (Yes/No) [N] ? y

 Clock reads 04/22/2007 20:21:39
 Change time & date (Yes/No) [N] ? n

 Existing deployment data file will be
 erased.  Continue (Yes/No) [N] ? y

 Enter new deployment schedule (Yes/No) [N] ? n

 Schedule Verification

 Event   1 of  22 = 05/01/2007 00:00:00
 Event   2 of  22 = 06/01/2007 00:00:00
 Event   3 of  22 = 07/01/2007 00:00:00
 Event   4 of  22 = 08/01/2007 00:00:00
 Event   5 of  22 = 09/01/2007 00:00:00
 Event   6 of  22 = 10/01/2007 00:00:00
 Event   7 of  22 = 11/01/2007 00:00:00
 Event   8 of  22 = 12/01/2007 00:00:00
 Event   9 of  22 = 12/15/2007 00:00:00
 Event  10 of  22 = 01/01/2008 00:00:00
 Event  11 of  22 = 01/15/2008 00:00:00
 Event  12 of  22 = 02/01/2008 00:00:00
 Event  13 of  22 = 02/15/2008 00:00:00
 Event  14 of  22 = 03/01/2008 00:00:00
 Event  15 of  22 = 04/01/2008 00:00:00
 Event  16 of  22 = 05/01/2008 00:00:00
 Press any key to continue.
 Event  17 of  22 = 06/01/2008 00:00:00
 Event  18 of  22 = 07/01/2008 00:00:00
 Event  19 of  22 = 08/01/2008 00:00:00
 Event  20 of  22 = 09/01/2008 00:00:00
 Event  21 of  22 = 10/01/2008 00:00:00
 Event  22 of  22 = 11/01/2008 00:00:00

 Modify an event  (Yes/No) [N] ?
```

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
============================================================
```

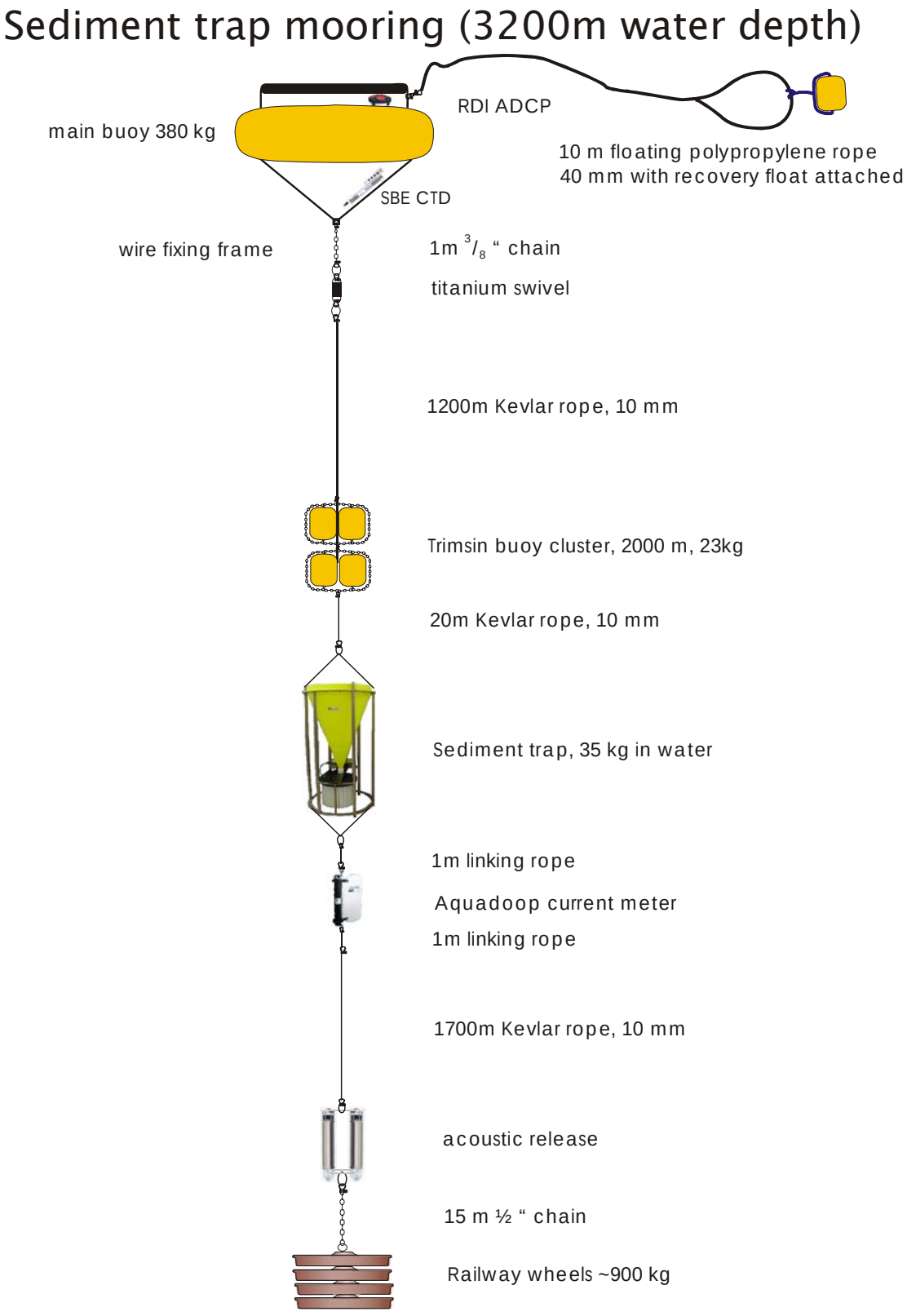


FIGURE 3.1.1 DIAGRAM OF 3200M MOORING

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: s**afety** + **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!!

TABLE 3.1.3 PARFLUX SEDIMENT TRAP DEPLOYMENT SETTINGS (21 CUPS)

```
          McLane Research Laboratories, USA
            ParFlux 21-Cup Sediment Trap
         Version: pst-21_1.c   S/N: ML11966-01

          É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
          º          Main Menu          º
          È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
              Wed Nov 22 20:04:08 2006

         <1> Set Time           <5> Create Schedule
         <2> Diagnostics        <6> Deploy System
         <3> Fill Containers    <7> Offload Data
         <4> Sleep              <8> Contacting McLane

          Selection  ? 5

Existing deployment data file will be
erased.  Continue (Yes/No) [N] ? y

Enter new deployment schedule (Yes/No) [N] ? n

Schedule Verification

Event   1 of  22 = 12/01/2006 00:00:00
Event   2 of  22 = 12/15/2006 00:00:00
Event   3 of  22 = 01/01/2007 00:00:00
Event   4 of  22 = 01/15/2007 00:00:00
Event   5 of  22 = 02/01/2007 00:00:00
Event   6 of  22 = 02/15/2007 00:00:00
Event   7 of  22 = 03/01/2007 00:00:00
Event   8 of  22 = 04/01/2007 00:00:00
Event   9 of  22 = 05/01/2007 00:00:00
Event  10 of  22 = 06/01/2007 00:00:00
Event  11 of  22 = 07/01/2007 00:00:00
Event  12 of  22 = 08/01/2007 00:00:00
Event  13 of  22 = 09/01/2007 00:00:00
Event  14 of  22 = 10/01/2007 00:00:00
Event  15 of  22 = 11/01/2007 00:00:00
Event  16 of  22 = 12/01/2007 00:00:00
Press any key to continue.
Event  17 of  22 = 12/15/2007 00:00:00
Event  18 of  22 = 01/01/2008 00:00:00
Event  19 of  22 = 01/15/2008 00:00:00
Event  20 of  22 = 02/01/2008 00:00:00
Event  21 of  22 = 02/15/2008 00:00:00
Event  22 of  22 = 03/01/2008 00:00:00

Modify an event  (Yes/No) [N] ?
```

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
- Bettery utilisation approx 200 % (can use up to 400% for Lithium battery).

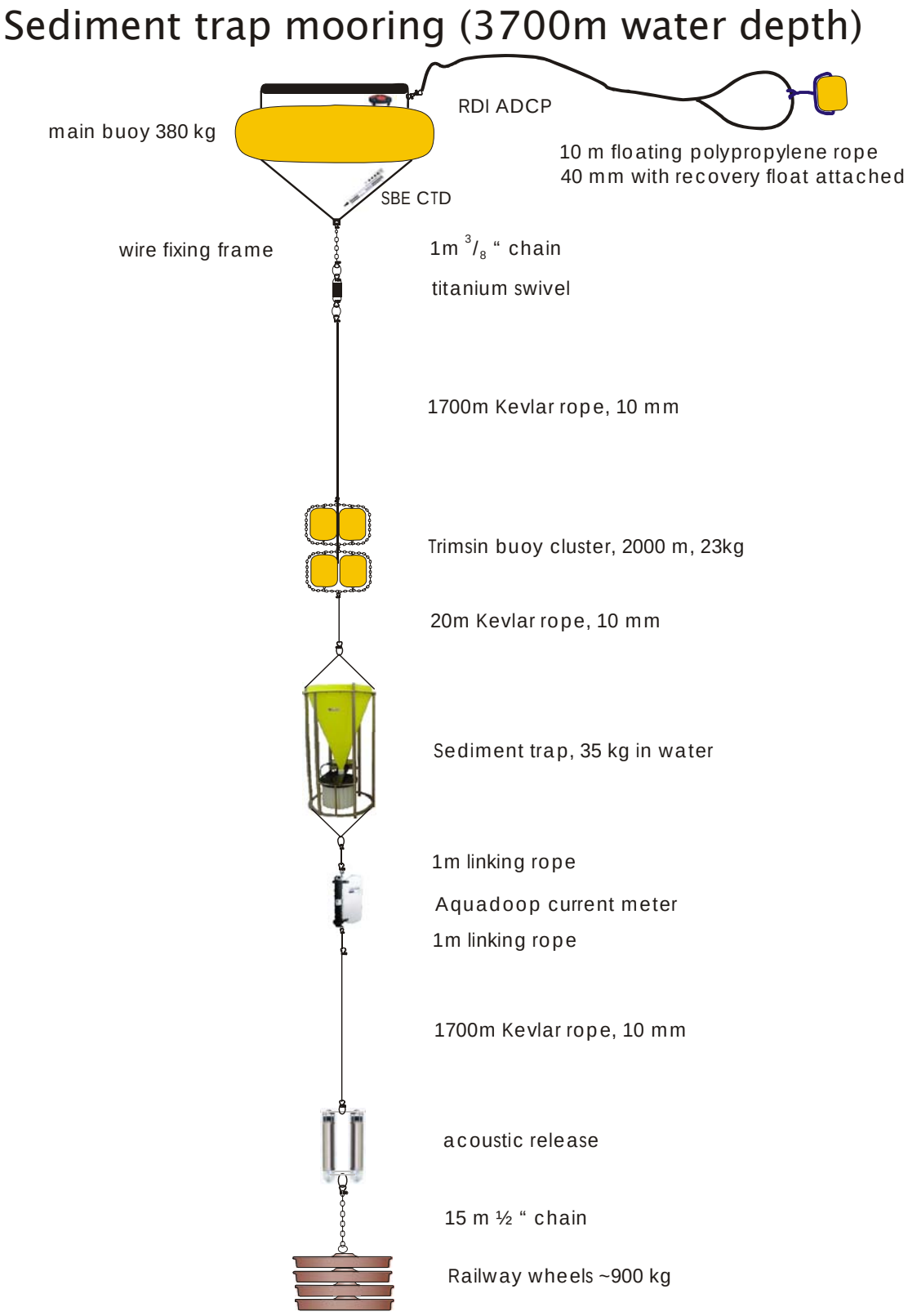


FIGURE 3.1.2 DIAGRAM OF 3700M MOORING

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.

3.2.1Refurbishment

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 where deployed according 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 3.2.2WHALE POP-UP INFORMATION OF ALL DEPLOYED UNITS:

	Deployment (09.02.2008)			Sonardyne	
Pop-up ID	Time (GMT)	Depth	Position	Release code	HDD no.
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

3.2.5Setup 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: HA3OA70S
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

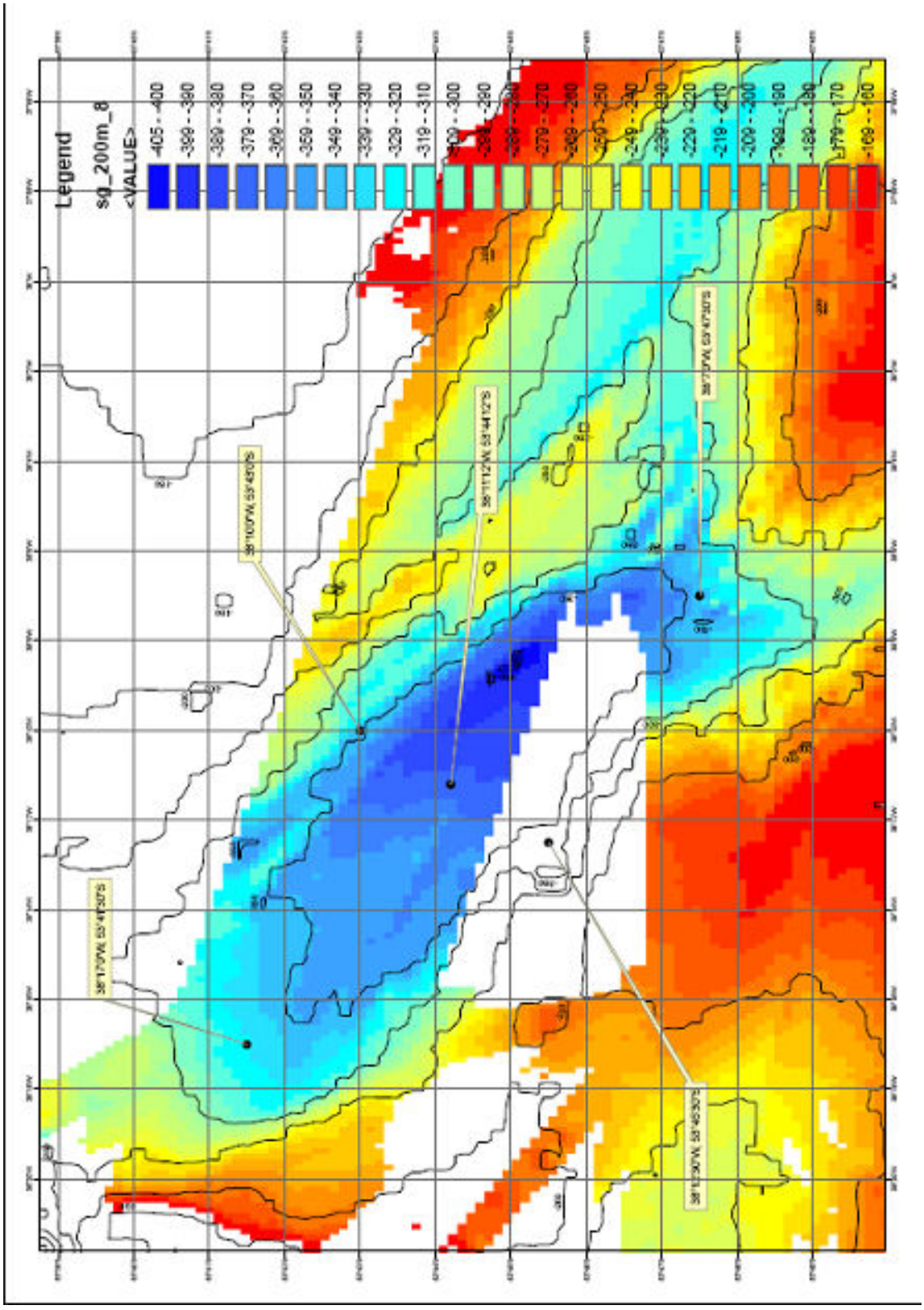
Pop Up 54 (in hard hat 54) – stand alone unit

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 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 (NO_3+NO_2-N), ammonium (NH_4-N), silicic acid ($Si(OH)_4$-Si) and phosphate (PO_4-P) using a Technicon-based segmented-flow analyser (Whitehouse 1997). Data were logged to a PC 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.

4.6 References

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

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

5 Carbon Cycling in the Scotia Sea

Elizabeth Jones, Dorothee Bakker and Andy Watson

5.1 Rationale

Present atmospheric concentrations of carbon dioxide (CO_2) 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 CO_2 by absorbing about half of the CO_2 released from anthropogenic activities since 1800 (Sabine et al., 2004). The future rate of the oceanic CO_2 uptake is unknown and is determined by physical and biological processes. The difference in the partial pressure of CO_2 (pCO_2) between the ocean and the atmosphere is the driving force for oceanic CO_2 uptake. Changes in Southern Ocean circulation have been implicated in increased uptake of atmospheric CO_2 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 CO_2 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 CO_2 uptake in the Southern Ocean. Given the paucity of surface water pCO_2 data in the Southern Ocean, we clearly need to increase our effort to better quantify the current CO_2 sink and to predict the future carbon cycle.

5.2 Objectives

- To quantify the accuracy and precision of a new CASIX pCO_2 instrument, previously installed on James Clark Ross (JCR), by running a UEA pCO_2 instrument in parallel.
- To make a seasonal comparison of the magnitude of the oceanic CO_2 sink.
- To quantify the summertime biological carbon uptake across a major productivity gradient.

5.3 Methods

Underway pCO_2 and O_2

Continuous measurements of pCO_2 in surface water and marine air were made throughout the cruise with two underway CO_2 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 CO_2

A ¼" Dekabon tubing air line is run from the pCO_2 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 CO_2

Determination of the partial pressure of carbon dioxide (pCO_2) in seawater is achieved by measuring the pCO_2 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 CO_2 and moisture content of the headspace is determined every minute during a 30 minute cycle. The analysis of the CO_2 content in the headspace was interrupted for that of the CO_2 content in marine air (4 × 30 minutes per 8 hours) and in four CO_2 standards (1 × 30 minutes per 8 hours each).

The pCO_2 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.

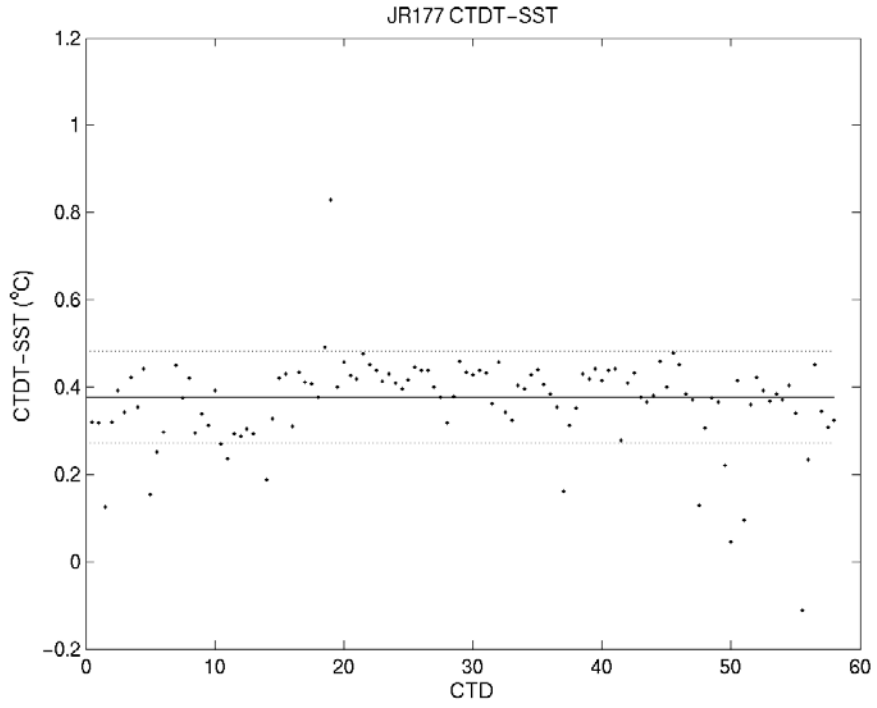

FIGURE 5.1 CARBON 1. DIFFERENCE BETWEEN SURFACE CTD TEMPERATURE AND OCEANLOGGER SST.

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 infra-red analyser, LI-COR 7000, to measure the $CO2_{(g)}$ and $H2O_{(g)}$ content. The LI-COR is calibrated using four gas standards of known CO_2 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 CO_2 and moisture measurements, once the pressure had been corrected for. The pCO_2 is calculated from the product of the mole fraction of carbon dioxide (xCO_2) and the atmospheric pressure, P, (pressure of equilibration):

$$pCO_2 = xCO_2.P$$

Values for pCO_2 are then corrected for water vapour pressure and to the measured sea surface temperature (DOE, 1994). The pCO_2 measurements were time stamped by a Garmin GPS unit mounted starboard side of the ship.

