Q3 DYNAMOE PROGRAMME
BIOLOGICAL SCIENCE DIVISION
BRITISH ANTARCTIC SURVEY

FLUMPEX

FLUX AND MARINE PRODUCTION EXPERIMENT

JR70 SCIENTIFIC CRUISE
JANUARY & FEBURARY 2002

CRUISE REPORT

TABLE OF CONTENTS

FLUX AND MARINE PRODUCTION EXPERIMENT (FLUMPEX)

JR70 CRUISE REPORT

INTRODUCTION

(JON WATKINS)

DYNAMOE (DYNAMICS AND MANAGEMENT OF OCEAN ECOSYSTEMS)

The DYNAMOE programme is examining the globally important question of how regional marine ecosystems are connected to large-scale biological and physical processes. Understanding such connections across a range of scales is fundamental to predicting the effects of human induced impacts through activities such as harvesting, or more indirectly through climate change.

The Southern Ocean ecosystem is an excellent model system for addressing these questions. Traditionally the food-web has been characterised as relatively simple with a single species, Antarctic krill, being the major item in the diet of many of the predators, although that view is now considered to be too simplistic. The Scotia Sea region of the Southern Ocean is one of the few areas globally, where such large-scale ecosystem integration is possible.

The DYNAMOE programme focuses on the South Georgia ecosystem, it's links in the Scotia Sea ecosystem and considers the Southern Ocean wide implications. It is undertaking fundamental research to determine what aspects of the ecosystem operation are crucial to successful prediction and hence management.

The programme consists of a series of focused studies aimed at elucidating the key interactions and the dominant biological - physical links in the ecosystem. Extensive multi-disciplinary, ship-based, studies are being combined with land-based studies on seal and seabird feeding ecology and population dynamics. These process-oriented studies are being combined with analyses of data from long-term studies to investigate the responses to variability and change. Studies on the ecology of key exploited and dependent species are being undertaken to examine the impacts of harvesting in the ecosystem and will contribute to the scientific base for developing an ecosystem approach to sustainable management.

This cruise and the associated field work at Bird Island form a key part in the DYNAMOE programme. The following pages form a valuable record of the objectives, methods and preliminary results arising from the cruise. The web-based cruise report should provide a valuable resource to all staff and scientists connected with the DYNAMOE programme.

RECOMMENDATIONS

RECOMENDATIONS FOR THE SCIENTIFIC GEAR

UOR

The problems that led to the final breakdown of the modem could have been present earlier in the cruise, so we cannot be sure that Chelsea Instruments did not fix the fault experienced last year.

The first rubber pigtail to fail lasted much less time than is normal, we may need to look at the routing of the cable from the tow bar to the body.

Problems such as those outlined above, would be much quicker to diagnose (and fix) if we had more spares, the connectors are expensive but lost sea time is even more expensive.

ITS RECOMMENDATIONS

LEVEL A GYRO REMOVAL

Removal of the level A for the Gyro. There are limited spares for this and if it fails then no Gyro data can be logged. Andy Barker is going to test a replacement soon

JRNA MEMORY UPGRADE

More memory for JRNA. It is due to be upgraded next season so it may not be nessecary till then. Richard Cable will investigate. scratch drive increase

Increase the size of the scratch drive, possibly implement some housekeeping procedures pre and post cruise. Wide use was made of the scratch drive, not just for official cruise data but for cruise participants publishing digital photographs.

EA500 INTEGRATION WITH EK500

Investigate if it possible to have the EA500 from the bridge logging to the EK500 logging Pc's. I have checked the EA500 and it is networked and can be pinged. The remote & local IP addresses for both the PC and echosounder are correct. Also they are on the same subnet, 129.177.31.0. It may be that the EA500 has older firmware, to be looked into at Cambridge.

UPGRADE TO RJ45 CABLE

Investigate if it would be possible to connect instrumentation to SCS via rj45 instead of serial connections.

RECOMMENDATIONS FOR DATA MANAGEMENT

LONG TERM ARCHIVING OF DARTCOM DATA

At present HRPT images from passing NOAA satellites are collected by the Dartcom dish on the Wheelhouse Top and archived to a PC on the Bridge. However, only 25 raw images are archived at any one time (approx. 2 days of data) and are constantly replaced by more images that are recent. As HRPT images comprise useful scientific data (sea surface temperature can be derived for example) it would make sense to archive all the images that are received to allow further analysis back at HQ. A simple solution would be an addition of a large capacity hard drive (100Gb would archive about 120 days) connected to the Bridge PC. This could be easily achieved by purchasing a relatively cheap snap network drive (approx. £350) and attaching it directly to the datacom logging system.

OBJECTIVES OF JR70 CRUISE

(PETE WARD)

Cruise JR70 was planned as an integrated field season linking the cruise to field work undertaken at Bird Island and aimed at determining the relative importance of flux and local production in maintaining krill and zooplankton populations at South Georgia. The main study area comprised the Western Core Box (WCB) located to the north of Bird Island, which we have routinely sampled in previous years to establish the degree of interannual variability in krill biomass and environmental conditions (Fig 1).

Other sampling was also planned aimed at describing the physics and biology along the north coast of the island and in particular establishing the rates of transport and links between water (and zooplankton) arriving at the eastern end of the island and its fate in the west.

The conceptual model describing inputs into and outputs from the WCB assumed that processes occurring within the core box would affect krill biomass such that changes in between the beginning and end of the study ( ) biomass) would be the product of what goes into the box, what comes out of the box, growth (production) within the box and the predator demand:

) biomass = Kin + G - Kout - Pout

This example shows the equation for krill, but it was hoped that we could calculate many of these flux, production and loss elements for nutrients, phytoplankton and zooplankton. The object of the cruise was therefore to parameterise these equations with associated variances as appropriate.

To undertake these calculations we needed to collect data on:

i. Physical transport through detailed description of current regime (using CTD, ADCP and satellite drogued drifters)

ii. Concentration of nutrients and biomass of phytoplankton within box

iii. Biomass of krill and zooplankton within the box (from acoustic and net sampling)

iv. Densities of phytoplankton, zooplankton and krill along box boundaries

v. Estimates of primary production, and zooplankton and krill growth (production) within the box

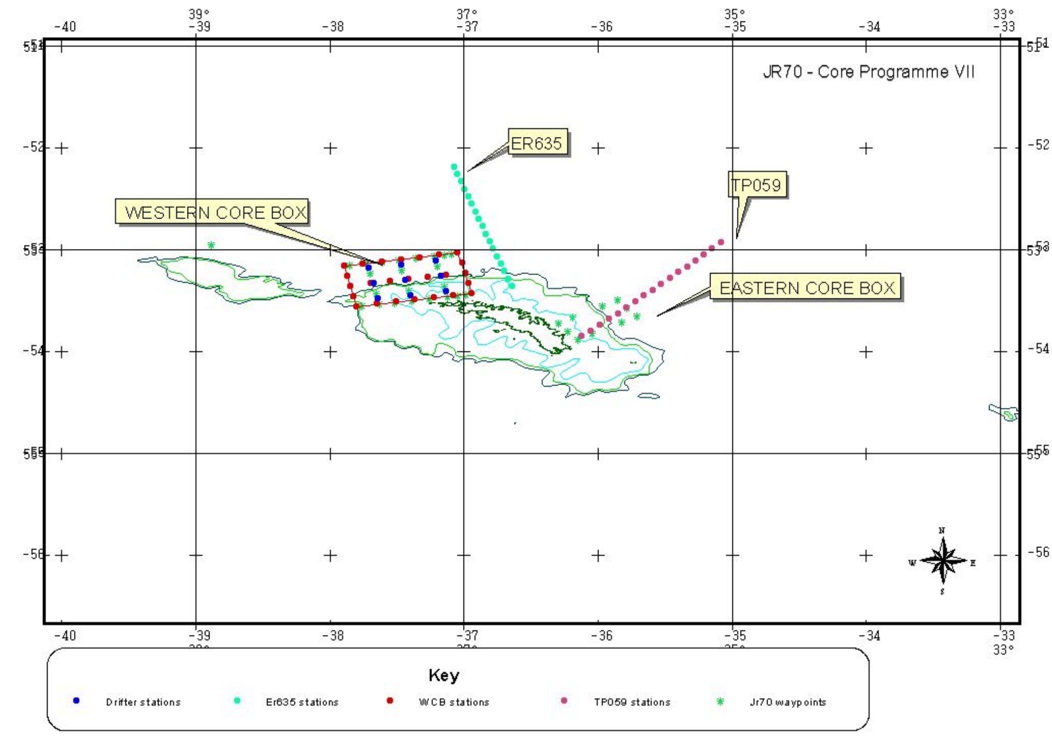
vi. Estimates of losses through predation estimated from at-sea distribution and

vii. Abundance of predators (marine mammals, avian predators and key pelagic predators)

The cruise was also planned to tie in with concurrent predator observations at Bird Island, particularly the satellite tracking and diet sampling of key krill predators. Undertaking the cruise in January was to a large extent determined by the fact that fur seal tracking starts from mid-December onwards, macaroni penguin tracking is best during chick-rearing phase from mid/late January and black-browed albatross tracking takes place from mid/late January.

It was also thought advantageous to link predator data with the ground fish survey around South Georgia undertaken by Dorada.

FIGURE 1: THE STUDY AREA AROUND SOUTH GEORGIA



CRUISE STRUCTURE

A modular structure was decided upon which comprised:

i. Two acoustic surveys of the WCB separated in time, to determine krill biomass. Each survey comprising 4 transect pairs with stations inshore and offshore on the second of each of the first 3 transect pairs. Acoustic surveying was planned to take place during the day with stations (CTDs and nets) worked at night. Planned time for each survey 3.5 days.

ii. A near bottom CTD boundary box survey comprising 25 stations with a separation of 20 km aimed at obtaining geostrophic flows to complement the instantaneous current flows obtained for the surface waters using the ADCP. Boundary to comprise the perimeter of the box and a line across the centre running west to east approximately along the 1000 m depth contour. Planned time 4 days.

iii. An ADCP survey around the boundary of the box to determine surface flows. Time Planned 1 day

iv. Time stations aimed at collecting information on diurnal distribution of plankton collected using a Longhurst Hardy Plankton Recorder that can be put into the flow field calculations to determine likely residence time in the box. Time Planned 2 days.

v. Ongoing shipboard experiments, during the entire cruise we plan to conduct onboard production measurements. Many modules in the cruise have short periods of time that might be utilized to catch live material.

vi. Key measurements to carry out will include: Measurements of krill growth (moult rate and growth increment) and deck incubations for primary production estimates. Time Planned: Where possible as required

vii. Long Transect Surveys. We planned to survey two transects (ER635 and TP059) running out from over the shelf and continuing for some 240 km (Fig). These will be run from the inshore end at 10 knots towing the UOR, deploying XBT's and collecting acoustic data. On the return leg, 17 stations will be occupied at 15 km intervals where we plan to carry out bongo net hauls and near bottom CTDs. These will be used to determine geostrophic flow along the north coast and in particular, to locate the Southern Antarctic Circumpolar Current Front (SACCF) which retroflects along the north coast and which might be a fast track way of transporting krill to the western end of the island. Time Planned: 4 days each, total 8 days.

viii. Satellite tracking of drifters. Additional measurements of potential transport rates through the South Georgia region will be determined by using satellite tracked drogued drifters. Twelve drifters will be deployed within the Western Core Box during our first occupation.. The remaining 8 drifters will be deployed further to the east, most likely at key points along Long Transect TP59. Position data from these drifters will then provide current flow information on a variety of spatial scales; detailed movements within the core boxes, general movement from east to west along the north coast and fate of krill after they pass out of the western core box.

In addition, the cruise will carry out measurements to determine interannual variation in: oceanic regime

i. Nutrients and chlorophyll levels

ii. Zooplankton community structure

iii. Krill abundance and population structure.

The combined programme was contained in a cruise of 35 science days (plus 3 days for mobilization and demobilization, 2 days for transfers at Bird Island and 2 days due to starting the cruise in Montevideo rather than Stanley). The cruise started mobilising on December 31 2001 and ended on February 8 2002 to maximize the overlap with predator observations.

NARRATIVE (PETE WARD)

29th Dec

Science party and ships company departed Heathrow 2200 hrs for Sao Paulo.

30th Dec

Arrived in Montevideo on time and transported to v/l arriving around 1330 hrs local.

31st Dec

Mobilisation commences in the morning, containers emptied and gear starting to be set up in the labs. Fireworks sporadically going off throughout the day and the streets littered with the cut up remains of old calendars and diaries. On the whole rather a quiet new year for most, although some did investigate and greatly enjoyed the Uruguayan club scene well into the early hours.

1st Jan

New Years day. Safety brief and boat drills carried out in the morning. V/L sailed for South Georgia at 1500 hrs. Bird observations commenced almost immediately. Mobilisation continuing.

2nd Jan

First full day at sea. Science briefing in the morning. Lab gear continues to be unpacked and readied for use. Krill tanks in the cold room worked on and 'bird hide' constructed on the monkey island. Pod of around 30 sperm whales seen in the early morning by a lucky few.

3rd Jan

Passage towards South Georgia continues in a rolling beam swell. Getting a little wearisome having to go and rearrange one's cabin at regular intervals. Late afternoon and into the evening, thousands of Prions and a few Fin whales noted along with irregular surface patches of krill, all broadly coincident with the position of the sub Tropical Convergence.

4th Jan

Gear trialling starts. Undulator deployed around 1100hrs. Transmitting data but reluctant to dive. After lunch, CTD, bongo nets and RMT successfully launched.

Plankton catches were predominantly salps and Phronima sp., an amphipod that makes its home in old doliolid cases.

The last of the gear located in the evening when Nathan found the 'missing' CTD transmissometer and fluorometer. Everything now appears to fully functioning.

Sched with Bird Island in the afternoon.

5th Jan

Ship riding more comfortably in the more usual westerlies. UOR tested successfully in the morning. The first batch of drifters laid out on deck and activated. First icebergs appearing thick and fast as we head to the start of the XBT passage down transect ER635. ETA transect had 0600 hrs tomorrow morning. Weather starts to get lumpy again.

6th Jan

Onto transect on time and the cruise has started! Confirmation from Andy Wood in the afternoon that the drifters were being heard. Transect successfully completed at 1900 local. Krill fishing overnight was successful with almost 500 individuals being set up for the growth experiments in the CT room tanks. Moving towards Stewart Strait ETA 0700 8th.

XBT section indicates the SACCF to be broadly where it was seen earlier on JR66 but with the an interesting flow reversal at the inshore end. Will be interesting to learn what the drifters indicate about water transport in the WCB.

7th Jan

Arrive BI and boats away around 0800 hrs. Weather calm enough for Sascha Hooker to bring her camera out to the ship for calibration. Tony Martin put ashore and Daffyd Roberts comes onboard to help out with the predator observations. Depart around 11.15 to start deploying drifters in the WCB.

Weather now thick fog. Continue into the evening but visibility much reduced which is slowing progress considerably.

8th Jan

Poor visibility persists making it impossible to start the biomass survey. Switch to CTD boundary box module once all drifters are deployed. Start at station 10 and work initially from west to east.

9th Jan

Decent day for a change! Visibility much improved and cracking on with the CTDs. Outer layer of forward winch drivers window in UIC room crazed due to a faulty heating element. Plywood cover constructed to strengthen it.

10th Jan

Reasonable progress made in the early part of the day but latterly the fog has returned. Interesting fixes from the drifters coming in, which indicate, as anticipated faster transport offshelf. Out of dense phytoplankton for a few stations along the middle section of the box but returns again as we move westwards in the evening.

Progress slowed again overnight. Time to appease the Gods by sacrificing a few virgins..any volunteers?

11th Jan

Good catch of krill last night which has topped up the experimental tanks. The end of the CTD box is in sight. Interim report sent out by JLW to Cambridge

12th Jan

Complete CTD box around 2 in the afternoon; total time a little over 4 days. Target fishing towards W1.1S in the afternoon which resulted in a good catch of myctophids from a fishy looking echo.

13th Jan

Started first transect pair from W1.1S which was completed around 1500 hrs in the afternoon. Visibility patchy but just enough to tow the undulator all the way round. Unsuccessfully fished for live krill into the afternoon arriving on station around 1830. Problem with the CTD which mean't a reshuffling of the batting order. CTD not ready to deploy at first station. Carry on to second towing into station with an RMT. CTD fixed in time to do a couple of deployments. Cable reterminated and although successfully working, underlying problem not really understood.

Rags' birthday bash at lunchtime. In a spirit of friendship and bonhomie (not to mention Plymouth gin) Nathan bravely made the ultimate sacrifice on behalf of us lesser mortals. Who says the age of heroism is past? Candidate for man of the cruise award?

14th Jan

Started transecting W2.2 at something approaching normal speed but then fog and ice curtailed the undulator tow Visibility patchy for much of the remaining time on transect. Start station activities at 1730 hrs in an attempt to fit all in.

15th Jan

Hallelujah! The fog has lifted and blown away. A much fresher day and peoples spirits correspondingly lifted. Activities as per schedule during the day (transecting W3.1 and W3.2) but station work starts to get difficult in the evening as a stiff westerly picks up. First glimpses of South Georgia this cruise during the first RMT with blowing spray and a fine rainbow to starboard. The second RMT of the evening was ruled out as the sea state was worsening. By the time of the final station (W3.2N) conditions were marginal. Ship unable to easily maintain station amongst the bergs so cancelled and eventually ship hove to in a force 8.

16th Jan

Conditions not improved overnight. Following a meeting to discuss remaining priorities in the morning we are heading to Stromness to undertake the acoustic calibration. Rearranged programme posted later in day. Essentially we will undertake the eastern long transect (TP059) as a priority post calibration and move the corresponding western transect to the back of the programme to soak up any more bad weather. Looking to effect BI pax exchange sometime around the 30th Jan.

Remaining drifters will be deployed on TP059 once we locate the SACCF. We will miss the satellite passes for both transects but can't be helped. Rolling run down the north coast with a following sea. Krill fishing overnight supplied another batch of animals for the tanks. Still lots of bergs and strips of brash to negociate.

17th Jan

Into Stromness at around 0700hrs. Fresh wind as we came in which led to a few doubts as to how effective the calibration would be. However moderated shortly afterwards and eventually the calibration underway late morning to be successfully completed by late evening. Ship very stable on DP and the absence of the buoy not a problem.

Beautiful sunny day and most people who wanted to, got ashore for walks around the valley and foreshore

18th Jan

Calibrators ashore at 0800 hrs for a few hours in continuing sunshine. V/L departed 1100 hrs and onto a zig-zag course down to the start of transect TP059. Multinet and LHPR successfully tested mid-late afternoon, crashing through a few krill swarms in the process. A couple of RMT hauls during the evening and night has filled up the krill tanks again.

Dorada passes inshore mid afternoon and Shackleton later in the evening enroute from KEP bound for Signy.

19th Jan

Onto TP059 at 0500hrs. Easy tow in fair conditions although weather deteriorates towards the end. UOR recovery a trifle nerve wracking as wire jumped out of sheave as the undulator body caught a wave as it was being brought in. Station work starts immediately. XBT transect indicates inshore front crossed between stations 5 & 6.

20th Jan

Slowly back down the transect doing station work. Very confused swell in early part of day that moderates throughout the day. Unsuccessful fhing in bright sunshine during the afternoon at some deep targets. Problem with powerpack in the evening. Broken coupling between pump and motor suspected. Work recommences after a short delay, although not at the moment able to use the stern gantry.

21st Jan

Continue overnight and onto station 8 by midday. First two drifters deployed midway between stations 8 & 9. Powerpack still giving concern. we are now down to one pump which has been rigged to operate both midships and stern gantry, although the root cause of the failure will require a period of around 24hrs downtime! Hopefully not during this cruise.

Weather grey, raining and dismal. Update from BI on predator distributions.

22nd Jan

Meeting with Captain, Chief Engineer and other interested parties after breakfast to discuss power pack failure. Agree to test tonight after station work finished.

Cracking on in good conditions with good views of Cooper Island to the SE.Finish TP059 at around 1700hrs, so completed in around 3.5 days. Different biology to last years effort. Low surface chlorophyll down most of transect but frontal jet found easily enough. Trouble holding station with bongo nets and CTD streaming out in a flow that turned out to be around 40 cm sec-1. Remaining drifters deployed OK. Out to deeper water to test RMT at around 2100 hrs. Test completed satisfactorily around 23 hrs and a good catch of adult krill in second net. Continue on overnight to the WCB.

23rd Jan

Onto W4.2 at around 0500 hrs in bright and breezy weather.Pretty uneventful although the undulator tow had to be ended prematurely when a screw in the tailplane came loose. Good haul of krill in early evening and large numbers of fur seals noted in the area. Overnight steam to W1.1S. Glorious day of not doing very much of anything (for the PSO that is).

24th Jan

0500 hrs start. Discuss cruise report with Nathan after breakfast and send out details later in the day. Transects W1.1 and W1.2 completed without mishap. Half hours delay in evening when midships gantry started dripping oil. Station work started around 1800 hrs and was completed overnight as per schedule. Weather still looking good although a couple of vigorous depressions waiting in the wings.

25th Jan

Raced from W1.2N to W2.1N at 17 knots(!) and underway at just after 0500 hrs. Views of Willis Main Island shrouded in cloud as we reach the inshore end of the first transect. Patchy fog on second transect of the pair which hampers progress slightly. Stations start at 1730 hrs shadowed by an over-familiar iceberg. Problems with the RMT-suspected electrics this time. Fixed some time later but already underway to next station. There is simply no slack in the programme. Good catch of krill in RMT immediately devoured by the experimenters.

26th Jan

W3.1 started around 0500 hrs. UOR not communicating. Recovered and continue with acoustics only. UOR reterminated in readiness for tomorrow. Concentrations of fur seals and prions seen at shelf break (upwelling?).First evening station worked inshore and completed but weather deteriorated for the outer station forcing the cancellation of the RMT and the bongos. Sit on station waiting for a weather window .

27th Jan

Onto W4.2 and 4.1 at around 0500 hrs now that Wx has moderated. Complete acoustics around 1430 hrs although on the return leg the fog returns delaying completion until 2000hrs. A quick RMT for live krill was successful as krill plentiful at the inshore end of the transect. Run back up again overnight with the towfish out and back down again in the morning.

28th Jan

Start ADCP box around 1030 hrs. Going to be slower than the 23 hours budgeted for because of the fog. Such exciting science!

29th Jan

Fog eventually clears overnight. Because of slow progress decide to bring the BI call forward by a day. Sched with BI before breakfast to put them on standby. Complete box around 1430 hrs and then straight to Elsehul and boats take Daf back and pick up Tony Martin. Straight onto W2.2S and start LHPR series around dusk. Two deployments carried out at inshore end then backwards and forwards between W2.2S and 2.2N. Send out cruise update.

30th Jan

LHPRs continue successfully until around 1330 hrs when we break off and start searching for krill moving towards the inshore start of the Western Long Transect (ER635). Plenty of krill caught overnight.

31st Jan

Onto transect at 0500 hrs but the UOR craps out shortly afterwards. Wx 6-7, blustery with intermittent sunshine,and not terribly pleasant. Decide to work stations from inshore to the transect head. Gives somthing like 3 days to sort out the UOR problems. Continue up transect during the day. Wind touching 40 kts as we arrive on station 4. Delay bongos until after CTD. Some signs of moderation by evening.

1st Feb

Grey morning but a beautiful rainbow and sunlit berg brightens things up. Still blustery and marginal conditions for bongos throughout much of day. Target fishing in the morning at a near-surface layer which was seen in the cell of warmer surface water during the XBT run down the transect at the start of the cruise. Turned out to be Themisto and very little else. Moved station in afternoon because of growlers in the vicinity.Wind subsides in the evening as we move onto Stn 11. Managing about 1 station per watch which puts us finishing late tomorrow.

2nd Feb

Continue working stations in more settled conditions. Should complete in early hours of tomorrow morning. Finalise remainder of programme.

3rd Feb

Complete station work around 0300 hrs. Run back down the transect using acoustics only, the UOR having been pronounced dead yesterday. Complete around 1730 hrs, somewhat behind schedule. Continue west towards the WCB and pick up a couple of krill swarms with the RMT. Run a short piece of swath in the box for the moorings project next year, before turning south in the early hours of the 4th to deploy the two remaining drifters on the southern shelf break.

4th Feb

Run south in the early morning before a rather heavy sea. Drifters deployed OK and then make rather slow headway to start of swath lines near Shag Rocks. Course altered in afternoon to pass south of Shag Rocks and attempt to pick up waypoints further west.

5th Feb

Little improvement in weather. West *South 9 at lunch time and nobody allowed on deck. Not much happening in the way of packing equipment although the last krill experiments taken down in the evening.

6th Feb

Wx improved overnight. Pick up swath at WP12 for a few hours before heading straight to Stanley. ETA afternoon of 7th. Packing and report writing continue.

OCEANOGRAPHY SAMPLING

(MIKE MEREDITH, SALLY THORPE, ALEX TATE & SHARON GRANT)

CONDUCTIVITY-TEMPERATURE-DEPTH (CTD) PROFILING

CONFIGURATION AND PROCEDURE

The BAS SeaBird (SBE) 911plus CTD was used for station-based profiling of the water column on JR70. The BAS SBE 911plus system consists of dual temperature and conductivity sensors and a pressure transducer connected to an SBE 32 twelve-position carousel water sampler, with each position having a 10 litre Niskin bottle fitted. For JR70, an altimeter, a transmissometer, a fluorometer and a photosynthetically active radiation (PAR) sensor were also mounted to the system. Details of the sensor types, serial numbers and calibration dates are given in Table 1, calibration coefficients are given in the Appendix. The BAS SBE35 deep ocean standards thermometer was not available on JR70 due to a pin connector breakage on cruise JR67. The raw binary data are logged to the CTD PC, a Viglen Genie 4Dx266 attached to the SBE deck unit. Data were logged using the SeaBird seasave module from the Seasoft version 4.226 set of utilities. Seasoft runs under DOS and has been configured to be accessed using a menu by typing "ctdmenu" at the DOS prompt; this menu system prompts for resetting of the PC clock, an essential step to ensure correct time-stamping of the CTD data. Calibration data are entered using the utility seacon. Sampling rate for JR70 was set to 24 Hz, the maximum permitted with the system. The instrument set-up entered into seacon is listed in Table 2.

The CTD package was deployed from the midships gantry and hauled/veered on the CTD/hydro winch. The BAS swivel was not used, since the package was sufficiently compact that rotation was not deemed a likely problem. The general procedure was to power up the deck unit prior to deployment and commence logging, then lower the package to about 10 metres depth, where it was left to soak for 5 minutes (this procedure was not followed for casts to collect water from specific light levels conducted for Dr. R. Korb). The pumps are saltwater activated after 60 seconds using a conductivity switch, and so do not operate until the CTD is in the water. With the word display on the deck unit set to "E", the least significant digit on the display denotes pumps active (1) or pumps inactive (0). The soaking ensures the pumps are running when the cast starts and that the CTD system has had some time to adjust to the water temperature from the atmospheric temperature. After soaking the CTD was brought to the surface, the winch wireout zeroed, and the CTD lowered to about 10 metres above the seabed using the altimeter to judge the approach. For offshelf standard core box CTDs following UOR transects, the deepest level was 1000 metres rather than 10 metres above the bottom. Details of the CTD stations occupied during JR70 are given in Table 3.

Instrument	Type	Serial Number	Calibration Date
Underwater Unit	SBE 9 plus	09P15759-0480	-
Deck Unit	SBE 11 plus	11P15759-0458	-
Primary Temperature	SBE 3 plus	03P2709	12-Sep-00
Primary Conductivity	SBE 4C	42255	13-Sep-00
Secondary Temperature	SBE 3 plus	03P2705	02-Jul-01
Secondary Conductivity	SBE 4C	42222	13-Sep-00
Pressure Transducer	Series 410K-105 Digiquartz pressure transducer.	67241	30-Jun-00
Altimeter	Tritech	2130.26993	-
Pylon	SBE 32	90194U 3220391-0128	
Niskin Bottles	Ocean Test Equipment		-
Primary Pump	SBE 5 T	51813	
Secondary Pump	SBE 5 T	51807	
Fluorometer	Chelsea Mk III Aquatracka	88216	11-Jun-01
Transmissometer	Wet Labs C-Star	CST-396DR	05-Jul-01
PAR sensor	"Biospherical Inc.	QCD905L"	18-Jun-01

TABLE 1: CTD EQUIPMENT USED ON JR70,

Channel	Description
No of voltage words to suppress	0
No of frequency channels to suppress	0
Computer interface	RS232C
Frequency 0	Primary temperature
Frequency 1	Primary conductivity
Frequency 2	Pressure
Frequency 3	Secondary temperature
Frequency 4	Secondary conductivity
External voltage 0	Altimeter
External voltage 1	spare
External voltage 2	Transmissometer
External voltage 3	spare
External voltage 4	Fluorometer Chelsea
External voltage 5	spare
External voltage 6	Irradiance (PAR)
External voltage 7	spare

TABLE 2: DETAILS OF JR70.CON (SEACON CONFIGURATION FILE)

Event	Station	Date	Latitude	Longitude	Latitude	Longitude	Water depth (m)	Cast depth (m wire out)	Bottom cast press (dbar)	Bottle 1 (m)	Bottle 2 (m)	Bottle 3 (m)	Bottle 4 (m)	Bottle 5 (m)	Bottle 6 (m)	Bottle 7 (m)	Bottle 8 (m)	Bottle 9 (m)	Bottle 10 (m)	Bottle 11 (m)	Bottle 12 (m)
3	Test	04.01.02	-46.2138	-44.4585	46ø 12.828' S	44ø 27.510' W	4945	1001	1007	1001	800	600	400	200	150	125	100	80	60	40	20
51	BB-10	08.01.02	-53.5350	-39.6718	53ø 32.100' S	39ø 40.308' W	2769	2770	2822	2770	2000	1000	600	200	150	125	100	80	59	40	20
54	BB-9	08.01.02	-53.3590	-39.7120	53ø 21.540' S	39ø 42.720' W	3371	3350	3418	3350	2000	1000	600	200	150	125	100	80	60	40	20
57	BB-8	09.01.02	-53.3223	-39.3835	53ø 19.338' S	39ø 23.010' W	4002	3930	4018	3930	2500	1000	600	200	150	125	100	80	60	40	20
60	BB-7	09.01.02	-53.2861	-39.0551	53ø 17.166' S	39ø 3.306' W	3688	3625	3703	3625	2500	1000	600	200	150	125	100	80	60	40	20
63	BB-6	09.01.02	-53.2516	-38.7287	53ø 15.096' S	38ø 43.722' W	3804	3735	3817	3735	2500	1000	600	200	150	125	100	80	60	40	20
66	BB-5	09.01.02	-53.2187	-38.4004	53ø 13.122' S	38ø 24.024' W	3642	3585	3663	3585	2500	1000	600	200	150	125	100	80	60	40	20
69	BB-4	09.01.02	-53.1760	-38.0673	53ø 10.560' S	38ø 4.038' W	3690	3623	3703	3623	2500	1000	600	200	150	125	100	80	60	40	20
73	BB-3	10.01.02	-53.1457	-37.7865	53ø 8.742' S	37ø 47.190' W	3332	3362	3331	3362	2500	1000	600	200	150	125	100	80	60	40	20
76	BB-2	10.01.02	-53.3100	-37.6592	53ø 18.600' S	37ø 39.552' W	2260	2205	2243	2205	1500	1000	600	400	200	150	100	80	59	40	20
79	BB-1	10.01.02	-53.4870	-37.6063	53ø 29.220' S	37ø 36.378' W	1671	1689	1722	1689	1500	1000	600	200	150	125	100	80	60	40	20
82	BB-16	10.01.02	-53.5240	-37.9352	53ø 31.440' S	37ø 56.112' W	1774	1725	1755	1725	1500	1000	600	200	150	125	100	80	60	40	20
85	BB-15	10.01.02	-53.5621	-38.2656	53ø 33.726' S	38ø 15.936' W	1555	1515	1541	1515	1000	600	400	200	150	125	100	80	60	40	20

88	BB-14	10.01.02	-53.5959	-38.5924	53ø 35.754' S	38ø 35.544' W	2050	2015	2052	2015	1500	1000	600	200	150	125	100	80	60	40	20
92	BB-13	11.01.02	-53.6195	-38.9044	53ø 37.170' S	38ø 54.264' W	1321	1281	1301	1281	800	600	400	400	150	125	100	80	60	40	20
95	BB-12	11.01.02	-53.6680	-39.2504	53ø 40.080' S	39ø 15.024' W	1761	1753	1783	1753	1500	1000	600	200	150	125	100	80	60	40	20
98	BB-11	11.01.02	-53.7148	-39.6008	53ø 42.888' S	39ø 36.048' W	2185	2155	2194	2155	1500	1000	600	200	150	125	100	80	60	40	20
101	BB-25	11.01.02	-53.8926	-39.5452	53ø 53.556' S	39ø 32.712' W	349	325	329	325	250	200	150	125	100	75	50	40	30	20	10
104	BB-24	11.01.02	-54.0684	-39.4912	54ø 4.104' S	39ø 29.472' W	1080	1045	1061	1045	800	599	400	200	150	125	100	80	60	40	20
107	BB-23	11.01.02	-54.0210	-39.1403	54ø 1.260' S	39ø 8.418' W	231	215	220	215	200	150	125	100	80	60	50	40	30	20	10
110	BB-22	12.01.02	-53.9849	-38.8112	53ø 59.094' S	38ø 48.672' W	198	180	183	180	175	150	125	100	80	60	50	40	30	20	10
113	BB-21	12.01.02	-53.9400	-38.4571	53ø 56.400' S	38ø 27.426' W	142	130	131	130	120	100	90	80	70	60	50	40	30	20	10
117	BB-20	12.01.02	-53.9139	-38.1525	53ø 54.834' S	38ø 9.150' W	98	84	86	84	80	80	70	60	60	50	40	30	20	20	10
120	BB-19	12.01.02	-53.8779	-37.8243	53ø 52.674' S	37ø 49.458' W	158	142	144	142	125	125	100	80	70	60	50	40	30	20	10
123	BB-18	12.01.02	-53.8419	-37.4954	53ø 50.514' S	37ø 29.724' W	116	100	102	100	100	80	60	60	50	40	40	30	20	20	10
126	BB-17	12.01.02	-53.6547	-37.5516	53ø 39.282' S	37ø 33.096' W	278	260	264	260	200	150	125	100	80	60	50	40	30	20	10
136	Test after failure	14.01.02	-53.5953	-39.2043	53ø 35.718' S	39ø 12.258' W	172	Not given		N/A											
140	W1.2N: Beki	14.01.02	-53.4937	-39.2532	53ø 29.622' S	39ø 15.192' W	2708	70	71	70	60	60	55	35	35	25	25	14	14	3	3

