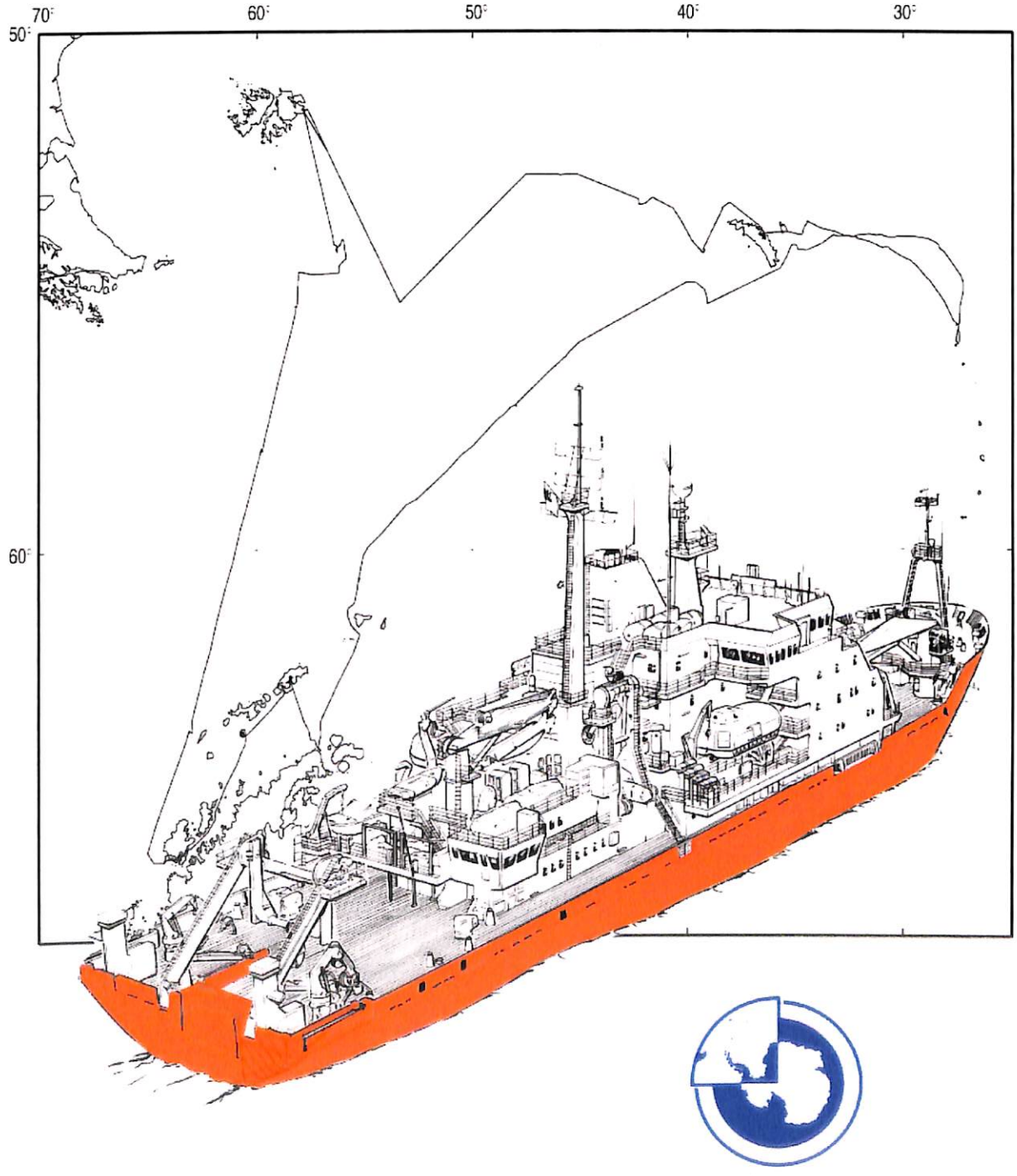
British Antarctic Survey

Pelagic Ecosystem Studies

Research Cruise report no. 4



RRS *James Clark Ross* Cruise JR26

British Antarctic Survey

Cruise Report No.4

RRS *James Clark Ross* Cruise 26
17 November – 14 December 1997

GeneFlow Cruise

Principal Scientist: P G Rodhouse DSc

2000

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ABSTRACT

The GeneFlow Cruise was a collaborative, interdisciplinary expedition to collect data and specimens necessary for the study of the interactions between oceanography and genetic structure of marine populations. Populations of the principle marine resource species (krill, fish and squid), as well as other planktonic fish larvae and invertebrates were sampled around the periphery of the Scotia Sea to test levels of genetic isolation and determine genetic exchange, or gene flow, between them. A substantial collection of fish larvae, krill, juvenile cephalopods and other marine invertebrates was made, and the oceanography of the water masses in which the samples were taken was thoroughly characterised in all areas where biological sampling took place. Heavy pack ice meant that the ship was not able to proceed from the South Sandwich Islands to the South Orkney group as originally intended so no samples were collected from that area.

KEYWORDS

Population genetics, gene flow, oceanography, marine resources, fish, krill, cephalopods, invertebrates

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William Kerswell	2nd Engineer
Roger Jones	3rd Engineer
Steven Eadie	4th Engineer
Simon Wright	Deck Engineer
Norman Thomas	Electrician
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James Williams	Bosun's Mate
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Carl Fairbrother	Seaman
Westly Macko	Seaman
Peter Cossey	Seaman
Raymond Davies	Seaman
Sydney Smith	Motorman
Mark Robinshaw	Motorman
Roy Fox	Chef
David Bailey	2nd Cook
Derek Lee	Steward
Francis Hardacre	Steward
Lawrence Baldwin-White	Steward
Simon Hadgraft	Steward

Ship's Doctor

Susan MacIver

Objectives

The GeneFlow Cruise was a collaborative, interdisciplinary study of the role of ocean currents, fronts and gyres on the genetic structure of populations of marine animals. It set out to sample populations of the principle marine resource species (krill, fish and squid), as well as other planktonic fish larvae and invertebrates, throughout the periphery of the Scotia Sea to test levels of genetic isolation and deduce the degree of genetic exchange, or gene flow, between them. The science addresses general questions about the role of physical oceanographic boundaries in the structuring of populations and evolutionary processes and will be relevant to the management of living marine resources in the CCAMLR area.

The principle objectives were to: a) characterise physical oceanographic processes around the periphery of the Scotia Sea; b) sample krill at fixed stations and also underway between stations; c) sample larval fish at fixed stations; d) sample adult squid with a new squid jigger system using incandescent fishing lights; and e) make comprehensive collections of other planktonic fish and invertebrates from each station.

The intention was to carry out underway sampling using an Acoustic Doppler Current Profiler (ADCP), Undulating Oceanographic Recorder (UOR), echosounder (EK500) and high speed tow net (HSTN), and station sampling with the CTD, squid jigger, rectangular midwater trawl (RMT8), neuston net (F-net) and Bongo net.

A total of 29 major stations were planned where CTD casts, squid jigger operations and net hauls would be carried out and 11 minor stations where only CTD casts would be made. The stations were chosen at a series of key sites around the periphery of the Scotia Sea starting at the Falkland Islands, stretching eastwards along the north Scotia Arc to Shag Rocks, South Georgia, the South Sandwich Islands and then westwards along the south Scotia Arc to the South Orkneys, Elephant Island and the Antarctic Peninsula. The final leg across the Drake Passage would end with a small series of stations over Burdwood Bank and at the edge of the Patagonian Shelf.

Narrative

All times are given as Universal Time (UTC), ship time was 3h behind UTC throughout the cruise.

Friday 14 November
Having taken off from RAF BZN late on the previous evening the scientific group arrived at RAF MPA a little behind schedule and were transported by bus to Stanley where males were accommodated in the new Ross shanty and females at the Upland Goose. The JCR was already alongside at FIPAS with the scientific group from JR25, four of whom will stay on board for JR26.

Saturday 15 November
Was spent organising the laboratories and preparing sampling equipment with Doug Bone (PES gear technologist) who will not be joining JR26.

Sunday 16 November
Was spent completing yesterday's tasks and in orientation on the ship and in the Falkland Islands.

Monday 17 November
A short meeting for all the scientific party was held in the ship's library at 1200z during which the visiting scientists were welcomed and a brief overview of the cruise itinerary was presented by the Principal Scientist. A scheme for scientific watch keeping was agreed and the need for efficiency at stations was emphasised given the tight schedule. It was also emphasised that there would be a need for team work in order to ensure a sound collection of material (GeneBank) that would form a common resource, as well as the collections required by individuals. The cruise report was discussed together with information about communications and other domestic matters.

The ship cast off from FIPAS promptly at 1700z in fine weather. The scientific sampling gear and laboratories had been prepared and were largely ready for use before sailing so, after the ship's safety briefing, the scientific party, some of whom were embarking on their first scientific cruise, were able to find their sea legs in relatively relaxed circumstances.

Tuesday 18 November
We arrived at Station 1 (Rhine Bank) at 1945z. The seamount shown on the Admiralty chart was not located in the position shown but sampling proceeded at this open ocean location to the north of the Antarctic Polar Front (APF). A CTD cast was made and the squid jigger operated simultaneously. This was the first time that the jigger had been used at sea and it operated faultlessly although no squid were caught. Two RMT8 and F net hauls followed. Samples included myctophid fish and a variety of pelagic invertebrates.

Wednesday 19 November
Arrived at Station 2 at 2028z. The RMT8 and F nets were deployed first so that the squid jigger, with the CTD, would be operating in darkness. Two RMT8 hauls were made which yielded myctophids and invertebrates.

Thursday 20 November
Arrived at Station 3 at 0934z. The CTD and jigger were deployed first, followed by one RMT8 and F net haul. We then departed for Station 4 at Shag Rocks and arrived there about 10 hours later at 2202z. The first RMT8 and F-net haul were made approximately along the 200 m bathymetric contour. A second and third haul with these nets was then made over the shelf between Shag Rocks and Black Rock. The ship then moved to the 1000 m contour to the NE of Shag rocks were the CTD and squid jigger were deployed. This allowed a deep CTD cast to be made and enabled the squid jigger to be operated on the bathymetric feature where *Martialia* had been caught by a commercial Korean squid jigger in June 1997. However, no squid were caught.

Friday 21 November
After leaving Station 4 we steamed south east towards Station 5 south of Bird Island and near the South Georgia shelf break. Several miles before reaching Station 5 we ran into loose (one to two tenths) pack ice at 54° 36'S 39° 16'W. We were able to continue to the Station, arriving at 1642z but the presence of pack ice this far north suggested that we may have problems later reaching some of the southerly stations scheduled for the cruise. This was confirmed later by the news that *RRS Bransfield* had encountered ice well to the north of the South Orkney Islands and had not been able to get within 8 miles of Signy Island. At the Station position the CTD and squid jigger were deployed. We then steamed to the 500 m contour where the RMT8 was deployed and fished through a strong acoustic layer at about 200 m. The F net was not used because of the danger of damage by loose pack ice. The catch from the RMT8 was small and included salps. However, this layer and most of the similar layers at this depth that we have seen are much more likely to be caused by myctophiids. If the acoustic layer had been caused by salps they could not

have avoided the net and it would have been swamped by them . These echoes are stronger at 38kHz than at 120kHz suggesting that the source may be targets larger than krill.

Saturday 22 November
Station 6 was chosen, during cruise planning, to represent the box to the north west of South Georgia routinely sampled by the PES Core Programme. We arrived there at 0335z and deployed the CTD and squid jigger. Three RMT8 deployments then followed with F nets and substantial quantities of krill were caught. We left Station 6 and proceeded towards Cumberland Bay at 1028z.

We arrived in Cumberland East Bay at 1630z and deployed the RMT8 and F net immediately. This successfully caught numerous fish larvae. We then went alongside at Grytviken for a couple of hours to deliver mail, leaving King Edward Cove to continue with the next RMT8 in Cumberland East Bay at 2336z.

Sunday 23 November
The RMT8 haul was accompanied by 3 F nets to maximise opportunities to catch fish larvae in the surface layer and was recovered at 0118z off Larsen Point. Two more RMT8 hauls with 3 F nets were then made, the second being completed at 0555z after which we set course for Station 8 in the eastern PES Core Programme box.

By the time we had reached Station 8 heavy weather meant that we were unable to launch any nets and the vessel hove to. Given the conditions, and the expected improvement in the weather later in the day, based on a met report from Rothera, it was decided that the best use of time would be to return to Cumberland Bay and carry out some further RMT8 hauls for fish larvae. We went to Cumberland West Bay and launched the RMT8 at 1415z and a second at 1712z. Three F nets were deployed with each RMT8 and all hauls yielded good catches of fish larvae. We then went into Cumberland East Bay to trial the High Speed Tow Net (HSTN). In calm water at the head of the Bay it was launched successfully at four, six, eight and ten knots. At 2000 we proceeded for the second time towards Station 8.

Monday 24 November
The CTD was deployed at Station 8 at 0144z but conditions were still too rough to work the squid jigger. The RMT8 and F net were deployed in an area where krill marks were seen but failed to catch krill although other invertebrates were collected. The Station was completed at 1257z and the vessel set course for Station 9. The UOR was deployed immediately but we came upon pack soon afterwards. The vessel changed course to port in order to try and skirt the pack to the north but by 1800z it was clear that this strategy was not going to work so the UOR was recovered and stowed on deck. We then set course for a point to the north of the South Sandwich Islands planning to make CTD casts at five hourly intervals and target acoustic marks opportunistically with the nets.

Tuesday 25 November
At 0001z the first of the five hourly CTD casts was started and the squid jigger operated for one hour. The ship then got underway and at 0435z the RMT8 was deployed to sample myctophids and successfully target krill marks seen on the echosounder. A second RMT8 was deployed soon afterwards. The second five hourly CTD cast was started at 0711z with the squid jigger running simultaneously and the third was started at 1303z. One hour after the end of this CTD station a relatively large krill mark appeared on the echosounder. The vessel turned around and the target was successfully fished with the RMT8 which caught a large haul of small krill with a distinctly different size structure to those caught previously. The fourth CTD station on this leg

was started at 2153z with the squid jigger.

Wednesday 26 November
At 0733 the last CTD/squid jigger station before turning southwards was occupied. This was completed at 0840z after which we set course for a point on the 1000 m contour to the east of Zavodovski Island, the most northerly island in the South Sandwich Islands chain. Both yesterday and today we have been steaming through extensive areas of pack ice that reduce our speed to about four knots and we occasionally break out into stretches of open water when we can increase to ten knots. We arrived at our Station off the east of Zavodovski Island at 1504z and deployed the CTD and squid jigger. We then did two RMT8 hauls through loose pack near the edge of the shelf off the east of Zavodovski Island. No F net hauls were made because of the danger of ice near the bow. With care there does not appear to be any danger to the RMT8 in these conditions and we continued to be conservative about conditions in which it will be launched. At dusk the vessel was taken into an area of dense pack and we then started to drift with the ice which we will to do until daylight when we will deploy the RMT8 in shallower water, inside the 200 m bathymetric contour.

Thursday 27 November
Before first light we started to move in towards the 200 m contour and at 0534z the RMT8 was launched in an area extending into a large lead around the east side of the Island. A second haul was then made in this lead and recovered at 0910. We caught krill and several invertebrate species including *Thysanoessa* but no fish larvae which we had hoped for. During this morning's hauls we have been steaming through huge flocks of chinstrap penguins in the water and there is evidence of extensive areas of their pink faeces in the snow on Zavodovski Islands and on several icebergs that appear to be grounded nearby. Visibility was very good and beyond Zavodovski we had had views of Viskoi, the small island, Leskov, to the SW and Candlemas in the distance.

After we finished the second RMT8 haul we left the area in an approximately NNE by N direction which in the opinion of the Master is the direction of the nearest ice free water. Given the unusual pack ice conditions this year we were not going to be able to complete the South Orkney and other southern stations scheduled for this cruise so, after leaving the ice, we steamed westwards, past the north of South Georgia, in order to minimise the time taken to reach the Antarctic Peninsula. Here we hoped to meet relatively ice free conditions, complete the scheduled stations in that area and then review the ice situation with regard to the area of shelf around South Orkney Islands

Friday 28 November
Since sailing from the South Sandwich Islands there had been no scientific activities other than underway acoustics, ADCP ocean logger recording, but we had received a NOAA ice chart and weather forecast. Strong northerly wind in the South Georgia area seemed to be pushing the loose pack ice south perhaps allowing us to take a shorter course towards the Antarctic Peninsula which would take us to the south of South Georgia. With this in mind a discussion was held after dinner among the science group. It was agreed that we would try and target nets on krill swarms on the south side of South Georgia as we pass and that a series of CTD stations would be occupied across the Scotia Sea. We will also target nets on any mesopelagic layers that we see in the next few days to collect myctophids that are needed for genetic comparison with material from north of the APF.

Saturday 29 November
We arrived at the CTD Station on the 1000 m contour south of South Georgia at 0937z and deployed the instrument together with the squid jigger. The Station was completed at 1045z and we set course for the next position. We had now started our transect across the middle of the Scotia Sea towards Elephant Island and the Antarctic Peninsula. We would not be taking a direct course but would curve to the north in order to avoid pack ice encountered by Bransfield north of Coronation Island. In the absence of unexpected conditions we would arrive in the Peninsula area more or less as scheduled during cruise planning in Cambridge. This would mean that we would miss the South Orkney shelf stations and those running in and out of that area. However, we already had a good collection of material for genetic analysis from a range of water masses, so if the Peninsula stations, and those after, went well we would have achieved a substantial part of the original objectives. Between South Georgia and Elephant Island we planned to occupy CTD (1000 m) stations at 100 mile intervals. As it happened we were backtracking along the route of Shackleton's voyage in the *James Caird*.

At 2215z we arrived at the next CTD Station and departed at 2322z. The squid jigger was not deployed because repairs to the trampoline were needed.

Sunday 30 November
At 0048z the vessel passed over some acoustic marks which were probably krill and so the vessel turned around to deploy the RMT8 and F nets. The haul was completed by 0257z and caught a good sample of krill, myctophids, salps and other invertebrates. Between 1038 and 1138z and 1954z and 2100z the next two CTD/squid jigger Stations in the series across the Scotia Sea were occupied.

Monday 1 December
Between midnight and 0300z the HSTN was deployed four times for about 30 minutes each, taking an assorted catch, and a CTD/squid jigger station was occupied between 0640z and 0748. Prior to the CTD cast, promising krill marks had been seen on the echosounder and so when the cast was finished the vessel steamed 3 km back to the position where these had been seen and the RMT8 was deployed between 0758 and 0905z. This was targeted at the acoustic marks and caught a substantial quantity of krill. A further CTD/squid jigger Station was occupied between 1730 and 1832z.

Tuesday 2 December
The final CTD/squid jigger Station on the South Georgia/Elephant Island transect was occupied between 0708 and 0815z. At 1620z the RMT8 was deployed to fish a large krill target to the north of Elephant Island. It was hauled at 1750z with a very large krill catch (two fish boxes full). Between 2020 - 2100 a CTD/squid jigger Station was occupied at the 200 m bathyemetric contour to the north of Elephant Island. The vessel then steamed down a transect to the west of Elephant Island where it was intended that the RMT8 be deployed to catch fish larvae during darkness. This was necessarily done first in daylight with no nets because the area is poorly surveyed.

Wednesday 3 December
The RMT8 was deployed off Elephant Island from 0136 - 0300 and from 0339 - 0515 in the upper 100 m and took good catches of krill together with large numbers of larvae of *Trematomus hansoni*, *Lepidonothen larseni* and several species of icefish apart from *Champsocephalus gunnari*. The vessel then set course across the Bransfield Strait for Antarctic Sound occupying a CTD/squid jigger Station at the mid-point between 1102 - 1222z and deploying the RMT8 from 1338 - 1537 to successfully target a krill swarm seen on the echosounder. We arrived at

Antarctic Sound in the afternoon to find a great deal of ice, including large numbers of bergs. The recent satellite AVHRR image from Rothera, received on 2 December, had suggested that the Sound was reasonably clear but this is a very dynamic area. We entered the sound on the west side where there was a reasonably clear passage but were unable to get as far as Hope Bay because of a combination of ice and fog banks. We therefore deployed the RMT8 from 2156 - 0054 in a lead of clear water off Mount Bransfield and then returned to the start position to deploy the CTD/squid jigger from 0146 - 0226z as far into Antarctic Sound as possible under the prevailing ice and visibility conditions.

Thursday 4 December
After the CTD Station the ship moved to a bank shown on the chart near the western side of the entrance of Antarctic Sound and the RMT8 was deployed from 0540 - 0726z. The net caught some icefish larvae (not *C. gunnari), Harpagifer, Pleuragramma, T. hansoni* and a sample of small krill. After that the vessel set course for Admiralty Bay, King George Island. On arrival in Admiralty Bay we proceeded to the head of the Bay and deployed the CTD/squid jigger between 1621 - 1705z. There were then three RMT8 deployments in the bay between 1757 - 0318z to catch krill and fish larvae, after which we proceeded to Maxwell Bay.

Friday 5 December
On arrival in Maxwell Bay one RMT8 deployment from 0428-0624z was carried out and then we went into Marian Cove to calibrate the EK500 with the ship held with the Dynamic Positioning System (DPS). This process started with a CTD cast at 0813 - 0826z. The calibration continued until 2032 - 2043z when the CTD was deployed to complete the data. During the calibration a group including the PSO went ashore at 1200z to visit the Korean Station (King Sejong) at the entrance to Marian Cove and afterwards a group of six Korean scientists and support personnel visited the ship for a short tour of the laboratories etc. At 2043z the vessel set course for Deception Island.

Saturday 6 December
We arrived in the caldera at Deception Island and deployed the CTD at 0809 - 0830z. A total of six RMT8 with F-net tows were then made in the caldera between 0900 and 0133z covering daylight and semi-darkness (it does not get fully dark at this season and latitude). The hauls caught krill and fish larvae including *C. gunnari.*

Sunday 7 December
Fog delayed our departure but after 0600 it lifted enough for us to leave Neptunes Bellows and haul the RMT8 between 0653 - 0839z over the shallow ground just outside the Bellows. This produced another sample of krill and fish larvae, again including *C. gunnari.* After this haul we set course for the Gerlache Strait. By early afternoon we were in the northern part of the Gerlache Strait where we deployed the RMT8 from 0133 - 0310z followed by a CTD cast with the squid jigger at 1908 -1858z. Another RMT8 haul was then made at 1912 - 2011z.

Monday 8 December
In the early evening we entered the Gerlache Strait and deployed the RMT8 in the northern part of the Strait at 0030 - 0212z. This caught a large amount of krill. We then proceeded to a position south of Anvers Island where a CTD/squid jigger station was occupied from 0634 - 0737z. An RMT8 haul was then made in the area at 0815 - 0837z. This caught large samples from three distinct swarms of krill in three separate nets for genetic comparison between swarms. An RMT8 haul was made in deeper water in the Bismark Strait from 0910 - 1104z in which caught some myctophids, a scabard fish and invertebrates. Another RMT8 haul was then made in <200 m near Cape Lancaster from 1230 - 1410z. We then anchored off Palmer Station for a

short visit, during which some krill that had been collected in shallow water by the Americans were obtained. We then set course for the shelf break off Smith Island.

Tuesday 9 December
We arrived at the shelf break and deployed the CTD/squid jigger at 1025 - 1132z. There were some krill marks on the echosounder as we approached the Station so these were targeted with the RMT8 from 1145 - 1324z.

Wednesday 10 December
Further marks were seen on the echosounder and targeted with the RMT8 at 0220 - 0230 - 0438z and 1133 - 1216z. Both caught krill, the first yielded a very high catch (c. 200 l). At around 1900z, in the vicinity of the APF, some small but dense acoustic marks were seen on the EK500 at about 350 m depth. These were interpreted as possible squid marks lying beneath a layer of myctophids. The ship ran back over these marks and a sector search with three mile legs was initiated and more marks of the same type were seen on the third leg of the first pattern. An RMT8 haul from 2124 - 2256z targeted the layer and was fished near one of the possible squid marks. The haul included salps and myctophids. The vessel then took up station over one of the dense marks and the fishing lights and jigger deployed at 2330z. The layers came up in the night and a dense layer in the upper 50 m was formed. Numerous salps, krill, small zooplankton and pelagic polychaetes came to the surface under the lights and a large flock of albatrosses, including several grey-headed albatrosses, formed on the dark side of the ship but no squid were caught. Once darkness fell there were no signs of likely squid marks on the echosounder. At 0240z the jigger operation was finished and the vessel set course for the next Station.

Thursday 11 December
At 0859 - 1016z a CTD/jigger Station was occupied north of the APF and at 1022 - 1224z an RMT8 haul was made which caught a variety of oceanic invertebrates: salps, pteropods, hyperiids and myctophids (*Protomyctophum bolini*). At 1911 - 2242z the RMT8 was deployed to collect the last sample of oceanic pelagic fauna north of the APF and before we reach the Burdwood Bank. This net caught a sample of small squid juveniles which could not be identified but which were not ommastrephids.

Friday 12 December
As we approached the Burdwood Bank we altered to an easterly course in order to skirt the southern edge of the shelf via a series of shoal areas on the south east side of the Bank. We soon passed over a shoal area and launched the RMT8 at 0435 - 0819z. The haul caught several species of invertebrate including *E. valentini* and a *Gonatus antarcticus* juvenile in very good condition. We then steamed around the eastern end of Burdwood Bank passing over several more shoal areas marked on the chart. No promising acoustic marks were seen so when we had reached the north east side of the Bank we went in over the 200 m bathymetric contour and deployed the RMT8 and F net from 1819-2020z. We then did a series of six RMT8 hauls, the first of which started at 2106z, along the northern edge of Burdwood Bank. Each haul started near the seabed over the Bank and passed over the 200 m contour at approximately the mid-point, continuing out beyond the shelf.

Saturday 13 December
The last of the series on RMT8 hauls was completed at 1315z. They had collected squid larvae, a small sample of larval fish including toothfish, and several invertebrate species. A final CTD cast was made at 1619 - 1720z between Burdwood Bank and the southern edge of the Patagonian Shelf. Following the CTD we set course for Stanley.

Principle Scientist's report

Overview
The cruise achieved most of the original objectives. A substantial collection of fish larvae, krill and juvenile cephalopods was made covering most of the periphery of the Scotia Sea. The oceanography of the water masses in which the samples were taken was thoroughly characterised in all areas and these data will provide the basis for the interpretation of population genetic structure of the species that will be examined.

Heavy pack ice meant that the ship was not able to proceed from the South Sandwich Islands to the South Orkney group as originally intended and so no samples were collected from that area. Although small juvenile squid were sampled by the RMT net system the squid jigger was not successful in catching adult squid. The jigger performed well mechanically and data from squid predators at Bird Island subsequent to the cruise indicated that squid were very scarce in the predators' foraging areas.

Health and safety
Potential problems exist in the ship's laboratories because of the need for the crew to clean the decks and surfaces where hazardous chemicals may be stowed. This was raised at the Ship's Safety Committee meeting on 10 November and discussed afterwards by the PSO, Master and Chief Engineer. It was agreed that a locker would be identified in the main laboratory where cleaning materials would be stowed and a cordless vacuum cleaner would be located on the bulkhead near the photocopier. The science group would be responsible for keeping a rota for maintaining cleanliness in their own laboratory spaces, including the Computer Office and Data Prep Room. Alternatively, if they wish the ship's crew to clean, the request should be made through the PSO. The science group would then ensure that hazardous materials were cleared in advance from the area to be cleaned.

These arrangements should be presented as part of the safety briefing at the start of a cruise.

Radioactive material
The GeneFlow Cruise did not involve use of radioactive material but discussions were also held with the ship's safety officer on procedures for use of radioactive material on future cruises.

A form will in future be issued to the PSO, at the start of a cruise, which will require all radioactive hazards for use on the cruise to be reported. This will be kept on file by the Master. At the end of the cruise a certificate of radioactive decontamination will be completed after the laboratory, stowage space and associated equipment have been surveyed for any residual radioactive spillage or contamination. This must be signed by the designated person responsible for radioactive substances and the form submitted to the Master. The form will then be forwarded to the Radiation Protection Supervisor at BAS.

SCIENCE REPORTS

Overview of science - John Thorpe

Over a number of years it has become increasingly apparent from empirical (genetic) data that for many marine species the expected levels of gene dispersal are not being achieved. In the Southern Ocean it might appear initially that there are few barriers to restrict the dispersal of planktonic or other marine animals. However it has been hypothesised that great depths between continental shelves and/or various oceanographic phenomena such as confluences and gyres may restrict or preclude dispersal of genes between geographically separated populations. A knowledge of gene flow in essential for the understanding of population structure in many ecologically or commercially important Antarctic species. With this in mind the GeneFlow cruise has been devised specifically to obtain samples for the study of the processes of gene dispersal in selected Antarctic species.