Seawater O_2

Oxygen (O_2) 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 O_2 data will be corrected for sea water temperature and salinity and CASIX O_2 readings will be checked against equivalent O_2 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 μL 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	60º 29.89'S	48º 11.55'W	R1	49	20	1
005	008	09:07:00	60º 12.49'S	44º 24.47'W	C2 CTD 9	88	20	2
008	009	13:41:40	60º 25.86'S	44º 35.55'W	CTD 8	109	10	
010	010	09:54:47	61º 39.69'S	44º 04.05'W	CTD 5	112	10	
012	010	22:59:58	62º 21.27'S	43º 31.65'W	CTD 3	116	5	3
012a	011	00:54:50	62º 20.75'S	43º 31.40'W	CTD 3	117	5	3
014	011	09:30:28	62º 36.53'S	43º 14.69'W	CTD 1	120	10	
015	012	07:46:30	60º 39.98'S	45º 31.15'W	CTD 7	122	5	4
016	013	09:14:44	59º 56.17'S	44º 14.35'W	CTD 10	128	10	
017	015	07:32:10	59º 41.32'S	44º 03.27'W	C3 CTD 11	146	20	
021	017	00:25:07	59º 08.64'S	43º 41.62'W	CTD 13	170	10	
023	017	10:01:14	58º 35.89'S	43º 30.55'W	CTD 15	173	5	5
025	019	07:02:00	58º 01.38'S	42º 59.08'W	C4 CTD 17	186	20	
028	020	21:41:07	57º 45.49'S	42º 48.07'W	CTD 18	208	10	
030	022	04:43:27	57º 08.38'S	42º 25.98'W	R2 CTD 20	216	10	
033	022	15:57:45	56º 50.59'S	42º 15.40'W	CTD 21	223	20	6
035	023	13:10:15	55º 54.11'S	41º 43.17'W	CTD 24	225	10	7
037	025	11:50:53	55º 12.42'S	41º 14.76'W	P2 CTD 26	227	20	
041	028	20:11:36	54º 54.77'S	41º 10.40'W	CTD 27	259	10	8
042	029	10:31:23	54º 35.45'S	40º 59.80'W	CTD 28	262	10	
043	029	15:09:10	54º 12.97'S	40º 48.79'W	CTD 29	263	10	
044	029	19:06:20	53º 53.83'S	40º 38.67'W	CTD 30	264	10	
045	030	04:23:00	53º 31.57'S	40º 27.54'W	CTD 31	267	10	
046	030	11:18:53	53º 09.27'S	40º 16.55'W	CTD 32	270	10	
048	032	07:24:13	52º 51.49'S	40º 05.84'W	P3	279	20	
051	033	21:28:16	52º 43.62'S	40º 08.82'W	P3	303	10	9
053		08:10:01	52º 37.60'S	39º 06.09'W	R3	317	20	
055	040	15:45:40	53º 42.86'S	37º 57.86'W	R5	368	10	
058	042	17:45:15	53º 34.04'S	34º 57.74'W	CTD 88	381	10	
059	042	21:50:12	53º 41.46'S	35º 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 pCO_2 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 CO_2 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.

Species	R1	C2	C3	C4	R2	P2	P3	R3	R4	Sd and sh*
POM	x	x	x	x	x	x	x	x	x	
Calycopsis borchgrevinki	x	x	x	x		x	x	x		
Diphyes sp.1	x	x	x	x		x	x	x		
Diphyes sp.2	x	x	x	x						
Atolla sp.	x	x	x	x		x	x			
Paraphyllina ransoni		x	x	x						
Periphylla periphylla	x		x			x	x			
Stygiomedusa gigantea		x								x (sh)
Metridia sp.		x	x	x	x	x	x			
Calanoides acutus	x	x	x	x	x	x	x			
Calanus propinquus					x	x	x			
Calanus simillimus						x				
Pareuchaeta sp.					x	x	x			
Rhincalanus gigas	x	x	x	x	x	x	x	x		
Themisto gaudichaudi				x	x	x	x	x	x	
Euphausia frigida					x		x	x		
Euphausia triacantha		x	x	x		x	x		x	
Euphausia superba	x	x	x	x			x	x		x (sd)
Thysanoessa sp.		x	x	x	x	x	x			x (sd)
Galiteuthis glacialis		x	x			x				
Sagitta sp.	x	x	x	x		x	x	x		
Salpa 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 (Lannzuel 2007).

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

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.

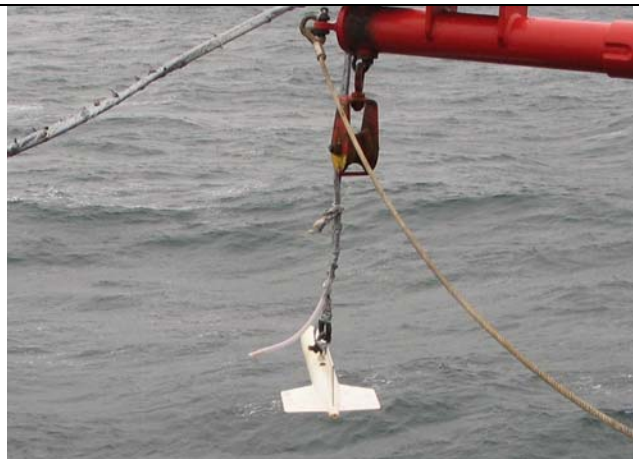

FIGURE 7.1.1, TORPEDO TOWFISH

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.

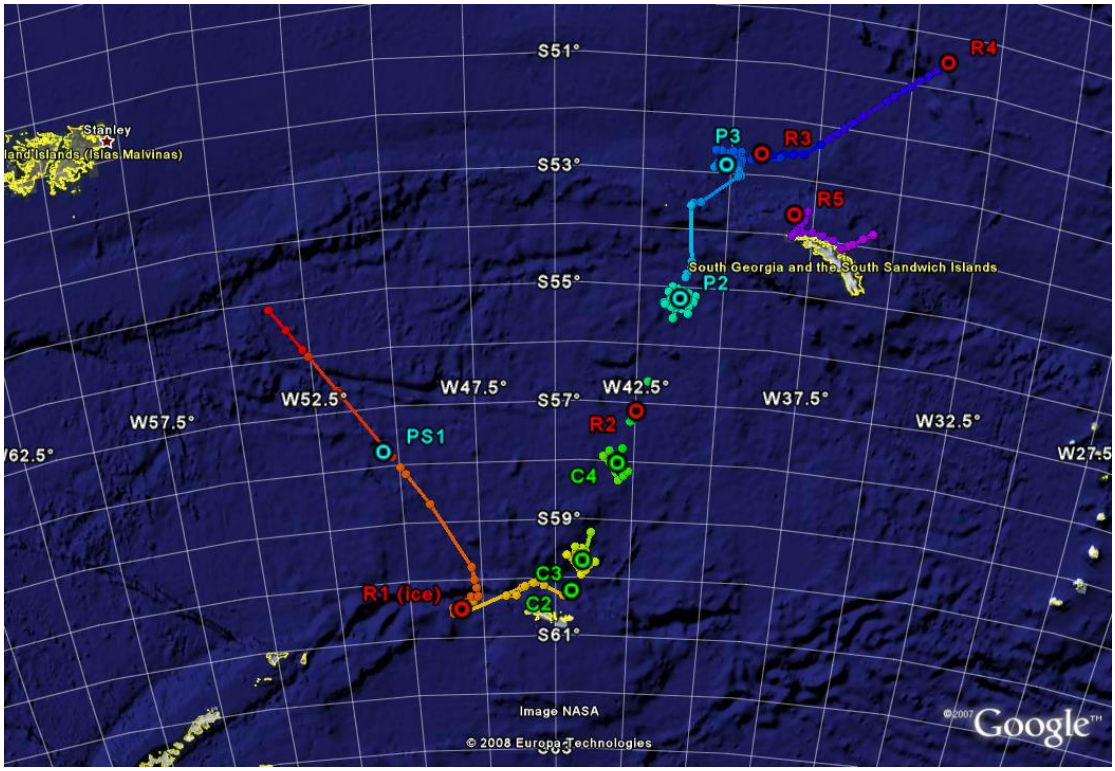

FIGURE 7.1.2 UNDERWAY SAMPLING COLOURED BY DAY.

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 FAST*tracka*™ 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 FAST*tracka*™ 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*™ I

Saturation of variable chlorophyll fluorescence was performed using 100 flashlets of 1.1µs duration with a 2.3µs repetition rate. Subsequent relaxation of fluorescence was monitored using flashlets provided at 98.8µs 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 frrf1).

	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 FAST*TRACKA*™ 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 frrf2).

	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 frrf3). 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 frrf4). 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 FAST*tracka*™ 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™ (FAST*tracka*™ I) or manufacturer-provided software (FIRe™).

	Sampling location	Sampling method	Start date	End date	FAST*tracka*™ 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 FAST*tracka*™ I FRRf and the bench top FIRe™ FRRf (Table frrf5). Samples were taken from 10 shallow depths (Table frrf6) 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	FAST*tracka*™ 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 macronuntrient 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 14C following the standard methods of Korb. This method basically follows the JGOFS protocol and uses an on deck incubator with incubations lasting 24 hours in tubes with100, 77, 54, 30, 10, 6, 1, and 0% surface irradiance. Trace metal clean techniques were followed. 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 ºC 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 $\mu g.ml^{-1}$ 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 anlaysis 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.

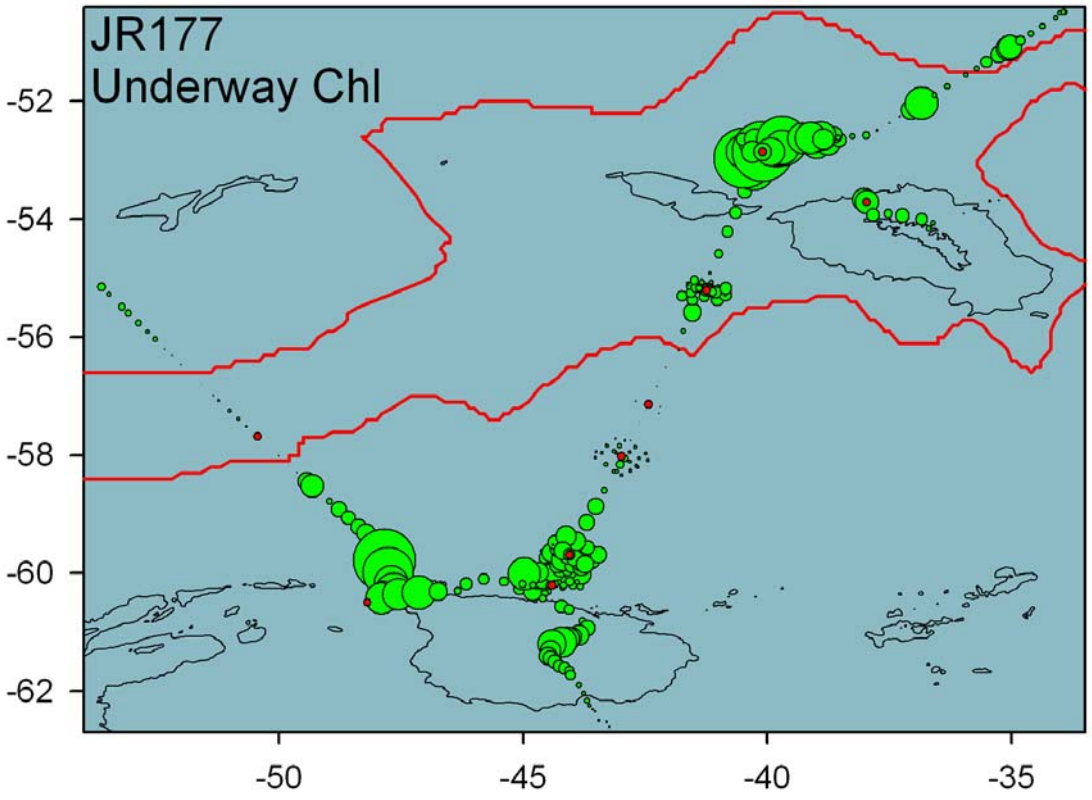


FIGURE 8.1. UNDERWAY CHL *A* CONCENTRATIONS DURING JR177. THE LARGEST BUBBLES REPRESENT VALUES OVER 7 MG M^{-3}, THE SMALLEST, VALUES < 0.5 MG M^{-3}.

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	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	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
Chl 20 m only	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes	No
SF Chl 20 m	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No	No	Yes	Yes	No	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
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
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
Bioassay	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
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
GoFlo POC	No	No	Yes	No	No	No	Yes	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 Straight, 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 0101	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 1735	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	17/01/208	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	20/01/208		2000				5		
200	20/01/208		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 lugols 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 lugols 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 to1000 m with a sampling resolution of around 25 m. To achieve this the gauze advance was set to 2 minutes and the net deployed to 1000 m. By paying out cable at around 40 m per minute at a ships speed of 2.5kts, one thousand meters net depth was achieved when approximately 2000 m of wire had been payed 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 m^3 of water was swept.
Gauzes were cut into respective patches onboard ship and frozen at –20^oC 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 nightime 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.

9.2.2Method

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^{o}C to await carbon analysis. At two of the stations *O. frigida* was also sufficiently abundant to allow the same procedure to take place.

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.

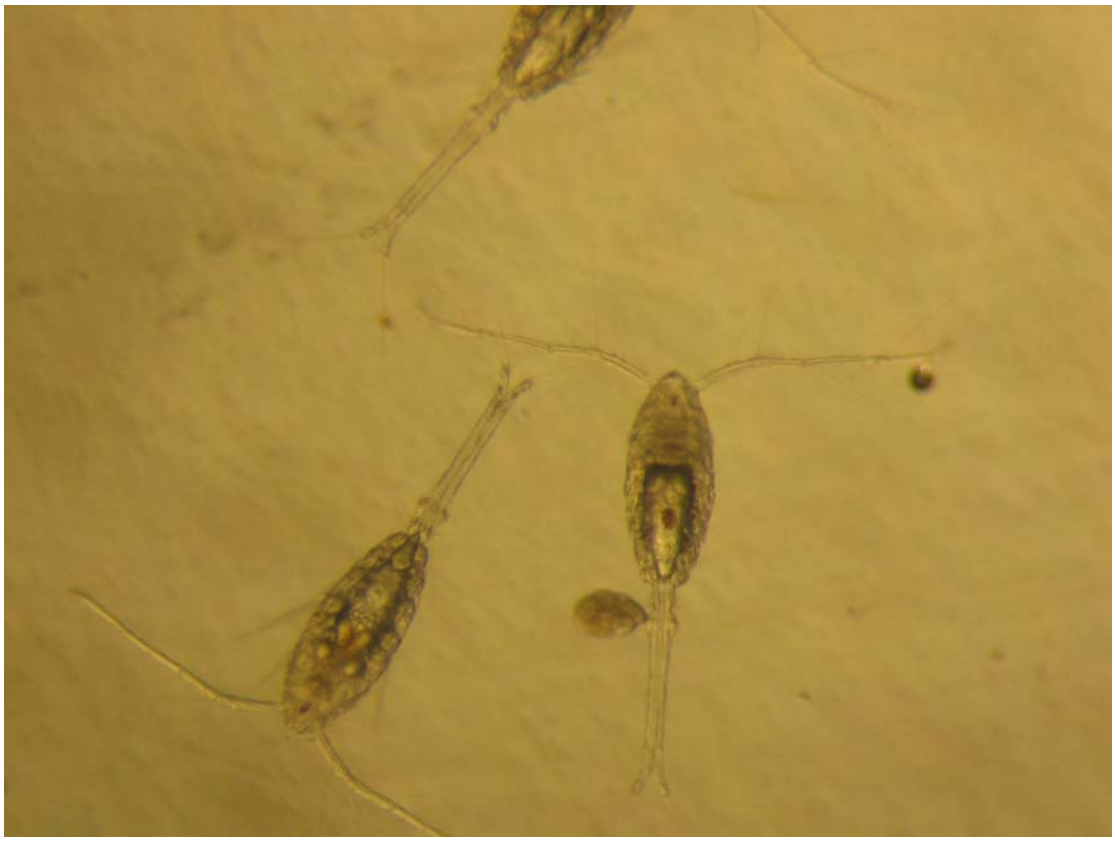
9.2.5 References

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

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

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^{o}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^{o}C for analysis of CHN in Cambridge. All filters were photographed for future record of pellet dimensions and quantities as a guide for CHN analysis.

These rates of fecal egestion will be compared with in situ gut contents of krill, which will be analysed on the krill samples frozen immediately after capture. I took water from the non-toxic supply at target fishing sites which was kindly processed for chl *a* by Min 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 deioinised water and transfer to 2ml micro-centrifuge tubes. These larger volume samples were frozen (-80^{o}C) for later analysis of dry mass and elemental content.

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 ~1L 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 Ecology1*** 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 egesting 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 Ecology1***). The sinking rate of the fecal pellets varied nearly 30-fold, from 0.051 cm s^{-1} to1.41 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 Ecology1***). 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 ECOLOGY1*. A SUMMARY OF RMT 8 AND RMT25 NET CATCHES USED FOR KRILL FECAL PELLET EXPERIMENTS

Event	Date (2008)	Net no.	Freshly frozen (t_o) krill		Fecal egestion measurement			Bulk pellets (no. h after t_o	Incubation Temp (^oC)	No. of pellets settled	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.

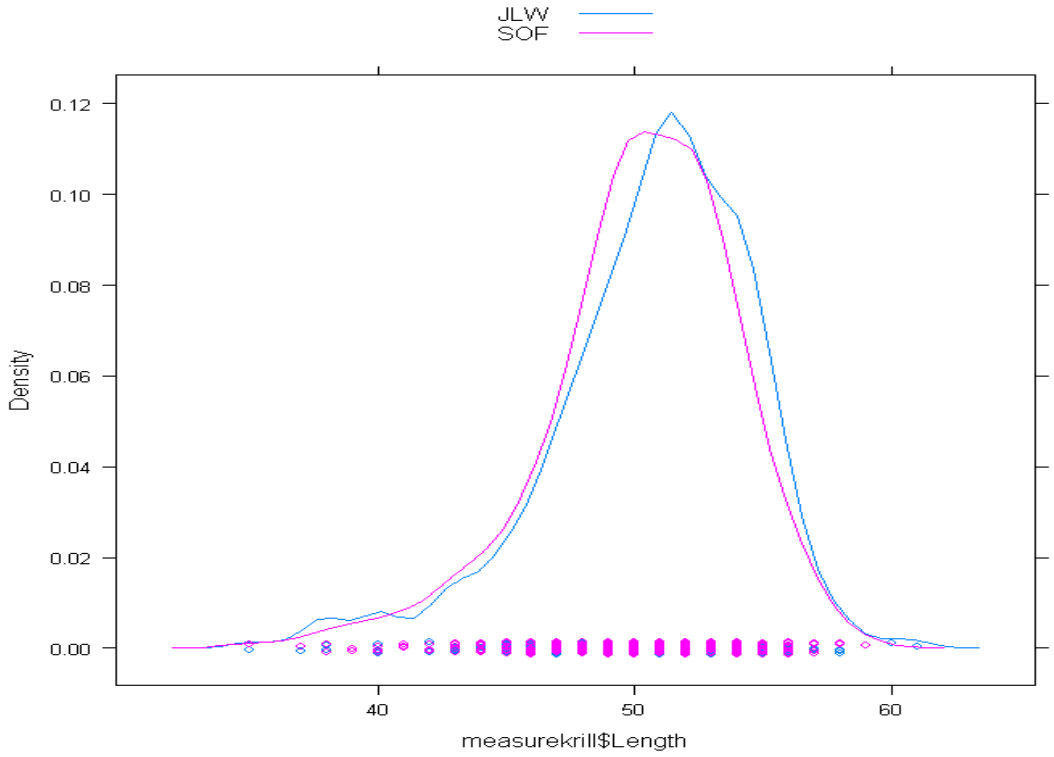
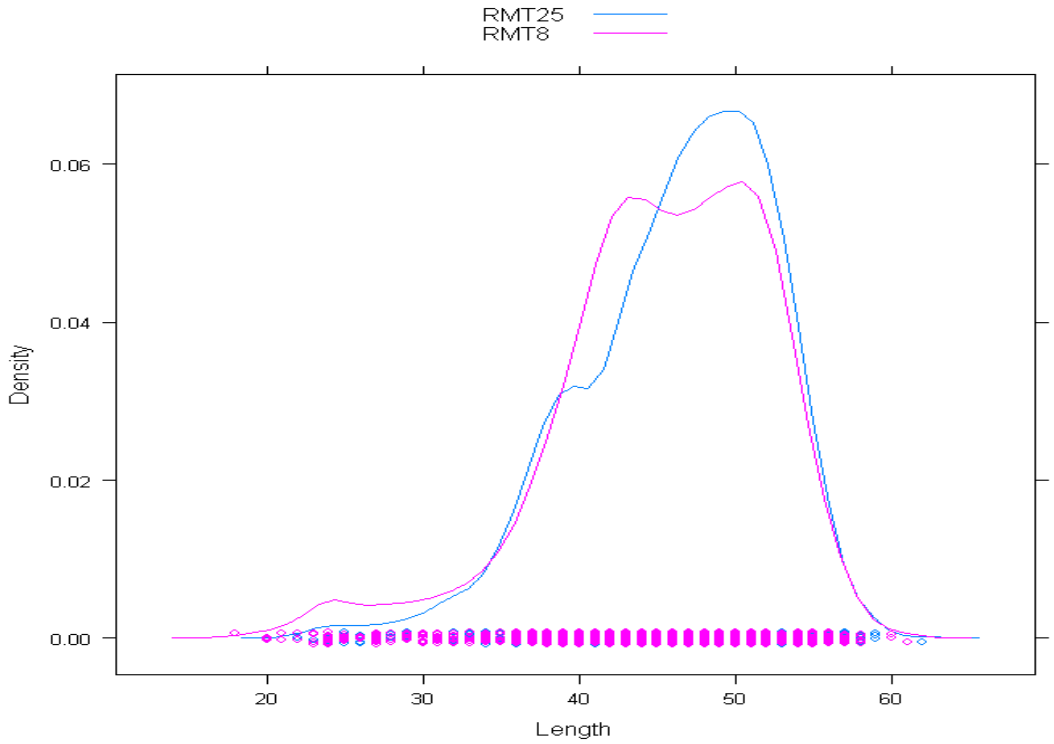


FIGURE 10.2.2_KRILL/F_2: OVERALL LENGTH DISTRIBUTIONS FOR KRILL SAMPLED FROM RMT25 AND RMT8 NETS.