143	W1.2N	14.01.02	- 53.4943	-39.2589	53ø 29.658' S	39ø 15.534' W	1016	988	1002	988	800	600	400	200	150	125	100	80	60	40	20
145	W2.2N	14.01.02	- 53.4322	-38.6956	53ø 25.932' S	38ø 41.736' W	3150	1000	1013	1000	800	600	400	200	150	125	99	80	60	40	20
148	W2.2N: Beki	14.01.02	- 53.4320	-38.6951	53ø 25.920' S	38ø 41.706' W	3142	17	18	17	17	12	12	10	10	5	5	2	2	Not fired	
155	W2.2S	15.01.02	- 53.7850	-38.5830	53ø 47.100' S	38ø 34.980' W	205	195	197	195	180	160	150	140	125	100	80	60	40	20	10
159	W3.2S	15.01.02	- 53.7142	-37.9657	53ø 42.852' S	37ø 57.942' W	127	120	122	120	120	100	80	80	60	60	50	40	30	20	10
162	W3.2S: Beki	15.01.02	- 53.7142	-37.9662	53ø 42.852' S	37ø 57.972' W	138	50	52	50	50	36	36	27	27	11	11	2	2		
166	EK500 calibration	17.01.02	- 54.1588	-36.6953	54ø 9.528' S	36ø 41.718' W	74	67	68	N/A											
194	TP059-17	19.01.02	- 52.9625	-33.1726	52ø 57.750' S	33ø 10.356' W	2652	2585	2634	2585	2000	1000	600	200	150	125	100	80	60	40	20
197	TP059-16	20.01.02	- 53.0625	-33.3176	53ø 3.750' S	33ø 19.056' W	2677	2607	2658	2607	2000	1000	600	200	150	125	100	80	59	40	20
200	TP059-15	20.01.02	- 53.1687	-33.4643	53ø 10.122' S	33ø 27.858' W	2691	2619	2672	2619	2000	1000	600	200	150	125	100	80	60	40	20
203	TP059-14	20.01.02	- 53.2725	-33.6068	53ø 16.350' S	33ø 36.408' W	2729	2660	2712	2660	2000	1000	600	200	150	125	100	80	60	40	20
206	TP059-13	20.01.02	- 53.3710	-33.7550	53ø 22.260' S	33ø 45.300' W	2908	2835	2893	2835	2000	1000	600	200	150	125	100	80	60	40	20
210	TP059-12	20.01.02	- 53.4774	-33.9069	53ø 28.644' S	33ø 54.414' W	3084	3011	3073	3011	2000	1000	600	200	150	125	100	80	60	40	20
213	TP059-11	21.01.02	- 53.5787	-34.0525	53ø 34.722' S	34ø 3.150' W	3063	2991	3053	2991	2000	1000	600	200	150	125	100	80	60	40	19
216	TP059-10	21.01.02	- 53.6801	-34.2012	53ø 40.806' S	34ø 12.072' W	2976	2905	2965	2965	2000	1000	600	200	149	125	100	80	60	40	20

219	TP059-9	21.01.02	-53.7824	-34.3518	53ø 46.944' S	34ø 21.108' W	3331	3259	3328	3259	2000	1000	600	200	150	125	100	80	60	40	20
224	TP059-8	21.01.02	-53.8839	-34.5028	53ø 53.034' S	34ø 30.168' W	3300	3325	3396	3325	2000	1000	600	200	150	125	100	80	60	40	20
227	TP059-7	21.01.02	-53.9855	-34.6547	53ø 59.130' S	34ø 39.282' W	3312	3238	3306	3238	2000	1000	600	200	150	125	100	80	60	40	20
230	TP059-6	22.01.02	-54.0867	-34.8063	54ø 5.202' S	34ø 48.378' W	3688	3673	3750	3673	2500	1000	600	200	150	125	100	80	60	40	20
237	TP059-5	22.01.02	-54.1870	-34.9634	54ø 11.220' S	34ø 57.804' W	3323	3340	3411	3340	2500	1000	600	200	150	125	100	80	60	40	20
240	TP059-4	22.01.02	-54.2863	-35.1146	54ø 17.178' S	35ø 6.876' W	1048	1046	1058	1046	800	600	400	200	150	125	100	80	60	40	20
244	TP059-3	22.01.02	-54.3883	-35.2678	54ø 23.298' S	35ø 16.068' W	294	290	294	290	250	200	150	125	100	75	50	40	30	20	10
247	TP059-2	22.01.02	-54.4889	-35.4237	54ø 29.334' S	35ø 25.422' W	271	270	273	270	250	200	150	125	100	75	50	40	30	20	10
251	TP059-1	22.01.02	-54.5884	-35.5800	54ø 35.304' S	35ø 34.800' W	256	235	239	235	200	150	125	100	80	60	50	40	30	20	10
256	W1.2S	24.01.02	-53.8461	-39.1441	53ø 50.766' S	39ø 8.646' W	292	275	279	275	250	200	150	125	100	75	50	40	30	20	10
259	W1.2S: Beki	24.01.02	-53.8461	-39.1440	53ø 50.766' S	39ø 8.640' W	295	56	59	56	56	38	38	28	28	7	7	2	2	Not fired	
266	W1.2N: Beki	25.01.02	-53.4932	-39.2511	53ø 29.592' S	39ø 15.066' W	3155	30	32	30	30	30	22	22	22	10	10	10	3	3	3
269	W1.2N	25.01.02	-53.4933	-39.2528	53ø 29.598' S	39ø 15.168' W	3157	1000	1012	1000	800	600	400	200	148	125	100	80	60	39	20
271	W2.2N	25.01.02	-53.4319	-38.6951	53ø 25.914' S	38ø 41.706' W	3503	1000	1014	1000	800	600	400	199	150	125	100	80	60	40	20
274	W2.2N: Beki	25.01.02	-53.4321	-38.6969	53ø 25.926' S	38ø 41.814' W	3504	42	43	42	42	27	27	19	19	3	3	Not fired			

277	W2.2S: Beki	26.01.02	-53.7851	-38.5841	53ø 47.106' S	38ø 35.046' W	213	55	57	57	57	40	40	40	31	31	12	12	4	4	4
280	W2.2S	26.01.02	-53.7859	-38.5842	53ø 47.154' S	38ø 35.052' W	212	195	197	195	175	150	125	100	80	70	60	40	30	20	10
282	W3.2S	26.01.02	-53.7139	-37.9661	53ø 42.834' S	37ø 57.966' W	127	120	123	120	120	100	80	80	60	60	50	40	30	20	10
285	W3.2S: Beki	26.01.02	-53.7140	-37.9661	53ø 42.840' S	37ø 57.966' W	138	50	52	50	50	36	36	27	27	11	11	3	3	Not fired	
289	W3.2N	27.01.02	-53.3608	-38.0830	53ø 21.648' S	38ø 4.980' W	2664	1000	1015	1000	800	600	400	200	150	125	100	80	60	40	20
306	ERS635-1	31.01.02	-53.7142	-36.7959	53ø 42.852' S	36ø 47.754' W	181	164	165	164	160	150	125	100	80	60	50	40	30	20	10
309	ERS635-2	31.01.02	-53.5849	-36.8612	53ø 35.094' S	36ø 51.672' W	692	676	686	676	500	400	200	150	125	100	80	60	40	20	10
312	ERS635-3	31.01.02	-53.4554	-36.9265	53ø 27.324' S	36ø 55.590' W	895	872	885	872	800	600	400	200	150	125	100	80	60	40	20
313	ERS635-4	31.01.02	-53.3262	-36.9913	53ø 19.572' S	36ø 59.478' W	1512	1460	1484	1460	1000	600	400	200	150	125	100	80	60	40	20
318	ERS635-5	01.02.02	-53.1967	-37.0556	53ø 11.802' S	37ø 3.336' W	3233	3165	3232	3165	2000	1000	600	200	150	125	100	80	60	40	20
319	ERS635-6	01.02.02	-53.0446	-37.1309	53ø 2.676' S	37ø 7.854' W	2796	2731	2783	2731	2000	1000	600	400	200	150	125	100	80	60	20
324	ERS635-7	01.01.02	-52.9379	-37.1836	52ø 56.274' S	37ø 11.016' W	2536	2471	2518	2471	2000	1000	600	400	200	150	100	80	60	40	20
327	ERS635-8	01.01.02	-52.8083	-37.2471	52ø 48.498' S	37ø 14.826' W	2220	2160	2199	2160	1500	1000	600	200	150	125	100	80	60	40	20
331	ERS635-9	01.01.02	-52.679	-37.3102	52ø 40.740' S	37ø 18.612' W	2013	1955	1989	1955	1500	1000	600	200	150	125	100	80	60	40	20
334	ERS635-10	01.01.02	-52.5707	-37.3818	52ø 34.242' S	37ø 22.908' W	2230	2175	2210	2175	1500	1000	600	200	150	125	100	80	60	40	20

337	ERS635-11	01.01.02	-52.3231	-37.4814	52ø 19.386' S	37ø 28.884' W	2655	2595	2643	2595	1500	1000	600	200	150	125	100	80	60	40	20
340	ERS635-12	02.02.02	-52.291	-37.4982	52ø 17.460' S	37ø 29.892' W	2993	2933	2993	2933	2000	1000	600	200	150	125	100	80	60	40	20
343	ERS635-13	02.02.02	-52.1605	-37.5607	52ø 9.630' S	37ø 33.642' W	3321	3254	3321	3254	3000	2500	1000	600	200	125	100	80	60	40	20
346	ERS635-14	02.02.02	-52.0310	-37.6210	52ø 1.860' S	37ø 37.260' W	3606	3535	3613	3535	2500	1000	600	200	150	125	100	80	60	40	20
349	ERS635-15	02.02.02	-51.9016	-37.6817	51ø 54.096' S	37ø 40.902' W	3770	3700	3780	3700	2500	1000	600	200	150	125	100	80	59	40	20
352	ERS635-16	02.02.02	-51.7714	-37.7435	51ø 46.284' S	37ø 44.610' W	3936	3861	3950	3861	2500	1000	600	200	150	125	100	80	60	40	20
355	ERS635-17	03.02.02	-51.6418	-37.8043	51ø 38.508' S	37ø 48.258' W	4097	4028	4120	4028	2502	1001	606	252	147	125	99	81	64	42	12

TABLE 3: EVENT LOG OF CTD CASTS ON JR70

Variable	Description
0	Scan number
1	Time [s]
2	Pressure [db]
3	"Primary Temperature [degC
4	Primary Conductivity [mScm-1]
5	"Secondary Temperature [degC
6	Secondary Conductivity [mScm-1]
7	Pressure Temperature [degC]
8	Number of bottles fired
9	Light transmission
10	Fluorometer (Chelsea)
11	Irradiance (PAR)

TABLE 4: VARIABLES EXTRACTED FROM RAW SEABIRD CTD FILE WITH DATCNV.,,,,,,

DISCRETE SALINITY SAMPLES

Discrete water sampling was conducted on the upcast of the CTD, with the exception of the station conducted at Stromness for the calibration of the EK500 echosounder. The winch was stopped at each desired bottle level, and 10 second intervals left before and after firing the Niskin. These intervals are needed since the data from each side of the firing time are averaged to create the CTD data comparable to the bottle data.

The primary purpose of discrete salinity sampling is to calibrate the salinity measurements made by the CTD sensors. Samples were drawn into 200 ml medicine flats, each having been rinsed thoroughly prior to filling. The bottles were filled to about an inch below maximum, to allow expansion of the (cold) samples, and to allow effective mixing upon shaking of the samples prior to analysis. The rim of each bottle was wiped with a tissue to prevent salt crystals forming upon evaporation, and a plastic seal inserted into the bottleneck to prevent salinification through evaporative loss of sample. A bakelite cap was screwed down to keep the insert in place. The bottles and crates were numbered and colour coded for reference. Twelve samples were taken from every deep cast; this was reduced to six for shallower casts due to the high number of salt samples being generated. Stations conducted for discrete sampling at specific light levels had varying numbers of Niskins closed, but none were sampled for salinity analysis.

Once a crate of samples was full, the crate was moved into the James Clark Ross's Bio Lab, where the BAS Guildline Autosal model 8400B serial number 65763 was sited for JR70. This had been swapped for the 8400B number 63360 (used on the previous cruise, JR67/69) at the start of JR70 due to the observed tendency of 63360 to fluctuate in reading by around 0.003 for unknown reasons (see JR67 cruise report). The samples were left for a minimum of 24 hours to enable their temperatures to equalise with the laboratory temperature (around 19.5°C). The samples were then analysed on the 8400B, with measurements being made using Ocean Scientific standards P137 (K15 = 0.99995, S = 34.998, date of preparation = 9-Dec-1999) and P140 (K15 = 0.99991, S = 34.997; date of preparation = 10-Nov-00). One ampoule of standard was used per twelve samples. The 8400B cell temperature was set to 21°C for the duration of JR70. Once conductivity measurements had been made for each sample, they were manually entered into a Quattro Pro spreadsheet for conversion to salinity, with the resultant data being written out as ASCII and transferred (via FTP) to JRUF for subsequent processing in Pstar.

CTD DATA PROCESSING (SEASOFT)

CTD data files were named within the SBE software as 70ctdNNN.dat, where NNN was the event number of the station in question. Once logging was terminated, the Seasoft module datcnv was run; this creates an ASCII format file (70ctdNNN.cnv) containing the calibrated data. Datcnv also creates files 70ctdNNN.bl (containing the bottle firing datacycle numbers extracted from the raw data file), 70ctdNNN.con (configuration data, generally a copy of the input configuration file jr70.con) and 70ctdNNN.hdr (header file containing sensor information). The variables written out using datcnv are listed in Table 4.

The effect of the thermal mass of the conductivity cells was removed from the data using the standard SeaBird software celltm. The ASCII input file 70ctdNNN.cnv was converted to 70cnvNNN.cnv. The algorithm used was:

$$dt = t_i - t_{i-7}$$

$$ctm_i = -b * ctm_{i-7} + a * dcdt * dt$$

$$c_{cori} = ctm_{measi} + ctm_i$$

$$a = 2\alpha /(7\Delta * \beta + 2)$$

$$b = 1 -(2a /(\alpha)) \quad dcdt = 0.8 * (1 + 0.006 * (t_i - 20))$$

where α, the thermal anomaly amplitude is set at 0.03 and β, the thermal anomaly time constant, is set at 1/7 (the SeaBird recommended values for SBE911plus pumped system). Δ is the sample interval (1/24 second), dt is the temperature (t) difference taken at a lag of 7 sample intervals. c_{cori} is the corrected conductivity at the current data cycle (i), c_{measi} the raw value as logged and ctm_i is the correction required at the current datacycle, dcdt is a correction factor which is a slowly varying function of temperature deviation from 20°C. A full analysis of the effect of the thermal mass correction was performed by Dr. E. Kent (SOC) on cruise JR67; we refer the reader to the JR67 cruise report for further details.

CTD DATA PROCESSING (UNIX)

After completion of celltm, all data pertaining to the event in question were transferred to the Unix system using FTP, where they were further processed using Unix scripts that called Pstar routines. The procedure for processing the data on the Unix system was overhauled following experience gained on cruise JR67 (SOC Drake Passage hydrographic transect SR1, Nov-Dec 2001). The procedure followed is outlined here:-

70seactd0: reads in the ASCII file to Pstar format using pascin. The start time is extracted from the ASCII file and will be the PC clock time. The header time was set to the start of the CTD cast, with the time variable being seconds thereafter (this modification was brought in on JR67 to avoid the extraordinarily large values for the time variable being generated previously). The water depth is extracted from the Simrad EA500 SCS file, and latitude and longitude from the SCS Trimble navigation file and inserted into the Pstar header. The output file is 70ctdNNN.raw.

70seactd1: extracts data from 70ctdNNN.raw corresponding to the bottle firing times taken from the ASCII file 70ctdNNN.bl. Data are extracted for 3 seconds before the bottle close start datacycle and 5 seconds after the bottle close end datacycle. The bottle closing time is about 1.5 seconds meaning that just less than 10 seconds of data are extracted. These 10 seconds of data are averaged within 70seactd1 using pbins to give a file containing a single datacycle for each bottle firing. These are appended using papend to give a Pstar file of CTD data corresponding to each bottle firing. As 12 data cycles were required, absent data were appended to the end of the file if fewer than 12 bottles were fired. The output file is 70ctdNNN.btl.

70seactd2: applies shifts to the timings of the conductivity readings such that the primary conductivity was retarded by 0.0208333333 seconds (+0.5/25 cycles) and the secondary conductivity advanced by 0.0416666667 seconds (-1.0/24 cycles). These corrections are needed because the temperature and conductivity sensors are separated in space within the pumped system, and the seawater first passes the temperature sensor and then the conductivity sensor. Details are given in SeaBird Electronics Application Note 38, "Fundamentals of the TC duct and pump-controlled flow used on SeaBird CTDs, December 1992; see also the JR67 cruise report. The default time separation of the temperature and conductivity measurements is 0.073 seconds (1.75/24 seconds). The Deck Unit is set up to advance the primary conductivity by this amount but the secondary conductivity is not shifted in time. The values of the time shifts applied using 70seactd2 are those derived by Dr. E. Kent on JR67, who examined various time shifts and observed which resulted in the greatest minimisation of the noise level of derived salinity. Whilst different sensor configurations may need different values for the time shifts, the temperature and conductivity sensors were configured the same on JR70 as on JR67, hence the derived values are adopted unaltered. The time shifts were performed by using pcopya to copy time and the conductivity variable into another file, pcalib to adjust the time base and pmerg2 to combine the files again. This was done for each conductivity variable separately. The salinity and potential temperature were recalculated from the adjusted conductivities using peos83. The output file is 70ctdNNN.tsh.

70seactd3: This performs various automated editing procedures on the CTD data, and relies heavily on a set of routines written on JR67 by Dr. E. Kent and Dr. S. Bacon of SOC. Initially, data for the period when the CTD was out of the water is excluded. This is done by considering the first 20 minutes and last 5 minutes of each cast: these periods of data were compressed (pbins) into 10 second bins, with the start (end) of good data being taken as the first (last) bin in which the standard deviation of conductivity is less than 0.05 mS cm-1. These times were identified using datpik and conductivity and salinity data outside these times removed using peditc. At this stage, an output file 70ctdNNN.ed1 is created. Further automatic editing was performed using noise levels of the data: the differences of salinity and potential temperature from their 1 second filtered values were calculated for both the primary and secondary sensors. pcopya was used to duplicate these four variables, pfiltr to apply a 25 point running mean and parith to take the difference of the instantaneous and filtered quantities. peditc was then used to remove conductivity and salinity values where the absolute difference from the filtered salinity value was greater than 0.01 and to remove temperature and potential temperature were the absolute difference from the filtered temperature value was greater than 0.05ºC. At this stage, an output file called 70ctdNNN.ed2 is created. A final step is to exclude any remaining negative pressures; a file of form 70ctdNNN.ed3 is then written. If needed, manual editing is then performed on the 70ctdNNN.ed3 file using the large-buffer interactive editor plxyedlots.

Thus far the scripts described have been used for processing of the SBE CTD data. At this stage, comparison with the discrete salinity samples is needed. The processing of the salinity sample data within Unix, to bring it into a useable state, is conducted as follows:

1. At the start of the cruise, an ASCII file sam70.names was created. This contained 2 columns, specifically variable name and variable units. All variables required in subsequent processing were included. A blank Pstar sample file called sam70.blank was created from this using the script pblankexec. This contained 12 data cycles, corresponding to the 12 positions on the rosette.

2. After each cast, samblank.exec was run. This created an empty copy of sam70.blank called sam70NNN. Date, time, position and depth information is written into the header.

3. samfir was then run, to paste variables from CTD file 70ctdNNN.btl into sam70NNN.

4. importsalts.exec was then run, to convert the text file samp70NNN.txt (the ASCII file written out from the Quattro Pro spreadsheet) into a Pstar file sal70NNN.bot.

5. passal was then run, to paste sample salinity data from file sal70NNN.bot into sam70NNN.

6. botcond was then run, to calculate sample conductivity from bottle salinity, CTD pressure and (primary) temperature. Bottle minus CTD conductivity was calculated for each sample and for both CTD conductivity sensors. These operations all pertain to file sam70NNN.

7. bottlecond.offset was then run. This uses mlist to create quick plots of conductivity offset (bottle minus CTD) versus conductivity for each of the primary and secondary conductivity sensors. Desired conductivity offset ranges are then requested, and summary statistics for all the bottles with conductivity offsets within these ranges are calculated (no. of bottles, mean offset, standard deviation of offset). This provides a useful check on the bottle/CTD discrepancy of each station. It could also be used to derive a conductivity calibration on a station-by-station basis, if such a thing were desired (this was the procedure used on previous BSD cruises, although only the primary conductivity was then considered).

The bottle salinity data are now is a useable state (in the form of the file sam70NNN), and examination of the data alongside the CTD data is required. Two Unix scripts were written for investigating the performance of the CTD conductivity (also temperature) sensors. Both of these consider solely the data below 500 m, and hence can only be applied to deeper casts. There are a number of reasons for this restriction, namely that (1) the sampling policy on BSD cruises strongly favours the upper part of the water column, since this is the region of most interest to colleagues involved in nutrient and chlorophyll analyses. In itself, this poses no problem, except (2) the region heavily sampled is also the region of the halocline, where vertical gradients in salinity are greatest. These strong gradients, combined with (3) the offset levels between the Niskins and CTD conductivity sensors and (4) the "wake effects" noted in both CTD and SBE35 data, lead to significantly more noise in the conductivity offset data in the upper part of the water column. Thus, for the most accurate possible assessment of the performance of the CTD conductivity sensors, we restrict our analysis here to the waters deeper than 500 m. The aim here is to understand the relative and absolute behaviour of the conductivity sensors for the duration of the cruise: once these are determined (using data from deeper than 500 m), corrections can be applied to all data irrespective of their depth. The Unix scripts used at this stage were:

1. offsets.ctd.below500: runs through a list of specified CTD stations (those containing data from deeper than 500 m), extracts the portions deeper than 500 m, then calculates the offsets between primary and secondary conductivity, primary and secondary temperature, and salinity derived from paired primary and secondary sensors. Although not useable to create a conductivity (or temperature) calibration in their own right, these numbers do provide information on the relative drift of the sensors, i.e. the performance of the primary sensors with respect to the secondary ones.

2. offsets.sam.below500: runs through a list of specified stations (those containing bottle firing depths deeper than 500 m), extracts the portions deeper than 500 m, and calculates the offsets between (a) bottle conductivity and CTD primary conductivity, and (b) bottle conductivity and CTD secondary conductivity. These data invariably seem noisier than the primary-minus-secondary CTD conductivity offsets – this is only to be expected, since they are based on far fewer data (a handful of bottles, as opposed to several hundred or thousand metres of high-resolution data), and also contain additional noise

signals from the bottle measurements that will not be correlated with the noise in the CTD measurements and hence will not disappear upon subtraction.

These three data series (primary-minus-secondary CTD conductivity, bottle-minus-primary conductivity, and bottle-minus-secondary conductivity) provide the desired information on the behaviour of the CTD conductivity sensors throughout the duration of the cruise, and form the basis of the calibration. Two Matlab scripts were used to fit polynomials to these series, namely fit_to_botoffset.m and fit_to_condoffset.m. Matlab was preferred to Pstar for this to take advantage of the routines polyfit and polyval, which are ideal for this purpose. The standard deviations of the residuals were calculated; only when these were sufficiently small was an acceptable fit deemed achieved.

One single fit could not adequately describe the behaviour of the sensors for the whole of JR70; instead, smaller subsets of the data were analysed separately. This is possibly a feature of the behaviour of the sensors when exposed to high pressures, since we observed that the offsets (bottle-minus-CTD) tend to drift progressively more when the casts are very deep, and reset to lower values when the casts are repeatedly shallow. As noted on JR67, the conductivity sensors do not show a dependence on pressure on a cast-by-cast basis, however it is possible that repeated exposure to high pressures (casts down to around 3000 m) gradually alters the response of the sensors with time, whereas exposure to low pressures (or no casts at all) allows the sensors chance to recover their more normal responses. This is, at present, a tentative hypothesis: further investigation on future cruises is desirable so as to better understand the behaviour of the conductivity sensors. The temperature sensors showed negligible drift for the duration of the cruise.

Once the conductivity offsets (for calibration) had been obtained using the functions derived above, they were applied to the 70ctdNNN.ed3 files using the script apply_cal_ctd.exec, yielding the files 70ctdNNN.cal and 70ctdNNN.24Hz. Downcast sections of the data were extracted by initially using plist to note the datacycles at the surface (after the soak) and at maximum depth, and then applying the script extract_down70.scr. Averaging to 2 dbar intervals was performed using the script create_2db.scr, creating the file 70ctdNNN.2db. If the 1 dbar level was missing (such as happens if the package is not raised completely to the surface after the soak), it was copied in from the 3 dbar level using fill_to_surface (output is again 70ctdNNN.2db). The calibrations applied in apply_cal_ctd.exec were also applied to the sample files using apply_cal_sam.exec, creating the file sam70NNN.cal.

SUMMARY

Yet again the SeaBird CTD performed very well. Data produced seem of a high quality, and were obtained with no very significant problems. One instance of data loss was when a cast was aborted due to failed comms between the deck unit and the CTD. The problem resolved itself following retermination and reconnection of the CTD leads, but the cause of the problem was not traced unambiguously (see separate report by Mark Preston, ETS). "False bottoms" were a recurrent feature of the altimeter, though these were not unduly problematic: by keeping check of the wire out on the winch monitor and the EA500 echosounder depth, it was easy to deduce which height-above-bottom readings were real and which false. The replacement 8400B salinometer performed well. One instance of a stubborn bubble in a conductivity cell arm was cleared by soaking and flushing the cell with a detergent-based washing fluid, supplied by Mick Whitehouse. Various problems with the CTD logging PC were noted already on JR67 (slow processing and transfer speeds, small harddrive, no continuous backup of data during collection); it is understood that this PC is soon to be replaced.

One minor but annoying problem was occasional deterioration of data quality following a spike in the altimeter signal. Upon investigation, it became clear that when the altimeter reads zero (whether it be a real reading or a spike), the pumps on the CTD automatically turn off. Presumably this is to prevent sediment being pumped through the system in the event of a genuine landing. However, the pumps do not restart for 60 seconds once they have been turned off, so if the zero reading was due to a spike (as opposed to contact with the seabed), the following minute of data is compromised. At the standard veer/haul rate used, this equates to 60 m worth of data. Temperature is moderately affected; salinity much more so. If a method of manually restarting the pumps from the deck unit could be devised, it would help circumvent this problem.

VESSEL-MOUNTED ACOUSTIC DOPPLER CURRENT PROFILER (VMADCP)

INSTRUMENT CONFIGURATION

The acoustic Doppler current profiler (ADCP) on the RRS James Clark Ross is an RD Instruments 153.6 kHz unit sited in a sea chest that is recessed within the hull to afford protection from sea ice. The fluid in the sea chest is a mixture of 90% deionised water and 10% ethylene glycol, and is closed to the sea by a 33 mm thick window of Low Density PolyEthylene (LDPE). The orientation of the transducer head is offset by approximately 45° to the fore-aft direction.

For cruise JR70 the VMADCP was configured to record data in 64 x 8 m bins, in ensembles of 2 minute duration. The 'blank beyond transmit' was set to 4 m such that the centre depth of the first bin was 14 m, given the approximate transducer depth of 6 m. The system uses 17.07 firmware and version 2.48 of RDI Data Acquisition Software (DAS) run on a Viglen IBM-type 286 PC. The two minute ensembles of data are passed via a printer buffer directly to the Level C. Data can be recovered from the PC PINGDATA files in the instance of any problems with the ship's Level C system.

The VMADCP was operated in two modes during JR70. Data in bottom tracking mode were collected in shallow waters (shallower than approximately 500m), generally over the South Georgia shelf. Data in water track mode were collected where water depth was sufficient to preclude useful bottom tracking, typically in depths greater than 500m. The command FH0004 was used to set the instrument to make one bottom track ping for every four water track pings.

DATA PROCESSING

VMADCP data were processed in 12 hour sections, specifically 0000 to 1159 hrs and 1200 to 2359 hrs of each day. A sequence of unix scripts calling Pstar routines were used for the data processing:

1. *Read data into PSTAR 70adpexec0:* Data were read from the RVS Level C system into Pstar creating two output files 70adp[jday][a/p] and 70bot[jday][a/p], containing water track and bottom track data respectively. When the ADCP was configured to record water track information the bottom track file contained engineering data.

2. *Temperature correction 70adpexec0.1:* The VMADCP DAS software assumes that the fluid surrounding the transducers is ambient seawater. A speed of sound is derived using the temperature measured at the transducer head and an assumed salinity of 35. A correction must be made to this to take into consideration the difference between the speed of sound in seawater and the mixture of 90% deionised water and 10% ethylene glycol.

The required modification was derived on JR55 by Meredith and King, and has been employed on subsequent cruises. Measurements of the variation in sound speed versus temperature were obtained from RDI and used to derive an equation for the speed of sound through the mixture as a function of temperature,

$$c = 1484 + 3.6095 \times T - 0.0352 \times T^2 \quad (1)$$

where the individual velocity measurements were given to an accuracy of 0.01%, and the environmental conditions were known to within ± 35 kPa pressure and ± 0.5°C temperature.

This equation was used to derive a correction term to adjust the assumed speed of sound such that it was appropriate for the fluid mixture within the sea chest

$$(1484 + 3.6095\, T - 0.0352\, T^2) \,/\, (1449.2 + 4.6\, T - 0.055\, T^2 + 0.00029\, T^3) \quad (2)$$

This correction term was applied to both the raw water and bottom tracked velocities measured on JR70. On JR55, a residual dependence of A on temperature was also found, due probably to the speed of sound in the fluid in the sea chest not being perfectly known. Following estimates using bottom track data on JR55 a residual correction of

$$1 - 0.00152\, T \quad (3)$$

was also applied.

The output files created were 70adp[jday][a/p].t and 70bot[jday][a/p].t.

3. *Clock Correction 70adpexec1:* The VMADCP data stream was time stamped by the 286 PC clock running the DAS software. The PC clock drifts from the ship's master clock at an approximate rate of one second per hour. This results in there being a timing error associated with the raw data. The time difference was measured at approximately 4 hour intervals, and a correction applied to the data. This created the files 70adp[jday][a/p].corr, 70bot[jday][a/p].corr and clock[jday][a/p].

4. *Gyrocompass error correction 70adpexec2* The VMADCP measures the water velocity relative to the ship. To calculate true east and north water velocities over ground, we need to include information on the ship's heading and speed. The ship's gyrocompass provides near-continuous measurements of heading, however it can oscillate for several minutes after a manoeuvre, due to an inherent error. The gyro heading can be corrected using data from the Ashtech ADU-2. However, the Ashtech system does not provide continuous data, and hence a correction can only be applied on an ensemble by ensemble basis. The two-minute averaged Ashtech-minus-gyro heading correction ("a-ghdg") was manually despiked and interpolated. The required correction was then applied to the data creating the output files 70adp[jday][a/p].true and 70bot[jday][a/p].true.

5. *Calibration 70adpexec3:* Two further corrections are applied to the VMADCP data:-

    i. *A* an inherent scaling factor associated with the VMADCP velocities

    ii. a compensation for the misalignment of the Ashtech antenna array relative to the VMADCP transducers.

During routine (pre-calibration) processing, bottom tracked velocities were adjusted using a nominal scaling of A=1 (scaling factor) and ϕ=0 (misalignment angle). To calculate the true values of A and ϕ, the two minute ensembles of VMADCP data were merged with a smoothed version of GPS navigation, and 20 minute average absolute speeds and headings were derived from the satellite fixes. The bottom track VMADCP data were also used to derive 20 minute average speeds and headings. Data outside the range 400-750 cm s^{-1} were excluded from the calibration

A and ϕ were calculated using:

$$A = U_{gps} / U_{VMADCP} \quad (4)$$

$$= \phi_{gps} - \phi_{VMADCP} \quad (5)$$

where U_{gps} and U_{VMADCP} , and fgps and ϕ_{VMADCP} are the 20 minute averaged speeds and headings, derived from the GPS and bottom track VMADCP data respectively.

The direction of f was reversed to put it in the correct orientation and it was put in the range -180° < ϕ< 180°. Outliers were excluded, and values of A and ϕderived:-

A = 1.0290 and ϕ= -1.55

These values compare to 1.0269 and –1.55 (Meredith and King, JR55), 1.0253 and –1.48 (Meredith, JR57), and 1.0314 and –1.81 (Hawker, King and Meredith, JR67/69). The data were reprocessed using the new values for A and ϕ to produce calibrated water velocities relative to the ship, creating the output files 70adp[jday][a/p].cal and 70 bot[jday][a/p].cal.

6. *Derivation of absolute velocities 70adpexec4:* Ship's velocities between ensembles were derived by merging in position information from the RVS navigation data. The absolute water velocities were then derived by removing the ship's velocities from the VMADCP data. These final velocities were output to the files 70adp[jday][a/p].abs and 70bot[jday][a/p].abs.

SUMMARY

No particular problems were encountered with the VMADCP, which performed well for the duration of the cruise. One brief instance of data loss occurred when the logging PC hard drive became full. Removing the PINGDATA files that had accumulated cleared this, but it is symptomatic of a larger problem, namely the virtually obsolete PC that is being used. ETS are aware of this problem; Jim Fox is already investigating what is needed to implement a full upgrade of the logging hardware and software without losing the flexibility afforded by the RDI DAS software. Other brief instances of data loss occurred when switching from bottom-tracking to water-tracking mode, or vice versa. When pinging was resumed, sometimes the ensembles of data were not fed through to the SCS. It is wise to check the data updating on the SCS each time pinging is stopped and resumed.

OCEANLOGGER (UNDERWAY MEASUREMENTS)

Prior to the 2001/2 Antarctic season, the RRS James Clark Ross oceanlogger system was upgraded since the existing system had been performing poorly for some time. The oceanlogger system is comprised of a thermosalinograph and fluorometer connected to the ship's non-toxic pumped seawater supply, plus meteorological sensors measuring air pressure, air temperature, humidity, total incident radiation (TIR) and photosynthetically available radiation (PAR). Data are time-stamped using the ship's master clock. The suite of oceanlogger sensors is given in Table 5.