For many years a major rôle of genetic techniques in marine biology has been to attempt to understand how populations of marine species and the species themselves are structured. Clearly if two of more populations of a species become geographically separated they are likely to start to diverge genetically. The reasons for and processes concerned in this divergence are still subject to debate, but may be considered to include stochastic drift (genetic divergence following from random chance fluctuations in gene frequencies), possible natural selection and chance genetic mutations. There are numerous proposed models of gene flow between allopatric populations, but a major conclusion from nearly all of these is that even very small levels of gene flow between populations are likely to greatly reduce or effectively eliminate divergence of gene frequencies under most natural conditions. Consequently it is clear that understanding gene flow is of the greatest importance in describing the structuring of marine, or any other, natural populations.

Among marine species a large proportion of the studies of genetic structuring which have been carried out have been on temperate invertebrates, many of these intertidal or shallow subtidal benthic species. In many of these the adults are either sessile (e.g. bivalves, barnacles, sponges, bryozoans) or of very limited mobility (e.g. snails, limpets, crabs, worms), with the result that for most of them the pelagic larva is the main dispersive phase of the life cycle. Indeed it had become almost axiomatic in much of the relevant literature that marine larvae were evolved "for dispersal" and that such dispersal was of indisputable benefit to the species. Such "group selectionist" views have been challenged and such challenges have been increasingly supported empirically by population genetic data indicating wide variation in gene flow mediated by apparently similar larvae. In particular, whilst many long lived larvae appear to effect the expected widespread gene flow, others apparently do not and some species with long lived larvae show significant divergence of gene frequencies over very short distances. In such cases very localised hydrographic or ecological factors have frequently been hypothesised to be reducing dispersal.

In the Antarctic, geographical distances are much greater than those encompassed in many of these temperate studies and many key species show greater mobility so that any genetic differentiation may be expected to occur only over these much larger distances. Species in which gene flow is of particular ecological interest or commercial significance include pelagic planktonic species (e.g. krill, salps, ctenophores and various small fish), some larger benthic fish species (e.g. ice fish, tooth fish) and various cephalopods (e.g. the pelagic squid *Martialia hyadesi* and the benthic octopus *Pareledone spp.*).

For the larger (benthic) fish and cephalopods major barriers to dispersal may be deep water areas between continental shelves. By conventional standards many of these with lower distribution limits of thousands of metres are relatively deep water species, but in the Antarctic the continental shelf areas and sea mounts are typically separated by very deep (4000+ m) water. Such depths probably constitute insuperable barriers for the adults even in the larger fish species, but pelagic larvae may or may not be able to cross. Whether they can do so will depend on such factors as length of larval life, distance to be crossed, current direction and the existence of possible oceanographic barriers. The importance of the latter in influencing larval dispersal is becoming increasingly apparent and indeed in one of the very few studies to date of pelagic larval dispersal in the Antarctic. Allcock *et al.* (1997) conclude that a previously suspected oceanographic barrier between Shag Rocks and South Georgia prevents transport between the two areas for the larvae of the octopus *Pareledone turqueti.*

For the pelagic organisms of the Antarctic the major unknown in their population genetics is the extent to which to which these also may or may not cross between water bodies. It is highly likely that planktonic animals like salps, ctenophores and krill cannot move significant (horizontal) distances under their own power and thus, to a large extent, can move only with the bodies of water in which they find themselves. However, they may have considerable control of their own buoyancy and consequently can regulate the depths at which they float. With this capability they could possibly select currents at different depths to carry them in some "preferred" direction. The main water mass of the Southern Ocean rotates in an easterly direction around the Antarctic continent, but at a speed which would take perhaps several years for a complete circumnavigation. This might indicate that planktonic species cannot avoid a high degree of genetic mixing, albeit over an extended time scale. However, there is also oceanographic evidence of separation of various component parts of the Southern Ocean. For example, the Weddell-Scotia Confluence seems to separate water to the west of the Scotia Arc from that immediately to the east, whilst other bodies of water show rotational movements (gyres) of long duration (e.g. perhaps a year or more in the Weddell Sea), which may lead to planktonic species being retained, and thus genetically isolated, within these bodies of water. Thus empirical data are needed to understand the extent to which the oceanography of the Antarctic Ocean may effect the genetic isolation of planktonic organisms.

The main purpose for which the GeneFlow Cruise (JR26) was devised was to collect a wider range of Antarctic organisms, showing varying mobilities and propensities for widespread distribution, and to use these as models to assess gene flow throughout the area. In particular the aim was to use comprehensive oceanographic data collected simultaneously so that all samples of species collected could be directly allocated to known water masses, and that other parameters like temperatures and current speeds and directions would also be known.

Net Sampling - A.W. North and M. G. White

A range of different nets were used to collect zooplankton, nekton and demersal fish during the Geneflow Cruise. An 8 m^2 rectangular midwater trawl (RMT8) was the main zooplankton/ichthyoplankton sampling device. In addition, a foredeck net (FNET) and a high speed tow net (HSTN) were deployed alongside the foredeck to collect samples from the surface 0-3m. A Bongo net was available as a backup to the RMT8 but was not required and an Agassiz Dredge was not used. The nets used during the Geneflow Cruise are summarized below, followed by a separate section on problems experienced.

RMT8

The opening and closing, multiple RMT8 net (8 m^2, 5 mm mesh, 1 mm mesh cod-end) was towed at 3 ± 0.5 knots at various depths behind the ship. This was deployed closed, and then a series of three nets were fished in pre-planned depth layers, or at acoustic targets visualized using the EK500 scientific echo sounder. A down wire net monitor deck unit and PC (DWNM) were used to operate the nets and receive sensor indications on net depth, altitude (above seabed), horizontal and vertical flow rate, angle in the water, water temperature and salinity. Net 1 was opened at the required target depth. When net 1 was closed this opened the second net, and similarly, as the second net was closed the third net was opened. Fishing was ended by closing the third net, and then the three closed nets were hauled to the surface.

Several near-bottom tows and tows amongst pack-ice were conducted using the RMT8 net. The RMT8 net caught most material including euphausiids, squid, lanternfish, fish larvae, amphipods and other crustaceans, salps, jellyfish, a few nemerteans and other taxa.

The RMT8 system performed almost faultlessly during the Cruise.

FNET

A foredeck net (1 m^2, and 5 mm mesh, with 1 mm mesh cod-end) was towed alongside the ship in the surface 0-2 m depth layer during many of the RMT8 tows. The FNET was deployed from the starboard "Effer" crane fully extended horizontally so the net was towed in reasonably undisturbed water beside the vessel. A wire stay attached on the foredeck restrained the jib from swinging aft. The foredeck net caught pteropods, krill, salps, ctenophores and fish larvae (including *Dissostichus eleginoides*), and other minor taxa. The FNET and HSTN were not deployed when there was ice in the vicinity, because they were vulnerable to damage by ice passing down the side of the vessel.

HSTN

A high speed towed net (23 cm diameter, 0.166 m^2, and 1.5 mm mesh) was towed alongside the ship in the surface 0-3 m depth layer at a speed of 8 to 10 knots.
This net was deployed from the starboard "Effer" crane in a similar manner to the FNET but a second wire stay to the foredeck was used to retrain the net. When towing the head of the crane was lowered to near the water surface so that the restraining wires and the towing wire were in line.

Four tows with the HSTN caught 4 fish larvae (*N. coriiceps*) and at least 2 krill, besides numerous *Limacina*, small *Themisto*, amphipods and a few salps etc.

FISH IDENTIFICATION

The basic sample treatment is described elsewhere in this Cruise Report. Whenever possible, fish were identified as soon as practical after the samples arrived on deck so that the specialist treatments could be undertaken on fresh material from known species.

Species were identified according to North & Kellermann (1989) and contributions by various experts in the book edited by Gon and Heemstra (1990). Species names are after Gon and Heemstra (1990).

PROBLEMS

RMT8 Handling

A limited number of personnel were experienced in using the RMT8 net. Most of those without experience were heavily committed to dealing with the samples soon after they were collected. The RMT8 net was re-rigged immediately after recovery because we intended to fish good acoustic "krill" marks as they were encountered. Consequently few inexperienced people were available to be instructed how to rig the net. The limited number of personnel familiar with the work on deck to rigging, deploying and recovering the RMT8 net, and operating the Down Wire Net Monitor PC, meant that the small number of individuals with this experience often worked long watch periods.

It is recommended that two people with RMT8 experience are required for each watch period. During each watch there should be 2 experienced RMT8 people on watch duty and available to work with the RMT8. Consequently with 12 hour shifts, a minimum of 4 experienced RMT people are required for each cruise.

Ice contact

Pack-ice was a persistent hazard during Cruise JR26.

We encountered 3/10 to 7/10 pack-ice in an area around the South Sandwich Islands. Two hauls were conducted in loose pack-ice with no difficulty. During the 3rd RMT8 haul in loose pack-ice (Event 138), while towing with net 1 open at about 90 m depth, the ship was deflected by contact with heavy pack-ice and turned slightly which resulted in pack-ice drifting behind the ship and snagging on the towing wire. The ship was immediately slowed and wire was paid out. After a couple of minutes the wire slid off the ice and the RMT8 dropped rapidly. All signals through the DWNM appeared normal. The ship was in ice, which may catch on the net while it is being deployed/recovered at the surface, and so the haul was continued and the net was recovered later in an area of open water. On recovery the opening/closing bridle of Net 1 was snagged around the instrumentation frame on the net-monitor cross. No major damage had occurred, although there was some abrasion on the end of a bolt holding the flowmeter, and one Allen screw and lower plastic roller on the bottom of the port side had disappeared. As a result of this incident a revised protocol was published to advise RMT handlers and watch fore-persons - see Appendix 1.

Two further hauls were conducted amongst the pack-ice without incident.

Seabed contacts

Event 230 was towing on the shelf near Palmer Station over "well surveyed" ground. The objective was to sample close to the seabed to catch *Pleuragramma*. The plan was to approach the coast and tow mostly over the shelf at around 135 m depth and then towards the end of the tow to head out off the shelf into deeper water. Following continuous acoustic information the tow was conducted with the net around 12 to 30 m above the seabed over undulating ground. Towards the end of the planned deployment as the net was being hauled at 30 m/min, the seabed rose to 20 m in a few seconds and the net clipped the bottom, the net immediately rose and remained above the seabed. Then the seabed came up from 145 m to 60 m in about 3 minutes, and the ship turned and slowed slightly. The net was then hauled at what was judged the maximum safe emergency rate (around 40 m/min). A request to increase the ship's speed was

declined owing to navigational priorities. While being hauled at 40 m/min with a large wire angle to starboard, the net again made contact with the top of the 60 m depth underwater peak. The net was recovered immediately. After the net was recovered a scratch on the middle of the weight bar and the starboard bottom brass block was observed. The catch included a very small starfish, an isopod, a small sea urchin and a few rock fragments, as well as krill. Bathymetric information on the Admiralty chart for the shelf area around Palmer station could be improved.

The RMT8 net made contact with the sea floor during Event 271. The objective was to fish close to the seabed on the Burdwood Bank for the early stages of squid. When fishing at 7 m above a very level bottom with the towing wire at a moderately large horizontal angle (to port) from the ship (due to winds, tides and currents) the seabed suddenly rose 5 m and the net clipped the bottom. The haul was continued as normal. The port end of the weight bar came to the surface draped with benthos.

The net made also contact with the seabed during Event 279. The net was recovered immediately. There were a few benthic animals, including an isopod, in the catch. No damage to the net was observed.

Wire termination

Prior to deployment for Event 279, communication between the DWNM and the net was greatly reduced from normal. Moving the plastic cable, where it exits the terminal metal sleeve and joins the rubber cable to the net monitor, cured the problem. The design of this termination could probably be improved. The metal link continually threatens to guillotine the plastic cable and bends the flexible cable through a sharp angle when the monitor is 'parked' on the deck frame. The joint is continually flexing, even while the net is on deck, as the towing wire swings with the ships movement. A belated solution was to secure the towing wire forward level with the deck.

A new wire termination should be made and tested before the next cruise.

Wire twisting

Particularly during Events 266 to 275, and to a lesser extent before this, the wire was twisting as the net was raised up below the gantry, particularly during recovery, causing the net monitor to rotate and tangle the side wires with the release jaws and the towing bridles. After Event 275, in an attempt to remove this unwanted turn in the wire, the wire was disconnected from the net, pulled down the deck under tension and then re-fitted to the net. A kink was discovered in the towing cable about 20 m from the end which had not been observed previously because this section is hidden within the vertical trunking between winch and deck. The time of occurrence and cause for the kink is not known.

Altimeter

Prior to Event 271 the altimeter had given a occasional intermittent erroneous readings - spiking to 2 to 3 times the expected altitude. After Event 271 the altimeter gave good readings with 250 m of wire out and a net depth of up to 125 m, but subsequently gave a large proportion of spurious readings. This defect ceased for a while at the beginning of Event 279 but altimeter records soon became erratic again. The problem may indicate an intermittent connection in the wire between the net monitor and the end of the towing cable. Another possibility is that the net monitor is twisting slightly as the load comes off the towing wire when the ship drops with the swell, so that the altimeter is pointing to one side instead of vertically down. The quality of the

altimeter readings varies with the amount of wire out and depth of water, so the altimeter should be set at the optimal angle for the expected depth of water.

HSTN

The HSTN was tested in Cumberland East Bay starting at 6 knots for deployment and recovery and then 8 knots and 10 knots. Everything went well in the calm waters of the Bay. In the open ocean, four HSTN tows were conducted in relatively calm seas with moderate to light swell. The first 3 were deployed and recovered at 6 knots and fished at 10 knots. Deployment and recovery was relatively easy in the near ideal conditions. The cod-end (#1) was slightly damaged after the 3rd tow, with a small hole in the mesh about 2 cm from the rim of the bucket and 2 pin-prick holes higher up. The cod-end had not snagged on anything and so the cod-end damage was probably due to towing at 10 knots and clogging with *Limacina*. The 4th net was fished at 8 knots for the remainder of the tow and the cod-end (#2) appeared undamaged.

The fine meshes of the HSTN net easily get clogged with pteropods and other taxa. Some thought should be given to making the net easier to clean if it is required during a future cruise. To reduce items sticking to the lower edge of the cod-end netting, placing one or two fine mesh windows in the solid cod-end so that it drains down a few cm below the upper rim may be a solution.

References

Gon, O. & Heemstra, P.C., eds. (1990). *Fishes of the Southern Ocean.* J.L.B. Smith Institute of Ichthyology, Grahamstown.

North, A.W. & Kellermann, A. (1989). Key to the early stages of Antarctic fish. *BIOMASS Scientific Series* **10**, 1-44.

Appendix 1

RMT net deployments among pack-ice

NOTES FOR RMT NET HANDLERS & WATCH FORE-PERSONS

Deployment amongst pack- ice is new to most of us - but a few points must be considered.

Do not veer wire at **>30m/min** except in dire emergency. This especially true with an open net because unloaded wires can snag the net monitor.

Do not launch net when going **from open water into an ice edge or from light to heavier ice**. Wait until you are sure that the helm can keep the wire astern in the centre of the wake.

If a **significant wire-snag** occurs then **recover the net ASAP** to check for damage. Do not continue the tow until this has been done. Liaise with the Bridge to choose an optimal moment.

No sample is worth losing a net for ....

Sample Quantification and Collection - Alex Rogers

Samples collected using rectangular midwater trawls (RMT8) and foredeck nets (FNETs) were immediately transferred in the net codends (liners) to a CT room set at 2°C. Prior to sample processing the total overall sample volume was estimated by dipping the net codend containing the samples in to a graduated bucket containing seawater and recording the rise in water level in the bucket. If samples were small (<500ml), volume was estimated by eye. Samples were then individually emptied in to white plastic trays which, in the case of the RMTs, were numbered 1-3. Net codends were rinsed in a bucket with seawater if they had a lot of material adhering to them. Washings from the bucket were sieved using a domestic sieve and the material collected was also placed in the appropriate sample tray.

Prior to sorting an estimate was made of the quantities of the commonest species in each sample. For gelatinous or extremely numerous species this was carried out by estimating the approximate volume they occupied. For less numerous species an estimate of numbers of individuals was made. After quantification samples were sorted and preserved for subsequent genetic analysis. The most numerous species were generally either preserved in 95% ethanol or frozen at -70 - -80°C. Preservation protocols can be summarised for different taxa thus:

(i) All amphipods, pteropods, copepods, decapod larvae, chaetognaths, polychaetes cephalopods and krill species not including *Euphausia superba*. All specimens up to a count of approximately 300 individuals were preserved in 95% ethanol in glass vials or plastic containers for subsequent DNA extraction. Containers were filled to approximately a third of the depth of ethanol with specimens. If specimen volume exceeded this further containers of 95% ethanol were used to preserve an appropriate number of specimens.

(ii) Common species of gelatinous zooplankton (mainly salps). Specimens were placed in a ziplock bag and placed directly in the -70°C freezer for subsequent DNA extraction or allozyme electrophoresis. Ten specimens were placed in an individual bag to a maximum of 150 individuals preserved from a single catch.

(iii) *Euphausia superba*. Randomly chosen samples of krill were frozen individually on plastic trays at -70°C to a maximum of 400 for a single net haul. Once specimens were frozen (6 hours) they were transferred to plastic ziplock bags for storage in the -70°C freezer for subsequent DNA extraction or allozyme electrophoresis. Where catches of krill were particularly large further specimens were preserved in 95% ethanol in large kilner jars for subsequent DNA extraction. Jars were filled to approximately one third of the depth of alcohol with specimens. Ethanol was changed after 24 hours to ensure adequate preservation of samples and to remove strongly discoloured ethanol. Where possible 100 krill from each RMT net within a haul were measured, sexed and their maturity stage estimated.

(iv) Fish. Specimens from each net were individually numbered, identified and then scanned on to a PC using a scanner through transparent plastic sheeting or a petri dish (Microtek Scanmaker E6, Microtek International, Taiwan). The tail of each specimen was removed up to the anus and preserved in 95% ethanol for subsequent DNA extraction. The rest of the fish was frozen at -70°C for allozyme electrophoresis and otolith removal for chemical microanalysis. If specimens were large a tissue subsample was removed for preservation in ethanol and only the head was frozen. The length of specimens was subsequently measured from scanned images on a PC.

All samples were labelled on the outside of specimen containers (tubes, jars or bags),using taped paper labels or insoluble markers. Labels made from paper or waxed paper were inserted in to all specimen containers in case external labels were removed in transit. The labels for each container contained the following information: Cruise number; sample event number; net (e.g. RMT1 or FNET); taxa contained in the sample; date. Samples were boxed and stored in the 2°C CT room and a comprehensive database of preserved specimens was kept, as the cruise progressed.

A small sample of the major organisms collected in each RMT net was collected and preserved in 10% seawater formalin. This was carried out to assist in identification of specimens preserved for genetic analysis back in the U.K. and to keep a record of the major species making up samples to provide background ecological data. These samples were labelled as for DNA/allozyme samples.

Squid Jigging Machine - Cairistiona I. H. Anderson

Cruise objectives:
To field test the squid jigging machine.
To expand our knowledge of the distribution of *Martialia hyadesi* in the Scotia Sea area.
To explore the possibility of using the squid jigging machine for sampling other Antarctic cephalopod species.

Summary:

The Geneflow cruise was viewed primarily as an opportunity to field test the equipment, with both Paul Rodhouse and myself onboard, before the Core Program cruise in January 1998 (JR28) where it will be used to sample *Martialia hyadesi*. As such it was partially successful, in that the machine was deployed at most of the stations and was used opportunistically on one occasion (Event 255). The major exceptions were Station 8 where the wave conditions were considered too severe and Station 15 where the presence of floating ice and the lack of obvious targets on the acoustics justified not deploying the machine. The machine was also not deployed at Station 7, in Cumberland Bay, South Georgia, Station 27, in Marion Cove, King George Island, and Station 28, in Deception Island, as these were shallow water inshore stations where pelagic squid are extremely unlikely to be found.

The jigging machine was used without major problems on nearly all occasions. The exception was at Station 14, where the ship's manoeuvring to avoid floating ice lead to the aft jig line wrapping once round the CTD cable. This situation was easily rectified as the CTD was brought onboard the ship and the change in the behaviour of the jig line meant that it was unlikely that the problem could have been overlooked. Under normal conditions there appeared to be no conflict between the use of the jigging machine and the deployment of the CTD, as long as the manoeuvres carried out by the ship to maintain station over the CTD were performed slowly.

Unfortunately, no cephalopods were caught using the machine during this cruise. The acoustics record for the sites where the machine was deployed suggests this probably had more to do with a lack of potential targets than any major deficiencies in the machine or the fishing techniques used. However, this means that the various techniques used can not be properly assessed for their suitability to catch *Martialia hyadesi* on future cruises. In the longer term, if specimens of *M. hyadesi* are subsequently caught using similar techniques, this cruise will have provided useful negative data on the distribution of this species at this time of year and so fulfilled the second cruise objective.

It is possible that the squid jigging machine could be used for sampling a wider range of species of Antarctic squid, but this cannot be confirmed from the current cruise. It seems likely that to have a significant success rate more concentrated, targeted fishing activities would be required than have so far been attempted.

No major modifications appear to be required for future use of the machine, but several small improvements could be made [See Additional Comments]. The lamp covers provided are not really strong enough to withstand continued use in rough weather. After only a short period of strong winds and waves, the forward most cover is significantly warped and the others are also affected to some degree. The heavy nylon line that makes up the top section of the jig lines and the net used to cover the outrigger are of poor quality. The net should be replaced as a priority as it is brittle and has already started to break under the pressure of waves breaking against it. A softer woven net is likely to be more durable and easier to repair if it does give way. It may be more cost effective, and certainly more reliable, to replace the heavy nylon line with fine wire rope such as that used on Japanese commercial jiggers. This would reduce the likelihood of failure due to damage during storage, as well as that caused by general wear and tear. The provision of at least one spare light bulb and spare net for the 'trampoline' would also be sensible given the working conditions experienced.

Deployment Log.

Event Number	Station Number	Depths Fished	Catch
19	1	150m	none
40	2	50m, 100m, 100m	none
45	3	150m	none
65	(4)	150m	none
66	5	190m, 200m	none
70	6	150m, 50m	none
112	9	80m	none
118	10	150m	none
122	11	150m	none
127	12	200m, 200m, 70m	none
131	13	200m	none
136	14	200m	none
142	16	200m	none
150	18	200m	none
153	19	200m	none
160	20	200m	none
164	21	200m, 60m	none
172	22	200m	none
183	23	200m	none
187	24	200m, 200m	none
197	25	150m	none
204	26	200m	none
222	29	200m	none
227	30	200m	none
231	31	200m	none
255	n/a	200m, 100m, 200m	none
260	32	125m	none

Data recorded during each event.

For the whole event:

Event number
Station number
Date
Target Depth (with notes)
Time lights on (hh:mm, GMT)
Time lights off (hh:mm, GMT)

For each set of casts:

Power (inc. Manual or Automatic setting)
Lifting speed
Descent speed
Fishing depth
Shakuri (Y/N, with stop depth below surface if yes)
Start time (hh:mm, GMT)
End time (hh:mm, GMT)
Time jig not running during cast set (total mins/ start & stop times)
Catch (no. of animals)
[Lifting cycle times for different speed and depth settings]

Figure 1. A diagram of the motor unit control panel.

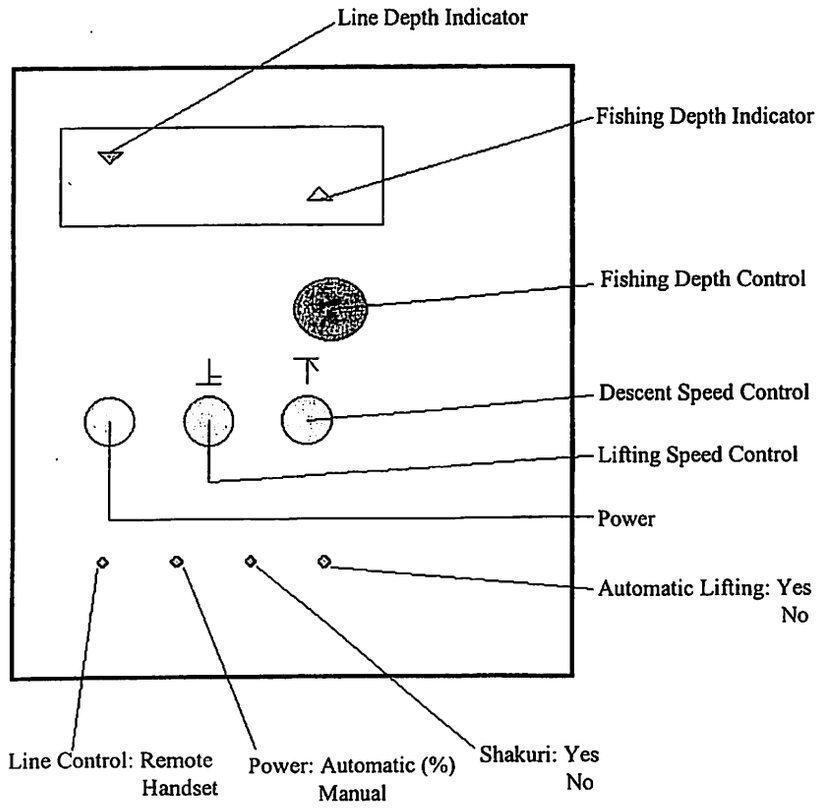
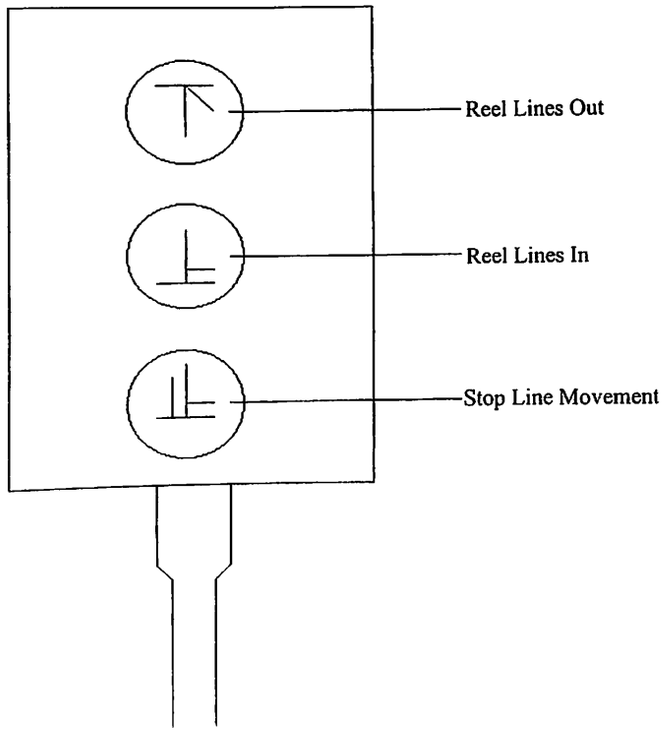


Figure 2. A diagram of the handset controls.



Technical notes on the Set-up and use of the squid jigging machine.

Set-up

On arriving on the ship, on 15th January 1997, the jigging machine was assembled on the side deck according to the plans provided by Andy Tait. The details of its assembly are given below.

- The frame (without the outrigger) was initially assembled facing inwards against the side of the main lab, so that the light fittings were accessible from the walkway above.
- The upright pieces of the frame were inserted into their sockets and then the crosspieces were dropped down onto them. The upper crosspiece was fixed in place initially, and the lower crosspiece was fixed after being lined up under the lamp covers.
- The lamp covers and light fittings were attached to the brackets on the crosspieces and then the bulbs were inserted after they had all been fixed in place.
- Initially, mainly single fixing points were used but these broke easily. It was then retied so that the sides and the outboard edge were connected with continuous lashings and the rest of the net was left free to flex under any impacts.
- The rollers were assembled and attached to the outrigger. The position of the supports holding the rollers prevented the supplied nuts being used as spacers. Instead, the same size nuts with the threads drilled out and extra washers were used as spacers, and the supplied nuts and wing nuts were used on the outside of the supports to fix the rollers in position.
- The main frame was swung into position using the crane and the outrigger was attached. It was later discovered that the outrigger can easily be removed and re-hung without the use of a crane even at sea.
- The base of the machine was bolted onto the outboard edge of the 1m deck matrix immediately aft of the midships scientific hydraulics manifold. It was successfully used in this position throughout the cruise and did not appear to interfere with any other on-deck activities.
- The electric cables were led off the top of the frame along a rope to the walkway outside the UIC room and then along the edge of the walkway to the water bottle annex. The light cables were strung behind the CTD crane, and then through a cable port to the ballast located on a bracket by the power outlets at the forward end of the annex. The motor cable was strung inside the crane (above deck level) as it was shorter, and then lead directly to the power outlet through the cable port.
- The lifting rope was tied to the front edge of the outrigger and passed through a block attached to the bracket on the lower crosspiece of the frame. A second block was attached to the base of the walkway guard-rail and the rope was passed through this and tied off on the handrail below.
- 200m of heavy nylon fishing line was wound onto each reel using the lifting action of machine. The jig traces were then tied to the end of this line and wound on by hand.
- Each jig trace comprised of 20 jigs separated by 1m lengths of fine nylon fishing line with a swivel clip at each end of the trace. An extra pair of swivel clips separated by 1m of fine line was added to the head end.
- Pieces of heavy nylon line, approximately 2m long, with clips on the lower end were then added to each reel to attach the weights to. The weights were only attached when the jigging machine was in use.
- Two fish boxes were found to sit in the wells at the base of the frame when the machine was in use to collect the catch.