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. Moult 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 interva	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 limacine* 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 ^{o}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 equilibrator circuits was installed to suck the air out of the carboys instead of using the gas from the cylinder.

The CO_2 concentration measurements were confirmed using a pH meter (2 decimal points) and sys CO_2 computer programme.

With the increasing concentration of CO_2 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 CO_2 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 Experiment1 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 CO_2 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 2^{nd} and 4^{th} day of experiment. The experiment had to be stopped on the 4^{th} 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 CO_2 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 CO_2 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 CO_2 and pH values will be obtained.

Spongiobranchaea australis (Experiment V) was used to observe the high CO_2 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 CO_2 enriched seawater were collected from the experiments to which $HgCl_2$ was added to prevent any form of biological contamination. These samples will be freighted back to UEA for analysis.

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

To test either Gymnosomes exclusively feed on euthecosomes, an experiment with 30 Oithonas and 2 (or 1) *Spongiobranchaea* 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 Geogia. 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

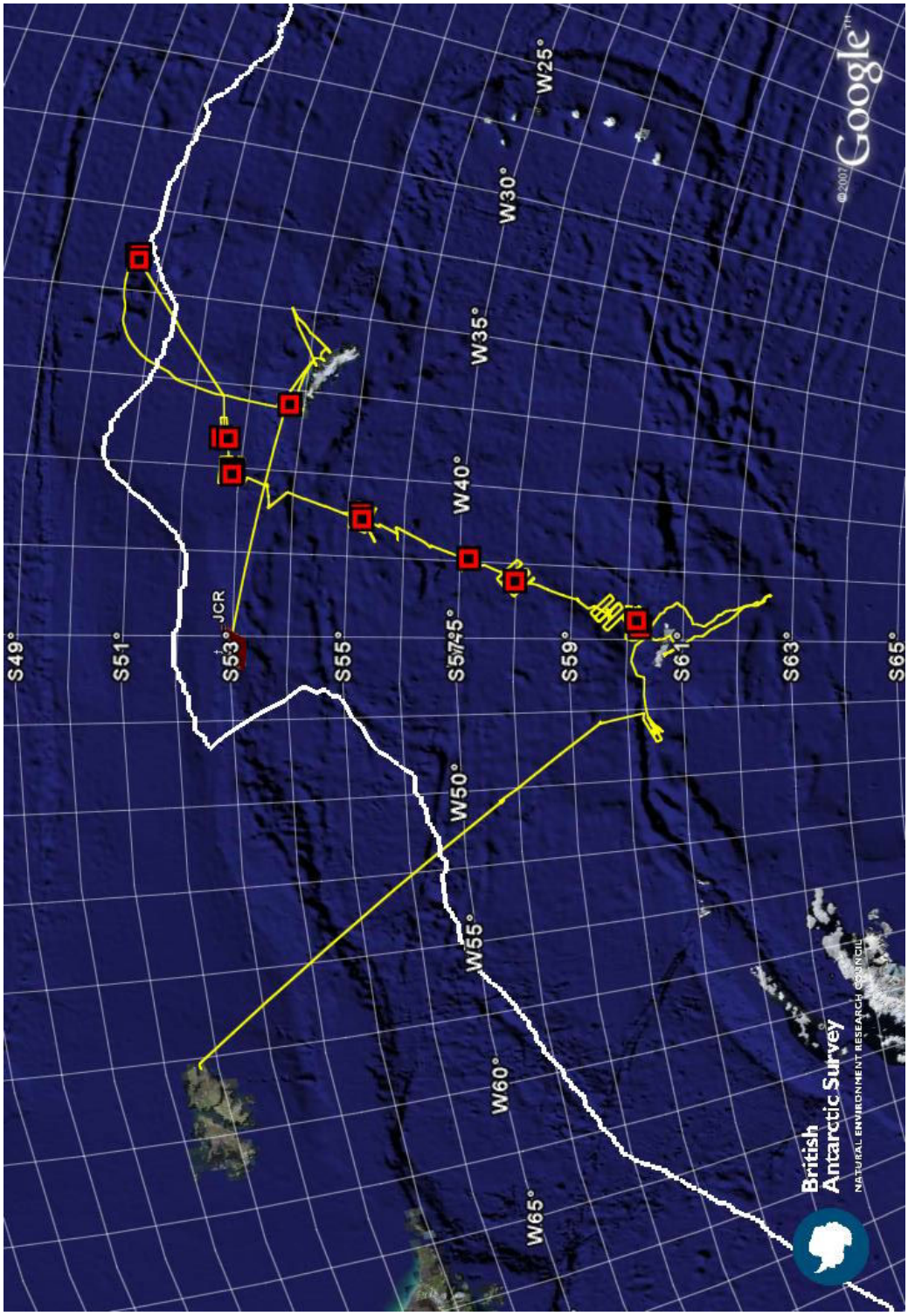
TABLE 13.1: ALL THE EVENTS WHERE PTEROPODS WERE CAUGHT

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

	312	27	MOCNESS	all	03-Feb					x(tray9:D1-D12, E1-E12 & G1-G3)	-52.5824 -39.0894
Clio recurva	329	10	RMT25	1	05-Feb	x(3) (the body of one animal from the treatment added)		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)				
	297	cca 800	Bongo		02-Feb	x(3 vials)	x(17 vials for 4 days 7/2-10/2 each with 30 animals)				-52.8571 -40.0208
	314	cca 800	Bongo		04-Feb	x(4 vials)	x(13 vials for 8 day exp and 15 vials for 12day Exp; each with 30 animals)				-52.5824 -39.0894
Clio pyramidata	329	2	RMT25	2	05-Feb	x (smashed shell)					-52.5824 -39.0894
	85	11	MOCNESS		08-Jan	x (smashed shell)				x(tray2:A1-A11)	-60.2203 -44.5074
	81	4	MOCNESS		07-Jan	x (smashed 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

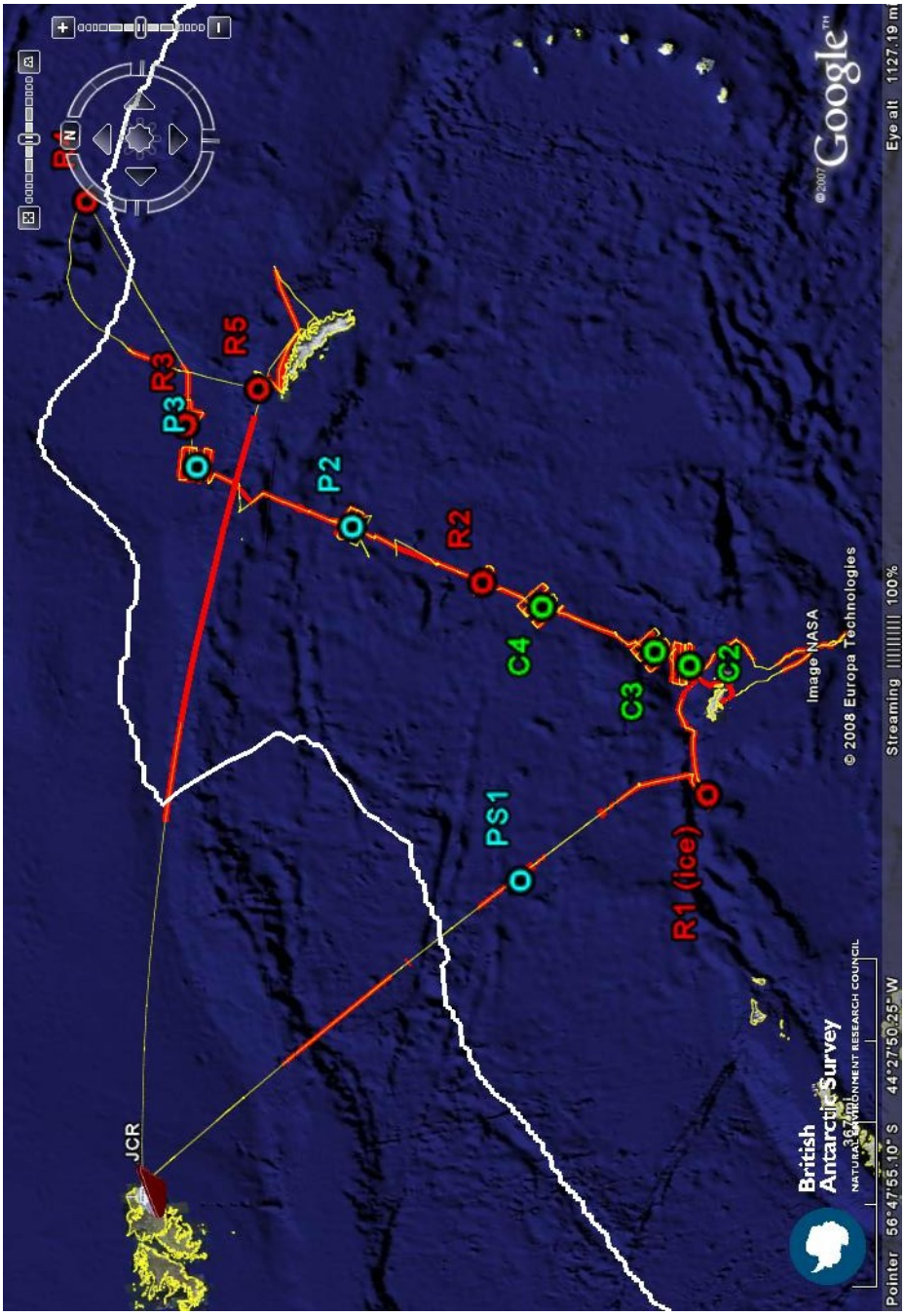
observations with their mesoscale survey work, Helen Peat and Nathan Cunningham for their ACCESS expertise and Hugh Venables for being an extra “pair of eyes”.

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
	Movement:	
	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
	Feeding:	
	F	Not used (used surface feeding codes instead)
	0	Not used
	1	Not used
	Foraging:	
	DDD	Used when potentially diving to locate prey (but not plunging)
	FPT	Not used (used "SFP" instead)
	FDP	Used if not hydroplaning ("SHY")
	General foraging:	
	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 penguis 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 kings 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 if 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 foramalin. 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 euphausids 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 were 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	2993	2.5-18.2
250	Stratified	1	27-Jan-08	16:38:00	0:46:00	-55.20	-41.24	3278	701.8-999.8
250	Stratified	2	27-Jan-08	17:31:00	0:45:00	-55.22	-41.30	3397	399.6-703.7
251	Stratified	1	27-Jan-08	20:39:00	0:45:00	-55.20	-41.20	3231	201.7-400.9
251	Stratified	2	27-Jan-08	21:25:00	0:48:00	-55.21	-41.26	3338	11.4-214.1
252	Target	1	27-Jan-08	23:26:00	0:05:00	-55.20	-41.20	3198	49.7-63.8
252	Target	2	27-Jan-08	23:32:00	0:06:00	-55.20	-41.20	3212	53.5-75.8
253	Target	1	28-Jan-08	0:27:00	0:11:00	-55.19	-41.19	3190	5.2-32.9
253	Target	2	28-Jan-08	0:38:00	0:11:00	-55.20	-41.20	3213	6-20.9
254	Stratified	1	28-Jan-08	1:44:00	0:46:00	-55.19	-41.22	3227	190.8-402.3
254	Stratified	2	28-Jan-08	2:30:00	0:46:00	-55.21	-41.25	3298	8.4-201.4
255	Stratified	1	28-Jan-08	5:09:00	0:45:00	-55.19	-41.23	3248	702.3-1006
255	Stratified	2	28-Jan-08	5:55:00	0:45:00	-55.22	-41.26	3357	399.8-707.5
295	Stratified	1	02-Feb-08	5:56:00	0:45:00	-52.86	-40.11	3793	700.4-999.5
295	Stratified	2	02-Feb-08	6:45:00	0:48:00	-52.87	-40.05	3796	407.2-702.9
300	Stratified	1	02-Feb-08	12:49:00	0:45:00	-52.85	-40.09	3792	707.5-1002.2
300	Stratified	2	02-Feb-08	13:38:00	0:46:00	-52.87	-40.13	3795	401.2-705.6
301	Stratified	1	02-Feb-08	15:43:00	0:46:00	-52.90	-40.21	3797	203-402
301	Stratified	2	02-Feb-08	16:35:00	0:44:00	-52.88	-40.15	3794	1.6-201.4
305	Stratified	1	03-Feb-08	1:10:00	0:46:00	-52.83	-40.12	3789	200-401.2
305	Stratified	2	03-Feb-08	2:02:00	0:45:00	-52.86	-40.10	3794	15.5-206
328	Stratified	1	05-Feb-08	0:05:00	0:45:00	-52.72	-39.08	3725	204.1-405
328	Stratified	2	05-Feb-08	0:54:00	0:46:00	-52.73	-39.03	3719	12-205.4
329	Stratified	1	05-Feb-08	3:27:00	0:46:00	-52.72	-39.05	3723	703.7-1001.9
329	Stratified	2	05-Feb-08	4:15:00	0:49:00	-52.74	-39.01	3716	401.2-701
334	Stratified	1	05-Feb-08	11:19:00	0:45:00	-52.62	-39.12	3730	703.4-1007.3
334	Stratified	2	05-Feb-08	12:05:00	0:47:00	-52.64	-39.09	3725	406.9-719.6
335	Stratified	1	05-Feb-08	15:10:00	0:45:00	-52.61	-39.15	3728	198.9-400.1
335	Stratified	2	05-Feb-08	15:55:00	0:44:00	-52.63	-39.11	3727	3-208.7
346	Stratified	1	06-Feb-08	15:49:00	0:45:00	-50.49	-33.93	4752	198.7-400.9
346	Stratified	2	06-Feb-08	16:38:00	0:35:00	-50.50	-33.99	4759	10.3-201.4
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	1098	199.2-400.4
379	Stratified	1	10-Feb-08	6:21:00	0:36:00	-53.58	-37.66	1075	26.3-211.4
379	Stratified	2	10-Feb-08	7:02:00	0:01:00	-53.61	-37.66	796	55.9-63.8

TABLE X2 FISH CAUGHT IN RMT25 NET HAULS DURING JR177

Family	Species Name	Count
Myctophidae	Electrona carlsbergi	271
Myctophidae	Electrona antarctica	1083
Myctophidae	Electrona subaspera	1
Myctophidae	Gymnoscopelus bolini	2
Myctophidae	Gymnoscopelus fraseri	95
Myctophidae	Gymnoscopelus nicholsi	23
Myctophidae	Gymnoscopelus opisthopterus	36
Myctophidae	Gymnoscopelus braueri	590
Myctophidae	Gymnoscopelus sp.	5
Myctophidae	Krefftichthys anderssoni	192
Myctophidae	Lampanyctus achirus	11
Myctophidae	Protomyctophum andreyeshevi	1
Myctophidae	Protomyctophum gemmatum	1
Myctophidae	Protomyctophum bolini	202
Myctophidae	Protomyctophum tenisoni	103
Myctophidae	Protomyctophum choriodon	54
Bathylagidae	Bathylagus antarcticus	544
Bathylagidae	Bathylagus sp.	128
Channichthyidae	Champsocephalus gunnari	2
Chiasmondontidae	Chiasmondontidae sp.	1
Gempylidae	Paradiplospinus gracilis	7
Gonostomatidae	Cyclothone sp.	255
Macrouridae	Cynomacrurus piriei	13
Melamphidae	Poromitra crassiceps	8
Microstomatidae	Nansenia antarctica	8
Muraenolepidae	Muraenolepis microps	1
Paralepididae	Notolepis coatsi	33
Paralepididae	Notolepis sp.	95
Scopelarchidae	Benthalbella elongata	4
Scopelarchidae	Benthalbella macropinna	2
Stomiidae	Stomias gracilis	2
Stomiidae	Stomias sp.	2
Stomiidae	Borostomias antarcticus	11
Zoarcidae	Melanostigma gelatinosum	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 where no mismatches between the Gauze advances and the advances given by the software.

16.1.6 Acousitic 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 where 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 in 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 then 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 serval useful data discovery products were produced. For example Martin Collins king penguin data was plotted using Google Earth and overlays of sea surface temperature and chlorophyll (from Beki Korb) were combined to help identify where the last polar front process station should be located.

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

16.4.4 Polar View Project

Working with Andrew Fleming a number of Polar View products were available for use on the ship. The most impressive is the high quality sea ice images. These were used by the JCR Officers to help inform them of the conditions around Signy. The

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

16.4.5 Web Based Data Tools

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

17 Appendices

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

Rebecca Korb[1], Eric Achterberg[2], Tom Bibby[2], Christopher Moore[2], Maria Nielsdottir[2], Mick Whitehouse[1] ([1]British Antarctic Survey, [2]National 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.

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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,	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 CO_2. Drawdown of CO_2 into the ocean is driven by the difference in the partial pressure of CO_2 (pCO_2) between the atmosphere and the ocean. Novel pCO_2 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* pCO_2 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 pCO_2 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 pCO_2 system for use aboard *JCR* is from CASIX, the Centre for observation of Air-Sea Interactions and FluXes, Plymouth. BAS support of this CASIX pCO_2 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 resourecs of the pCO_2 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 pCO_2 data needed to quantify CO_2 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 CO_2 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 CO_2 between the ocean and the atmosphere.

9. BRIEF SCIENTIFIC CASE

Present atmospheric concentrations of carbon dioxide (CO_2) 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 CO_2 by absorbing about half of the CO_2 released from all human activities since 1800 (Sabine et al., 2004). The future rate of the oceanic CO_2 uptake is unknown and is determined by physical and biological processes. The difference in the partial pressure of CO_2 (pCO_2) between the ocean and the atmosphere is the driving force for oceanic CO_2 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 CO_2 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 CO_2 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 CO_2 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 CO_2 uptake in the Southern Ocean. Given the paucity of surface water pCO_2 data in the SO, we clearly need to increase our effort to better quantify the current CO_2 sink and to predict the future C cycle.

The Project

The largest predicted CO_2 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 pCO_2 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) CO_2 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 pCO_2 and the overall C budget in the SW Atlantic sector.

BAS is comparing the predicted pCO_2 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 pCO_2 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 pCO_2 instrument inter-calibration and the collection of vertical profiles of dissolved inorganic carbon and alkalinity to quantify the seasonal sink of CO_2 and the biological uptake of inorganic C across this area.

Objectives

1) ***To quantify the accuracy and precision of the JCR's pCO_2 instrument from CASIX, by running a UEA pCO_2 instrument in parallel.***
2) ***To make a seasonal comparison of the magnitude of the oceanic CO_2 sink.***
3) ***To quantify the summertime biological carbon uptake across a major productivity gradient***.