DATA PROCESSING

Oceanlogger data were processed in 12-hour segments throughout the course of JR70. Three Unix scripts calling PSTAR software routines were used for this processing:

1. *70oclexec0:*Reads the oceanlogger data streams into a PSTAR format and merges in relative wind speed and direction from the anemometer data stream. Output files are 70ocl[jday][a/p].raw and ocl701. The former of these is the 12-hour data segment for morning (a) or afternoon (p) of Julian day jday. The latter is the master file to which successive 12-hour sections are appended.

2. *70oclexec1:* Divides the data into ocean data and meteorological data files, writing meteorological data to a separate file. Output file is 70met[jday][a/p].raw (containing the meteorological data).

3. *Twvelexec:* Merges the met data file with gyrocompass and navigation data streams in order to calculate ship motion and true wind velocity. Output file is 70met[jday][a/p].true.

TABLE 5. OCEANLOGGER COMPONENTS

Instrument	Make	Serial No.	Location	Calibrated
Digital Barometer	Vaisala PTB210 Classe B	V145002	Logger rack	10/04/00
Digital Barometer	Vaisala PTB210 Classe B	V145003	Logger rack	10/04/00
Air humidity and temperature	Rotronic MP103A-CG030-W4W	Sn.15619015	Foremast	29/03/00
Air humidity and temperature	Rotronic MP103A-CG030-W4W	Sn.15619025	Foremast	29/03/00
Thermosalinograph	SeaBird SBE45	SBE45 4524698-0016	Prep lab	04/12/00
Fluorometer			Prep lab	
TIR sensor (pyranometer)	Kipp & Zonen SP LITE	990684	Foremast	18/11/99
TIR sensor (pyranometer)	Kipp & Zonen SP LITE	990685	Foremast	18/11/99
PAR sensor	Kipp & Zonen Quantum PAR LITE	990069	Foremast	08/10/99
PAR sensor	Kipp & Zonen Quantum PAR LITE	990070	Foremast	08/10/99
Flow meter		45/59462	Prep lab	03/05/01
Uncontaminated seawater temp		Transducer space		
Ultrasonic Anemometer	Solent Meteorological	Foremast		1994 (installation)

SALINITY CALIBRATION

During JR70, discrete salinity samples were taken from the ship's non-toxic supply at approximately 4 hour intervals. These were drawn into a 200 ml sample bottle that had been thoroughly rinsed, with the neck of the bottle dried and an air tight seal inserted after sample collection. Samples were left to acclimatise in the ship's Bio laboratory (where the salinometer was sited) for at least 24 hrs prior to analysis. Measurement procedure was identical to that followed for the CTD salinity samples. The resulting data were used for calibration of the thermosalinograph conductivity.

Calibration procedure adopted was the same as for JR57. Initially, conductivity was calculated using the measured bottle salinity and the temperature of the thermosalinograph housing. Conductivity residuals were then calculated by differencing these bottle conductivities with the measured thermosalinograph conductivities. Diagnostic plots were produced of these residuals versus (a) time and (b) bottle conductivity. Outliers were removed, and a running mean of total width 5 samples was applied to the data. Endpoints were extrapolated so that the conductivity residual series overlapped the thermosalinograph series at both the start and finish. The data were merged and interpolated, and the thermosalinograph data were then corrected according to the residual appropriate for the time of data collection. This procedure is believed to be more appropriate than a simple regression of bottle conductivity against thermosalinograph conductivity.

PROBLEMS

The main problem with the previous oceanlogger system (severe salinity spiking) does not appear to exist in the new system. A problem with the new system noticed on cruise JR67 (one of the humidity channels actually reporting air temperature via the SCS) was fixed prior to JR70. Two further problems noted on JR67 remain, viz the large offset between the two air temperature readings (atemp1 and atemp2), and the TIR sensors reaching upper threshold values well below actual values. The JR67 cruise report should be consulted for further details on these.

SIMRAD EA500 BATHYMETRIC ECHO SOUNDER

The RRS James Clark Ross is equipped a Simrad EA500 echo sounder, which was run virtually continuously during cruise JR70 (a notable exception was during the EK500 echosounder calibration at Stromness; 17/01/2002). The EA500 transducer is mounted on the hull just to starboard, with the primary visual display and controls located on the bridge.

EA500 data were logged by the SCS into the simulated level C data stream SIM500 and retrieved into twice-daily Pstar files using the script jr70_sim. This ran the Pstar routine datapup, taking the jday and am or pm as the requisite inputs. This data stream features uncorrected depth, i.e. it produces bottom depth calculated assuming a mean vertical sound velocity of 1500 m s-1. The unix script jr70_sim ran pedita on the uncorrected depths, since the EA500 data often features spurious zeroes; these were replaced with absent data markers. Since the data are often very spiky, pmdian was run from within jr70_sim, whereby each successive value was replaced with the median of a moving window of five adjacent data cycles. Navigation data were merged in from the RVS Bestnav stream. Corrected depths were calculated using pcarter, which feeds the ship's position into a set of reference tables to correct for the assumption that vertical sound velocity averages to 1500 m s-1. The output files created by jr70_sim were 70sim[jday][a/p].raw (containing the raw data from the SCS), 70sim[jday][a/p] (containing the cleaned data), 70sim[jday][a/p].mrg (the cleaned data plus merged navigation}, and 70sim[jday][a/p].corr (the above data corrected using a more representative speed of sound).

Following jr70_sim, plxyed was run on the data, so as to enable manual despiking to be performed to remove any remaining obvious spurious data. This routine marks any data cycles identified as missing; to create continuous data, pintrp was run to linearly interpolate across the gaps. Final cleaned data were stored in files named as 70sim[jday][a/p].corr.dspk.

One frequently-occurring problem with the EA500 was its tendency to lock onto a depth range outside that containing the true depth. This resulted in depth readings that often seemed plausible in the absence of other information. It caused particular problems during CTD operations, where the EA500 depth was often relied upon to distinguish false bottoms (as indicated by the altimeter) from the true one. This problem does not appear to have occurred on previous cruises, and its presence now is puzzling; certainly it should be investigated and fixed as soon as practicable.

EXPENDABLE BATHYTHERMOGRAPHS (XBTS)

A sequence of XBT drops were performed from RRS James Clark Ross during JR70. These were performed along the western long transect (ERS-2 groundtrack 635) at the start of the cruise, during the EK500 calibration at Stromness, along the eastern long transect (Topex/Poseidon groundtrack 59), and on the run back from South Georgia to the Falkland Islands.

Sippican T5 and T7 probes were used, having been provided by the U.K. Hydrographic Office, Taunton. All data are to be returned to UKHO at the end of the cruise. A fixed launcher was used initially, sited on the rear port side of the aft deck. However, problems arose when launching XBTs while towing the UOR: the XBT wire would short out on the UOR cable. Consequently the launcher was detached and used as a hand-held launcher on the starboard side of the aft deck.

Data were logged by a Viglen IBM-type 486 PC running the Sippican WinMk12 software. Once a successful drop had been performed, data were transferred via FTP to the central unix system (JRUF) for processing. Two unix scripts were used to process the data:

1. *xbtexec0*: This reads the data from ACSII into Pstar format, sets up header information, and extracts navigation and water depth from the RVS data streams appropriate for the time of the drop. Creates the file 70xbtNNN.raw, where NNN is the event number of the XBT drop in question.

2. *xbtexec.edit:* This runs a median despiking routine on the data, and launches the Pstar program plxyed, which enables interactive editing of the XBT profile. This was used to remove any remaining spurious spikes, and also remove the noise recorded after the probe had reached its terminal depth. The file 70xbtNNN.edt was created.

The details of the XBT drops are listed in Table 6. There were a few bad drops where excessive spiking or clearly unrealistic values were logged. These drops were allowed to complete before repeating the attempt.

TABLE 6 XBT DROPS

Event	Station	Date	Time	Latitude	Longitude	Latitude	Longitude	Water depth (m)	Type	Fail?
1	Test	02.01.02	1706	-38.5507	-52.8072	38ø 33.042' S	52ø 48.432' W	Not logged	T5	
7	ERS635-17	06.01.02	901	-51.6450	-37.8023	51ø 38.700' S	37ø 48.138' W	4086	T5	Y
8	ERS635-17	06.01.02	907	-51.6614	-37.7948	51ø 39.684' S	37ø 47.688' W	4059	T5	
9	ERS635-16	06.01.02	948	-51.7722	-37.7430	51ø 46.332' S	37ø 44.580' W	3927	T5	
10	ERS635-15	06.01.02	1036	-51.9006	-37.6821	51ø 54.036' S	37ø 40.926' W	3764	T5	
11	ERS635-14	06.01.02	1125	-52.0310	-37.6208	52ø 1.860' S	37ø 37.248' W	3602	T5	Y
12	ERS635-14	06.01.02	1130	-52.0438	-37.6147	52ø 2.628' S	37ø 36.882' W	3564	T5	
13	ERS635-13	06.01.02	1214	-52.1599	-37.5599	52ø 9.594' S	37ø 33.594' W	3320	T5	
14	ERS635-12	06.01.02	1303	-52.2900	-37.4975	52ø 17.400' S	37ø 29.850' W	2984	T5	
15	ERS635-11	06.01.02	1352	-52.4198	-37.4352	52ø 25.188' S	37ø 26.112' W	2649	T5	
16	ERS635-10	06.01.02	1439	-52.5497	-37.3725	52ø 32.982' S	37ø 22.350' W	2246	T5	
17	ERS635-9	06.01.02	1527	-52.6795	-37.3090	52ø 40.770' S	37ø 18.540' W	2000	T5	
18	ERS635-8	06.01.02	1618	-52.8087	-37.2470	52ø 48.522' S	37ø 14.820' W	2215	T5	Y
19	ERS635-8	06.01.02	1625	-52.8252	-37.2372	52ø 49.512' S	37ø 14.232' W	2204	T5	Y
20	ERS635-8	06.01.02	1632	-52.8443	-37.2287	52ø 50.658' S	37ø 13.722' W	2227	T5	
21	ERS635-7	06.01.02	1706	-52.9389	-37.1824	52ø 56.334' S	37ø 10.944' W	2532	T5	
22	ERS635-6	06.01.02	1753	-53.0642	-37.1198	53ø 3.852' S	37ø 7.188' W	2838	T5	
23	ERS635-5	06.01.02	1845	-53.1972	-37.0565	53ø 11.832' S	37ø 3.390' W	3236	T5	
24	ERS635-4	06.01.02	1937	-53.3279	-36.9898	53ø 19.674' S	36ø 59.388' W	1508	T5	
25	ERS635-3	06.01.02	2026	-53.4540	-36.9273	53ø 27.240' S	36ø 55.638' W	902	T5	
26	ERS635-2	06.01.02	2116	-53.5843	-37.8615	53ø 35.058' S	37ø 51.690' W	698	T5	Y
27	ERS635-2	06.01.02	2124	-53.6079	-36.8494	53ø 36.474' S	36ø 50.964' W	461	T5	
28	ERS635-1	06.01.02	2205	-53.7154	-36.7954	53ø 42.924' S	36ø 47.724' W	175	T7	
39	Swath SVP	07.01.02	2338	-53.3286	-38.5740	53ø 19.716' S	38ø 34.440' W	3352	T5	Y
40	Swath SVP	07.01.02	2346	-53.3322	-38.6033	53ø 19.932' S	38ø 36.198' W	3396	T5	
167	Ek500 cal.	17.01.02	1241	-54.1587	-36.6952	54ø 9.522' S	36ø 41.712' W	74	T7	
173	TP059-1	19.01.02	747	-54.6039	-35.6074	54ø 36.234' S	35ø 36.444' W	271	T7	
174	TP059-2	19.01.02	853	-54.4809	-35.4112	54ø 28.854' S	35ø 24.672' W	285	T7	
175	TP059-3	19.01.02	937	-54.3895	-35.2701	54ø 23.370' S	35ø 16.206' W	296	T7	
176	TP059-4	19.01.02	1026	-54.2913	-35.1190	54ø 17.478' S	35ø 7.140' W	1026	T5	Y
177	TP059-4	19.01.02	1032	-54.2782	-35.0986	54ø 16.692' S	35ø 5.916' W	1172	T5	Y
178	TP059-5	19.01.02	1118	-54.1825	-34.9542	54ø 10.950' S	34ø 57.252' W	3245	T5	Y
179	TP059-5.5	19.01.02	1143	-54.1319	-34.8763	54ø 7.914' S	34ø 52.578' W	3389	T5	
180	TP059-6	19.01.02	1203	-54.0904	-34.8140	54ø 5.424' S	34ø 48.840' W	3601	T5	
181	TP059-7	19.01.02	1255	-53.9853	-34.6531	53ø	34ø 39.186'	3310	T5	

						59.118' S	W			
182	TP059-8	19.01.02	1348	-53.8932	-34.5128	53ø 53.592' S	34ø 30.768' W	3222	T5	
183	TP059-9	19.01.02	1434	-53.7945	-34.3690	53ø 47.670' S	34ø 22.140' W	3395	T5	
184	TP059-10	19.01.02	1533	-53.6774	-34.1964	53ø 40.644' S	34ø 11.784' W	3001	T5	
185	TP059-11	19.01.02	1619	-53.5801	-34.0550	53ø 34.806' S	34ø 3.300' W	3088	T5	
186	TP059-12	19.01.02	1712	-53.4769	-33.9042	53ø 28.614' S	33ø 54.252' W	2987	T5	
187	TP059-13	19.01.02	1811	-53.3667	-33.7451	53ø 22.002' S	33ø 44.706' W	3967	T5	
188	TP059-14	19.01.02	1903	-53.2650	-33.5998	53ø 15.900' S	33ø 35.988' W	3911	T5	
189	TP059-15	19.01.02	1956	-53.1588	-33.4493	53ø 9.528' S	33ø 26.958' W	2688	T5	
190	TP059-16	19.01.02	2042	-53.0663	-33.3189	53ø 3.978' S	33ø 19.134' W	2676	T5	
191	TP059-17	19.01.02	2132	-52.9656	-33.1708	52ø 57.936' S	33ø 10.248' W	2656	T5	
358	Swath SVP	04.02.02	00:03	-53.7318	-37.4873	53ø 43.908' S	37ø 29.238' W	294	T7	
361	Drifter depl.	04.02.02	1210	-54.8733	-38.8827	54ø 52.398' S	38ø 52.962' W	2920	T5	Y
363	Drifter depl.	04.02.02	1657	-54.6009	-40.1673	54ø 36.054' S	40ø 10.038' W	2856	T5	Y
364	Drifter depl.	04.02.02	1709	-54.5860	-40.1715	54ø 35.160' S	40ø 10.290' W	2780	T5	Y
365	Drifter depl.	04.02.02	1717	-54.5768	-40.1750	54ø 34.608' S	40ø 10.500' W	2720	T7	Y

NAVIGATION

(MIKE MEREDITH, SALLY THORPE, ALEX TATE & SHARON GRANT)

INTRODUCTION

Data from four of the scientific navigational instruments on RRS James Clark Ross were logged routinely into Pstar during cruise JR70. Three of these data streams were used regularly in processing other oceanographic datasets. The instruments used were the Trimble 4000 GPS receiver, the Sperry Mk 37 Model D Gyrocompass, the Ashtech ADU-2 GPS receiver and the GLONASS GPS (Ashtech GG24) receiver. Data from the Chernikeeff Aquaprobe Mk V Electromagnetic log and the Sperry SRD 421 Doppler log were not routinely logged; the latter of these was operational only briefly during the cruise. In addition to these instruments, a Racal Satcom received GPS SV range correction data via INMARSAT B: this was passed to the Trimble and other GPS receivers to allow them to operate in differential mode (DGPS). The navigation data were processed twice daily using a set of unix scripts detailed below.

TRIMBLE 4000

The Trimble 4000 in differential mode was the primary source of positional information on JR70. The data were processed using the unix script gpsexec0. This first calls datapup to transfer the data from the RVS SCS data stream to Pstar binary files. It then executes pcopya, which resets the raw data flag, and pheadr, which sets up the Pstar dataname and header. Finally a datpik command is performed to remove data with a dilution of precision (hdop) greater than 5. The two twice-daily output files are called 70gps[jday][a/p].raw and 70gps[jday][a/p], these being written before and after the datpik stage respectively. The processed data were then appended to a master file called 70gps01.

GYROCOMPASS

The data stream from the gyrocompass constitutes the most continuous information available on ship's heading. It is involved in processing data from meteorological instrumentation (so as to derive information on true wind velocity), and in processing the Acoustic Doppler Current Profiler (ADCP) data. It is also drawn into the bestnav stream (see below) to derive positional information by dead reckoning during periods of no GPS data coverage. Twice daily processing was performed using the unix script gyroexec0. This uses datapup, pcopya and pheadr in a similar manner to gpsexec0 to retrieve the information from the RVS data stream and set the header information; followed by datpik to force all the heading data to lie between 0 and 360 degrees. The output file is called 70gyr[jday][a/p].raw. The data were also appended to a master file called 70gyr01. The Pstar routine pcopym was run within gyroexec0 to exclude duplicate time stamps from the processed data.

ASHTEC ADU-2

The ship's gyrocompass is subject to an inherent error and can oscillate for several minutes after a turn. Consequently, the Ashtec ADU-2 is used to correct errors in the gyrocompass heading prior to input of the data to the ADCP processing. The data were processed using the four unix scripts ashexec0, ashexec1, ashexec2, and ashedit.exec.

1. *ashexec0:* uses datapup, pcopya and pheadr to read in the data from the RVS data stream, reset the raw data flag, and set the header information. The output filename is 70ash[jday][a/p].raw.

2. *ashexec1*: uses pmerge to merge in data from the master gyro file (see below), followed by parith and prange to calculate the difference between the gyro and Ashtech heading, and force it to lie in the range +/- 180 degrees. The output file is 70ash[jday][a/p].mrg.

3. *ashexec2*: edits the merged data file, using the following Pstar programmes:

   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

   heading difference ("a-ghdg") outside -5° to 5°

   pmdian - remove outliers in a-ghdg of greater than 1° from a 5 point mean.

   pavrge - set the data file to 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 - reset the data file to a 2 minute time base.

   pmerge - remerge in the heading data from the master gyro file.

   pcopya - change the order of the variables.

   The output files are 70ash[jday][a/p].edit and 70ash[jday][a/p].ave.

4. *ashedit.exec*: was used to manually remove obvious outliers from a-ghdg and interpolate any gaps in the data, producing the output file 70ash[jday][a/p].ave.dspk. Data were also appended to a master file called 70ash01.int.

GLONASS

The Ashtech GG24 receiver works by accepting data from both American GPS and the Russian GLONASS satellites. This increases accessibility to satellite fixes, and hence should provide more accurate navigation data than standard GPS coverage allows. However, previous experimentation revealed disappointing performance from the instrument (accuracy approximately 15 m on JR47; see also analysis on JR67). Data were logged routinely using ggexec0, but were not used in the processing of other data streams. Filenames were of the form 70glo[jday][a/p].raw. Some basic quality control is performed on this file, with the resulting data stored in 70glo[jday][a/p].

BESTNAV

Bestnav is a processed data stream, which contains 30 second interval position data. It uses the best available data source: GPS when available, dead reckoning from the ship's gyrocompass and speed otherwise. On JR70, the script navexec0 was called to read 12 hours of data at a time, and append them to a master file called abnv701. The script first runs datapup, pcopya and pheadr to retrieve the data and set its header information. posspd calculates east and north velocities, after which papend is used to append the data to the master file. pdist calculates the distance run, after which pcopya is used to remove the RVS calculated distance variable. A second script navexec1 was then run to average and filter the navigation data. This takes a straight copy of the unsmoothed navigation and smooths and despikes it, putting the data in abnv701.av.

DRIFTER BUOYS DATA

(MIKE MEREDITH, JON WATKINS & NATHAN CUNNINGHAM)

EQUIPMENT

Twenty ClearSat-15 drifters were purchased and shipped south for deployment on cruise JR70. These each consisted of a spherical surface float, a tether, and a length of wire connecting to a holey sock drogue. The wire lengths were 20 m on fifteen of the drifters, and 50 m on the remaining five. The drogues on the end of 50 m wires were larger than those on the 20 m wires, so as to maintain the correct 40:1 drag ratio. The drifters featured GPS positioning in addition to standard Argos positioning, plus measurement of sea-surface temperature. Drifters were specified to last for 12 months. For the first 8 weeks drifters will transmit continuously, however after that time they will shift to a limited used duty cycle of 12 hrs On and 24 hrs Off. This will reduce the operating costs to one third of that for continuous transmission. Full cost for Argos satellite time is £10 per PTT day. However with 'limited use' and a large user bonus negotiated through NERC the total cost for one year's Argos time should be less than £15,000.

The rationale behind the different drogue depths was to enable paired deployment of drifters at essentially the same geographical position. The different trajectories followed would then be an indication of the effects of current shear at that location. Of course, the same exact location could not be used for both of the deployments, hence there is an issue concerning the effects of horizontal current shear versus vertical shear. It is our intention to undertake high-resolution modelling studies in combination with future drifter deployments to investigate this more closely.

DEPLOYMENT

Drifter release information is given in Table 7. Each drifter was activated by having its magnet removed at least one day prior to its scheduled deployment date, so that a check could be made on whether the unit was functioning properly. Deployment was made from the aft deck of the James Clark Ross by reducing the ship's speed to around 1-2 knots, lowering the aft gate, and lowering the drifter (buoy end first) into the water. The wire was paid out as the ship moved away, with the drogue end being deployed last. The main site for deployment was the Western Core Box, the location for the fluxes study being undertaken as part of the cruise. Twelve drifters were deployed here in a grid of nine separate locations (three deployments were paired 50 and 20 m drogue depths), three on each of the offshelf region, the shelfslope region, and the onshelf region. In addition, six more drifters were deployed during the occupation of the eastern long transect (Topex/Poseidon groundtrack 059), so as to gain information on how currents advect water along the northern side of the island towards its northwestern end. The remaining two drifters were deployed at the end of the cruise to the south and west of South Georgia, to gain information on how water approaches the Western Core Box area.

DATA ROUTE AND PROCESSING

The drifter data are received via the Argos satellite system; a CD-ROM containing the data will be sent to BAS HQ each month, and will constitute the main data resource for scientific analysis. However, for the purposes of the cruise, we arranged for data to be transferred in near-real time to the ship.

The daily drifter data are retrieved from the ARGOS server in full DS format; this also is the format we expect to receive the monthly data in (on CD-ROM). The record and field description of this data is predefined and well documented (please refer to the Argos User Manual for full technical details – this is available on the web). Clearwater Instrumentation has the data streams that the Clearsat-15 Surface Drifters communicates to the ARGOS satellite system designed so that they are easily expressed in the ARGOS full DS format. Clearwater Instrumentation has provided us with documentation on technical details on the structuring of the surface drifter data streams that its drifters send to satellite. These data, subsequently received from ARGOS via CD-ROM or from daily telnet sessions, have to be decoded from hexadecimal/binary notation into ASCII text before anyone can interpret it. This conversion to ASCII is achieved using a Perl parsing script primarily developed by Andy Wood, resulting in a text file which (see Table 8 for generalized data structure of decode program) is automatically e-mailed down to the ship. After the cruise has finished this parsing script will be used (and further developed to implement validation and verification functionality) throughout the operational life of the drifters to provide the ASCII file primary data sets.

The current daily file sent to the ship contains a single page of data with columns for the drifter number, date, time, latitude, longitude. These data (held in q:\jr70\drifters\updated_positions\raw) have been pasted into an Excel spreadsheet (q:\JR70\drifters\updated_positions\deployed_argo_pos.xls) containing a separate page for each drifter.

A semi-objective despiking of the data was carried out by JLW. The difference between consecutive latitude and longitude values was calculated and then inspected. Maximum values of the difference were displayed to aid detection of outlying positions. In general differences greater than 0.05 decimal degrees were replaced with a value from the nearest point in time, however, this depended on the time period between adjacent records.

Anomalous drifter positions seemed to fall into three distinct groups:

1. Records at times in between the regular half-hourly pattern of the GPS fixes. These records are assumed to be ARGOS satellite fixes. They were often different from those generated by the GPS;

2. Records at near duplicate times. These were usually offset by 2 seconds; while most of the time these duplicates were equal, occasionally the latitude and/or longitude was different;

3. Records with erroneous clock times. These were usually totally wrong dates such as 20020506.

The size of the differences between anomalous and normal drifter positions could be quite variable:

1. Differences where latitude and/or longitude greater than 90 or 180 deg respectively;

2. Values where the – sign missing but otherwise appearing sensible;

3. Values varying by 0.5 to 20 degrees.

Each day the cleaned data were saved in the worksheet and then loaded into GIS Arcview. An Arcview project (q:\jr70\drifters\updated_positions\drifter_jon.apr) was linked to the spreadsheet and updated automatically every time the Arcview project was opened.

PROBEMS

The return of GPS data from the drifters during the cruise was disappointing. Two drifters failed to return any GPS data after having their magnets removed on deck. Five further drifters in the Western Core Box ceased returning GPS data soon after deployment. Andy Wood is contacting the manufacturers to try and identify the cause of this problem; we are hoping that data are still available (Argos positioning at the very least). If there was a recurrent hardware fault or programming error in the drifters, we recommend (1) recompense be sought from the manufacturers, and (2) drifters be sourced from a different company for future cruises.

TABLE 7:DRIFTER DEPLOYMENTS JR70

Argos PTT	Drogue Depth	Drogue Colour	Unit activated				Unit Deployed				Event
			Date	Time (GMT)	Lat (S)	Lon (W)	Date	Time (GMT)	Lat (S)	Lon (W)	
11714	20m	Black	01/05/02	14:19	49 10.57	40 57.89	01/07/02	15:58	53 48.1	37 56.2	35
13931	20m	Black	01/05/02	14:19	49 10.57	40 57.89	01/07/02	18:48	53 32.22	38 01.41	36
13930	20m	Black	01/05/02	14:19	49 10.57	40 57.89	01/07/02	21:19	53 19.64	38 06.64	37
11623	50m	Black	01/05/02	14:19	49 10.57	40 57.89	01/07/02	21:22	53 19.64	38 06.69	38
11715	20m	Turquoise/Beige	01/06/02	11:55	52 06.58	37 35.05	01/08/02	00:39	53 20.6	38 43.43	41
11659	20m	Black	01/06/02	11:55	52 06.53	37 35.05	01/08/02	03:22	53 36.55	38 38.36	42
11622	50m	Black	01/06/02	11:55	52 06.58	37 35.05	01/08/02	03:25	53 36.44	38 38.39	43
12335	20m	Black	01/06/02	11:55	52 06.58	37 35.05	01/08/02	05:34	53 49.48	38 34.2	44
13533	20m	Black	01/06/02	11:55	52 06.58	37 35.05	01/08/02	08:41	53 56.08	39 6.99	45
11604	50m	Black	01/06/02	11:55	52 06.58	37 35.05	01/08/02	08:58	53 55.03	39 07.32	46
11766	20m	Black	01/06/02	11:55	52 06.58	37 35.05	01/08/02	11:27	53 40.17	39 11.88	47
13735	20m	Black	01/07/02	18:55	53 32.0	38 02.0	01/08/02	13:36	53 24.08	39 16.34	48
12732	20m	Black	17/1/02	19:15	54 09.53	36 41.72	21/1/02	14:24	53 49.98	34 25.6	220
11620	50m	Black	17/1/02	19:15	54 09.53	36 41.72	21/1/02	14:26	53 49.98	34 25.6	221
12333	20m	Black	17/1/02	19:15	54 09.53	36 41.72	22/1/02	03:20	54 05.15	34 48.95	231
11621	50m	Black	17/1/02	19:15	54 09.53	36 41.72	22/1/02	03:20	54 05.15	34 48.95	232
12332	20m	Black	17/1/02	19:15	54 09.53	36 41.72	22/1/02	12:40:00	54 20.3	35 11.5	241
12334	20m	Black	17/1/02	19:15	54 09.53	36 41.72	22/1/02	18:06	54 32.33	35 30.15	248
12729	20m	Black	01/06/02	11:55	52 06.58	37 35.05	02/04/02	16:55	54 36.26	40 9.96	362
13262	20m	Black	17/1/02	19:15	54 9.53	36 41.72	02/04/02	12:15	54 52.20	38 52.87	360

TABLE 8: GENERALIZED DATA RECORD PRODUCE FROM THE PERL PARSING SCRIPT

	Ptt	Date	Time	Lat	Lon	Battery Status	Submergence	SST	Quality Flag
Field	nnnnn	nnnnnnnn	nn:nn:nn	nn.nnnn	nnn.nnnn	5 to 14	0 to 1800	-5.00 to 46.15	0 to 3
Example text	11604	20020121	00:34:26	- 53.9397	-38.7868	13	600	1.25	2

PRELIMINARY RESULTS

(MIKE MEREDITH)

Physical oceanographic studies on JR70 focussed on three main regions. The first of these was the Western Core Box (WCB), the main target for the Fluxes and Marine Productivity Experiment (FLUMPEX). The others were long transects to the east and north-northwest of the island. These transects were aligned along satellite altimeter groundtracks, namely ERS-2 groundtrack 635 (north-northwestern transects) and Topex/Poseidon groundtrack 59 (eastern transect), and hence became known as ERS635 and TP59 respectively. The general pattern of the cruise is shown in Figure 1.

The occupation of the long transects followed on from the successful long transect across the Southern Antarctic Circumpolar Current Front (SACCF) completed as part of cruise JR57. By aligning the transects with altimeter groundtracks, it is hoped that surface velocities of the SACCF across these lines can be derived as a function of time, dating back to the launch dates of the satellites. The temporal resolution of the time series will be the repeat length of the satellite orbits: 35 days in the case of ERS-2, and 10 days in the case of Topex/Poseidon. Since it is believed that passive advection of krill by the SACCF is an important controlling factor in the South Georgia ecosystem, these time series will be of benefit in understanding further the operation of the ecosystem.

The main instrumentation used in the physical oceanographic studies was the SeaBird Conductivity-Temperature-Depth (CTD) package, expendable bathythermographs (XBTs), the undulating oceanographic recorder (UOR), and Clearwater drogued drifters. Information on the configurations used for the instruments are given in separate sections.

WESTERN CORE BOX

The work in the WCB featured a grid of CTD stations around the edge of the box, and across the middle in an approximately east-west direction (Figure 1). This middle section coincided roughly with the location and orientation of the shelf slope. UOR transects were run back and forth across the box in approximately meridional directions, following the standard pattern of previous years for the WCB. These transects were run on two separate occasions, to enable an assessment to be made of the intra-cruise variability in the locality. Twelve drogued drifters were deployed inside the WCB at the very start of the cruise. When combined with data from the vessel-mounted Acoustic Doppler Current Profiler (ADCP), the ensemble of physical data collected in the WCB will enable derivation of a velocity field from which volume fluxes can be derived. It will also enable derivation of fluxes of krill, subject to the validity of the assumption that krill transport is dominated by passive advection rather than active swimming. Even if this assumption were demonstrably oversimplistic, the calculations would give the component of krill transport due to physical advection, with work on krill behaviour needed to be conducted to derive the component due to their horizontal swimming. It is believed that the physical oceanography data collected are sufficient to enable the solving of the quasi- or semi-geostrophic omega equations, and thereby facilitate the diagnosing of vertical water movements. These would be of great benefit to the ongoing ecosystem analysis, since vertical fluxes of nutrients associated with regions of upwelling and downwelling will undoubtedly affect the levels of primary production in the region.

Examples of the data from the WCB are shown in Figure 2(a, b, c); these are the sections along the northern (offshelf) edge of the box, the middle (shelfslope) region, and the southern (onshelf) edge. The offshelf and shelfslope data show the general pattern of vertical stacking of water masses that one expects in this region of the Southern Ocean during the austral summer. Comparatively warm surface waters overlie a temperture minimum that is centred close to 100 m depth. This temperature minimum is the remnant of the winter mixed layer, and hence is commonly termed Winter Water (WW). Beneath the WW is Circumpolar Deep Water (CDW), derived from the products of deep convection in the North Atlantic. Beneath CDW there is a mixing continuum toward the Antarctic Bottom Water (AABW), the cold dense water mass that forms primarily on the shelf regions of the Antarctic through mixing of a form of CDW with local WW and salinified shelf water.

Although there is no clear evidence of the SACCF in the WCB at the time of JR70, we observe that the temperature maximum layer close to 500 m depth (the CDW layer) is interrupted along the offshelf transect, where potential temperatures fall below 2°C. (Conversely, the shelfslope section shows a more solid CDW layer, with no potential temperature maxima below 2°C.) This is possibly indicative of prior mixing of these waters with the waters of the SACCF, though this is highly speculative at this stage.

The onshelf waters show a strong thermocline in the upper 100 m of the water column, beneath which lies a weak temperature minimum layer. In some casts on the shelf, there was a pronounced bottom mixed layer, up to 60 m thick in places. These layers were associated with low light transmission, indicative of high loads of suspended sediment. The most likely explanation for these is strong bottom currents (possibly tidal) interacting with the bathymetry in the region of the across-shelf canyons, resulting in high levels of turbulent mixing.

The surface waters in the WCB were observed to be progressively warmer with increasing distance from South Georgia. At the time of the JR70 cruise, the surface waters were anomalously warm, up to 4.25°C in some of the undulator transects. This is far warmer than measured during the previous annual occupations of the WCB, and may have consequences for the level of primary production occurring in the box at the time. For example, it was noted during the cruise that regions of highest surface temperature as measured by the oceanlogger thermosalinograph coincided spatially with regions of high surface fluorescence – see Figure 3(a, b). It also begs the question of how representative the results from JR70 are likely to be when compared with the general situation in the WCB encountered in previous years. Consideration of this will have to be given if the results from JR70 are to be placed in the context of longer-term variability.

It is too early to make an assessment of the fluxes through the WCB from the CTD and ADCP data, since the data have only just been collected and need a great deal of processing before the calculations can begin. However, these data will ultimately yield the most reliable quantitative flux estimates. At present, the circulation in and adjacent to the WCB is most clearly depicted by the trajectories of the drogued drifters.

Nine of the drifters deployed in the WCB had drogues at 20 m depth, the remaining three had them at 50 m: these differences were to allow some paired deployments at the same locations, and thereby an investigation of the effects of vertical current shear on the Lagrangian trajectories of the drifters. The pattern of deployment was a 3-by-3 grid, with the outermost three sites being over the deep ocean, the middle three being along the shelf slope (nominally 1500 m), and the innermost three being on the South Georgia shelf. Paired deployments were made at the northeasternmost site, the middle site, and the southwesternmost site.