Stowing between stations:
When not in use, the machine was left as outlined below:

- The lines were taken off the rollers and the outrigger raised with the rollers folded in. The rope was tied to the handrail on the main lab wall.
- The weights were removed from the jig lines and the free ends of the lines were coiled and tied to stanchions. The control box flex was also coiled and tied below motor unit using a short piece of rope.
- The cover was placed on the motor unit, and the fish boxes and the weights were removed.
- The power supplies to the light ballast and the motor unit were turned off at the outlets.

Use:
On arriving at a station the process of stowing the machine was reversed and the machine was deployed according to the notes given below.

- The lights were put on as soon as possible on reaching the jigging station. They were generally but not always used during daylight.
- The various controls on the motor unit were set according to the conditions (see Figure ?a.)

  Power: kept at 75% on automatic
  Lifting speed: range used 4-7 (recommended 5.5-7.5)
  Descent speed: range used 5-8 (recommended 3-8)
  Fishing depth: range used 50-200m (max. possible 0-380m)
  Shakuri: used for 9 cast sets
  Automatic lifting: always used

- Lifting speed
  - This was varied with the water temperature to try to match the speed of the lures to the swimming speed of the potential targets i.e. lower speeds were used in colder waters.
  - Setting 6 appears most appropriate for water over 2^0C (i.e. for *Martialia hyadesi*)
- Descent speed
  - This was varied with the fishing depth and the wave conditions to provide the fastest smooth release of the line.
  - Under calm conditions setting 6 appears most appropriate for 200m depth and setting 7 for 100m. At greater speeds the lines go slack towards the bottom of the cast.
  - As the swell increases the descent speed must be slowed to prevent the lines going slack as the ship rolls towards them.
- Fishing depth
  - This was varied depending on the water depth and the depth of the acoustic targets seen.
  - Where no clear targets were seen, the maximum possible fishing depth was used (currently 200m in open water).
  - Where small acoustic targets (i.e. potential squid prey) were seen, the fishing depth was set to fish right through them as squid are more likely to be below prey than above it.

- Shakuri
  - This was only used on deep casts (i.e. those of 200m)
  - It is not generally recommended as it has not been seen in use on commercial squid jiggers.

Additional Comments

Pat Cooper

Squid Jigger

The mechanical frame is a substantial structure but could benefit from the following modifications:

Central Support:

This support provides a platform for attaching the jigging unit. During normal operation this is adequate but when the jigger is in pulse mode the column flexes by several mm. This causes low frequency vibration which may cause the jigger to fail. Additional bracing may be required.

Lamp Frame:

The lamp frame is supported for only about a third of its height and is thus prone to flexing and vibration. The control and power cables are attached to this frame by way of a catenary rope from the side of the UIC room. A better solution would be to provide one or two struts to link the top of the lamp frame to the guard rail outside the UIC room. One of these struts could be used to replace the catenary system to provide a better protected cable run.

Power Control Box:

This box is currently located in the water bottle annexe. The CTD is washed down on a regular basis using a hosepipe. The control box should have at least an IP67 rating to conform to H&S regulations but does not meet this standard at this time. Special care has to be taken by the CTD operators to ensure that the control box does not get wet. The short term solution is to provide a waterproof cover for the unit but relocation to a more suitable area (Main Lab) should be considered.

JR26 Computing and Data Logging - A Barker and B Lamden

1) RVS ABC Data Logging System

1.1) Level A Systems

Most Level A systems performed well. The GPS_ASH and GPS_GLOS systems hung periodically and had to be reset. The CTD LevA hung once.

1.2) Level B System

The Level B system performed well with one exception.

On day 337 (3 December 1997) it developed the "Black Hole" syndrome (as documented by RVS and detailed below). This resulted in the loss of approximately 25 minutes of data between 10:49 and 11:15 GMT. The "Black Hole" broke the LevB to LevC link and caused the "fromlevb" process running on the LevC to sound an alarm. This was not heard until someone entered the Computer Room. As a result of this and to minimise future data loss an extra alarm has since been fitted in the UIC room.

"Black Hole" symptoms:

I) The "fromlevb" alarm sounds (this will only occur if the link is in use)
ii) The link backlog does not increment
iii) The logical write pointer does not increment
iv) The tape backlog will constantly show 0 (normally flashes to 1024 and then back to 0)
v) Everything else about the level B display will appear as normal

There are two courses of action:

1) This is only likely to work if the Black Hole has been spotted in it's infancy.

a) Turn Off Logging to Tape
b) Turn Off the Level B to Level C link
c) The logical write pointer may start incrementing
d) The Link and the tape may then be restarted (only if logical write pointer has started incrementing, if not refer to action 2)

2) Reboot the Level B

a) This is the only option left if the Black Hole was not caught in it's early stages
b) This can be done by logging in as GURU and running the close_up command

Note:

If the black hole is identified quickly and a re-boot is necessary at most 2-3 minutes of data will be lost. However if action 1 is successful then no data will be lost.

1.3) Level C

The new Sparc10 Level C performed well although it continues to report transceiver errors periodically as did its IPC predecessor. On one occasion it lost its network connection breaking the link with the LevB. The solution was to restart the network interfaces using the *ifconfig* command. No data were lost. Summaries of data logged are given in Tables 1 and 2.

2) Antarctic Communications and the Groupwise Message System

The High Speed Data (HSD) connection proved reliable but the increased number of MIME encoded attachments received presented a problem since the present comms system cannot process such attachments. Each message that arrived with a MIME attachment was edited using PFE to add missing Carriage Return characters before being processed with *Xferpro* (found in the directory y:\xferpro) which enables the MIME attachment to be extracted. This is a temporary solution to the MIME problem whilst a patch for the comms system is currently being addressed at Cambridge.

At the start of JR26 some newly created Groupwise accounts failed to function correctly producing "user not found" errors. This proved to be due to a corruption in the user database and was fixed by performing a full database rebuild. During the previous cruise (JR25) the Message Server had hung frequently requiring rebooting. After the database rebuild the Message Server performance improved.

Table 1 : Summary of raw data logged to the Level C

Stream	Variables	No. of records	Size	Start Time	End Time	Data interval
adcp	ampl, bindepth, bottomew, bottomns, depth, good, heading, pitch, roll, temp, velerr, velew, velfa, velns, velps velvert	1217984	121MB	97 321 17:22:36	97 348 10:51:58	2min
anemom	wind_dir,wind_spd	2404735	38.4MB	97 321 17:10:40	97 348 10:56:55	1 sec
aqashut	cond, temp, press, chlor, tran, par, wifd1, wifd2, wifd3, wifd4, wifd5, wifu1, wifu2, wifu3, wifu4, wifu5, depth, cdpth, wing,stran	19464	2.4MB	97 326 23:13:31	97 328 18:36:20	1 sec
bas_ctd	pres, temp, cond, ch1, delstat	110339	3.7MB	97 322 19:38:49	97 347 17:18:52	1 sec
dop_log	speedfa, speedps	2305951	36.9MB	97 321 17:10:37	97 348 10:56:53	1 sec
em_log	speedfs	1025709	10.2MB	97 321 17:10:39	97 348 10:56:54	variable
gps_ash	sec, lat, lon, hdg, pitch, roll, mrms, brms, attf	2273815	131MB	97 321 17:10:39	97 348 10:56:53	1 sec
gps_glos	utc, type, svc, lat, lon, alt,cmg, smg, vvel, pdop hdop, bdop, tdop	2279882	186MB	97 321 17:10:39	97 348 10:56:54	1 sec
gps_nmea	lat, lon, gq, svc, hdop, dage, dbase	2308787	106MB	97 321 17:10:39	97 348 10:56:54	1 sec
gyro	heading	2308092	23MB	97 321 17:10:40	97 348 10:56:55	1 sec
netmon	depth, temp, cond, light, flow1, flow2, flow3, angl1, angl2, alt, fluor, sp1, sp2, sp3, sal, net, type	186652	19.7MB	97 322 21:09:44	97 347 13:01:32	2-3 secs
oceanlog	astemp, mstemp, sstemp, hum, par, tir, fluor, flow, sp1 - sp13, press, cond, tstemp	446717	66.1MB	97 321 17:10:40	97 348 10:56:50	5 secs
sim500	uncdepth, rpow, angfa, angph	447048	12.5MB	97 321 17:10:39	97 348 10:18:46	1 sec
winch	cabltype, cablout, rate, tension, btension comp, angle	39842	1.8MB	97 322 19:38:08	97 348 10:18:46	variable

Table 2 : Summary of processed data

Stream	Variables	No. of records	Size	Start Time	End Time	Data interval
bestdrf	vn, ve, kvn, kve	76896	2.1MB	97 321 17:10:30	97 348 10:30:00	30 mins
bestnav	lat, lon, vn, ve, cmg, smg, dist_run, heading	76908	4MB	97 321 17:10:30	97 348 10:30:00	30 mins
relmov	vn, ve, pfa, pps, pgyro	76961	2.6MB	97 321 17:10:30	97 348 10:56:30	30 mins

Samples for genetic analysis - Luca Bargelloni and Lorenzo Zane

The aim of this cruise was to investigate the extent of gene flow, among different geographical locations, at the intra-specific level. Target organisms are marine species, belonging to both vertebrate (fish) and invertebrate (crustaceans, molluscs) taxa. To achieve this goal, we expect to use highly polymorphic genetic markers, which should enable us to assess whether heterogeneity in allele frequencies is present among different population samples. Depending on the species analysed, one or more of the following methods will be used:

a) analysis of length polymorphism of "short tandem repeat" (STR or microsatellite) loci
b) analysis of sequence polymorphism of mitochondrial genes
c) analysis of sequence polymorphism at nuclear loci

In any case, all planned analyses will be conducted using DNA-based techniques. In light of this, samples were sorted in a constant temperature room at 2-4 C, in order to delay post mortem degradation of DNA. Specimens were then preserved in 95% ethanol, as described above (see section on sample handling), and stored at 4 C. Once fixed in ethanol, the samples are stable for a long period of time (years) and can be transported at room temperature. Since genetic analyses will be undertaken in different labs, some quite far apart from BAS, Cambridge, preservation of samples in alcohol should allow the easiest as well as safest way to transport specimens. Because of this, subsamples have already been drawn from the common sample repository, in order to provide each group involved in the genetic analysis with the samples needed. Also those samples which have been frozen (see section on sample handling), will be transferred in ethanol if not needed for allozyme analysis, at arrival in Cambridge and then subdivided and sent by courier to different labs according to their needs.

Besides a careful preservation of collected specimens, all care has been taken to obtain, whenever possible, a sufficient sample size for each of the species present at each location. This is of pivotal importance when trying to assess genetic differentiation between geographic populations. In fact, the statistical robustness of any result relies on a sufficient sampling size. Although the number of specimens needed varies with the level of polymorphism, a reasonable sample size is achieved when at least 30-50 individuals per location are collected. However, this often depends on the genetic markers used as well as on the species analysed. Indeed, a preliminary study conducted on a few population samples of *E. superba* (Zane et al. unpublished) seems to suggest that a larger sample size is needed when dealing with species having a substantial population size. Based on this evidence, the largest possible number of individuals for each species was always collected.

Except for the targeted fishes, because of the bigger sample size, invertebrates were not individually classified. Individuals presumably of the same species were pooled together. An electronic spreadsheet was produced, recording the species sampled, the event number, the method of preservation and, in some cases, the approximate number of individuals.
If the criterion of sufficient sample size at each of several geographically distinct sites is applied, a few species emerge as possible candidates for population genetics analysis:

1) **Euphausiids**

Classification of these animals is to be considered tentative; animals were not individually classified and may be mixed with a few specimens of different species. It is suggested that, at the time of analysis, new identification must be provided.

a) *Euphausia superba*: krill was collected in all the major water masses; except some minor catches, in the far North, the sample size for each station was at least 100 specimens. Samples for the main stations were preserved in ethanol and frozen. At least two catches can be considered from a single swarm. Care must be taken when analyzing small specimens, because of the chance that samples are mixed with specimens of E. *crystallorofias*.

b) *Euphausia triacantha*: this species was collected, with an average sample size of about 100 specimens on three occasions: in the route from Stanley in two stations, North and South of the convergence, in the Scotia sea, and in the route back from the Antarctic Peninsula, still both before and after the convergence.

c) *Euphausia crystallorofias*: this species has been caught in at least three presumably different areas, namely Weddell waters, Scotia sea waters and Bellingshausen sea waters. Sample size from these key locations is at least 100.

d) *Thysanoessa*: for this genus identification was not possible besideto the species level, because of net induced damage at the diagnostic upper antennulae flagellum. In all the cases for which the classification was possible, inside the Convergence, they were attributed to the species *Thysanoessa macrura*; no information is present on board about the possibly co-occurring *T. vicina*. Provided that it is possible to reliably classify these samples, they were caught at the majority of stations, with a sample size of about 50 specimens.

2) **Fish species**

Fish specimens (either larvae or adults) have been a regular catch in most of the nets, but only for a few species a sufficient sample size has been reached at more than a single location.

a) *Champsocephalus gunnari*
This species was sampled at three separate locations, as follows:

I) **14** specimens at Shag Rocks (events 53-60)
ii) **48** specimens at South Georgia (events 80-98)
iii) **31** specimens at Deception Island (events 208-220)
(all catches are listed below according to event and net number)

event#	net#	specimens		event#	net#	specimens
53	RMT-3	2		98	RMT-1	3
56	RMT-2	2		208	RMT-1	1
56	RMT-3	1		208	RMT-2	1
59	FNET	2		208	RMT-3	2
60	RMT-2	7		212	RMT-1	7
80	RMT-2	3		212	RMT-2	2
80	RMT-3	8		214	RMT-3	1
83	RMT-1	4		217	RMT-1	2
83	RMT-2	6		217	RMT-2	7
83	RMT-3	6		217	RMT-3	2
85	FNET	1		218	RMT-1	5
87	RMT-3	10		218	RMT-3	3
91	RMT-2	2		220	RMT-1	2
93	FNET	3				

As can be evident from the table above, the number of specimens for individual net was fairly low. This led to the necessity of an additional effort consisting in multiple deployment of nets at the same location. Catches from different nets are pooled into larger samples in order to reach a sufficient sample size. This was done according to the geographic position of the sampling station. Despite the small sample size at Shag Rocks, we could consider that three locations have been successfully sampled. This should allow to test whether any genetic difference exists between *C. gunnari* populations at S. Georgia and Shag Rocks, but especially whether any gene flow is present between Deception Island, located close to the Antarctic Peninsula and the two locations at the upper limit of the Scotia Sea.

b) *Protomyctophum bolini*

This myctophid species has been successfully sampled at different locations:

I) **19** specimens at station 2 (before crossing the PFZ)

ii) **12** specimens in the Shag Rocks - South Georgia area (small, pooled sample, possibly heterogenous)

iii) **25** specimens in the northern are of Scotia Sea south of S. Georgia

iv) **16** specimens just north of the PFZ

event#	net#	specimens		event#	net#	specimens
35	RMT-1	9		144	RMT-2	19
35	RMT-2	1		144	RMT-3	3
37	RMT-1	3		205	RMT-1	1
37	RMT-2	2		206	RMT-2	1
37	RMT-3	4		229	RMT-2	1
46	RMT-1	1		242	RMT-2	3
46	RMT-3	4		242	RMT-3	1
53	RMT-2	1		254	RMT-1	16
55	FNET	4		261	RMT-1	7
76	RMT-2	1		266	RMT-1	3
76	RMT-3	1		270	RMT-3	2
144	RMT-1	4				

Although all samples have relatively small size, they come from four different sites, some of them quite far apart. Moreover, two sites are located outside the PF while two fall within this hydrographic barrier. This should give the chance to test whether either the Antarctic Convergence or mere geographical distance might act as barrier to gene flow in this mesopelagic species. Not all the specimens could be pooled in a single location, leaving some "odd" samples, with small size.

c) *Trematomus hansoni*

For this species three major samples were obtained:

I) **60** specimens at Shag Rocks (events 53-60) (some of these specimens are of dubious identification)

ii) **32** specimens at S. Georgia (events 80-83)

iii) **65** specimens from the Elephant Island (event 184-185)

event#	net#	specimens		event#	net#	specimens
53	RMT	2		184	RMT-1	25
56	RMT-1	8		184	RMT-2	26
56	RMT-2	15		185	RMT-1	10
56	RMT-3	33		195	RMT-1	1
57	FNET	2		198	RMT-2	1
80	RMT-1	4		207	RMT-2	1
80	RMT-2	24		212	RMT-3	1
80	RMT-3	4		220	RMT-1	1
83	RMT-2	4		220	RMT-2	1

As for *C. gunnari*, the three samples obtained should allow to test the presence of genetic differences among *T. hansoni* populations from Shag Rocks, South Georgia, and Elephant Island.

d) *Lepidonotothen larseni*

For this species three locations have been sampled, plus a small sample from a fourth site.

I) **18** specimens at Shag Rocks (event 60)

ii) **23** specimens at South Georgia (events 73-80)

iii) **45** specimens from Deception Island (events 212-220)

iv) **9** specimens from Anvers Island (event 230)

event#	net#	specimens		event#	net#	specimens
60	RMT	18		214	RMT-3	2
73	FNET	3		216	RMT-1	7
80	RMT-1	2		216	RMT-3	8
80	RMT-2	5		217	RMT-1	1
80	RMT-3	13		217	RMT-2	10
140	FNET	1		217	RMT-3	11
198	RMT-3	1		220	RMT-2	1
212	RMT-1	1		230	RMT-1	9
212	RMT-2	4				

For other fish species a good sample size has been obtained only at a single geographic location. These samples are hardly being useful for population genetics purposes, at the present time. At least two samples from different areas are needed to test for population differentiation. However, a single sample for a certain species might be complemented with other samples of the same species from previous or future cruises. This is possibly the case for *Pleuragramma antarcticum*, which has been already sampled in the East Weddel Sea and Ross Sea.

3) Other species

Samples of several other species (salps, molluscs, crustaceans other than euphausiids) have been collected at different locations. These samples still need to be identified to the species level, therefore, at the present time, it is not possible to decide whether there will be sufficient material for a population genetics study.

Scientific Echo-sounding during JR26 - Brierley and Goss

Acoustic data were recorded continually throughout cruise JR26 at 38, 120 and 200 kHz using the Simrad EK500 system. All data were collected using the hull-mounted transducers, but the calm sea conditions which prevailed throughout the majority of the cruise resulted in a data set mainly uncompromised by weather induced dropouts. Acoustic data were used for investigation of species distribution patterns, for species identification and size classification, and to locate targets before and during fishing.

Scales of distribution

The long transects steamed during JR26 provided an invaluable opportunity to investigate large-scale distribution patterns of krill and other components of the pelagic ecosystem. The resulting data, in conjunction with simultaneous oceanographic observations, will provide an insight into mechanisms of krill dispersal throughout the Scotia Sea, and will be used to place estimates of krill abundance at South Georgia in the context of abundance throughout the whole Scotia Sea. The relative abundance data will be used to test hypotheses pertaining to transport of krill to the South Georgia region from the Antarctic Peninsula. Understanding of these mechanisms is central to MLS investigations of variability in the marine ecosystem at South Georgia. The large-scale distribution data will additionally be of great interest to those planning the forthcoming synoptic survey of krill abundance throughout CCAMLR statistical area 48.

Varying degrees of ice cover were encountered during JR26, increasing to a maximum of 7 or 8 tenths to the north of the South Sandwich Islands and in Antarctic Sound. Passage through the pack often resulted in production of acoustic noise spikes, which were particularly evident at 38 kHz. The acoustic data set thus contains an indirect indication of the regions in which ice was encountered and, on a finer scale, where localised bands of pack-ice began and ended. Analysis of this record in parallel with analysis of patterns of krill occurrence may reveal whether or not krill abundance tends to be elevated in the vicinity of pack ice. Such information could have implications for our understanding of krill flux across the Scotia Sea.

Target identification / size classification

Target fishing on acoustically detected subjects allowed our database of size class and species-specific multi-frequency acoustic signatures to be enhanced. Recent echo-sounder calibration data were available for the South Georgia region (calibration having been undertaken at South Georgia on day 229 during JR25), enabling data collected in this area during JR26 to be fully processed at sea (but see Discussion within the EK500 Calibration section of this report). By so doing, we were able to get immediate estimates of δmvbs (the difference between mean volume backscattering strength at 38 and 120 kHz), and to relate this parameter to estimates of size frequency distribution of net caught specimens. Length frequency measurements of all net samples of Antarctic krill (and other euphausiid species) were made, since detailed knowledge of size distributions at different locations is essential for development of understanding of population dynamics and recruitment. The δmvbs technique can be used post-cruise to obtain estimates of size for those krill targets that we were unable to fish.

Orchestration of fishing activities

In most cases the echo-sounder display provided the major cue for the exact location of fishing activities at each station, enabling individual krill swarms and aggregations of other unidentified species to be targeted directly. The sounder also provided fine-scale bathymetric data essential for trajectory control of near-bottom net hauls.

Acoustic data were also collected during jigging operations at CTD stations, in the hope that our characterisation of echoes caused by squid, and of estimates of TS values from individuals, would be improved. Data quality from near-surface regions during the jigging tended to be poor at times because of the bubble cloud generated by the thruster activity necessary to keep the ship on station.

Comments on other acoustic matters arising during JR26

200 kHz noise levels - The EK500 200 kHz channel appeared to oscillate between two sensitivity states, sudden jumps in background noise being apparent in a number of the integrated data files. Background noise at 200 kHz also increased substantially upon deployment of the RMT, and numerous noise spikes compromised quality of 200 kHz data associated with these events, especially in the deeper part of the depth range. Background noise at 200 kHz also displayed a modulating pattern of variability from time to time, and this pattern coincided on more than one occasion with the observation of whales in the immediate vicinity of the ship.

HP Paint Jet Printers - Printer 2 suffered several crashes during the latter parts of JR26. It appeared as though the ink cartridge caught during some printing passes, and this caused the EK500 to issue "Printer 2 not ready" alarms. The printer started again after a power down, but short sections of chart were left unrecorded during the down time. This printer problem is probably symptomatic of its age, and of the amount of use the printers are subjected to (running continually for months at a time). The requirement to print charts continually would be overcome by switching to the EchologEK / Echoview software, since this allows raw data to be replayed on a pc screen, and important sections to be printed as and when needed.

SONAR - The overlying purpose of the GeneFlow cruise was to obtain samples of selected species from as many locations as possible. During JR25 it became apparent that krill abundance at South Georgia was low. On the Master's suggestion, it had been our hope to use the ship's SONAR system to aid in location of krill swarms at South Georgia during JR26, in spite of the known problems of the SONAR interfering with the EK500 (in this instance the interference was not a major problem since we were not attempting to obtain quantitative estimates of abundance on transect). Unfortunately, however, the SONAR was not functional. Installation of a SONAR system that could be synchronised to the EK500, operating at a frequency not in conflict with it, and with a display visible in the UIC, could be a valuable addition to the acoustic capabilities of JCR, and could aid with sample location and collection (e.g. for experimental purposes) in areas / seasons of low availability.

Palmer Station - During the call at Palmer to collect a near-shore krill sample, we were given a demonstration of the ROZE zodiac acoustic system used by the American LTER programme. This inflatable-borne 120 kHz system would be ideal for small scale swarm studies, and could probably be deployed from JCR without too much difficulty. The equipment on board included a BioSonics sounder, ESP Integrator, interface to DAT tape, GPS, CTD and krill fishing gear. Personnel at Palmer indicated that they would be keen to collaborate on such work in the future.

Calibration of the EK500 echo-sounder during JR26

Introduction

Calibration of the EK500 hull-mounted transducers was carried out just prior to cruise JR26 at South Georgia (day 209 during JR25). However, much of JR26 was to be conducted in higher Antarctic latitudes, and hence in colder waters than those encountered during most recent PES cruises. Because there is a demonstrated effect of temperature on transducer efficiency, a calibration in these colder waters was required, and this was scheduled at the Antarctic Peninsula. The Dynamic Positioning System (DPS), which had been used successfully for the JR25 calibration, allowed a site to be selected solely on grounds of suitability for calibration, without constraints imposed by the need for a good anchorage. Our criteria for such a site were calm sea

conditions, and deep water (ideally at least 60 m water depth, minimum 40 m) preferably away from glaciers, melt water from which could influence salinity and hence sound speed. During the planning stages of JR26 Potter Cove at King George Island had been selected as the calibration site. This was mainly because a calibration had been performed there during a previous season. It was apparent from the Admiralty Chart, however, that Potter Cove was more exposed, and shallower at its inner end, than was the neighbouring Marion Cove. Marion Cove (62° 12.78'S, 58° 46.39'W) was thus selected for the calibration during JR26.

Calibration narrative

We entered Marion Cove at around 5 am (local) on day 339, more than half way through the cruise, and rapidly established a stable position using DPS in over 100 m of water. The cove had a glacier at its head (as did Potter Cove and most other inlets in this area), but the comparatively low air temperatures (ranging between 0.5 and 2.5°C throughout the course of the calibration) meant that the amount of melt water being produced was not expected to affect salinity greatly.

Once on station, a CTD cast was made to determine water temperature and salinity beneath the ship. Sound speed and attenuation coefficients were determined from CTD data averaged between 5 m (just shallower than the transducers) and 30 m (the approximate sphere depth) for this purpose. Environmental conditions at the calibration sites from the CTD, and temperature from the oceanlogger, are given in Table 1.

Once the CTD had been recovered, the calibration spheres were rigged in turn beneath the ship in the usual manner. Each sphere was centred in the beam of the frequency to be calibrated using the EK500 TS display. Adjustments to the sphere suspension lines were made by reel operators on deck, hauling or veering as necessary under instruction given by radio from the sounder operator. A full calibration of each of the three hull mounted transducers, using both frequency-specific copper and a generic tungsten carbide sphere, and beam mapping with the Simrad programme 'Lobe' for 38 and 120 kHz sounders, took around 12 hours. During the calibration exercise we requested that discharge from the ship (sewage waste etc) be avoided. This was achieved until shortly before we had completed the calibration, but unfortunately discharge was resumed before the final CTD cast was underway. It had been our hope that the final CTD cast would indicate whether water conditions had changed appreciably over the calibration period.

Results

Calibration proceeded generally smoothly using the DPS, although positional stability seemed less robust at Marion Cove than it had been at Gritvyken during JR25. This may have been because of reduced satellite availability at the higher latitude. On occasion thruster activity increased suddenly, and the ensuing motion of the ship caused the calibration sphere to swing completely outside the beam. On the whole, however, the DPS again proved satisfactory for the purposes of calibration.

The sound speed value © calculated from the CTD data at Marion Cove (1448.6 m s^{-1}) was different to that set in the machine on survey (1451.5 m s^{-1}). After calibration c was returned to the approximate pre-calibration value, where it remained until the end of the cruise.

Table 3 shows the results for the JR26 calibration, and Figure 1 sets S_v and TS transducer gains in the context of those obtained during previous Southern Ocean calibrations. TS gains at 38 and 120 kHz obtained during JR26 using the copper spheres were very close to those obtained during JR25. Sv transducer gains obtained using the copper spheres were slightly lower for the cold

water calibration than they were for the South Georgia event. Calibrations at 38, 120 and 200 kHz with the tungsten carbide sphere differed quite considerably from those with the copper spheres, and from calibrations obtained with the WC sphere in previous years. The 200 kHz S_v and TS gain settings for both sphere types ranged over nearly 4 dB. When the 38 kHz and 120 kHz values are viewed in the context of the last three years, there is an overall downward trend in transducer gains. The 200 kHz results show the same trend if only results from the copper sphere are included. The larger tungsten carbide sphere may not be ideal for the 200 kHz calibration in all conditions, because this frequency is probably above the level at which sharp fluctuations occur in the relationship between frequency and acoustic cross-section. (see Maclennan and Simmonds, 1992). Although previous calibrations may have shown a close correlation between the results from the recommended 13.7 mm copper sphere and those from the 38.1 mm tungsten carbide sphere, this relationship may break down when conditions change, such as when the densities of both the water and metal are increased by the low ambient temperature. Because of this uncertainty over the tungsten carbide sphere the results from the copper sphere will be used in preference.