Methods

Objective 1. Since the *JCR*'s (CASIX) pCO_2 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 pCO_2. 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 CO_2 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 pCO_2 data will allow quantification of the oceanic CO_2 sink in summer. In addition, discrete samples will be taken from the CTD rosette for the analysis of DIC (total dissolved inorganic carbon, or TCO_2) and alkalinity. These analyses will allow calculation of pCO_2 in the winter mixed layer south of the Polar Front, where remnant winter water (with its remnant pCO_2 signal) persists below the summertime mixed layer. This will allow quantification of the summer and previous winter's CO_2 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 pCO_2 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.*, 149, 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 & Lambshead 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 krill[3].

The molecular dissection of circadian clocks reveals that they are generated from proteins that are able to feedback and inhibit their own transcription[4]. 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 *vrille* (*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 mechanisms[4]. Moreover, in both model organisms, these genes are involved in the photoperiodic components of seasonal reproduction[12] and, at least in flies, provide a mechanism for latitudinal adaptation to changing light and temperature regimes[13]. The expression of clock genes establishes the pace of the oscillation, whilst clock-controlled genes *(ccg*s*)* 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 nations[18]. 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 stocks[22] 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 decade[19] 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 decade[20]. 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 krill[21]. The 80% decrease in krill stocks over the past 80 years may be a direct result of these changes[22] 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 feeding[27]. 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 spawning[28]. 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 driven[2]. Given that all metazoans contain circadian clocks[4], 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 night[3]. 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. Buchholz[28] 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 activity[29]. 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 period[30]. Tarling & Cuzin-Roudy[29] 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 upon[32]. Moult synchronisation could reduce the cannibalism of soft, newly moulted individuals by those that are still hard[33]. Therefore, the process may be an adaptive strategy for a number of different reasons.

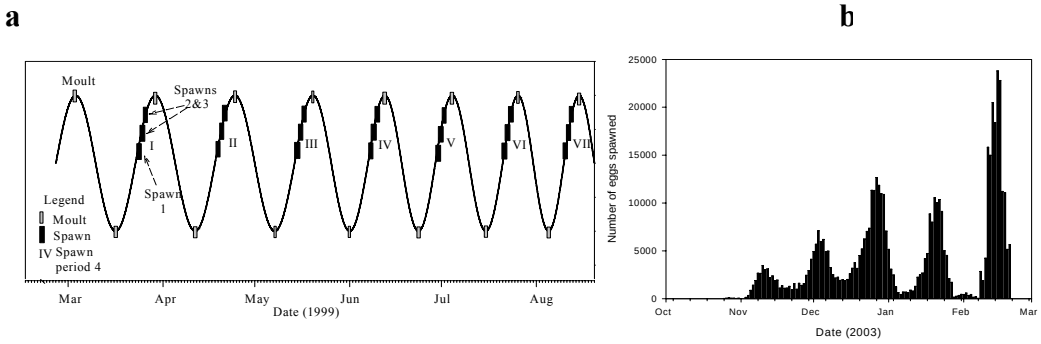

Fig. 1. (**a**) *Meganyctiphanes norvegica* reproductive cycles in the Clyde Sea during 1999, with a periodicity of around 20 to 26 days[29]. (**b**) Estimated number of eggs released per day by 55 females of *Euphausia superba* at South Georgia in 2003, showing a periodicity of around 23 to 26 days[31].

The periodicity of egg pulses is suggestive of a lunar influence[32]. Biological processes can entrain to a wide variety of periodicities, and lunar components are particularly important for marine organisms[34], 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), vrille (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).

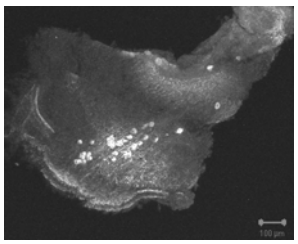

Fig. 2. Projection from 50 confocal sections of the optic lobe of northern krill, *Meganyctiphanes norvegica,* immunostained with anti-PDH antibodies. In crustaceans, the hormone PDH (Pigment Dispersing Hormone) affects body colour changes. However, its homologue in flies has a role as a circadian neuro-regulator 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 swarms[38]. 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 females[39]). 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 animals[40]. We will then hybridise Cy_3/Cy_5 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 standard[41]. 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 accurately[40]. After normalisation the microarray data will be analysed using GeneSpring (SiliconGenetics, Redwood City, CA) and/or R/Bioconductor[42] 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 CO_2 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 (30th Dec – 16th 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 proceeding 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 Cjhh@bas.ac.uk

PART 1			
CRUISE NUMBER JR177	**CRUISE TITLE** Discovery 2010 Summer cruise	**DATES** Jan-Feb 2008	**PRINCIPAL SCIENTIST** Geraint Tarling
ADDRESS BAS	**TELEPHONE NUMBER** 01223 221596	**FAX NUMBER** 01223 221259	**EMAIL** gant@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	☒	XBT	☒
SCINTILLATON COUNTER	☒	AUTOSAL SALINOMETER	☒
MAGNETOMETERS (STCM1 AND STCM2)	☐		
ACOUSTIC SYSTEMS			
VESSEL MOUNTED ADCP	☒	PRECISON ECHOSOUNDER (PES)	☐
EM120 MULTIBEAM	☒	EM120 ALDEN BACKSCATTER PLOTTER	☐
TOPAS SUB-BOTTOM PROFILER	☐	EPC PLOTTER FOR USE WITH TOPAS	☐
EK60 FISHERIES ECHOSOUNDER	☒	EK60 HP DESKJET PRINTERS	☐
SOUND VELOCITY PROFILER (SVP)	☐	10k Hz PINGER	☐
12k Hz PINGER	☐		
GPS SYSTEMS			
TRIMBLE 4000DS DGPS	☒	ASHTEC ADU2 DGPS	☒
ASHTEC GLONASS GG24	☒		
OCEANLOGGER			
BAROMETER (AIR PRESSURE)	☒	AIR HUMIDITY AND TEMPERATURE	☒
THERMOSALINOGRAPH (UNCONTAMINATED WATER FLOW)	☒	FLUOROMETER (UNCONTAMINATED WATER FLOW)	☒
TIR SENSOR (PYRANOMETER)	☒	PAR SENSOR	☒
FLOW METER (UNCONTAMINATED WATER FLOW)	☒	SEAWATER TEMPERATURE (AT UNCONTAMINATED WATER INLET)	☒
CTD			
DECK CONTROL SBE11 PLUS UNIT	☒	UNDERWATER SBE9 PLUS UNIT	☒
12 BOTTLE CAROUSEL, PYLON AND FRAME	☒	C.T. AND PRESSURE SENSORS	☒
FLUOROMETER	☒	STANDARDS THERMOMETER (SBE35)	☒
ALTIMETER (FOR USE NEAR SEA BED)	☒	TRANSMISSOMETER	☒
DISSOLVED OXYGEN SENSOR	☒	PAR SENSOR	☒
NAVIGATIONAL INSTRUMENTS LOGGED			
EA600 DEPTH	☒	HEAVE, ROLL, PITCH (TSS HRP)	☒
ANEMOMETER	☒	GYRO	☒
DOPPLER LOG	☒	EMLOG	☒
COMMENTS: NB> there is a requirement for the SEATEC differential GPS in addition to the other GPS systems			

PART 3 INSTRUMENTATION FIT – NON-BAS EQUIPMENT Tick if required.	
Please itemise below, equipment to be used during the cruise that will be provided by agencies other than BAS. Please identify purpose, scope and specification of equipment, services, requirements, operator demand and any issues related to fitting equipment to the ship.	
EQUIPMENT DETAILS	**EQUIPMENT OWNER**
24 bottle CTD rosette (suitable for attachment of L_ADCP)	UKORS
L-ADCP (300 kHz with battery pack, fittings and PC)	UKORS
Moorings and mooring instrumentation (sediment traps, ADCPs, current meters)	UKORS
CI Fasttracka FRRF	UKORS
CTD for iron sampling (Ti frame)	UKORS
Moving vessel profiler (MVP)	UKORS
Clean chemistry container	UKORS

PART 4 INFORMATION TECHNOLOGY BAS SUPPLIED SYSTEMS Tick if required			
PC / NOVELL SYSTEMS	☒	UNIX SYSTEMS	☒
COMMUNICATION: EMAIL	☒	COMMUNICATION DATA TRANSMISSION	☒
BAS DATA LOGGING SYSTEM (SCS)	☒		
COMMENTS:			

PART 5 INFORMATION TECHNOLOGY FIT NON-BAS EQUIPMENT	
Please itemise below, equipment to be used during the cruise that will be provided by agencies other than BAS. Please identify purpose, scope and specification and any LAN connector requirements. Also needed are details of any operator demand.	
EQUIPMENT DETAILS	**EQUIPMENT OWNER**

PART 6 SHIP SYSTEMS AND EQUIPMENT FIT BAS SUPPLIED SYSTEMS Tick if required			
WINCHES	☒	HYDRAULICS	☒
ELECTRICAL SUPPLIES	☒	WATER SUPPLIES	☒
FUME CUPBOARDS	☒	RADIO CHEMICAL FACILITIES	☒
COLD ROOMS / FREEZERS	☒	DYNAMIC POSITIONING SYSTEM	☒
BAS LOGGING SYTEM	☒		
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	Achtaberg AFI-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)	☒	IT ENGINEER (NO CHARGE)	☒
ADDITIONAL STAFF:			
	☐		☐
	☐		☐
	☐		☐
	☐		☐

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 interfere 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 spacial 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 priontisation 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 10degrees 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 TCPIP 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	Scientific Instrumentation	IT and Computing	Ships Systems and Equipment Fit
Chris Hindley	Jim Fox	Jeremy Armitage	David Blake
cjhh@bas.ac.uk	jwf@bas.ac.uk	jsar@bas.ac.uk	dmbl@bas.ac.uk
Tel: 01223 221497	Tel: 01223 221446	Tel: 01223 221408	Tel: 01223 221477

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/Virtual/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)	Buffered Formalin	Recently dead	
Aquarium (Min)	-20oC	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 31st 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				Precruise 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 redepoyed. % 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) *(else LHPR if conditions marginal)*
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) *(else LHPR if conditions marginal)*
27 Jan	15:30	18:00	RMT25 (Shallow) *(else MOCNESS if conditions marginal)*
27 Jan	18:00	22:00	Target fishing (RMT8 then RMT25)
27 Jan/ 28 Jan	22:00	00:30	RMT25 (shallow) *(else MOCNESS if conditions marginal)*

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.

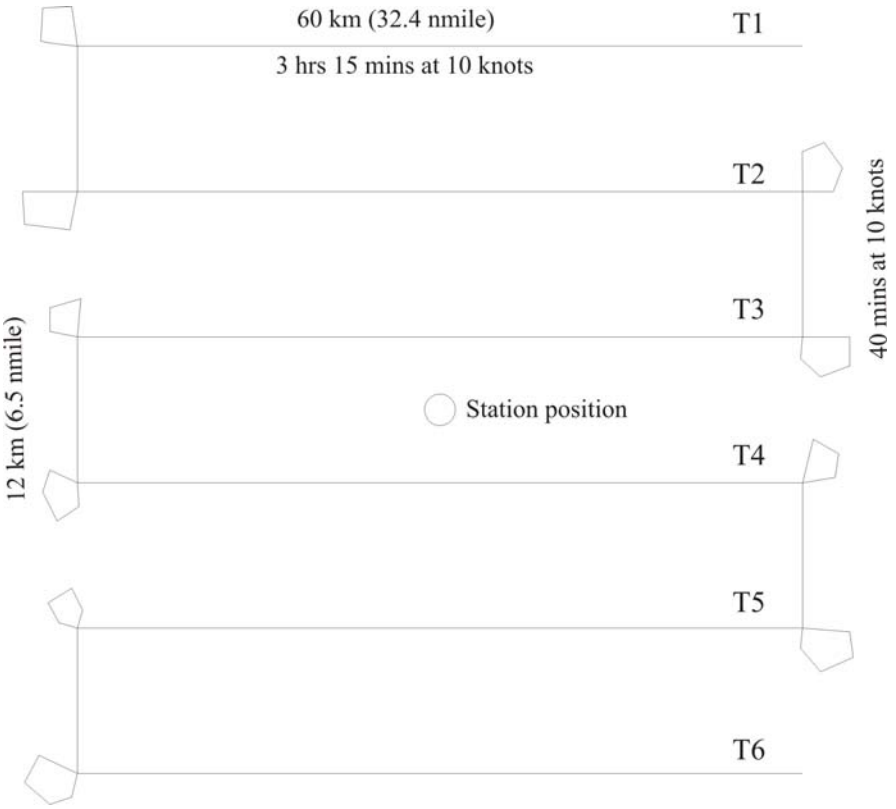
3) The orientation of the survey could be considered from various angles (cross front, cross transect etc). However, it was decided that the strategy adopted in JR161 (to head in the direction that creates the best quality data set) was as good as any other.

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 Questionaire Form

NATURAL ENVIRONMENT RESEARCH COUNCIL

Marine Facilities Planning

[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.	QUE PART 1 : Equipment Pool SECTION A : Portable Equipment
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	QUE PART 1 : Equipment Pool SECTION A : Portable Equipment
5.2 Gas bottle storage racks.	Yes

PART 1 : Equipment Pool SECTION B : Ship Fitted Equipment

4. RRS James Clark Ross	QUE PART 1 : Equipment Pool SECTION B : Ship Fitted Equipment
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	QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions
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.)	QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions
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)	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.	
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.

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.

PI will investigate a method for measuring depth during the go-flo bottle deployments e.g. BAS SVP, microcat, pressure sensor, CTD etc.

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.

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.

PI will investigate a method for measuring depth during the go-flo bottle deployments e.g. BAS SVP, microcat, pressure sensor, CTD etc.

4.5 Moving Vessel Profiler (MVP)	QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions
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	QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions
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 FFRF deployment and associated weights	

4.11 SC ADCP / L ADCP option - SC ADCP RDI WH Sentinel 300 kHz	QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions
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	QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions
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	QUE PART 1 : Equipment Pool SECTION C : Full Equipment Descriptions
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	QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions
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	QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions
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	QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions
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)	QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions
Bin numbers :	
BAS scientists will manage this instrument	
Preferred Software :	

SIMRAD EK60 - Fisheries Echo Sounder (18,38,70,120 & 200 kHz)	QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions
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	QUE PART 1 : Equipment Pool SECTION D : Full Ship Fitted Systems Descriptions
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	QUE PART 1 : Equipment Pool SECTION E : Shipboard Fitted Computing
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	QUE PART 1 : Equipment Pool SECTION E : Shipboard Fitted Computing
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	QUE PART 3 : Laboratory Space SECTION A : Laboratory Space
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 Demobilise	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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SECTION A : Freight Table	10
SECTION B : Mobilisation Table	10
SECTION E : Progress form	10

17.13 LHPR Deployment Log Sheet

JR177	Event number		Date		Station name
	Start latitude Start longitude Time (local)	Number of increments	End latitude End longitude Veer/Haul rate	Comments	Water depth (m) Wind strength
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

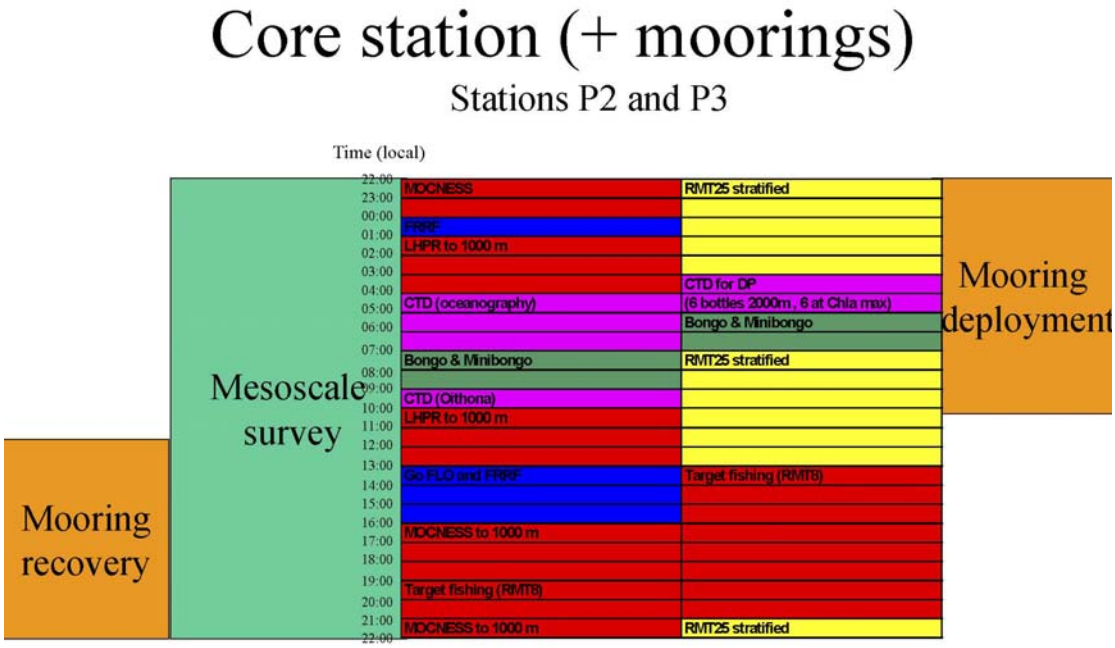
17.16 Uncontaminated Sea Water Log for JR177

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	JR177
4	23:25	2	1	Mid	Filters Changed over and Cleaned	~ ¼ Full Of 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
13	11:35	2	1	Mid	Filters Changed over and Cleaned	~ 40 Krill (mostly alive)	JR177
14	11:22	2	2	Mid	Filters Changed over and Cleaned	~ 40 Krill	JR177
15	18:38	2	1	Mid	Filters Changed over and Cleaned	Filter surface full of Krill	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
23	4:12	2	2	Mid	System Tripped	Gassed Up - Rough Seas	JR177
23	4:33	2	2	Mid	Filter Cleaned	Clean	JR177
23	4:33	1	2	Down	System Back On	Pumps Changed Over	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	Bridge Request	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

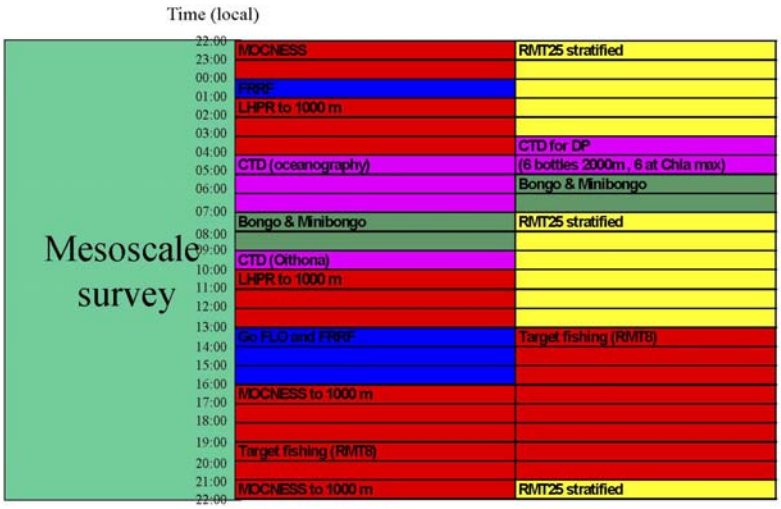
16	11:05	1	2	Down	Filters Changed over and Cleaned	Thermisto Mesh ¼ covered in salps, etc	JR177
17	9:04				Filters Changed over and Cleaned	Almost Clean	JR177
17	9:04			Up	System Shutdown	Arrival Stanley	JR177

17.17 Sampling Station Plan



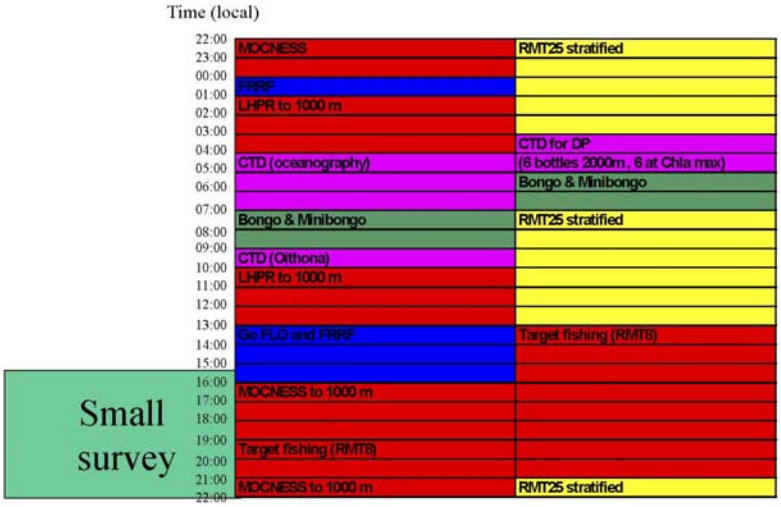
Core station

Stations C2, C3, C4

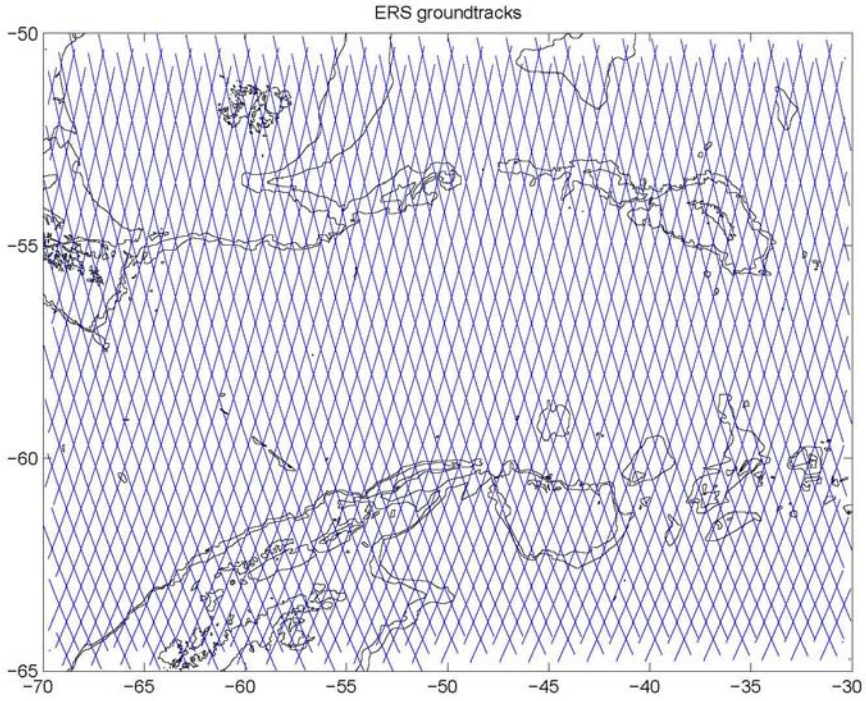


Responsive station

Stations R1, R2, R3, R4



17.18 ERS satellite tracks across Scotia Sea



17.19 Cruise Summary Form

CRUISE SUMMARY REPORT

FOR COLLATING CENTRE USE

Centre: BODC Ref. No.:

Is data exchange restricted ☐ Yes ☐ In part ☐ 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 (set sail) 31/ 12/ 2007 day/ month/ year to 16 /02 /2008 day/ month/ year end (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.

