JB11:

RRS John Biscoe
South Georgia
Marine Biology (OBP11)
January 1991 - February 1991

JB11 Cruise Report

Introduction

Cruise JB11, the final biological cruise of RRS John Biscoe, was a 30 day multidisciplinary cruise around South Georgia. Projects covered biogeochemistry, and zooplankton, krill, fish and squid ecology. As in previous years, specialists from several other institutes joined BAS personnel for the cruise. Certain of the projects undertaken built on previous work around South Georgia in cruises JB6, JB7, JB8 and JBlO. Other work, such as studies on the vertical distribution of squid, broke new ground using new equipment.

The cruise was organized around a series of sampling modules for each main discipline. There were three 3-day squid stations at the Antarctic Polar Frontal Zone (APFZ) southeast of the Falkland Islands, northwest and southeast of Bird Island respectively. There were five 2½-day fish stations off Possession Bay, Cumberland Bay, Stmmness Bay, Bay of Isles and Royal Bay. There were two zooplankton stations off Bird Island, one in oceanic water and one on the shelf. In addition krill sampling periods usually of 1 day duration, were interspersed through the cruise. These modules were arranged so that there was time for analysis between sampling periods of any one discipline. This arrangement also had the advantage of spreading the work load for each group through the cruise. The provisional itinerary was modified a number of times during the cruise; the final itinerary is shown in appendix I, the cruise track is shown in Fig.1.

Project objectives.

Biogeochemistry: (1) organic biochemistry - the main aim was to identify biomarkers in phytoplankton and zooplankton and to estimate transfer of pigments and pigment products in the food chain of the Southern Ocean.(2) physical oceanographic studies - in addition to supporting other projects the main aim this year was to locate, delineate and characterise the Polar Front to the souteast of the Falkland Islands. Vertical sections across the front enabled the type and vertical extent of the water masses to be determined and it should also be possible to calculate current strength and mass transport.(3) nutrient chemistry - in addition to mapping the Polar Front (see 2), continuous silicate and nitrate horizontal profiling in search of nitrate holes first found on JB10 were carried out. Some vertical profiles were also undertaken as well as supporting other projects on the cruise.(4) protozooplankton ecology - here the main aim was to determine grazing rates in waters surrounding South Georgia by dilution and fluorescently labelled bacterial assays.(5) measurement of microbial respiration rates - the aims of this study were to quantify the temperature coefficient of communtiy respiration rates from a number of different areas, to obtain *in situ* rates of gross and net community production and respiration and to characterize the horizontal and vertical distribution of dissolved oxygen and carbon dioxide.

Cephalopod biology; there were two objectives on this cruise. (1) to sample the vertical distribution of juvenile pelagic cephalopods in relation to the hydrological structure of the water column at the APFZ and the South Georgia shelf break (SGSB). (2) to sample the vertical distribution of the nektonic community, particularly with respect to the biomass spectrum, at the same geographical locations. The research was carried out on a collaborative basis with Martin White (MGW,BAS) and Uwe Piatkowski (UP, Institut Fur Meereskunde, Kiel, F.R. Germany).

Ichthyoplankton studies: two major projects were undertaken during (JB11. (1) an investigation of the abundance of larval fish in relation to distance from the northern coast of South Georgia (2) a study of fish as components of the mesopelagic community. In addition, a number of secondary studies were also undertaken as follows: to compare the sire class of '0' group *Champsocephalus gunnari* at Shag Rocks and *South* Georgia, to collect endoparasites from adult demersal fish, also to collect otoliths from mesopelagic fish for squid diet analysis and from postlarval fish for daily growth studies.

Krill ecology: four projects were planned for this cruise. (1) Instantaneous growth rates (IGR) experiments on freshly caught live krill were carried out to determine the moult and growth rates. The intermoult period

interval calculated from this study will be correlated with rates calculated from moult stage analysis using the technique developed by Buchholz (IFM, Kiel). (2) the velocity of sound through krill and other pelagic organisms was investigated to calculate theoretical acoustic target strengths of animals using published scattering models. (3) data on acoustic biomass and distribution of krill was assessed during passages, net hauls and when searching for krill. (4) photogrammetric studies on krill swarms were planned to obtain information on swarm structure in relation to swarm density and in particular data on tilt angle of free-swimming krill for use in target strength determination. In addition to these projects live krill were captured for a project on biochemical flux in the Antarctic food web.

Pytoplankton-zooplankton biochemical flux studies; this study focused on the biochemical composition of Antarctic marine phytoplankton and the changes brought about by grazing by Antarctic krill. This utilised an inventory approach, characterising the composition of the animal, its food, gut contents and faeces. Crude grazing experiments were undertaken.

Acoustics; dual frequency acoustics was used to investigate the technique of identifying organisms in the water column from their acoustic signature and in particular the different frequency response shown by animals of different sires. Net hauls with the LHPR and RMT were used to validate the acoustic observations. Predator observations during acoustic transects were also undertaken to derive fine-scale data on predator-prey relationships.

Zooplankton this year work concentrated at the shelf and oceanic stations worked last year during cruise JBlO. The overall aims were to provide a fine scale picture of the vertical distribution of zooplankton at both stations using the PML Double LHPR aud to estimate grazing activity of the dominant species of copepod. The latter was carried out through the collection of live animals with vertically hauled ring nets and by bottle incubations.

Cruise narrative

Tuesday 8 January: Science complement joined ship in Stanley.

Wednesday 9 - Thursday 10 January: OBP team unloaded cargo cage and two 20' containers of equipment sent by sea freight.

Friday 11 January: RMT25 net swung out into position aft of gantry. Ship sailed at 1600 for squid station at APFZ

Saturday 12 January: Trial RMT25 haul carried out successfully once ship south of Burdwood Bank.First CTD took place to north of convergence to characterize subtropical water.

Sunday 13 January: Arrived at site for second CTD (58°S 55°W) which was south of convergence. Ship then returned to area of convergence to carry out first RMT25 at squid station number 1.

Monday 14 - Wednesday 16 January: Fishing at squid station (57°8'S 55°14'W) with RMT25 continued. Net worked well although one catch never entered cod-end because recovery ropes strangled net. Generally net catching plenty of fish and large decapods such as Nematocarcinus sp, Acanthophyra sp and the mysid Gnathophasia gigas as well as squid

Recovery of net photographed from Gemini by Chris Gilbert (CG) and samples of water, phytoplankton and zooplankton collected using water bottles and vertically hauled nets (PNETs and ZNETs). Itinerary modified so that a CTD carried out at convergence for Carolyn Symon (CS) as well as a CTD halfway along the RMT haul transect.

Final night-time RMT25 haul completed by 0200 on Wednesday, followed by shallow CID (1000 m). Ship sailed for Shag Rocks at 0415

Thursday 17 January: On passage to Shag Rocks, echo-sounder showing diffuse but extensive marks on chart which turned out to be *'Phaeocystis' type* flagellates and salps when fished with RMT8+1.

Friday 18 January: RMT8 just NW of Shag Rocks to collect fish larvae undertaken at 0100. Then continued towards South Georgia, heading for position (53°22' S 39°12'W). Ship ran down transect used on previous OBP cruises to position (53°48' S 38°22' W). Only a few marks on echo-sounder and nothing identified as krill. Ship sailed over area where large krill swarm detected last year but nothing seen on echo-sounder this time.

By evening ship to NE of Bird Island target fishing for live krill. Two RMT8 hauls and a FNET produced few krill but plenty of *Themisto guudichuudi.* A total of 4 live krill caught in evening's work!

Saturday 19 January: Carried out acoustic search on grid extending out from Bay of Isles. Two faint layers were observed on echo-sounder, the lower layer comprised a mixture of *T. gaudichaudi, Euphausia frigida, Thysanoessa sp* and *Rhincalanus gigas* while the upper layer was just *T. gaudichaudi.*

Ship returned to station 4 miles off Possession Bay to carry out CTDs, water bottles, PNETs and ZNETs before starting the first fish station at dusk.

A series of three RMT8+1M hauls were completed during hours of darkness for first fish station. Many fish larvae were caught but these were mixed in with thousands of *T. gaudichaudi* so sorting was not easy.

Sunday 20 January: After finishing RMT hauls an Agassiz trawl was fished twice to collect fish, octopus and brittle stars. After this an acoustic run out from Possession Bay towards the shelf-break and deep water (>1000 m) to look for krill was undertaken with concurrent predator observations. Unfortunately nothing krill-like was seen on the echo-sounder apart from one tiny spike. So after crossing shelf-break at 1340, ship returned to position 12 miles off Possession Bay. Here we carried out a CTD ZNET and water bottle cast before starting the night-time series of RMTs for fish station 1. As expected the hauls contained fewer larval fish but unfortunately just as many *T. gaudichuudi.*

Monday 21 January: Midnight and predawn RMTs took longer than expected and the second and third nets of the predawn RMT were actually post-dawn. Weather not ideal for an extended zig-zag transect to Bird Island via the shelf-break and so replaced with a transect at 8 knots along the shortest route to position of the zooplankton station (53°48' S 38°22' W). Arrived on station in time to start first ZNET at midday. This was followed by a CTD before embarking on a mammoth series of ZNETs - one every 2 hours for 24 hours. Copepods collected in this series were utilized for feeding experiments or determination of gut fullness.

Tuesday 22 January: Series of ZNETs continued until 1400. Weather remained reasonable and wind moderate. A CID and water bottle cast to collect samples for David Pond (DP) preceded two horizontal LHPR hauls to look at the fine scale distribution of zooplankton in the area. At dusk started collecting water for a rig deployment using CTD with Niskin bottles and a total of nine 30 litre Go-Flo bottle casts. This was completed in time to deploy the double LHPR in an oblique haul at midnight. Unfortunately power pack cut out when the net was at 80m. When power was restored after 20mins the winch brake remained jammed on for another 5 mins. While this ruined the net descent, a good set of samples was obtained on the net ascent.