Discussion

TS gains at 38 and 120 kHz indicated by the Antarctic Peninsula calibration exercise during JR26 were identical to those obtained during JR25. The S_v transducer gains at these frequencies were however lower in both instances during the Antarctic Peninsula calibration. This reduction in gain with reducing temperature is consistent with the previously detected trend, confirmation of which justifies the time devoted to calibration during this cruise. In order to indicate which of the JR25 or JR26 calibrations was most appropriate for data collected over the oceanographically diverse region covered by JR26, we plotted sea surface temperature along the cruise track on a scale designed to highlight the differences between the temperature regimes prevailing at the two calibration sites. Minimum sea surface temperature (SST) at South Georgia during JR25 was 1.7°C. Maximum SST at Marion Cove was 0.4°C. Splitting the difference between these two values indicates a pragmatic cut off point between the SST values where one or other calibrations should be applied of 1.05°C. The plot of SST (Figure 2) along the cruise track indicates that the vast majority of ocean traversed south of the APF during JR26, including that around South Georgia, exhibited an SST value of less than 1.05°C. The calibration most appropriate therefore for JR26 is that conducted at the Peninsula. The confined waters of Cumberland Bay would appear to be relatively warm and, as such, their suitability as a calibration site, even for cruises conducted around South Georgia, should be questioned.

Given that the 38 and 120 kHz channels both respond in the same direction to decreases in temperature, and by approximately the same amount (target strength at 38 kHz and 120 kHz reduced by 0.64 and 0.48 dB respectively) the δmvbs value, the parameter which we use to distinguish krill from other scatters, will probably not be affected greatly by changes in temperature, and thus correct target identification will occur in most instances.

JR26 was not intended to provide quantitative estimates of absolute biomass and no grid surveys were conducted. We are however interested in compiling relative abundance estimates for distinct regions, and for this purpose either of the Sv calibration values would suffice. Change between these calibrations can be implemented simply, and the relative values from each calibration are given below in Table 4 for use on such occasions.

Figure legend

Figure 1 Gain values at 38, 120 and 200 kHz.

Figure 2 Sea surface temperature along the JR26 cruise track.

	26/10/97 Grytviken	05/10/97 Marion Cove 0800h	05/10/97 Marion Cove 2000h
salinity (ppt)	33.55	34.16	34.17
temperature (°C) (oceanlogger)	0.8 (1.7 to 2.0)	0.06 (0.41)	-0.36 (0.12)
sound speed (m s^{-1})	1451.5	1448.6	1446.6
absorption coeff. 38 kHz	10.23	10.31	10.27
absorption coeff. 120 kHz	26.50	25.98	25.70
absorption coeff. 200 kHz	40.24	40.04	39.89

Table 1. Water conditions during 1997 calibrations

Period	Sound speed m s^{-1}	comment
prior to JR25 calibration	1460	default
during and after JR25 calibration	1451.5	CTD derived
during JR26 calibration	1448.6	CTD derived
immediately after JR26 calibration	1451	return to pre cal value (≈)

Table 2. Sound speed values set at various times during JR25 and JR26.

JR26 EK500 Calibration - James Clark

Date	35562	35562	35562
Time (Z)	09:17 am	12:23 pm	15:07 pm
Place	Marion Cove	Marion Cove	Marion Cove
Software version	5.30	5.30	5.30
Frequency	**38**	**120**	**200**
Test oscillator	-54.7	-56.9	-60.3
Water depth	105.0	105.1	104.5
Temperature	0.06	0.06	0.06
Salinity	34.16	34.16	34.16
Sound speed	1448.6	1448.6	1448.6
Alpha	10	26	40
Angle sensitivity	21.9/21.9	15.7/15.7	
Ping rate	1.0	1.0	1.0
Transmit power	normal	normal	normal
Max power	2000	1000	1000
Pulse duration	medium	long	long
Bandwidth	wide	narrow	narrow
Sphere TS	-33.80	-40.30	-44.85
Sphere type	**Cu 60.0**	**Cu 23.1**	**Cu 13.7**
Default TS gain	26.00	20.44	23.18
Calibrated TS gain (lobe)	**25.95 (25.73)**	**20.19 (19.63)**	**22.50**
Default 2-way beam	-20.7	-18.3	-20.9
Range to sphere	31.1	31.65	31.02
Default Sv gain	25.80	20.50	23.26
Calibrated Sv gain	**25.55**	**19.81**	**22.14**
Athwart beam width	7.24	9.35	
Along beam width	7.02	10.35	
Athwartship offset	-0.05	-0.38	
Alongship offset	0.06	0.18	

Table 3. JR26 Calibration Data

	38 kHz	120 kHz
26/10/97 Grytviken	25.87	20.05
05/10/97 Marion Cove	25.55	19.81
Default	25.80	20.50

Table 4. S_v transducer gains for each calibration, and the default values in the EK500 on collection.

Hard Structures. The microstructure and microchemistry of otoliths and statoliths - Martin Bailey, University of Aberdeen.

Aim.
The aim of this component of the GeneFlow cruise was to obtain specimens of two main target species of larval fish (*Dissostichus eleginoides* and *Champsocephalus gunneri*) and the squid* *Martialia hyadesi* so that their respective otoliths and statoliths can be analysed to investigate the following:

1) The age and growth history of individual specimens utilising increment counts and widths.

2) The signatures of trace elements incorporated into the otolith/statolith microstructure so that population structure and distribution can be addressed.

3) The correlation between the ratio of ^{18}O:^{16}O in the otolith/statolith microstructure to that found in the water column as an indicator of water temperature during individual growth histories.

Fish.
Representative samples of larval, post larval and juvenile fish were collected from all deployments of the RMT8 and Fnet samplers. Additional material was obtained from plankton samples taken during trials of the High Speed Tow Net which was deployed at shallow (< 10m) depth in Cumberland Bay, South Georgia.

On recovery of the gear from the water, the catch was transferred to a CT room maintained at 3°C where fish were immediately sorted from the catch. Following taxonomic identification specimens were scanned to produce an image which could be stored digitally on a PC for further analysis of basic morphometrics (Hauser, this report). At every station, the heads from up to 25 of each fish species were removed using a clean scalpel and placed separately into individual numbered and labelled zip lock polythene bags. Small heads were stored in labelled 1ml eppendorf tubes to minimise damage during preservation and transit back to Cambridge. These were then frozen at -80°C so that tissue samples could be taken at a later date for allozyme analysis by other participants in the GeneFlow project.

Of the main target species, *D. eleginoides* was not obtained in high numbers during the survey; however, secondary species including *Trematomus hansoni*, *Lepidonotothen larseni* and *Protomyctophum bolini* were more abundant at several stations positioned over a wide geographic range covered by several water masses (Table I). At present, these species together

with the specimens of *C. gunneri* will provide the material to address otolith microchemistry as a means of tracking transport mechanisms and differentiating between spawning groups, areas and events. The analysis of otolith microstructure (i.e. age and growth rate) from the limited number of *D. eleginoides* larvae obtained during JR26 will, nevertheless, provide important information on the early life history of these important species. Furthermore, the analysis of ^{18}O:^{16}O ratios and temperature from CTD samples collected during the cruise (Brandon, this report) and comparison with the respective ratios derived from microprobe analysis of the otoliths will address the relationship between temperature and growth.

	SAZ	*PFZ*	*WSC*	*WSW*	*BRS*	*BSW*	*ACC*	**Total**
Champsocephalus gunnari	63	-	-	-	31	-	-	**94**
Chaenocephelus aceratus	-	8	45	-	1	-	-	**54**
Chionodraco rastrospinosus	-	-	7	6	20	-	-	**33**
Dissostichus eleginoides	4	-	-	-	-	-	-	**4**
Trematomus hansoni	-	92	61	2	4	-	-	**159**
Lepidonotothen larseni	-	41	1	1	45	9	-	**97**
Gobionotothen gibberefrons	-	54	-	-	-	-	-	**54**
Pleuragramma antarcticum	-	-	-	6	52	-	-	**58**
Protomyctophum bolini	2	56	-	-	2	1	31	**92**

* No *Martialia hyadesi* were obtained for the purposes of statolith analysis during the cruise.

Table I. The total number of specimens processed for otolith analysis by water mass based on preliminary discussions on hydrographic data.

SAZ - Sub-Antarctic Zone (North of the Polar Front).
PFZ - Polar Frontal Zone.
WSC - Weddell/Scotia Confluence.
WSW - Weddell Sea Water.
BRS - Bransfield Straight Water.
BSW - Bellingshausen Sea Water.
ACC - Antarctic Circumpolar Current.

Use of scanning technology for sample imaging and morphometrics - Lorenz Hauser

Introduction

The collection of tissue samples for genetic analyses generally requires rapid preservation of small pieces of tissue by either ethanol fixation or freezing. In the short time available before preservation, additional work like the collection of morphometric measurements, comparisons between specimens to reconfirm species identification and extensive documentation of the collected samples is therefore often not possible. Furthermore, the amount of tissue required for genetic analyses will generally preclude any further work on preserved specimen of small animals such as fish larvae. One method to record the phenotypic appearance of collected specimen is to use a high-resolution scanner to capture images of the fish, which can then not only be used for species identification, but also to investigate morphological differentiation between fish from different geographic areas. The primary aim of the present scanning trials was to collect morphometric data from fish larvae and krill, but it was also intended to use the scanner for measuring standard lengths of fish larvae and to record images of the catch.

Methods

Image formats, digitisation and calibration

Scanning was usually carried out in black and white to conserve disk space; only few specimen of each species were scanned in colour. The resolution of the scanned images was set to 600 dpi (dots per inch), resulting in a resolution of about 0.04 mm. Image files were saved in Windows bitmap format (*.BMP) on 100 MB Zip (Iomega) disks.

Distances were measured from the image files by defining XY co-ordinates of two points using the program WinDIG (D. Lovy, University of Geneva, Switzerland). From these pixel co-ordinates, distances (*e.g.* standard lengths) were calculated on a spreadsheet. The accuracy of distance measurements with this method was verified by scanning a stage graticule normally used to calibrate microscopes; deviations were never more than 0.15 mm, and usually well below 0.1 mm.

Fish larvae

Fish larvae and juveniles were sorted from the rest of the catch and, after identification, placed in a petridish on a flatbed scanner (Mikrotek ScanMaker E6). After initial trials, a white A4 paper was used as a background, which proved to be most suitable for most fish larvae. To allow a natural placement of the specimen and to enhance resolution of fins, petridishes were usually half filled with water; this method obviously requires minimal rolling of the ship, and is therefore only possible under reasonably calm conditions. Standard lengths of most of the fish have already been measured and are incorporated in the fish data (Wakefield, this report). An example of a fish image is shown in Figure 1.

Krill (Euphausia superba)

The method for scanning krill was similar to that of scanning fish larvae. Only dead or nearly dead krill were used, as the warm water in the petridish appeared to cause muscle contractions and the curling up of the specimen. As some krill samples were originally not scanned, and only frozen specimens were available, all subsequent samples were scanned, sexed, and frozen for at least 24 hours at -80°C before scanning them again. It will therefore be possible to compare the frozen samples from the first two locations (South Georgia, South Sandwich Islands) with frozen samples from other areas. In total over 700MB of krill images of more than 1000 individuals were collected (*e.g.* Figure 2, Table 1), which will be used to obtain a variety of morphological measurements (*e.g.* length and height of abdominal segments, eye diameter, length and width of the first segment of the pleopods and the antennae).

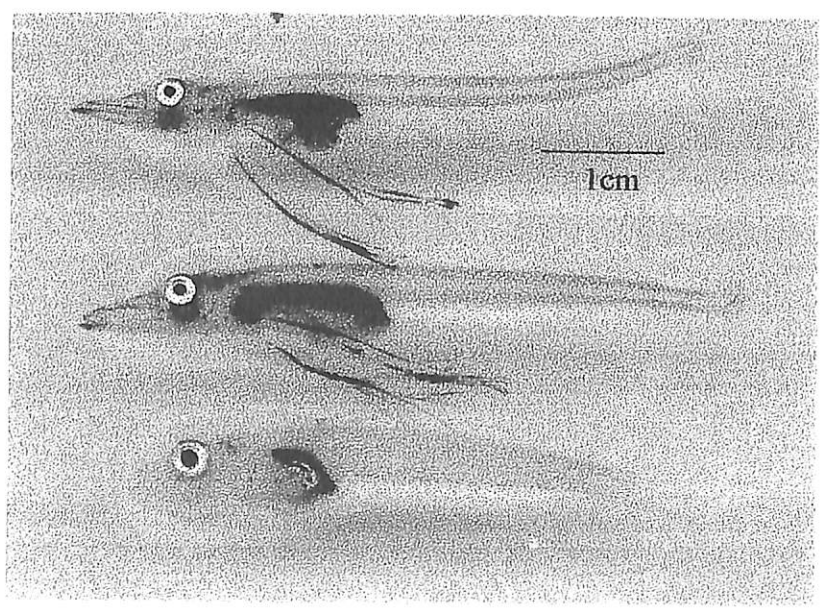


Fig.1 Scanned images of two larval fish: *Cryodraco antarcticus* (top) and a *Trematomus hansoni* (bottom) from King George Island, Antarctica.

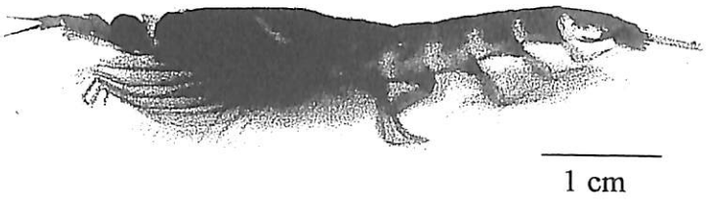


Fig 2. **Scanned image of Antarctic krill *Euphausia superba* from the Scotia Sea.**

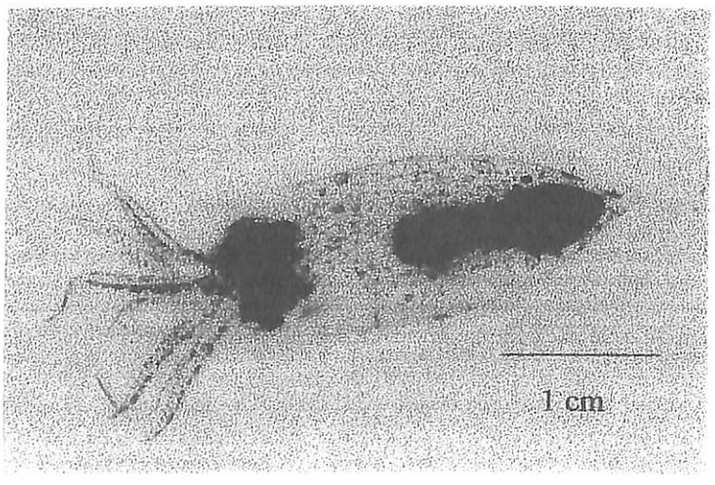


Fig 3. **Scanned image of an unidentified squid paralarva.**

Table 1: Sample sizes of krill collected for morphometrics, for each sex and major region separately. With the exception of South Georgia and the South Sandwich Islands, all krill were scanned before and after freezing.

Location	males	females	juveniles
South Georgia	33	28	
Zavodovski Is	28	29	
Scotia Sea	30	45	
Elephant Is	40	43	
Antarctic Sound	56	35	
King George Is	59	85	
Deception Island	59	6	
Berlach Strait	80	39	
Neumayer Strait		1	45
Bismarck Strait			100
Continental shelf break,	25	25	
Drake Passage	53	60	
Total	**463**	**396**	**145**

ADCP measurements on JR26: Geneflow - Mark Brandon and Katie Rubython

Summary

This report describes the method of acquisition of ADCP data on JR26 and the problems encountered. In general the ADCP worked well with one major problem documented below. The data was collected throughout the cruise in 2 minute ensembles with the exception of one 55 hour period in the Bransfield Strait.

The configuration of the ADCP

The RRS *James Clark Ross* is fitted with an RD Instruments 150 kHz hull-mounted acoustic Doppler current profiler (ADCP). In contrast to other research ships in the NERC fleet, the orientation of the transducer head is offset by approximately 45° to the fore-aft direction in the hope that the instrument would give a better response in the main direction of motion (i.e for-aft). Another difference with other British ships is that to protect the transducer from ice, it is mounted in a sea chest that is recessed in the hull. This sea chest is closed to the sea by a 33 mm thick window of Low Density PolyEthylene (LDPE) and the cavity around the transducers filled with a silicone oil. The version of the firmware used by the ADCP was 17.07 and the version of RDI Data Acquisition Software (DAS) was 2.48 and the software ran on a IBM 386. Throughout the cruise the ADCP was operated in bottom track mode, with one bottom track ping to four water tracked and recorded data in 2 minute ensembles in 64 x 8 m bins. The 'blank beyond transmit' was set to 4 m, this coupled to the depth of the transducer being approximately 6 m gave the centre of the first bin depth at 14 m.

Unlike virtually all the other instruments on the RRS *James Clark Ross*, the ADCP has no Level A application and does not log directly to the Level B. The 2 minutes ensembles of data are fed (for historical reasons) through a printer buffer directly into the Level C. This means that when there is a problem with the ships Level C system, the only way in which the data is stored is on the dedicated PC and the files have to be recovered later.

Standard Method of processing

The data, once in the Level C, were read into pstar files of 24 hours length and processed using the pstar data processing software. The processing of the ADCP is complex and involves data from several navigation streams (described in the navigation data report). A schematic of the data processing path for the ADCP data is shown in figure 1.

Step 1: Read in the data.

The data were read using our conventions for underway data in 24 hour chunks, with one Julian day per file. This was achieved with a Unix script 26adpexec0 which outputs two files. One containing the water track data and one containing the bottom track data.

Step 2: Correction for temperature around transducers

As stated above, the transducer head of the ADCP is behind an LPDE screen and in a bath of silicone oil. King and Alderson (1994) recognised that this oil within the sea chest requires a correction to be made to the derived water speed data. The standard method of deriving the speed of sound at the transducer head within the DAS software is to use the temperature of the water around the transducer head (this is recorded by the DAS software as "water temperature") and a salinity of 35 psu. Unfortunately the DAS software has no facility for the problem when the temperature of the water reported is not that of water but of another substance such as oil. The oil causes a problem as variation of the speed of sound in the oil is opposite to that in of the variation of the speed of sound in seawater. This can lead to large errors in the derived water velocity. King and Alderson (1994) document the amusing story of how they tried to find out exactly what oil is contained in the sea chest. In short, nobody knows exactly what the oil is and it has received no "topping up" or maintenance since the construction of the *James Clark Ross* in 1990.

Following King and Alderson (1994) we apply a correction factor based on the variation of the speed of sound with temperature in Dow Corning 710 silicone oil. This correction is then

$$Correction = 1 - 0.004785T \times 0.0000355T^2$$

and T is the "water temperature" reported by the DAS software. This correction is applied to both the raw water and bottom tracked velocities using the Unix script 26adpexec0.1.

Step 3: Correction for the PC clock drift.

Another problem that has to be accounted for in ADCP processing is that the DAS software time stamps the data. Unfortunately this time stamp comes from the 386 PC clock which drifts at a rate of approximately one second per hour. To correct this to the ships master clock, the time drift was measured several times a day and a correction derived and applied to the ADCP data time using the Unix script 26adpexec1.

Step 4: Correction for the gyrocompass error.

The ADCP actually measures water velocity relative to the ship. To calculate east and north water velocities from the data an input into the ADCP is taken from the ship's gyrocompass (described in the navigation report). However it is well known that as well as having an inherent error, gyrocompasses can oscillate for several minutes after a turn before steadying on a new course. As well as that there is a deviation that varies as cosec (latitude). To overcome these difficulties the ADCP data is "corrected" with data from the Ashtec GPS3DF. We cannot use the Ashtec as a gyrocompass substitute because we do not have continuous coverage, we can however correct the data on an ensemble by ensemble basis.

From the navigation report, after the "standard processing" the Ashtec data has been edited on our standard criteria and is a file of 2 minute averages. The data still however contains both gaps, and large spikes. These spikes are removed using an interactive editor, and the correction linearly interpolated. The correction is applied to the ADCP data through the Unix script 26adpexec2.

Step 5: Calibration of the ADCP data
A final correction is now required to correct for the misalignment between direction as defined by the Ashtech GPS3DF antenna array and the actual direction of the ADCP transducers. This correction is called the heading misalignment ϕ. There is also an inherent scaling factor , A, associated with the ADCP which the water velocities must be multiplied by to scale them correctly. The method of calculating A and ϕ is described below. These corrections are applied through the Unix script 26adpexec3.

Step 6: Derivation of Absolute velocities
By this stage the data contains calibrated water velocity relative to the ship. To derive absolute velocity we merge the files with position from the "bestnav" navigation file (see navigation report for description) and derive ship velocity between ensembles. This velocity is then removed from the water velocity data to give absolute water velocity. This is performed using the Unix script 26adpexec4.

Method of derivation of the calibration coefficients A and ϕ.
To derive values for A and ϕ a standard procedure was followed. This procedure is described below.

1. Periods where identified when the ADCP gave bottom tracked data - that is when the ship was working in water depths of less than 300 m. Luckily on this cruise there were many such days with periods of bottom tracking data.
2. The days with bottom tracking data were then calibrated with a nominal scaling in 26adpexec3 by setting the scaling factor A to one and the misalignment angle ϕ to zero.
3. The two minute ensembles of ADCP data were then merged with bestnav position fixes. From these bestnav fixes the ships east and north velocity were calculated. The absolute ADCP bottom tracking velocities were also calculated from the ADCP. Time periods within the data were then identified and copied out when the ships heading and velocity did not deviate greatly over a period of at least 6 minutes.
4. The absolute ADCP bottom track velocities are then multiplied by -1 as the velocity of the ship given by the bestnav fixes is in the opposite sense to the velocity of the bottom as derived by the ADCP.
5. Values for A and ϕ were derived from vector mathematics using

$$A = \frac{U_{gps}}{U_{ADCP}}$$

where U_{adcp} is the bottom tracked ADCP derived ship speed and U_{gps} is the GPS position fix derived ship speed, and

$$\varphi \quad \varphi_{gps} - \varphi_{adcp}$$

where ϕ_{gps} is the direction of motion derived from the GPS navigational fixes and ϕ_{adcp} is the direction of motion as derived from the bottom tracked ships motion. This was achieved using a Unix script adcp_calibration_exec.

In total on JR26 we collected eight hours twenty minutes of data suitable for calibration. The full table of calibration data is in table 1. Using a time weighted mean of data we used a value for A of 1.0331 and a value of -2.319 for ϕ.
Closer inspection of the calibration data may lead to improvements in the estimation of A and ϕ.

Problems encountered
In general the ADCP performed as well as it had in previous seasons. On Day 322 at 1958 there was a PC crash that was restored at 2130 by re-booting the PC. Unfortunately a worse problem was to follow. On day 336 at 1640, the PC stopped logging. This was most likely due to someone tapping the keyboard, the software was restarted but the PC was not rebooted. This hung the heading input from gyrocompass at a value of 360 degrees and was not spotted until day 338 at 2300 when the PC was re-booted, thus curing the problem. The total data loss was around 55 hours, and covers the period involving two crossings of the Bransfield Strait and the Antarctic Sound.

Suggestions
The most obvious suggestion is that the ADCP data be checked carefully everyday for problems such as that encountered on day 336-38. The data was being read with a 1 day delay, but was not inspected for another day, thus two days data were lost. The PC should also be updated as it is getting very old. A more radical suggestion is that the oil in the transducer sea chest be removed and replaced with sea water. Even in heavy ice conditions we have data to show the transducers do not get below 6 C, a long way from the -2 C needed to freeze the seawater. This would reduced the complexity of analysis of the ADCP data on this ship and bring it in line with the rest of the British Fleet.

Figure 1: The ADCP data processing route

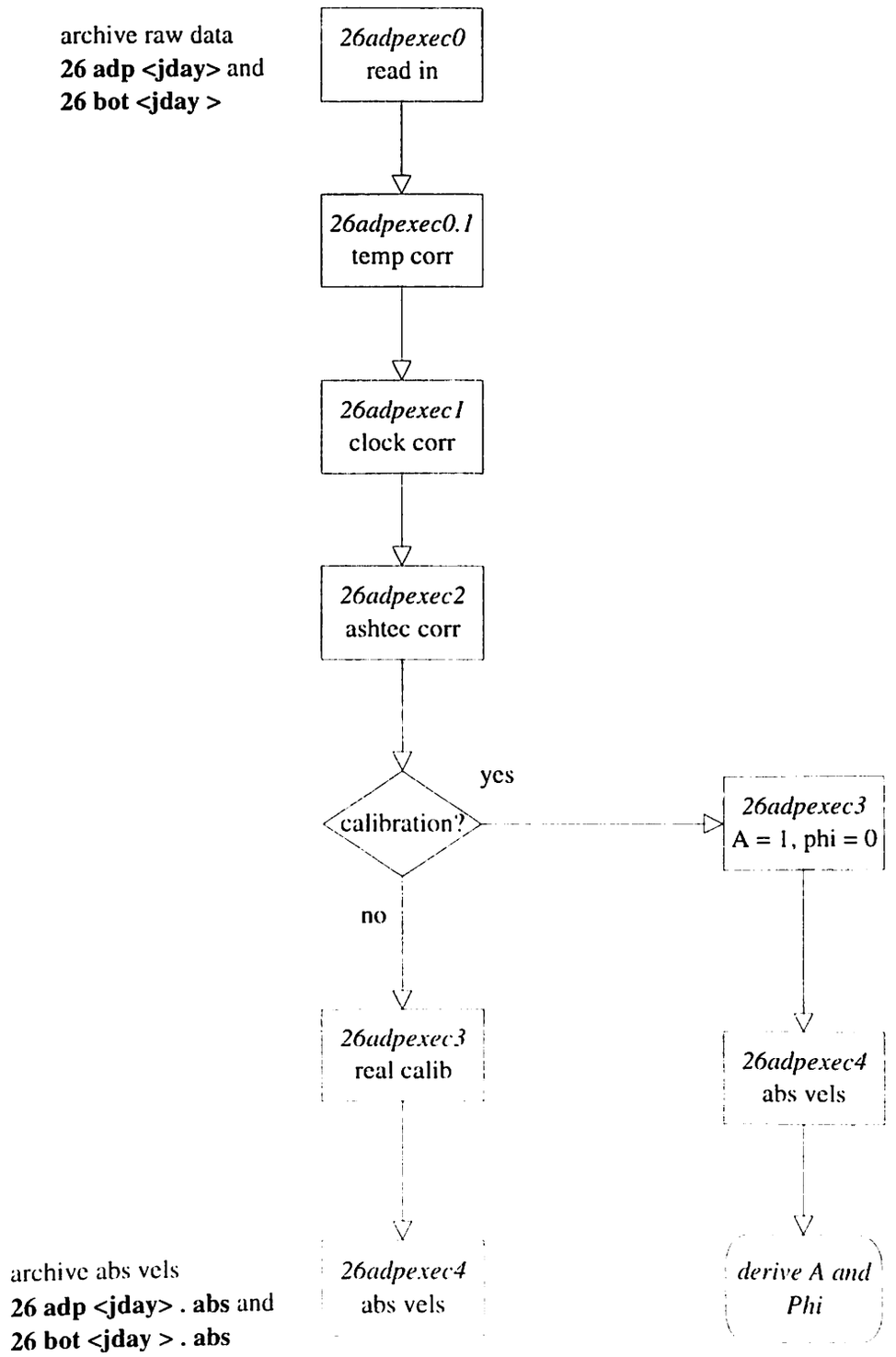


Table 1 . ADCP calibration values for A and phi (ϕ)

JDAY	Time Period No.	Duration of data sample (mins)	Velocity amplitude correction A (ratio)	Heading misalign. correction ϕ (°)	SD of Ve (cm/s)	SD of Vn (cm/s)	SD of Heading (°)	Comment
325	1	8	**1.0374**	**-1.9163**	2.5815	0.7373	0.0915	
325	2	8	**1.0651**	**2.2869**	7.4528	6.3975	0.0974	
325	3	16	**0.9204**	**-0.9320**	1.4797	2.7714	0.6093	
325	4	10	**0.9537**	**2.2762**	1.5966	1.7222	0.8747	
325	5	18	**1.0573**	**-2.4567**	3.7511	12.9086	0.4006	
326	6	10	**0.9750**	**-0.8455**	2.9027	1.8706	0.1900	
326	7	16	**0.9796**	**-0.6823**	5.0164	3.0024	0.2469	
326	8	44	**0.9997**	**-1.4359**	4.7345	4.0951	0.4439	
326	9	22	**1.0125**	**-2.3297**	3.2518	2.6515	0.2320	
326	10	10	**0.9598**	**-0.8272**	1.8372	2.3888	0.1541	
326	11	8	**0.9956**	**-2.5096**	12.7729	3.7229	0.2981	
327	12	12	**0.9813**	**-4.7952**	4.7350	1.7734	0.3673	Cumberland Bay
327	13	10	**1.0020**	**-6.9278**	5.2908	1.8875	0.2098	Cumberland Bay
333	14	10	**0.9209**	**2.2652**	9.7798	6.6045	0.8966	
333	15	10	**1.0227**	**-0.9316**	3.3731	4.0852	0.3376	
336								heading error in bot file
340	16	10	**1.0875**	**1.0066**	12.2855	10.3500	0.3289	
340	17	14	**1.0902**	**3.1857**	24.6991	33.5840	2.4427	
340	18	12	**1.0482**	**2.3601**	15.9939	12.2362	2.3710	
340	19	10	**1.0448**	**2.7239**	3.7535	1.7721	2.8412	
340	20	26	**1.0856**	**-1.1997**	2.2062	2.5725	0.2502	
340	21	14	**1.0067**	**-0.9014**	4.7275	2.5292	1.4291	
340	22	16	**1.0165**	**-4.7312**	14.1574	14.1219	2.2417	

340	23	6	**0.8959**	**-3.9969**	5.2623	3.9010	4.4870	
340	24	14	**0.9986**	**-4.2344**	11.0927	6.7254	2.5381	
340	25	10	**0.9351**	**-4.2193**	3.6615	6.4192	0.2915	
340	26	16	**0.9591**	**-3.0598**	1.6780	1.7987	1.2645	
340	27	14	**0.9985**	**-6.1459**	12.0600	15.2225	0.5245	
341	28	12	**1.0156**	**-3.5794**	11.4960	2.1304	4.3772	
341	29	8	**0.9461**	**-5.8854**	2.8138	6.7632	5.2765	
341	30	12	**0.9926**	**0.4631**	6.5559	10.3779	1.6870	
341	31	16	**0.9899**	**-0.6696**	22.7382	15.6862	5.4457	
342	32	8	**0.9494**	**2.7149**	38.3211	34.9226	1.2313	
342	33	16	**1.0178**	**-2.7037**	1.3056	1.4527	0.3784	
342	34	8	**1.0551**	**-5.5466**	12.1412	3.3773	1.0567	
342	35	10	**1.0051**	**2.4394**	2.0709	10.0272	4.2806	
342	36	16	**1.0463**	**-4.1589**	22.3562	25.9940	6.4824	
342	37	18	**1.2088**	**-3.1952**	31.8831	26.9075	0.9028	
343	38	18	**1.0692**	**2.0398**	66.1693	98.0582	3.2346	
343	39	8	**0.9973**	**0.8758**	6.7737	14.4769	0.5518	
343	40	14	**0.9492**	**-2.1648**	15.2432	36.2958	2.4881	
343	41	8	**0.9283**	**0.1445**	4.0092	7.4386	0.6645	
346	42	8	**0.9202**	**-1.6312**	4.5094	3.2659	1.4291	
346	43	10	**0.8942**	**2.2378**	2.8488	2.5445	1.0945	
346	44	6	**0.9759**	**357.8657**	4.2336	1.3866	0.8536	note: ϕ = 357.8657
346	45	20	**0.9175**	**1.0907**	3.4645	6.7278	1.1049	
346	46	12	**0.9224**	**-0.4607**	1.8684	2.6997	1.3989	
346	47	8	**0.8802**	**-0.7072**	5.9993	8.5325	1.3351	
346	48	6	**0.8952**	**1.8194**	19.4139	4.9764	0.5852	

CTD Operations JR2 - Project Geneflow Mark Brandon, Pat Cooper, Sharon Grant and Sally Thorpe

Summary

In this report we first give details of problems encountered and then the calibration route in detail for the CTD data collected on cruise JR26. A full station list is given in table 1. The route for the calibration process is detailed in figure 1. In all CTD stations the 2 dbar averages of the downcast data are reported as the final product. In some cases the 1 db and 3 db level are missing from the final file. In these cases the shallowest level with data present was copied to these pressure levels.