Initial trajectories for the first few days are shown in Figure 4. The "pigtail" nature of many of the tracks is indicative of inertial currents: these are caused by variability in the overlying wind field and the effect of the Earth's rotation. The size of each inertial loop depends on current speeds, but the period of each loop (in hours) depends solely on the latitude of the drifter. The northernmost drifters deployed in the WCB seem to be moving most rapidly, initially in a westward direction before retroflecting and returning to the east and the north.

The drifters deployed on the shelf in the WCB show generally much lower speeds, and there is some evidence of their trajectories being influenced by the underlying bathymetry. Of particular interest is the pair of drifters at the very southwest corner of the box. Despite being deployed immediately adjacent to each other, the two 20 m- and 50 m-drogued drifters have diverged very rapidly. This is an indication of pronounced vertical current shear. It stresses the need to incorporate the diurnal vertical migration of krill in particle-tracking studies of their advection, since it demonstrates very clearly the different trajectories they can be subject to at comparatively small vertical offsets.

The drifter deployed at the shelfslope (middle) site on the eastern edge of the WCB shows a very unusual characteristic: it moved rapidly eastward, apparently against the general pattern of flow immediately to the north of South Georgia. It crossed the line of the ERS635 transect on January 23rd 2002, travelling in a northeastward direction, before retroflecting and crossing the line again, this time further to the north and moving in a westward direction. The results from an XBT transect, conducted at the very start of the cruise, support this observation of eastward flow at the southern end of the line.

ERS635 TRANSECT

Figure 5 shows the long XBT section completed along a line extending north-northwest from the vicinity of Cumberland Bay. This line crossed the North Georgia Rise (NGR), a distinct bathymetric feature in the deep ocean off the shelf from South Georgia. The position of the SACCF with respect to the NGR has been subject to some speculation: if the westward-flowing component of the SACCF were to lie south of the NGR, it would permit direct input of krill to the northwestern end of South Georgia. Conversely, if the SACCF were to lie north of the NGR, direct input of large amounts of krill by passive advection could be accomplished less easily.

The South Georgia shelf-break is on the left side of Figure 5, and the end of the section on the right. The NGR is centred close to 53°S, but the XBTs did not extend deep enough to be cut short by its topography. The westward-flowing component of the SACCF is apparent around 52.5-52.75°S, i.e. north of the NGR. Its retroflection is present just north of this, around 52°S. Most interesting, however, is the apparent presence of a third front (possibly the SACCF): this lies immediately adjacent to the shelf break (around 53.25°S), and significantly is flowing eastward. It is within this band of eastward-flowing water that the drifter crossed the ERS635 transect. Our working hypothesis is that the SACCF is shifted to the north by the NGR, and hence its westward-flowing component and retroflection both lie north of this; in addition, a recirculation of the SACCF around the NGR brings water from its north side close to the South Georgia shelf break on its south side. Detailed water mass analysis using the CTD section performed along the ERS635 line will be conducted to test this hypothesis. (At present these CTD data are still being processed, hence they will not be presented here.) Analysis of satellite altimeter data will prove very useful in testing the temporal robustness of this oceanographic situation. If found persistent, it would mean that the input of krill to the western end of South Georgia by passive advection is even more complicated than previously surmised.

TP059 TRANSECT

Figure 6 shows potential temperature along the TP059 transect, conducted on a line running northeastward from the easternmost tip of South Georgia. The same vertical stacking of water masses described previously is present; note in particular the deepening of the WW layer as it intrudes onto the shelf. The location of the SACCF is clearly visible around 54.1°S. At this location, the front is flowing westward (into the page); calculations of geostrophic velocity relative to the seabed give surface velocities around 45 cm s-1 here. A weaker eastward-flowing manifestation of the front is also present, sited close to 53.8°S. Geostrophic surface velocities are much lower here, around 10 cm s-1 .

Drogued drifters were deployed along this transect, with paired deployments (20 m and 50 m drogue depths) targeted at the two manifestations of the SACCF. The trajectories of these drifters are shown in Figure 4. It is immediately apparent that the outermost deployments were made in a ring or eddy, since the drifters have rotated about each other since being deployed. One of these drifters has escaped the eddy, and has moved in a north-eastward direction following a topographic bank. The drifter deployed just on the shelf moved very rapidly in a north-westward direction; this took it off the shelf, and its subsequent course towards the ERS635 transect suggests it is now in the SACCF. The drifter deployed closest to South Georgia on this line also moved rapidly in a north-westward direction, though staying much closer to the island. It slowed dramatically upon reaching the vicinity of the ERS635 transect, presumably due to the interaction of the currents with a large bathymetric feature there. At the time of writing, the drifter appeared to be moving toward the WCB; it is still over the shelf, but now much closer to the shelf break. If this drifter does indeed enter the WCB, it will provide evidence for a route of relatively rapid and direct transit along the northern edge of South Georgia, and thus may well be significant in deducing how krill reach the WCB.

FIGURE 2A: NORTHERN OFFSHELF EDGE OF WESTERN CORE BOX

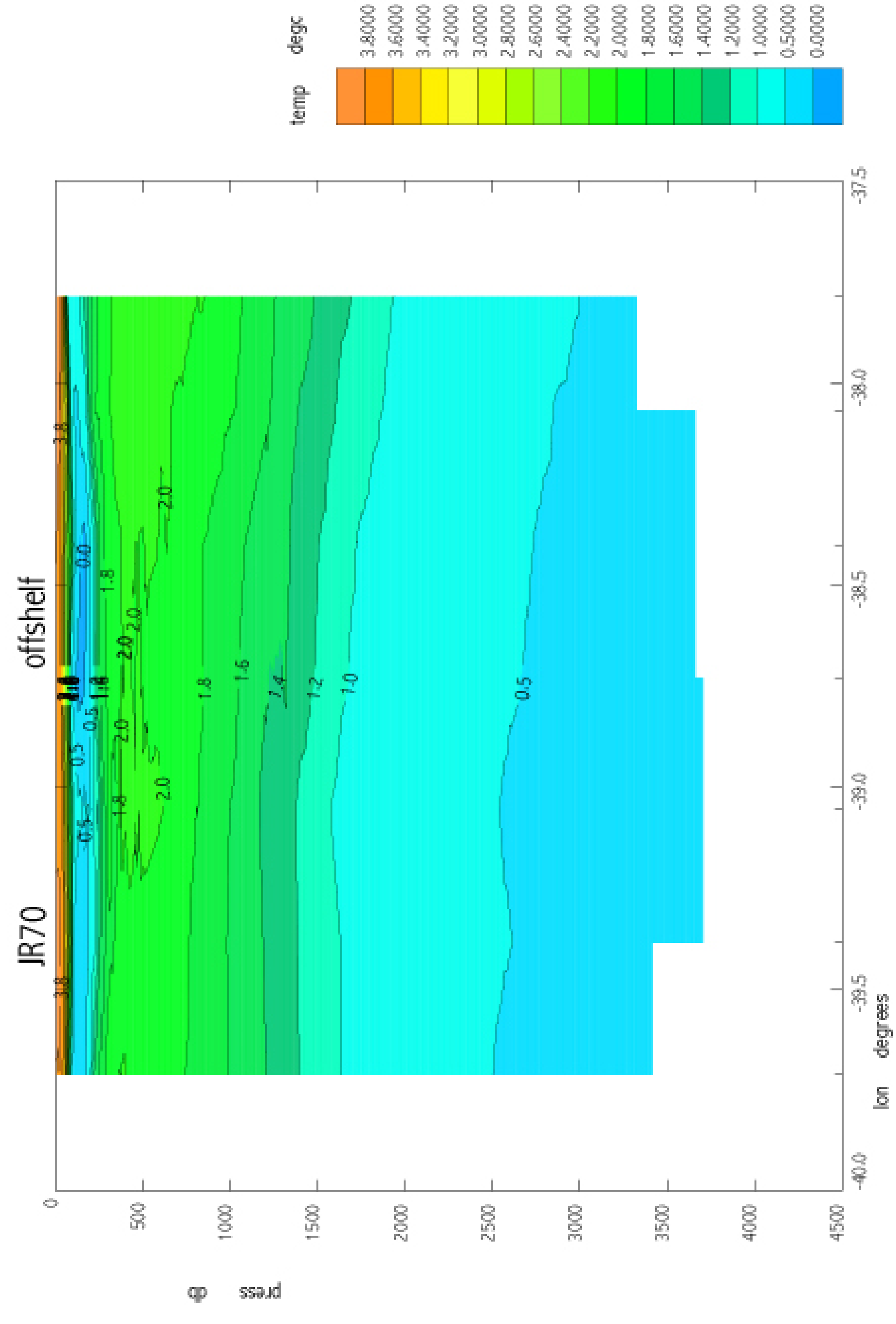


FIGURE 2B: MIDDLE SHELF SLOPE OF WESTERN CORE BOX

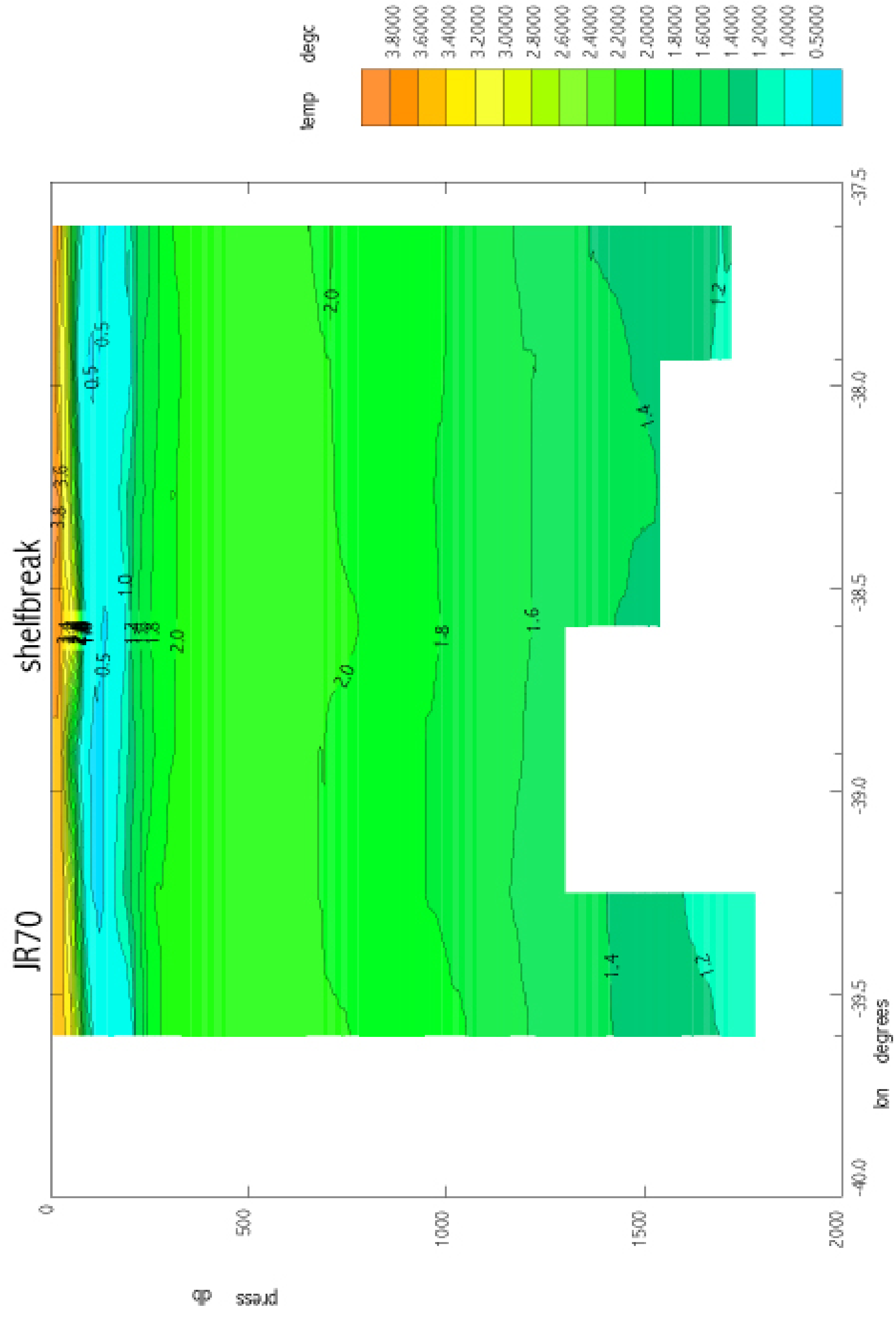


FIGURE 2C: SOUTHERN ONSHELF EDGE OF WESTERN CORE BOX

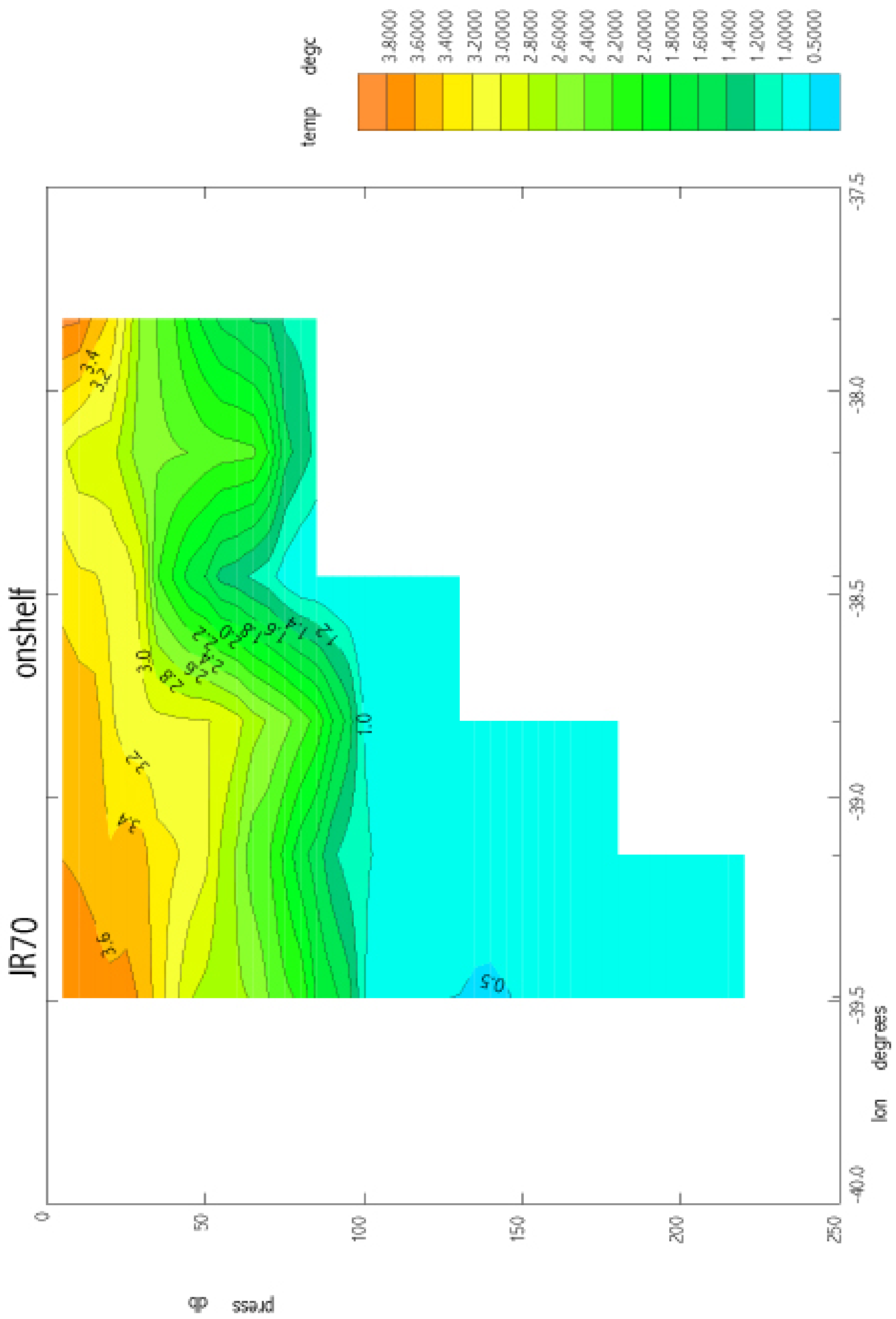


FIGURE 3A: WCB TEMPERATURES

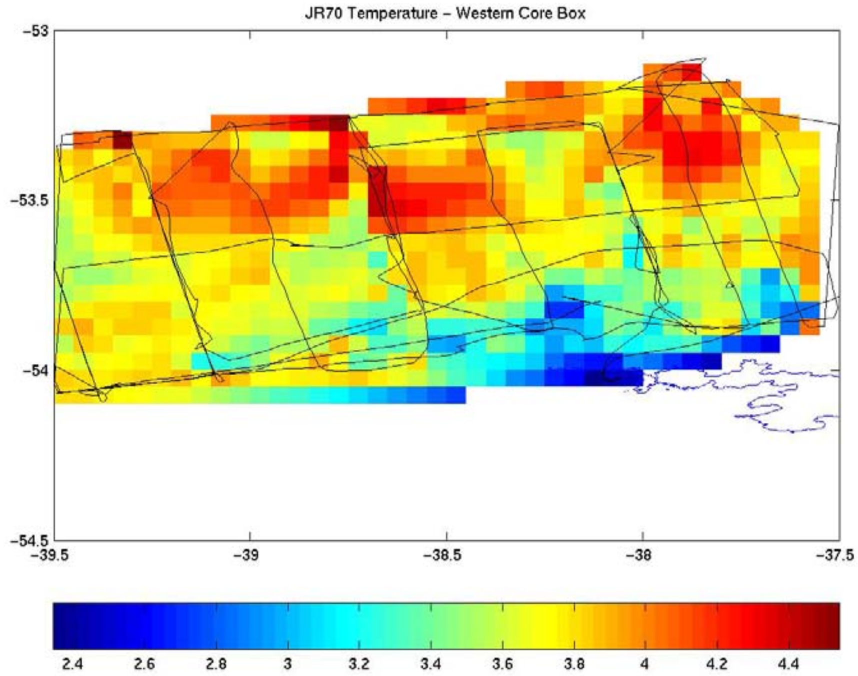


FIGURE 3B: WCB SALINITY

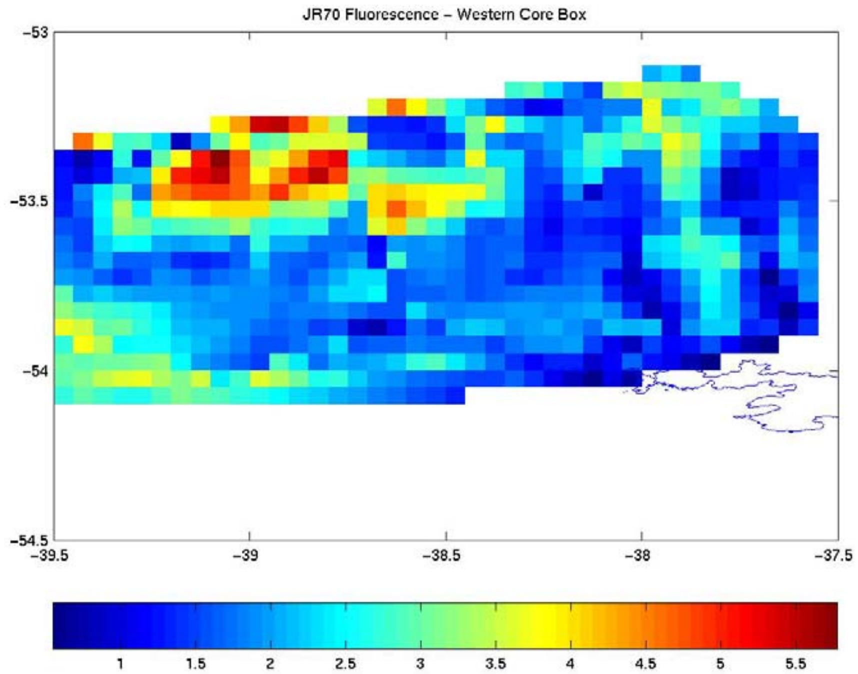


FIGURE 4: DRIFTER TRAJECTORIES

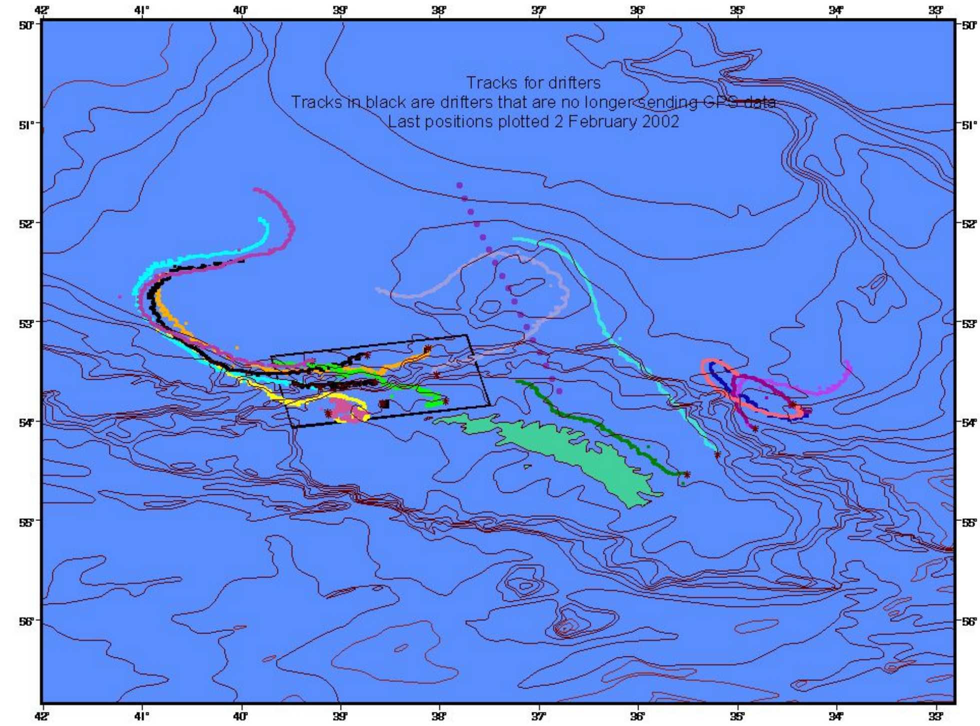


FIGURE 5: XBT TRANSECT ERS635

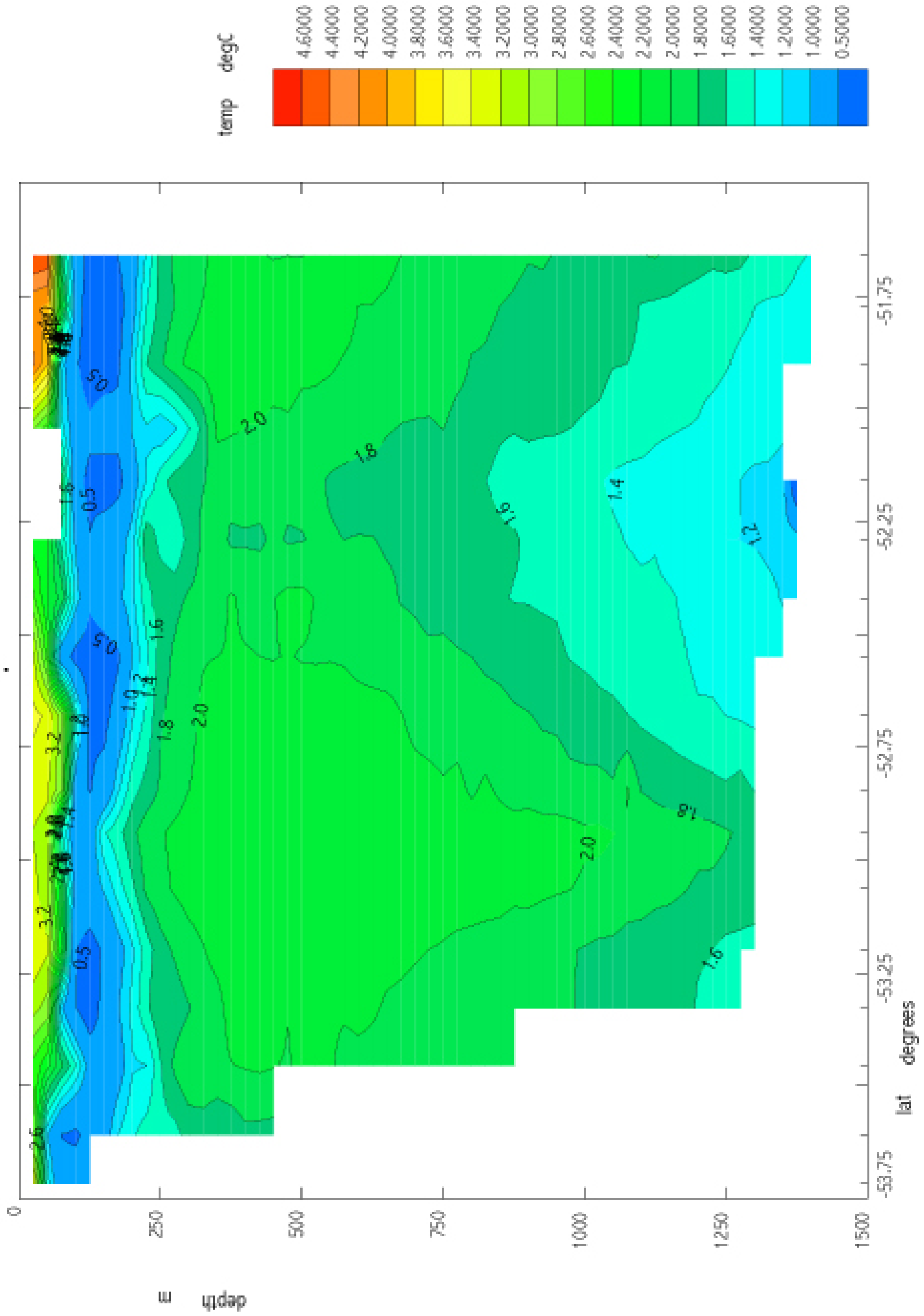
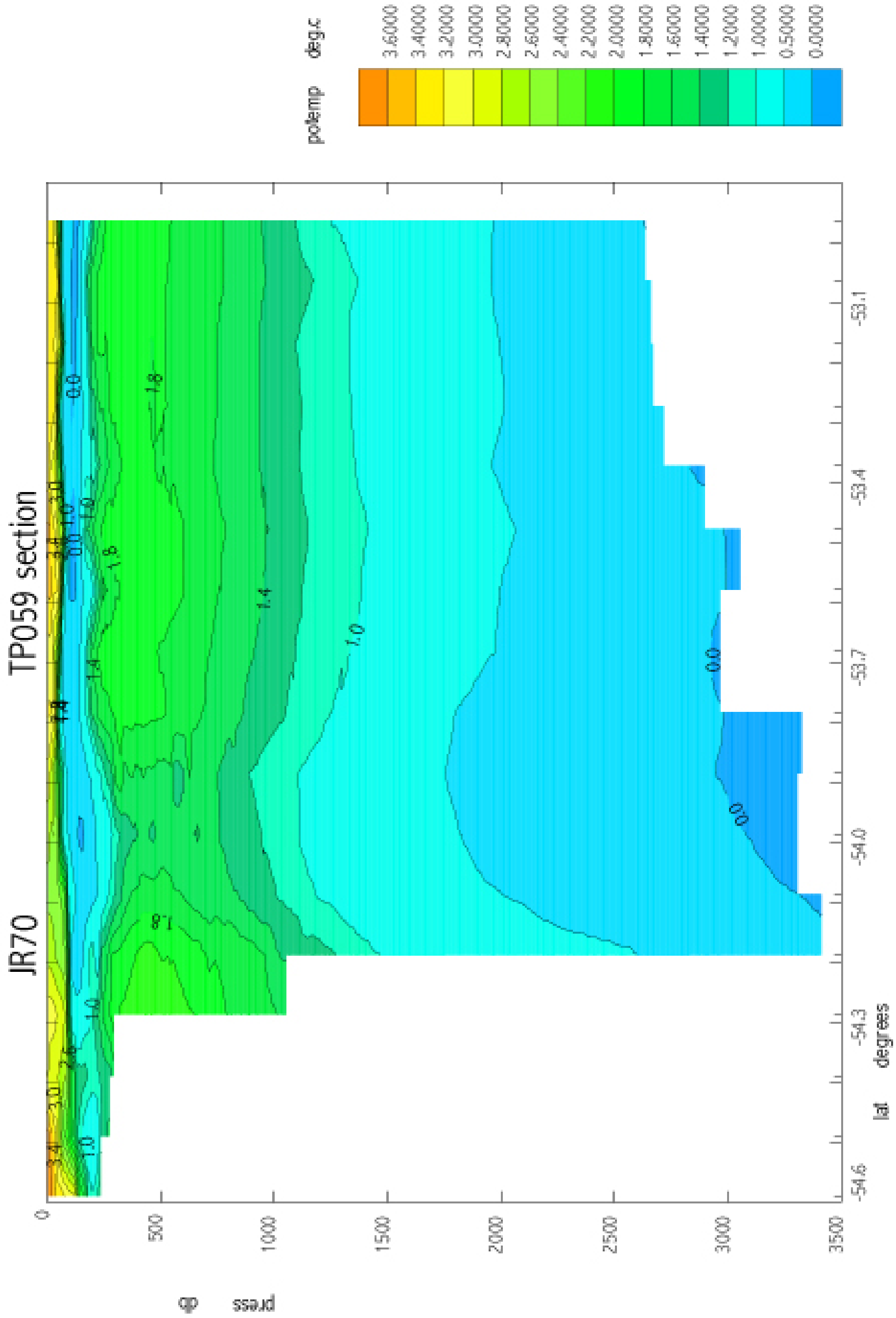


FIGURE 6: POTENTIAL TEMPERATURES ALONG TRANSECT TP059



NUTRIENT ANALYSIS

(MICK WHITHOUSE & MIN GORDON)

INTRODUCTION

During cruise JR70 nutrient concentrations were monitored in conjunction with primary production (standing stock and growth rate) measurements (see Korb, this report) to assess the importance of local as opposed to imported phytoplankton growth to the South Georgia system Generally speaking depletions of nutrients such as silicate, nitrate and phosphate indicate the extent of recent (weeks to months) phytoplankton growth. Ammonium is usually linked to nitrogen remineralisation (eg. due to microbrial activity at the pycnocline), and as reduced nitrogen source is frequently preferred by phytoplankton. A recent review (Atkinson et al. 2001) highlighted elevated growth rates and temporally and spatially extensive blooms (as shown by SeaWiFS satellite imagery), and suggested that local growth was an important factor in the waters surrounding the island. However, measurements made during cruise JR57 (austral summer 2000-2001), revealed elevated chlorophyll a levels and substantial nutrient depletion at the Southern Antarctic Circumpolar Current Front (SACCF) jet to the northeast of the island - indicating the potential role played by plant growth imported into the South Georgia system (Ward et al. in prep.).

During the present study, by sampling along the northern flank of the island and at a variety of locations with respect to the prevailing ocean currents, we aimed to:

1. Quantify the magnitude of phytoplankton productivity along two transects that crossed the SACCF.

2. Quantify the magnitude of phytoplankton productivity found during repeat occupations of the Western Core Box.

3. Make further observations of the deep, oceanic phytoplankton blooms that occur to the north (Adownstream@ ?) of South Georgia.

4. Further investigate the relationship between South Georgia=s primary and secondary producers.

5. Maintain the long-term investigation into the dynamic and changing environmental variability found at South Georgia.

METHODS

Water bottle sub-samples for nutrient analysis were collected at the following Western Core Box and Boundary Box CTD stations (events 051, 054, 057, 060, 063, 066, 069, 072, 076, 079, 082, 085, 088, 092, 095, 098, 101, 104, 107, 110, 113, 117, 120, 123, 126, 140, 143, 145, 148, 155, 159, 162, 159, 256, 259, 266, 269, 271, 274, 277, 280, 282, 285, 289), transect TP059 CTD stations (events194, 197, 200, 203, 206, 210, 213, 216, 219, 224, 227, 230, 237, 240, 244, 247, 251), and transect ER635 CTD stations (events 306, 309, 312, 313, 318, 319, 324, 327, 331, 334, 337, 340, 343, 346, 349, 352, 355). See CTD Operations Report for sample collection details such as bottle depth, collection time, station position, water depth etc. (Meredith, this report). Generally speaking, in addition to standard CTD sample depths (approximately 20, 40, 60, 80, 100, 125, 150 and 200 m, and a further four depths sampled between 200 m and the bottom of the cast), a near-surface sample (6-7 m) was taken from the ships non-toxic seawater supply .

During meso- and large-scale underway surveys (eg. Western Core Box transects, transect TP059, transect ER635), the ship=s non-toxic seawater supply (6-7 m) was continuously monitored for nutrient levels, and the results were logged to a PC once every ten seconds.

Samples were filtered through a cellulose nitrate membrane (Whatman WCN, pore size 0.45 ?m), and the filtrate was analysed colorimetrically for dissolved nitrate+nitrite (NO3+NO2-N), nitrite (NO2-N), ammonium (NH4-N), silicate (Si(OH)4-Si) and phosphate (PO4-P) using a Technicon segmented flow analyser (Whitehouse and Woodley 1987, Whitehouse 1997). Data were logged with a programme written by Mark Preston using LabVIEW 6i (National instruments), which is a development of an earlier acquisition programme (Whitehouse and Preston 1997). Full data analysis and verification will be undertaken on our return to the UK, therefore concentrations given in the brief summary below should be regarded as approximate.

INITIAL OBSERVATIONS

WESTERN CORE AND BOUNDARY BOX

Near-surface concentrations were patchy and very variable throughout the surveyed area with some exceedingly low levels in some regions. During the Boundary Box CTD survey surface silicate, nitrate and phosphate concentrations were between 5-20, 10-20, and 0.5-1.5 mmol m-3 respectively, with the lower levels found particularly along the northern edge of the area. Pycnocline concentrations of ammonium were particularly high with up to 3 mmol m-3 at some stations, whereas surface levels were typically low - possibly indicating active phytoplankton use at the top of the water column. During the second survey of the Core Box nutrient concentrations were exceedingly low in the northeast sector with silicate, nitrate and phosphate levels as low as 2-3, <8 and 0.5 mmol m-3 respectively. Concentrations as low as this are rarely found in Antarctic waters and as well as indicating the magnitude of depletion due to phytoplankton growth, also have implications as to the type of nitrogen use/preference.