PRINCIPAL INVESTIGATORS: Enter the name and address of the Principal Investigators responsible for the data collected on the cruise and who may be contacted for further information about the data. (The letter assigned below against each Principal Investigator is used on pages 2 and 3, under the column heading 'PI', to identify the data sets for which he/she is responsible)

A. Oceanography. Mike Meredith BAS

B. Nutrients. Mick Whitehouse BAS

C. Phytoplankton. Rebecca Korb. BAS

D. Zooplankton – copepods. Pete Ward. BAS

E. Krill ecology and behaviour. Geraint Tarling. BAS

F. Fish. Martin Collins. BAS

G. High predator observations. Andrew Black. BAS

H. Sediment trap – biogeochemistry. David Pond. BAS

I. Whale buoys. Tony Martin. BAS

J. Echosounder acoustics. Jon Watkins. BAS

K. Iron chemistry. Erich Achterberg. NOC

L. Krill feeding. Angus Atkinson. BAS

MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

This section should be used for reporting moorings, bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the cruise. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

PI See top of page.	APPROXIMATE POSITION LATITUDE deg	min	N/S	 LONGITUDE deg	min	E/W	DATA TYPE enter code(s) from list on last page.	DESCRIPTION Identify, as appropriate, the nature of the instrumentation the parameters (to be) measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any identifiers given to the site.
H	52	43	S	48	08	W	B73 B28 D01 D71 H10**	Sediment trap mooring Recovered 31/1/08 ;Redeployed 2/2/2008 at Station P3, in productive waters to the NW of South Georgia. 1 x Sediment trap at 2000m, 1 x CTD at 500m, 1 x ADCP at 200m 1 x CTD at 200 m * 2 depths only
H	55	12	S	41	07	W	B73 B28 D01 D71 H10*	Sediment trap mooring Recovered 25/1/2008; Redeployed 28/1/2008 at Station P2, in low productivity waters to the SW of South Georgia. 1 x Sediment trap at 2000m, 1 x ADCP at 200m 1 x CTD at 200 m * single depth only
I	53	42	S	38	17	W	B26	Deployed 9 Feb 2008
I	53	43	S	38	10	W	B26	Deployed 9 Feb 2008
I	53	44	S	38	11	W	B26	Deployed 9 Feb 2008
I	53	45	S	38	12	W	B26	Deployed 9 Feb 2008
I	53	47	S	38	7	W	B26	Deployed 9 Feb 2008
								Please continue on separate sheet if necessary

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 see page 2	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on last page	DESCRIPTION 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**	✔

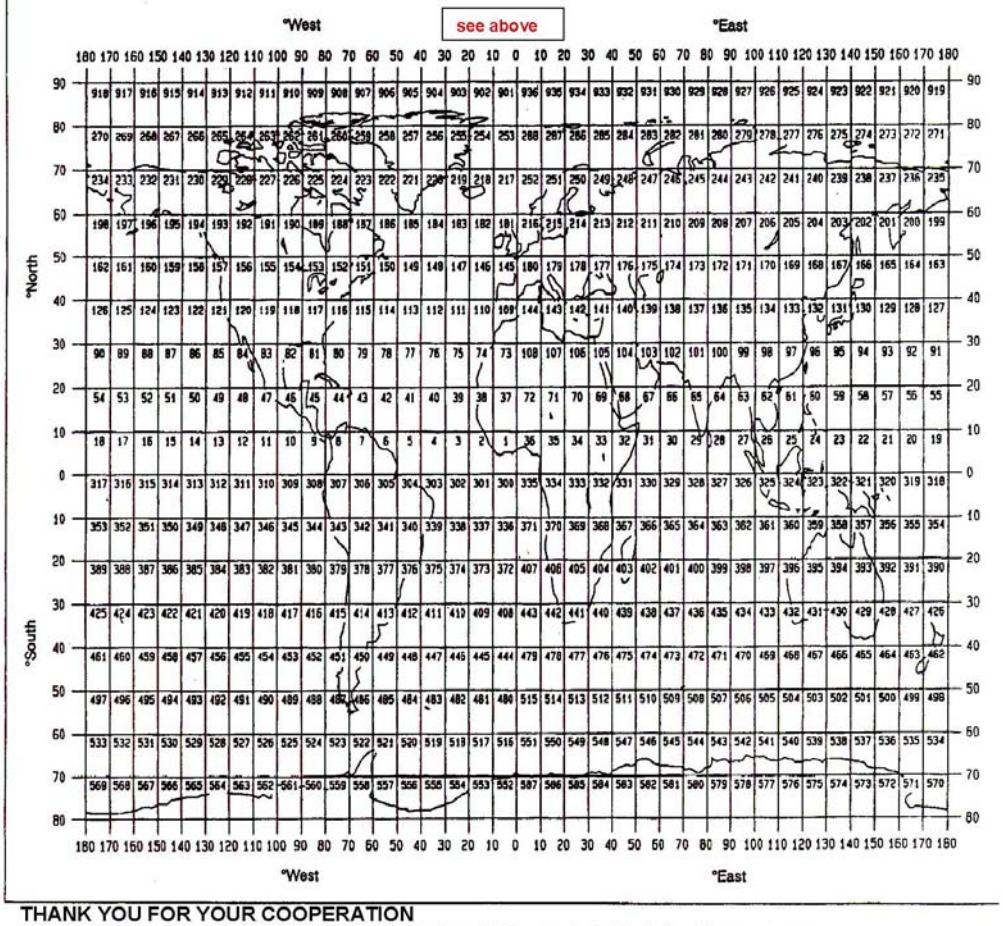
GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise – please use commonly recognised names (see, for example, International Hydrographic Bureau Special Publication No. 23, 'Limits of Oceans and Seas').

Scotia Sea. Altantic 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/drifting 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	Phytobenthos
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	Event Code	Station Code	Time	Lat	Lon	Comment
1	NTOW		31/12/2007 20:33	-51.8503	-57.4609	NOC towfish deployed at 4 knots.
1	NTOW		09/01/2008 14:48	-60.4309	-44.5929	NOC towfish recovered
2	XBT		31/12/2007 22:37	-52.1712	-57.0999	XBT completed.
3	XBT		01/01/2008 04:45	-53.1492	-55.9871	XBT DEPLOYED @ 6 KNOTS/ FAILED
4	XBT		01/01/2008 04:54	-53.1609	-55.9719	XBT DEPLOYED @ 6 KNOTS
4	XBT		01/01/2008 05:02	-53.1721	-55.9592	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
5	XBT		01/01/2008 06:33	-53.4116	-55.6909	XBT DEPLOYED @ 6 KNOTS
5	XBT		01/01/2008 06:42	-53.425	-55.6758	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
6	XBT		01/01/2008 08:04	-53.6427	-55.4237	Speed reduced to 6kts for XBT
6	XBT		01/01/2008 08:11	-53.6522	-55.4116	XBT deployment completed. Increasing speed.
7	XBT		01/01/2008 09:51	-53.9055	-55.112	Reducing speed for XBT.
7	XBT		01/01/2008 10:05	-53.928	-55.0858	XBT deployment completed.
8	XBT		01/01/2008 11:46	-54.1795	-54.7864	XBT DEPLOYED @ 6 KNOTS
8	XBT		01/01/2008 11:50	-54.1847	-54.7793	XBT Completed Increasing Speed
9	XBT		01/01/2008 13:22	-54.43	-54.4944	XBT DEPLOYED @ 6 KNOTS
9	XBT		01/01/2008 13:27	-54.4373	-54.486	XBT Completed Increasing Speed
10	XBT		01/01/2008 15:00	-54.6854	-54.1869	XBT DEPLOYED @ 6 KNOTS
10	XBT		01/01/2008 15:06	-54.694	-54.1758	XBT Completed Increasing Speed
11	XBT		01/01/2008 16:39	-54.9377	-53.8776	XBT DEPLOYED @ 6 KNOTS
11	XBT		01/01/2008 16:46	-54.9497	-53.863	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
12	XBT		01/01/2008 18:16	-55.1932	-53.5737	XBT DEPLOYED @ 6 KNOTS
12	XBT		01/01/2008 18:24	-55.2059	-53.5578	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
13	XBT		01/01/2008 19:55	-55.4518	-53.2615	Speed reduced to 6 knots for XBT.
13	XBT		01/01/2008 20:01	-55.4598	-53.2505	XBT completed. Increasing speed.
14	XBT		01/01/2008 21:32	-55.6958	-52.9601	Reducing speed to 6 knots for XBT.
14	XBT		01/01/2008 21:42	-55.7109	-52.9409	XBT completed.
15	XBT		01/01/2008 23:30	-55.9646	-52.6289	XBT DEPLOYED @ 6 KNOTS
15	XBT		01/01/2008 23:37	-55.9739	-52.6183	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
16	XBT		02/01/2008 01:16	-56.2158	-52.3174	XBT DEPLOYED @ 6 KNOTS
16	XBT		02/01/2008 01:23	-56.2258	-52.3048	XBT Completed Increasing Speed
17	XBT		02/01/2008 02:59	-56.4705	-52.0013	XBT DEPLOYED @ 6 KNOTS/ FAILED
18	XBT		02/01/2008 03:07	-56.4814	-51.9876	XBT DEPLOYED @ 6 KNOTS
18	XBT		02/01/2008 03:19	-56.5012	-51.9625	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
19	XBT		02/01/2008 04:44	-56.729	-51.6758	XBT DEPLOYED @ 6 KNOTS/ FAILED
20	XBT		02/01/2008 04:49	-56.7362	-51.6673	XBT DEPLOYED @ 6 KNOTS
21	XBT		02/01/2008 05:00	-56.7558	-51.6441	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
22	XBT		02/01/2008 06:17	-56.9686	-51.3705	COMMENCE SLOWING FOR XBT
22	XBT		02/01/2008 06:22	-56.9783	-51.3596	XBT DEPLOYED @ 6 KNOTS
23	XBT		02/01/2008 08:06	-57.2411	-51.0196	XBT deployed at 6 knots.
24	XBT		02/01/2008 09:36	-57.4794	-50.7156	Reducing speed for XBT.
24	XBT		02/01/2008 09:46	-57.495	-50.6937	XBT deployment completed.
25	XBT	PS1	02/01/2008 11:19	-57.7415	-50.377	XBT DEPLOYED @ 6 KNOTS
25	XBT	PS1	02/01/2008 11:27	-57.752	-50.3641	XBT Completed
26	MOC	PS1	02/01/2008 11:47	-57.7468	-50.3647	Mocness deployed @ 2.0kts
26	MOC	PS1	02/01/2008 12:23	-57.736	-50.3919	Mocness on deck.
27	LHPR	PS1	02/01/2008 12:53	-57.7231	-50.4189	LHPR Deployed
27	LHPR	PS1	02/01/2008 13:00	-57.7182	-50.4278	LHPR Recovered
28	LHPR	PS1	02/01/2008 13:01	-57.7175	-50.4291	LHPR Deployed

28	LHPR	PS1	02/01/2008 13:25	-57.7016	-50.4596	LHPR Recovered
29	RMT25	PS1	02/01/2008 14:11	-57.7447	-50.3683	RMT 25 deployed.
29	RMT25	PS1	02/01/2008 14:46	-57.7305	-50.4059	RMT Recovered
30	ATOW	PS1	02/01/2008 15:01	-57.7206	-50.4206	PES Fish deployed
30	ATOW	PS1	02/01/2008 15:06	-57.7189	-50.4201	increase speed to 10 kts
30	ATOW	PS1	02/01/2008 15:13	-57.7073	-50.4297	Vessel at 10 knots
30	ATOW	PS1	02/01/2008 15:16	-57.6999	-50.4364	Slow down for PES tow fish recovery
30	ATOW	PS1	02/01/2008 15:22	-57.6906	-50.443	Vessel at 2 knots
30	ATOW	PS1	02/01/2008 15:23	-57.69	-50.443	Motor blows on PES gantry. Recovery suspended while problem is investigated
30	ATOW	PS1	02/01/2008 15:38	-57.6852	-50.4425	Vessel stopped on DP to ease load on tow fish cable
30	ATOW	PS1	02/01/2008 15:48	-57.6852	-50.4423	Fish secured
30	ATOW	PS1	02/01/2008 20:36	-57.6741	-50.4228	PES fish recovered inboard.
31	FRRF	PS1	02/01/2008 17:34	-57.6852	-50.4423	FRRF deployed
31	FRRF	PS1	02/01/2008 17:47	-57.6852	-50.4424	FRRF @ 150m
31	FRRF	PS1	02/01/2008 18:05	-57.6852	-50.4423	FRRF recovered
32	CTD	PS1	02/01/2008 18:25	-57.6851	-50.4423	CTD deployed
32	CTD	PS1	02/01/2008 19:39	-57.6789	-50.4296	CTD held at 4110m
32	CTD	PS1	02/01/2008 21:23	-57.6733	-50.4169	CTD recovered to deck and gantry secured.
33	XBT		02/01/2008 23:52	-57.9999	-50.0337	XBT DEPLOYED @ 6 KNOTS
33	XBT		03/01/2008 00:01	-58.0117	-50.0176	XBT Completed Increasing Speed
34	XBT		03/01/2008 01:33	-58.2505	-49.6906	XBT DEPLOYED @ 6 KNOTS
34	XBT		03/01/2008 01:40	-58.2593	-49.678	XBT COMPLETE.
35	XBT		03/01/2008 03:44	-58.5086	-49.346	XBT DEPLOYED @ 6 KNOTS
36	XBT		03/01/2008 05:47	-58.7638	-48.994	XBT DEPLOYED @ 6 KNOTS
37	XBT		03/01/2008 07:45	-59.0213	-48.6433	XBT deployed at 6 knots
38	XBT		03/01/2008 09:34	-59.2819	-48.2743	XBT deployed at 6 knots
39	XBT		03/01/2008 11:11	-59.5295	-47.9281	XBT DEPLOYED @ 6 KNOTS
39	XBT	N1	03/01/2008 11:17	-59.5369	-47.9161	XBT COMPLETE.
40	RMT8	N1	03/01/2008 11:45	-59.5199	-47.8925	RMT 8 deployed
40	RMT8	N1	03/01/2008 12:22	-59.5346	-47.9351	RMT 8 recovered
41	RMT8	N1	03/01/2008 12:48	-59.5213	-47.8966	RMT 8 deployed
41	RMT8	N1	03/01/2008 13:20	-59.5362	-47.9405	RMT 8 recovered
42	XBT		03/01/2008 14:51	-59.7758	-47.844	XBT DEPLOYED @ 6 KNOTS
42	XBT		03/01/2008 14:57	-59.7844	-47.8395	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
43	XBT		03/01/2008 16:16	-60.0349	-47.7512	XBT DEPLOYED @ 6 KNOTS
43	XBT		03/01/2008 16:25	-60.0524	-47.7435	XBT COMPLETE. VESSEL BACK TO 12 KNOTS
44	XBT		03/01/2008 17:34	-60.2767	-47.6499	COMMENCE SLOWING FOR XBT
44	XBT		03/01/2008 17:39	-60.2869	-47.6459	XBT DEPLOYED @ 6 KNOTS
45	ATOW	R1	03/01/2008 18:36	-60.3008	-47.8568	Deploy PES fish
45	ATOW	R1	03/01/2008 18:44	-60.3024	-47.8623	PES fish not working
45	ATOW	R1	03/01/2008 18:49	-60.3032	-47.8648	TowFish recovered
46	ATOW	R1	04/01/2008 01:07	-60.3902	-47.7959	deployed towfish
46	ATOW	R1	04/01/2008 01:11	-60.391	-47.7955	TowFish recovered
47	RMT8	R1	04/01/2008 02:21	-60.4512	-48.0293	RMT 8 deployed
47	RMT8	R1	04/01/2008 02:51	-60.4621	-48.0645	RMT 8 recovered
48	LHPR	R1	04/01/2008 04:12	-60.4669	-48.089	LHPR deployed.
48	LHPR	R1	04/01/2008 07:09	-60.527	-48.3007	LHPR recovered.
49	CTD	R1	04/01/2008 07:49	-60.4982	-48.1924	CTD deployed (1416 metres EA 600)
49	CTD	R1	04/01/2008 08:17	-60.4982	-48.1924	CTD held at 1376m wire out.
49	CTD	R1	04/01/2008 09:09	-60.4982	-48.1924	CTD recovered.
50	BON	R1	04/01/2008 09:25	-60.4982	-48.1924	Bongo nets deployed from midships gantry. 400 metres.
50	BON	R1	04/01/2008 09:44	-60.4982	-48.1924	Commence recovering bongo nets.