The CTD equipment

The CTD unit used for the measurement program was the BAS Neil Brown Mk IIIb (serial number 01 - 3838 - 1086). The most recent calibration had been carried out by Ocean Scientific International from 4 July to 6 August 1997. The CTD was mounted in a purpose built frame with a General Oceanics 12 position bottle rosette. On each position on the rosette was a 10 litre General Oceanics sampling bottle controlled via a General Oceanics RMS MKVI 1015 - PM controlling unit. The package was also fitted with a 10 kHz pinger to enable accurate near bottom approach. On two of the 10 L bottles were SIS Temperature Sensors. These were in one pair (serial numbers T716 and T717) and serial number T713 alone.

Deployment of the CTD package was from the midships gantry and A-frame on a single conductor, torque balanced cable. This CTD cable was made by Rochester Cables and was hauled on the 10T traction winch. There were no problems deploying the CTD package as close control was maintained with the gib arm and two hand lines by the ship's crew whilst the package was suspended above the surface.

CTD data were logged via a Neil Brown Instrument Systems deck unit, model 1150, to a 386 Viglen PC running E.G. and G. Marine Instruments CTD data acquisition module version 2.02
control software, and also to the RVS ABC system through a dedicated microcomputer. The CTD level A, mainly through historical reasons, averages the data at this point to 1 second values and passes the data through a simple editing procedure. During this editing procedure pressure jumps of greater than 100 raw units (eg for the pressure transducer equivalent to 10 DB) are removed along with spikes in individual channels through a median sorting routine. The rate of change of temperature change over 1 second is also calculated. These one second data are then passed to the ship's UNIX system and archived. Calibration routines are then applied to the data as described below.

Bottle problems

During the cruise a handle on one of the bottles snapped as the bottle was being cocked. This is quite dangerous but fortunately only a few scratches resulted. The handle was replaced and the others carefully and frequently inspected. The reversing thermometer rack mounted on bottle one was also found to be sticking. To cure this bottle 9 was swapped with bottle one after event 143.

Reterminations

No reterminations were required for this cruise, probably due to the generally very calm weather and working within the pack ice resulting in very little ship movement.

10 kHz Pinger

The 10 KHz pinger worked well throughout the cruise, although the listening unit PC is badly sited for CTD operations.

The calibration of the CTD

As stated, the BAS Neil Brown MK IIIb serial number 01 - 3838 - 1086 was used for all CTD stations. This unit was calibrated by Ocean Scientific International using six temperature standards, ten pressure standards and four conductivity standards and we use values from this calibration for the pressure and temperature sensors. The conductivity sensor was calibrated against *in-situ* salinity samples from the GO water bottles. We report 13 sets of coefficients for the conductivity and this is described in greater detail below.

Temperature calibration

The temperature calibration was derived by Ocean Scientific International using six calibration points between 0.6° and 26°C and was applied to the data through the following equation

$$T = -2.09169 + 4.9535\times10^{-4}T_{raw} + 1.01587\times10^{-12}T_{raw}^{2} \quad (1)$$

To allow for the mismatch in response times between the temperature sensor and conductivity sensor, following the standard procedure, the temperature was lagged for the salinity calculation. This lag was achieved by adding a fraction Δ of the rate of change of temperature that is output from the level A (dT/dt) to the temperature. The temperature is then

$$T_{new} = T + \Delta\frac{dT}{dt} \quad (2)$$

From experiment the spiking in the derived salinity was minimized with Δ = 0.15.

Pressure calibration

A pressure calibration derived by Ocean Scientific International from 10 pressures between 0 and 5500 DB was applied through the following equation

$$P = -6.87333 + 9.99769\times10^{-2}P_{raw} - 1.6916\times10^{-9}P_{raw}^{2} \quad (3)$$

Following King and Alderson (1994) the pressures were then modified by the addition of a factor ΔP, to take into account the effect of temperature on the pressure sensor so that

$$P = P + \Delta P \quad (4)$$

And ΔP is calculated from

$$\Delta P = -0.4 \times (T_{lag} - 20.0) \quad (5)$$

Here T_{lag} is a lagged temperature in °C and is constructed from the CTD temperatures. We use a time constant for the lagged temperature of 400 seconds and update the temperature following the method put forward in King (1996). If T is the CTD temperature and t_{del} the time interval in seconds over which the temperature is being updated, and T_{const} our time constant of 400 seconds then the factor W is

$$W = \exp\left(-\frac{t_{del}}{T_{const}}\right) \quad (6)$$

and now

$$T_{lag}(t=t_0+t_{del}) = W \times T_{lag}(t=t_0) + (1 - W) \times T(T=T_0 + t_{del}) \quad (7)$$

We finally make an adjustment to the upcast pressure to take into account hysteresis in the sensor. The extent of the hysteresis was calculated using a series of laboratory measurements. The hysteresis after a cast to 5500 m (which we denote by *dp5500(p)*) is given in table 2. These values were derived from a laboratory calibration at IOSDL in 1994. Intermediate values are found by linear interpolation. If the pressure of the cast is outside the values in table 2 then *dp5500(p)* is set to zero. For a cast in which the maximum pressure reached is p_{max} dbar, the correction to the upcast CTD pressure (p_i) is

$$p_{out} = (dp5500(p_i) - ((\frac{p_i}{p_{\max}}) \times dp5500(p_{\max}))) \quad (8)$$

Salinity (conductivity) calibration

We first describe the principal of our method and then detail the steps. For this cruise we calibrated the conductivity against *in-situ* samples collected with the GO multisampler rosette. Once the conductivity of the CTD was calibrated, we derived salinity. A full data processing route is detailed at the end of this report. In brief, first we applied a nominal calibration of the form

$$cond = 1 \times cond_{raw} + 0.0 \quad (9)$$

From the salinity samples, once successfully matched, we calculated the bottle sample conductivity using *in-situ* temperature and pressure from the CTD. From this *in-situ* conductivity we calculated the difference of the bottle conductivity ($cond_b$) and CTD conductivity ($cond_{ctd}$) to derive a value ΔC. We now plot bottle conductivity (*x variable*) against deltaC (*y variable*). This should give a straight line where from

$$y = m x + c \quad (10)$$

and we have

$$\Delta C = m\, cond_b + c \quad (11)$$

After rejecting suspect salinity samples we use linear regression (the pstar program "cndcoef") to derive m and c for ΔC.

Now, as

$$\Delta C = cond_b - cond_{ctd} \quad (12)$$

the calibration coefficients for the CTD conductivity are derived through substituting equation (12) into (11), the CTD conductivities are now

$$cond_{ctd} = a + b\, cond_{raw} \quad (13)$$

and from the m and c in equation (11)

$$a = \frac{c}{1 - m} \tag{14}$$

and

$$b = \frac{1}{1 - m} \tag{15}$$

These values for a and b are output from the program "cndcoef" and are entered into the calibration files for both the pstar and RVS system. The processing route is then repeated and the new graph of ΔC against $cond_b$ gives the conductivity residuals, which should now be random with a mean of zero.

This calibration procedure does have a feature in that as we travelled from west to east and moved into waters where the entire water column was of lower conductivity than the station used for the initial calibration, the validity of the original m and c are called into question because of extrapolation. Accordingly we used different sets of coefficients for a and b when the calibration broke down. These coefficients are detailed in table 3.

After applying these calibration coefficients to the relevant stations there is still a residual drift within the conductivity signal with time. For each station this drift is the mean of the ΔC values.

$$\Delta C = residual\ drift$$

From substitution into our original equations we can now remove this residual drift.

Salinity Samples

Twelve salinity samples were taken for all of the CTD casts made for the physical oceanographic program from the GO 10 L bottles. This gave a total of 360 samples and 6 duplicates (366 in total). The salinity samples were taken in 300 ml medicine bottles, each bottle being rinsed twice before being filled to just below the neck. The rim of the bottle was then wiped with tissue, a plastic seal inserted and the crew cap replaced. The salinity samples were placed near to a salinometer to allow the sample temperatures to equalise with the salinometer for at least 24 hours. The samples were then analysed on the BAS Guildline Autosal model 8400 S/N 45363. This salinometer was serviced and electronically aligned by Ocean Scientific International in August 1997, but was found to be extremely erratic when first used. In an attempt to cure the problem, the conductivity cell was then cleaned with a mixture of very pure ethanol and a non-surfactant glass cleaner. This treatment seemed to work well and the Salinometer subsequently performed well. For each CTD station one vial of OSIL standard seawater (batch P130, 1996 and batch P132, 1997) was run through the salinometer to enable a calibration offset to be derived. Once analysed the conductivity ratios were entered by hand into an Apple Macintosh based EXCEL spreadsheet using software written by Dr Brian King (S.O.C.) before being transferred to the UNIX system as described below. For the 6 duplicate samples the mean difference was 0.0001 and the standard deviation 0.00002.

The quality of the conductivity calibration procedure

After applying the calibration coefficients and adjusting for the residual offset ΔC, the salinity of the bottle sample was differenced with the derived CTD salinity. After rejecting samples detailed in table 4 the mean of the remaining samples was 0.0001 with a standard deviation of 0.0017 psu. In table 4 we list the conductivity calibration file number used for each station along with the residual offsets applied to the cast after calibration (ΔC). We can see in table 4 that the drift of the sensor is small.

O_{18} Sampling stations

Six CTD stations were sampled for the stable Oxygen isotope 0_{18}. These stations are listed in table 5. The protocol for taking O18 samples was that they were sampled first and taken from the shallowest six levels of the CTD cast. This was usually 25, 50, 100, 200, 300 and 400 m. The samples bottles were rinsed twice and the tops and caps carefully dried. The cap was then screwed on tightly and sealed with a form of self amalgamating tape (brand name Nescofilm manufactured by Nippon Shoji Kaisha Ltd, Osaka, Japan).

Problems with the system

The only serious problems with the system were during two CTD casts. After a bottle was closed on event 039, when the Level A stream was turned back on, the Level B monitor screen showed a continuous stream of "serial overruns". This was cured by switching off and on the level A stream. On event 226 the Level B monitor showed the stream was "dead". This was cured by pressing reset on the CTD Level A application. A full list of CTD problems is given in table 6.

Suggestions.

The most useful suggestion to make is to point out that the BAS CTD unit is now very old and we should be seriously thinking of replacement to a more modern instrument. At the very least the PC should be updated to a new system. It also has to be noted that the organisation of space within the UIC / Winch area is poor. When doing a CTD to near bottom there is a constantly moving cycle where the operator moves from the PC to the winch monitor to the echo sounder PC. It would be a lot easier if there was possibly a winch monitor screen by the echo sounder PC so at least the attention was reduced to two things rather than three.

The CTD processing route for JR26

Step 1: ctdexec0

Purpose: To read in the CTD data from the RVS stream.

The programmes are

datapup - input the data from an RVS stream (bas_ctd) into a pstar file.

pcopya - reset the raw data flag in the pstar file.

pheadr - set the header of the pstar file.

The output is 26 ctd $num .raw

Step 2: ctdexec1

Purpose: To calibrate the ctd data.

The programmes are

ctdcal - to apply a nominal calibration to the ctd data.

mlist - to determine the on-deck pressure offset.

pcalib - remove the deck pressure offset.

peos83 - derive a sigma0.

The output file is 26 ctd $num

Also output is the data cycle at the end of the downcast. Record this value for step 8.

Step 3: sal.exec
Purpose: To read in the sample file from the mac to the UNIX system.
The programmes are
getexel.exec - reads data file from the mac
There are two files output. An ascii file called sam $num.txt,
and a pstar file sam $num.bot.
The file has six variables. These are bottle number, the salinity of the bottle, the salinity of the duplicate and the three thermometer values.

Step 4: ctdexec2
Purpose: To merge the bottle firing data to the sample data.
The programmes are
mrkcal - create an ascii file containing 10 s averages of the data *before* bottle firing.
sed - here we use a sed script to clear unwanted information from the ascii file.
pascin - read the ascii bottle firing data into a pstar file.
pcopya - copy in six t extra variables to the firing file.
ppaste - paste the six variables from sam$num.bot into the firing file.
peos83 - calculate *in-situ* conductivities of the salinity samples.
parith - calculate conductivity residuals (ΔC above).
mlist - get a quick and dirty plot of ΔC vs $cond_h$.

The output file is in the form 26 sam $num .cond
The exec requires 12 bottle firing levels to run successfully. For some of the CTD stations - in particular the shallow stations, more than one bottle was closed at each level. Therefore we end up with an ascii file from mrkcal with less than twelve levels. The exec will detect this and finish cleanly. To cure the problem we must manually edit the ascii file from mrkcal (cal_output) and copy the missing levels in. For example if we fired five bottles at 150 m we copy the 150 m level in cal_output four times to give five lines in cal_output for the 150 m level. You must then run "ctdexec2_fix" to run the exec from the point at which the sed operates on the ascii file.

Step 5: Determine the individual ctd offset
Use phisto to calculate residual ΔC for the station. This value of ΔC is the input for ctdexec3.

Step 6: ctdexec3
Purpose: To add the ΔC offset for the station.
The programmes are
pcalib - add the ΔC offset to 26 ctd $num
peos83 - derive a salinity from the new conductivity.
The output of the exec is in the form 26 ctd $num.cal

Step 7: Find the start of the downcast
Here we use mlist on the file 26 ctd $num.cal to list the variables pressure, temperature and salinity to find the start of the downcast. In the standard operating procedure (see appendix N) the package should enter the water and descend to approximately 10 DB. After a couple of minutes the package will be brought to the surface (pressure will decrease) before descending. The data cycle at which the pressure is a minimum (but > 0) and salinity does not go to zero is recorded as the start data cycle.

Step 8: ctdexec4
Purpose: To get the final output from the ctd data
The programmes are
pcopya - use the data cycles from step 2 and step 7 to copy out the downcast.
peos83 - derive a potential temperature (θ) and potential density (σ_0).
pmdian - remove large spikes from individual data streams.
pintrp - interpolate missing data removed by pintrip.
psort - sort the down cast into a file containing only increasing pressure (26 ctd $num.1hz).
pavrge - create 2 dbar averages of the .1hz file.
pintrp - remove missing data from the 2dbar file (usually none).
The output files from the exec are 26 ctd $num .1hz for the sorted 1 second down cast
and 26 ctd $num .2db for the 2dbar averaged file.

Step 9: samexec0
Purpose: To create a sample file with the corrected CTD data and calculate residuals. This step is similar to step 4, ctdexec2
Programmes
mrkcal - create an ascii file containing 10 s averages of the data before bottle firing.
sed - use a sed script to clear unwanted information from the ascii file.
pascin - read the ascii bottle firing data into a pstar file.
pcopya - copy in six extra variables to the firing file.
ppaste - paste the six variables from sam$num.bot into the firing file.
parith - calculate salinity residuals (ΔS).
There are two output files 26 sam $num .final
and 26 sam $num .offsets
The same problem that exists with ctdexec2 when there are less than 12 bottle levels exists for samexec0. You must edit the ascii file (cal_output) in the manner described above and run "samexec0_fix" to successfully run the exec.

Step 10: plot the data
We use a programme such as plotxy to plot the temperature, salinity and potential density of the CTD data. A hardcopy of the data is not required at this stage. What we are looking for is to see if there are any unrealistic density inversions in the regions of high temperature and salinity gradients at the surface. If there are such inversions move onto step 11.

Step 11: plxyed
Here we use the pstar interactive editor to remove the spikes identified in step 10. This editor replaces the bad data points with missing data.

Step 12: ctdexec5
Purpose: To remove the missing data from step 12
The programmes are
pintrp - interpolate across the bad temperature and salinity data.
peos83 - re-derive potential temperature (θ) and potential density (σ_0).
The output file is again called 26 ctd $num .2db

TABLES

Table 1: A full Station list for JR26

Event number	Date (yy/mm/dd)	Time (hh:mm)	Lat	Lon	Cast depth (m)	Water depth (m)
26ctd018	97/11/18	19:46	-55.5335	-53.3643	1026.0	3824.0
26ctd039	97/11/20	01:12	-53.0016	-47.4108	1029.0	2193.0
26ctd044	97/11/20	09:35	-53.0021	-45.1589	1022.0	2468.0
26ctd064	97/11/21	08:46	-53.6926	-40.6834	771.5	811.0
26ctd067	97/11/21	16:45	-54.6031	-39.2634	1027.0	1567.0
26ctd069	97/11/22	03:35	-53.6643	-38.3296	240.7	252.0
26ctd104	97/11/24	01:44	-54.1724	-35.3262	617.8	668.0
26ctd111	97/11/25	00:00	-54.2189	-32.8715	1026.0	3927.0
26ctd117	97/11/25	07:00	-54.2873	-32.1711	1017.0	4758.0
26ctd121	97/11/25	13:05	-54.4559	-30.7526	1028.0	5614.0
26ctd126	97/11/25	21:46	-54.8341	-29.3623	1026.0	6999.0
26ctd130	97/11/26	07:30	-55.3822	-28.3077	1024.0	3925.0
26ctd135	97/11/26	15:02	-55.9640	-27.5034	1028.0	1179.0
26ctd141	97/11/29	09:40	-55.0933	-36.6855	1022.0	1194.0
26ctd143	97/11/29	22:13	-55.1615	-40.0280	1022.0	3135.0
26ctd149	97/11/30	10:35	-55.8084	-42.8204	1022.0	3443.0
26ctd152	97/11/30	19:51	-56.4886	-45.5097	1017.0	4213.0
26ctd159	97/12/01	06:39	-57.4871	-47.9374	1024.0	2971.0
26ctd163	97/12/01	17:25	-58.3815	-50.5321	1024.0	3214.0
26ctd171	97/12/02	07:05	-59.4808	-53.6236	1025.0	3665.0
26ctd182	97/12/02	20:20	-60.8925	-55.4704	196.0	212.0
26ctd186	97/12/03	11:15	-62.1456	-56.1813	1021.0	1252.0
26ctd196	97/12/04	01:42	-63.2280	-57.0407	460.3	477.0
26ctd203	97/12/04	16:18	-62.1279	-58.4382	409.0	437.0
26ctd209	97/12/05	08:07	-62.2130	-58.7729	102.0	115.0
26ctd210	97/12/05	20:24	-62.2133	-58.7728	92.2	115.0
26ctd211	97/12/06	08:06	-62.9810	-60.6134	106.8	115.0
26ctd222	97/12/07	18:05	-64.1691	-61.8872	641.4	675.0
26ctd226	97/12/08	06:30	-64.9087	-64.2933	1022.0	1160.0
26ctd232	97/12/09	10:24	-62.8987	-63.0924	1022.0	1108.0
26ctd259	97/12/11	08:57	-56.9967	-58.9741	1020.0	3621.0
26ctd287	97/12/13	16:16	-53.5798	-57.5453	1021.0	2637.0

Table 2: The table of hysteresis corrections in the pressure sensor

p (dp)	dp5500(p) db
0.0	0.0
100	2.7
200	3.9
1000	5.9
1500	6.3
2000	5.8
2500	5.7
3000	5.1
3500	4.5
4000	3.7
4500	2.4
5000	1.5
5500	0.0

Table 3: Calibration coefficients used for the conductivity calibration

calibration number	a	b	from station
1	1.0699440E-02	0.91631798277	OSI calibration
2	-0.058401620	0.918531520	26 ctd 018
3	-0.026085650	0.917589386	26 ctd 044
4	-0.013412195	0.917181543	26 ctd 064
5	0.064299188	0.914695342	26 ctd 069
6	-0.000061944	0.916731427	26 ctd 104
7	0.015356147	0.916335895	26 ctd 130
8	-0.019271558	0.917394250	26 ctd 141
9	-0.006386921	0.916965149	26 ctd 171
10	-0.040561402	0.918065559	26 ctd 186
11	0.025868875	0.916004389	26 ctd 226
12	-0.009827431	0.917072499	26 ctd 232
13	-0.049395303	0.918263007	26 ctd 259

Table 4: Calibration summary for CTD stations on JR26

Station event number	Identifier	Offset	Rejected bottles	Calibration file
018	1	0.0000		2
039	2	-0.0006		1
044	3	0.0000		3
064		-0.0002	9	4
067	5	0.0008		4
069	6	0.0002	12	5
104	8	0.0000		6
111	9	0.0027	9	6
117	10	0.0016	10	6
121	11	0.0016	11	6
126	12	0.0018	9	6
130	13	0.0000		7
135	14	-0.0009		7
141	16	0.0003	9	8
143	17	-0.0015		8
149	18	0.0002	6, 12	4
152	19	-0.0008	9	8
159	20	-0.0006		8
163	21	-0.0007	9	8
171	22	0.0000		9
182	23	-0.0010	7	9
186	24	0.0000		10
196	25	0.0019		10
203	26	0.0022		10
209	27	0.0000		
210	27	0.0000		
211	28	0.0022	11, 12	10
222	29	0.0022		10
226	30	0.0000		11
232	31	0.0003	9	12
259	32	0.0003	7	13
287				

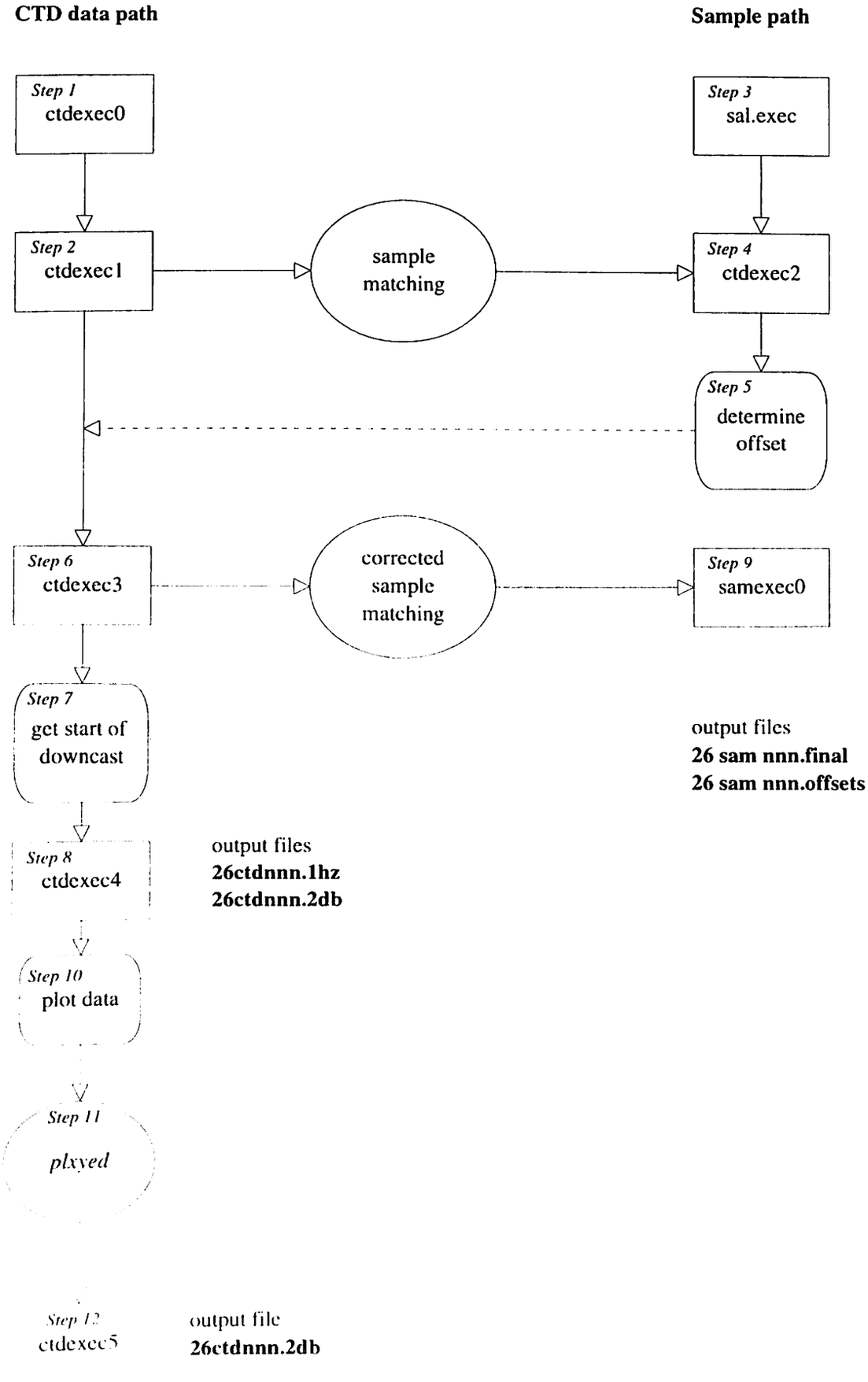
Table 5: O_{18} sample stations

Station event number	Identifier	Number of samples	Bottle numbers
039	2	6	1 - 6
064		6	7 - 12
135	14	6	13 - 18
196	15	8	19 - 26
259	32	6	27 - 32
287		6	33 - 38

Table 6: Full list of CTD problems.