Wednesday 23 January: Weather still holding and barometer steady so *in situ* rig consisting of sediment trap and six frames holding bottles for oxygen and protozoan production deployed at dawn. Rig deployed very smoothly considering it was first time for many people. It was much easier to attach frames to wire with karabiners rather than with bolts as was done last year.

A ZNET sample taken at 0530 before starting a clover-leaf search with 3 mile legs to look for fishable targets for Lauro Madureira (LM). Each time passed through centre-point of grid the buoy of rig passed within a couple of hundred metres of ship.

By 1000 weather deteriorated rapidly, wind changed direction and increased with result that rig drifting to south at over 0.5 knots. By 1030 decided that probably better to recover rig now rather than leave it out as planned. Alternative option of leaving rig in until wind and increasing swell decreased seemed less viable given direction of drift.

Rig recovered under very trying conditions with faultless performances from ship's officers and deck crew. Several frames had become entangled around wires, and in two cases the karabiners had managed to become unclipped from shackles while still remaining attached to wire. (How this could possibly have happened remained a mystery until several days later when Helen Hill (HJH) demonstrated how a twisting motion could losen gate and spring latch!). All frames recovered but unfortunately no sediment trap attached to bottom of wire. When rig launched, wire already had shackle and swivel attached to receive trap. So trap shackled on below swivel. Only explanation is that top shackle either broke or came undone. Unfortunately these shackles had not been seized (I do not think they were seized last year either?).

After premature rig recovery, some ZNETs and water bottle casts were undertaken. It was then decided to make a slow speed run north west from the station towards proposed site for zooplankton station 2 (last year's station 6,53°22' S 39°12' W) because the weather was not suitable for any other activities. However, weather deterioated further and by evening ship was hove-to only a few miles from our starting position.

Thursday 24 January: By first light weather moderated sufficiently to consider getting back on station. At 0500 set off to steam back to zooplankton station, arrived at 0800. Weather conditions were suitable for a ZNET and a CTD but still not good enough for an LHPR. Waited until 1100 but when conditions still not suitable for LHPR steamed off to Stromness fish station via Bird Island and coastal route. Arrived at position 4 miles off Stromness Bay in time to start fish station but now a day ahead of schedule because krill searching and fishing out at zooplankton station postponed. Will insert krill fishing after fish station. Calibration will also take place a day earlier than planned.

Friday 25 January: Three multiple RMT8s fished through night with a good selection of fish larvae caught. After last RMT a shallow CTD fitted in while the Agassiz trawl was readied for operation. Spent considerable time discussing best way to moor ship for calibration. Both Leith and Stromness buoys considered as well as mooring off jetty in a Mediterrean style. Decided that Leith preferred because of presence of vessel Thrusk alongside jetty at Stromness.

By 0645 steaming into Leith to look at conditions at buoy. Although wind strong (20-30 knots) water calm and ship steady on bowthrust. Mooring went ahead, laying out both anchors about 1.2 cables inshore of buoy and then dropping back to tie stem ropes onto buoy 50' astern. Ship very stable and ideal for calibration.

Calibration started after breakfast. There was great difficulty finding a reasonable peak value on 38 kHz sounder, therefore tried 120 kHz. We found the centre of the beam very quickly although peak value was lower than last year (took a while to remember that peak value depended on sphere depth!). Sounder and integrator calibration for 120 kHz finished by 1500 and returned to 38 kHz. Decided to put off departure time from bay until 1800, rather than at 1630, by postponing CTD until tomorrow but to no avail. By 1730 signal from 38 kHz still an order of magnitude lowerthan expected although obtained good bottom signal. Finally admitted defeat at 1745 and sailed out to fish station 12 miles off Stromness Bay.

Again managed to start fish hauls by darkness and found some krill mixed in with fish larvae. DP managed to get a few live krill from one net.

Saturday 26 January: The last net of the third RMT8 fished during the night fished during daylight. Fewer fish larvae at this off-shore station. After RMT managed CTD four large water bottle casts aud a ZNET before starting an acoustic survey.

Survey ran from fish station NNE out to just beyond shelf break (>1000 m) and then zig-zagged eastwards over shelf break, going from >1000 m to < 200 m on each leg. Uncomfortable steaming due to beam or quartering sea Wind gott up during day so that conditions were not good for fishing although a few small swarms were seen on the shelf break in conjunction with some feeding fur seals (behaving suspiciously as LM put it).

Saw a trawler about 20 miles off Cumberland Bay at 1200. Transects finished by mid-afternoon and conditions deemed too bad to fish out at sea, so decided to return to area off Stromness to fish for live krill during night.

Nothing much on echo-sounder so fished blind hoping to catch dispersed krill. Around Stromness caught mainly ctenophores with just a few krill

Sunday 27 January: Fished RMTs through night while moving slowly NW towards a position off Possession Bay. Managed a few live krill, at least enough for an experiment for DP.

Set up acoustic survey to run out to squid station 2 just off shelf-break near OBP10 station 4.

At 1400 LM saw faint small traces on the echo-sounder at 40 m as we crossed shelf-break on a zig-zag course. Fished RMT but only caught a few *T. guudichaudi* and copepods. After this haul changed over to RMT25 ready for evening's squid fishing.

Squid fishing did not start as planned because of large swell.

Monday 28 January: By dawn conditions improved considerably although still a somewhat confused swell. Ship positioned 12.5 miles from station with wind from south. Fished deep hauls (600-800; 800-1000 m), but while first net worked correctly there were problems with opening and closing the second net. Net had to be hauled to 400 m before it responded to commands and opened. Fished down to 600 m but had to haul to surface open because could not close net. Length of tow longer than expected and so altered ship's course to keep away from shelf. Ended up towing net across wind which worked well as sea conditions were improving all the time. When net inboard over six hours of sampling had produced one usable sample.

Second haul also only had one usable sample as recovery ropes twisted around cod-end of second net. By the end of the day we were attempting the third RMT25 haul. Still found time for a ZNET for Angus Atkinson (AA) in afternoon.

Tuesday 29 January: Night-time RMT25 up by 0100 and ship repositioned in an hour, however, again only one net sample usable. Next net fished one night-time horizon and then left in water until after dawn so that second net used for a daytime sample. This last haul caught a good number of fish and squid with *Euphausia triacantha* dominating the invertebrate catch. A few *E. superba* also caught in net.

Next net fished after miday but again there were problems getting the net to respond to commands (only 1 net usable). Decided to take CTD and a series of water bottle casts to give Doug Bone (DGB) time to sort out the net monitors. Still working on net release gear at midnight. Considered extending this squid station at expense of squid 3 station.

FNETs fished by Geoff Cripps (GC) caught *E. superba and T. guudichaudi.* DP set up first grazing experiment in chest freezer and all seems to be going well on that front although a few more krill would help. Fish team busy analysing samples from RMT25. LM and Mick Whitehouse (MJW) observed large flock of feeding birds and seals coincident with definite swarm on the echo-sounder earlier in day. First reasonable swarm detected.

Weather continued good with winds below 20 knots and low swell. Ideal for RMT25 because towed in all directions which minimized re-positioning time after 5-6 hour tows.

Wednesday 30 January: DGB, Stuart Bell (SAB) and Steve Bremner (SFB) overhauled release gear that had a few faults although none seemed to account for original problem. Net in water and fishing by 0300. DP and HJH were successful with FNET hauls catching over 40 live krill. First grazing experiment going well and krill alive and kicking.

Net worked well and decided to allocate extra 24 hours from squid 3 to fish this station properly. Paul Rodhouse (PGKR) prepared to use squid 3 as an opportunity to experiment with net and get some samples rather than investigate the biomass spectrum of the water column.

Day-time hauls completed by 1400 although net was reluctant to close at first (at 1000 m), it yielded on hauling to 950 m. Wind now increased to 30 knots. A CTD for Carol Robinson (CR) and a series of water bottle casts were carried out before starting the last evening haul with the RMT25.

Evening haul fished successfully although again had to haul from 1000 m to 950 m before last net would close. Net on deck by midnight and PGKR and UP walking around with big smiles after successfully completing station.

Thursday 31 January: HJH and DP tried some FNETs with a light rigged out on a boom over the side. Tony North (AWN) and Jon Watkins (JLW) tried more after ship moved closer to shelf. Best catch about 50 krill and 1 squid (with the lights off). However, only a few krill from each net survived although there were a number of live ***Notothenia neglecta*** **and N.** ***rossi.*** Strong wind and swell so fished later FNETs down wind to try to get more live animals.

0By 0345 started acoustic run from station out to SW. Quite a big sea and put off moving RMT25 until daytime. Conditions improved through morning and RMT25 replaced with RMT8. Some echoes that registered on both echo-sounder frequencies suggested krill.

Received fax from Inigo Everson on Falklands Protector, he found large quantities of krill in fish stomachs off Cape Charlotte, to east of us.

LM & co fished RMT8 in afternoon through some interesting deep targets. Caught four myctophid fish and one squid.

Started krill fishing after dark, a few krill were caught in six FNETs before midnight but because of a large swell they were in poor condition when put in the tanks.

Friday 1 February: Continued fishing for krill with FNET until dawn and found around 10 krill per net. After dawn set short acoustic run to end at JB 10 station 6 to start oceanic zooplankton station at 1100.

Fishing on station started with double LHPR haul to 500 m. In the following CTD cast three bottles were damaged when the winch driver brought the CTD up to the platform without waiting for clearance from the laboratory. More CTDs interspersed with ZNETs for AA taken through afternoon.

From dusk to midnight 15 large water bottles taken to get water for CR and Ray Leakey (RJGL) for rig.

Saturday 2 February: Midnight oblique double LHPR haul to 500 m fished without incident. ZNET for AA changed to simple water bottle and so completed quickly.

By 0230 started to get rig ready for deployment. All shackles secured with cable ties! Rig went over with minimum of fuss and all finished by 0400. Waited about an hour while LHPR readied for deployment then off on an acoustic run towards shelf-break. Once picked up shelf-break ran along towards east. Fished LHPR on faint marks just prior to lunch but when it came back on board net was ripped and 1 gauze was missing! Later in afternoon encountered shallow area with large flock of birds feeding. Echo-sounder

showed swarms below. LHPR fished and caught some krill (largest to date). After fishing LHPR ship headed back towards zooplankton station to carry out LHPR haul and recover rig.