50	BON	R1	04/01/2008 10:01	-60.4982	-48.1924 Bongo nets recovered to deck.
51	BON	R1	04/01/2008 10:03	-60.4982	-48.1924 Bongo nets deployed.
51	BON	R1	04/01/2008 10:34	-60.4982	-48.1924 Bongo nets recovered to deck.
52	MON	R1	04/01/2008 10:45	-60.4982	-48.1924 Mini bongos deployed.
52	MON	R1	04/01/2008 11:14	-60.4982	-48.1924 Mini Bongos Recovered
53	MON	R1	04/01/2008 11:16	-60.4982	-48.1924 Mini Bongo Deployed
53	MON	R1	04/01/2008 11:50	-60.4982	-48.1927 Minibongo Recovered
54	CTD	R1	04/01/2008 12:05	-60.4983	-48.1928 CTD deployed 1415m
54	CTD	R1	04/01/2008 12:16	-60.4983	-48.1934 CTD stopped @ 400m
54	CTD	R1	04/01/2008 12:34	-60.4983	-48.1934 CTD recoverd to deck
55	LHPR	R1	04/01/2008 13:26	-60.4667	-48.0847 LHPR Deployed
55	LHPR	R1	04/01/2008 15:23	-60.5115	-48.2399 LHPR recovered
56	RMT8	R1	04/01/2008 16:44	-60.4428	-47.9635 Commence deployment of RMT 8
56	RMT8	R1	04/01/2008 16:49	-60.4418	-47.9704 RMT 8 deployed
56	RMT8	R1	04/01/2008 17:31	-60.4313	-48.0319 RMT 8 recovered
57	MOC	R1	04/01/2008 18:42	-60.5101	-48.1133 Commence mocness deployment
57	MOC	R1	04/01/2008 18:44	-60.5097	-48.1154 Mocness deployed
57	MOC	R1	04/01/2008 21:29	-60.4817	-48.2939 Mocness recovered to deck
58	BON	R1	04/01/2008 22:05	-60.4981	-48.192 Bongo nets deployed
58	BON	R1	04/01/2008 22:34	-60.4981	-48.192 Bongo nets recovered
59	BON	R1	04/01/2008 22:35	-60.4982	-48.192 Bongo nets redeployed
59	BON	R1	04/01/2008 23:04	-60.4981	-48.192 Bongo nets recovered
60	MON	R1	04/01/2008 23:21	-60.4981	-48.192 Mini Bongos Deployed
60	MON	R1	04/01/2008 23:52	-60.4982	-48.192 Mini Bongos Recovered
61	MOC	R1	05/01/2008 00:16	-60.4934	-48.2052 Mocness deployed
61	MOC	R1	05/01/2008 02:31	-60.4469	-48.3158 Mocness recovered
62	CTD	R1	05/01/2008 05:18	-60.4983	-48.1912 CTD deployed (water depth 1415m)
62	CTD	R1	05/01/2008 05:23	-60.4982	-48.1911 Problem with CTD
62	CTD	R1	05/01/2008 05:28	-60.4982	-48.1911 CTD recovered
62	CTD	R1	05/01/2008 05:38	-60.4982	-48.191 CTD redeployed
62	CTD	R1	05/01/2008 06:07	-60.4983	-48.1905 CTD @ depth 1354m
62	CTD	R1	05/01/2008 06:42	-60.4982	-48.1906 CTD recovered
63	RMT25	R1	05/01/2008 07:36	-60.4983	-48.1924 Commence deployment of RMT 25.
63	RMT25	R1	05/01/2008 07:44	-60.4978	-48.2041 RMT 25 deployed. Course over ground approx. 276T.
63	RMT25	R1	05/01/2008 08:06	-60.4958	-48.2368 Net recovered to deck for maintenance.
64	RMT25	R1	05/01/2008 08:18	-60.4932	-48.2544 RMT redeployed.
64	RMT25	R1	05/01/2008 09:12	-60.4877	-48.3365 RMT 25 at 1676m wire out. Hauling.
64	RMT25	R1	05/01/2008 10:27	-60.4824	-48.4521 RMT 25 recovered.
65	BON	R1	05/01/2008 11:34	-60.498	-48.1922 V/L on Station Deploying Bongos net
65	BON	R1	05/01/2008 12:04	-60.498	-48.1922 bongos net recovered
66	BON	R1	05/01/2008 12:07	-60.498	-48.1922 Bongo nets deployed.
66	BON	R1	05/01/2008 12:34	-60.498	-48.1922 Bongo Nets on board.
67	MON	R1	05/01/2008 12:39	-60.498	-48.1922 Mini Bongos Deployed
67	MON	R1	05/01/2008 13:07	-60.498	-48.1922 Mini Bongos Recovered
68	MON	R1	05/01/2008 13:14	-60.4982	-48.1923 Mini Bongos Deployed
68	MON	R1	05/01/2008 13:39	-60.4982	-48.1923 Mini Bongos Recovered
69	FRRF	R1	05/01/2008 13:49	-60.4982	-48.1923 FRRF dep
69	FRRF	R1	05/01/2008 14:18	-60.4982	-48.1923 FRRF on deck.
70	GOF	R1	05/01/2008 14:35	-60.4982	-48.1923 Go Flo deployed
70	GOF	R1	05/01/2008 14:43	-60.4982	-48.1923 Go Flo recovered
71	GOF	R1	05/01/2008 14:58	-60.4982	-48.1923 Go Flo deployed
71	GOF	R1	05/01/2008 15:22	-60.4982	-48.1923 Go Flo wire at 1000m Trigger weight deployed.

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.
74	RMT25	R1	05/01/2008 19:51	-60.5012	-48.2316 RMT 25 deployed. Course over ground approx. 270T. 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

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 towards LHPR deployment position.
96	LHPR	C2	08/01/2008 19:18	-60.2524	-44.4574 LHPR deployed @ 2.5 knots.
96	LHPR	C2	08/01/2008 19:58	-60.2286	-44.4296 LHPR @ 2058m cable out. Hauling in.
96	LHPR	C2	08/01/2008 21:24	-60.1765	-44.3712 LHPR recovered. Ship turned and steaming downwind on course 213T.
97	RMT25	C2	08/01/2008 22:16	-60.257	-44.4724 RMT 25 deployed. Course over ground 035T.
97	RMT25	C2	08/01/2008 22:47	-60.2383	-44.4444 RMT 25 recovered. Ship steaming downwind at 6 knots while changing deck for towed bongo.
98	TON	C2	08/01/2008 23:22	-60.2619	-44.4824 Towed Bongo deployed. 1.0kts requested
98	TON	C2	08/01/2008 23:45	-60.256	-44.471 Towed bongo net recovered.
99	TON	C2	08/01/2008 23:50	-60.2545	-44.4683 Towed bongo deployed.
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 deployed.
100	TON	C2	09/01/2008 00:34	-60.2418	-44.4462 Towed bongo net recovered.
101	TON	C2	09/01/2008 00:40	-60.2408	-44.4437 Towed bongo deployed.
101	TON	C2	09/01/2008 00:51	-60.2378	-44.4403 Towed bongo net recovered.
102	RMT25	C2	09/01/2008 01:29	-60.2235	-44.4244 RMT 25 deployed.
102	RMT25	C2	09/01/2008 03:43	-60.1408	-44.3475 RMT 25 recovered
103	CTD	C2	09/01/2008 04:36	-60.2092	-44.4089 CTD deployed
103	CTD	C2	09/01/2008 05:13	-60.2092	-44.4089 CTD @depth 1989m
103	CTD	C2	09/01/2008 06:02	-60.2092	-44.4089 CTD recovered
104	BON	C2	09/01/2008 06:14	-60.2092	-44.4089 Bongo deployed
104	BON	C2	09/01/2008 06:46	-60.2093	-44.4088 Bongo recovered
105	BON	C2	09/01/2008 06:47	-60.2092	-44.4088 Bongo redeployed
105	BON	C2	09/01/2008 07:18	-60.2092	-44.4089 Bongo nets recovered.
106	MON	C2	09/01/2008 07:24	-60.2092	-44.4089 Mini bongo nets deployed.
106	MON	C2	09/01/2008 07:54	-60.2092	-44.4089 Mini bongo nets recovered.
107	MON	C2	09/01/2008 07:58	-60.2093	-44.4089 Mini bongo redeployed.
107	MON	C2	09/01/2008 08:28	-60.2092	-44.4089 Mini bongo recovered.
108	RMT25	C2	09/01/2008 08:47	-60.2048	-44.4024 Commence RMT 25 deployment.
108	RMT25	C2	09/01/2008 08:52	-60.2019	-44.3978 RMT 25 deployed.
108	RMT25	C2	09/01/2008 09:35	-60.1768	-44.357 RMT 25 @ 1344m cable out. Hauling in.
108	RMT25	C2	09/01/2008 10:46	-60.1342	-44.2941 RMT 25 recovered. Holding station.
109	CTD		09/01/2008 13:42	-60.4309	-44.593 CTD deployed
109	CTD		09/01/2008 14:03	-60.4309	-44.5929 CTD @ 986m
109	CTD		09/01/2008 14:37	-60.4309	-44.5929 CTD recovered to deck
110	CTD	N2	10/01/2008 00:57	-61.1981	-44.4081 CTD deployed 329m
110	CTD	N2	10/01/2008 01:08	-61.1981	-44.4082 CTD @ depth 315m
110	CTD	N2	10/01/2008 01:41	-61.1981	-44.4081 CTD recovered

111	GOF	N2	10/01/2008 02:04	-61.1981	-44.4082 Go Flo deployed
111	GOF	N2	10/01/2008 02:39	-61.1981	-44.4082 Go Flo recovered
112	CTD	N3	10/01/2008 09:54	-61.6619	-44.0665 CTD deployed. EA600 depth 584 metres. Vessel moving with pack ice to stay in pool of clear water.
112	CTD	N3	10/01/2008 10:09	-61.6632	-44.0617 CTD all stopped at 565 metres wire out.
112	CTD	N3	10/01/2008 10:40	-61.6654	-44.0516 CTD recovered to deck.
113	GOF	N3	10/01/2008 10:55	-61.6671	-44.0449 Go Flo deployed. 104m
113	GOF	N3	10/01/2008 11:13	-61.6691	-44.0401 Go Flo recovered.
114	CTD	N4	10/01/2008 17:33	-62.1629	-43.6941 CTD deployed
114	CTD	N4	10/01/2008 17:50	-62.1629	-43.6941 CTD @ 674m
114	CTD	N4	10/01/2008 18:14	-62.1629	-43.6941 CTD recovered
115	CTD	N4	10/01/2008 18:22	-62.1629	-43.6941 CTD redeployed
115	CTD	N4	10/01/2008 18:43	-62.1629	-43.6941 CTD @ 1053m
116	CTD	N5	10/01/2008 23:04	-62.3545	-43.5277 CTD deployed (EA 600 water depth 1266 metres).
116	CTD	N5	10/01/2008 23:25	-62.3529	-43.5275 CTD at deph (cable out 1220m)
116	CTD	N5	11/01/2008 00:21	-62.3484	-43.5249 CTD recoverd to deck
117	CTD	N5	11/01/2008 00:56	-62.3457	-43.523 CTD deployed 1263m
117	CTD	N5	11/01/2008 01:03	-62.3451	-43.5226 CTD @ 120m
117	CTD	N5	11/01/2008 01:24	-62.344	-43.5217 CTD recovered
118	GOF	N5	11/01/2008 01:31	-62.344	-43.5215 Go Flo deployed
118	GOF	N5	11/01/2008 01:59	-62.344	-43.5198 Go Flo recovered
119	CTD		11/01/2008 05:38	-62.5161	-43.3132 CTD deployed
119	CTD		11/01/2008 06:19	-62.5179	-43.3079 CTD @ 2000m
119	CTD		11/01/2008 07:19	-62.52	-43.2993 CTD recovered.
120	CTD	N6	11/01/2008 09:30	-62.6089	-43.2444 CTD deployed. EA 600 depth 3078 metres.
120	CTD	N6	11/01/2008 10:25	-62.6078	-43.239 CTD stopped at 3015 metres wire out.
120	CTD	N6	11/01/2008 11:45	-62.608	-43.2344 CTD recovered to deck.
121	GOF	N6	11/01/2008 11:50	-62.608	-43.2341 Go Flo deployed. 104m.
121	GOF	N6	11/01/2008 12:24	-62.608	-43.232 Go Flo recovered to deck.
122	CTD		12/01/2008 07:46	-60.6662	-45.519 CTD deployed. EA 600 depth 192 metres.
122	CTD		12/01/2008 07:53	-60.6662	-45.519 CTD stopped at 180 metres.
122	CTD		12/01/2008 08:12	-60.6662	-45.519 CTD recovered.
123	RMT25	C2	12/01/2008 22:39	-60.2018	-44.3696 RMT 25 deployed.
123	RMT25	C2	13/01/2008 01:40	-60.1936	-44.6428 RMT 25 recovered.
124	RMT25	C2	13/01/2008 02:06	-60.1911	-44.6844 RMT 25 Deployed
124	RMT25	C2	13/01/2008 04:00	-60.1855	-44.8557 Commence recovery of RMT 25
124	RMT25	C2	13/01/2008 04:23	-60.1852	-44.8844 RMT 25 recovered
125	TON	C2	13/01/2008 04:56	-60.1853	-44.9035 Towed bongo deployed @ 1 knot
125	TON	C2	13/01/2008 05:12	-60.1853	-44.9124 Towed bongo recovered
126	TON	C2	13/01/2008 05:17	-60.1851	-44.9151 Towed bongo redeployed
126	TON	C2	13/01/2008 05:43	-60.1845	-44.9317 Towed bongo recovered
127	TON	C2	13/01/2008 05:51	-60.1841	-44.9367 Towed bongo redeployed
127	TON	C2	13/01/2008 06:31	-60.1861	-44.9609 Towed bongo recovered
128	CTD		13/01/2008 09:15	-59.9362	-44.239 CTD deployed. EA 600 depth 4731 metres.
128	CTD		13/01/2008 10:37	-59.9362	-44.239 CTD stopped at 4673 metres wire out.
128	CTD		13/01/2008 12:18	-59.9361	-44.239 CTD recoverd to deck
129	UOR		13/01/2008 12:39	-59.9362	-44.239 UOR Deployed
129	UOR		13/01/2008 13:10	-59.9362	-44.239 UOR recovered
130	NTOW		13/01/2008 12:52	-59.9362	-44.239 NOC towfish deployed
130	NTOW		25/01/2008 19:05	-55.2218	-41.2402 NOC towfish recovered (to allow mooring deployment).
131	ATOW		13/01/2008 14:18	-60.0248	-43.995 PES Fish deployed
131	ATOW		14/01/2008 01:39	-59.5086	-44.3841 PES fish recovered inboard.
132	UOR		13/01/2008 14:30	-60.0185	-44.0082 UOR Deployed

132	UOR		13/01/2008 20:21	-59.8082	-44.1241 UOR recovered
133	UOR		13/01/2008 22:22	-59.8575	-43.7186 UOR deployed and at depth. Increasing speed.
133	UOR		13/01/2008 22:48	-59.8101	-43.8167 Reducing speed for UOR recovery.
133	UOR		13/01/2008 22:52	-59.804	-43.8286 UOR recovered. Increasing to 10 knots.
134	UOR		14/01/2008 02:29	-59.4505	-44.2266 UOR Deployed
134	UOR		14/01/2008 03:06	-59.5153	-44.0995 UOR recovered due to technical problems
135	FRRF	C3	14/01/2008 14:33	-59.6886	-44.055 FRRF deployed
135	FRRF	C3	14/01/2008 15:07	-59.6886	-44.0549 FRRF recovered
136	GOF	C3	14/01/2008 15:17	-59.6886	-44.055 Go Flo deployed
136	GOF	C3	14/01/2008 15:42	-59.6886	-44.0549 go flo @ 1004m trigger weight deployed
136	GOF	C3	14/01/2008 16:23	-59.6886	-44.0549 Go flo recovered
137	MOC	C3	14/01/2008 17:02	-59.7289	-43.9978 Mocness deployed
137	MOC	C3	14/01/2008 18:02	-59.7015	-44.0361 Mocness @ 1723m
137	MOC	C3	14/01/2008 19:33	-59.6603	-44.0985 Mocness recovered. Ship turned downwind and steaming back while RMT net is made ready.
138	RMT8	C3	14/01/2008 20:25	-59.7345	-43.9975 RMT 8 deployed.
138	RMT8	C3	14/01/2008 20:47	-59.725	-44.0134 RMT 8 recovered.
139	TON	C3	14/01/2008 21:00	-59.7212	-44.0183 Towed Bongo deployed from scientific crane forward.
139	TON	C3	14/01/2008 21:19	-59.7186	-44.0256 Towed bongo recovered
140	TON	C3	14/01/2008 21:35	-59.7165	-44.0315 Towed bongo redeployed
140	TON	C3	14/01/2008 21:45	-59.7153	-44.0343 Towed bongo recovered
141	TON	C3	14/01/2008 21:52	-59.7143	-44.0367 Towed bongo redeployed.
141	TON	C3	14/01/2008 22:17	-59.7106	-44.045 Towed bongo recovered.
142	TON	C3	14/01/2008 22:40	-59.7068	-44.0515 Towed Bongo deployed from aft gantry
142	TON	C3	14/01/2008 22:51	-59.7051	-44.0549 Towed Bongo @ 120m wire out.
142	TON	C3	14/01/2008 23:32	-59.698	-44.0706 Towed bongo recovered
143	MOC	C3	15/01/2008 00:00	-59.7246	-44.0072 Mocness deployed @ 2.0kts
143	MOC	C3	15/01/2008 02:44	-59.6497	-44.1192 Mocness recovered.
144	FRRF	C3	15/01/2008 03:36	-59.6882	-44.0546 FRRF deployed
144	FRRF	C3	15/01/2008 04:08	-59.6882	-44.0546 FRRF recovered
145	LHPR	C3	15/01/2008 04:38	-59.7193	-44.0337 LHPR Deployed @ 2.0kts
145	LHPR	C3	15/01/2008 05:35	-59.6889	-44.0554 LHPR @ 1770m cable out
145	LHPR	C3	15/01/2008 06:57	-59.6441	-44.0819 LHPR recovered
146	CTD	C3	15/01/2008 07:32	-59.6887	-44.0544 CTD deployed. EA600 depth 4143 metres.
146	CTD	C3	15/01/2008 08:44	-59.6887	-44.0543 CTD @ 4080m. Recovery commences.
146	CTD	C3	15/01/2008 10:15	-59.6887	-44.0544 CTD recovered.
147	BON	C3	15/01/2008 10:22	-59.6887	-44.0544 Bongo nets deployed.
147	BON	C3	15/01/2008 10:55	-59.6888	-44.0544 Bongo nets recovered.
148	BON	C3	15/01/2008 11:08	-59.6887	-44.0544 Bongo deployed
148	BON	C3	15/01/2008 11:41	-59.6887	-44.0544 Bongo nets recovered
149	MON	C3	15/01/2008 11:45	-59.6888	-44.0544 Mini Bongos Deployed
149	MON	C3	15/01/2008 12:16	-59.6887	-44.0544 Mini Bongos Recovered
150	MON	C3	15/01/2008 12:19	-59.6887	-44.0544 Mini Bongos Deployed
150	MON	C3	15/01/2008 12:51	-59.6887	-44.0544 Mini Bongos Recovered
151	CTD	C3	15/01/2008 12:59	-59.6887	-44.0544 CTD Deployed
151	CTD	C3	15/01/2008 13:13	-59.6887	-44.0544 CTD @ 400m
151	CTD	C3	15/01/2008 14:02	-59.6887	-44.0544 CTD recoverd to deck
152	LHPR	C3	15/01/2008 14:39	-59.6728	-43.9677 LHPR Deployed
152	LHPR	C3	15/01/2008 15:41	-59.6848	-44.0377 Commence hauling LHPR
152	LHPR	C3	15/01/2008 17:06	-59.7021	-44.1283 LHPR recovered
153	TON	C3	15/01/2008 14:47	-59.6743	-43.9776 Towed Bongo deployed from scientific crane forward.
153	TON	C3	15/01/2008 15:09	-59.6788	-44.0032 Towed bongo recovered
154	RMT8	C3	15/01/2008 18:20	-59.6614	-43.9548 RMT 8 deployed