TRANSECT TP059

Near-surface nutrient concentrations were consistently high throughout this transect. Silicate, nitrate and phosphate concentrations rarely fell below 25, 20 and 1.5 mmol m-3 respectively and were at times considerably higher. At the stations over the South Georgia shelf, high ammonium concentrations extended from the pycnocline to the top of the water column (up to 2 mmol m-3) - identified by Gilpin et al. (in press) as a surplus of remineralised nitrogen and indicative of low phytoplankton use/turnover.

TRANSECT ER635

Although near-surface nutrient concentrations were generally high along the transect (silicate, nitrate and phosphate levels 20, 20, and 1.2 mmol m-3 respectively), there were some notable exceptions.Atstations 5 and 6 silicate, nitrate and phosphate levels were reduced to 2-3, <12 and 0.7 mmol m-3 respectively. Nitrate and Phosphate concentrations were similar at station 10, with silicate levels remaining a little higher (-6 mmol m-3). At several stations along the transect ammonium concentrations were exceedingly high near the pycnocline eg. >3 mmol m-3 at stations 8 and 9, and again at stations 16 and 17. Although near-surface silicate concentrations were low at stations 16 and 17 (-5 mmol m-3), nitrate and phosphate levels remained high (-15 and 1 mmol m-3 respectively). This, along with surface temperatures >6EC, may be indicative of Polar Frontal Zone water.

INSTRUMENTS AND LOGISTICS

The autoanalyser performed well overall, however a full and thorough service will be required before another cruise. Attention is needed particularly to the colorimeters. Mark Preston's new data acquisition programme worked most satisfactorily and shows potential for further development in the analysis of acquired data.

Mobilisation went smoothly with the possible exception of identifying hazardous chemicals - it would be so much easier if the packers were to label the boxes with the cruise number and the consignor's name. It is information that we routinely supply and have repeatedly asked to be printed on the outside of containers - next season?

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Atkinson (2001)

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PHYTOPLANKTON PRIMARY PRODUCTION - WATER COLUMN PRODUCTION

(BEKI KORB, PETER ENDERLEIN & MIN GORDON)

OBJECTIVES

To provide biomass and primary production estimates to determine the relative importance of flux and local production in maintaining krill and zooplankton populations at South Georgia.

INTRODUCTION

In contrast to the High-Nutrient-Low-Chlorophyll conditions that persist over much of the Southern Ocean, high chlorophyll levels (up to 20 mg m-3), and substantial nutrient depletions (eg. less than 5 mmol m-3 Si(OH)4) are frequently recorded in the waters around South Georgia. Secondary production is also high, and although krill are not believed to reproduce in the island's vicinity, the Antarctic Circumpolar Current (generally comprising waters of low primary productivity) appears to deliver an ample supply for South Georgia's numerous higher predators. However, the island's productivity is highly variable both temporally and spatially. For example, primary production rates can vary from approximately 0.1 g C m-2 d-1 to the east of the island in February-March to greater than 2.75 g C m-2 d-1 to the west during January.

In accordance with the overall aims of FLUMPEX, we aim to calculate the flux, production and loss elements for nutrients and phytoplankton. To undertake these calculations we will need to collect data on the concentration of nutrients and biomass of phytoplankton within the western core box and along the box boundaries, and estimates of primary production. In addition, this years sampling will provide data to determine interannual variation in nutrients and chlorophyll levels.

METHODS

UNDERWAY CHL-A

Chl-a in the surface waters was continuously monitored as the ship was on passage. Seawater from the ships non toxic supply was pumped through a Turner Designs Model 10 through-flow fluorometer and data logged at 5 second intervals to the ship's data acquisition system.

Discrete samples for calibration were taken from the outflow from the fluorometer. When the ship was on passage between and during transect legs, samples were taken at approximately hourly intervals.

During transects, the UOR (Nv-shuttle) was deployed and in vivo chlorophyll fluorescence was measured using a Chelsea Instruments flashlamp fluorometers. PAR profiles through the water column were also measured from the undulator.

STATION BASED CHL-A

Chlorophyll fluorescence through the water column was measured with a Chelsea Instruments Aquatracker on the CTD. The instrument was calibrated against discrete samples taken from standard depths of 20, 40, 60, 80, 100 and 125 m. In addition, a surface sample was obtained from the outflow from the fluorometer.

MEASUREMENTS OF EXTRACTABLE PARTICULATE CHLOROPHYLL

Samples for whole-community chlorophyll were filtered under moderate vacuum onto Whatman GF/F glass-fibre filters. Samples were then extracted in 10 ml of 90% acetone in the dark at approx 4°C for 24 hours. Fluorescence was measured using a Turner TD-700 fluorometer, before and after acidification of the extract with dilute hydrochloric acid.

Size fractionated estimates of Chl-a were obtained by filtering 250 ml of water from the 20m CTD water sample through a series of 12, 2 and 0.2 mm polycarbonate membrane filters. A sample from 20 m was also preserved in Lugols for phytoplankton identification at BAS HQ.

The bench top fluorometer was calibrated against a standard prepared from chlorophyll a extracted from the cyanobacterium Anacystis nidulans (Sigma Chemicals). The standard solution will be calibrated using a spectrophotometer at BAS HQ.

PRIMARY PRODUCTION

Where possible, a separate CTD cast was carried out to collect water samples from within the euphotic zone for primary production studies. The sampling regime was designed to approximate the percentage light levels in the water column based on bio-optical profiles calculated from the PAR sensors on the UOR and the ships mast.

On a number of occasions, it was not possible to a carry out a separate CTD and so water was sampled from the standard station based CTD's using water bottles corresponding closest to the percentage light levels.

Whole community and size fractionated primary production was determined by ^{14}C uptake over 24 hours under ambient light and water temperatures using an on-deck incubator. On occasion, a parallel experiment would be set up in the lab to produce a photosynthesis-irradiance curve using the photosynthetron.

PRACTICAL PROBLEMS

Good estimates of water column primary production are reliant on an estimation of the percentage light levels from the UOR data. As production experiments are carried out during the night/early dawn, it is vital to run the UOR during the day or have access to the CTD PAR data. While there was excellent support for gaining access to the PAR data, on a number of occasions, the UOR was not run and thus it was worthwhile to set up a primary production experiment.

It is also preferable to carry out a separate CTD cast for production experiments, especially at the deep water stations where few surface samples are taken. In view of the minimal time taken to drop a CTD to a maximum depth of 70 m, it is recommended that in future, separate CTD casts are performed for all primary production work or that an independent and smaller CTD rosette be operational.

Working in the new radioisotope fume hood would best be described as difficult and at worst dangerous! The hood is placed at some distance back from the edge of the bench top making it almost impossible to reach more than a few inches into the hood. In addition, there was no suitable chair for working at the fume hood, resulting in my face being level with the opening sash. See Heath and Safety Officers recommendations. On a positive note the new scintillation counter performed well at sea although the waste management software never did work.

PRELIMINARY RESULTS

EASTERN CORE BOX, LONG TRANSECT.

Phytoplankton biomass was generally low throughout the length of the transect (< 0.5 mg chl a. m-3, see Fig. 7). A slight peak in chl-a was observed off shelf between stations 10 and 11, with values reaching 1.4 mg chl a. m-3 and similar values were found on the shelf (stations 1-3). In contrast to last years cruise, JR57, there was no deep chlorophyll maximum or elevated phytoplankton biomass observed between stations 5-6 where the SACCF is positioned.

Integrated primary production values were also low along the transect with a mean value of approximately 0.12 g C m-2. d-1 (Table 9).

WESTERN CORE BOX – BOUNDARY BOX.

Whilst the eastern end of the island was rather low in chl-a, large phytoplankton blooms occurred to the western end of the island (Fig. 8). Generally, the greatest biomass was found off the shelf with values as high as 16 mg chl a. m-3. Whilst there was no evidence of subsurface blooms, chl-a remained high down to approximately 50m. At the shelf break, biomass decreased to values less than 8 mg. m-3, again extending down to 50m. Over the shelf region, high biomass (8-12 mg. m-3) was recorded in the surface waters, though this was restricted to the top 10m of the water column.

A 2-way ANVOA was run to examine differences between chl-a in the shelf, shelf break and deep water regions surveyed. It was found that there were significant differences in chl-a between the regions (p values <0.05). A Tukeys Test showed chl-a concentration is significantly highest in the upper 40 meters of the water column. Below 40 m there are no significant differences in the chl-a concentrations.

WESTERN CORE BOX – REPEATED CTD STATIONS.

There were large differences in phytoplankton biomass at 2 of the stations where repeat CTD surveys was carried out. Over 10 days, surface biomass decreased from values of 10-15 mg. m-3 at the off shelf stations W1.2N and W2.2N, to 3-5 mg. m-3 (Fig. 9). In addition, integrated water column production at these stations was reduced by 10-50 % (Table 10).

PHOTOINHIBITION

Results suggest that primary production may be inhibited by high light intensities. PI curves from the photosynthetron show a reduction in ^{14}C uptake rates at light intensities greater than 500 mmol photons m^{-2}. s^{-1} and from on deck incubations, primary production rates were slightly reduced in water samples incubated in full sunlight.

UNDERWAY MEASUREMENTS

Phytoplankton biomass was greatest at the western end of the island, mainly to the west of the areas surveyed and over deep waters (Fig 10). Uncalibrated fluorescence data from the ocean logger, suggested that this elevated biomass was extremely variable over short distances and appeared to be correlated with temperature.

TABLE 9: PRIMARY PRODUCTION VALUES FOR WCB STATIONS SURVEY 1

Station	Primary production	Chl a
	(g $m^{-2}.d^{-1}$)	(g m^{-2})
W1.2 N	6.22	0.553
W2.2 N	1.319	0.378
W3.2 S	0.402	0.103

TABLE 10: PRIMARY PRODUCTION VALUES FOR WCB STATIONS SURVEY 2

Station	Primary production	Chl a
	(g $m^{-2}.d^{-1}$)	(g m^{-2})
W1.2 S	0.6	0.065
W1.2 N	0.714	0.387
W2.2 N	0.783	0.274
W2.2 S	1.337	0.084
W3.2 S	0.52	0.169

FIGURE 7: PHYTON PLANKTON BIOMASS ALONG TRANSECT TP059

Fig. 1. Chlorophyll concentrations during Eastern long transect (TP059)

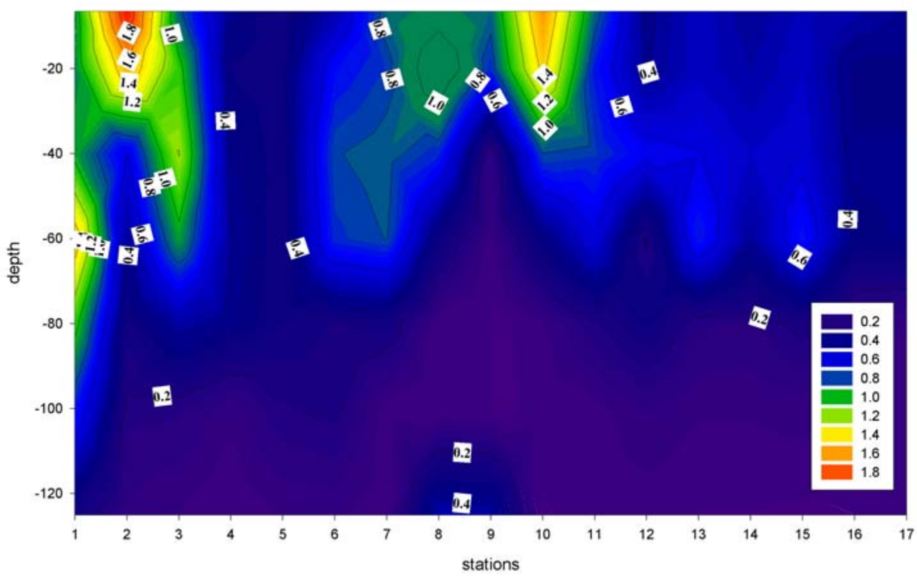


FIGURE 8: PHYTON PLANKTON BIOMASS IN THE WCB

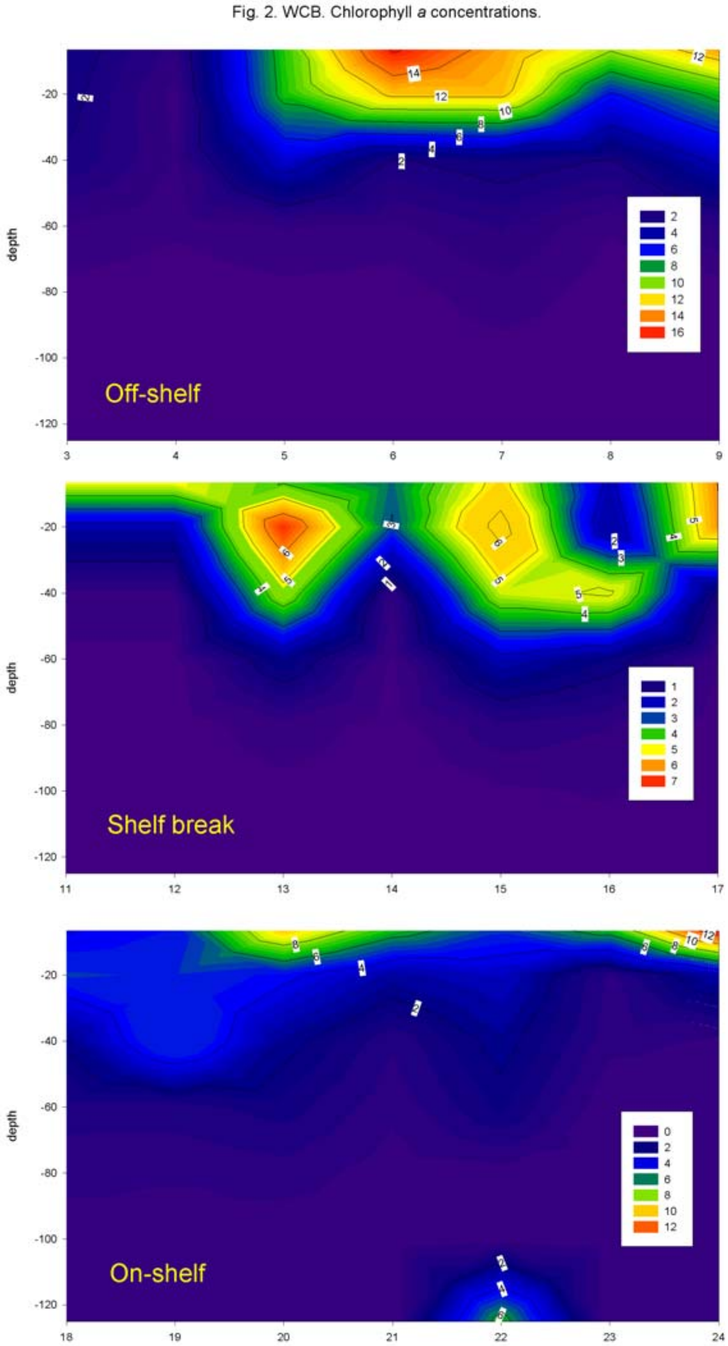


FIGURE 9: CHL-*A IN THE WCB*

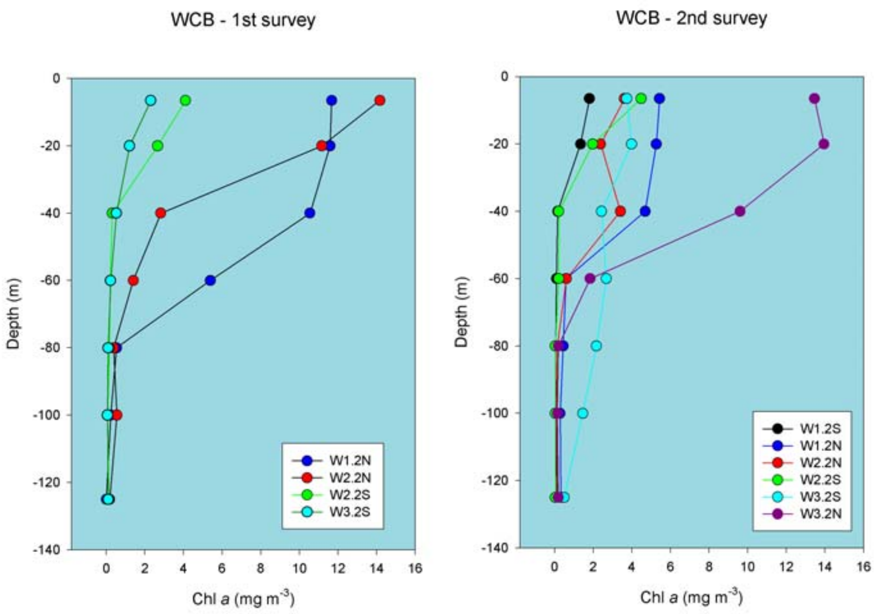
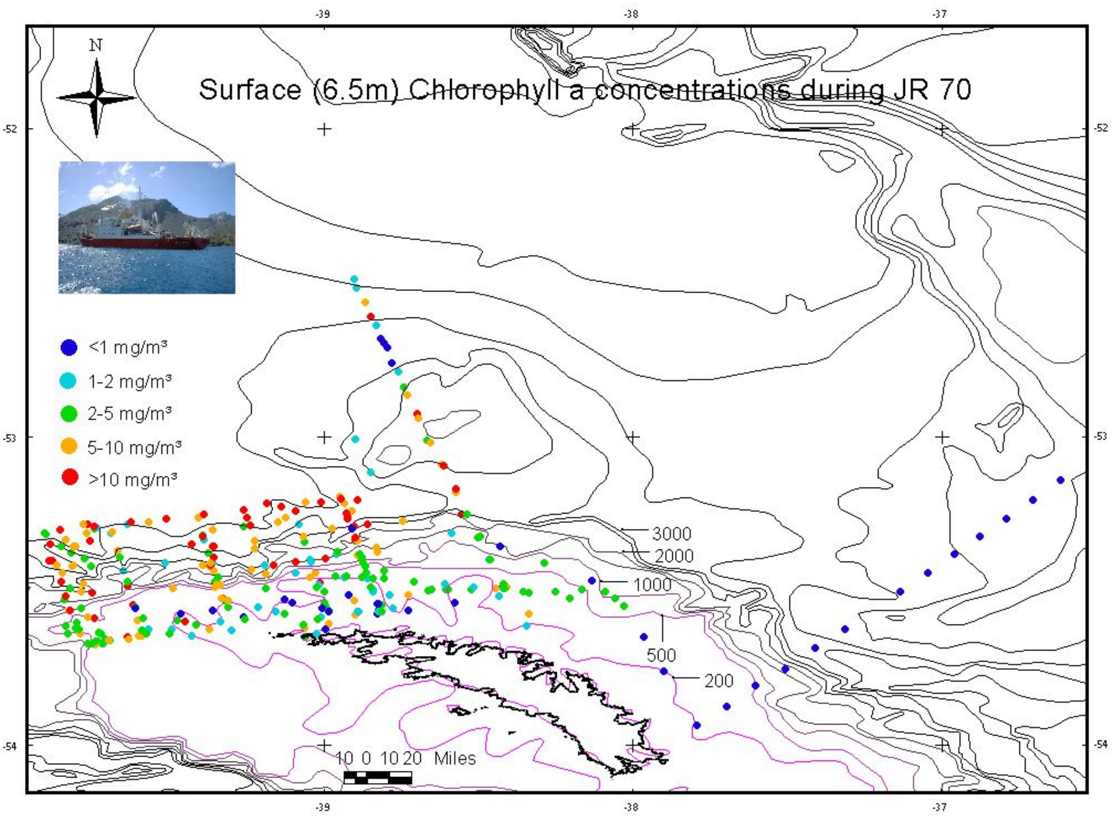


Fig. 5. Chl-*a* in the WCB stations

FIGURE 10: PHYTON PLANKTON CONCENTRATIONS DURING JR70



MESO-ZOOPLANKTON RESEARCH

(PETE WARD, GERAINT TARLING & KATE ARNOLD)

Zooplankton samples have again been taken this cruise using the bongo nets comprising paired nets of 100 mm and 200 mm mesh fitted with solid cod ends. All sampling was planned to take place at all of the standard stations worked during the cruise, deploying the nets from surface to 200 m. Two hauls were usually taken, the first so that samples could be sorted for live animals, usually 30 female copepods (Rhincalanus gigas) which were placed in incubation pots for 24 h to determine egg production rates and copepodite stages iv and v of Calanoides acutus which were placed into foil capsules in groups of 10 and 5 respectively for determination of carbon mass and carbon and nitrogen analysis in UK. Data from previous cruises have indicated that such analyses reflect copepod fecundity and condition and along with an estimation of copepod abundance, obtained from preserved catches, relates to past feeding history over a variety of time scales. Both samples from the second haul were preserved in 10% (v:v) formalin seawater for analysis in UK. These data will be looked at in light of the physical oceanography, nutrient and phytoplankton measurements. Ultimately we wish the estimate the relative importance of advection and in situ production in producing the standing stock of zooplankton within the box.

The first series of samples were those associated with the 25 stations worked as part of the CTD boundary box between 8th-12th Jan All samples from the stations were successfully obtained and egg production experiments set up. Initial results indicated great station to station variability in egg production (EP) but with highest EP along the western flank of the box.

Both long transects were also successfully sampled. In contrast to last year (JR57) when highest levels of EP were coincident with the westwards inner arm of the SACCF this year on TP059 highest EP rates were present in the waters between the inner eastwards and middle westwards flowing jets. Similarly for ER635 stations 9 and 10 were where EP was highest.

Similar measurements were carried out during the two biomass surveys of the WCB. On both occasions 5 of the 6 samples were successfully obtained the errant station being W3.2N which both times we could not sample because of poor Wx conditions.

A period of around 18 hrs on 29th/30th Jan allocated as a time station allowed us to use the Longhurst Hardy Plankton Recorder to obtain finely resolved samples, to build a picture of the diurnal vertical distribution of plankton at two stations W2.2S and W2.2N. These data will be valuable in interpreting the relative residence time of plankton in the WCB at both inshore and oceanic sites.

At all stations water was filtered from the upper mixed layer (usually 20 m) to obtain samples for fatty acid and POC determinations.

KRILL GROWTH AND ENERGY BUDGETS

(RACHAEL SHREEVE, GERAINT TARLING, KATE ARNOLD & ANGUS ATKINSON)

INTRODUCTION

There are still major uncertainties over the various gain and loss terms in the energy budget of krill. Practical difficulties of measuring these rates are responsible, and at South Georgia we know more about the energy budgets of major copepod species. The measurement of krill growth is part of the cruise aim to estimate a krill budget for the WCB. We also wanted to gain a wider regional coverage, and to measure indices of animal condition, feeding rate and food quantity and quality. This is in order to obtain a more mechanistic understanding of the factors affecting growth, as well as a "snapshot" measurement. The data collected on this cruise, and on the following one, are aimed towards the generation of first-stage predictive models for krill growth rate. The growth measurements are described below. There follows summaries of our parallel studies looking at age structure, sex and maturity stage composition, energy budgets and the food environment.

METHOD FOR INSTANTANEOUS GROWTH RATE

The method used for determining krill growth rate is known as the Instantaneous Growth Rate (IGR) method. This involves incubating freshly caught animals individually for several days and recording the fraction that moult. The inverse of this moulting frequency is the inter-moult period. If krill are growing, the new body is larger than the moulted exoskeleton, by a fraction known as the percentage growth per inter-moult period. The average daily percentage growth rate in length is thus a product of the moulting frequency and the percentage growth per inter-moult period.

Krill were caught with the RMT 8, the two nets of which were used to target separate swarms, where possible. Table Q/JR70/Cruisereport/krill/Krilltable1 summarises the net hauls used to set up IGR experiments. The krill were transferred to 500 ml perforated pots maintained in three tanks of ~0.5 m3 in the cold room. Filtered seawater was pumped through these tanks at 1-2 L min-1, at ambient seawater temperature. At daily intervals, usually for 6 days (see Table 11) each animal was checked to ascertain whether it had moulted. Those that had were removed and both uropods on the moult and the new animal were measured to determine the percentage growth per inter-moult period. All animals in the experiment, both moulters and non-moulters, were also measured and ascribed to sex and maturity stage.

MAIN RESULTS

The most striking result was that growth rates per inter-moult period varied greatly during the cruise (Table 11). The highest rates were among the maximum recorded for krill by this technique and were found in the productive waters of the WCB on our first visit there (events 33 and 89). Growth rates to the east, in generally lower phytoplankton concentrations, were lower.

The other striking finding was that over the course of the experiment, percentage growth per intermoult period declined. This was most noticeable when initial growth rates were high, an example of which is shown in Fig 11. Such a decrease is almost certainly due to the absence of food imposed by the IGR technique. It suggests that only the first 1-2 days gives a meaningful representation of in-situ growth, and contrasts with previous work, which has recommended 4 day incubation periods. The inter-moult period varied between 12 and 28 days across experiments, and work in the UK will determine whether these are related to animal size, sex and maturity, or environmental conditions.

INTERPRETATION OF GROWTH RATES IN RELATION TO THE KRILL BUDGET

It seems as if we incubated sufficient total krill (>3000) and sampled sufficient swarms (~20-25) to enable a reasonable estimation of growth within the WCB. It should be noted, however, that the growth we measured is in terms of length, and not in terms of biomass. If krill are not getting much longer between moults, they may still be growing rapidly, for example with gamete production, as evidenced by the swollen bodies of the gravid females encountered on this cruise. Quantification of the growth term for the krill budget will require a careful interpretation of its component measurements, for example age structure and relative biomass and distribution of the population, as well as moulting frequencies and size increments per moult. Phytoplankton concentrations were generally rather lower on our second visit to the WCB, as were growth rates, as suggested by Table 12. As is probably the case with the other terms in the budget, krill growth is likely to vary substantially from week to week.

PARALLEL AND SUPPORTING MEASUREMENTS

ANALYSIS OF MOULT STAGE

The IGR method relies on moulting being random, rather than synchronous. The extended duration of the experiments (6 days) has helped us to observe day-to day variation in moulting frequencies. In addition, Geraint analysed moult stage of the non-moulters at the end of the experiments, to determine whether moulting was random. Each non-moulted animal remaining at the end of the experiment was allocated to one of eight stages in the moult cycle. The statistical analysis of these data will be done in Cambridge. In addition, a random subsample of animals from each catch were frozen, and analysis of their moult stage will provide an independent estimate of the inter-moult period.

ENERGY BUDGET

Kate Arnold's PhD involves the modelling of energy budgets of krill based on their chemical composition. For the events where moulting experiments were set up, she froze a variety of sex and maturity stages, having dissected them into hepatopancreas and somatic regions. Products (eggs from gravid females, moulted exoskeletons and faecal pellets) were also preserved for later analysis. It is envisaged that in the UK, whole animal analyses can be also be made on the same material used for the moulting experiments, economising on time and effort. These analyses will include assessments of protein, carbohydrate, lipid, nucleic acid, chitin, plus elemental composition both of the whole animal and dissected tissues.

SIZE, SEX AND MATURITY STAGE COMPOSITION

Quantifying a krill budget needs not only knowledge of the resident krill biomass, but also of its regional composition. This information is available (see Table 12) for all the animals incubated for the moulting rate catches, as well as other, non-targeted RMT 8 hauls generally with lower catches.

FOOD QUANTITY AND QUALITY

Understanding the availability of suitable food will probably be a major step to predicting growth rates of krill. Data for this were collected in a number of ways. First, underway fluorescence (from the pumped seawater supply) will give a continuous picture of surface layer phytoplankton concentrations, having been calibrated at hourly intervals throughout the cruise. Second, we collected a series of samples of upper mixed layer water at every CTD station and at most of the target fishing stations. These were preserved in lugols Iodine solution for microscopic analysis or filtered onto ashed GFF filters for POC or fatty acid analysis. These samples are summarised in file Q/JR70/Cruisereport/krill/krillTable2. It is hoped that satellite imagery and maps of nutrient deficits will allow us to look at past feeding regimes as integrators of growth.

KRILL FEEDING

With so much effort put into measuring krill growth, little could be put into krill feeding. However, for each of the events shown in Table12, we preserved usually at least 50 krill immediately on capture for microscopic analysis of gut content. This will yield information on their intake of phytoplankton (their primary food source) and the regional and diel importance of heterotrophs, their suggested secondary food source.

For 15 of the net hauls, ~50 krill were incubated individually for an hour after capture, before transferring to the moulting experiments. The faecal pellets produced in this time were collected for later analysis of diet and faecal pellet

TABLE 11: EVENT LOG FOR KRILL CATCHES

event	date	net	mean krill length	nos animals incubated	experimental duration	mean % IGR
30	6	1&2	42	15	6	*
32	7	1		7	6	*
32	7	2	41	46	6	6.2
33	7	1	40	201	6	8.11
33	7	2	39	213	6	8.99
89	10	1	41	330	5	8.42
89	10	2	41	110	5	10.59
134	13	2	52	56	6	4.09
164	16	1	39	120	3	3.78
165	16	1	40	163	4	3.19
165	16	2	40	151	4	2.57
168	18	1	40	67	6	2.36
168	18	3	40	73	6	2.84
170	18	1	39	168	6	1.82
171	19	1	39	60	6	2.75
171	19	2	40	64	6	1.72
252	22	2	46	384	6	3.75
254	23	1	42	55	6	*
254	23	2	44	55	6	5.65
276	26	2	42	240	7	4.5
286	26	1	46	83	7	2.56
291		1	42	52	6	3.18
291		2	42	49	6	3.89
301	30	1	54	96		0.71
302	30	1	41	265		1.64
302		2	41	25		0.81
357	32	1	41	175		3.57
357	32	2	41	109		3.57

TABLE 12: POSITIONS OF CATCHES

Event	Lat	Lon	5	Date	Net	Mean krill length	nos animals incubated	Experimental duration	Mean % IGR
30	-53.70649	-36.78100	30	6	1&2	42	15	6	*
32	-53.71860	-37.16143	32	7	1		7	6	*
32	-53.71860	-37.16143	33	7	2	41	46	6	6.2
33	-53.71768	-37.17969	34	7	1	40	201	6	8.11
33	-53.71768	-37.17969	89	7	2	39	213	6	8.99
89	-53.63622	-38.83650	128	10	1	41	330	5	8.42
89	-53.63622	-38.83650	129	10	2	41	110	5	10.59
134	-53.84055	-39.1419	131	13	2	52	56	6	4.09
164	-53.39677	-38.03102	134	16	1	39	120	3	3.78
165	-53.36101	-38.08222	137	16	1	40	163	4	3.19
165			149	16	2	40	151	4	2.57
168			152	18	1	40	67	6	2.36
168			163	18	3	40	73	6	2.84
170	-54.30097	-35.74345	164	18	1	39	168	6	1.82
171	-54.4521	-35.62724	165	19	1	39	60	6	2.75
171	-54.4521	-35.62724	170	19	2	40	64	6	1.72
252	-53.79652	-36.05101	171	22	2	46	384	6	3.75
254	-53.79835	-38.11508	207	23	1	42	55	6	*
254	-53.79835	-38.11508	252	23	2	44	55	6	5.65
276			254	26	2	42	240	7	4.5
286			260	26	1	46	83	7	2.56
291			263		1	42	52	6	3.18
291			276		2	42	49	6	3.89
301			286	30	1	54	96		0.71
302			291	30	1	41	265		1.64
302			301		2	41	25		0.81
357			302	32	1	41	175		3.57
357			328	32	2	41	109		3.57
			357						

FIGURE 11: TYPICAL MOULTING KRILL

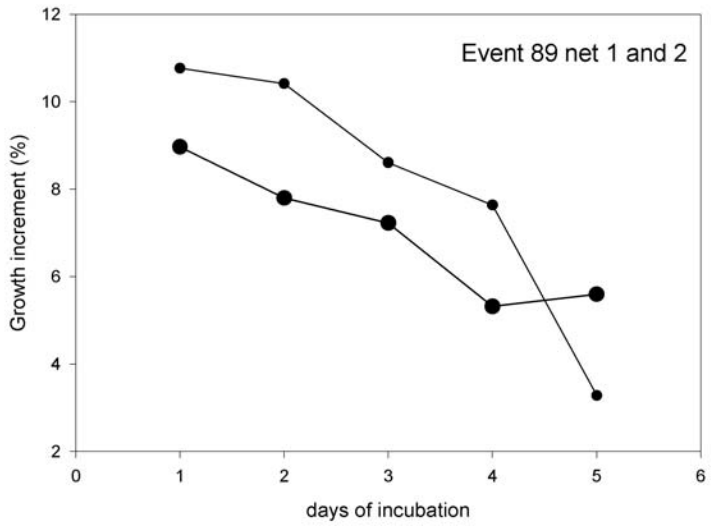


Fig. Krill 1.

Typical decline in length increment in moulting krill over the 5 days of incubation.

ABUNDANCE – ACOUSTICS (JON WATKINS & CATHY GOSS)

INTRODUCTION

Acoustics form a central part of the BSD cruises. Using a scientific echosounder we can estimate the biomass and observe the distribution and behaviour of scattering organisms such as Antarctic krill, zooplankton and pelagic fish. Here we describe the set-up, calibration and preliminary results obtained by the acoustic group during cruise JR70.

SYSTEM SPECIFICATION

Acoustic data were collected during cruise JR70 using a Simrad EK500 echosounder operating at 38, 120 and 200 kHz through hull-mounted transducers. The 38 kHz and 120 kHz transducers are split-beam designs with beam widths of 7° and 9°. The 200 kHz transducer is a single beam transducer with a beam width of 7°. The 120 and 200 kHz transducers are located in an Arctic tank in the hull between frames 88 and 89. The 38 kHz is located between frames 81 and 82. In addition to the 3 hull-mounted tranducers this year a 200 kHz single beam 7° transducer was mounted in the BSD tow fish. The transducer was aligned so that it pointed out at right angles to the track of the ship and was inclined upwards at 20°.

Acoustic data were output from the EK500 to a dedicated local area network (LAN). Data were logged using SonarData Echolog_EK software running on two dedicated WindowsNT workstations. The data were viewed and monitored in real time using SonarData Echoview. All logged data were saved on CD-rom in daily backups. Post-processing of data was carried out using SonarData Echoview to apply calibration corrections, identify acoustic scattering types and calculate survey biomass.

Further details are provided in the following sections.