Rig seen on radar at about 6 miles from station. It had drifted only a couple of miles SW since being dropped 20 hours earlier.

Sunday 3 February: Arrived within 4 miles of station at 0200 and towed LHPR towards station. Rig tracked on radar in dense fog. Low visibility delayed rig approach untilfirst light. Due to calm sea ship approached to within a couple of 100 m of rig before it was lost fromthe radar.

Rig recovered with no problems in calm conditions and just after 0400 first of day's CTDs went over. Water bottle rosette giving problems in water although worked well in the lab. By 0500 starting 24 hour series of ZNETs and CTDs. Pairs of ZNETs from 140-70 m and 70-O m every 1.5 hours were undertaken with CTDs and water bottle casts interspersed at intervals for the first 12 hours. For the last 12 hours the deck crew launched a pair of ZNETs every hour. Everyone bored with ZNETs by end, especially winch drivers, but fortunately weather remained good.

Monday 4 February:Finished last pair of ZNETs and station at 0450. Then steamed to area where feeding flocks of birds found yesterday. Time for a short search and a single LHPR haul. Unfortunately few krill around and best indication occurred as net being recovered at end of haul.

Set sail for Leith and mid-season break, arrived at 1700. Tied up at main jetty of whaling station for 24 hours.

Tuesday 5 February: Various groups up early (0300) to go walking. Rain early on cleared by 0900 so glorious for all those out during middle of the day.

Power down on ship from 1400 and not restored until later than expected. Ship did not sail until 2100 and so fish station 4 miles off Cumberland Bay started late. Tween decks filled with wood for Jerome Poncet, as a result it is much harder to reach the -60°C deep freeze and packing up will be harder. Sharp edges of metal sheet wrapped over the wood will cause a number of gashes to peoples legs over the next couple of weeks!

Wednesday 6 February: Large numbers of fish larvae caught at station off Cumberland Bay. One net contained over 2 litres of almost pure fish larvae. This was the first time that the fish team sub-sampled without reluctance! Last RMT haul of night took place during morning because of last night's late start CTD at station before moved into Cumberland Bay for a daylight haul.

Wind and swell increased so that Hobart Rock not suitable place to repeat acoustic calibration. Therefore steamed to Leith and anchored on buoy. In spite of fore and aft mooring, ship swinging significantly when calibration started at midday. Eventually foundthat problem with 38 kHz sounder was a defective 20 log R gain amplifier board. Calibrated 38 kHz with both boards and also repeated the 120 kHz sounder calibration before left at 1900 for fish station 12 miles off Cumberland Bay. Still managed to start fish station more or less on time.

Thursday 7 February: Successful night's fishing at offshore station, 12 miles out from Cumberland Bay. Good fish catches and also some krill. First net of third haul caught over 800 krill although other nets of this haul, fished after dawn, contained mainly ***T. gaudichaudi.*** After CTD at station arranged acoustic runs for LM to fish with LHPR. Started off in area of station and fished with little success. Captain very keen to help increase success rate of LHPR fishing by doing whatever we wished e.g. turning with net in water to try to hit a target a second time.

Proceeded towards east where a good bank with steep shelf on east side (east of Cumberland Bay at 54°l0' S 35°40' W). LHPR fished and krill found. As night approached, LHPR jammed with krill. Many krilI were

still alive in recorder box and DP extracted hundreds for his experiments. After dark tried FNETs but krill did not rise to surface and some shallow swarms were seen on echo-sounder.

Friday 8 February: Fished for live krill very successfully in night. Two swarms detected on echo-sounder were fished several times and litres of krill caught on each occasion. Had to set up third krill tank on after deck to cope with catches. AWN and PGKR not happy as fish and octopus moved from one tank to another.

After RMTs changed over to LHPR and continued fishing krill swarms, jammed LHPR again in process. A small acoustic grid search for JLW and Alistair Murray (AWAM) broken off when more tempting targets appeared. Unfortunately LHPR failed to connect with swarm even though ship turned through 180° while net in water. Continued acoustic survey, zig-zagged across east side of bank until at 1030 had to leave to steam to Bay of Isles fish station. Time for an LHPR for LM on route.

Saturday 9 February: Fished RMT8 at fish station 3 miles off Bay of Isles. Rig today but have had to change times of deployment to get everything in. CTD for fish team followed last RMT which again caught krill.

Steamed to position 12 miles off bay where we collected water for rig. While CR and RJGL processed water samples ship moved to a shallow bank to east where two Agassiz trawls for specimens for MGW.

At 1030 rig deployed amid jokes about what a beautiful dawn. After deployment spent rest of day on acoustic runs and target fishing interesting echo-sounder indications for LM and JLW. Arrived back at position 12 miles off Bay of Isles by 1820 for CTD prior to starting post-dusk haul for fish team.

Sunday 10 February: Successfully completed RMTs for Bay of Isles offshore station. For once last haul actually pm-dawn rather than post-dawn haul. Plenty of krill in last fish haul and needed to subsample. Time before collected rig spent on acoustic grid around station. Fished LHPR once on good swarm indications.

Alongside rig by 1030 and recovered successfully but RJGL's frame had fallen off - 6 mm wire sheered through and one plier-tightened karabiner missing! After retrieval of rig took ZNET for AA before leaving to return to area east of Cumberland Bay where krill found previously.

One LHPR fished on route during glorious afternoon with sun and little wind. On arrival at bank, two more LHPRs target-fished at krill swarms although first net did not wind on properly. By midnight finished with LHPR and ready to use RMT.8 to catch live krill.

Monday 11 February: Krill fishing for live animals started slowly, swarms seemed to have disappeared. Needed three runs over slope before located krill swarms but net only caught ***T. gaudichaudi.*** A zig-zag search and a quick turn to launch the net over the second krill swarm produced a good haul and extra hands called to help pull up cod-end.

A third RMT after dawn caught only ***T. gaudichaudi.*** again. Took water bottles and a ZNET before repeating zig-zag transect down edge of bank.

While ship stationary after transect, two Southern Right whales observed and ship edged closer to them. Whales circled ship for a couple of hours while everyone took pictures. Continued with acoustics until time to steam in towards position of final fish station 12 miles off Royal Bay. Collected water for rig deployment tomorrow before started fish station at dusk.

Tuesday 12 February: Encountered problems with RMT release gear during night. Net 2 did not fish properly but still got good catches of krill and fish larvae. After finished last RMT put rig into water although few miles from where water collected. Then deployed CID at fish station before took two Agassiz trawls as steamed in direction of yesterday's bank.

By 0800 started CTD grid on slope of bank where krill fishing and surveying has been concentrated over last few days. Started with 3 CTDs on each of two transects but results looked so good that extended to a third transect. Finished grid at 1300.

Managed two LHPR hauls before departed to pick up rig successfully at 1800 and then proceeded to last fish station 3 miles off Royal Bay.

Monday 13 Februay: Only managed two hauls through the night because both net monitors played up. The normally reliable J50 stopped working first and in the process of hying to fix it a multimeter and monitor tester stopped working! In desparation DGB tried J15 which gave a great signal but wouldn't open or close nets. So last haul became just one net fished down and up, down and up. Fortunately lots of fish and some krill were caught.

Not enough time for third RMT so deployed CTD took water bottle sample, ZNET and de-rigged RMT8 ready to swing RMT25 into position. Then set off to steam to squid 3 via southern end of South Georgia. Route close inshore abandoned because of poor visibility and in mid-morning ship steamed flat out at 10.5 knots into 40 knot head wind. However by afternoon sea calmed and made good time to arrive at squid station to start fishing before dusk.

RMT25 towed at 2.5 and 3.5 knots. Decided to tow other nets at 3 knots and a series of depth horizons allocated.

Thursday 14 February: Day spent fishing with RMT25 at squid 3 on knoll with depth 2000 m SW of Bird Island. Also found time for water bottles for GC and DP plus a CTD Several of the nets strangled and so did not fish properly. Only a couple of squid caught at the entire station, however, plenty of fish for MGW and AWN. AA made a bid for last event of cruise to be a ZNET!

Friday 15 February: Final RMT25 in at 0230 and so ready to leave for Stanley. Decided to leave RMT25 outside gantry until ship pitching less. Now only activities to undertake are a couple of CTDs for CR and packing. Team off rostered watches at 1200.

Saturday 16 February: Still many people who have been on nights up at 0300/0400 - eating toast as usual. Due to cross convergence around 0900 but ship slowed by lumpy sea and so CTD delayed and delayed until 1400. CTD winch not taken out of gear before taking a water bottle sample and so wire stretched around deck head and conductor broken. Opportunity taken to bring RMT25 inboard and de-rig but still too bouncy for much work in 'tween decks.

Party /darts match in evening in crew bar. Fids won!

Sunday 17 February: Arrive Stanley at 1800. Plenty of activity packing as weather improved. Followed by tea and biscuits at 1500 and sun-downers before dinner.

Monday 18 February: At 0600 alongside Black Pig and wood unloaded. Steamed up to **FIPASS at 0930.**

Day spent packing and on cargo. Rumour that Bransfield drifting without power towards Signy but later heard that power restored. DP will now stay on ship to look after krill so gets his peninsula trip.

Tuesday 19 February: In morning unloaded all OBP cargo and stored in FIPASS. In afternoon unloaded containers with Faraday and Signy equipment and stowed on board. Four of team flew back to UK.

Wednesday 20 February: Day off for most people with Biscoe's farewell dinner dance in evening.