154	RMT8	C3	15/01/2008 18:44	-59.6684	-43.9845	RMT 8 recovered
155	RMT25	C3	15/01/2008 19:30	-59.6617	-43.9552	RMT 25 deployed.
155	RMT25	C3	15/01/2008 19:47	-59.6672	-43.9765	RMT 25 @ 190m cable out. Hauling in.
155	RMT25	C3	15/01/2008 20:01	-59.672	-43.9956	RMT 25 recovered
156	TON	C3	15/01/2008 20:21	-59.6742	-44.0028	Towed Bongo deployed from aft gantry
156	TON	C3	15/01/2008 21:03	-59.6754	-44.0224	Towed Bongo @ 100m wire out
156	TON	C3	15/01/2008 21:33	-59.679	-44.0333	Towed Bongo recovered
157	TON	C3	15/01/2008 21:39	-59.6797	-44.0356	Towed bongo redeployed
157	TON	C3	15/01/2008 21:51	-59.6807	-44.0409	Towed Bongo @ 120m wire out. Hauling in
157	TON	C3	15/01/2008 22:37	-59.6864	-44.0619	Towed bongo recovered. Ship turned and steaming downwind towards RMT deployment position.
158	RMT25	C3	15/01/2008 23:10	-59.6706	-43.9696	RMT 25 deployed.
158	RMT25	C3	16/01/2008 02:16	-59.7313	-44.2091	RMT 25 recovered.
159	TON	C3	15/01/2008 23:25	-59.675	-43.9901	Towed Bongo deployed from scientific crane forward.
159	TON	C3	15/01/2008 23:50	-59.6815	-44.0213	Towed bongo net recovered.
160	TON	C3	15/01/2008 23:51	-59.6818	-44.0226	Deployed Towed Bongo
160	TON	C3	16/01/2008 00:02	-59.6847	-44.0376	Recovered towed bongo
161	RMT25	C3	16/01/2008 03:29	-59.6727	-44.0019	RMT 25 deployed
161	RMT25	C3	16/01/2008 05:36	-59.7133	-44.1681	RMT recovered
162	CTD	C3	16/01/2008 06:29	-59.6801	-44.0565	CTD deployed
162	CTD	C3	16/01/2008 07:07	-59.6801	-44.0571	CTD stopped at 2000 metres wire out.
162	CTD	C3	16/01/2008 07:49	-59.6801	-44.0571	CTD recovered.
163	BON	C3	16/01/2008 08:05	-59.6801	-44.0571	Bongo nets deployed.
163	BON	C3	16/01/2008 08:34	-59.6801	-44.0571	Bongo nets recovered.
164	BON	C3	16/01/2008 08:36	-59.6801	-44.0571	Bongo nets redeployed.
164	BON	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.
165	RMT25	C3	16/01/2008 09:46	-59.6582	-43.9617	RMT 25 deployed.
165	RMT25	C3	16/01/2008 10:50	-59.6723	-44.052	Wire held at 2230 metres.
165	RMT25	C3	16/01/2008 13:16	-59.6892	-44.2716	RMT 25 recovered
166	RMT25	C3	16/01/2008 14:44	-59.6693	-43.9572	RMT 25 deployed.
166	RMT25	C3	16/01/2008 16:51	-59.6969	-44.1243	RMT Recovered
167	MON	C3	16/01/2008 17:21	-59.6978	-44.1277	Mini bongo deployed
167	MON	C3	16/01/2008 17:52	-59.6977	-44.1278	Mini bongo recovered
168	UOR		16/01/2008 18:06	-59.6911	-44.1296	UOR deployed
168	UOR		16/01/2008 19:51	-59.448	-43.8637	UOR recovered due to technical issues
169	CTD		16/01/2008 20:24	-59.4152	-43.8705	CTD deployed. EA600 depth 3093 metres.
169	CTD		16/01/2008 20:33	-59.4152	-43.8705	CTD returning to surface. Problem with underwater unit.
169	CTD		16/01/2008 20:55	-59.4147	-43.87	CTD Cancelled due to technical problems. V/L off DP and heading for next CTD.
170	CTD	N7	17/01/2008 00:26	-59.144	-43.6935	CTD Deployed
170	CTD	N7	17/01/2008 01:31	-59.1441	-43.6935	CTD stopped @ 3540m
170	CTD	N7	17/01/2008 03:07	-59.1441	-43.6934	CTD recovered
171	TON	N7	17/01/2008 03:34	-59.145	-43.6881	Towed bongo deployed
171	TON	N7	17/01/2008 04:05	-59.1517	-43.6723	Towed bongo recovered
172	CTD		17/01/2008 06:01	-58.8716	-43.5094	CTD 14 deployed
172	CTD		17/01/2008 06:55	-58.8716	-43.5093	CTD @ depth 2890m
172	CTD		17/01/2008 08:10	-58.8716	-43.5093	CTD recovered.
173	CTD		17/01/2008 10:01	-58.5982	-43.3309	CTD deployed. EA 600 depth 3112 metres.
173	CTD		17/01/2008 10:57	-58.5996	-43.3329	CTD stopped at 3051 metres wire out.
173	CTD		17/01/2008 12:08	-58.5996	-43.3329	CTD recovered and gantry secured
174	CTD		17/01/2008 14:23	-58.2778	-43.141	CTD Deployed (water depth 2907m)
174	CTD		17/01/2008 15:13	-58.2778	-43.1409	CTD @ 2858m

174	CTD		17/01/2008 16:15	-58.2778	-43.141	CTD recovered
175	ATOW		17/01/2008 17:06	-58.3498	-42.9718	PES Fish deployed
175	ATOW		18/01/2008 00:47	-58.2205	-42.6928	PES fish recovered inboard.
176	ATOW		18/01/2008 07:35	-58.1175	-42.5126	PES fish deployed.
176	ATOW		18/01/2008 16:06	-58.1891	-42.6706	PES fish recovered
177	MOC	C4	18/01/2008 19:14	-57.9835	-43.0377	Mocness net deployed
177	MOC	C4	18/01/2008 21:50	-58.0507	-42.9388	Mocness recovered. Ship turned and steaming downwind at 6 knots.
178	RMT8	C4	18/01/2008 22:38	-57.9986	-42.9764	RMT 8 net deployed.
178	RMT8	C4	18/01/2008 22:53	-58.0068	-42.9715	55 metres wire out
179	RMT8	C4	18/01/2008 23:10	-58.019	-42.9652	RMT 8 net deployed.
179	RMT8	C4	18/01/2008 23:30	-58.0317	-42.9583	RMT 8 net recovered
180	TON	C4	18/01/2008 23:51	-58.0463	-42.9496	deployed towed bongo
180	TON	C4	19/01/2008 00:25	-58.051	-42.941	towed bongo recovered
181	MOC	C4	19/01/2008 01:03	-57.9729	-42.9669	Mocness net deployed
181	MOC	C4	19/01/2008 03:45	-58.0597	-42.9946	Mocness recovered
182	FRRF	C4	19/01/2008 04:15	-58.0227	-42.9804	FRRF deployed
182	FRRF	C4	19/01/2008 04:40	-58.0227	-42.9804	FRRF recovered
183	LHPR	C4	19/01/2008 05:16	-57.9868	-42.9234	LHPR deployed
183	LHPR	C4	19/01/2008 06:48	-58.0258	-42.9864	LHPR recovered
184	TON	C4	19/01/2008 05:23	-57.9899	-42.9283	Towed bongo deployed from scientific crane
184	TON	C4	19/01/2008 06:04	-58.0071	-42.956	Towed bongo recovered
185	CTD	C4	19/01/2008 07:02	-58.0229	-42.9843	CTD deployed. EA600 depth 2842 metres.
185	CTD	C4	19/01/2008 07:53	-58.0228	-42.9813	CTD stopped at 2778 metres wire out.
185	CTD	C4	19/01/2008 09:00	-58.0228	-42.9809	CTD recovered.
186	BON	C4	19/01/2008 09:06	-58.0228	-42.9809	Bongo nets deployed.
186	BON	C4	19/01/2008 09:35	-58.0228	-42.9809	Bongo nets recovered.
187	BON	C4	19/01/2008 09:38	-58.0228	-42.9809	Bongo nets redeployed.
187	BON	C4	19/01/2008 10:08	-58.0228	-42.9809	Bongo nets recovered.
188	MON	C4	19/01/2008 10:13	-58.0228	-42.9809	Mini bongo deployed.
188	MON	C4	19/01/2008 10:44	-58.0228	-42.9809	Mini bongo recovered.
189	MON	C4	19/01/2008 10:48	-58.0228	-42.9809	Mini bongo redeployed.
189	MON	C4	19/01/2008 11:19	-58.0228	-42.9809	Mini bongo recovered.
190	MON	C4	19/01/2008 11:27	-58.0228	-42.981	Mini bongo redeployed.
190	MON	C4	19/01/2008 11:57	-58.0228	-42.9809	Mini bongo recovered.
191	CTD	C4	19/01/2008 12:11	-58.0228	-42.9809	CTD deployed. EA600 depth 2840 metres.
191	CTD	C4	19/01/2008 12:34	-58.0228	-42.9809	CTD recovered.
192	GOF	C4	19/01/2008 12:42	-58.0228	-42.9809	Go-Flo Deployed
192	GOF	C4	19/01/2008 13:55	-58.0228	-42.9809	Go-Flo Recovered
193	FRRF	C4	19/01/2008 14:06	-58.0228	-42.9809	FRRF Deployed
193	FRRF	C4	19/01/2008 14:37	-58.0228	-42.9809	FRRF recovered
194	LHPR	C4	19/01/2008 15:17	-58.0223	-42.887	LHPR deployed
194	LHPR	C4	19/01/2008 16:05	-58.0228	-42.9361	LHPR @ 1728m
194	LHPR	C4	19/01/2008 17:14	-58.0194	-43.0079	LHPR recovered
195	RMT8	C4	19/01/2008 17:48	-58.0223	-42.9633	RMT 8 deployed
195	RMT8	C4	19/01/2008 18:23	-58.023	-43.0089	RMT8 recovered
196	RMT25	C4	19/01/2008 19:18	-58.0229	-42.9647	RMT 25 deployed
196	RMT25	C4	19/01/2008 19:49	-58.0233	-43.0093	RMT 25 recovered. Ship turned downwind and steaming back for redeployment.
197	RMT25	C4	19/01/2008 20:32	-58.0224	-42.9634	RMT 25 deployed.
197	RMT25	C4	19/01/2008 20:56	-58.023	-42.9966	445 metres wire out.
197	RMT25	C4	19/01/2008 21:31	-58.0232	-43.0455	Commence hauling.
197	RMT25	C4	19/01/2008 21:53	-58.023	-43.0741	RMT 25 recovered. Turning and steaming 4 miles downwind of station.

198	RMT25	C4	19/01/2008 22:47	-58.0325	-42.8573	RMT 25 deployed.
198	RMT25	C4	20/01/2008 01:42	-58.0168	-43.0801	RMT 25 recovered
199	RMT25	C4	20/01/2008 02:41	-58.0169	-43.0228	RMT 25 deployed
199	RMT25	C4	20/01/2008 04:50	-58.0082	-43.1843	RMT recovered
200	CTD	C4	20/01/2008 06:09	-58.0271	-42.9718	CTD deployed
200	CTD	C4	20/01/2008 06:46	-58.0271	-42.9718	CTD @ 2000m
200	CTD	C4	20/01/2008 07:34	-58.0271	-42.9719	CTD recovered.
201	BON	C4	20/01/2008 07:40	-58.0271	-42.9718	Bongo nets deployed.
201	BON	C4	20/01/2008 08:08	-58.0271	-42.9719	Bongo nets recovered.
202	BON	C4	20/01/2008 08:10	-58.0271	-42.9718	Bongo nets redeployed.
202	BON	C4	20/01/2008 08:40	-58.0271	-42.9719	Bongo nets recovered.
203	MON	C4	20/01/2008 08:46	-58.0271	-42.9719	Mini bongo nets deployed.
203	MON	C4	20/01/2008 09:18	-58.0271	-42.9718	Mini bongo nets recovered.
204	MON	C4	20/01/2008 09:20	-58.0271	-42.9718	Mini bongo nets redeployed.
204	MON	C4	20/01/2008 09:49	-58.0271	-42.9718	Mini bongo nets recovered.
205	RMT25	C4	20/01/2008 10:46	-58.0232	-42.8893	RMT 25 deployed.
205	RMT25	C4	20/01/2008 13:48	-58.0191	-43.1309	RMT 25 recovered
206	RMT25	C4	20/01/2008 15:18	-58.0261	-42.8974	RMT deployed
206	RMT25	C4	20/01/2008 18:00	-58.0216	-43.1089	RMT recovered
207	RMT25	C4	20/01/2008 18:15	-58.0212	-43.1252	RMT 25 deployed
207	RMT25	C4	20/01/2008 19:15	-58.0216	-43.2005	RMT 25 recovered. Ship steaming head to wind for net stowage
208	CTD		20/01/2008 21:40	-57.7583	-42.8011	CTD deployed . EA600 depth 2913 metres.
208	CTD		20/01/2008 22:35	-57.7582	-42.8011	CTD stopped at 2850 metres wire out.
208	CTD		20/01/2008 23:49	-57.7582	-42.8013	CTD recovered.
209	CTD		21/01/2008 02:50	-57.4368	-42.6104	ctd deployed
209	CTD		21/01/2008 03:49	-57.4368	-42.6103	CTD @ 3232m
209	CTD		21/01/2008 05:16	-57.4368	-42.6102	CTD recovered
210	LHPR	R2	21/01/2008 14:07	-57.1562	-42.3407	LHPR Deployed
210	LHPR	R2	21/01/2008 16:15	-57.1321	-42.4818	LHPR recovered
211	FRRF	R2	21/01/2008 16:55	-57.1397	-42.4337	FRRF deployed
211	FRRF	R2	21/01/2008 17:27	-57.1396	-42.4337	FRRF recovered
212	GOF	R2	21/01/2008 17:35	-57.1396	-42.4337	Go flo deployed
212	GOF	R2	21/01/2008 18:01	-57.1396	-42.4337	Go flo @ 1004m
212	GOF	R2	21/01/2008 18:43	-57.1396	-42.4337	Go flo recovered
213	MOC	R2	21/01/2008 19:24	-57.1554	-42.3492	Mocness deployed
213	MOC	R2	21/01/2008 20:25	-57.145	-42.4074	1794 metres wire out. Commence hauling.
213	MOC	R2	21/01/2008 20:57	-57.1395	-42.4382	Mocness recovered.
214	RMT8	R2	21/01/2008 22:47	-57.1318	-42.4602	RMT 8 deployed.
214	RMT8	R2	21/01/2008 23:25	-57.1241	-42.5109	RMT 8 Recovered
215	MOC	R2	22/01/2008 01:09	-57.1506	-42.3636	Mocness deployed
215	MOC	R2	22/01/2008 03:40	-57.1324	-42.547	Mocness recovered.
216	CTD	R2	22/01/2008 04:43	-57.1396	-42.4329	CTD deployed
216	CTD	R2	22/01/2008 06:03	-57.1396	-42.4328	CTD @ 3624m
216	CTD	R2	22/01/2008 07:32	-57.1396	-42.4326	CTD recovered.
217	BON	R2	22/01/2008 07:39	-57.1396	-42.4327	Bongo nets deployed.
217	BON	R2	22/01/2008 08:09	-57.1408	-42.4327	Bongo nets recovered.
218	BON	R2	22/01/2008 08:10	-57.1408	-42.4327	Bongo nets redeployed.
218	BON	R2	22/01/2008 08:41	-57.1408	-42.4327	Bongo nets recovered.
219	MON	R2	22/01/2008 08:44	-57.1408	-42.4327	Mini bongos deployed.
219	MON	R2	22/01/2008 09:13	-57.1408	-42.4327	Mini bongos recovered.
220	MON	R2	22/01/2008 09:17	-57.1408	-42.4327	Mini bongos redployed.
221	CTD	R2	22/01/2008 09:56	-57.1408	-42.4327	CTD deployed.

221	CTD	R2	22/01/2008 10:01	-57.1408	-42.4327 CTD recovered to investigate fault.
221	CTD	R2	22/01/2008 10:24	-57.1408	-42.4327 CTD deployed.
221	CTD	R2	22/01/2008 10:35	-57.1408	-42.4327 CTD stopped at 398 metres wire out.
221	CTD	R2	22/01/2008 10:53	-57.1408	-42.4327 CTD recovered.
222	CTD	R2	22/01/2008 12:12	-57.1408	-42.4326 CTD deployed . EA600 depth 2000 metres.
222	CTD	R2	22/01/2008 12:51	-57.1408	-42.4326 CTD @ 2000m
222	CTD	R2	22/01/2008 13:34	-57.1408	-42.4327 CTD recovered
223	CTD		22/01/2008 15:57	-56.8432	-42.2566 CTD deployed . EA600 depth 4199 metres.
223	CTD		22/01/2008 17:13	-56.8432	-42.2566 CTD @ 4155m
223	CTD		22/01/2008 18:46	-56.8432	-42.2566 CTD recovered
224	CTD		22/01/2008 21:08	-56.5212	-42.0717 CTD deployed. EA600 depth 4042 metres.
224	CTD		22/01/2008 22:21	-56.5212	-42.0715 CTD @ 4005m
224	CTD		22/01/2008 23:55	-56.5211	-42.0715 CTD recovered.
225	CTD		23/01/2008 13:14	-55.9018	-41.7195 CTD deployed
225	CTD		23/01/2008 14:15	-55.9017	-41.7195 CTD @ 3521m
225	CTD		23/01/2008 15:36	-55.9017	-41.7194 CTD recovered
226	CTD		23/01/2008 18:46	-55.5804	-41.5343 CTD deployed
226	CTD		23/01/2008 19:46	-55.5803	-41.5343 CTD @ 3332m cable out.
226	CTD		23/01/2008 21:04	-55.5803	-41.5343 CTD recovered.
227	CTD	P2	25/01/2008 11:52	-55.2064	-41.2465 CTD deployed . EA600 depth 3240 metres.
227	CTD	P2	25/01/2008 12:50	-55.209	-41.2447 CTD @ 3185m
227	CTD	P2	25/01/2008 14:04	-55.21	-41.2444 CTD recovered
228	BON	P2	25/01/2008 14:18	-55.2101	-41.2444 Bongo nets deployed.
228	BON	P2	25/01/2008 14:48	-55.2121	-41.2439 Bongo nets recovered.
229	BON	P2	25/01/2008 14:50	-55.2123	-41.2439 Bongo nets redeployed.
229	BON	P2	25/01/2008 15:21	-55.2136	-41.244 Bongo nets recovered
230	MON	P2	25/01/2008 15:26	-55.2136	-41.244 Mini bongo deployed
230	MON	P2	25/01/2008 15:56	-55.2156	-41.2421 Mini bongo recovered
231	MON	P2	25/01/2008 16:00	-55.2159	-41.2418 Mini bongo nets redeployed.
231	MON	P2	25/01/2008 16:30	-55.2175	-41.2403 Mini bongo recovered
232	FRRF	P2	25/01/2008 16:35	-55.2175	-41.2402 FRRF deployed
232	FRRF	P2	25/01/2008 17:05	-55.2175	-41.2402 FRRF recovered
233	CTD	P2	25/01/2008 17:16	-55.2175	-41.2402 CTD deployed
233	CTD	P2	25/01/2008 17:27	-55.2175	-41.2402 CTD @ 400m
233	CTD	P2	25/01/2008 17:45	-55.2175	-41.2402 CTD recovered
234	GOF	P2	25/01/2008 17:55	-55.2175	-41.2402 Go flo deployed
234	GOF	P2	25/01/2008 18:23	-55.2188	-41.2402 Go flo @ 1004m
234	GOF	P2	25/01/2008 18:45	-55.2204	-41.2402 1st bottle not fired. Trigger weight redeployed at 970m.
234	GOF	P2	25/01/2008 19:35	-55.225	-41.2402 Go Flo recovered.
235	MOO	P2	25/01/2008 20:26	-55.2035	-41.1162 On station for mooring release.
235	MOO	P2	25/01/2008 20:28	-55.2036	-41.1162 Hydrophone deployed.
235	MOO	P2	25/01/2008 20:30	-55.2035	-41.1162 Mooring released.
235	MOO	P2	25/01/2008 20:57	-55.2065	-41.1137 Mooring buoy recovered to deck.
235	MOO	P2	25/01/2008 21:41	-55.2064	-41.1137 Trimsin buoy cluster on deck.
235	MOO	P2	25/01/2008 21:48	-55.2065	-41.1137 Sediment trap on deck.
235	MOO	P2	25/01/2008 22:37	-55.2065	-41.1137 Acoustic release on deck. Completed mooring recovery.
236	NTOW	P2	25/01/2008 23:01	-55.2065	-41.1137 NOC towfish deployed
236	NTOW	P2	31/01/2008 16:57	-52.7222	-40.1393 NOC tow fish recovered
237	TON	P2	25/01/2008 23:13	-55.2058	-41.1176 Towed bongo deployed
237	TON	P2	26/01/2008 00:56	-55.2003	-41.1599 Towed bongo recovered
240	CTD	P2	27/01/2008 03:08	-55.2069	-41.1567 CTD deployed (238
240	CTD	P2	27/01/2008 03:47	-55.2069	-41.1567 CTD @ 2000m