Station event number	Identifier	Problem
018	1	Bottle 1 may not have sealed properly
039	2	Serial overrun
104	8	Thermometers on bottle 1 snagged
143	17	One thermometer on bottle 1 didn't trigger until the CTD was on deck
149	18	Bottles 1 and 9 swapped
152	19	Bottle 7 valve open during deployment
182	23	Bottle 6 not sealed properly
186	24	Level "B" failure - delayed start

Figure 1: The CTD processing path



A Standard operating procedure for the BAS Neil Brown Mk III CTD unit - Mark Brandon, MLSD Pat Cooper, ETS.

At the CTD

Check the package is ready for deployment - i.e all the rosette bottles are both empty and cocked and screw valves at the top of each bottle are shut. Ensure protective cap is removed from temp/salinity probe. Set the reversing thermometers to sample.

In the UIC

1) Make sure the unit source selector above the CTD PC is switched to CTD.
2) Switch on the CTD PC, the EG+G software will automatically load.
3) Fill in the CTD form whilst the PC is booting up.
4) set the Level B terminal to show data for the bas_ctd data stream. Set the comments to be on for the bas_ctd.
5) Switch on the CTD deck unit. (Bottom unit to right of PC - silver front panel with digital display. Switch "source" should be "direct". Switch "Audio" should be "off". White switch should be set to "on"). The unit should start whirring and light up.
6) Switch the Level A stream on. (Grey unit labelled "Data Transfer Switch" above deck unit).
7) Check data is scrolling on the Level B terminal.
8) Check at least one "Bas_ctd clock correct" message prints on the Level B screen.
9) Switch clock input to off. (Silver faced unit to right of Level A switch labelled ESW-225. Put switch in position 2).

At the PC

To use the PC software you can move along the top of the menu's with the left and right keyboard arrow. The only important menu's is the "Settings " menu.

10) Select the "Graph Set up" screen in the "Settings Menu".
11) Select the axes limits using the up and down arrows keys. Enter the correct axes limits. It is a good idea to add an additional 100 m to the depth of the cast for the pressure axes.
12) To leave this form **press F2** which means "read form".
13) Go to the "Acquisition Menu". "Deploy Instrument" will be highlighted. Press return.
14) Press Space Bar on PC to start PC logging.
15) Switch on Rosette Control Unit. (Black unit beneath Level A switch and clock. Switch on RHS, a bright red light and a green light should come on).

CTD can now be deployed

16) Notify winch operator that CTD is ready for deployment.
17) Deploy the CTD to 9 m depth. NOTE TIME IN WATER ON LOGSHEET.
18) Wait 2 minutes for package to "acclimatise".
19) Depending on conditions bring the CTD as close to the surface as is safe.
20) Start lowering the CTD increasing to a maximum rate of 60 m/min. NOTE TIME START DOWN ON LOGSHEET.

At the Bottom

21) NOTE RELEVANT DETAILS ON LOGSHEET.
22) Press control F10 on the PC.
23) Press return twice to get past unnecessary inputs.
24) Press "y" for "acquire data on the upcast", and then press space bar.
25) press F10 to pause the PC
26) switch off the Level A data stream.
27) Fire one rosette bottle - light on the rosette control unit will go from green to orange.

28) When the CTD deck unit digital display is stable *switch the Level A data stream back on.*
29) Check data stream on Level B monitor.
30) Press space bar on PC.

On the upcast

31) At each of the chosen levels for water samples, stop the package at that level and let it sit for 1 minute, turn off the level A and fire a bottle. (If the bottle has a reversing thermometer attached, the package is to sit for 30 seconds *after* the bottle has been closed)
32) press F10 to pause the PC
33) switch off the Level A data stream.
34) Fire one rosette bottle - light on the rosette control unit will go from green to orange.
35) When the CTD deck unit digital display is stable *switch the Level A data stream back on.*
36) Check data stream on Level B monitor.
37) Press space bar on PC.
38) Repeat until ALL bottles are closed.
39) Do not bring the package out of the water without firing all the rosette bottles.

At the End of the Cast

40) press control F10 on the PC followed by a couple of returns to avoid unnecessary inputs, and then "escape" to leave the software.
41) Switch off the Level A data stream.
42) Switch on the clock (to position 1).
43) Switch off the rosette control unit.
44) Switch off the deck unit.
45) Inform the watch leader that it is all done.

At The CTD package

1) Read reversing thermometers.
2) Using *one sample crate* per CTD cast, take one 300 ml sample of water from each bottle. Note carefully the sample and bottle numbers on the log sheet.
3) Place the sample crate in the prep lab and stow next to the salinometer for analysis.

Troubleshooting

There is not data scrolling on the Level B monitor

1) Check Monitor is switched to show data for bas_ctd.
2) Check Level A data stream switch is "on".
3) Make sure clock switched off.
   Switch off Level A data switch
   Press red reset switch on the CTD Level A (unit above data switches labelled "Quarndon Systems").
   Wait 30 seconds
   Switch on clock
   Wait until you see a clock correct message on the level B monitor
   Switch on Level A data stream
4) If data still does not scroll on the Level B terminal ***seek technical assistance***.

WARNING
WHEN THE CTD IS ON DECK AND THE ROSETTE POWERED UP, THE INSTRUMENT IS DANGEROUS
KEEP PEOPLE CLEAR OF THE CTD CONTROL EQUIPMENT

JR26 XBT Report - Mark Brandon and Sally Thorpe

Summary

During JR26 a total of 115 XBT probes (84 of type T5 with a potential depth of 1800 m, and 31 of type T7 with a potential depth of 760 m). There were 20 failures. These probes were kindly supplied by the Hydrographic Office, Taunton. The probes were deployed generally every two hours whilst the ship was sailing between sampling sites. In general the probes gave excellent data, due in part to the calm weather on the cruise. In ice, if the wire was not damaged by a floe the probes performed extremely well.

System and procedure

The XBT system on the RRS James Clark Ross consists of two distinct parts: The deck system and the computer system. The deck system currently consists of a Sippican hand held Launcher and the XBT probes. Before use the XBT probes were stored on deck in their cardboard crates and lashed to a palette to allow the temperature shock as they enter the water to minimised. The computer system consists of an stand alone 286 PC Running Sippican MK 9 Data Acquisition System software at version 5.2, connected to a MK 9 Digital XBT System Deck Unit running on 115 V. Both software and deck unit were manufactured by Sippican Ocean Systems, MA. The deployment of XBT probes is a 2 person job and all deployments followed the procedure written by Brandon and Cooper (1996). A full list of XBT deployments is given in table 1. When the deployment failed another probe was deployed.

The data route

At each deployment the pc software produced a raw data file with an extension ".sip", All of these files will be returned to the Hydrographic Office on return. The raw data file was transferred to ascii file containing depth and temperature using the Sippican Mk9 Post Trace Analysis Application Version 3.2 (December 1990). As the 286 PC is not on the ships network, these ascii files were copied to a DOS disk and transferred to the Unix system using "ftp". Once in the Unix system the files were converted to pstar format using the c shell script "xbtexec0". The position in the XBT file was then corrected to the position from the Trimble DGPS (see navigation report) at the actual time of launch using the script "xbtpos". Finally the data were edited using the interactive PSTAR programme *plxyed*.

Problems

After three successive failures the pins to the hand held launcher were carefully cleaned. This cured the problem. On 26xbt008 a T7 probe was selected in the mk9 software instead of the T5 probe that was deployed. To overcome this problem the ".sip" file was edited and the drag coefficients for a T7 probe replaced with the coefficients for a T5 probe. On events 26xbt176 and 26xbt177 the opposite problem occurred in that a T7 probe was selected when a T5 should have been. This was cured in the same way.

Suggestions

The XBT system is getting a lot of use. On JR25 we launched 60 probes, on this cruise 115 probes, and on the AMT cruises over 100 probes. With this degree of use update of the system should be considered. For modifications to the existing system the Cable to the XBT launcher should be lengthened by at least 10 m. To greatly improve our system we should aim to have a hull mounted launcher fitted to one of the stern quarters - with the option of using the hand launcher if sea conditions make the hull mounted launcher unsatisfactory. We should be looking at a more modern system as the current one 8 years old and has apparently not been updated.

Table 1: XBT deployments during JR26

Event number	Date (yy/mm/dd)	Time (hh:mm)	Lat	Lon	Water depth (m)
26xbt001	97/11/17	21:04	-52.1174	-57.1599	370.0
26xbt003	97/11/17	23:04	-52.4076	-56.8582	876.0
26xbt004	97/11/18	01:01	-52.6930	-56.5427	1407.0
26xbt008	97/11/18	03:54	-53.1235	-56.0836	
26xbt010	97/11/18	06:00	-53.4252	-55.7467	2893.0
26xbt011	97/11/18	07:57	-53.7149	-55.4221	3051.0
26xbt012	97/11/18	10:01	-54.0192	-55.0912	2137.0
26xbt013	97/11/18	11:57	-54.3121	-54.7560	2480.0
26xbt014	97/11/18	14:05	-54.6479	-54.3812	4316.0
26xbt015	97/11/18	16:03	-54.9604	-54.0285	3767.0
26xbt016	97/11/18	17:03	-55.1178	-53.8497	3831.0
26xbt017	97/11/18	18:13	-55.3068	-53.6303	3468.0
26xbt024	97/11/19	01:59	-55.3173	-52.8543	4311.0
26xbt025	97/11/19	03:57	-55.0775	-52.2858	4251.0
26xbt026	97/11/19	05:59	-54.8182	-51.6819	4129.0
26xbt028	97/11/19	08:01	-54.5772	-51.1013	4694.0
26xbt029	97/11/19	09:59	-54.3247	-50.5431	4070.0
26xbt030	97/11/19	11:57	-54.0719	-49.9593	4575.0
26xbt031	97/11/19	14:00	-53.8138	-49.3428	4398.0
26xbt032	97/11/19	16:32	-53.4766	-48.5865	4335.0
26xbt033	97/11/19	18:16	-53.2642	-48.0904	3853.0
26xbt034	97/11/19	19:59	-53.0496	-47.6088	2746.0
26xbt041	97/11/20	03:59	-52.9976	-46.9414	2069.0
26xbt042	97/11/20	05:58	-52.9998	-46.2870	2085.0
26xbt043	97/11/20	07:59	-53.0082	-45.6510	2479.0
26xbt048	97/11/20	13:57	-53.0927	-44.6266	2178.0
26xbt049	97/11/20	16:14	-53.2123	-43.9759	1873.0
26xbt050	97/11/20	18:03	-53.3038	-43.4576	1101.0
26xbt051	97/11/20	20:00	-53.4098	-42.8580	563.0
26xbt052	97/11/20	21:56	-53.5123	-42.2751	216.0
26xbt095	97/11/23	12:55	-54.2050	-36.4455	273.0
26xbt096	97/11/23	13:10	-54.2432	-36.4376	240.0
26xbt097	97/11/23	13:25	-54.2839	-36.4240	253.0
26xbt100	97/11/24	19:59	-54.0419	-34.1105	2943.0
26xbt109	97/11/24	21:32	-54.1169	-33.6304	3154.0
26xbt111	97/11/24	22:59	-54.1644	-33.1429	3431.0
26xbt113	97/11/25	02:32	-54.2468	-32.5202	4318.0
26xbt114	97/11/25	03:55	-54.2596	-32.2315	4640.0
26xbt119	97/11/25	09:26	-54.3223	-31.8673	4943.0
26xbt120	97/11/25	10:58	-54.3938	-31.3706	5354.0
26xbt124	97/11/25	16:38	-54.5436	-30.4396	5678.0
26xbt125	97/11/25	18:32	-54.6381	-30.1043	5598.0
26xbt128	97/11/26	02:03	-55.0732	-28.8841	7678.0
26xbt129	97/11/26	04:18	-55.1825	-28.6368	6416.0
26xbt134	97/11/26	11:48	-55.6461	-27.9292	2349.0
26xbt143	97/11/29	14:04	-55.3386	-37.8481	3797.0
26xbt148	97/11/30	06:07	-55.4340	-41.2447	3375.0
26xbt151	97/11/30	16:30	-56.1463	-44.3909	3427.0

26xbt157	97/12/01	01:48	-56.9882	-46.7894	3722.0
26xbt162	97/12/01	13:32	-57.9282	-49.3278	3754.0
26xbt165	97/12/01	22:58	-58.8684	-51.8206	3750.0
26xbt166	97/12/02	01:00	-59.0557	-52.3327	3851.0
26xbt167	97/12/02	01:57	-59.1490	-52.6132	3870.0
26xbt168	97/12/02	02:51	-59.1989	-52.8524	3623.0
26xbt169	97/12/02	05:14	-59.2924	-53.1817	3635.0
26xbt170	97/12/02	06:00	-59.3829	-53.3897	3659.0
26xbt173	97/12/02	08:57	-59.5652	-53.8154	3711.0
26xbt174	97/12/02	09:56	-59.6846	-54.1120	3645.0
26xbt175	97/12/02	10:56	-59.8027	-54.3951	3590.0
26xbt176	97/12/02	12:02	-59.9258	-54.7204	3499.0
26xbt177	97/12/02	14:03	-60.2257	-55.1147	3427.0
26xbt179	97/12/02	15:10	-60.4365	-55.2215	3628.0
26xbt181	97/12/02	18:10	-60.5127	-55.2725	3579.0
26xbt182	97/12/02	19:14	-60.7222	-55.3634	3453.0
26xbt189	97/12/03	17:41	-62.5718	-56.7504	348.0
26xbt191	97/12/03	18:34	-62.7215	-56.9544	197.0
26xbt192	97/12/03	19:59	-62.9436	-57.0223	106.0
26xbt193	97/12/03	20:59	-63.0462	-57.0556	81.0
26xbt194	97/12/03	21:56	-63.2045	-57.1267	385.0
26xbt199	97/12/04	09:54	-62.9298	-57.5714	277.0
26xbt200	97/12/04	12:10	-62.7928	-57.7820	646.0
26xbt201	97/12/04	13:54	-62.5029	-58.0718	1851.0
26xbt202	97/12/04	14:48	-62.3239	-58.2493	1729.0
26xbt234	97/12/09	16:36	-62.3579	-62.6857	2727.0
26xbt236	97/12/09	18:44	-61.9808	-62.4018	4747.0
26xbt237	97/12/09	20:40	-61.6163	-62.1067	3718.0
26xbt238	97/12/09	22:33	-61.2510	-61.8814	3697.0
26xbt240	97/12/10	00:39	-60.8557	-61.5742	3705.0
26xbt241	97/12/10	01:45	-60.6461	-61.4295	3724.0
26xbt246	97/12/10	07:23	-60.3264	-61.1795	3731.0
26xbt247	97/12/10	09:33	-59.9078	-60.8953	4166.0
26xbt250	97/12/10	12:35	-59.5644	-60.6981	4018.0
26xbt251	97/12/10	15:04	-59.1086	-60.3530	4188.0
26xbt252	97/12/10	17:18	-58.6489	-60.0329	3742.0
26xbt253	97/12/10	19:05	-58.2840	-59.7941	3071.0
26xbt256	97/12/11	02:45	-58.2835	-59.7198	2989.0
26xbt257	97/12/11	04:58	-57.8248	-59.4787	3413.0
26xbt258	97/12/11	06:59	-57.3991	-59.2202	3215.0
26xbt262	97/12/11	13:16	-56.7289	-58.8010	4496.0
26xbt263	97/12/11	15:17	-56.3147	-58.5385	3683.0
26xbt265	97/12/11	17:33	-55.8493	-58.2710	4182.0
26xbt267	97/12/11	23:25	-55.4470	-58.1155	4304.0
26xbt268	97/12/12	01:52	-54.9404	-58.0429	886.0
26xbt269	97/12/12	03:48	-54.9670	-57.7112	592.0

UOR and OPC Operations Report - Mark Brandon and Sharon Grant

Summary

This report summarises the measurements taken on JR26 with the BAS Chelsea instruments undulating oceanographic recorder (UOR), the Nshuttle. During the cruise there was one deployment of the package, the total towing time being 5 hours 22 minutes, the distance covered being 91 km. This report should be read in light of data collected on JR25 where the set-up of the package and the detailed ironing out of problems for the season occurred.

Introduction

The aim of using the UOR on Geneflow was twofold: Firstly the package was to provide and framework of oceanographic information for the genetics programme, secondly it was to provide high horizontal resolution oceanographic information on the link between South Georgia and the Antarctic Peninsula. Within the cruise plan it was hoped that there would be significant amounts of undulating between the genetics sampling stations to complete these aims. However, this proved not possible due to ice conditions in the Scotia Sea and the package was only used once on the cruise. This deployment was event 106 and the package operated perfectly. In the light of previous problems with the UOR it must be noted that all significant problems had been ironed out on the previous cruise ("JR25: Spring Processes") and the package was expected to perform well. The oceanographic context of the project did not suffer within the Geneflow concept as there were extra deep CTD stations across the Scotia Sea, although necessarily horizontal resolution was lost.

Operation of the UOR

The setup of the UOR system on this cruise was identical to that described in Trathan and Bone (1997) and it was deployed with a Focal Technologies Inc Optical Plankton Counter. We therefore avoid reproducing their details of operating the UOR at sea. A brief narrative of event 106 is provided.

Event 106.

The package was deployed during the day on 24 November and the JCR started to steam eastwards towards the South Sandwich Islands at 10 knots. After three hours sea ice was sighted by the OOW and the ship turned to the north, hoping to avoid further hindrances. Unfortunately the ice was quite continuous to the east and after 30 km on a northern heading the package was recovered and the ship turned eastwards to avoid losing time. The track of the deployment is shown in figure 1. In this brief deployment it seems likely that the JCR crossed important Southern Antarctic Circumpolar Front (SACCF), and as the data was just the east of the MLSD Eastern Core Box, the data will be of great use within that project.

Calibration and data processing

The UOR data was logged to the ships ABC computer system where they were read into pstar files using the previously developed c shell scripts uorexec0, uorexec1 and uorexec2 for the undulator data and opcexec0 and opcexec1 for the optical plankton counter data. A flowchart of the data analysis sequence is provided in figure 2. Following the path in figure 1, the UOR data was calibrated in uorexec1 on the basis of a calibration performed in the summer of 1997 by Chelsea Instruments.

Pressure Calibration

A pressure calibration was applied to the raw data following

$$P \quad 9.8793 + 3.36097\times10^{-3}P_{raw} \quad 2.2952\times10^{-10}P_{raw}^{2}$$

Temperature Calibration
A temperature calibration was applied to the raw data following

$$T = -3.6439 + 6.21689\times10^{-4}T_{raw} + 7.0822\times10^{-11}T_{raw}^2$$

As the Chelsea calibration was for the 1968 International temperature scale, following normal conventions this was converted to the 1990 scale by

$$T := 0.999760075\,T$$

Conductivity Calibration
A conductivity calibration was applied to the raw data following

$$C = -0.8064 + 1.10747\times10^{-3}C_{raw} - 3.9095\times10^{-11}C_{raw}^2$$

To avoid artificial salinity spikes from the temperature lag associated with the Chelsea Aquapack conductivity cell, a lagged temperature was constructed by lagging the temperature 0.65 second (Brandon, 1996), and from calibrated conductivity, pressure and the lagged temperature a salinity value was derived. Post cruise this salinity value is expected to be adjusted to match the salinity of the near CTD stations following the method used by Brandon (1996).

Cholorphyll Calibration
A nominal calibration was applied to the cholorphyl data stream following

$$Chl = 73.77 - 2.225\times10^{-3}Chl_{raw}$$

Par Calibration
A calibration was applied to the par (photosynthetically available radiation) data stream following

$$Par = 0.0112\,e^{7.49249 \cdot 2.28653 \times 10^{-4}Par_{raw}}$$

Transmissometer data
This data stream has not been calibrated, although it has been inspected closely and the data appears to be good.

OPC data
The OPC data has been read into a pstar file and the data appear to correlate well with the other physical data from event 106.

Conclusions.
In summary, the UOR functioned perfectly well on this cruise. The data were successfully calibrated and archived. Problems with the system that still remain are exactly the same as those listed in Bone Brandon and Grant (1997) which are currently being cured.

EA 500 Bathymetric data on Geneflow - Alistair Murray and Mark Brandon

Bathymetric soundings were collected using a Simrad EA500 12 kHz echo sounder with a hull-mounted transducer at 6.3 m depth. The EA500 sounder was synchronised with the EK500 bioacoustic sounder, causing the ping interval of the former to be dependant upon the settings of the latter which varied according to water depth and operational requirements. Thus soundings are obtained at somewhat irregular intervals.

The EA500 generated suspect bathymetric data on a number of occasions. The bad data normally occurred in moderate to rough sea conditions, when the ship changed course very quickly, or when a rapid change in sea depth caused the instrument to report a false bottom. Data were processed on a daily basis in 24 hour sections using the UNIX script JR26_sim. After this script plots were made of the data at 30 second spacing and further spikes were occasionally visible. Remaining bad data were located by use of an interactive graphical data editor (plxyed) and removed from the data set. A record was generated of the points which were edited. Only data which showed very obvious spikes were removed. The Steps for the Unix script JR26_sim are as follows.
Jr26_sim
purpose: This exec reads in and routinely edits 24 hours of simrad data at 30 second resolution.
The programmes are
datapup -transfers the data from RVS binary files to pstar binary files.
pcopya - resets the raw data flag on the binary file.
pheadr - sets up the header and dataname of the file.
pmdian - remove data with a jump of 100 m in successive 30 second data.
plotxy - get a plot of the data to see if further manual editing is required.
The output files are in the form 26 sim < jday > .raw
and 26 sim < jday >

The settings on the EA500 sounder were noted at the end of the cruise and are shown in the table below. The default sound velocity of 1500 m/s has been used in the soundings. The transducer depth was 6.3 m for the cruise.

Instrument settings for Simrad EA500 12 kHz echo sounder on cruise JR26 (Noted on 13/Dec/97)

MENU	SETTING
OPERATION MENU/ PING MODE	EXT. TRIG.
OPERATION MENU/ TRANSMIT POWER	NORMAL
OPERATION MENU/ NOISE MARGIN	12 dB
TRANSCEIVER MENU/TRANSDUCER DEPTH	6.3 m
TRANSCEIVER MENU/ ABSORPTION COEFF	1 dB/km
TRANSCEIVER MENU/ PULSE LENGTH	LONG
TRANSCEIVER MENU/ BANDWIDTH	AUTO
TRANSCEIVER MENU/ MAX POWER	4000 W
TRANSCEIVER MENU/ ANGLE SENSITIVITY	10.0
TRANSCEIVER MENU/ 2-WAY BEAM ANGLE	-10 dB
TRANSCEIVER MENU/ S_v TRANSDUCER GAIN	14 dB
BOTTOM DETECTION MENU/ MINIMUM DEPTH	variable
BOTTOM DETECTION MENU/ MAXIMUM DEPTH	variable
BOTTOM DETECTION MENU/ MINIMUM LEVEL	-66 dB
SOUND VELOCITY MENU/ PROFILE TYPE	ABSOLUTE
SOUND VELOCITY MENU/ DEPTH UPPER	0
SOUND VELOCITY MENU/ DEPTH LOWER	12000
SOUND VELOCITY MENU/ VELOCITY MIN.	1600 m/s
SOUND VELOCITY MENU/ VELOCITY MAX.	1490 m/s
SOUND VELOCITY MENU/ Edit Prof. Menu	Sound velocity = 1500 m/s

Net data collection - Sharon Grant

Summary

This report describes the collection of data associated with the deployment RMT 8 and FNET's during JR26, and also the data pathway which was used on this occasion.

Introduction

The RMT 8 was the main method used for collecting biological samples during JR26. It was planned that hauls would be taken at stations and also whenever it was thought that there were interesting and significant acoustic targets. The Fnet was a secondary collection instrument and was generally fished in tandem with the RMT8. In total there were 64 RMT hauls and 53 FNET tows. Figure 1 shows the locations of the RMT tows. Fnets were only towed together with the RMT 8 and so no figure is included charting their positions.

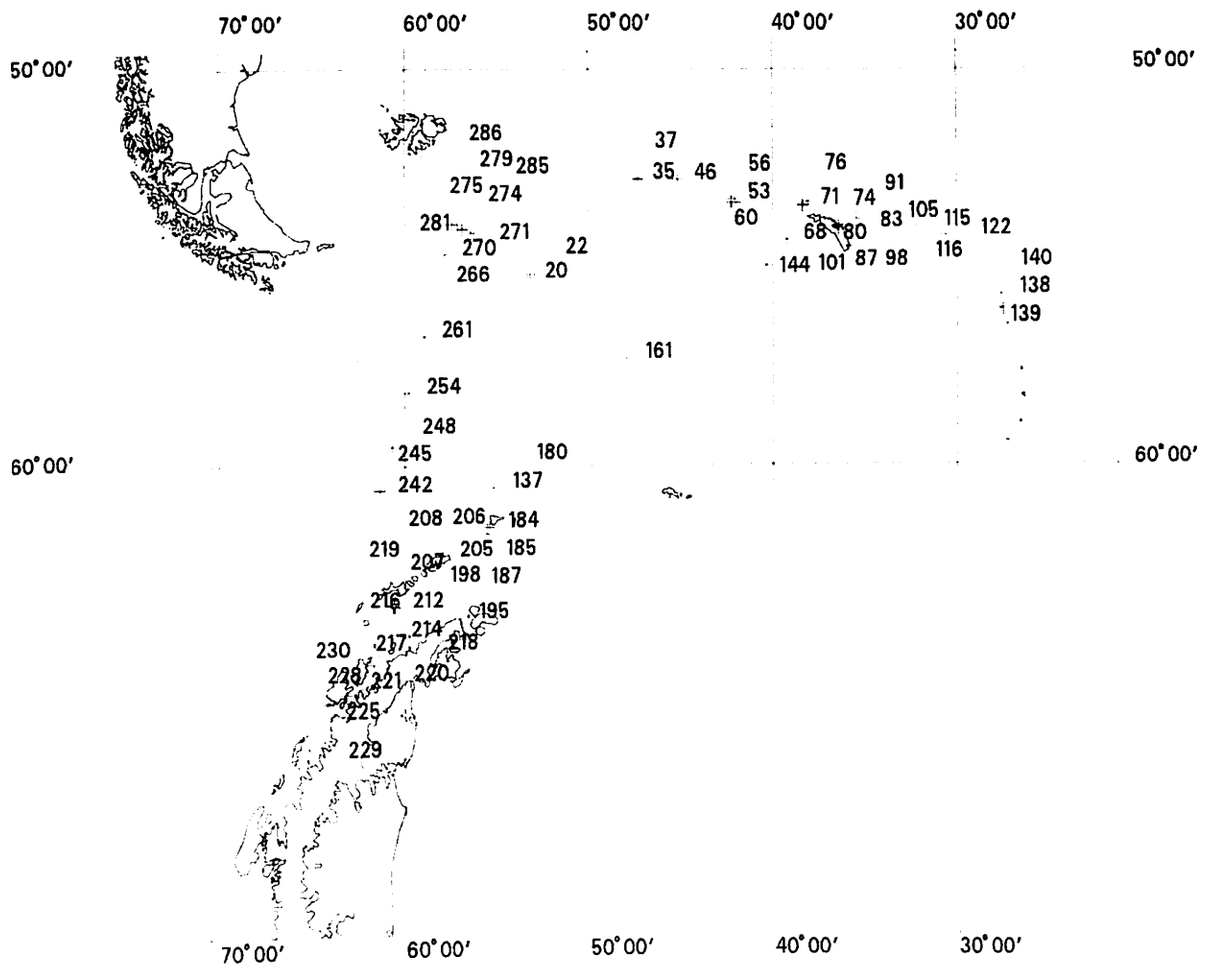


Figure 1: Locations of RMT net hauls during JR26

The RMT 8 data set:

The RMT 8 is equipped with a package called the Down Wire Net Monitor (DWNM) which is made up of; an electro-mechanical device which is used to facilitate the opening and closing of the nets on the RMT 8, a series of sensors for recording oceanographic variables, and a software package which allows the operator to monitor the position of the net in the water, which allows the operator to open and close nets and collects data from the sensors. The DWNM is also used for operating the Longhurst-Hardy Plankton Recorder but this facility was not used on this cruise.

The mechanical section of the DWNM is attached to the net cross and causes a pair of bridles holding the mouth of each of the nets closed, to be released when signals are received from the software. It is also where the various sensors are attached.

The software which controls the DWNM (dwnm56) was originally created in 1991 by Paul Woodroffe (B.A.S.), and an updated version was created in October 1997 for use in the austral summer season of 97/98 (dwnm71), however, after testing with the LHPR on JR25 it was found that the new version was not performing correctly and so version dwnm56 was used for the duration of the JR26 instead.