Thursday 21 February: Rest of OBP team flew home to UK, arrived at BAS by early afternoon despite the bus breaking down

Individual accounts and preliminary results of major projects

Biogeochemistry

Organic biogeochemistry (GC) - Water, particulates and zooplankton were sampled using Go-Flo bottles, ZNET, PNET, RMT and the 3 m seawater inlet. All the samples were stored at -60°C for later analysis by Capillary GC and HPLC in Cambridge for pigments, pigment degradation products and aliphatic biomarker compounds. Using these compounds the interactions between species, food/prey and environment will be studied. At 6 out of the 10 stations a complete sample programme was achieved, i.e. a number of different zooplankton species, depth profile of particulates and surface particulate size fractionation from the same water body were obtained.

Water samples were filtered through 0.7 pm ashed glass fibre membranes and extracted with 'SeppaK' Cl8 cartridges, the cartridges were then stored for analysis in the UK. Particulates were sampled using water from 100,75,50,25,10 and 3 m depths on 0.7 µm membranes, the 3 m samples were size fractionated at 0.7,2.4 and 20 pm. At two stations the >20 pm fraction was prefiltered at 100 and 200 pm. The FNET was used to obtain zooplankton samples in the best possible condition from which animals were frozen separately (mainly ***Euphausia superba).*** Bulk samples were taken from RMT hauls. At three stations a clean RMT haul with a number of different animals was sampled for species interaction and particulate grazing studies (c.f. phytoplankton and sediment trap samples). In addition, environmental samples of water, particulate and shoreline sediment were taken in Leith Harbour and Stromness Bay to be monitored for hydrocarbons. In total 8 depth profiles and 11 surface fractionations were carried out; samples were taken from 6 FNET, 7 ZNET and 13 RMT hauls.

A number of events caused problems for this project. The 20µm mesh PNET was damaged beyond repair as a result of careless handling on deck and only made three hauls. The surface film sampler remained safely in its package; few 'real' opportunities arose to deploy it. The firing of Niskin bottles from the rosette was found to be unreliable by 'squid 2', profiles were subsequently carried out with 5 litre Go-Flo bottles which luckily were on board. The small freezer in the hydrographic laboratory did not work from the outset.

Oceanography (CS) - Physical oceanographic data to support JB 1 l's diverse biological programme were obtained using CTDs, XBTs and a thermosalinograph. Approximately 40 CTD profiles were undertaken ranging in depth from 100 m to 4000 m and (in the first part of the cruise at least) water samples were collected from specified depths using twelve 2.2litre niskin bottles attached to the CTD rosette. These vertical profiles were supplemented by about 25 XBTs. In addition to the vertical profiles a thermosalinograph was run throughout the cruise giving a continuous horizontal profile of salinity and temperature. The water passing through the thermosalinogmph was derived from the 3m surface intake and so represents (with relatively few exceptions) conditions within the surface mixed layer.

The first investigation was a physical and chemical transect across the APFZ. Unfortunately, there was only time for three deep CTDs; one in subantarctic water, one in the polar frontal zone and one in antarctic surface water. In addition to the CTDs, approximately 15 XBTs were deployed and a horizontal transect was obtained for temperature, salinity, nutrients and oxygen. Marked physical and chemical variations were observed. In addition CTD were used to (i) character& water masses prior to squid fishing (ii) investigate the hydrography of regions trawled for fish (iii) investigate small scale vertical variations in water structure with respect to diurnal zooplankton migrations and finally (iv) investigate the possibility of upwelling along an underwater ridge favoured by krill For the latter the limited time available permitted a grid of 9 CTDs and 6 XBTs across the region of greatest change in depth. Bird observations, nutrient concentrations and acoustic profiles were obtained in addition to the physical data.

Nutrient chemistry (MJW)- Surface silicate and nitrate levels were continuously measured during all the major transects throughout the cruise. Between the Falklands and Squid Station 1 nutrients were monitored in conjunction with physical oceanographic parameters and oxygen measurements in order to identify and characterize the APFZ. Although the three CTDs in the vicinity of the convergence were the minimum needed for our project, the data gained, together with the horizontal profile, should provide a reasonable description of a complex water mass system.

Horizontal profiling of nutrients around South Georgia once more showed a considerable depletion in surface silicate as found on JBl0. However, significant increases in levels were found over steep bathymetry changes on the shelf and surface depletion was not evident during the transect to the south of the island.

The couloximeter was once again used to monitor oxygen levels in the krill IGR experiments. As a comparison with the UCNW Winkler apparatus, surface samples were simultaneously measured on the couloximeter and Winkler. The results were mostly in agreement with each other to within 1%.

Protozooplankton ecology (RJGL) - Microbial studies focused on the characterization of the microplankton community and the quantification of protozooplaukton grazing in coastal, shelf and oceanic surface waters near South Georgia. Vertical profiles of microplankton abundance and biomass, and in situ grazing experiments, were undertaken at the two zooplankton stations (ZOO1 & ZOO2) and at fish stations off the Bay of Isles (FISH4) and Royal Bay (FISH5).

At each station water samples were taken from 10,15,20,30,50 and 70 m depth using 30 litre Go-Flo bottles. Three replicate subsamples from each bottle were then taken for the determination of chlorophyll a concentration (fluorometric analysis), photosynthetic pigment concentrations (HPLC analysis), and the quantification of bacterial, algal and protozoan populations (fluorescence and inverted microscopy). Protozooplankton grazing on algal and bacterial populations was then investigated on water from 15 m by dilution assay (Landry MR and Hassett RP 1982 Marine Biology 67: 283-288), with experimental treatments incubated in ***situ*** for 24 hours. All vertical profile and experimental samples were stored cool or frozen for post-cruise analyis. This was necessitated by the difficulty in undertaking high quality microscopy at sea, and the lack of appropriate analytical equipment on ship.

Microplaukton sampling throughout tbe surface water column at the first zooplankton station was incomplete due to unreliable firing of Niskin bottles from tbe CTD rosette. Subsequently all further microplankton sampling was undertaken successfully using Go-Flo bottles. Complete vertical profiles of the microplankton community will therefore be available for Z 002, FISH4 and FISH5 upon post-cruise analysis of the samples. Sampling and preparation of the dilution experiments was undertaken successfully at all stations but the ***in situ*** incubation of the experimental treatments at ZOO1 and FISH4 failed due to early recovery of the ***in situ rig*** (2001) and loss of all incubation bottles (FISH4); both occurrences resulting from an increase in sea state during rig deployment. Incubations undertaken at ZOO2 and FISH5 were, however, successful and should allow comparison of coastal and oceanic protozooplankton grazing activity. Assessment of the results of these experiments, and of the characterization of the microplankton community awaits post-cruise analysis of the samples.

Other cruise activities included (1) trial experiments using fluoxescently labelled populations of natural bacteria as tracers of bacteriovory by protozooplankton, (2) the measurement of size fractionated microbial respiration in collaboration with CR, and (3) construction of the ***in situ*** incubation rig in collaboration with DGB and Steve B.

Oxygen budget of water column (CR) - The data collected during JB 11 can be divided into the following categories:

(i) The quantification of the temperature coefficient of community respiration. Water was collected, either from the 3m pumped seawater supply or with a 30 l Go-Flo from depths between 10 m and 75 m. After an

equilibration period of 1 - 2 hours, the sample was incubated for 24 hours in au aluminium temperature gradient block. Oxygen consumption was measured using au automated Winkler titration system, and the Q_{10} of community respiration was calculated from a regression of temperature against respiration rate. Twenty such experiments were completed from a number of locations (coastal, shelf and oceanic) giving values ranging between 2 and 10. Subsequent community characterisation from analysis of comcomitant lugols, bacterial numbers and chlorophyll samples may provide the cause for such a wide range of values.

(ii) Proliles of community respiration aud photosynthesis, size fractionated respiration and copepod respiration rates. Four *in situ* productivity rigs were deployed during the cruise for measurement of gross and net community production, and respiration. Traditional 24 hour light/dark bottle incubations were undertaken. Changes in dissolved oxygen were measured on board and samples were collected for future analysis of TCO_2 alkalinity, dl3C-DIC and dl3C-POC at UCNW. Gross production ranged from 3 to 10 $\mu mol\ O_2\ kg.day^{-1}$ at 10 m. Positive net community production was restricted to the top 20 m, with respiration continuing to 75 m. PAR measurements were taken at hourly intervals during the rig deployment days using a T&J Crump light meter in order to calibrate the ship'sPAR measurements. Secchi disc deployments gave 1% light levels corresponding to 5- 7 m. Further depth profiles of respiration only were completed when logistics allowed the time consuming collection of 30 litre Go-Flo samples.

Two size fractionation respiration experiments were undertaken in conjunction with RJGL. The highest proportion of respiration appeared to be associated with the <2 pm size fraction. Again community characterization by Lugols, chlorophyll and bacterial numbers will aid interpretation.

Two experiments to measure the respiration rate of *Rhincalanus gigas were* undertaken in collaboration with AA. Means of respiration rates from up to 20 individuals were 6 and 8 $\mu mol\ O_2\ individual.day^{-1}$ respectively.

(iii) Horizontal and vertical distribution of dissolved oxygen, TC02, alkalinity, dl3C-DIC and dl3C-POC. Samples were collected from the 3 m pumped seawater supply at hourly intervals for analysis of 02, TCO2, alkalinity, dl3C-DIC, dl3C-POC, chlorophyll and lugols whilst the ship crossed the Antarctic Convergence at the beginning and again at the end of the cruise. These results will be collated with the physical (temperature and salinity) and chemical (nutrient) parameters obtained by CS and MJW at the same time. Samples were also collected from the 2.2 litre Niskin bottles on the CID rosette to determine the vertical distribution of 02 across the convergence.

The underway sampling regime provided the opportunity to intercalibrate dissolved oxygen measurements made with the Winkler titrator (UCNW) and those obtained by couloximetry (MJW; BAS). A detailed list of all samples collected is held by the Principal Scientist,

Cephalopod Biology (PGKR, UP, Emma Hatfield)

Three positions were investigated, theAPFZ south of the Falkland Islands and the SGSB in two places (SGSBl and 2), one to the north and the other to the south of Bird Island. At the APPZ and SGSBl the EMT25 opening/closing net was fished in a vertical series through 200 m layers from the surface to 1000 m. Two 2 hour hauls were made in each layer, one in daylight and the other in darkness, defined by sunrise and sunset. It had been intended that the same procedure be adopted at SGSB2 but time allocated to 'cephalopod biology' was lost during the second vertical series through inclement weather and temporary gear failure. A modified procedure was adopted at this third station so that one hour hauls were made at a series of discreet depth horizons at 100 m intervals to 800 m.