240	CTD	P2	27/01/2008 04:34	-55.2069	-41.1567	CTD recovered
241	FRRF	P2	27/01/2008 04:41	-55.2069	-41.1567	FRRF deployed
241	FRRF	P2	27/01/2008 05:13	-55.2072	-41.1566	FRRF recovered
242	BON	P2	27/01/2008 05:20	-55.2072	-41.1566	Bongo deployed
242	BON	P2	27/01/2008 05:51	-55.2112	-41.1558	Bongo nets recovered
243	BON	P2	27/01/2008 05:53	-55.2114	-41.1558	Bongo nets redeployed
243	BON	P2	27/01/2008 06:23	-55.2168	-41.1543	Bongo nets recovered
244	BON	P2	27/01/2008 06:24	-55.2169	-41.1542	Bongo nets redeployed
244	BON	P2	27/01/2008 06:54	-55.2206	-41.1537	Bongo nets recovered.
245	MON	P2	27/01/2008 07:00	-55.2215	-41.1538	Mini bongos deployed.
245	MON	P2	27/01/2008 07:32	-55.2247	-41.1536	Mini bongos recovered.
246	MON	P2	27/01/2008 07:33	-55.2248	-41.1536	Mini bongos redeployed.
246	MON	P2	27/01/2008 08:03	-55.2276	-41.1536	Mini bongos recovered.
247	MON	P2	27/01/2008 08:07	-55.2282	-41.1536	Mini bongos redeployed.
247	MON	P2	27/01/2008 08:36	-55.2317	-41.1535	Mini bongos recovered.
248	RMT25	P2	27/01/2008 09:21	-55.1702	-41.193	Commence deployment of RMT 25
248	RMT25	P2	27/01/2008 09:27	-55.172	-41.1999	RMT 25 deployed
248	RMT25	P2	27/01/2008 09:45	-55.1825	-41.2134	RMT 25 @ 610m cable out.
248	RMT25	P2	27/01/2008 10:27	-55.2042	-41.2491	RMT 25 recovered.
249	MOC	P2	27/01/2008 12:05	-55.2296	-41.2858	Mocness deployed
249	MOC	P2	27/01/2008 14:37	-55.2824	-41.3912	Mocness recovered
250	RMT25	P2	27/01/2008 15:41	-55.1883	-41.1684	RMT 25 deployed
250	RMT25	P2	27/01/2008 18:56	-55.2508	-41.3939	RMT 25 recovered. Ship steaming to redeployment position.
251	RMT25	P2	27/01/2008 20:14	-55.1898	-41.1746	RMT 25 deployed
251	RMT25	P2	27/01/2008 20:55	-55.2038	-41.2224	770 metres wire out. Commence hauling.
251	RMT25	P2	27/01/2008 22:24	-55.2394	-41.3203	RMT 25 recovered
252	RMT25	P2	27/01/2008 23:20	-55.1951	-41.1917	RMT 25 deployed.
252	RMT25	P2	27/01/2008 23:46	-55.2017	-41.2167	RMT recovered.
253	RMT25	P2	28/01/2008 00:22	-55.1937	-41.1893	RMT 25 deployed.
253	RMT25	P2	28/01/2008 00:51	-55.2009	-41.2148	RMT 25 recovered.
254	RMT25	P2	28/01/2008 01:22	-55.1757	-41.1998	RMT 25 deployed.
254	RMT25	P2	28/01/2008 03:26	-55.2344	-41.2946	RMT 25 recovered
255	RMT25	P2	28/01/2008 04:18	-55.1656	-41.1862	RMT 25 deployed.
255	RMT25	P2	28/01/2008 07:18	-55.2684	-41.3301	RMT 25 recovered. Changing over to LHPR.
256	LHPR	P2	28/01/2008 08:16	-55.2405	-41.2847	LHPR deployed.
256	LHPR	P2	28/01/2008 10:54	-55.1529	-41.185	LHPR recovered.
257	MOO	M1	28/01/2008 14:11	-55.2	-41.1231	V/L on DP for mooring deployment
257	MOO	M1	28/01/2008 14:57	-55.1999	-41.1237	Commenced mooring Deployment
257	MOO	M1	28/01/2008 15:05	-55.1999	-41.1237	Accoustic release deployed
257	MOO	M1	28/01/2008 16:06	-55.1999	-41.1237	Sediment trap and current meter deployed
257	MOO	M1	28/01/2008 16:12	-55.1999	-41.1237	Trimsin buoy cluster deployed
257	MOO	M1	28/01/2008 17:04	-55.1999	-41.1236	Main buoy released. Mooring deployment complete
258	CTD	M1	28/01/2008 17:43	-55.1971	-41.1254	CTD deployed
258	CTD	M1	28/01/2008 17:54	-55.1971	-41.1254	CTD @ 400m
258	CTD	M1	28/01/2008 18:05	-55.1971	-41.1254	CTD recovered
259	CTD		28/01/2008 20:12	-54.9128	-41.1732	CTD deployed. EA 600 depth 3413 metres.
259	CTD		28/01/2008 21:12	-54.9128	-41.1733	CTD stopped at 3374 metres wire out.
259	CTD		28/01/2008 22:36	-54.9128	-41.1732	CTD recovered.
260	MOC	P2	29/01/2008 00:36	-55.1782	-41.1785	Mocness deployed
260	MOC	P2	29/01/2008 03:07	-55.2316	-41.295	Mocness recovered.
261	LHPR	P2	29/01/2008 04:04	-55.2107	-41.1814	LHPR Deployed
261	LHPR	P2	29/01/2008 06:32	-55.1975	-41.3296	LHPR recovered

262	CTD		29/01/2008 10:31	-54.5908	-40.9966 CTD deployed. EA 600 depth 3285 metres.
262	CTD		29/01/2008 11:29	-54.5909	-40.9966 CTD @ 3236m
262	CTD		29/01/2008 12:45	-54.5909	-40.9966 CTD recovered
263	CTD		29/01/2008 15:09	-54.2162	-40.813 CTD deployed . EA600 depth 2424 metres.
263	CTD		29/01/2008 15:53	-54.2162	-40.813 CTD @ 2418m
263	CTD		29/01/2008 16:49	-54.2162	-40.8131 CTD recovered
264	CTD		29/01/2008 19:06	-53.8972	-40.6444 CTD deployed. EA 600 depth 1185 metres.
264	CTD		29/01/2008 19:32	-53.8972	-40.6444 CTD held at 1214m cable out
264	CTD		29/01/2008 20:19	-53.8972	-40.6445 CTD recovered. Ship proceeding to Shag Rocks shelf for target fishing.
265	RMT8		30/01/2008 00:09	-53.5806	-41.0304 RMT 8 deployed
265	RMT8		30/01/2008 00:45	-53.5917	-41.0672 RMT 8 Recovered
266	RMT8		30/01/2008 02:23	-53.5606	-40.7945 RMT 8 deployed
266	RMT8		30/01/2008 02:40	-53.5663	-40.8131 RMT 8 Recovered
267	CTD	N8	30/01/2008 04:23	-53.5261	-40.4588 CTD deployed. EA 600 depth 2057 metres.
267	CTD	N8	30/01/2008 05:02	-53.5263	-40.4595 CTD @ 2006m
267	CTD	N8	30/01/2008 06:00	-53.5264	-40.4594 CTD recovered
268	RMT8	N8	30/01/2008 07:00	-53.5233	-40.461 RMT 8 deployed
268	RMT8	N8	30/01/2008 07:31	-53.54	-40.4878 RMT 8 recovered
269	RMT8	N8	30/01/2008 07:57	-53.5163	-40.4503 RMT 8 deployed.
269	RMT8	N8	30/01/2008 08:57	-53.5472	-40.505 RMT 8 recovered. Ship steaming to CTD position 32.
270	CTD	N9	30/01/2008 11:20	-53.1547	-40.2755 CTD deployed
270	CTD	N9	30/01/2008 12:30	-53.1551	-40.2752 CTD @ 3968m
270	CTD	N9	30/01/2008 13:56	-53.1551	-40.2753 CTD recovered
271	BON	N9	30/01/2008 14:09	-53.1552	-40.2753 Bongo nets deployed.
271	BON	N9	30/01/2008 14:23	-53.155	-40.2755 Bongo nets recovered
272	ATOW		30/01/2008 15:39	-53.0882	-40.5103 PES fish deployed
272	ATOW		31/01/2008 14:42	-52.8587	-40.487 PES towfish recovered
273	CTD	M2	31/01/2008 16:51	-52.7222	-40.1392 CTD deployed
273	CTD	M2	31/01/2008 17:01	-52.7222	-40.1393 CTD @ 400m
273	CTD	M2	31/01/2008 17:19	-52.7222	-40.1393 CTD recovered
274	MOO	M2	31/01/2008 17:28	-52.7222	-40.1393 Hydrophone deployed.
274	MOO	M2	31/01/2008 17:30	-52.7223	-40.1393 Mooring released
274	MOO	M2	31/01/2008 17:32	-52.7223	-40.1393 Mooring sighted. Off DP proceeding for recovery
274	MOO	M2	31/01/2008 17:53	-52.7237	-40.1477 Commence recovery of mooring
274	MOO	M2	31/01/2008 17:55	-52.7237	-40.1477 Main buoy and whale buoy recovered
274	MOO	M2	31/01/2008 18:58	-52.7237	-40.1477 Trimsin buoy cluster recovered.
274	MOO	M2	31/01/2008 19:06	-52.7236	-40.1477 Sediment trap recovered.
274	MOO	M2	31/01/2008 19:49	-52.7236	-40.1477 Acoustic release on deck. Completed mooring recovery.
275	RMT8	P3	31/01/2008 21:00	-52.751	-40.0696 RMT 8 deployed. Heading west.
275	RMT8	P3	31/01/2008 21:52	-52.751	-40.1295 RMT recovered.
276	MOC	P3	01/02/2008 00:12	-52.8571	-40.0208 Mocness deployed
276	MOC	P3	01/02/2008 02:43	-52.8573	-40.1596 Mocness recovered.
277	FRRF	P3	01/02/2008 03:31	-52.859	-40.0961 FRRF deployed
277	FRRF	P3	01/02/2008 04:01	-52.859	-40.0961 FRRF recovered
278	LHPR	P3	01/02/2008 04:30	-52.848	-40.0471 LHPR deployed
278	LHPR	P3	01/02/2008 06:48	-52.8811	-40.1633 LHPR recovered
279	CTD	P3	01/02/2008 07:25	-52.8583	-40.0971 CTD deployed. EA 600 depth 3791 metres.
279	CTD	P3	01/02/2008 08:32	-52.8589	-40.0969 CTD stopped at 3736 metres wire out.
279	CTD	P3	01/02/2008 09:59	-52.859	-40.0969 CTD recovered.
280	BON	P3	01/02/2008 10:06	-52.859	-40.0969 Bongo nets deployed.
280	BON	P3	01/02/2008 10:35	-52.859	-40.0969 Bongo nets recovered.
281	BON	P3	01/02/2008 10:38	-52.859	-40.0968 Bongo nets redeployed.

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.

303	CTD	M2	02/02/2008 21:40	-52.7269	-40.1471	CTD at 400 metres depth.
303	CTD	M2	02/02/2008 22:05	-52.7269	-40.1471	CTD recovered.
304	RMT8	P3	02/02/2008 23:33	-52.7707	-39.9295	RMT 8 deployed.
304	RMT8	P3	02/02/2008 23:56	-52.7657	-39.955	RMT 8 Recovered
305	RMT25	P3	03/02/2008 00:49	-52.8192	-40.134	RMT 25 deployed
305	RMT25	P3	03/02/2008 02:57	-52.8888	-40.0654	RMT 25 recovered
306	RMT8	R3	03/02/2008 08:43	-52.7147	-39.168	Target fishing
306	RMT8	R3	03/02/2008 09:11	-52.7354	-39.1742	RMT 8 recovered.
307	ATOW	R3	03/02/2008 09:27	-52.7421	-39.1627	PES fish deployed
307	ATOW	R3	03/02/2008 15:37	-52.6515	-39.2906	PES and NOC towfish recovered
308	RMT8	R3	03/02/2008 16:00	-52.6384	-39.2774	RMT 8 deployed for target fishing
308	RMT	R3	03/02/2008 16:29	-52.6583	-39.2903	RMT 8 Recovered
309	NTOW	R3	03/02/2008 16:24	-52.6548	-39.2882	NOC towfish redeployed
309	NTOW	R3	11/02/2008 23:57	-53.6911	-35.2584	NOC tow fish recovered
310	FRRF	R3	03/02/2008 17:21	-52.627	-39.1155	FRRF deployed
310	FRRF	R3	03/02/2008 17:52	-52.627	-39.1155	FRRF recovered
311	GOF	R3	03/02/2008 18:00	-52.627	-39.1155	Go flo deployed
311	GOF	R3	03/02/2008 18:24	-52.627	-39.1156	Go flo @ 904m
311	GOF	R3	03/02/2008 19:06	-52.6269	-39.1155	Go Flo recovered. Moving 3 miles downwind for Mocness.
312	MOC	R3	03/02/2008 19:43	-52.5824	-39.0894	Mocness deployed.
312	MOC	R3	03/02/2008 20:52	-52.6194	-39.1125	2000 metres wire out. Commence hauling.
312	MOC	R3	03/02/2008 22:34	-52.6764	-39.149	Mocness recovered. Proceeding to station position.
313	CTD	R3	03/02/2008 23:10	-52.6268	-39.1153	CTD deployed in 3730m water depth
313	CTD	R3	03/02/2008 23:48	-52.6273	-39.1157	CTD at depth 2000m
313	CTD	R3	04/02/2008 00:34	-52.6273	-39.1157	CTD recovered.
314	MOC	R3	04/02/2008 01:12	-52.5796	-39.1032	Mocness deployed
314	MOC	R3	04/02/2008 02:23	-52.6205	-39.1143	2040m wire out
314	MOC	R3	04/02/2008 02:35	-52.6276	-39.116	Vessel passed through R3 station
314	MOC	R3	04/02/2008 04:05	-52.68	-39.126	Mocness recovered
315	FRRF	R3	04/02/2008 04:09	-52.6809	-39.1263	V/L on DP for FRRF - FRRF deployed
315	FRRF	R3	04/02/2008 04:38	-52.6808	-39.1263	FRRF recovered
316	LHPR	R3	04/02/2008 05:20	-52.6145	-39.0681	LHPR deployed
316	LHPR	R3	04/02/2008 07:33	-52.6395	-39.1851	LHPR recovered. Proceeding to station for CTD.
317	CTD	R3	04/02/2008 08:10	-52.6267	-39.1148	CTD deployed. EA600 depth 3730 metres.
317	CTD	R3	04/02/2008 09:17	-52.6273	-39.1153	CTD at depth. Commence hauling.
317	CTD	R3	04/02/2008 10:41	-52.6272	-39.1152	CTD recovered.
318	BON	R3	04/02/2008 10:47	-52.6272	-39.1152	Bongo nets deployed.
318	BON	R3	04/02/2008 11:16	-52.6272	-39.1152	Bongo nets recovered
319	BON	R3	04/02/2008 11:18	-52.6272	-39.1152	Bongo nets deployed.
319	BON	R3	04/02/2008 11:51	-52.6272	-39.1152	Bongo nets recovered
320	BON	R3	04/02/2008 11:56	-52.6272	-39.1152	Bongo nets deployed.
320	BON	R3	04/02/2008 12:06	-52.6272	-39.1152	Bongo nets recovered
321	MON	R3	04/02/2008 12:14	-52.6272	-39.1152	Mini bongo deployed
321	MON	R3	04/02/2008 12:41	-52.6272	-39.1152	Mini bongo nets recovered.
322	MON	R3	04/02/2008 12:45	-52.6272	-39.1152	Mini bongo nets deployed.
322	MON	R3	04/02/2008 13:19	-52.6272	-39.1152	Mini bongo nets recovered.
323	MON	R3	04/02/2008 13:22	-52.6272	-39.1152	Mini bongo nets deployed.
323	MON	R3	04/02/2008 13:51	-52.6272	-39.1153	Mini bongo nets recovered.
324	CTD	R3	04/02/2008 14:02	-52.6272	-39.1152	CTD deployed to 400m
324	CTD	R3	04/02/2008 14:10	-52.6272	-39.1152	CTD @ 400m
324	CTD	R3	04/02/2008 14:29	-52.6272	-39.1152	CTD recovered
325	LHPR	R3	04/02/2008 14:59	-52.6626	-39.174	LHPR Deployed

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.
333	MON	R3	05/02/2008 09:05	-52.6275	-39.1164	Mini bongos recovered. Ship proceeding 3 miles 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.
350	XBT	R4	06/02/2008 19:37	-50.4664	-34.1562	XBT deployed at beginning of second transect. Course 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.
355	XBT	R4	06/02/2008 22:11	-50.5832	-33.9097	Complete XBT deployment. Turning head to wind for 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]

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

386 ACO	03/01/2008 21:40	-60.5332	-48.6812	End of transect
386 ACO	03/01/2008 22:11	-60.612	-48.5951	Begin second leg of transect along course 060(T)
386 ACO	04/01/2008 00:55	-60.3881	-47.8082	Complete Transect
387 ACO	06/01/2008 19:31	-60.3158	-44.9517	V/l passes waypoint 1 of C2 on course 090 at 10.0kts
387 ACO	06/01/2008 21:16	-60.3152	-44.3661	Course altered to approx. 055T for pack to the east.
387 ACO	06/01/2008 21:56	-60.2538	-44.1867	Resume transect along course 090 at 10.0kts
387 ACO	06/01/2008 22:54	-60.253	-43.863	End of transect
388 ACO	06/01/2008 23:37	-60.2084	-43.8629	Commence Acoustic transect @ 10.0kts
388 ACO	07/01/2008 02:53	-60.2081	-44.9481	Complete Transect
388 ACO	07/01/2008 03:02	-60.208	-44.9825	A/C to 360degrees @ 5 knots
388 ACO	07/01/2008 03:07	-60.2053	-44.9944	Turn complete
388 ACO	07/01/2008 03:42	-60.1171	-45.0081	Reduce to 5 knots
388 ACO	07/01/2008 03:48	-60.106	-45.0076	A/C to 090 degrees
388 ACO	07/01/2008 04:03	-60.0989	-44.9488	Commence transect 3 of mesoscale survey at 10 knots
388 ACO	07/01/2008 07:17	-60.1004	-43.8666	End of transect 3. Reducing speed to 5kts for turn.
388 ACO	07/01/2008 07:24	-60.1003	-43.8404	Commence turn to the north at 5 knots
388 ACO	07/01/2008 07:33	-60.0916	-43.8279	Complete turn. Increasing speed to 10 knots.
388 ACO	07/01/2008 08:11	-59.9984	-43.8111	Commence turn at 5 knots towards next transect.
388 ACO	07/01/2008 08:27	-59.9928	-43.8717	Commence transect 4 at waypoint 7. Course 270T. Speed 10 knots.
388 ACO	07/01/2008 11:43	-59.9929	-44.9489	Complete Transect
388 ACO	07/01/2008 13:30	-60.2081	-44.9498	Commence Acoustic transect @ 10.0kts
388 ACO	07/01/2008 16:05	-60.208	-44.0807	V/l nearing ice edge. Slow to 2 knots for recovery of PES tow fish
388 ACO	07/01/2008 17:05	-60.1589	-43.8605	End of mesoscale survey
389 ACO	13/01/2008 14:43	-59.9994	-44.0448	commenced transect
389 ACO	13/01/2008 17:24	-59.6833	-44.6724	End of transect 1
389 ACO	13/01/2008 17:27	-59.6774	-44.6845	UOR @ 30m flight
389 ACO	13/01/2008 17:32	-59.6703	-44.6979	V/L @ 5 knots
389 ACO	13/01/2008 18:16	-59.5931	-44.5644	Commence turn to starboard @ 5 knots for transect leg 2
389 ACO	13/01/2008 18:29	-59.6055	-44.5249	Commence leg 2 of acoustic transect @ 10 knots
389 ACO	13/01/2008 21:22	-59.924	-43.8935	Ship passes waypoint 4. End of second transect. Reducing speed to 5 knots for turn.
389 ACO	13/01/2008 21:33	-59.929	-43.8687	Turn completed. Increasing to 10 knots.
389 ACO	13/01/2008 22:11	-59.8675	-43.7152	Commence turn towards transect 3
389 ACO	13/01/2008 22:29	-59.8475	-43.7428	Commence 3rd. transect. Course 315T. Speed 10 knots.
389 ACO	14/01/2008 01:15	-59.5287	-44.3732	Transect Complete
389 ACO	14/01/2008 02:32	-59.4536	-44.2203	Commenced acoustic transect
389 ACO	14/01/2008 05:16	-59.7705	-43.5971	Complete transect leg 4/ A/C to 045degrees
389 ACO	14/01/2008 06:00	-59.6976	-43.4378	Commence transect leg 5
389 ACO	14/01/2008 08:43	-59.3786	-44.067	End of transect. Course altered to 227T.
389 ACO	14/01/2008 10:01	-59.5307	-44.3687	Commence repeat of middle transect in south easterly direction.
389 ACO	14/01/2008 12:45	-59.8476	-43.7423	Complete Transect
390 ACO	17/01/2008 17:25	-58.3358	-42.9673	Commence leg 1 of mesoscale survey
390 ACO	17/01/2008 20:08	-58.0171	-43.5699	Complete first transect. Reduce speed to 5 knots for turn.
390 ACO	17/01/2008 20:17	-58.0053	-43.592	Course altered to 045T.
390 ACO	17/01/2008 21:00	-57.9285	-43.4622	Commence course alteration to 135T.
390 ACO	17/01/2008 21:13	-57.9407	-43.427	Commence second transect. Course 135T. Speed 10 knots.
390 ACO	17/01/2008 23:56	-58.2562	-42.8311	Completed transect.
390 ACO	18/01/2008 01:09	-58.1855	-42.6773	Commenced transect.
390 ACO	18/01/2008 03:50	-57.8648	-43.2811	Complete transect leg 3
390 ACO	18/01/2008 04:38	-57.7874	-43.1401	Commence transect leg 4
390 ACO	18/01/2008 07:20	-58.1053	-42.5424	End of transect. Reducing speed for PES fish deployment.

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