Net monitor data:

There were 10 instruments on the DWNM during JR26, plus three spare channels (sp1 sp2 and sp3), descriptions of these are given in table 1, and for detailed information reference should be made to the Down Wire Net Monitor System Documentation a copy of which during JR26 was kept in a drawer near the DWNM pc. Not all of the instruments where operational, as a result no data were collected from the light meter, flow meters 2 and 3, from inclinometer 2 or from the fluorometer. The light meter was not used to avoid having to take it on and of the net if the net was required to go below 500m. Data from all the other instruments were logged directly to the DWNM pc, at which point three further variables were added to the data stream, these being salinity (derived from conductivity), net number and net type. Output from the DWNM pc was in the RVS ship message protocol (SMP) format and so was passed directly to the RVS Level-B system for archiving and then to the Level-C system to produce the data stream netmon with data logged every 2 seconds (see fig 2a).

No.	Quantity measured (Variable Name)	Units	Sensor description
1	Net depth (depth)	metres	TransInstrument BHL-4269-01 Pressure range 0 - 250 bA
2	Sea Water Temperature (temp)	degrees Celsius	Sea-Bird SBE3 Range: -5.0°C - 35°C
3	Sea Water Conductivity (cond)	Siemans/metre*	Sea-Bird SBE4 Range: 0 - 7 Siemans/metre*
4	Irradiance (light) **NOT USED ON JR26**	Output: mV** Calibrated: ln µW cm^{-2}	Chelsea Instruments PR46
5	(flow1)	?	B.A.S. radial flow meter / LHPR axial flow meter 1
6	(flow2) **NOT USED ON JR26**	?	LHPR axial flow meter 2
7	(flow3) **NOT USED ON JR26**	?	?
8	(angl1)	degrees	Sensorex 41600 Inclinometer Range +/- 90 degrees
9	(angl2) **NOT USED ON JR26**	degrees	Sensorex 41600 Inclinometer Range +/- 90 degrees
10	Depth above sea bed (alt)	metres	Tritech ST200 Range 0 - 100m
11	Chlorophyll-a (fluor) **NOT USED ON JR26**	Output: mV Calibrated: µg/l	Chelsea Mk III Aquatracker Range 0 - 100µg/l +/- 0.005 µg/l + 5% of value.
12	Spare channel (sp1)		Not in use
13	Spare channel (sp2)		Not in use
14	Spare channel (sp3)		Not in use
15	Salinity (sal)	ppt	Derived from sa water conductivity
16	Net number (net)	Integer 0,1,2,3 or 4	
17	(type)		RMT8, RMT25 or LHPR

Table 1: Descriptions of the sensors present on the Down wire net-monitor during JR26.

* - mmho/cm = Siemans/metre * 10
** - PAR (ln µW cm^{-2}) = 6.9767 - (0.005147 * light)
*** - Concentration (µg/l) = 0.01121 x 10^{output} - 0.0182
? - Information unavailable during JR26

Net-monitor data processing:

During JR26 data from the Level C netmon data stream were processed using the pstar execs rmtexec0, rmtexec1, the C-Shell script rmt_info and the SAS script rmt.pgm. These were used, to create a series of data files, one for each RMT event and a series of net summaries for the whole cruise (see fig. 1b). These were placed on the pc network and also on the Unix server jrue. The execs and scripts can be found in Appendix I and table 2 shows an example of the output from rmt_info. Figure 2a outlines the data processing path.

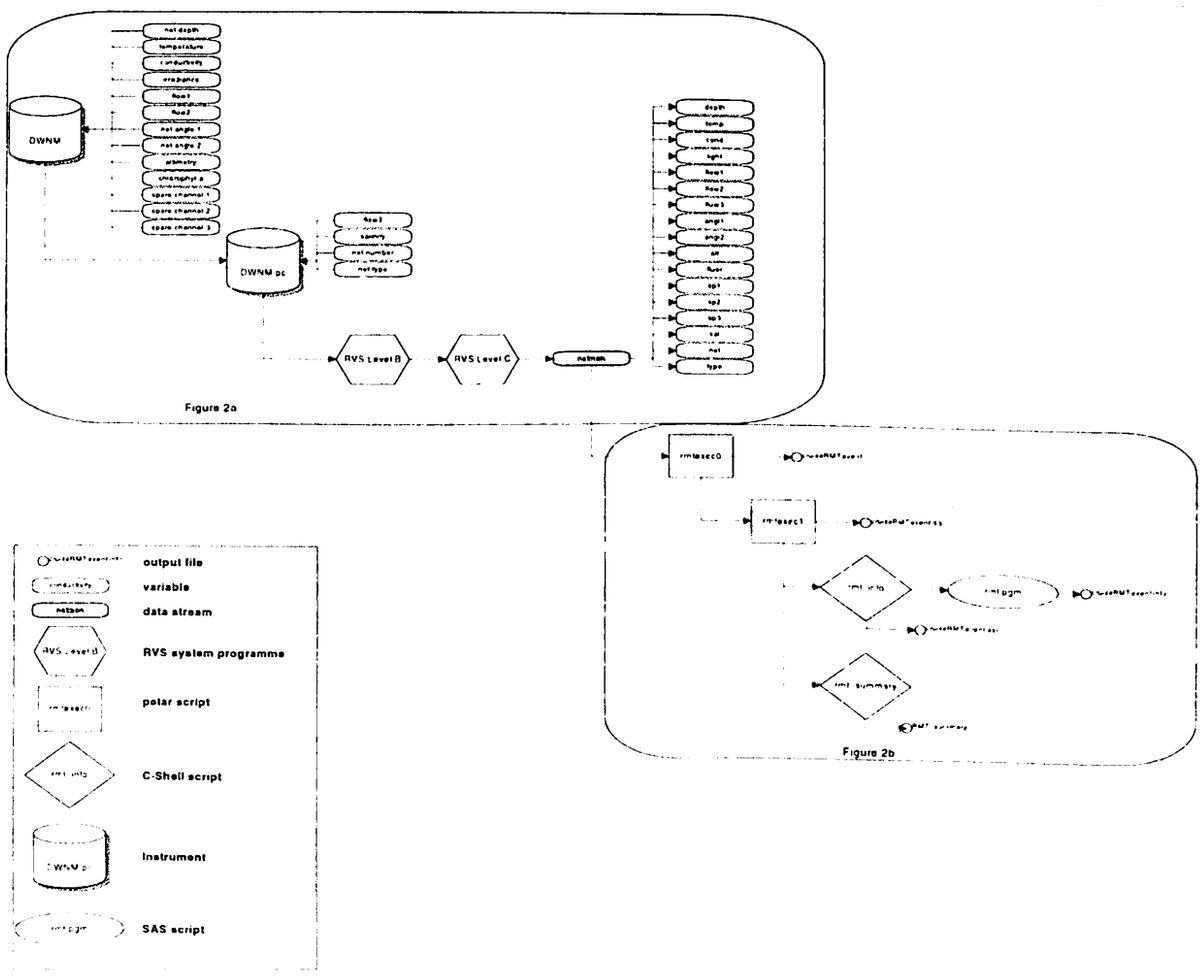


Figure 2: Data pathway used for processing raw data from the B.A.S. net-monitor on JR26.

The tables produced in this way were created as a complement to the catch data as recorded by Jeff Wakefield and outlined below. Details of the contents of the hauls and data from the DWMN will be held at BAS HQ in Cambridge by the PES data manager.

The SAS System 21:09 Wednesday, December 10, 1997 1

NET	N Obs	Variable	Minimum	Maximum	Mean
0	399	DEPTH	0	221.9000000	97.0172932
		FLOW1	0.1000000	1.3000000	0.8453634
		TEMP	-1.2329000	2.1672000	-0.1913190
		COND	-0.00010000	2.9838000	2.3822506
		SAL	33.0931000	34.9070000	33.8984305
1	825	DEPTH	203.800000	244.400000	220.6727273
		FLOW1	1.0000000	1.6000000	1.3427879
		TEMP	0.9903000	1.6394000	1.3760395
		COND	2.9371000	3.0012000	2.9747895
		SAL	34.1933000	34.3164000	34.2553868
2	480	DEPTH	51.3000000	225.000000	143.2681250
		FLOW1	1.3000000	1.9000000	1.5937500
		TEMP	-0.9764000	1.0717000	-0.4440521
		COND	2.7352000	2.9493000	2.7957758
		SAL	33.7964000	34.2608000	33.9703592
3	848	DEPTH	26.3000000	50.0000000	30.3737028
		FLOW1	1.2000000	1.9000000	1.5628538
		TEMP	-1.0459000	-0.6591000	-0.8868514
		COND	2.7201000	2.7599000	2.7387183
		SAL	33.6929000	33.8083000	33.7695368
4	87	DEPTH	0	26.9000000	14.4517241
		FLOW1	0.1000000	2.0000000	1.4942529
		TEMP	-3.4859000	-0.6288000	-1.2244632
		COND	0	2.7629000	2.2423172
		SAL	33.5300000	33.8139000	33.7100803

Details of RMT haul 21:09 Wednesday, December 10, 1997 2

NET=0

OBS	Date of haul	Start Latitude	Start Longitude	Depth net fired (m)	Temp. when net fired	COND	LIGHT	Flow when net fired (m/s)	FLUOR	Salinity (ppt)	
1	971121	-54.5681	-39.2056	0	-0.7331	2.7	6.978	0.2	0	33.0931	

OBS	DISTRUN	ANGLE	Time net fired	Event number	ACTION	Length of time net open	AVR_ANG	Volume of water filtered
1	0.2502	80.1	18:54:26	068	downcast	0:12:14	128.935	4963.97

NET=1

OBS	Date of haul	Start Latitude	Start Longitude	Depth net fired (m)	Temp. when net fired	COND	LIGHT	Flow when net fired (m/s)	FLUOR	Salinity (ppt)
2	971121	-54.5747	-39.2176	220.6	1.4921	2.9852	6.978	1.4	0	34.2615

OBS	DISTRUN	ANGLE	Time net fired	Event number	ACTION	Length of time net open	AVR_ANG	Volume of water filtered
2	1.331	68	19:06:40	068	open 1	0:29:22	67.9336	18927.94

NET=2

OBS	Date of haul	Start Latitude	Start Longitude	Depth net fired (m)	Temp. when net fired	COND	LIGHT	Flow when net fired (m/s)	FLUOR	Salinity (ppt)
3	971121	-54.5846	-39.245	225	1.0717	2.9493	6.979	1.4	0	34.2608

OBS	DISTRUN	ANGLE	Time net fired	Event number	ACTION	Length of time net open	AVR_ANG	Volume of water filtered
3	3.521	67.5	19:36:02	068	open 2	0:17:08	56.035	13107

NET=3

OBS	Date of haul	Start Latitude	Start Longitude	Depth net fired (m)	Temp. when net fired	COND	LIGHT	Flow when net fired (m/s)	FLUOR	Salinity (ppt)
4	971121	-54.5893	-39.2664	50	-0.963	2.7355	6.978	1.8	0	33.7988

OBS	DISTRUN	ANGLE	Time net fired	Event number	ACTION	Length of time net open	AVR_ANG	Volume of water filtered
4	5.02	47	19:53:10	068	open 3	0:30:06	60.9792	22580.11

NET=4

OBS	Date of haul	Start Latitude	Start Longitude	Depth net fired (m)	Temp. when net fired	COND	LIGHT	Flow when net fired (m/s)	FLUOR	Salinity (ppt)
5	971121	-54.5983	-39.3029	26.9	-0.6385	2.762	6.978	1.7	0	33.808

OBS	DISTRUN	ANGLE	Time net fired	Event number	ACTION	Length of time net open	AVR_ANG	Volume of water filtered
5	7.6212	59.5	20:23:16	068	upcast		92.1172	

Table 2: Example of Net-monitor summary table produced by rmt_info

rmt_info variable name	Description and derivation
depth	mean, minimum and maximum depth of the net during the time that it was open.
flow1	mean, minimum and maximum rate of flow of water through the open net.
temp	mean, minimum and maximum water temperature during the time that it was open.
cond	mean, minimum and maximum conductivity of the water during the time that the net was open
sal	mean, minimum and maximum salinity of the water during the time that the net was open.
Date of Haul	GMT date of net opening
Start Latitude	Location that net was fired
Start Longitude	Location that net was fired
Depth net fired	Depth recorded when the net variable changes value
Temp. When net fired	Temperature recorded when the net variable changes value
cond	Conductivity recorded when the net variable changes value
light	PAR recorded when the net variable changes value
flour	Chlorophyll - a
salinity	Salinity recorded when the net variable changes value
distrun	Horizontal distance from time net launched to time net fired
Time net fired	Time net fired
Event Number	Bridge assigned ID
action	description of what the net is doing
length of time net open	time between current net and following net being opened
avr_ang	Average angle of tilt for the net mouth
volume of water filtered	How much water has moved through the net given an effective mouth area of 8 m^2

Table 3: Description of rmt net summary fields.

The Fnet data set

There was no physical data collected about the fnet unlike the RMT 8, and details about time of deployment was generally collected after the event from the bridge science log book. Catch details were recorded in a similar manner to the RMT 8.

Catch data from the Fnet's and RMT 8

Total volume of each event net was estimated and a formalin subsample taken from it; subsamples are designated, *jr26-event number-net designation-vial number (JR26-132-1- 73).* Trays were then separated, volume or number of major component species estimated and all fishes removed. Invertebrates of interest were separated and placed into vials containing 95% ethanol and labelled as above. If was size required, invertebrate samples were placed in bottles of 95% ethanol and designated *jr26-event number-net designation-"contents" (JR26 - 132 - 1 - THYSANOESSA).*Often, Euphausiids were saved in lots for future analysis. These lots were either frozen or preserved in 95% etoh and designated *jr26-event number-net designation-Euphausiid sp (eg JR26 - 132 - 1 - E.Superba).*

After sorting, fish were identified. The first fifty of any species were assigned a discrete number with the following format, *jr26-event number-net designation-fish number (eg JR26 - 301 - 2 - 79)*. If more than fifty of a single species were collected, the excess fish were preserved in ethanol as a group designated *jr26-event number-net designation-vial number (JR26-132-1- 73)*. When possible, fish were scanned for future sizing and confirmational identification. Unless otherwise noted, each discrete number has a corresponding tissue sample stored in 95% ethanol and a frozen otolith sample.

In excess of 1500 samples were collected over four weeks. To organize this data, three indices were created. The first lists and describes all biological events; it contains the date, latitude, longitude, exact times, and net profile. The second catalogues individual fish samples. The final index lists all samples with "vial number" designations as well as Euphausiid and oversize collections. Examples of index formats can be found in Tables 4 and 5. In addition to the three indices, each event has an associated Quatropro spreadsheet titled by event number. The spreadsheet has estimated total volume of catch, volume of major component species, and a list of all species taken.

cruise #	event #	net #	fish #	species	notes	length in mm
jr26	35	1	1	Protomyctophum bolini		61.26
jr26	35	1	2	Protomyctophum bolini		55.87
jr26	35	1	3	Protomyctophum bolini		55.63
jr26	35	1	4	Protomyctophum bolini		46.46

Table 4: Details of the Fish Index

Description	Vial number	Event	Net designation	Notes
Bottle	1	38	FNET	THEMISTO+AMPHIPODS
Frozen	2	22	RMT 2	E. TRIACANTHA (150)
Vial	3	22	RMT 2	E. TRIACANTHA (170)
Vial	4	46	RMT 3	E. TRIACANTHA (194)

Table 5: Details of the Invertebrate and oversized index

RMT Net						
Event Number	Date	Time (GMT)	Latitude	Longitude	Depth (m)	Net number
20	971118	21:21:50 pm	-55.5222	-53.336	124.4	1
	971118	21:52:14 pm	-55.5047	-53.2973	65.6	2
	971118	22:22:02 pm	-55.4889	-53.2586	49.4	3
22	971118	23:23:02 pm	-55.4557	-53.1803	61.9	1
	971118	23:47:52 pm	-55.4455	-53.1532	255.6	2
	971119	00:18:06 am	-55.4328	-53.1233	271.3	3

Figure 3: Net log

Problems with net data collection on JR26

The Geneflow cruise has been an attempt by PES to combine research in the areas of oceanography and genetics for the first time. As a result it has been necessary to develop new strategies for the storage of a novel data set, in a manner which can easily be related to the continuing oceanographic data set which is currently held by PES. It was thought that using spreadsheets to record information about net catches would be a familiar tool for scientists to use in the field. Whilst, this was the case to a certain extent, it has been seen that using individual files for each haul is perhaps cumbersome for the user and expensive in terms of computer space, in the absence of a fulltime data manager, especially when the number of net tows is high. A possible alternative could be recording a day's catch data in a single spreadsheet file. However, due to diligent management data were recorded in a format which can be returned to the data manager in Cambridge.

There has also been highlighted a need for a standardised net monitor procedure, whereby logging of operations and event details are systematic. Ideally, event numbers would be electronically recorded on the bridge and immediately available to all scientists over the network. It is also propriotous, for the purposes of trouble shooting, for mishaps and accidents to be logged in a detailed manner.

Oceanlogger data report JR26 - Project Geneflow - Mark Brandon

1. Summary

This report summarises the state of the Oceanlogger data collected on JR26. The instrument functioned well although there is still a problem with part of the system that must be cured for future seasons.

2. Introduction

The Oceanlogger system is a BAS designed and built (P. Woodroffe, E.T.S.) PC based logging system. It emulates the function of several RVS level A interfaces, has an input from the ship's master clock and has real time display of data. This system logs sea surface data gathered from the ship's non-toxic pumped sea water supply and some meteorological data to the RVS ABC system with a ship's master clock time stamp on the data. The instruments with an analogue output are connected to self-contained digitising Rhopoint modules located close to the relevant instrument. The modules are then interrogated by the controlling PC using the RS485 protocol. A full list of the sensors used is given in table 1.

Table 1: The instruments connected to the Oceanlogger.

instrument	type	location	Field Name
sea temperature	4 wire PRT	Transducer space	sstemp
flow meter	Liter Meter	prep lab	flow
Thermosalinograph	Sea Bird SBE 21 serial No. 214800-0820	prep lab	temp_h and cond
fluorometer	Turner Systems	prep lab	fluor
Air temperature	vector T351	foremast	atemp
PAR sensor	Kipp & Zonen CM5	foremast	par
TIR sensor	Didcot DRP1	foremast	tir
Barometer	Vaisala PA11	UIC	Press
Anemometer	Guildline Sonic	formast	wnd_speed, wind_dir

3. Logging information

In general, information about instrument calibrations is sketchy and difficult to find aboard the JCR. The last calibration of the Seabird SBE 21 was on 3 July 1997 by Seabird Inc, Seattle, U.S.A. One difficulty with the Oceanlogger system is that the Turner fluorometer and the SBE 21 have very different water requirements from the non-toxic supply. The fluorometer requires a flow of 2 - 3 litres per minute for maximum response. In contrast the SBE 21 would like up to 25 - 30 litres per minute for maximum response. Flow rate averaged 5.3 litres per minute during JR26. This means that there is a fundamental compromise in the system with neither instrument at optimum performance. For the duration of cruise JR26 the sampling rate was set to 5 seconds (the maximum the present system is capable of) and the data logged to the level B system. The only time the system was not logging was when the ship was alongside in Grytviken for a few hours. In addition there were occasions when the ship was in pack ice when the filters became clogged with ice and the pumps tripped because the flow through the system became inadequate. The pumps were re-started at the earliest opportunity. The longest gap of xxhours occurred in the vicinity of the South Sandwich Islands. The blockages are evident from the logged flow rates. A full list of the times when the Oceanlogger was not functioning is given in table 2. The details of the daily cleaning of filters are given in table 3. Although the anemometer is not strictly part of the Oceanlogger system (having a separate level A interface), we consider it as such because we merge this stream into the data set at the earliest opportunity. In table 4 we list times when the anemometer did not function due to icing from freezing fog.

Table 2: Times when the oceanlogger was not functioning

Start time	End time	Total duration	cause
326 : 1907	326 : 2311	4 hours 4 minutes	moored at Grytviken
329 : 0921	329 : 0937	16 minutes	ice blockage
329 : 1921	329 : 1930	9 minutes	ice blockage
330 : 0923	331 : 1643	31 hours 20 minutes	ice blockage
332 : 0347	332 : 0351	4 minutes	ice blockage
337 : 1049	337 : 1115	26 minutes	RVS ABC "Black Hole"
337 : 2053	337 : 2223	1 hour 30 minutes	ice blockage

Table 3: Times when the oceanlogger intake filters system were cleaned

Date	Time (GMT)	Filter In Use	Pump In Use	Comments
17/11/97	19:25	Fwd	Fwd	Pumped Sea Water Started on departing Stanley, probe in full down position.
18/11/97	18:51	Aft	Fwd	Filter ¼ covered with small Thermistos, bits of fish and small krill.
19/11/97	18:47	Fwd	Fwd	Light covering of part of filter of Algae and other matter and a few krill.
20/11/97	18:47	Aft	Fwd	Light covering of Juvenile Krill and other small animals.
21/11/97	19:20	Fwd	Fwd	Probe moved to mid-position ~ 14:45 Clean apart from a small amount of Algae and Ice.
22/11/97	:	Aft	Aft	Pump tripped ~ 19:15 (Ice), back on @ 23:45. The filter was ¼ covered with krill and other remains.
23/11/97	20:18	Fwd	Aft	Filter ¼ covered with animal matter.
24/11/97	19:13	Aft	Aft	Filter ½ covered wit Phytoplankton and Algae.
25/11/97	19:32	Fwd	Aft	Pumps stopped, filter cleaned of Phytoplankton and Ice.
26/11/97	11:32	Aft	Aft	Pumps stopped due to Ice, filter was full of ice and clean.
27/11/97	16:45	Aft	Aft	Sea water back on at 16:45, but still in loose pack.
28/11/97	17:43	Fwd	Fwd	Filter ¼ covered in Phytoplankton.
29/11/97	19:27	Aft	Fwd	Filter ⅓ covered in Phytoplankton and Diatoms.
30/11/97	14:47	Fwd	Fwd	Filter ⅓ covered in Phytoplankton, Diatoms and a single krill.
01/12/97	19:43	Aft	Fwd	Filter clean apart from a small amount of Algae and Phytoplankton.
02/12/97	20:18	Fwd	Fwd	Filter covered with a small amount of Algae and ~ 20 Krill and Krill remains.
03/12/97	19:55	Aft	Fwd	Filter surface clean and contained ~ 20 Juvenile Krill .
04/12/97	20:20	Fwd	Fwd	Filter clean.
05/12/97	18:32	Aft	Fwd	Filter clean.
06/12/97	12:17	Fwd	Fwd	Inside Deception Island all day, filter contained krill.
07/12/97	11:30	Aft	Fwd	Filter ¾ covered in Krill.
08/12/97	23:53	Fwd	Fwd	Filter contained ~ 50 mostly small Krill and remains.
09/12/97	20:09	Aft	Fwd	Filter ½ covered in krill remains and about 20 lose krill.
10/12/97	20:12	Fwd	Fwd	Remains of five krill otherwise filter clean.
11/12/97	19:21	Aft	Fwd	Filter ⅓ covered with terrapods and krill remains.
12/12/97	17:42	Fwd	Fwd	Almost Clean part from one small fish.
13/12/97	19:08	Aft	Fwd	Mostly clean apart from a few small krill.
14/12/97	07:00			System shut down entering Stanley.

Information Supplied By : Simon Wright (Deck Engineer), R.R.S. *James Clark Ross*

Table 4: Times when the anemometer did not function due to icing.

Start time	End time
jday 338 : 0400	jday 335 : 0800
jday 343 : 0400	jday 343 : 0800

4. Routine Processing

The data were read into the UNIX system daily in 24 hour sections using a Unix script (JR26_ocean). This script also produces a series of five diagnostic plots for the 24 hours of data against time. At the this point the data are also split up into five files.

File 1: The raw data. This file contains all 5 second data cycles for the 24 hour period in a completely unedited form. Following standard MLS procedure the filenames are of the form

26ocl<jday>.raw

File 2: Ocean Data. This file contains the 5 second data for the sea surface streams and has some initial editing described below in the detailed description of the data processing route. The variables in this file are time, sea surface temperature (stream: sstemp), Thermosalinograph temperature (stream: tstemp), conductivity from the Thermosalinograph (stream: cond), flow from the liter meter (stream: flow), raw fluorescence from the Turner Fluorometer (stream: fluor), and a derived raw salinity value. At this stage the salinity is usually very noisy as will be described below. Filenames were constructed in the form 26ocl<jday> .

File 3: Averaged data. This file contains 2 minute averages of file 2 with positional information merged in from the differential GPS level A stream. Thus, the file contains the same variables as above with the addition of latitude and longitude. This file was mainly used for rapid plotting of data with geographical coordinates. Filenames were constructed in the form 26ocl<jday>.2min

File 4: Meterological data. This file contains the 5 second data for the meterological parameters recorded by the Oceanlogger for a 24 hour period in a completely unedited form The variables in the file are time, air temperature (stream: atemp), air pressure (stream: press), the total incident radiation (stream: tir), the photosynthetically available radiation (stream: par), and the wind speed and direction (streams: wind_spd and wind_dir). File names were constructed in the form 26met<jday>.raw .

File 5: Fluorescence specific data. This stream was constructed specifically to help in the analysis of the fluorescence data. The stream contains time, sea surface temperature, par, tir, flow and three different versions of the fluorescence. One of the fluorescence fields is the raw data, one with a median filter (1 minute window) to the raw data, and one with a 'top hat' filter over five minutes applied to the median filtered data. These data will be described in a subsequent sections. Filenames were constructed in the form <jday>.fl .

5. Further processing

The meterological data from file 4 above were combined with gyrocompass data and positional information from the bestnav data stream to derive true wind velocity using a Unix script called *twvelec*. Thus true winds were derived for the whole cruise with the exception of the time periods listed in table 4.

6. Underway salinity samples

Salinity samples were drawn from the non-toxic supply as it left the Thermosalinograph approximately once every six hours. These samples were treated in the exactly the same manner as those taken for the CTD calibration. The 300 ml sample bottle was rinsed twice and the neck of the bottle dried carefully before an air tight plastic seal was inserted and the cap screwed back on. The samples were then stored in the prep lab beside the Guildline Salinometer for at least 24 hours before the conductivity was measured against Ocean Scientific Standard Seawater batches P130 and P132. The sample conductivity values were entered into a Macintosh Excel Spreadsheet and transferred to Unix using the script *ocl_samples*. The data were then converted into a standard RVS format time using the script *oclexec3*. In total there were 58 underway salinity samples which are now ready to be merged with file 2 - (the sea surface data) to derive a salinity calibration for the cruise. This calibration may be either a constant or a tide-dependant adjustment.

7 Fluorescence data - Alistair Murray

Calibration samples were taken from the non-toxic water supply outlet from the fluorometer at hourly intervals while the vessel was underway between stations. Volumes filtered varied from 200 - 500 ml according to the *in vivo* fluorescence reading on the fluorometer with larger volumes necessary when the readings were low especially in off-shore oceanic waters. Water was filtered through a Whatman GF/F 25 mm filter which was then extracted in 10 ml of acetone for a minimum of 24 hours. Extracted samples were assayed using the benchtop Chelsea Instruments Aquapack-type fluorometer previously calibrated on JR25. A further calibration was run on 14/12/97. Assay followed a standard procedure whereby fluorescence was read and averaged for ten flashes of the excitation lamp, 1 ml of 10% HCl was added and when the readings stabilised a further ten readings were averaged. Data were entered into a QuattroPro spreadsheet for calculation of chlorophyll concentration in the water. A total of 332 samples were processed during the cruise. Three samples around South Georgia contained so much chlorophyll that the benchtop fluorometer was saturated and these samples are considered as missing values. It was noted that extraction was poor, as evidenced by colour present on the filter after 24 hours extraction, for some of the South Georgia samples.

Raw fluorescence from the Turner fluorometer was processed by Pstar exec flocean0 to give despiked and smoothed fluorescence data. The window for median despiking was set to 1 minute and for moving average to 5 minutes on the basis of previous experience. On this cruise there will be additional post-processing difficulties because of the highly variable ship's speed and course while in pack ice. Pstar exec flocean1 was used to subset the data corresponding to extracted chlorophyll samples; these data were then merged into the QuattroPro spreadsheet. *In vivo* fluorescence yield per mg chlorophyll extracted was then calculated.

It was noticed that the measurements of photosynthetically active radiation (par) are often subject to periods of rapid and substantial variation. It is now suspected that this might be due to shading of the sensors by the ship's foremast. Previously it had been assumed that the sensors were on the top of the mast. In the absence of documentation this is hard to establish - but visual inspection from the bridge suggests that this is not the case. Clearly this is very undesirable - such sensors should be sited where they cannot be shaded and if there is any possibility of this then twin sensors should be used with readings being taken from the one in direct light.