Each vertical series produced small but useful collections of juvenile squid which were identified and measured, and at the APFZ and SGSB 1 a complete series of nekton samples were collected and analysed aboard ship. A sample of these data are given in Table 1.

The opening/closing RMT25 was fished at a variety of speeds and in downwards oblique and horizontal modes. However, by comparison with results obtained during JB7 when the net was fished open in downward oblique hauls, it caught less specimens and a lower diversity of squid species. It did catch satisfactory samples of nektonic species, especially fishes and decapod crustaceans.

The squid data will provide information on vertical distribution of the juvenile forms of several species ***(Brachioteuthis picta, Galiteuthis glacialis, Histioteuthfs eltaninae, Alluroteuthis antarcticus) all*** of which occur in the diet of vertebrate predators at South Georgia. Data were also collected to contribute to an on-going study on the allometric scaling of the feeding structures of these species during the juvenile growth phase.

The data from the nekton study will contribute to research on modelling the impact of predation by pelagic cephalopods on the midwater community. The importance of this question was recognised when, two years ago, squid ***(Martialia hyadesf)*** taken by commercial vessels at the APFZ were found to have been feeding on myctophid fishes. In view of the importance of this squid in the diet of several vertebrate predators, the squid-myctophid link is clearly an important aspect of the pelagic food web in the Scotia Sea which has, until now, not been examined.

The performance of the RMT25 suggests that in the future an alternative approach will need to be adopted to adequately sample squid, especially adult specimens, from research vessels. However, it appears to be an effective tool for sampling discreet depth layers and/or horizons for other nektonic species especially midwater fishes.

Ichthyoplankton **studies (MGW, AWN)**

Ichthyonekton abundance - Previous studies over the continental shelf at South Georgia have indicated that the early stages of notothenioid fish are more abundant near to the coast and within the fjords. This study investigated whether this distribution pattern was generally representative along much of the northern shelf and to gain some indication of interannual variations in species occurrence.

Samples were collected using a RMT8+1M at 4 and 12 miles from the coast off five fjords, from the Bay of Isles to Royal Bay on the northern coast using three oblique hauls of three nets from tbe surface to near the sea bottom at each station. Nets were deployed after dark to reduce net avoidance. The objective of collecting 9 replicate samples at each site was not fully achieved due to the shortness of the darkness hours and some gear malfunctions but an adequate number of samples was taken at most stations. In all, 28 net deployments were made, comprising 80 nets fished for 39.7 hours aud sampling a total of c. 1471578 m^3 from the water column.

A total of 10765 fish were sampled during the survey comprising twenty one species ***Champsocephalw gunnari (7568), Nototheniops nudifrons (2046) and Notothenfa gibberifrons*** (1010) were the most abundant. Both C. ***gunnari*** and N. ***nudifions were*** represented by higher abundances (usually by an order of magnitude) nearer to the coast while the distribution of N ***gibberifrons conformed*** to this pattern in the north-west but were more abundant off-shore to the south-east of the study area (Table 2).

Some species that were previously common, such as ***Pagothenia hansoni*** and ***Nototheniops larseni and*** small (<20 mm standard length (sl)) larval stages were notable by their relative absence when compared with samples collected at the same time of the year in 1987. It was not possible to determine the reasons for this but it is evident that marked interannual variations in larval abundance among species take place at South Georgia and knowledge of this will be important for understanding recruitment.

Preliminary analysis of the size of the larval stages of the most abundant species from the northern shelf at South Georgia and Shag Rocks indicates that there are marked difference between the mean size of postlarval C. gunnari at the two localities (36.7 mm sl and 66.3 mm respectively); while the mean sixes of

N. nudifrons and N. *gibberifrons are* not noticeably different. Growth, as indicated by change in mean length during the survey, show rates between 0.17-0.27 mm d^{-1} which are similar to those previously reported for these species during the summer.

Mesopelagic fish - Previous samples collected using an RMT25 demonstrated a rich and diverse community of mesopelagic fish at South Georgia. Development of an opening/closing RMT25 with two nets enabled the vertical distribution and community structure from the surface to 1000 m to be studied at the Polar Front, the northern and southern continental slope waters at South Georgia. Time constraints due to gear malfunctions aud poor weather resulted in the latter station being incomplete and being used for experimenting with the net performance.

Twenty seven different species of mesopelagic fish were represented in the samples of which more than half were myctophids. The myctophids ***Electrona antarctica, Krefftichthys anderssoni, Protomyctophum bolini, Gymnoscopelus braueri and the*** bathylagid ***Bathylagw antarcticus were the*** most abundant, with ***B. antarcticw*** dominating the fish biomass below 400 m. Vertical stratification of the ichthyofauna was evident at each station. Among the myctophids ***P. bolini, K anderssoni and G braueri*** occurred at progressively deeper depths. ***E antarctica was spread*** throughout the water column but differences in sexual composition and maturity stage occurred with depth. Marked differences were observed in abundance and biomass between night and day samples within each of the 200 m depth strata in the upper 600 m. By day, catches were less than at night and the biomass/abundance maximum was shallower. These observations were interpreted as the combined result of net avoidance and vertical migration (Fig 2).

Preliminary analysis of the size-structure of the fish fauna showed that generally and within species the size of individuals tended to increase with depth. The size of most fish was between 40-90 mm sl. The size distribution conformed to a negative binomial distribution with few specimens of less thau 40 mm sl. The smaller fish probably passed through the larger of the meshes (17 mm& 5 mm aperture) in the body of the net.

Initial evaluation of the experiment at the third station, where the net was towed faster but for shorter duration, did not increase the number of fish caught per unit swept volume or the size of specimens caught. This suggests that at the normal sampling speed (2.5-3.0 knots) the net performs effectively in sampling the majority of components of the mesopelagic community, except for the most active species such as squid.

Krill ecology (JLW, LM, HJH)

This year the cruise was characterized by very low numbers of krill swarms seen on the echo-sounder and few krilI caught in the nets. This situation was especially marked in the period before the mid-season break when the ship worked to the west of the Cumberland Bay and around Bird Island.

Net hauls to the west of Shag Rocks contained many salps but fortunately few salps were seen in the South Georgia area itself. The dominant macrozooplankter this year was ***Themisto gaudichaudi. This species was*** frequently seen on the echo-sounder as diffuse layers or aggregations and when sampled with nets it often occurred with large copepods aud small euphausiids such as ***Euphausia frigida*** and ***Thysanoessa*** sp. Tbis lack of krilI at the west end of the island was mirrored in the early breeding success of mollymawks, penguins and fur seals at Bird Island.

Towards the end of the cruise w&n the ship moved towards the eastern half of the island, catches of krill increased dramatically and swarms were visible on the echo-sounder for the first time. This increase in krill catches occurred in an area where krill were found in fish stomach samples by Dr I Everson working on MV Falkands Protector.

The mean length of krill throughout the study period was 42 mm and this was fairly consistent in all hauls (Table 3). The majority of the krill were immature adults and the large numbers of juvenile krill that

dominated the catches in 1982 and 1988 were absent. There were also very few mature adult krill found this year in contrast to the situation detected last year in the same area.

IGR experiments - a total of 400 live krill were maintained in the scientific cool room in individual 1.2 litre containers to monitor moult and growth rates. Calculated intermoult periods (IMP) for the first two experiments were 10 and 10.5 days, which are some of the highest rates recorded in the literature. The other experiments 5 days later were 25 and 27 days respectively. Thus there were large differences between the two sample dates but very similar results from the replicates taken from the same wild population of lcrill. Analyses of growth rates and a comparison of methods of calculating IMP will be carried out in Cambridge.

Sound velocity experiments - the equipment developed by Dr KG Foote from Bergen and purchased this year worked much more successfully than the equipment used on previous cruises. The noise level on the equipment was higher than that observed when the equipment was tested on MV Michel Sars in Norway in December 1990 and it is hoped that this will be less of a problem on RRS James Clark Ross. A total of 18 experiments on krill, ***T. gaudichaudi,*** salps and fish were carried out. In Cambridge the derived sound speed contrast calculated from these results will be combined with density data to derive theoretical Target Strength values for different species of macrozooplankton and nekton.

Underwater photogrammetry - no experiments were made for this project this year due to the delay in finding suitable concentrations of krill. It was decided that the available time was better devoted to obtaining comprehensive data for other krill projects, in particular the study on identification of targets using the differing acoustic response of various species to two echo-sounder frequencies. In retrospect, it would have been useful to deploy the equipment at least once to test the modifications to the lighting system and the tilt angle sensors installed on the camera frame.

Phytoplankton-zooplankton biochemical flux studies (DP)

Specimens of krill were collected from fish, zooplankton and krill hauls with the RMT8, LHPR and FNET and frozen individually at -60°C Initially the relatively low abundance of krill and the rough seas made the collection of live krill difficult Prior to the mid-season break 40 live krill had been maintained on board for two weeks with only **1 mortality in the** tanks.

T.gaudichaudi **dominated in the early catches and approx 50 animals per haul were preserved.**

Particulates were sampled regularly (once a day if possible) from three depths (surface, 3 m and 40 m). These samples were size fractionated to 10 µm, 20 µm and 200 µm and then stored in methanol and frozen at -60°C.

Grazing experiments were conducted in containers of either 5, 15 or 20 litres. Each experiment lasted for 8 to 22 hours and consisted of 3 to 7 replicates with 1 to 6 krill in each container. Water samples were filtered for lipid analysis in the UK and 200 ml preserved in Lugols for cell counts and identification at the start and end of each experiment. Multisizer analysis was also undertaken to monitor experimental conditions in containers. There was large individual variation in feeding rates and some lcrill did not appear to feed at all.