SURVEY DESIGN

The cruise consisted of 3 main modules each with slightly differing acoustic requirements:

1. Biomass surveys of the western core box
2. Boundary box surveys
3. Long transects

The key requirements of each type of module are described briefly below.

1. The biomass survey of the western core box (WCB) consisted of 8 parallel transects orientated in a NW – SE direction spaced across the WCB. The positioning of these transects was the same as those designed and described for cruise JR57. The position of each transect was set out in a 2 stage randomization process. Each transect was nominally 80 km in length and average transect spacing was of the order of 18 km. The WCB biomass survey was carried out twice during the cruise.

2. The boundary box surveys were either made up of a series of short (18 km) transects between CTD stations or was a continuous survey around the whole of the boundary box. Because survey took place during day and night it was important to understand if any krill were above the hull-mounted transducers at

night. Therefore the tow fish with sideways-looking 200 kHz transducer was deployed when available during these surveys.

3. Long transects were generally more exploratory and information on the distribution of any kind of scattering targets was of interest.

4. These different surveys are shown in the cruise track.

CALIBRATION

CALIBRATION PROTOCOL

Calibration protocols have evolved over the last few years. In Appendix 1, we provide an up to date description of the calibration process. Calibration was carried out in Stromness Harbour using the DPS system to anchor the ship. Both hull mounted transducers and the 200 kHz tow fish transducer were calibrated. Full details are available in Appendix 1.

NOISE

Noise on the EK500 has been a perennial problem. This year we have noted noise on the 120 kHz display as a result of running the 200 kHz. On January 13 tested the tow fish with the sideways-looking 200 kHz transducer. When we reconnected the 200 kHz hull-mounted transducer we noticed that background noise on the 120 kHz increased by about 3 dB (see echoview files at 03:30 – 03:45 Z). This occurred when the cable was connected into the EK500 system box prior to switching the 200 kHz sounder to active. Removing the 200 kHz cable resulted in a reduction in noise. We therefore decided that, as good 120 kHz data were a priority for the core box surveys, we would not run the hull-mounted 200 kHz transducer during the core box surveys.

TOW FISH AND AN UPWARDS-INCLINED 200 KHZ TRANDUCER

Antarctic krill often migrate towards the surface at night, and even during the day there are reports of krill occurring very close to the sea surface. With transducers located in the bottom of the ship, there is effectively a blind spot if krill are shallower than 10 m. To minimize the effect of such vertical migration on our krill biomass estimates we traditionally only survey during the hours of daylight. To test the assumption that krill only occur within the range of hull-mounted transducers during the day and to understand the degree of surface migration at night we have used an upwards-inclined transducer during cruise JR70.

The BSD tow fish has previously been used with a full complement of transducers that mimic the set in the hull of the RRS James Clark Ross. However this has caused considerable problems in the past because of the thickness of the tow cable required to carry all the different signals to the laboratory. Previously, with such a thick cable it has been impossible to obtain a cable fairing that has prevented vibration and strumming and that can be recovered using the existing tow fish winch and davit.

This year the tow fish has been reconfigured to contain a single beam 200 kHz transducer that points sideways and upwards at an angle of 20°. The electrical requirements for such a transducer system are relatively simple and it has been possible to use the same cable and fairing that have been used successfully on the BSD UOR. This tow fish is towed from the forward PES winch and deployed at 20 m. Further details are available in the gear and equipment section.

DATA COLLECTION AND LOGGING

Data are output from the EK500 over a dedicated LAN. The EK500 telegrams that are output as standard are shown on the Ethernet com. menu shown in the key settings dump (Appendix 4). SonarData Echolog_EK (version 2.20.05) running on EK500 Workstation 1 is used to log the raw binary output from the EK500. The D: \sonardata directory on EK500 Workstation 1 is also visible from EK500 Workstation 2. This enables this latter machine to be used for post-processing.

On JR70 we installed the SonarData dongle on Workstation 1 and carried out live viewing and processing on this machine. Thus all SonarData functions were carried out on the same machine. In addition we split the video signal from Workstation 1 and fed this into the monitor of Workstation 2 which we placed next to the Down-Wire Net Monitor workstation so that the net driver could see the acoustic screen while driving the net. This worked very successfully and we recommend that an additional monitor is purchased for the future cruises. We connected a spare monitor to Workstation 2 so that we could continue to use this workstation. All data collected during cruise (raw data and processed ev files) has been backed up on CD-rom. EK500, WS_1 and WS_2 clocks were set manually with reference to the ship's master clock each morning.

The recommended logging setup is as described below:

> Acoustic data should be logged exclusively to PC using Echolog_EK (). Data were logged to EK500 Workstation 1 (EK500_WS_1, IP address 129.177.031.009, Internal IP port 2863, Ethernet address 00-01-02-a3-3d-27). The /Ethernet Com Menu settings needed to achieve this are given in Appendix 4. Data acquisition rate for three frequencies should be between 1.8 and 1.9 KB/s. EK500 settings should be downloaded daily using Echoconfig_EK (version 2.01.07, listening for EK500_WS_1 IP port 2863, writing to EK500 IP port 2000) to, for example, D:\sonardata\settings dumps\January7_2001.txt. While Workstation 1 is dedicated to logging/EK500 control, data should be viewed live and post processed on Workstation 2 using Echoview (version 2.00.106). The SonarData dongle is therefore installed in WS_2. The D: directory on WS_1 should be shared as G: on WS_2 to facilitate live viewing. Echolog_EK and Echoconfig_EK should be installed on EK500_WS_2 so that in the event of a crash on EK500_WS_1 logging can be swapped to WS_2 quickly and data loss will be minimal. In this event the remote IP and ethernet addresses in the EK500 would have to be changed to those of WS_2 (IP address 129.177.031.010, Ethernet address 00-01-02-14-53-d6).

PROCESSING

Post-processing is carried out using SonarData Echoview. Within this software package the raw data files are read and processing steps comprising applying calibration corrections, removing noise, identify scattering types and carry out integration (a full description of processing steps can be found in Appendix 3). The integrated data are then output as comma-separated-value (.csv) files and imported into Microsoft Excel where the biomass is calculated.

RESULTS

WESTERN CORE BOX SURVEYS

Two surveys of the Western Core Box were carried out. The first 13 – 15 January 2002 was cut short by bad weather and only 3 pairs of transects were surveyed. The calculated biomass for this survey was higher than has recently been seen in the Western Core Box. The distribution of krill from the survey can be seen in Figure 12. The biomass is shown in Table 13.

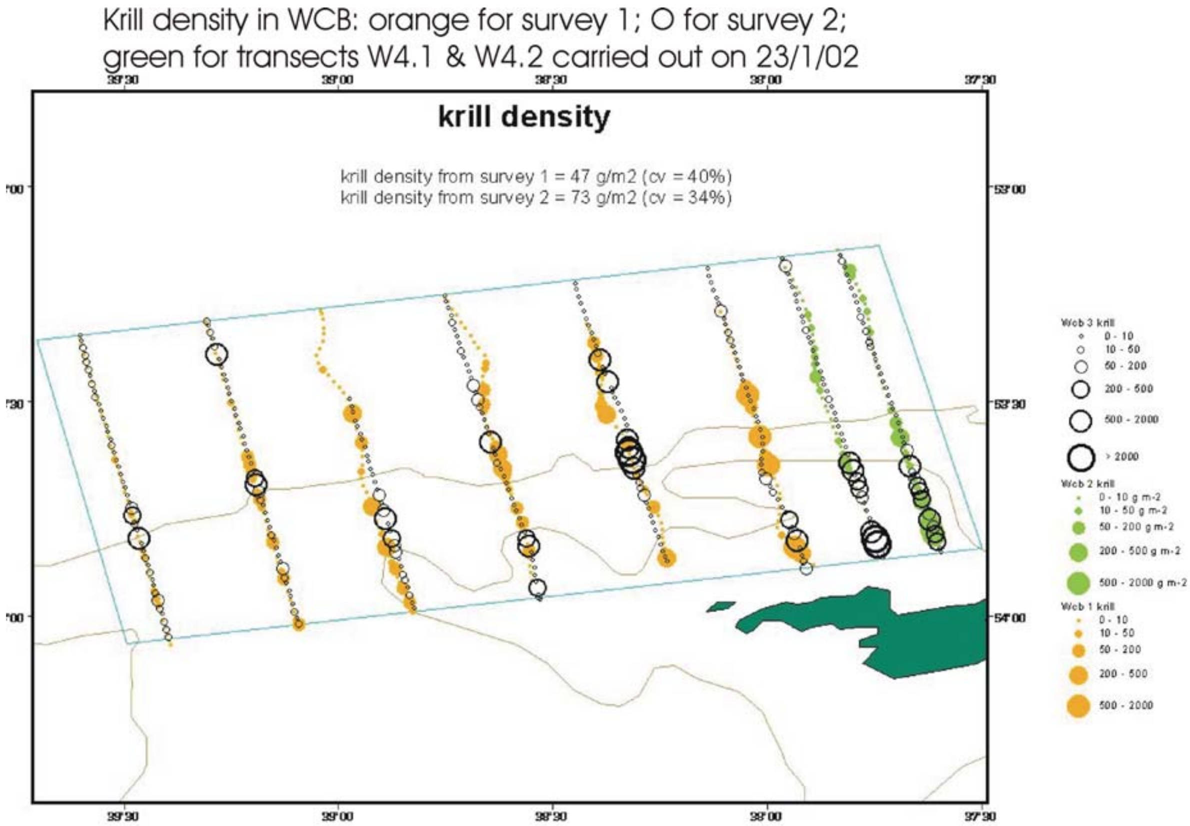
The second Western Core Box survey was carried out during 24 – 27 January 2002. Before this there was, an opportunity to survey transects W4.1 and W4.2 on 23 January 2002. The distribution for these surveys are shown in Figure 12. The biomass is shown in Table 1. After undertaking the second core box survey we continued to run along survey line W4.2 undertaking, a series of repeat transects at different types of the day and night. In total we carried out 4 consecutive runs along the transect. One of these being within the hours of darkness on 27/28 January 2002. During these repeat runs the 200 kHz transducer in the tow fish was utilized to provide information on any krill near the surface. Times at which krill have been observed on the 200 kHz sounder can be seen in the acoustic log (Appendix 5).

TABLE 13: BIOMASS

Description	**Survey Density (g m^{-2})**	**CV (%)**	**Krill biomass for Western Core Box**
Western Core Box 1	46.60	40.22	497059 tonnes
Western Core Box 2	72.88	33.87	777363 tonnes
Repeat Transects W4.2	70.34	18.99	750276 tonnes

Further details of processing to achieve these results can be found in Appendix 4

FIGURE 12 KRILL DISTRIBUTION



APPENDIX 1: CALIBRATION DETAILS

CALIBRATION NARRATIVE

Calibration was carried on 17 January in Stromness Harbour, starting at 07:30. The removal of the buoy by MOD earlier this year meant that it was not possible to use our usual technique of anchoring the ship with both anchors deployed forward and attaching mooring lines from the stern to the buoy. Instead the ship was anchored at the bow using a single anchor and held on station using the dynamic positioning system (DPS). The weather was fine but there was a gusty wind of up to 30 knots blowing down the Stromness valley. Ship stability was good despite the conditions although at times the DPS had to work hard to maintain the position of the ship and turbulence was noted during the morning. Conditions improved during the day and wind generally became lighter while changing to the east for a period in the middle of the day.

A CTD cast was made to determine temperature, salinity and sound speed profiles (Table 13). The mean value of sound speed between the transducers and the expected depth of the target sphere was calculated as 1456 m s^{-1}. The set sound speed for the calibration was 1455 m s^{-1}. In addition to the CTD cast, we carried out an XBT cast. We compared the sound velocity calculated from both XBT and CTD to determine whether in future years it might be possible to use a XBT rather than CTD thus saving considerable effort. The sound velocity profiles for the XBT and CTD show a difference of ~1 m s^{-1} over the complete profile (see Figure 13). We therefore conclude that in future years an XBT should give an adequate estimate of sound velocity for the calibration.

Heaving lines were rigged under bow and along the port side from the foredeck to the aft deck. The calibration lines were then rigged and the 38.1 mm tungsten carbide sphere lowered beneath the ship. A shackle pin was fixed 2 m below the sphere to add extra stability. The sphere was not observed in any echosounder beam and a shackle was lowered down the starboard line as the angle of entry into the water suggested that it was snagged. Repeated attempts to clear and position the sphere resulted in the lines breaking twice. We therefore decided to retrieve all lines and replace the nylon monofilament with new 30 lb breaking strain line. New positioning marks were also put on the lines. To save time a single set of marks (for 38 kHz at 20 m) were measured out (see Table 14).

On redeployment the sphere was still not visible in the EK500 38 kHz TS window display, probably due to gusty winds affecting the stability of the vessel. However the sphere was observed in the 120 kHz beam (located in front of the 38 kHz transducer) at a depth of approx. 21 m. It was therefore centred in that beam and calibration carried out on that frequency first. Details of method are available in the Simrad EK500 manual appendix P2260E - 'Calibration of the EK500', and in Maclennan and Simmonds (1992) 'Fisheries acoustics'.

The 120 kHz TS gain was adjusted with reference to the mean TS value from on axis (sorted in Excel) single target detections exported from Echoview 2 (live view T1 single target detections, draw a box around the sphere trace (around 3 minutes worth), right click to "export selection" and choose "detections"). The Sv gain was adjusted with reference to s_A values obtained by Echoview integrations of sphere echoes (NASC in Echoview parlance). This process was repeated with the 38 kHz sounder.

Once the hull-mounted transducers had been calibrated the 200 kHz transducer mounted in the tow fish was calibrated using the separate tow fish calibration frame and submergible target winch motors. Calibration of the single beam 200 kHz transducer in the tow fish was complicated because it is not possible to observe the position of the target sphere in the echo-sounder beam using the TS identification window. Rather the position of the target has to be deduced from moving the target through the axes of the beam and observing the position that result in greatest degree of signal return. The calibration was complicated by the non-functioning of one of the target motor winches, examination of the winch after the calibration revealed leakage of water into the housing. Fortunately the marks on the calibration lines were sufficiently accurate that the sphere was found close to the middle of the transducer beam and strong readings were obtained by adjusting the two functioning target adjuster motors. (on-axis 200 kHz pings were obtained by trial and error). Results appear in Table 15.

VARIATION IN GAIN SETTINGS DERIVED FROM ALL CALIBRATIONS

The EK500 has been calibrated at least once on nearly every MLSD and BSD cruise. A plot of the gain settings (the primary calibration variable) is shown in Figure 14.

KEY CALIBRATION SETTINGS

Prior to the calibration the gain settings entered in the EK500 transceiver menu were set at the values shown in Table 3 under *Old TS gain* and *Old Sv gain*. After the calibration the transceiver menu settings were changed to those shown in Table 3 under **Calibrated TS gain** and **Calibrated Sv gain**. At all times apart from during the calibration, the sound velocity was set to 1450 m s^{-1}.

TABLE 13: CTD DATA USED FOR CALIBRATION AT STROMNESS

Pressure	Temperature	Salinity	Sound velocity
(db)	(øC)	(psu)	(m s-1)
6	1.9601	33.767	1456.4
8	1.9443	33.7697	1456.36
10	1.9253	33.7732	1456.32
12	1.951	33.7679	1456.46
14	1.9416	33.7696	1456.45
16	1.9107	33.7765	1456.36
18	1.8763	33.7846	1456.25
20	1.8117	33.7987	1456.01
Average	1.9151	33.7759	1456.33

TABLE 14: LINE LENGTHS USED ON PRESENT CALIBRATION

Sphere depth	Colour of mark	Port forward	Port aft	Starboard
20 m	Yellow	37.68 m	39.67 m	32.88 m

TABLE 15 EK500 CALIBRATION RESULTS FOR 17 JAN 2002

EK500 Calibration Results - James Clark Ross JR70				
Tungsten Carbide sphere				
				Towfish
Date		17-Jan-2002	17-Jan-2002	17-Jan-2002
Time (Z)		20:16	19:00	22:59
Place		Stromness	Stromness	Stromness
Software version		5.30	5.30	5.30
Frequency kHz		38	120	200
Test oscillator dB		-54.6	-56.6	-60.9
Water depth m		73	73	68
Temperature øC		1.85	1.85	1.85
Salinity		33.79	33.79	33.79
Sound speed m/s		1456.15	1456.15	1456.15
Alpha dB/km		10	28	41
Angle sensitivity		21.9	15.7	0.0
Ping rate		0.0	0.0	0.0
Transmit power		normal	normal	normal
Max power W		2000	1000	1000
"Pulse duration	ms"		"medium	1"
Bandwidth		wide	narrow	narrow
Sphere TS dB		-42.10	-39.7	-39.5
"Sphere type	size mm"		WC 38.1	WC 38.1
Old TS gain dB		25.60	20.26	23.07
Calibrated TS gain dB		25.83	21.14	22.90
Default 2-way beam angle dB		-20.8	-18.4	-20.8
Range to sphere m		21.7	21.5	14.9
Old Sv gain dB		25.49	20.26	22.78
Calibrated Sv gain dB		25.72	21.03	23.41

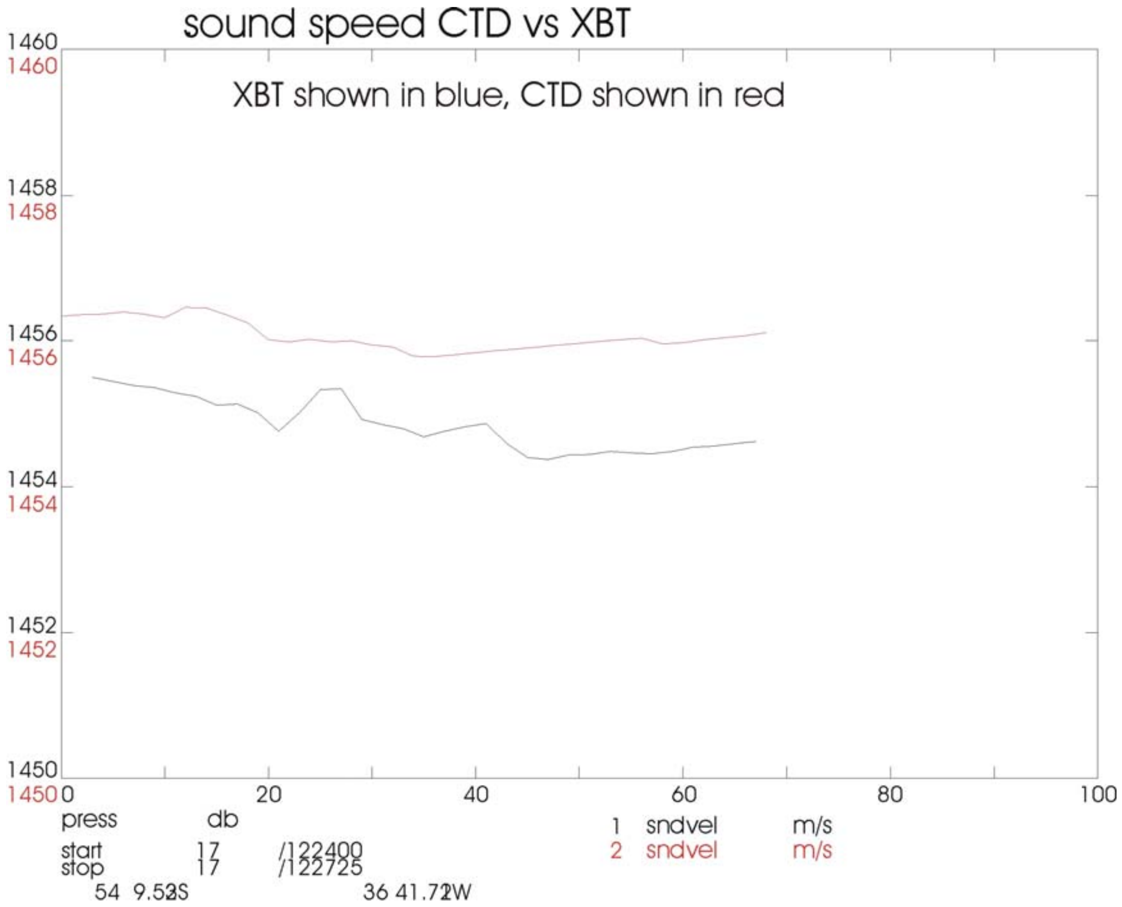


FIGURE 13: SOUND SPEED COMPARISON

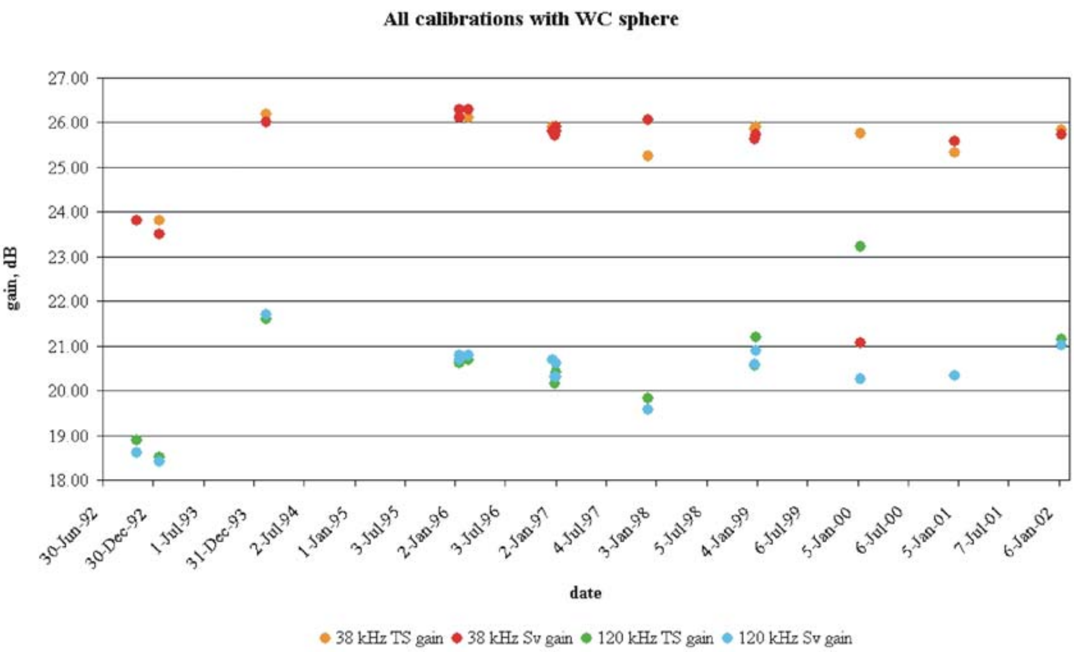


FIGURE 14: CALIBRATION PLOT

APPENDIX 2: ECHOVIEW PROCESSING STEPS TO APPORTION BACKSCATTER DUE TO KRILL AND OTHER SCATTERERS

OVERVIEW

Under normal operating conditions Echoview displays the acoustic backscatter (Sv) recorded at the three operating frequencies (38, 120 and 200 kHz). These are identified as Sv Qn telegrams Tn (where n = 1..3 for the 3 frequencies above). The backscatter detected is the summation of that due to krill, other biological organisms and background noise. For our analyses we wish to separate the backscatter due to krill from that arising from other sources. To do this we utilize the dB difference technique. A full description of this technique can be found in the following publications: *put links to them here.*

Echoview can be used to implement this delineation technique using the virtual echogram module which is implemented on the BAS dongles. The technique can be broken down into a series of processing steps which equate to a series of extra variables which are created in Echoview. Below we describe the processing steps. However, so that each variable does not have to be created anew each cruise, we also append an Echoview ev file which contains all the variables and which can be loaded and then edited as appropriate.

NEW VARIABLES:

The following variables are required in addition to the primary file set variables (Sv Q1 T1 .. Sv Q3 T3).

surf-bott_38, (surf-bott_120, surf-bott_200)
good data_38, (good data_120, good data_200)
include_38, (include_120, include_200)
38-e, 120-e, (200-e)
38-s, 120-s, (200-s)
noise 38, noise 120, (noise 200)
38-s-c, 120-s-c, (200-s-c)
diff-s-120-38
range diff-s
mask 38-s-c, mask 120-s-c, mask 200-s-c

The vital properties for each variable are detailed below. To use these variables it will also be necessary to ensure that two user defined lines are present and valid. The *surface noise* line defines the limit of noise extending down from the surface. It is often set a particular depth, eg 10 m, but can be modified or edited as necessary. The *integration stop* line defines the maximum depth of integration, eg 250 m, but again will need to be modified if the bottom intrudes into the integration depth range.
Any regions of the data file that fall outside the desired period of observation, such as before the start of the transect, should be marked as *bad* regions. Similarly any regions within the desired observation period that need to be excluded, such as false bottom detections on 38 kHz, should also be marked as *bad* regions.

SURF-BOTT_38 (SURF-BOTT_120, SURF-BOTT_200)

Function: create a bitmap of data between the *surface noise* and *integration stop*.
Operator: Line bitmap Operand: Sv Q1 T1 (Sv Q2 T2)
Line bitmap: Start line = *surface noise* Stop line = *integration stop*

GOOD DATA_38 (GOOD DATA_120, GOOD DATA_200)

Function: create a bitmap of data excluding *bad* regions
Operator: Region bitmap Operand: Sv Q1 T1 (Sv Q2 T2, Sv Q3 T3)
Region bitmap: Region type = Bad Invert output = ✓

INCLUDE_38 (INCLUDE_120, INCLUDE_200)

Function: combine bitmaps produced by previous two variables
Operator: And Operand 1: surf-bott_38 (include_120, include_200)
Operand 2: good data_38 (good data_120, good data_200)

38-E (120-E, 200-E)

Function: Apply bitmask derived above to primary data sets, retain only good data
Operator: Mask Operand 1: Sv Q1 T1 (Sv Q2 T2, Sv Q3 T3)
Operand 2: include_38 (include_120, include_200)
Mask: Zero is "no data" = ✓
Calibration: set to relevant calibration settings although should not effect processing
Processing: exclude lines = none
Other: note if the same sample range and number is set for all frequencies then it is not necessary to generate frequency specific files for surf-bot, good data and include.

38-S (120-S, 200-S)

Function: resample the input into defined time and depth bins
Operator: Resample by time interval Operand 1: 38-e (120-3, 200-e)
Resample: Time interval = 100 s Depths upper = 0, lower = 250, datapoints = 50
Other: see 38-e for comments about processing and calibration. Depth range, number of datapoints and time interval can be varied. Standard starting points are illustrated here.

NOISE 38 (NOISE 120, NOISE 200)

Function: generate a background noise level to subtract from the resampled data
Operator: Data generator Operand 1: 38-s (120-s, 200-s)
Generator: output type = Sv Sv at 1 metre (dB) = user input to decide suitable value
Apply TVG = ✓
Other: values used on JR70 for Sv at 1m ~ –143, -115 for 38 and 120 kHz respectively.

38-S-C (120-S-C)

Function: subtract noise from resampled data in linear domain
Operator: Linear minus Operand 1: 38-s (120-s)
Operand 2: noise 38 (noise 120)
Other: useful to compare 38-s and 38-s-c while adjusting noise 38

DIFF-S-120-38

Function: subtract 38 kHz from 120 kHz data now that noise removed
Operator: Minus Operand 1: 120-s-c Operand 2: 38-s-c

RANGE DIFF-S

Function: set dB difference range for species delineation (eg 2 – 12 dB for krill)
Operator: Range Operand 1: diff-s-120-38
Range: minimum in range = 2 maximum in range = 12

Other: for small krill may be necessary to go up to a maximum of 14 dB. For fish use min = –20 and max = 2.

MASK 38-S-C (MASK 120-S-C)

Function: apply bit mask to 38 kHz data so that only targets falling within dB difference range are selected
Operator: Mask Operand 1: 38-s-c (120-s-c) Operand 2: range diff-s
Other: this is the variable to integrate. The integration interval will be controlled by the values set in grid menu. For calculations of biomass large numbers of cells are not required and they just slow down succeeding processing stages, frequently it is not necessary to subdivide the water column and grid separation can be set to total integration depth. To get going try gps distance with interval of 1 nautical mile and grid separation of 250 m. For an analysis of distribution over small scales or within in the water column smaller integration units may be more appropriate (right down to the size of the resample cells if necessary).

SUMMARY

The above settings are starting points. Key variables that will change the final output are values entered for the noise removal, the resample size and the dB difference range. The integration grid used will not change the overall value rather just the way in which the results are output. With experience visualization of every processing step is not necessary, however, to start with much can be learned by following each step visually and noting changes that occur.

APPENDIX 3KEY SETTINGS USED DURING JR70

/OPERATION MENU/Ping Mode=Ext.Trig
/OPERATION MENU/Ping Auto Start=Off
/OPERATION MENU/Ping Interval=0.0 sec
/OPERATION MENU/Transmit Power=Normal
/OPERATION MENU/Noise Margin=0 dB
/PRINTER MENU/Printer-2 Menu/Model Type=DeskJet
/TRANSCEIVER MENU/Transceiver-1 Menu/Mode=Active
/TRANSCEIVER MENU/Transceiver-1 Menu/Transducer Type=ES38
/TRANSCEIVER MENU/Transceiver-1 Menu/Transd. Sequence=Off
/TRANSCEIVER MENU/Transceiver-1 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-1 Menu/Absorption Coef.=10 dBkm
/TRANSCEIVER MENU/Transceiver-1 Menu/Pulse Length=Medium
/TRANSCEIVER MENU/Transceiver-1 Menu/Bandwidth=Wide
/TRANSCEIVER MENU/Transceiver-1 Menu/Max. Power=2000 W
/TRANSCEIVER MENU/Transceiver-1 Menu/2-Way Beam Angle=-20.8 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/Sv Transd. Gain=25.72 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/TS Transd. Gain=25.83 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/Angle Sens.Along=21.9
/TRANSCEIVER MENU/Transceiver-1 Menu/Angle Sens.Athw.=21.9
/TRANSCEIVER MENU/Transceiver-1 Menu/3 dB Beamw.Along=7.0 dg
/TRANSCEIVER MENU/Transceiver-1 Menu/3 dB Beamw.Athw.=7.1 dg
/TRANSCEIVER MENU/Transceiver-1 Menu/Alongship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-1 Menu/Athw.ship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-1 Menu/Frequency=38 kHz
/TRANSCEIVER MENU/Transceiver-2 Menu/Mode=Active
/TRANSCEIVER MENU/Transceiver-2 Menu/Transducer Type=ES120
/TRANSCEIVER MENU/Transceiver-2 Menu/Transd. Sequence=Off
/TRANSCEIVER MENU/Transceiver-2 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-2 Menu/Absorption Coef.=28 dBkm
/TRANSCEIVER MENU/Transceiver-2 Menu/Pulse Length=Long
/TRANSCEIVER MENU/Transceiver-2 Menu/Bandwidth=Narrow
/TRANSCEIVER MENU/Transceiver-2 Menu/Max. Power=1000 W
/TRANSCEIVER MENU/Transceiver-2 Menu/2-Way Beam Angle=-18.4 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/Sv Transd. Gain=21.03 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/TS Transd. Gain=21.14 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/Angle Sens.Along=15.7
/TRANSCEIVER MENU/Transceiver-2 Menu/Angle Sens.Athw.=15.7
/TRANSCEIVER MENU/Transceiver-2 Menu/3 dB Beamw.Along=9.3 dg
/TRANSCEIVER MENU/Transceiver-2 Menu/3 dB Beamw.Athw.=9.3 dg
/TRANSCEIVER MENU/Transceiver-2 Menu/Alongship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-2 Menu/Athw.ship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-2 Menu/Frequency=120 kHz
/TRANSCEIVER MENU/Transceiver-3 Menu/Mode=Off
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Type=200-28
/TRANSCEIVER MENU/Transceiver-3 Menu/Transd. Sequence=Off
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-3 Menu/Absorption Coef.=41 dBkm
/TRANSCEIVER MENU/Transceiver-3 Menu/Pulse Length=Long
/TRANSCEIVER MENU/Transceiver-3 Menu/Bandwidth=Narrow
/TRANSCEIVER MENU/Transceiver-3 Menu/Max. Power=1000 W
/TRANSCEIVER MENU/Transceiver-3 Menu/2-Way Beam Angle=-20.8 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Sv Transd. Gain=23.41 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/TS Transd. Gain=22.90 dB

/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Along=0.0
/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Athw.=0.0
/TRANSCEIVER MENU/Transceiver-3 Menu/3 dB Beamw.Along=7.0 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/3 dB Beamw.Athw.=7.0 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/Alongship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/Athw.ship Offset=0.00 dg
/TRANSCEIVER MENU/Transceiver-3 Menu/Frequency=200 kHz
/TS DETECTION MENU/TS Detection-1 Menu/Min. Value=-90 dB
/TS DETECTION MENU/TS Detection-1 Menu/Min. Echo Length=0.8
/TS DETECTION MENU/TS Detection-1 Menu/Max. Echo Length=2.5
/TS DETECTION MENU/TS Detection-1 Menu/Max. Gain Comp.=6.0 dB
/TS DETECTION MENU/TS Detection-1 Menu/Max. Phase Dev.=2.0
/TS DETECTION MENU/TS Detection-2 Menu/Min. Value=-90 dB
/TS DETECTION MENU/TS Detection-2 Menu/Min. Echo Length=0.8
/TS DETECTION MENU/TS Detection-2 Menu/Max. Echo Length=2.5
/TS DETECTION MENU/TS Detection-2 Menu/Max. Gain Comp.=4.0 dB
/TS DETECTION MENU/TS Detection-2 Menu/Max. Phase Dev.=2.0
/TS DETECTION MENU/TS Detection-3 Menu/Min. Value=-60 dB
/TS DETECTION MENU/TS Detection-3 Menu/Min. Echo Length=0.8
/TS DETECTION MENU/TS Detection-3 Menu/Max. Echo Length=2.5
/TS DETECTION MENU/TS Detection-3 Menu/Max. Gain Comp.=4.0 dB
/TS DETECTION MENU/TS Detection-3 Menu/Max. Phase Dev.=2.0
/ETHERNET COM. MENU/Local ETH Addr.=08:00:14:51:57:90
/ETHERNET COM. MENU/Local IP Addr.=129.177.031.102
/ETHERNET COM. MENU/Remote ETH Addr.=00:01:02:A3:3D:27
/ETHERNET COM. MENU/Remote IP Addr.=129.177.031.009
/ETHERNET COM. MENU/Telegram Menu/Remote Control=On
/ETHERNET COM. MENU/Telegram Menu/Sample Range=0 m
/ETHERNET COM. MENU/Telegram Menu/Status=On
/ETHERNET COM. MENU/Telegram Menu/Parameter=On
/ETHERNET COM. MENU/Telegram Menu/Annotation=Off
/ETHERNET COM. MENU/Telegram Menu/Sound Velocity=Off
/ETHERNET COM. MENU/Telegram Menu/Navigation=On
/ETHERNET COM. MENU/Telegram Menu/Motion Sensor=Off
/ETHERNET COM. MENU/Telegram Menu/Depth=1
/ETHERNET COM. MENU/Telegram Menu/Depth NMEA=Off
/ETHERNET COM. MENU/Telegram Menu/Echogram=1&2&3
/ETHERNET COM. MENU/Telegram Menu/Echo-Trace=1&2&3
/ETHERNET COM. MENU/Telegram Menu/Sv=Off
/ETHERNET COM. MENU/Telegram Menu/Sample Angle=Off
/ETHERNET COM. MENU/Telegram Menu/Sample Power=Off
/ETHERNET COM. MENU/Telegram Menu/Sample Sv=Off
/ETHERNET COM. MENU/Telegram Menu/Sample TS=Off
/ETHERNET COM. MENU/Telegram Menu/Vessel-Log=On
/ETHERNET COM. MENU/Telegram Menu/Layer=Off
/ETHERNET COM. MENU/Telegram Menu/Integrator=Off
/ETHERNET COM. MENU/Telegram Menu/TS Distribution=1&2&3
/ETHERNET COM. MENU/Telegram Menu/Towed Fish=Off
/ETHERNET COM. MENU/Echogram-1 Menu/Range=500 m
/ETHERNET COM. MENU/Echogram-1 Menu/Range Start=0 m
/ETHERNET COM. MENU/Echogram-1 Menu/Auto Range=Off
/ETHERNET COM. MENU/Echogram-1 Menu/Bottom Range=0 m
/ETHERNET COM. MENU/Echogram-1 Menu/Bot. Range Start=10 m
/ETHERNET COM. MENU/Echogram-1 Menu/No. of Main Val.=700

/ETHERNET COM. MENU/Echogram-1 Menu/No. of Bot. Val.=0
/ETHERNET COM. MENU/Echogram-1 Menu/TVG=20 log R
/ETHERNET COM. MENU/Echogram-2 Menu/Range=250 m
/ETHERNET COM. MENU/Echogram-2 Menu/Range Start=0 m
/ETHERNET COM. MENU/Echogram-2 Menu/Auto Range=Off
/ETHERNET COM. MENU/Echogram-2 Menu/Bottom Range=0 m
/ETHERNET COM. MENU/Echogram-2 Menu/Bot. Range Start=10 m
/ETHERNET COM. MENU/Echogram-2 Menu/No. of Main Val.=700
/ETHERNET COM. MENU/Echogram-2 Menu/No. of Bot. Val.=0
/ETHERNET COM. MENU/Echogram-2 Menu/TVG=20 log R
/ETHERNET COM. MENU/Echogram-3 Menu/Range=100 m
/ETHERNET COM. MENU/Echogram-3 Menu/Range Start=0 m
/ETHERNET COM. MENU/Echogram-3 Menu/Auto Range=Off
/ETHERNET COM. MENU/Echogram-3 Menu/Bottom Range=0 m
/ETHERNET COM. MENU/Echogram-3 Menu/Bot. Range Start=10 m
/ETHERNET COM. MENU/Echogram-3 Menu/No. of Main Val.=700
/ETHERNET COM. MENU/Echogram-3 Menu/No. of Bot. Val.=0
/ETHERNET COM. MENU/Echogram-3 Menu/TVG=20 log R
/NAVIGATION MENU/Navig. Input=Serial
/NAVIGATION MENU/Start Sequence=$GPGGA
/NAVIGATION MENU/Separation Char.=002C
/NAVIGATION MENU/Stop Character=000D
/NAVIGATION MENU/First Field No.=2
/NAVIGATION MENU/No. of Fields=6
/NAVIGATION MENU/Speed Input=Manual
/NAVIGATION MENU/Manual Speed=10.0 knt
/NAVIGATION MENU/NMEA Transfer=On
/NAVIGATION MENU/Baudrate=9600
/NAVIGATION MENU/Bits Per Char.=8
/NAVIGATION MENU/Stop Bits=1
/NAVIGATION MENU/Parity=None

APPENDIX 4: PROCESSING DETAILS FOR WCB SURVEY BIOMASS ESTIMATES.