The final step in estimation of chlorophyll will be to apply the par-adjustment model and the interpolated yields to calculate chlorophyll concentrations from the underway data. This procedure will be carried out in Cambridge and will follow the scheme outlined in the paper by Murray and Priddle (to be submitted).

8. Problems

We find it necessary to make two suggestions for future cruises. The first one is simple. There really must be a central databank of the sensors and calibration data. This information should be to hand but apparently it is not.

The second problem is much more serious and is the still unexplained lag between the temperature sensor and the conductivity cell in the thermosalinograph. The problem was first reported during WOCE leg A23 (JR10) when it was noticed that conductivity from the SBE - 21 lagged the temperature of the housing (temp_h). This of course causes a spike in the derived salinity signal. The A23 scientists overcame this by applying a lag through a filter to temp_h. On previous MLS cruises (CF reports for JR16 and JR17) we tried filters of varying length in time to lag the temperature before settling on a length 48 one-way filter with n = 48 successive coefficients given by $W (1 - W)^{n-1}$. W was found by experiment to reduce the salinity spiking best at a value of 0.03. With the 5 second sampling rate the 48 point filter has an effect over 4 minutes. It is not clear to us however that this is the best way to proceed and so this step remains to be completed on return to Cambridge.

9. Suggestions

The priority must be to get to the cause of the temperature and conductivity spiking problem as this makes the salinity data rather difficult to use. At present every time the ship passes through a temperature gradient the salinity spikes badly. In the waters we generally operate in there are frequent temperature jumps and so the problem is significant.

The Oceanlogger data processing route for JR26

JR26_ocean which runs

Step 1: oclexec0

Purpose: To read in the Oceanlogger data from the RVS stream.

The programs are

datapup - read in the data from the RVS Oceanlogger stream into a pstar file.
pcopya - reset the raw data flag in the Oceanlogger pstar file.
datapup - read in the data from the RVS anemometer stream into a pstar file.
pcopya - reset the raw data flag in the anemometer pstar file.
pmerge - merge the two files together on time.
pheadr - set the header of the pstar file.

The output of the exec is in the form 26ocl<jday>.raw

Step 2: oclexec1

Purpose: To copy out the relevant file sections, and in one case merge in the navigation.

The programs are

pcopya - copya out the segment of the Oceanlogger that is sea surface data.
pheadr - set the variable names in the sea surface data file.
pedita - take out the large spikes in the flow sensor.
pcopya - copy out the segment of the Oceanlogger that is meteorological data.
pcalib - set the dummy pressure variable created in the first pcopya to zero.

pmdian - take out spikes of greater than 0.05 mmho/cm in the sea surface data.
peos83 - derive a raw salinity for the sea surface data.
pavrge - average the sea surface data to 2 minutes.
pmerge - merge the bestnav navigation to the 2 minute averaged sea surface data.

There are three output files. These are

26 met<jday>.raw
26ocl<jday>
and
26ocl<jday>.2min

Step 3: ocl_samples

Purpose: To read in the sample data from the Macintosh.

The programs are

getexcel.exec - read sample data from the mac.

The output file is

oclbt$num.bot

Step 4: oclexec3

Purpose: To reformat time in the sample file.

The programs are

pcopya - copy in an extra jday variable.
pheadr - change the name of the extra jday to time (seconds).
pcalib - take one from the time variable.
pcalib - multiply time by 86400, hrs by 3600 and mins by 60.
parith - add time and hours.
parith - add time and minutes.

The output file is

oclbt$num.samples

Step 5: twvelexec

Purpose: To reformat time in the sample file.

The programs are

pmerge - mege in the ships heading from the gyrocompass.
parith - add the wind direction and the ship's heading.
prange - keep wind direction between 0 and 360 degrees.
pcalib - convert wind speed from knots to m/s
pheadr - change wind units
pcmcal - break wind into east and north components.
pcalib - reverse the wind direction
pmerge - merge in lat and lon from the bestnav file.
posspd - derive ship velocity from position fixes.
pcalib - convert ship velocity to m/s
parith - add wind and ship velocity components.
pcmcal - convert back to true wind and direction.
pheadr -convert variable names.
pcopya - remove all of the junk variables.

The output file is

26met< jday>.true

Processing of Navigation data on JR26 - Project Geneflow - Mark Brandon

There are six navigational instruments for scientific use on the RRS *James Clark Ross* (listed in table 1). Although the six instruments seem in some cases similar, they are all unique. As well as the three GPS systems listed in table one, there are two additional GPS systems on board the JCR for the ship's use. These are a Leica MX400 and an Ashtech G12 receiver. In addition there is a Racal SkyFix Satcom which receives GPS SV range correction data via INMARSAT B. This data is passed to the Trimble, Leica, and G12 receivers allowing them to operate in Differential mode (DGPS). During JR26 the DGPS reference station at Stanley was used. The data flow for the GPS instrumentation and the layout of the GPS ariels on the monkey Island are shown in figure 1 and figure 2.

Table 1: Scientific navigation instruments on the RRS James Clark Ross.

Instrument	Type	Code	Use
Trimble 4000	GPS receiver	gps	Primary positional information
Ashtec GG24	GLONASS / GPS receiver	glo	Secondary positional information
Ashtec GPS3DF	GPS receiver	ash	Attitude information
Gyrocompass	Sperry Mk 37 model D	gyr	Heading information
Electromagnetic Log	Chernikeeff log Aquaprobe Mk V	eml	Velocity information
Doppler Log	Sperry SRD 421	dop	Velocity information

The collection and use of all of the navigation data are linked. On this cruise the data for all six instruments and the standard editing procedures were all done in one Unix script called "JR26_nav_go". This script requires the Julian day as an input and then executes a further 8 C shell scripts to read in 24 hours of data, and edit where necessary, for all six streams.

In this short report we briefly describe each instrument and explain the processing, as was done on the Marine Life Sciences Geneflow cruise - JR26.

The instruments

1. Trimble 4000

   The Trimble 4000 receiver in differential mode was the primary source of positional information for the scientific work on Geneflow. The data were logged at 1 second intervals and read in to a 24 hour pstar file using the Unix script gpsexec0. Individual steps in this exec are

   gpsexec0:

   purpose: To read Trimble data into the pstar format.

   The programmes are

   datapup - transfers the data from RVS binary files to pstar binary files.

   pcopya - resets the raw data flag on the binary file.

   pheadr - sets up the header and dataname of the file.

   datpik - removes data with a dilution of precision (hdop) greater than 5.

   Two files are output from this script.

   One is just before the editing stage (datpik) and is called 26 gps<jday>.raw

   the other is after the datpik, this is 26 gps <jday>.

   This edited file was appended to a 1 second master file.

2. Ashtec GLONASS (GG24)

The *James Clark Ross* is the only British research ship currently installed with a GG24 receiver and on JR17 was used as our primary source of positional, and therefore velocity information. On the present cruise the data were considerably poorer than last year, and almost an order of magnitude worse than the DGPS system (see below). Therefore the system was considered secondary to the Trimble DGPS. The GG24 works by accepting data from both American GPS and the Russian GLONASS satellite clusters. This extends the constellation of available satellites to 48 and should theoretically be significantly more accurate.

When we came onto the ship in October 1997 the GLONASS system was unserviceable. It was repaired on JR25 but it is still striking that the instrument considered last year as the primary position source should have become so rapidly neglected. My suspicion is that it is still not operating correctly and so its quality is degraded. Unfortunately the nature of this cruise has not allowed periods for experiment with the configuration and so once configured the system stayed the same. The GG24 can also receive the DGPS input from the SkyFix unit. This should be implemented as soon as possible.

It should be noted that the GLONASS frequently hangs. On these occasions the GG24 outputs a position of 0°N and 0°W, and more worryingly the data is flagged as good in the RVS system. The instrument generally came back to life but occasionally it required ITS intervention (in the form of power cycling). There is no apparent reason for these dropouts as there certainly are satellites available for positional information (the other GPS instruments do not drop out). For Geneflow the data were logged at 1 second intervals and read in 24 hour chunks using a C shell script called ggexec0.

ggexec0:

Purpose This exec reads in data from the GG24 into pstar format, It also does some primary editing.

The programmes are

datapup - transfers the data from RVS binary files to pstar binary files.
pcopya - resets the raw data flag on the binary file.
pheadr - sets up the header and dataname of the file.
datpik - rejects data on the following criteria

If there are less than 4 or greater than 24 space vehicles
If the positional dilution of precision is greater than 10
If the time dilution of precision is greater than 4
If the horizontal dilution of precision is greater than 4
If the vertical dilution of precision is greater than 4

Two files are output from this exec.

The first the raw data 26 glo <jday>.raw
and the edited data 26 glo <jday>.

3. Ashtec GPS3DF

When we arrived on the ship for JR25 there were rumours that there had been problems with the 3DF system. On inspection of the sub menus detailing the receiver configuration it was noted that there were unusual settings. The configuration data for the aerial array (which had not changed since summer 1996) were not entered, and the co-ordinates that were entered were wrong, the heading output from the unit being 90 degrees from the ships heading. The sub-menus from the receiver were set as in table 2.

Table 2: The sub menu settings on the Ashtec 3DF GPS system (menu 4 and sub-menus)

POS	54:17.0S, 35:40,W,+0.0m
Alt known	N
Ranger	0
Unhealthy SV	N
Rec. Intv	20
Min no. Sv	4
Elev mask	10
Pdop mask	40

PORT A (not used)	
nmea	off
real time	off
VTS	off
baud	9600
PORT B (Level A logging)	
nmea	on
real time	off
VTS	off
baud	4800
OPTIONS	PAT ON
	1 s rate

Attitude Control Menu

max rms	8			
search ratio	0.5			
1 s update	Y			
3 Sv search	N			
	TAU	**TO**	**Q**	**R**
Hdg	999	000	1.0e-2	1.0e-2
Pitch	020	000	4.0e-2	1.0e-2
Roll	020	000	4.0e-2	1.0e-2
Kalmann filter reset	N			

The coordinates in the following table are from a survey using the Ashtec software in Grimsby in September 1996. The port-aft antenna is designated number 1, port-fwd is 2, stdb-fwd is 3 and stbd-aft is 4. The XYZ vectors have been adjusted so that heading is defined by the direction normal to the 1-4 baseline (i.e. that baseline has Y = 0)

Vector	**X(R)**	**Y(F)**	**Z(U)**
1-2	2.955	4.751	0.0
1-3	11.499	4.754	0.0
1-4	13.227	0.0	0.0
offset	0(H)	0(P)	0(R)
Max cycle	0.2 cyc	smoothing	N
Max mag	0.08	Max angle	10

The Ashtec GPS3DF system performed well on JR26 with excellent data coverage. We use the instrument to correct the gyrocompass error inherent in the ADCP data. Our complex data procedure is therefore designed with this in mind. There were three execs involved in the processing these are ashexec0, ashexec1 and ashexec2

ashexec0:
purpose: This exec reads in data from the GPS3DF into pstar format
The programmes are

datapup - transfers the data from RVS binary files to pstar binary files.
pcopya - resets the raw data flag on the binary file.
pheadr - sets up the header and dataname of the file.

The output file is in the form 26 ash < jday> .raw

ashexec1:
purpose: This exec merges the Ashtec data to the master gyro file from gyroexec0
The programmes are

pmerg2 - merge the ashtec file with the master gyro file.
parith - calculate the differences in the ashtec and gyro headings (delta heading).
prange - force delta heading to lie around zero.

The output file is in the form 26 ash < jday > .mrg

ashexec2:
purpose: This exec is complicated as it edits the merged data file.
The programmes are.

datpik - reject all data outside the following limits
heading outside 0° and 360°
pitch outside -5° to 5°
roll outside -7° to 7°
attf outside -0.5 to 0.5
mrms outside 0.00001 to 0.01
brms outside 0.00001 to 0.1
delta heading outside -5° to 5°
pmdian - we remove flyers in delta heading of greater than 1° from a 5 point mean.
pavrge - set the data file to be on a 2 minute time base.
phisto - calculate the pitch limits.
datpik - further selection of bad data outside the following limits
pitch outside the limits created
mrms outside the range 0 - 0.004
pavrge - again set the data file to be on a 2 minute time base.
pmerge - merge back in the heading data from the gyro from the master gyro file.
pcopya - change the order of the variables.

The output files are 26 ash < jday > .edit
and 26 ash < jday > .ave.

We then followed an elaborate manual editing procedure following the suggestions and written notes of Raymond Pollard (S.O.C.) that is described in the ADCP data processing report.

4. Gyrocompass

The gyrocompass is a fundamental data stream. It is used by the RVS program *bestnav* to derive dead reckoning in the (very rare) absence of gps data - as well as being used for ADCP processing (ADCP report) and derivation of true wind velocity (ocean logger report). For JR26 the gyrocompass data was read in 24 hour chunks using the Unix exec gyroexec0

gyroexec0:
purpose: This exec reads in the gyrocompass data and removes the inevitable bad data.
The programmes are.

datapup - transfers the data from RVS binary files to pstar binary files.
pcopya - resets the raw data flag on the binary file.
pheadr - sets up the header and dataname of the file.
datpik - forces all data from the gyro to be between 0 and 360°.

The output file is in the form 26 gyr < jday > .raw
The script also appends the day file to a master file called 26 gyr 01.

5. Electromagnetic Log

The electromagnetic log gives the water velocity relative to the ship in a fore-aft direction. The data was read in 24 hour chunks using the very basic exec called emexec0

emexec0:
purpose: This exec reads in data from the electromagnetic log into pstar format.
The programmes are.

datapup - transfers the data from RVS binary files to pstar binary files.
pcopya - resets the raw data flag on the binary file.
pheadr - sets up the header and data name of the file.

The output file is in the form 26 eml < jday> .raw

6. Doppler Log

The Doppler log gives water velocity relative to the ship in both the fore-aft and port starboard direction. This vector information was read in as 24 hour chunks the using a simple exec dopexec0.

dopexec0: This exec reads in data from the Doppler log into pstar format.
datapup - transfers the data from RVS binary files to pstar binary files.
pcopya - resets the raw data flag on the binary file.
pheadr - sets up the header and data name of the file.

The output file is in the form 26 dop < jday> .raw

Daily Navigation Processing

As stated above the data was read in as daily (24 hour) files from 00000 Z to 235959Z. Once the data had been routinely edited following the procedures detailed above (and with our criteria), the data was fed back into the RVS system to utilise the RVS programme "bestnav". This program uses the navigation data from various streams to construct a JR26 navigation file with 30 second fixes. For JR26 the primary input to bestnav was the Trimble 4000 DGPS. In the absence of DGPS data the GLONASS data was substituted. In the absence of these two the Ashtec 3DF data were used (essentially this is the raw gps signal). In the absence of all three GPS receivers position was constructed from dead reckoning using the EM Log and the gyrocompass.

This navigation file was read into a pstar file using the scrip navexec0, which again was run in 24 hour chunks.

navexec0:
purpose: This exec reads in data from the bestnav stream into pstar format.
The programmes are.

datapup - transfers the data from RVS binary files to pstar binary files.
pcopya - resets the raw data flag on the binary file.
pheadr - sets up the header and data name of the file.
posspd - here we calculate the east and north velocities from position and time.
papend - the output file is added to the master file.
pdist - we now recalculate the distance run variable.
pcopya - and take out the RVS calculated distance run.

The output master file was called abnv261 and was used for all pstar required navigation information (i.e ADCP processing, true wind derivation, UOR data ect.).

Experiments

A comparison of navigation instruments

At the start of the cruise we tried a simple experiment to test the accuracy of the GLONASS GPS system against the Trimble DGPS system and Ashtec 3DF system whilst the ship was alongside FIPASS at Stanley. This was done by logging the three data streams at 1 second resolution for two periods of 12 hours. As specified in table 3.

Table 3: Time periods for the comparison of navigational accuracy.

Case	Start time	Stop time
Case 1	day 319 time 1800 Z	day 320 time 0600 Z
Case 2	day 320 time 1500 Z	day 321 time 0300 Z

For both cases the Trimble and Ashtec 3DF system were set to record in the same configuration. For the GLONASS the receiver was set in case 1 to accept both GLONASS and GPS satellites, for case two it was switched to record just the GLONASS cluster of satellites. In table 4 we report the standard deviation in metres of the position for these two cases and the three instruments. The conversion of longitude to metres was done for a latitude of -51.6919 S.

Table 4: Comparison of standard deviations of positional accuracy of the three satellite navigation instruments.

	case 1		case 2	
Instrument	Latitude (m)	Longitude (m)	Latitude (m)	Longitude (m)
Trimble 4000	1.4465	0.6248	2.0700	1.0752
GLONASS	12.5591	9.2064	49.5971	48.3355
Ashtec 3DF	46.3964	27.4160	32.0032	21.8320

We can see from Table 4 that although the Trimble 4000 and the Ashtec 3DF vary in accuracy (as would be expected) between the two periods, the contrast in the GLONASS is striking. Theoretically the GLONASS should give better positional accuracy with both clusters of satellites selected, but in addition the GLONASS system should be inherently more accurate than the GPS system as it does not suffer from the selective availability (SA) that pollutes the GPS signal. On the results of table 4, and the fact that they are so poor compared with the data collected 1 year ago, I suspect that the GLONASS receiver may be configured incorrectly, this should be investigated in Stanley. The GLONASS receiver was subsequently reset to accept both clusters of satellites and the Trimble DGPS taken as the primary input to the bestnav program.

Experiments with the EM and Doppler Log

To see which log was most accurate, 11 days of Doppler log data and 11 days of EM log were appended and their velocity (speed in the case of the EM log) were compared with the ship velocity using the 1 second DGPS data. This method has some weaknesses that are mainly based around the fact that the logs measure water velocity (speed) relative to the ship whereas the DGPS measures the ship velocity over ground. Therefore errors will be expected in regions where there are large ocean currents and strong tides. This error would be expected to average out over 11 days of data. Another error is that the EM log and the Doppler log both plateau in there values at high ship speeds (C. Elliot, Pers. Comm). By a simple linear regression the Doppler Log data was found to be for 887482 data points,

Ship Velocity = 0.97 * Doppler log velocity.

For the EM log the ship speed was found to be for 394754 data points.

Ship Speed = 0.93 * EM Log Speed.

Suggestions

The navigational instrumentation on the JCR is constantly going through large changes, thankfully for the good. However there is a lack of documentation on the ship about current "best configurations" of such instrumentation as the Ashtec GPS3DF and the GLONASS. There was also a lack of documentation about the current set up of the systems. This should be rectified. In addition, the SkyFix module has 4 ports: 1 is dedicated to the Leica and another serves both the Trimble and G12 (the serial connection is split at the receivers). There are therefore 2 ports still available and perhaps it could be possible to provide both the GG24 and Ashtec GPS3DF with GPS SV range correction data to increase our capabilities still further?

Figure 1: The flow of data for GPS systems

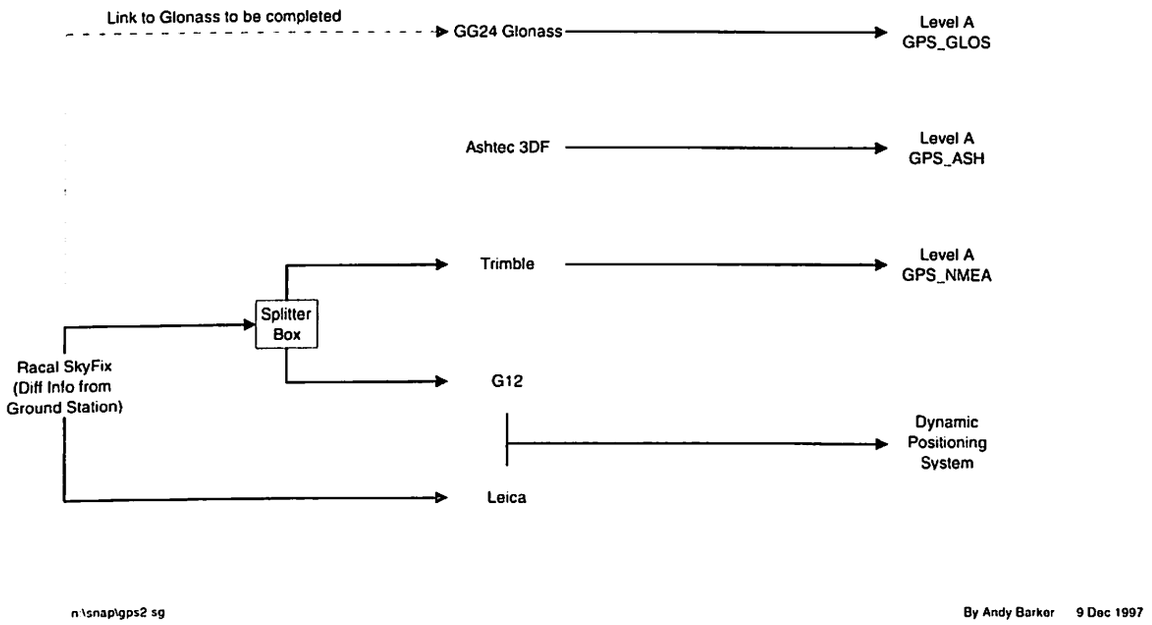
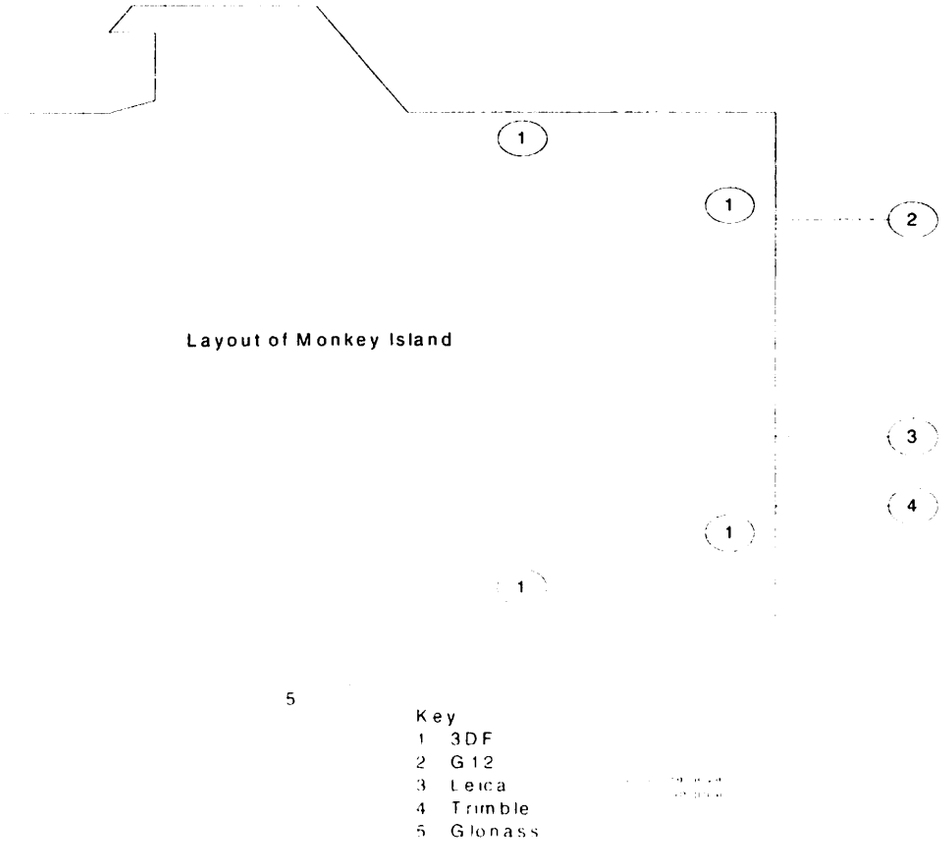


Figure 2: The location of gps aerials on the monkey island.



Data Management - Virtual Data Manager

Introduction

In the absence of a data manager during JR26, data was collected automatically using a series of scripts, outlined below and collectively known as the Virtual Data Manager (VDM). Whilst this has enabled raw data from the RVS level C system to be archived for return to Cambridge, it has been noticeable that there has been a reduction in the amount of processed data which has been available during the cruise, and this may reduce the speed with which data can be analysed on the return of scientists to Cambridge. It has also been the case that immediate requests for such preliminary data during the course of the cruise have been delayed.

Daily processing

ASCII text files were produced for each RVS binary stream for each day of the cruise for subsequent storage in the PES pesto data storage system. These files were created in Level C "listit" format, gzipped, and stored in the /data/pesto data area on the Unix workstation jrue. They were produced using the C shell script *rawdata.csh* which was executed using the *source* command. This script was modified from the original supplied by the data manager prior to JR26 to ensure the correct processing of streams with data that did not fully span a 24 hour period. The main modification being the implementation of a configuration file, *rawdata.cfg*, to define which streams should be processed.

Once the ASCII files were produced the C shell script *resets.csh* was run to derive lat/lon data for acoustics reset files mounted under /data/krilltimes. *Resets.csh* required "clairetime" files to be present in /data/krilltimes. If a "clairetime" file ran over midnight then it was necessary to rerun *resets.csh* the next day to add the missing lat/lat values. When running *resets.csh* for a day that has already been processed (eg. when a "clairetime" file has run over midnight) it was necessary to delete all the "latlon" files for the day concerned beforehand otherwise empty "latlon" files were created. *Resets.csh* calls the SAS script *resets.sas* and

NB:
/data/krilltimes was mounted from bsumlsb:/local1/data/ek500/pjc_avs/headed_ascii/times.

Cruise data

Together with the daily processing scripts there were a series of spreadsheets contained within the virtual data manager for recording net haul events, details of net haul data recording procedures can be found in the net data processing section of the JR26 cruise report. Also present was a spreadsheet for collating information from the bridge scientific log.

Geographical Information Systems on JR26 - Sharon Grant

Summary

This report outlines the use that was made of the Geographical Information System (GIS) Arc/Info on the British Antarctic Survey research cruise JR26.

Introduction

It is inevitable that as the sophistication of instrumentation which can be operated on board a research vessel such as the R.R.S. James Clark Ross increases so does the amount of data which is collected. This was one of the of the justifications for the creation of a PES data manager, as a result since JR11, PES data has been systematically collated and archived and has led to the development of the pesto data access system. This coupled with an increasing demand for some mechanism by which data can be quickly viewed in a graphical manner has led to the decision to use the GIS Arc/Info in an attempt to provide this quick access to data whilst at sea.

The Arc/Info software

Arc/Info is a software package created by ESRI for the storage and analysis of information which has a spatial component. It's most common use within B.A.S. is as a tool for producing cartographic maps, however, this is only a small component of it's capabilities. It is also a powerful tool for data analysis, which allows the scientist the opportunity to overlay datasets which have been referenced geographically and carry out selections on data from different layers There is also a facility built into Arc/Info for writing macros and menus which was. utilised to create a small interactive programme for viewing and printing, appendix I shows a flow diagram of the macros and scripts which make up the cov_view program.

The use of Arc coverages during JR26

Because of the large geographical area covered by the geneflow cruise (over 4000nm) and because of the unusual ice cover during this time there was a need for a wider set of oceanographic charts than was available, and so rough planning charts were created in Arc/Info using the 1996 gebco bathymetric coverage, together with the B.A.S. coastal contours coverage. There was generally a requirement for these in areas away from South Georgia such as at the South Shetlands.

It was also found to be useful to plot the positions of ctd's and rmt 8 net hauls in relation to bathymetry, and these plots were used in general discussions on the grouping of net samples with general oceanographic features such as sea surface temperature.

A third development was the use of Arc/info to plot surface oceanographic data directly onto bathymetry. This was only done for presentation purposes during the cruise but may be useful as a tool for integrating oceanographic data with species distributions in a wider more general GIS.

Arc Cover name	Description
coast_p	line coverage in polar projection of the Scotia arc from the BAS coastline coverage
JR26_bathy	line coverage from gebco '96 bathymetry. clipped to the Scotia arc and peninsula, and retaining the 100m, 200m, 500m and 1000m contours
JR26_rmt	point coverage of start position of rmt hauls
JR26_ctd	point coverage of ctd stations
JR26_xbt	point coverage of xbt locations
JR26_sstemp	point coverage containing sstemp data from the oceanlogger

Table 1: Description of Arc/Info coverages held presently for JR26

The future of Arc/Info on the ship's network

Whilst the presence of a complete set of oceanographic charts in the UIC room of the James Clark Ross would have negated the need for using Arc/Info to produce such charts, there was still a requirement for charts which could be used for *ad hoc* planning and for giving a rapid, if preliminary look at horizontal oceanographic features. There is also I feel a requirement the development of a PES GIS which utilises data held in the PES pesto data structure.

Coverages generated during JR26 will be held at Cambridge for general use as will postscript files of any plots created during the cruise.

Appendix I: Flow diagram of pesgis program