Many more live krill were caught in the second half of the voyage and several hundred were still surviving by the time the ship docked in Stanley. DP remained on board to continue experiments after the call in Stanley. At the time of writing about 60 krill still survive and are feeding well on spray-dried algal food.

Zooplankton studies (Pete Ward, AA)

The shelf station, situated 20 miles to the NW of Bird Island in 250 m of water, was occupied for a little over 2 days. CTD profiles indicated surface temperatures of 3.5°C with a marked thermocline at 40-60 m below which the temperatures fell to 0.75°C. The intention was to collect a midday and a midnight DLHPR

profile but only the latter was possible owing to bad weather. A 200 pm mesh coarseprofile, down to 180 m, was cut and frozen. The fine (20 pm mesh) profile patches were washed from the gauzes and split, half being preserved in formalin and half being filtered down onto a pm-ashed GFC for CHN and chlorophyll analysis in the UK. A water bottle profile was also undertaken with 4litres of water from 6 depths being screened (21) and unscreened (21) through 200 pm mesh and taken down onto a pre-ashed GFC.

Several horizontal hauls were also carried out just below the thermocline to examine the nature of plankton patchiness.

A similar regime was worked at the oceanic station some 60 miles to the NW of the shelf station. Here surface temperatures were around 4.5°C with a thermocline occurring at 60-l 10 m below which temperature dropped to 0.5°C. DLHPR profiles were obtained down to 500 m and treated similarly to those at the shelf station.

Preliminary observations at both stations indicate similarities in species composition and developmental stage structure of many species with data obtained last year. Although calanoid naupliar stages appear greater. Further analysis awaits in the UK.

Copepod feeding studies

Copepod feeding studies focused on two stations which had been studied intensively the previouus year. The shelf station and the contrasting oceanic station were occupied for 2 and 3 days respectively, with the objective of further quantifying the rates and periodicity of grazing of the four majorcopepod species. The relationship between diurnal vertical migration and feeding was examined during a 24 hour series of vertical net hauls, combined with temperature salinity and chlorophyll protiles. Zooplankton hauls from 0-70m and 70-140m were taken hourly and the catches frozen for fluorometric analysis of gut fullness in Cambridge. Rates of food passage through the copepods guts were concurrently measured at two hourly intervals. Estimates of feeding rates and particle selectivity were also provided by bottle incubations at the two stations.

At the fish and squid stations throughout the cruise, further bottle incubations were undertaken to investigate the magnitude of grazing by small copepod species. Also the moulting rate of the large copepod *Rhincalanus gigas was* determined. The life cycle of this biomass dominant is still rather a mystery, and its age structure during this season was radically different from that last year.

Biometrics (AWAM)

Statistical advice was available on request. Particular help was provided on anaylsis of oxygen Q 10 experiments. Data from the squid stations on commumty structure was subject to spectral analysis. The preliminary results of this are encouraging.

Some of the data from the ocean logger and BIOSONICS echo-integrator were put through spectral analysis. This indicated that the spatial distribution of temperature variance was unlike that seen on previous cruises, at least in the three transects studied so far. It is not clear whether this is a general phenomenon in the South Georgia area this year. If so it might have implications for the lack of swarming in the krill population.

Equipment summaries (DGB, Paul Woodroffe)

Four major pieces of gear were deployed from the afterdeck, these were LHPR, Agassis trawl, RMT8 +1M and RMT25. At times three of these were all used within the compass of one day.

With the exception of the acoustic net monitors, mentioned in detail below, few problems were experienced with gear. These were generally of the fair wear and tear variety to be expected with frequent hard use. One

haul failed due to problems with the connector between the monitor and release gear of the RMT8 system this was just about the only such failure in something like 10 years operation with Blectro oceauics connectors in this application.

RMT25. This net was used both in opening/closing mode and with two nets for the first time. A release gear built for RMT25 operation was borrowed from I.O.S. Wormley. In spit of being at the limit of size that can be deployed sefely from this vessel few problems were experienced, the most difficult and unsatisfactory aspect of the operation was recovery of the nets after the haul. These had to be hauled up onto the deck from beneath the stowed bars which limited access. This will not be necessary when operating from the new vessel. Ropes added to the edges of the nets to help in recovery caused tangles that led to strangulation of the nets and damage to the catch in some hauls.

Acoustic Net Monitors. The three acoustic net monitors that we have are all showing signs of age, of the original two, purchased in 1978 one has gone right out of calibration and gives an extra spurious trace, the other is liable to have the trace break up into a series of random dots. Neither of these can be relied upon to respond to commands when in the water although both function in respect on the bench. The third monitor, purchased more recently, has a good record or responding to commands up to a range of 2000M and providing the depth is at least one third of the range. However even at these ranges the return signal is weak and difficult to see through the noise it was not possible to see flow meter marks on any haul below 800M. The unreliability of the open/close function and loss of flow marks devalued the data from several of the deeper RMT25 hauls. Efforts to make the net respond at depth caused great frustration on the part of net operators and caused considerable loss of time as hauling nets up to the point where they could be closed could only be done slowly and this time was in addition to the fishing time allocated to the event. In addition to the regular problems described above, there was one day at one station where the monitor consistently failed to respond at much shallower depths. We suspect that this was due to the signal being'ducted' away by hydrological conditions. The problems experienced on this cruise cover the whole spectrum of faults that have occurred throughout the time that we have been using these monitors and strongly reinforce the case for changing to a Down wire system. Money spent on this new system would be rapidly repaid by the prevention of data loss and its consequent waste of ship time.

XBT - no problems were experienced with the XBT system and all the deployments were successful. The thermal profiles are available as plots and the data will go onto the OBP database.

CID - the new EG&G data aquisition and post processing software proved extremely useful and very lfexible. Unfortunately, the same could not be said of the hardware which proved extremely unreliable. The major problem concerned the bottle tiring mechanism. Although it was overhauled several times and some major components were replaced, the depths at which the bottles fired (when some actualIy fired) could not, at any stage of the cruise, be reliably determined. This caused a lot of inconvenience, particularly to chemists. After only a week or so of sub-surface was obtained using Go-Flo's (this had several disadvantages including, on coincident CID profile, reduced sample resolution and increased wire time). Thje CTRD profiles are currently avialable as plots (potential temperature v. depth, salinityv. depth, density (sigma theta) v. depth and potential temperature v. salinity) and the *in situ* temperature and salinity data will be loaded onto the OBP database at 1 db intervals. N.B. CID event 676 has been renamed as 691.

Thermosalinograph - this was the first OBP on which the thermosalinograph was used and it appeared to work well. Due to the large effort involved in integrating it into the oceanlogger software the system was run as a stand alone. The software provided a real-time and post real-time display of data. Using a 5 second sample rate it was possible to record 22 hours of data in the internal memory.

Turner Fluorometer - a number of problems were encountered. The machine had to be set up minus original baseboard and hoses. The cell had to be reconfigured because the supplied flow-thru doors did not fit. The reference beam mechanism had to be repaired. Towards the end of the cruise a sea water spill damaged the power supply and it was not possible to put the machine back in service with the limited documentation available.

PML data logger - this was used extensively during the LHPR profiles and for profiling during the Z net series. Unfortunately the depth sensor gave spurious data and all fluorescence and light profiles will have to be plotted against time/distance and not depth, which will be problematic. An intended calibration of the fluorescence sensor against the surface profiling fluorometer was forestalled when the latter became U/S due to an ingres of sea water. Instead the logger was placed in a bucket of surface pumped sea water and discrete samples filtered and frozen for phytopigment analysis in the UK.

Echo-sounders - The EK400 dual frequency sounder was used in conjunction with the BIOSONICS and Simrad QD echo-integrators. The later being controlled by a Walters PC running Kermit terminal emulation. Some surveys were also recorded on the digital audio tape(DAT) system.

The 120 KHz sounder worked without problem but the 38 KHz sounder caused a number of problems. It appeared that the two beams of the latter sounder were wired up out of phase. During the first calibration period at Leith it was not possible to attain a realistic signal level from the 38 KHz system. A second calibration period was allocated to find the fault. This was finally traced to a low gain in the TVG board. Calibrations on this board and a new board were obtained. Further details of the calibration procedure and the problems associated with the sounders can be obtained from the Chief Scientist.

Sediment trap - The loss of this piece of apparatus during the first deployment was particularly unfortunate. Projects such as organic biogeochemistry were seriously affected. In addition it was not possible to assess the performance of the new version of software and drive mechanism designed and built by ISG over the last year. Details of loss are given in cruise narrative.

Principal Scientist's summary

The PES component of this, the last cruise of RRS John Biscoe, was shorter than on most previous cruises, however, to make up for this the science group worked hard in frequently very cramped conditions. This lack of space also extended to cabins and to the Fids mess (by end of cruise 24 out of 26 berths were occupied). While there were a number of gear failures and some time lost to bad weather the majority of the science objectives were accomplished.

I would like to thank the entire science group for their hard work and help during the cruise. A successful cruise is very dependent on the good cooperation and help of the officers and crew of the ship and all the scientists are very grateful to ship's company for their enthusiastic support of the science programme this year. In particular I would like to thank the Master and Mate of the ship for their willingness to undertake whatever was requested to fit in with a very flexible itinerary.