WESTERN CORE BOX SURVEY 1

Transect no	Date	EVfile	Transect length (km)	Weighted transect density (g m^{-2})
W1.1	13 Jan 2002	JR70_WCB1.1_1	82.4	6.9
W1.2	13 Jan 2002	JR70_WCB1.2_1	81.7	29.0
W2.1	14 Jan 2002	JR70_WCB2.1_1	82.2	33.1
W2.2	14 Jan 2002	JR70_WCB2.2_1	77.3	37.5
W3.1	15 Jan 2002	JR70_WCB3.1_1	64.6	41.8
W3.2	15 Jan 2002	JR70_WCB3.2_1	70.1	131.3
W4.1	23 Jan 2002	JR70_WCB4.1_1	68.1	12.3
W4.2	23 Jan 2002	JR70_WCB4.2_1	81.1	91.7

Note that noise removed during processing was generated with the TVG generator set at –118.1 dB for all transects except WCB2.1 (-116.1) and WCB4.2 (–117.1). A dB difference of 2 to 12 dB was set to select krill. A TS of –39 dB kg^{-1} was used (this will need to be updated when the full set of krill length frequencies are available).

WESTERN CORE BOX SURVEY 2

Transect no	Date	EVfile	Transect length (km)	Weighted transect density (g m^{-2})
W1.1	24 Jan 2002	JR70_WCB1.1_2	81.0	21.9
W1.2	24 Jan 2002	JR70_WCB1.2_2	79.7	43.5
W2.1	25 Jan 2002	JR70_WCB2.1_2	57.0	29.5
W2.2	25 Jan 2002	JR70_WCB2.2_2	77.4	33.9
W3.1	26 Jan 2002	JR70_WCB3.1_2	63.2	189.8
W3.2	26 Jan 2002	JR70_WCB3.2_2	70.2	38.3
W4.1	27 Jan 2002	JR70_WCB4.1_2	68.0	164.4
W4.2	27 Jan 2002	JR70_WCB4.2_2	78.6	61.9

Note that 2 levels of noise removed during processing, csv files marked with suffix a had the TVG generator set at –118.1 dB while csv files marked with suffix b had TVG generator set at –116.1 dB. The results shown above are for noise = -116.1. In addition, csv files marked with suffix s had additional surface noise removed. This additional surface noise removal should be undertaken for all other transects, however, the likely difference in biomass is only 1-2 %. A TS of –39 dB kg^{-1} was used (this will need to be updated when the full set of krill length frequencies are available).

REPEAT TRANSECTS OF W4.2

Date	Time	EVfile	Transect length (km)	Weighted transect density (g m^{-2})
23 Jan 2002	08:50	JR70_WCB4.2_1	81.1	86.6
27 Jan 2002	13:12	JR70_WCB4.2_2	81.2	54.9
27 Jan 2002	18:22	JR70_WCB4.2_3	81.0	47.3
28 Jan 2002	01:05	JR70_WCB4.2_4	80.5	47.7
28 Jan 2002	08:22	JR70_WCB4.2_5	80.7	115.2

APPENDIX 5: ACOUSTIC ROUGH LOG

JANUARY 3, 2002

On Work Station 1, new template created:
d:\sonardata\Live Viewing Templates\new2002.ev

Echoview settings

Variable properties for all three frequencies updated (pages in italics):

	38 kHz	120 kHz	200 kHz
Data			
Time Varied Threshold, dB*	-145	-106	-91
Display			
Colour display minimum, Db	-100	-100	-100
Depth, m	1000	250	100
Grid			
GPS distance, nautical miles	0.5	0.5	0.5
Depth, m	50	50	50
Processing			
No exclusions			
Calibration logging and processing constants			
absorption coefficients, dB/m	0.010	0.027	0.041
sound speed, m/s	1456	1456	1456
transmitted power, W	2000	1000	1000
equivalent two-way solid beam angle	-20.8	-18.4	-20.8
Sv gain, dB, LOGGING	25.49	20.26	22.78
Sv gain, dB, CALIBRATED	25.59	20.32	22.71
Wavelength, m	0.038526	0.012200	0.007320
Transmit pulse length, ms	1	1	1
Frequency, kHz	38	119	200
draft correction, m	0	0	0
nominal angle, degrees	7.1	9.3	7.0
Lines			
off			

*NB TVT was selecected at 14 knots. This level does not exclude 'weather' spikes at 38 kHz, see d:\sonardata\jr70\38noise.bmp

Some problems were experienced with using live viewing templates to start up, but these largely disappeared when the name EK500_WS_1_EK.ev was renamed EK500_WS_1-EK.ev , although it still seemed impossible to startup with the cruise-track box open.

Echoview Settings to check in Export Page

Spreadsheet tick box at end

Sv mean

Sv max
Sv min
Sv noise
Samples
L Depth_U
L Depth_L
Ping S
Ping E
Num lay
Num interval

For SS integration results:

Spreadsheet

Grid 0.1nautical mile x 250 m
Sv mean
Sa mean
Sa noise
Date_M
Time_M
Lat_M
Lon_M

Configuration Files

Workstation 1 d:\sonardata\jr70\030102.txt created from download with a few changes made after reading both_cals_2000.wpd. The results of filecompare (dos command 'fc') were as follows:

Comparing files Mar16.txt and ..\JR70\030102.TXT
***** Mar16.txt
/OPERATION MENU/Ping Auto Start=Off
/OPERATION MENU/Ping Interval=0.0 sec
/OPERATION MENU/Transmit Power=Normal
***** ..\JR70\030102.TXT
/OPERATION MENU/Ping Auto Start=Off
/OPERATION MENU/Ping Interval=2.5 sec **– this is ok until ssu is used when it will need to be set to 0.0**
/OPERATION MENU/Transmit Power=Normal
*****

***** Mar16.txt
/DISPLAY MENU/Echogram Speed=1:1
/DISPLAY MENU/Echogram=1&2
/DISPLAY MENU/Echogram-1 Menu/Transd. Number=1
/DISPLAY MENU/Echogram-1 Menu/Range=50 m
/DISPLAY MENU/Echogram-1 Menu/Range Start=0 m
***** ..\JR70\030102.TXT
/DISPLAY MENU/Echogram Speed=1:1
/DISPLAY MENU/Echogram=1&2&3
/DISPLAY MENU/Echogram-1 Menu/Transd. Number=1
/DISPLAY MENU/Echogram-1 Menu/Range=500 m
/DISPLAY MENU/Echogram-1 Menu/Range Start=0 m

*****

***** Mar16.txt
/DISPLAY MENU/Echogram-1 Menu/TS Colour Min.=-60 dB
/DISPLAY MENU/Echogram-1 Menu/Sv Colour Min.=-75 dB
/DISPLAY MENU/Echogram-2 Menu/Transd. Number=2
/DISPLAY MENU/Echogram-2 Menu/Range=50 m
/DISPLAY MENU/Echogram-2 Menu/Range Start=0 m
***** ..\JR70\030102.TXT
/DISPLAY MENU/Echogram-1 Menu/TS Colour Min.=-60 dB
/DISPLAY MENU/Echogram-1 Menu/Sv Colour Min.=-100 dB
/DISPLAY MENU/Echogram-2 Menu/Transd. Number=2
/DISPLAY MENU/Echogram-2 Menu/Range=250 m
/DISPLAY MENU/Echogram-2 Menu/Range Start=0 m
*****

***** Mar16.txt
/DISPLAY MENU/Echogram-3 Menu/Transd. Number=3
/DISPLAY MENU/Echogram-3 Menu/Range=50 m
/DISPLAY MENU/Echogram-3 Menu/Range Start=0 m
***** ..\JR70\030102.TXT
/DISPLAY MENU/Echogram-3 Menu/Transd. Number=3
/DISPLAY MENU/Echogram-3 Menu/Range=100 m
/DISPLAY MENU/Echogram-3 Menu/Range Start=0 m
*****

***** Mar16.txt
/DISPLAY MENU/Echogram-3 Menu/TS Colour Min.=-60 dB
/DISPLAY MENU/Echogram-3 Menu/Sv Colour Min.=-80 dB
/PRINTER MENU/Printer-1 Menu/Model Type=DeskJet
***** ..\JR70\030102.TXT
/DISPLAY MENU/Echogram-3 Menu/TS Colour Min.=-60 dB
/DISPLAY MENU/Echogram-3 Menu/Sv Colour Min.=-65 dB
/PRINTER MENU/Printer-1 Menu/Model Type=DeskJet
*****

***** Mar16.txt
/TRANSCEIVER MENU/Transceiver-1 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-1 Menu/Absorption Coef.=10 dBkm
/TRANSCEIVER MENU/Transceiver-1 Menu/Pulse Length=Medium
***** ..\JR70\030102.TXT
/TRANSCEIVER MENU/Transceiver-1 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-1 Menu/Absorption Coef.=11 dBkm **10**
/TRANSCEIVER MENU/Transceiver-1 Menu/Pulse Length=Medium
*****

***** Mar16.txt
/TRANSCEIVER MENU/Transceiver-1 Menu/2-Way Beam Angle=-20.8 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/Sv Transd. Gain=25.10 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/TS Transd. Gain=25.85 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/Angle Sens.Along=21.9
***** ..\JR70\030102.TXT
/TRANSCEIVER MENU/Transceiver-1 Menu/2-Way Beam Angle=-20.8 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/Sv Transd. Gain=25.49 dB

/TRANSCEIVER MENU/Transceiver-1 Menu/TS Transd. Gain=25.60 dB
/TRANSCEIVER MENU/Transceiver-1 Menu/Angle Sens.Along=21.9
*****

***** Mar16.txt
/TRANSCEIVER MENU/Transceiver-2 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-2 Menu/Absorption Coef.=38 dBkm
/TRANSCEIVER MENU/Transceiver-2 Menu/Pulse Length=Long
***** ..\JR70\030102.TXT
/TRANSCEIVER MENU/Transceiver-2 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-2 Menu/Absorption Coef.=30 dBkm **27**
/TRANSCEIVER MENU/Transceiver-2 Menu/Pulse Length=Long
*****

***** Mar16.txt
/TRANSCEIVER MENU/Transceiver-2 Menu/2-Way Beam Angle=-18.4 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/Sv Transd. Gain=21.33 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/TS Transd. Gain=21.12 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/Angle Sens.Along=15.7
***** ..\JR70\030102.TXT
/TRANSCEIVER MENU/Transceiver-2 Menu/2-Way Beam Angle=-18.4 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/Sv Transd. Gain=20.26 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/TS Transd. Gain=20.26 dB
/TRANSCEIVER MENU/Transceiver-2 Menu/Angle Sens.Along=15.7
*****

***** Mar16.txt
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-3 Menu/Absorption Coef.=53 dBkm
/TRANSCEIVER MENU/Transceiver-3 Menu/Pulse Length=Long
***** ..\JR70\030102.TXT
/TRANSCEIVER MENU/Transceiver-3 Menu/Transducer Depth=0.00 m
/TRANSCEIVER MENU/Transceiver-3 Menu/Absorption Coef.=43 dBkm **40**
/TRANSCEIVER MENU/Transceiver-3 Menu/Pulse Length=Long
*****

***** Mar16.txt
/TRANSCEIVER MENU/Transceiver-3 Menu/2-Way Beam Angle=-20.8 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Sv Transd. Gain=23.92 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/TS Transd. Gain=23.53 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Along=0.0
***** ..\JR70\030102.TXT
/TRANSCEIVER MENU/Transceiver-3 Menu/2-Way Beam Angle=-20.8 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Sv Transd. Gain=22.78 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/TS Transd. Gain=23.07 dB
/TRANSCEIVER MENU/Transceiver-3 Menu/Angle Sens.Along=0.0
*****

***** Mar16.txt
/BOTTOM DETECTION MENU/Bottom Detection-2 Menu/Minimum Level=-50 dB
/BOTTOM DETECTION MENU/Bottom Detection-3 Menu/Minimum Depth=3.0 m
/BOTTOM DETECTION MENU/Bottom Detection-3 Menu/Maximum Depth=300 m
/BOTTOM DETECTION MENU/Bottom Detection-3 Menu/Min. Depth Alarm=0.0 m
***** ..\JR70\030102.TXT

/BOTTOM DETECTION MENU/Bottom Detection-2 Menu/Minimum Level=-50 dB
/BOTTOM DETECTION MENU/Bottom Detection-3 Menu/Minimum Depth=10.0 m
/BOTTOM DETECTION MENU/Bottom Detection-3 Menu/Maximum Depth=500 m
/BOTTOM DETECTION MENU/Bottom Detection-3 Menu/Min. Depth Alarm=0.0 m
*****

***** Mar16.txt
/LOG MENU/Nm Pulse Rate=200 /nm
/LAYER MENU/Super Layer=1
/LAYER MENU/Layer-1 Menu/Type=Surface
/LAYER MENU/Layer-1 Menu/Range=3.0 m
/LAYER MENU/Layer-1 Menu/Range Start=22.5 m
/LAYER MENU/Layer-1 Menu/Margin=1.0 m
***** ..\JR70\030102.TXT
/LOG MENU/Nm Pulse Rate=200 /nm
/LAYER MENU/Super Layer=2
/LAYER MENU/Layer-1 Menu/Type=Pelagic
/LAYER MENU/Layer-1 Menu/Range=48.0 m
/LAYER MENU/Layer-1 Menu/Range Start=2.0 m
/LAYER MENU/Layer-1 Menu/Margin=1.0 m
*****

***** Mar16.txt
/LAYER MENU/Layer-1 Menu/Sv Threshold=-100 dB
/LAYER MENU/Layer-1 Menu/No. of Sublayers=1
/LAYER MENU/Layer-2 Menu/Type=Off
/LAYER MENU/Layer-2 Menu/Range=50.0 m
/LAYER MENU/Layer-2 Menu/Range Start=50.0 m
/LAYER MENU/Layer-2 Menu/Margin=1.0 m
***** ..\JR70\030102.TXT
/LAYER MENU/Layer-1 Menu/Sv Threshold=-100 dB
/LAYER MENU/Layer-1 Menu/No. of Sublayers=23
/LAYER MENU/Layer-2 Menu/Type=Pelagic
/LAYER MENU/Layer-2 Menu/Range=50.0 m **5**
/LAYER MENU/Layer-2 Menu/Range Start=25.0 m **0**
/LAYER MENU/Layer-2 Menu/Margin=1.0 m
*****

***** Mar16.txt
/LAYER MENU/Layer-10 Menu/No. of Sublayers=25
/TS DETECTION MENU/TS Detection-1 Menu/Min. Value=-50 dB
/TS DETECTION MENU/TS Detection-1 Menu/Min. Echo Length=0.8
***** ..\JR70\030102.TXT
/LAYER MENU/Layer-10 Menu/No. of Sublayers=25
/TS DETECTION MENU/TS Detection-1 Menu/Min. Value=-90 dB
/TS DETECTION MENU/TS Detection-1 Menu/Min. Echo Length=0.8
*****

***** Mar16.txt
/TS DETECTION MENU/TS Detection-1 Menu/Max. Echo Length=2.5
/TS DETECTION MENU/TS Detection-1 Menu/Max. Gain Comp.=6.0 dB
/TS DETECTION MENU/TS Detection-1 Menu/Max. Phase Dev.=2.0
/TS DETECTION MENU/TS Detection-2 Menu/Min. Value=-60 dB
/TS DETECTION MENU/TS Detection-2 Menu/Min. Echo Length=0.8

***** ..\JR70\030102.TXT
/TS DETECTION MENU/TS Detection-1 Menu/Max. Echo Length=2.5
/TS DETECTION MENU/TS Detection-1 Menu/Max. Gain Comp.=4.0 dB
/TS DETECTION MENU/TS Detection-1 Menu/Max. Phase Dev.=2.0
/TS DETECTION MENU/TS Detection-2 Menu/Min. Value=-90 dB
/TS DETECTION MENU/TS Detection-2 Menu/Min. Echo Length=0.8
*****

***** Mar16.txt
/TS DETECTION MENU/TS Detection-2 Menu/Max. Echo Length=2.5
/TS DETECTION MENU/TS Detection-2 Menu/Max. Gain Comp.=6.0 dB
/TS DETECTION MENU/TS Detection-2 Menu/Max. Phase Dev.=2.0
/TS DETECTION MENU/TS Detection-3 Menu/Min. Value=-70 dB
/TS DETECTION MENU/TS Detection-3 Menu/Min. Echo Length=0.8
***** ..\JR70\030102.TXT
/TS DETECTION MENU/TS Detection-2 Menu/Max. Echo Length=2.5
/TS DETECTION MENU/TS Detection-2 Menu/Max. Gain Comp.=4.0 dB
/TS DETECTION MENU/TS Detection-2 Menu/Max. Phase Dev.=2.0
/TS DETECTION MENU/TS Detection-3 Menu/Min. Value=-90 dB
/TS DETECTION MENU/TS Detection-3 Menu/Min. Echo Length=0.8
*****

***** Mar16.txt
/ETHERNET COM. MENU/Telegram Menu/Remote Control=On
/ETHERNET COM. MENU/Telegram Menu/Sample Range=250 m
/ETHERNET COM. MENU/Telegram Menu/Status=On
***** ..\JR70\030102.TXT
/ETHERNET COM. MENU/Telegram Menu/Remote Control=On
/ETHERNET COM. MENU/Telegram Menu/Sample Range=0 m
/ETHERNET COM. MENU/Telegram Menu/Status=On
*****

***** Mar16.txt
/ETHERNET COM. MENU/Telegram Menu/Motion Sensor=Off
/ETHERNET COM. MENU/Telegram Menu/Depth=1&2
/ETHERNET COM. MENU/Telegram Menu/Depth NMEA=Off
***** ..\JR70\030102.TXT
/ETHERNET COM. MENU/Telegram Menu/Motion Sensor=Off
/ETHERNET COM. MENU/Telegram Menu/Depth=1 ????????????????
/ETHERNET COM. MENU/Telegram Menu/Depth NMEA=Off
*****

***** Mar16.txt
/ETHERNET COM. MENU/Telegram Menu/Integrator=Off
/ETHERNET COM. MENU/Telegram Menu/TS Distribution=Off
/ETHERNET COM. MENU/Telegram Menu/Towed Fish=Off
***** ..\JR70\030102.TXT
/ETHERNET COM. MENU/Telegram Menu/Integrator=Off
/ETHERNET COM. MENU/Telegram Menu/TS Distribution=1&2&3
/ETHERNET COM. MENU/Telegram Menu/Towed Fish=Off
*****

***** Mar16.txt
/ETHERNET COM. MENU/UDP Port Menu/Towed Fish=2200

/ETHERNET COM. MENU/Echogram-1 Menu/Range=250 m
/ETHERNET COM. MENU/Echogram-1 Menu/Range Start=0 m
***** ..\JR70\030102.TXT
/ETHERNET COM. MENU/UDP Port Menu/Towed Fish=2200
/ETHERNET COM. MENU/Echogram-1 Menu/Range=1000 m
/ETHERNET COM. MENU/Echogram-1 Menu/Range Start=0 m
*****

***** Mar16.txt
/SERIAL COM. MENU/Telegram Menu/Echogram=Off
/SERIAL COM. MENU/Telegram Menu/Echo-Trace=1
/SERIAL COM. MENU/Telegram Menu/Sv=Off
***** ..\JR70\030102.TXT
/SERIAL COM. MENU/Telegram Menu/Echogram=Off
/SERIAL COM. MENU/Telegram Menu/Echo-Trace=Off **?????????????????**

/SERIAL COM. MENU/Telegram Menu/Sv=Off
*****

***** Mar16.txt
/MOTION SENSOR MENU/Td-3 Alo. Offset=0.0 m
/UTILITY MENU/Beeper=On
/UTILITY MENU/Status Messages=On
***** ..\JR70\030102.TXT
/MOTION SENSOR MENU/Td-3 Alo. Offset=0.0 m
/UTILITY MENU/Beeper=Off
/UTILITY MENU/Status Messages=On
*****

Subsequent changes are shown in bold type

JANUARY 5, 2002

17:10 GMT Daily synchronization of pc and Ek500 clocks
Change ek500 Sound vel to 1450

Suggest this should be at 12noon every day

JANUARY 6, 2002

Clocks (PC & EK500) synchronized with master clock at 0545 (L) on 6/1/02

Cannot get Echoconfig to write settings or read settings – Cathy can you advise please –*answer*- See Echoconfig file menu under settings – the correct IP address for the EK500 for some reason defaults to the same as the logger and the last digit has to be changed from 9 to 102.

Transect T1 starting at 0900 on 6/1/02

At around 1100 (Z) the deep scattering layer started to shallow (going from 300-4000 up to less than 200 m). This seems to coincide with drop in sea surface temperature. May be crossing of SACCF? (Sally pers com). Surface layer also disappeared at this time. Interesting stuff. 1130(Z)

DSL starting to descend again. Shallowing corresponds to high surface chlorophyll. Eddy containing high chloro?

Would be good to sample above on next occupation of transect. MNET would allow multiple depth samples and good catching of range of zooplankton.

1350 (Z) deep layer (400m) again starting to rise. Few krill-like indications seen in last hour or so (1300 Z).

2205 (Z) end of transect – last section had a number of swarms, as did the shelf edge. Mark at 2203 used by the bridge for fishing target. In the hour it took to trial the neuston net and then return to the site, the swarms had moved off. Net fished for 1hr plus and only just before it was recovered did some small near surface marks appear. Turned out to be Themisto.

JANUARY 7, 2002

RMT8 Event 32: Fishing on targets detected at 02:15 (Z), only a few miles to west of transect end. Targets at 25-30m., returned along transect and seen again. Turned to fish and one swarm seen on echosounder but not as dense as before. Net appears to have opened prior to commands. Cycled through and only at end of haul does rise in net depth suggest that first net has opened. Hauling to surface to check if working correctly. All nets had been dropped prior to recovery on deck suggesting that had been working correctly.
Sv mean of krill swarm at 120 = 65.35 dB and at 38 = 74.28 dB equivalent to 9 dB difference. Catch of about 50 or so krill. Angus and Kate sorting and setting up animals.

RMT8 Event 33: Fishing on targets detected at 04:16, several extensive swarms at about 20-30 m. Quite dense with a dB difference of 8-9 dB. Net 1 fished on diffuse target, net 2 on discrete and denser swarm. Just after net 2 closed the densest target occurred – Murphy's law or something. The biggest swarm occurred right on the bridge's fishing mark. Next time need to wait a bit before opening the first net. About 500 ml to 1 litre of krill in each net. 0528 (Z) now heading for Bird Island.

Processed the files for transect T1. Created an ev file D:\sonardata\LogData\2002\t1\JR70_transectT1.ev This file has false bottom removed from38 kHz and a new bottom plotted. Then resampled at 20 pings and 100 samples over the depth range of 500 m. This then integrated over cell size of 2.0 min and 10 m. Written to a file D:\sonardata\LogData\2002\t1\JR70_transectT1_resampled_38kHz.xls and txt. The text file (tab separated ascii) then passed to Sally and Sharon for further processing to get to same size/scale as the XBT plot.

Lots of other swarms on approach to Bird Island.

16:57 Z. Files from first transect and before backed up onto WS_2 d: drive in directories *before t1* and *t1*. 11.2 GB space remains. Started logging to *day007*. 12.1 GB remain on WS_1 d: drive (mapped to g: on WS_2)

17:00 Z. Ship slowed down to 3 knots because of fog, deviation from transect for iceberg.

17:40 Z speeded up to 6 knots

18:00 Z strong krill marks at shelf break. dB difference around 5 – compare with value of 10 seen for many of the swarms encountered further east yesterday (200/120 difference around 1 is much the same as before)

20:25 Z swath bathymetry switched on, EK500 ping rate slowed down considerably. EM120 survey called western core box. (at least that was the plan. In fact it appears to have been called 'estern_core_box No_Name'). Sound speed at transducer: 1471. Sound speed profile from JR69 - jr69_01.asvp (South of Drake passage) note center depth of 2600 ish considerably more than EA500 2100 ish. Ping rate 1 every ~17 seconds driving EK500 and EA500.

22:00 Z EA 500 collecting data that fits with chart, but has strong interference band (EM120?)

22:30 Z Note spurious fixes in Echoview can be cancelled from the EV file properties Cruise Track page by alternating between 'southern hemisphere' and 'as recorded'

23:15 Z SSU reconfigured so that all three sounders ping simultaneously achieved by putting EA500 into passive mode (and external trigger). Ping interval down to 14 secs. Depths from EA and EM coincide. This generated some interference on EK500, so configuration altered: EA and EM in one group, EK in another, all on calculated pings.

JANUARY 8, 2002

01:38 Z Swarm with same characteristics as seen at 18:00 yesterday

02:32 Z As 01:38

02:40 Z Change EA unit on bridge from passive to active (transceiver menu). Stop logging swath. change groups so that EA and EK in same group and EM in separate. Turn EM trigger off turns line to grey, change EA time usage to TX pulse, turn EK5 time usage fixed 2.5 seconds.

04:31 (Z) Ship proceeding to last drifter deployment position on transect W2.2. Then off to start of transect on W1.1. Will start at Southern end rather than northern end as originally planned. ETA for start of transect is 07:00 (L). Delay due to fog, presently steaming at 5-6 knots.

16:40 Z EK500 and WS_1 clocks synchronized to master clock. New logging directory created *day008* for all files gathered outside transects. Transect files in *t1, t2* etc.

18:59 Z swarm reaching 32 dB at 120 kHz, dB difference 7.5

18:51 Z transects around boundary of western core box – start time taken as moment when ship was up to transect speed and heading. End time when ship started to slow down

JANUARY 9, 2002

02:08 Z config file downloaded to compare with earlier setups. Using filecompare (fc in DOS) there were only a few range changes since 030102. Nothing to explain the peculiar behaviour of the 120 data in Echoview. Although the raw data appears to be fine, derived variables seem to be empty, whether they were inherited from a march 2001 .ev file or created afresh. Raw data from the two RMTs that caught krill, with noise removed using the TVT, was examined using the schools module. Major schools had a very consistent dB difference in the vicinity of 8.5.

Looking at problem of 120 kHz derived variables seeming to be blank. Using Cathy's JR70 nets.EV file. Derived variables **surf-bott** and **good data** use the Sv Q1 telegrams (ie 38 kHz) as operand 1. Then **surf-bott** and **good data** are combined in new variable **include**, which is used as a mask for new variables **38-e** and **120-e**. However when viewed as echograms only **38-e** contains data, **120-e** is totally blank. If the operand 1 used for **surf-bott** and **good data** is changed to Sv Q2 telegrams (ie 120 kHz) then **38-e** is blank and **120-e** contains data. This can therefore be got around by producing a second set of **surf-bott** and **good data** variables which have Q2 telegrams as the operand 1. However it is not elegant and does not need to be done on last years data. So it appears that there is software problem somewhere which we need to investigate.

20:09 Z strong swarm with dB difference around 9

JANUARY 10, 2002

02:00 Z Data backed up to WS_2 in directories *day008* and *t2*. New logging directory started *t9*. *t2* contains transects 2 –8, west east section of boundary box. WS_1 and EK500 clocks synchronized to master clock. Printer tested from EK500, note that although labelled EK500 printer 2, this is controlled by printer 1 menus.

23:20 Z WS_1 and EK500 clocks synchronized to master clock. Directory *t9* backed up to WS_2. Created *t14*.

JANUARY 11, 2002

01:41 Z krill swarms located on boundary box transect, fished event 089. Swarm seen at 02:40 Z

14:36 Z 53° 44.25' S, 39° 35.88' W dense fish marks saved as fish.bmp on g:\jr70
The same marks were noted on the bridge EA500 sounder. –3.18 to -4.1 δ Sv for top part of aggregation.

20:28 Z yet more fish:

mean Sv values from small integrated regions at these locations

depth m	time Z	38 kHz	120 kHz	200 kHz	delta 120-38	delta 200-120	
20	20:36	-76.71	-64.11	-58.09	12.6	6.02	
75	20:28	-55.02	-58.65	-60.44	-3.63	-1.79	
85	21:25	-55.12	-54.35	-56.72	0.77	-2.37	very few data at 200
56	21:27	-69.42	-63.83	-58.68	5.59	5.15	very few data at 200

21:25 to 22:10 Z sitting over fish aggregations – visible on EA500

JANUARY 12, 2002

01:30 Z EK500 and pc clocks synchronized to master clock. Directory *t14* backed up to WS_2, directory *t21* created.

14:50 Z Interference in the form of red dots appears on 38 kHz chart.

15:40 Z Asked bridge if Marconi sounder can be turned off when we get moving

17:02 Z switched 200 kHz over to towed fish. Starting at around 2 knots, fish at 16 m, speeded up to 10 knots by 17:15, depth 15 m. 17:17 more wire out, fish descended to 19 – 20 m (~30 m wire below the sea surface). 17:29 slow turn from hdg 294° towards station BB23.

17:58 Z depth reduced to 12-13 m, now seeing surface at 75 m. (12 m water below surface) 10 m below the surface the towfish appeared to be sucked towards the ship.

18:06 Z disconnected 200 kHz, hull 200 kHz not connected.

18:17 Z transect T26 commenced to SW corner of core box, boundary box station 23. Numerous krill marks seen across box.

23:06 Z arrived at sta 23 and found large fish trace.

mean Sv values from small integrated regions at these locations

time Z	depth m	38 kHz	120 kHz	delta 120-38	
12/1/02					
14:08	67	-55.54	-46.78	8.76	
18:40	108	-53.23	-46.45	6.78	
19:00	95	-52.46	-45.35	7.11	
19:10	137	-53.08	-45.39	7.69	
19:12	148	-53.3	-47.07	6.23	
19:40	240	-57.14	-51.77	5.37	
19:45	196	-54.31	-45.92	8.39	
19:48	172	-55.55	-48.25	7.3	
21:55	126	-61.9	-54.78	7.12	
22:27	55	-62.89	-55.33	7.56	
22:28	58	-52.02	-48.94	3.08	
22:43	45	-61.29	-55.48	5.81	
23:06	81	-51.41	-53.26	-1.85	fish

JANUARY 13, 2002

03:18 Z Cathy commented that 200 kHz doesn't seem to be working. Reason was that hull-mounted cable never reconnected. So connected up and noise on 120 kHz increased by about 3 dB. This was before 200 kHz transducer switched to active. No additional increase in noise when transducer switched to transmit. Tested by switching off 200 kHz (no reduction in noise) and then by disconnecting cable which resulted in noise reduction. Tried the fish-mounted cable but didn't produce any change in the noise level. Tried the hull cable again (03:38) and immediate increase. **Cathy and I decided that for biomass survey should leave the 200 kHz disconnected.**

Started UOR transect at 0805 Z. Transect number T28. Some krill swarms seen at around 0830 to 0900 and continuing. Interesting that on 38 kHz appear to be some reflections of krill under the bottom echo – a double echo of krill!