Appendix I - Personnel

Krill Ecology	Jon Watkins	Scientist in charge
	Helen Hill	
	David Pond	Stirling University
	Lauro Madureira	Cambridge University
Fish Biology	MartinWhite	
	Tony North	
Squid Biology	Paul Rodhouse	
	Uwe Piatkowski	Institute fur Meereskunde, Kiel
	Emma Hatfield	
Secondary production	Peter Ward	
	Angus Atkinson	
Gear	Doug Bone	
Biogeochemistry	Geoff Cripps	
	Ray Leakey	
	Carol Robinson	UCNW, Bangor
	Carolyn Symon	
	Mike Whitehouse	
Biometry and statisitics	Alistair Murray	
Photography	Chris Gilbert	
Instrument and Systems Group	Paul Woodroffe	
	Stuart Bell	
	Steve Bremner	

Appendix II - Event Summary

Event type	Number
Agassiz hauls	6
Bird observations	31
Sediment trap	1
Secchi disk	1
Echo runs	163
Foredeck nets	29
Water samples	74
Horizontal chlorophyll	7
Horizontal surface monitoring	70
Horizontal salinity monitoring	59
In situ rig deployments	4
LHPR hauls	26
Vertical chlorophyll logging	7
Phytoplankton nets	3
RMT8 hauls	47
RMT25 hauls	21
CTD casts	41
Water bottle casts	37
XBTs	28
Zooplankton nets	74

JB11 - schedule

start	Finish	Duration	Activity
11 Jan 1600	12 Jan 0800	16.0 h	Passage time -
12 Jau 0800	12 Jan 1000	2.0 h	RMT25 - test deployment
12 Jan 1000	12 Jan 1600	6.0 h	Passage time -
12 Jan 1600	12 Jan 2000	4.0 h	DEEP CTD - position on chart
12 Jan 2000	12 Jan 2030	0.5 h	SURFACE GOFLOW - at CTD station
12 Jan 2030	13 Jan 1030	14.0 h	Passage time - towards 58°S,55°W
13 Jan 1030	13 Jan 1430	4.0 h	DEEP CTD - at or near 58°S,55°W
13 Jan 1430	13 Jau 1500	0.5 h	SURFACE GOFLOW - at CTD station
13 Jan 1500	13 Jan 1800	3.0 h	Passage time - return to SQUID 1
13 Jan 2000	14 Jan 0400	8.0 h	SQUID l- night hauls
14 Jan 0400	14 Jau 1200	8.0 h	SQUID l- day haul
14 Jan 1200	14 Jan 2000	8.0 h	SQUID l- day haul
14 Jan 2000	15 Jan 0400	8.0 h	SQUID l- night haul
15Jan 0400	15 Jan 1000	8.0 h	SQUID l- day haul
15 Jan 1000	15 Jan 1200	2.0 h	SQUID l- shallow CTD haul halfway along haul track
15 Jan 1200	15 Jan 1330	1.5 h	SQUID l- steam back along original Stanley transect til 4°C isotherm
15 Jan 1330	15 Jan 1730	4.0 h	SQUID l- deep CTD
15Jan1730	15Jan1930	1.0 h	SQUID l- Surface goflow, ZNET. PNET and WBOT for GC
15 Jan 1930	15 Jan 2100	8.0 h	SQUID l- return to start of squid haul
15 Jan 2100	16 Jan 0100	6.0 h	SQUID l- night(800-1000m)
16 Jan 0200	18 Jan 2000	66.0 h	Passage time - to Bird Island (600+ nmi), via Shag Rocks for fish RMT8+1M
18 Jan2000	18 Jan2200	2.0 h	Acoustic search (poss also TV)
18Jan2200	19 Jan0400	6.0 h	krill fishing (pass also TV)
19 Jan0400	19Jan1600	12.0 h	Acoustic transect
19 Jan 1900	19 Jan2100	2.0 h	FISH **1** - Off Possession Bay, CTD cast
19 Jan 2100	19 Jan 2300	2.0 h	FISH **1** - postdusk haul
19 Jan 2300	20 Jan 0100	2.0 h	FISH **1** - midnight haul
20 Jan 0100	20 Jan 0300	2.0 h	FISH **1** - predawn haul
20 Jan 0500	20 Jan 1100	6.0 h	FISH **1** - Agassiz trawling
20 Jan 2000	20 Jan 2200	2.0 h	FISH **1** - Off Possession Bay, postdusk haul
20 Jan 2300	21 Jan 0100	2.0 h	FISH **1** - midnight haul
21 Jan 0100	21 Jan 0300	2.0 h	FISH **1** - predawn haul
21 Jan 1200	21 Jan 1400	2.0 h	ZOOP SHELF- c t d
21 Jan 1400	22 Jan 1400	24.0 h	ZOOP SHELF - ZNETS @ 2 h, plus live animal h
22 Jan 1400	22 Jan 1600	2.0 h	ZOOP SHELF - CTD
22 Jan 1600	22 Jan 2200	6.0 h	ZOOP SHELF - Horiz LHPR/acoustics
22 Jan 2200	23 Jan 0100	3.0 h	ZOOP SHELF - CTDs for rig
23 Jan 0330	23 Jan 0530	2.0 h	ZOOP SHELF - launch CRAP and rig
23 Jan 0530	23 Jan 1130	6.0h	ZOOP SHELF - Horiz LHPR/acoustics
23 Jan 1200	23 Jan 1400	2.0 h	ZOOP SHELF - DLHPR
23 Jan 1400	23 Jau 1900	5.0 h	ZOOP SHELF - Horiz LHPR/acoustics
23 Jan 1930	23 Jan 2130	2.0 h	ZOOP SHELF - recover rig
23 Jan 2400	24 Jan 0200	2.0h	ZOOP SHELF - DLHPR
24 Jan 0200	24 Jan 0400	2.0 h	ZOOP SHELF - CTD
24Jan0400	24Jan1200	8.0 h	ZOOP SHELF - Horiz LHPR/acoustics
24 Jan 1800	24 Jan 1900	1.0 h	FISH 2 - Off Stromness, CTD cast, water for GC
24 Jan 1900	24 Jan 1930	0.5 h	FISH 2 - WBOT, water for David Pond
24 Jan 2000	24 Jan 2200	2.0 h	FISH 2 - postdusk haul
24 Jan 2230	25 Jan 0030	2.0 h	FISH 2 - midnight haul, plus ZNET for GC
25 Jan 0100	25 Jan 0300	2.0 h	FISH 2 - predawn haul
25 Jan 0400	25 Jan 0800	4.0 h	FISH 2 - Agassiz trawling
25 Jan 0800	25 Jan 1800	10.0 h	FISH 2 - Acoustic calibration
25 Jan 1800	25 Jan 1840	0.7 h	FISH 2-WBOT&ZNET for GC,
25 Jan 1840	25 Jan 1900	0.3 h	FISH 2 - WBOT for David Pond
25 Jan 2000	25 Jan 2200	2.0 h	FISH 2 - Off Stromness, dusk haul

25 Jan 2230	26 Jan 0030	2.0 h	FISH 2 - midnight haul
26 Jan 0100	26 Jan 0300	2.0 h	FISH 2 - predawn haul
26 Jan 0300	26 Jan 2000	17.0 h	Acoustic search (poss also TV)
26 Jan 2000	27 Jan 0800	12.0 h	Krill fishing (poss also TV)
27 Jan 0800	27 Jan 1800	10.0 h	Acoustic search - finishing at SQUID 2
27 Jan 2000	28 Jan 0400	8.0 h	SQUID 2 - night(too rough)
28 Jan 0400	28 Jan 1200	8.0 h	SQUID 2 - day(600-800)
28 Jan 1200	28 Jan 2000	8.0 h	SQUID 2 - day()
- 28 Jan 2000	29 Jan 0400	8.0 h	SQUID 2 - night(200-400;0-200)
29 Jan 0400	29 Jan 1200	8.0 h	SQUID 2 - day(200-400)
29 Jan 1200	29 Jan 1600	4.0 h	SQUID 2 - more day hauls
29 Jan 1600	29 Jan 1630	0.5 h	SQUID 2 - Surface goflow
29 Jan 2000	30 Jan 0400	8.0 h	SQUID 2 - night(400-600;600-800)
30 Jan 0400	30 Jan 1200	8.0 h	SQUID 2 - day(800-1000)
30 Jan 1200	30 Jan 2000	8.0 h	SQUID 2 - acoustics &./or CTD/WBOTs
30 Jan 2000	31 Jan 0400	8.0 h	SQUID 2 - night(800-1000)
31 Jan0400	31 Jan 1600	12.0 h	Acoustic search
31 Jan 2000	1 Feb 0400	8.0 h	Krill fishing
1 Feb 1200	1 Feb 1400	2.0 h	ZOOP OCEAN - midday DLHPR to 500m oblique
1 Feb 1400	1 Feb 1500	l.0h	ZOOP OCEAN - CID & rossette (GC) & fluor.
1 Feb 1500	1 Feb 1530	0.5 h	ZOOP OCEAN - ZNET (AA)
1 Feb 1530	1 Feb 2000	4.5 h	ZOOP OCEAN - 2 Horiz LHPR's from stn
1 Feb 2000	1 Feb 2100	1.0 h	ZOOP OCEAN - CID for RJGL
1 Feb 2100	1 Feb 2200	l.0h	ZOOP OCEAN - ZNETs for AA, GC
1 Feb 2200	2 Feb 0000	2.0 h	ZOOP OCEAN - Goflows for CR/RJGL/DP/GC
2 Feb 0000	2 Feb 0230	2.5 h	ZOOP OCEAN - midnight DLHPR oblique
2 Feb 0230	2 Feb 0300	0.5 h	ZOOP OCEAN - ZNETs (AA)
2 Feb 0300	2 Feb 0400	l.0h	ZOOP OCEAN - launch rig
2 Feb 0400	3 Feb 0100	21.0 h	ZOOP OCEAN - Horiz LHPR's/acoustics
3 Feb 0100	3 Feb 0300	2.0 h	ZOOP OCEAN - night LHPR at station
3 Feb 0300	3 Feb 0500	2.0 h	ZOOP OCEAN - recover rig
3 Feb 0500	3 Feb 0600	1.0 h	ZOOP OCEAN - CID & rossette & fluor (PW)
3 Feb 0600	4 Feb 0600	24.0 h	ZOOP OCEAN - ZNETs every hour, 3 fluor, CTD
4 Feb 0600	4 Feb 1200	6.0 h	ZOOP OCEAN - LHPR/acoustics to Stromness
4 Feb 1800	5 Feb 1800	**24.0** h	Midseason break - Stromness/Leith
5 Feb 2000	5 Feb 2200	2.0 h	FISH 3 - Off Cumberland Bay, postdusk haul
5 Feb 2230	6 Feb 0030	2.0 h	FISH 3 - midnight haul
6 Feb 0230	6 Feb 0430	2.0 h	FISH 3 - predawn haul
6 Feb 0430	6 Feb 0530	1.0h	FISH3-CTD
6Feb 0530	6Feb0730	2.0h	FISH 3 - RMT in Cumberland Bay
6 Feb 0730	6 Feb 1730	10.0 h	FISH 3 - Acoustic calibration in Leith/Cumberland Bay, depends on weather. - Agassiz if time available
6 Feb 1900	6 Feb 2100	2.0 h	FISH 3 - Steam to 12 mile off Cumberland Bay
6 Feb 2100	6 Feb 2300	2.0 h	FISH 3 - postdusk haul
6 Feb 2300	7 Feb 0100	2.0 h	FISH 3 - midnight haul
7 Feb 0130	7 Feb 0330	2.0 h	FISH 3 - predawn haul
7 Feb 0330	7 Feb 0430	1.0 h	FISH3-CTD
7 Feb 0430	7 Feb 1630	12.0 h	Acoustic search
7 Feb 2000	8 Feb 0400	8.0 h	Krill fishing
8 Feb 0400	8 Feb 1800	14.0 h	acoustics to FISH 4,3 mile off Bay of Isles, LHPR hauls if targets detected
8 Feb 1930	8 Feb 2200	2.5 h	FISH 4 - postdusk RMT8+1 haul at FRAN 1
8 Feb 2230	9 Feb 0100	2.5 h	FISH 4 - midnight haul
9 Feb 0130	9 Feb 0330	2.5 h	FISH 4 - predawn haul
9 Feb 0330	9 Feb 0400	0.5 h	FISH 4 - CTD at station FRAN 1
9 Feb 0400	9 Feb 0500	l.Oh	FISH 4 - steam to FRAN 2,12 mile off coast
9 Feb 0500	9 Feb 0800	3.0 h	FISH 4 - WBOT's for biogeochemistry and rig
9 Feb 0830	9 Feb 1000	2.5 h	FISH 4 - Agassiz trawling
9 Feb 1000	9Feb 1100	2.0 h	FISH 4 - &ploy rig near FRAN 2,12 mile off

9 Feb 1100	9 Feb 1830	7.5 h	FISH 4 - acoustics/LHPR fishing
9 Feb 1830	9 Feb 1900	0.5 h	FISH4-CTD at FRAN2
9 Feb 1930	9 Feb 2200	2.5 h	FISH 4 - postdusk haul RMT8+1 haul at FRAN 2
9 Feb 2230	10 Feb 0100	2.5 h	FISH 4 - midnight haul
10 Feb 0130	10 Feb 0330	2.0 h	FISH 4 - predawn haul
10 Feb 0330	10 Feb 0400	0.5 h	FISH 4 - WBOT for David Pond
10 Feb 0400	10 Feb 1000	6.0 h	Acoustics/LHPR fishing
10Feb 1000	10Feb 1100	1.0h	Recover rig, ZNET if time
10 Feb 1100	10 Feb 2000	9.0 h	Acoustics/LHPR towards krill NE of Cumberland Bay
10 Feb 2000	11 Feb 0400	8.0 h	krill fishing
11 Feb 0400	11 Feb0430	0.5 h	WBOT for David Pond, ZNET if time
11 Feb 0400	11 Feb 1530	11.5 h	Acoustics (whale watching in afternoon)
11 Feb 1530	11 Feb 1730	2.0 h	Steam to FISH 5.12 miles off Royal Bay
ll Feb1730	ll Feb1930	2.0 h	CTD and WBOTs (10) for rig, ZNET if time
11 Feb 1930	11 Feb 2200	2.5 h	FISH 5 - postdusk RMT8+1 haul, 12 miles off coast
11 Feb 2230	12 Feb 0100	2.5 h	FISH 5 - midnight haul
12 Feb 0130	12 Feb 0330	2.0 h	FISH 5 - predawn haul
12 Feb 0330	12 Feb 0400	0.5 h	FISH 5 - &ploy rig at 12 mile station
12 Feb 0400	12 Feb 0430	0.5 h	FISH 5 - CTD at 12 mile station
12 Feb 0430	12 Feb 0700	2.5 h	FISH 5 - Agassiz trawling
12 Feb 0700	12 Feb 1700	10.0 h	FISH 5 - Acoustics/LHPR fishing/CID grid over area of krill swarms
12 Feb 1800	12 Feb 1830	0.5 h	FISH 5 - recover rig
12 Feb 1830	12 Feb 1930	1.0h	FISH 5 - steam to station 3 mile off coast
12 Feb 1930	12 Feb 2200	2.5 h	FISH 5 - postdusk RMT8+1 haul
12 Feb 2230	13 Feb 0100	2.5 h	FISH 5 - midnight haul
13 Feb 0130	13 Feb 0330	2.0 h	FISH 5 - predawn haul
13 Feb 0330	13 Feb 0400	0.5 h	FISH5-CTD and then WBOT for CR
13 Feb 0400	13 Feb 2000	16.0 h	Acoustic transect to squid 3 (150 nmi via south)
13 Feb 2000	14 Feb 0400	8.0 h	SQUID 3 - night hauls
14 Feb 0400	14 Feb 2000	16.0 h	SQUID 3 - day hauls, plus CTD and WBOTs for GC, CR, ZNET for AA
14 Feb 2000	15 Feb 0200	6.0 h	SQUID 3 - night(800-1000)
15 Feb 0200	18 Feb 2000	90.0 h	Passage time to STANLEY (72Onautical miles)

Table 1: Biomass (ml/100 m^2 of major taxononic groups and selected dominant species calculated from RMT25 hauls made in darkness.

Group/Species	Station A 0 - 200 m	0 - 1000 m	Station b o - 200 m	0 - loo0 m
Coelenterata	46.2	2833.3	264.9	1812.6
mol lusca	1.8	23.5	2.1	15.8
Euphausiacea	2.4	4.1	119.7	146.1
Decapoda	4.1	b3.3	0.0	33.6
Amphipoda	0.2	13.7	0. 3	11.4
*Tunicata	2863.2	4157.0	0.2	1.1
Pi sces	48.7	492.2	48.9	421.6
Total	2966. 6	7587.1	436.8	2442.2
Atolla wyvillei	0.0	969.4	0.0	164.1
PeriphylIa periphyila	0.0	1067.5	1.5	1111.7
Brachioteuthis ?picta	1.7	6.3	2.5	7 . 5
Euphausuia triacantha	2.4	3.8	118.0	142.0
Acanthephyra pelagica	0.0	7.9	0. 0	22.3
Pasiphaea Iongispina	4.1	55.0	0.0	7.3
Electrona Antarctica	3.9	44.1	5.7	89.5
Electrona Carlsbergi	27.0	29.2	0.0	2. 7
Gymnoscopelus bolini	0.0	21.9	0.0	22.8
Gymnoscopelus Braueri	6.2	30.2	24.3	81.7
Krefftichthys anderssoni	0.0	48.6	0.1	30.9
Lampanytus achirus	0. 0	16.8	0.0	21.7
Protomyctophus bolini	5.4	16.4	7.4	10.1
Bathylagus antarcticus	0. 0	236.1	0.9	62.8
Borostomias antarcticus	0. 4	10.3	0.0	17.6
Cyanomacrurus pirei	0.0	17.5	0.0	30.9

* consists of Salpa thompsoni only

Table 2: Mean number of larvae per hour fishing at each of five sites off the coast of South Georgia.

Species	*gunnari*		*Notothenia nudifrons*		*Notothenia gibberifrons*	
	Nautical miles from the coast					
	4	12	4	12	4	12
Site						
B. of Isle	14	0.9	3	0.4	14	5
Possession B.	711	93	78	1.6	95	35
Stromness B.	213	11	34	4.3	11	20
Cumberland B.	399	0.0	285	0.5	3.0	6.2
Royal B.	315	0.7	52	0.7	24	63

Table 3: (a) Analysis of variance table of length of krill caught in net hauls during cruise (b) *mean* length of krill and standard deviation of mean for each net haul.

(a) ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F	p
NET HAUL	37	4279.8	115.7	7.68	0.000
ERROR	2163	32581.5	15.1		
TOTAL	2200	36861.2			

(b)

HAUL-NET	N	MEAN	STDEV
kr171 1	100	39.320	3.363
kr287-1	100	41.820	4.024
kr194-2	57	40.035	3.937
kr194-3	66	40.576	4.091
kr114-1	19	35.474	4.501
kr114-2	6	38.000	2.366
kr114-3	6	34.000	3.742
kr292-1	100	40.520	3.116
kr295-2	78	40.167	3.623
kr303-1	100	42.370	4.844
kr304-3	102	42.873	4.635
kr346-1	23	41.826	3.380
kr349- 1	45	40.911	2.054
kr532-1	22	42.636	5.132
kr546-1	22	39.455	2.923
kr546-2	12	38.833	2.038
kr5463	6	35.167	2.317
kr547-1	56	38.607	3.971
kr547-2	31	38.903	3.208
kr5473	100	39.270	2.957
kr561	100	39.950	4.396
kr600_1	33	39.939	3.848
kr600_2	100	38.970	3.580
kr600_3	55	39.055	4.668
kr617_1	18	41.278	5.222
kr617_2	12	40.167	5.702
kr617_3	16	44.062	5.385
kr619_1	10	43.900	5.953
kr619_2	100	40.260	3.335
kr619_3	69	41.478	3.505
kr620_1	100	41.040	4.038
kr620_3	100	40.350	3.465
kr663_1	100	39.060	3.856
kr664-1	49	40.449	4.971
kr666-1	50	38.820	3.160
kr666_3	50	38.540	4.171
kr702-1	100	40.450	4.086
kr704_1	88	38.818	3.204