15:37 Z. False bottom. True depth 2089 m.

21:18 Z Noise test. Interrupted by ship slowing for CTD

22:30 Z Echoview crashed ('abnormal program termination') when trying to open cruise track. No GPS

mean Sv values from small integrated regions at these locations

time Z	depth m	38 kHz	120 kHz	delta 120-38	
13/1/02					
1:07	105	-59.82	-61.85	-2.03	fish
1:20	134	-65.16	-71.84	-6.68	fish
17:23	84	-58.35	-49.96	8.39	
18:16	55	-68.55	-62.34	6.21	end of transect
19:26	125	-59.99	-52.74	7.25	
19:19	78	-83.02	-70.22	12.8	wispy layer

14 JANUARY 2002

03:45 Z GPS restored. SCS port stopped outputting data and reset by Richard. GPS logging actually stopped at 20:14 Z on 13 January 2002.

09:12 Z Slowing down because of fog. Going to be going at less than 6 knots so recovering UOR.

20:10 Z noise test. Apart from changing mode from active to passive, the synoptic survey noise settings had two other changes. The first was from ping rate 2 to 5, and the second was the Ethernet echogram ranges from 500m to 2500m in the case of 38 kHz and 5000m in the case of 120 kHz. As ping interval is now controlled by the SSU, this was not changed. Since 5000 m range would cause the 700 data points to be spread out over 5000/1450 seconds, the range was changed to 1000 m for 120 and 38 kHz for the test.

20:38 Z Settings Dump to file called 140102.txt Sound Velocity 1450

15 JANUARY 2002

00:04 Subsurface layer during RMT 151 had decibel difference of –3.69. Myctophiids in catch.

mean Sv values from small integrated regions at these locations

time Z	depth m	38 kHz	120 kHz	delta 120-38	
15/1/02					
0:04	25	-67.69	-71.38	-3.69	near surface fish
2:11	34	-62.83	-55.62	7.21	krill

00:20 Z directory *t40* begun. *T26* backed up to WS_2. clocks synchronized on ek500 and WS_1

22:45 Z directory *t47* begun.

16 JANUARY 2002

00:16 Z Noise test – send passive.txt to start and active.txt to end. 00:31:14 noise test end.

01:55:36 Z Started Echolog 2.20

02:07 Z *T40* backed up to WS_2. clocks synchronized on ek500 and WS_1

15:00 Z WCB survey abandoned because of high seas and very poor acoustic data, ship traveling to Stromness for calibration at first light tomorrow.

23:27 Z start of krill search parallel to coast

17 JANUARY 2002

00:19 Z krill patches identified for fishing:

How about a temperature probe in the transducer space if we get the go-ahead for new transducers?

Stromness for calibration 11:00 Z

18 JANUARY 2002

15:03 Z downloaded settings in Echoconfig. Saved on WS_1 in d:\sonardata\jr70 settings\calibration\after.txt. SV already changed back to 1450.

15:00 – 15:05 Z EK500 crash, rebooted. Symptoms: flashing screen, not cured by switching VDU off then on, very intermittent pinging on SSU. Rebooting EK500 reestablished regular pinging. No further symptoms except for the appearance of two sheets of paper from the EK500 printer (in spite of no printer settings being switched on), one of them dated and timed for the end of the break in output.

18:48 Z very interesting multinet tow through discrete swarms and wispy layer

20:10 Z Event 169 LHPR test Gauze 8 or 9 should catch krill swarm centered at 20:16 and 60m, swarm at 20:19 probably too shallow for gauze 13. 20:26 Z patch should arrive at gauze 19.

19 JANUARY 2002

Starting long transect TP0059 at 08:00. Z. Sea calm and sun shining.

Created evfiles for first Western Core Box biomass survey. Files saved in d:\sonardata\ev files\JR70_WCB1.1_1.ev etc. Need to check noise level to apply for different transects. At the moment values vary between 116 and 119.1. Should we standardize – yes I think so.

On long transect lots of small red flecks on 120 kHz

22:14 Z large swarm at station with unusually low delta Sv, seen again at 23:21 Z searched after CTD but weather too poor for RMT

mean Sv values from small integrated regions at these locations

time Z 19/01/02	depth m	38 kHz	120 kHz	delta 120-38	
22:14	45	-47.81	-44.14	3.67	swarm at station
22:16	50	-48.22	-45.66	2.56	swarm at station
23:21	24	-48.52	-46.1	2.42	very close to above loc

23:33 Z clocks synchronized on ek500 and WS_1. New directory on WS_1 for calibration data – *d:\LogData\2002\calibration*, also *t48* for data since then. *T40* and *t47* backed up from WS_1 to WS_2.

20 JANUARY 2002

19:30 Z after CTD station TP0059 13 sailed down wind of station to aim to fish through targets consistently seen at approx. 350 m on 38 kHz (also seen on first run of transect on the previous day). In spite of close proximity to target during haul, catch was tiny, 2nd net used for oblique haul from 295 to 8m.

GPS telegrams. While at CTD station logged some pure GPS telegrams for Nathan. File 20020120-093207 started so that can switch off all telegrams apart from navigation. Switched off dpeth, echogram, echotrace, vessel log and TS distributions. The started file 20020120-093436.ek5. This file contains couple of minutes of just navigation data. Then switched telegrams back on during file 20020120-093557 then back to normal logging for 20020120-093647.ek5. File then sent to Nathan.

Calculating biomass for WCB. Carried out work on EK500 Workstation_1.
Note that last year the dongle was in Workstation 2 and live viewing carried out from that workstation. Therefore only logging on workstation 1. However the change of monitor for workstation 2 (the original being used as a slave for net driving) means that it would be necessary to change the 3 monitors around if we wanted to live view on WS-2.
Created EV files for first survey of WCB in D:\sonardata\ev files. File names of type JR70_WCBx.x_y.ev where x.x represents the transect and y represents the survey number (ie 1 for first survey, should be 2 for the second survey).

Noise settings for the different evfiles initially quite variable. But finally set to the following:

WCB1.1 = 118.1
WCB1.2 = 118.1
WCB2.1 = 116.1 (several regions where noise floor rises for few minutes)
WCB2.2 = 118.1
WCB3.1 = 118.1
WCB3.2 = 118.1

DB difference set to 2-12 dB. Integration grid set to 1 nautical mile by 250 m. Integration exported to .csv files with same name as ev files. Placed in D:\sonardata\csv.

Note that on transect WCB3.2_1 a large 'krill' swarm at 17:37 was not selected by the 2-12 dB filter. This seems to be because there was extensive drop-out on the 38 kHz sounder and the dB difference was in region of 14-16 dB.

The ev files and csv files were copied to the q drive (q:\jr70\acoustic processing) and to d drive on my laptop (d:\acoustic\jr70). The csv files were incorporated into an Excel spreadsheet (JR70_WCB_1.xls) with one page for each transect. Density of krill was calculated using a TS of –39 dB and this will need to be refined once the krill length frequency distribution for the survey is available. On the front page of the spreadsheet the transect densities and the Jolly and Hampton method for estimating overall krill biomass and variance have been presented. These methods were copied from the spreadsheets generated last year by Andy Brierley (workstation 2 d:\jr57\integration\Jolly_jr57v2.qpw and jr57.qpw – these last two files have been placed on jlw laptop d:\acoustic).

The results from the 6 transects show that the overall mean biomass is high (46.6 g m^{-2}) with a high CV of 40.2%. This is due to the very high biomass found on transect W3.2 and the very low biomass found on transect W1.1. Echo-chart for W3.2 has been checked carefully and the biomass is due to strong mid-water aggregations rather than any artifact of integrated bottom.

21 JANUARY 2002

New directory on WS_1 *t55* for data since then. *t48* backed up from WS_1 to WS_2.
CD JR70ACOUSTIC3.

22 JANUARY 2002

Drifters deployed at 03:20 Z actually on station. Two Bongos deployed as leaving station so transect (T62) not started immediately on leaving station but rather after bongos recovered.

18:40 Z Drifter release between stations, transect divided.

20:31 Z Began transect to RMT test station. Vessel speed up to 16.5 knots. Loads of krill swarms.

23:30 Z clocks synchronized on ek500 and WS_1.
New directory on WS_1 *t70* for data since then. *T61* backed up from WS_1 to WS_2.
CD JR70ACOUSTIC4, 2 copies.

23 JANUARY 2002

20:44 Z shallow target seen close to planned fishing site, ran back over it at 20:24, returned upwind to fish seen again at 21:45. Fished successfully. Water 'boiling' with fur seals, and feeding prions.

New directory *t76* begun. *T70* backed up.

24 JANUARY 2002

02:18 Z NOTE changes made to directory structures on WS_1. All LogData stays as before, but .csv files and .ev files have been reorganized in *D:\sonardata\jr70* subdirectories *csv* and *evfiles*. (some ev files have been left in ev files)

02:26 Z settings dump 240102.txt

05:11 Z making our way to start of WCB survey 2. Signal on EK500 38 kHz showing plenty of dropout although ship's motion does not seem any worse than yesterday. Need to watch once we change direction and start transect.

11:40 Z rolling along transect W1.1. Beam sea causing substantial dropout on 38 kHz, not uncomfortable but getting near limit for acoustic observations.

16:10 Z strong aggregation at shelf break.

18:17 Z ship slowing down and change of course gives vastly improved echogram.

20:00 Z only 30 minutes remain for target fishing. Not attempted.

25 JANUARY 2002

Started transect W2.1 at 08:20 Z. Set logging and carried on processing drifter data. Noticed that at 09:35 no logging, EK500 had crashed at or around time transect had started. Switched everything off (echolog and EK500) and restarted. Sorry!!

26 JANUARY 2002

01:25 Z Typical 'night time' subsurface krill – exactly coincides with steep bottom gradient.

02:06 Z *t81* created, *t76* backed up to WS_2.

Transect started at 07:59 but UOR not communicating properly and therefore ship slowed to 5 knots to recover. 08:10 back up to 10 knots to continue transect without UOR.

Computer crashed while transect log open. Lost times for start and end of transects today. Will have to recreate from echo chart!! Or bridge log! Done

18:00 Z End of transect 3.2 had particularly dense predator aggregations but nothing special in the way of krill.

27 JANUARY 2002

02:51 Z *t81* backed up, *t92* created. Settings dump 270102.txt. EK500 and pc clocks synchronized

19:44 Z speed reduced to 8 knots because of fog

22:10 Z back up to 10 knots

28 JANUARY 2002

00:00 Z night fishing. Successful krill catch

01:01 Z night time transect to be carried out at 8 knots

01:13 Z started logging upward looking 200 kHz.

~16:00 Z Echoview appeared not to receive position data – although it was arriving at EK500 – this can be seen on Navigation Menu page of EK500. Restarting Echoview solved problem.

Towfish containing sideways looking 200 kHz sounder data:

Time Z	Depth m	comment
01:20	21.3	
01:30	21.9	
01:51	19.4	
01:58	18.0	
02:58	18.0	Surface swarms
03:33	17.8	
03:43	18.8	
05:22	18.6	
06:00 to 06:35		Descending layer, dB diff very negative at end. Seen on all 3 frequencies
07:20		Surface features on all 3 frequencies. DB diff krill like
07:53	21.8	Just one turn left on drum, 8 knots
17:43	20.0	10 knots, surface swarm
22:28	22.0	8 knots, short swell after change in direction from 260° to 350°
22:35		Very dense marks over shelf edge
23:00	21.9	
23:16	22.4	Slowing for fog
00:00 29/1/02	24.0	5 knots
03:14 29/1/02	21.9	7.5 knots
04:06 29/1/02	22.7	8 knots, surface swarms at 03:50, two at surface but only 1 on 120 & 38 kHz
05:05 29/1/02	22.3 – 21.6	
17:33 29/1/02		200 kHz stopped

01:27 Z 200 kHz Ethernet telegram range reduced from 250 to 100 m

29 JANUARY 2002

00:07 Z Directory *t102* created, *t92* backed up. Clocks synchronized.

18:26 Z En route to Bird Island, traveling at 15-16 knots needed more than 20 dB to remove extra noise from 38 kHz on shelf. Note krill over submarine gully at SE corner of core box still visible. Not included in transect log.

30 JANUARY 2002

18:30 Z krill fishing off shelf event 300, Small amount of krill caught, but two or three large swarms seen.

23:00 Z copy CDs created up to and including *t102*

31 JANUARY 2002

00:15 Z krill fishing on shelf after dark.

07:59 Z Started UOR transect along ER635 but UOR not playing therefore recovering UOR at 08:10.

15:08 Z Clocks synchronized

17:41 Z *t105* created

22:12 Z *t112* created

23:22 Z *t105* backed up

1 FEBRUARY 2002

14:00 Z RMT event 328 between stations 8 and 9 fished near surface mixed layer included fish and fish larvae.

22:22 Z *t123* created

22:32 Z *t112* backed up

2 FEBRUARY 2002

22:22 Z *t129* created

22:32 Z *t123* backed up

3 FEBRUARY 2002

06:00 Z towfish now deployed to run back down transect ER635. Ship turning round prior to start

Time (GMT)	Towfish depth	Comments
06:23	22.6 – 21.4	A couple of near surface targets seen on all sounders
07:40	20.1 – 19.8	Good target at 07:25
10:10	19.1 – 18.9	Swarm up to top of 120 but not appearing on 200.
19:43	19.6	Swarm on 200 not visible on 120
20:25		recovered
20:55		Switched off!

21:17 Z Huge aggregations after fishing!

4 FEBRUARY 2002

02:00 Z EK500 pinging at reasonable speed with EM120 while in shallow water, but odd line of interference appears at 100m on 38 kHz.

Huge lines of interference now obvious as depth changes. Need to get best setup for EK500 and EM120.

Alt 248 (on keypad) – shortcut for degree symbol °

151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
Ù	Ÿ	Ö	Ü	¢	£	¥	Pts	ƒ	Á	Í	Ó	Ú	Ñ	Ñ
166	167	168	169	170	171	172	173	174	175	176	177	178	179	219
ª	º	¿	⌐	¬	½	¼	¡	«	»	░	▒	▓	│	█
220	221	222	223	224	225	226	227	228	229	230	231	232	233	234
▄	▌	▐	▀	Α	ß	Γ	Π	Σ	Σ	µ	Τ	Φ	Θ	Ω
235	236	237	238	239	240	241	242	243	244	245	246	247	248	249
Δ	∞	Φ	Ε	∩	≡	±	≥	≤	⌠	⌡	÷	≈	°	·
250	251	252	253	254	255	256	257	258	259	260	261	262	263	264
·	√	^{n}	^{2}	■										

NET SAMPLING

(CATHY GOSS, JON WATKINS, KATE ARNOLD & GERAINT TARLING)

Excluding test deployments, a total of 29 RMT8 hauls were made during the cruise. These were carried out using three different fishing strategies dependent upon the purpose of the sampling. At the majority of core box stations double oblique (DO) deployments were carried out in conjunction with neuston net sampling (9 nets). When live material was required for krill growth experiments, directed hauls were made after locating targets thought to be krill from their appearance on the echosounder (Live Krill, LK, 16 nets). A small number of nets were fished in order to verify acoustic targets (AT, 4 nets). Table 1 lists the nets fished, together with locations, time and purpose.

For station sampling the RMT8 was fished as a DO, one net opened from near surface (<10 m) to 250 m (or within 10 m of bottom if depth <250 m) and a second from the maximum depth to near surface. Each net was fished for a nominal 30 minutes. The net had 4.5 mm mesh and 8 m2 mouth opening. Problems with winch operation prevented sampling at one core box station. While the DO nets were deployed, the neuston sledge was fished twice, each tow lasting 15 minutes.

When there was a requirement for live krill the RMT8 was deployed after targets had been located using the echosounder. Either extensive or numerous swarms were selected since single isolated swarms could not usually be relocated during fishing. Shallow swarms were preferred since this helped to ensure that the total haul time was as short as possible. 'Solid' cod ends that did not drain completely when brought onto the deck were also used for these hauls so that krill could be recovered in good condition. Attempts to catch live krill using the neuston net were not successful, probably because they could not be directed at specific targets since the normal downward looking echosounder does not observe the near-surface zone sampled by this net.

In previous core programmes, each day after the acoustic transects were finished there was a period of time which was utilized for fishing targets that had been detected with the EK500 scientific echo-sounder. During JR70 time was lost during transecting due to fog and ice, and there was additional station sampling, these factors combined to prevent target fishing on most days. The depth of the targets determined depths and fishing times for the target fishing that was carried out.

SAMPLE SORTING PROTOCOL

The total catch volume of all net catches was recorded. From each RMT8 deployment of two nets the sample from each net was split; half was preserved and half was sorted on board. The catches of each pair of Neuston nets were analysed in the same manner as the RMT8 catches. Generally, fish were removed from all samples, where possible, and frozen. Generally, the krill, or a sub-sample of krill was removed from all samples, the volume determined, and length (anterior of eye to tip of telson), sex and maturity stage recorded (K Arnold and JL Watkins). The total displacement volume of each catch was recorded, the major components were removed and their volume determined. The major taxa from the total sample, or from a known volume of sub-sample, were then counted. Notes were made of other minor taxa. When possible, fish were identified to genus, measured (standard length) and the displacement volume of the largest individuals was measured.

A similar protocol for acoustic target nets was carried out, however, in this case samples (or subsamples) from all net hauls were preserved in formalin for future reference in Cambridge.

TABLE 16 RMT EVENTS

Event number	Event type	Max depth m	Start Jday	Start date (GMT)	Start time (GMT)	Start T2POS yydddhhmmss	End Jday	End date (GMT)	End time (GMT)	End T2POS yydddhhmmss	Start Lat. Decimal	Start Long. Decimal	End Lat. Decimal	End Long Decimal
30	LK	40	6	06-Jan-02	2302	02006230200	7	07-Jan-02	0015	02007001500	-53.70649	-36.78100	-53.71520	-36.86783
32	LK		7	07-Jan-02	0256	02007025600	7	07-Jan-02	0256	02007025600	-53.71860	-37.16143	-53.71860	-37.16143
33	LK	23	7	07-Jan-02	0309	02007030900	7	07-Jan-02	0324	02007032400	-53.71768	-37.17969	-53.71731	-37.20374
34	LK		7	07-Jan-02	0456	02007045600	7	07-Jan-02	0523	02007052300	-53.72126	-37.26863	-53.71985	-37.30502
89	LK	25	11	11-Jan-02	0232	02011023200	11	11-Jan-02	0255	02011025500	-53.63622	-38.83650	-53.63376	-38.86745
128	AT	99	12	12-Jan-02	2310	02012231000	13	13-Jan-02	0000	02013000000	-54.01794	-39.13798	-54.01948	-39.12493
129	AT	142	13	13-Jan-02	0200	02013020000	13	13-Jan-02	0245	02013024500	-54.03843	-39.33407	-54.06903	-39.36566
131	LK	146	13	13-Jan-02	1958	02013195800	13	13-Jan-02	2048	02013204800	-53.93541	-39.1308	-53.90645	-39.0962
134	DO		13	13-Jan-02	2234	02013223400	13	13-Jan-02	2345	02013234500	-53.84055	-39.1419	-53.78918	-39.13485
137	DO		14	14-Jan-02	0307	02014030700	14	14-Jan-02	0412	02014041200	-53.57653	-39.20402	-53.51923	-39.21199
149	DO		14	14-Jan-02	2302	02014230200	15	15-Jan-02	0015	02015001500	-53.4172	-38.69768	-53.36814	-39.74796
152	DO		15	15-Jan-02	0317	02015031700	15	15-Jan-02	0425	02015042500	-53.67703	-38.61408	-53.72268	-38.67287
163	DO		15	15-Jan-02	2203	02015220300	15	15-Jan-02	2231	02015223100	-53.71238	-37.97139	-53.70524	-38.00457
164	LK		16	16-Jan-02	0035	02016003500	16	16-Jan-02	0100	02016010000	-53.39677	-38.03102	-53.37405	-37.97051

165	LK		16	16-Jan-02	0150	02016015000	16	16-Jan-02	0205	02016020500	-53.36101	-38.08222	-53.36092	-38.0824
170	LK	36	18	18-Jan-02	2239	02018223900	18	18-Jan-02	2310	02018231000	-54.30097	-35.74345	-54.28268	-35.77834
171	LK	363	19	19-Jan-02	0329	02019032900	19	19-Jan-02	0401	02019040100	-54.4521	-35.62724	-54.43305	-35.66196
207	AT	317	20	20-Jan-02	1910	02020191000	20	20-Jan-02	2019	02020201900	-53.3387	-33.77814	-53.37706	-33.74948
252	LK	53	23	23-Jan-02	0015	02023001500	23	23-Jan-02	0155	02023015500	-53.79652	-36.05101	-53.73908	-36.15314
254	LK		23	23-Jan-02	2136	02023213600	23	23-Jan-02	2159	02023215900	-53.79835	-38.11508	-53.80737	-38.14311
260	DO		24	24-Jan-02	2258	02024225800	25	25-Jan-02	0010	02025001000	-53.84889	-39.1576	-53.8705	-39.25705
263	DO		25	25-Jan-02	0321	02025032100	25	25-Jan-02	0435	02025043500	-53.48524	-39.16248	-53.494	-39.27326
276	DO		26	26-Jan-02	0203	02026020300	26	26-Jan-02	0308	02026030800	-53.79626	-38.51293	-53.78074	-38.60818
286	DO		26	26-Jan-02	2158	02026215800	26	26-Jan-02	2308	02026230800	-53.70979	-37.97629	-53.67154	-38.05765
291	LK	60	27	27-Jan-02	2339	02027233900	28	28-Jan-02	0015	02028001500	-53.82461	-37.57071	-53.81113	-37.61507
301	LK	55	30	30-Jan-02	1833	02030183300	30	30-Jan-02	1934	02030193400	-53.56256	-38.62369	-53.54406	-38.71711
302	LK	55	31	31-Jan-02	0014	02031001400	31	31-Jan-02	0055	02031005500	-53.64832	-37.63599	-53.64865	-37.69991
328	AT	54	32	01-Feb-02	1241	02032124100	32	01-Feb-02	1328	02032132800	-52.81322	-37.25592	-52.83537	-37.31553
357	LK	25	34	03-Feb-02	2341	53 43.87S 37 27.03W	34	03-Feb-02	2357	02034235700	-53.73115	-37.4505	-53.73151	-37.47377

TOP PREDATORS OBSERVATIONS

(KEES CAMPHUYSEN, MATT SWARBRICK & DAFYDD ROBERTS)

INTRODUCTION

This cruise was part of an integrated field season, which linked seabirds and marine mammal observations during the cruise with specific field work at Bird Island. With respect to the seabird and cetacean surveys, the plan of the trip was to perform systematic counts of seabirds and marine mammals off South Georgia, during the acoustic surveys for krill Euphausia spp. While focussing on the flux of krill through the western core box, the top-predator surveys were meant to locate the main foraging areas of seabirds and cetaceans and to evaluate and quantify (krill) consumption levels based on top-predator abundance. In the same period as the cruise, Antarctic Fur Seals Arctocephalus gazella, Macaroni Penguins Eudyptes chrysolophus and Black-browed Albatrosses Thalassarche melanophrys from Bird Island were tracked with satellite transmitters to assess foraging areas on that end. The timing of the cruise was to a large extent determined by the progress of the breeding season of these predators and the results of ship-based surveys were to be compared with the output from tracked penguins, albatrosses, and seals. Antarctic Fur Seal tracking started from mid-December onwards, tracking of Macaroni Penguin and Black-browed Albatross took place during the chick-rearing phase from mid-/late January.

METHODS AND OBSERVERS

For seabirds at sea transects, standard methods chosen were those described by Tasker et al. 1984, Van Franeker 1994, with modifications to provide detailed information on foraging behaviour and foraging densities according to Camphuysen & Garthe 2001. Ten-minute or five-minute period counts and a 300m wide transect, with a snapshot for flying and fast swimming birds and other marine wildlife formed the basis of the surveys. An outdoor position with clear forward views was required for these observations and a simple hide could be established on the top deck, where a power supply, seats and shelter were provided. Equipment used on board were 10x40 Zeiss binoculars for regular observations, 20x60 Zeiss binoculars for particularly distant sightings, a GarminTM II plus GPS for positioning and timing, and hand-held range-finders and portable computers for data processing. With respect to Antarctic Fur Seals and penguins, it was particularly difficult to discriminate between feeding and non-feeding individuals, because these animals forage under water. However, fast travelling, certainly non-feeding individuals (moving to an from feeding areas) were coded such that these could be put aside simply in future analyses. All more aerial seabirds were coded as suggested by Camphuysen & Garthe (2001), so that all their different feeding techniques and the level of joint feeding activities (multi-species feeding flocks; Camphuysen & Webb 1999) could be easily quantified.

A particular effort was made to identify cetaceans and brief descriptions were made by the PO for future reference. These descriptions are summarised in a separate, detailed cruise report produced to cover the work on seabirds and cetaceans and that will accompany the data files after rigorous final checks for consistency. Not ideally, whales and dolphins were registered during the strip-transect counts chosen as the standard methods for this survey, not line-transect counts. This was an inevitable compromise between what may have been desired for whales and dolphins and what we wanted to achieve in terms of biomass estimates for top-predators such as fur seals and seabirds in relation to krill. Therefore, in addition to the normal records stored into the database, angle (°) and estimated distance (km) of sightings were recorded separately and these are listed with the summarised descriptions mentioned earlier. We cannot state that a full 180° scan has been achieved in areas very rich in seabirds and seals, but it was certainly tried to have a permanent look-out far away and ahead off the ship as in line-transects.

Observers on board were Kees Camphuysen and Matthew Swarbrick for the entire cruise, Dafydd Roberts for the transects off Bird Island (picked up from and dropped at Bird Island during this cruise). Seabirds and marine mammals were observed by a principal observer (CJC) and a recorder (MW), with the presence and assistance of a third observer during most of the observations between the two visits of Bird Island (DR; 7 Jan - 29 Jan). The PO called out observations, and was responsible for all IDs, both of seabirds and marine mammals. All data have been computer and corrected by the PO on the same day as they have been collected, so that recording errors and inconsistencies could be corrected with a fresh memory and using additional field notes and descriptions made by the PO during the surveys. The database was maintained by the PO and updated daily. Daily updates were transferred to the shared disk-space at the ship's network, as a back-up and to be available for analysis by the entire team during the cruise. Basic lists of numbers of birds and mammals seen were put up in the officer's bar after each day of observations, for the information of other cruise members.

TAXONOMY

Seabird and marine mammal taxonomy are currently in a phase of constant change. For the albatrosses, we have tried to follow nomenclature proposed by Robertson & Nunn 1998, but all Wandering Albatrosses were coded Diomedea exulans (in fact only a single individual with characteristics of Diomedea dabbena has been observed, well north of the Antarctic Convergence). For Cory's Shearwater Calonectris borealis we have followed Sangster et al. 1999. For Spectacled Petrel Procellaria conspicillata we have followed a proposal by Ryan 1998. For cetaceans, we have not followed Rice 1998 but used more traditional nomenclature.

DATABASE FORMAT AND COPYRIGHTS

Survey data have been stored into a Corel Paradox 8.0 relational database. Database tables used were Birdbird.DB, Database.DB and Datatrip.DB. This database structure is consistent with that maintained by the European Seabirds at Sea Database co-ordinating group and is fully compatible with data collected by JNCC for the Falkland Islands region, now maintained by Falklands Conservation in Stanley (FI).

The Paradox 8.00.174 software is copyright protected by Corel Corporation (1997) and the version used was licensed to CJC (PO). Some specific Paradox forms used at sea were written by Andy Webb, JNCC, and are copyright protected: Crosstab.fsl, Maintool.fsl and Dmappdx8.fdl. These forms should not be used by BAS without permission. Position data were processed by copyright protected Excel sheets Position.xls, Postrans.xls, and Pos5min.xls, produced by CJC and these are free to be used by BAS. The three database files produced, will work in any recent database package available at BAS after importation and none of the copyright protected forms and Excel sheets are required to use them properly.

OBSERVER EFFORT

It has been attempted to cover all daylight hours during steaming (>5 knots), provided weather, wind and visibility were reasonable, including the crossing of the South Atlantic between Montevideo (Uruguay) and South Georgia and between South Georgia and Stanley (Falkland Islands). Acoustic transects were fully covered, with a 200m transect in foggy conditions, except when visibility dropped below 200m. Observer breaks during acoustic surveys were shortened and organised in such manner that the surveys could be continued at all times. A total observer effort of 244.3 hours was achieved (Table 16), covering 1377 km² (Table 17).

PRELIMINARY RESULTS

The preliminary results discussed here were all from South Georgian waters (within the Antarctic Convergence), unless otherwise stated. A total of 72 5-minute counts did not result in any records of seabirds and marine mammals (3.7% of all 1935 observation periods).

TABLE 16: SPECIES OBSERVED DURING SYSTEMATIC SURVEYS AROUND SOUTH GEORGIA, 6 JANUARY-3 FEBRUARY 2002.

	Poskeys used						Transect operated				Visibility		
Date	min	-	max	n =	Periods	Hours	no	200m	300m	A	B	C	D
01-Jan	1	-	24	24	10 mins	4			24				24
02-Jan	25	-	93	69	10 mins	11.5			69				69
03-Jan	94	-	178	85	10 mins	14.2			85				85
04-Jan	179	-	229	51	10 mins	8.5			51		11	14	26
05-Jan	230	-	302	73	10 mins	12.2			73				73
06-Jan	303	-	381	79	10 mins	13.2			79	32	14	33	
08-Jan	382	-	408	27	10 mins	4.5		20	7	20	7		
09-Jan	409	-	427	19	10 mins	3.2			19			19	
10-Jan	428	-	447	20	10 mins	3.3			20			20	
11-Jan	448	-	460	13	10 mins	2.2		7	6	13			
12-Jan	461	-	518	58	10 mins	9.7		14	44	22	36		
13-Jan	519	-	639	121	5 mins	10.1		16	105	109	12		
14-Jan	640	-	710	71	5 mins	5.9		23	48	71			
15-Jan	711	-	820	110	5 mins	9.2			110		23	40	47
18-Jan	821	-	842	22	5 mins	1.8			22			22	
19-Jan	843	-	996	154	5 mins	12.8		15	139	15	2	48	89
20-Jan	997	-	1034	38	5/10 mins	3.7	6		32				38
21-Jan	1035	-	1066	32	5 mins	2.7			32	11	3	4	14
22-Jan	1067	-	1128	62	5 mins	5.2			62				62
23-Jan	1129	-	1258	130	5 mins	10.8			130		11	25	94
24-Jan	1259	-	1383	125	5 mins	10.4			125	3	8	9	105
25-Jan	1384	-	1500	117	5 mins	9.8		1	116	3	3	54	57
26-Jan	1501	-	1623	123	5 mins	10.3			123		6	117	
27-Jan	1624	-	1742	119	5 mins	9.9			119	7	2	30	80
28-Jan	1743	-	1796	54	5 mins	4.5		15	39	24	30		
29-Jan	1797	-	1928	132	5 mins	11			132			67	65
30-Jan	1929	-	1969	41	5 mins	3.4			41				41
31-Jan	1970	-	2006	37	5 mins	3.1			37			12	25
01-Feb	2007	-	2046	40	5 mins	3.3			40			11	29
02-Feb	2047	-	2082	36	5 mins	3			36				36
03-Feb	2083	-	2237	155	5 mins	12.9			155				155
06-Feb	2238	-	2288	51	10 mins	8.5			51		10	41	
07-Feb	2289	-	2322	34	10 mins	5.7			34				34
				2322		244.3	6	111	2205	330	178	566	1248

TABLE 17: OBSERVER EFFORT (KMÝ SURVEYED PER DAY) IN EACH OF THE STUDY AREAS WITH ID CODES USED IN THE DATABASE (DATABASE.DB)

		0	ER635	TP059	W1.1	W1.2	W2.1	W2.2	W3.1	W3.2	W4.1	W4.2	WBox	kmý
1	Jan	24.8												24.8
2	Jan	77.2												77.2
3	Jan	104												104
4	Jan	54.8												54.8
5	Jan	82.7												82.7
6	Jan		72.5											72.5
8	Jan												17.3	17.3
9	Jan												19.2	19.2
10	Jan												17.7	17.7
11	Jan												9.7	9.7
12	Jan												48.6	48.6
13	Jan				25.4	22.9							5.4	53.7
14	Jan						6.2	13.5					9.9	29.6
15	Jan								20	20.8			8.3	49.1
18	Jan	22.5												22.5
19	Jan			66.4										66.4
20	Jan	0.0*		13.9										13.9
21	Jan			14.3										14.3
22	Jan	11.6		18.7										30.3
23	Jan	5.2									24.6	25.5	3	58.4
24	Jan				25.4	24.5							6.2	56.1
25	Jan						24.7	18.8					7.6	51.1
26	Jan								22.7	24.6			6.6	53.8
27	Jan										24.9	24.4	3	52.2
28	Jan												19.4	19.4
29	Jan	9.6											49.2	58.8
30	Jan												22.5	22.5
31	Jan		15.9											15.9
1	Feb		17.7											17.7
2	Feb		14.7											14.7
3	Feb		67.8											67.8
6	Feb	45.1												45.1
7	Feb	34.9												34.9
		472.6	188.6	113.3	50.8	47.4	30.8	32.3	42.7	45.3	49.5	49.9	253.8	1376.9

"*) one hour of whale surveys, where no transect was operated

TABLE 18:SPECIES OBSERVED DURING SYSTEMATIC SURVEYS AROUND SOUTH GEORGIA, 6 JANUARY-3 FEBRUARY 2002.

Code	Species		Number
10	No birds observed	No birds observed	72x
30	King Penguin	Aptenodytes patagonicus	280
80	Macaroni Penguin	Eudyptes chrysolophus	1856
170	Chinstrap Penguin	Pygoscelis antarctica	39
180	Gentoo Penguin	Pygoscelis papua	988
230	unidentified penguin		52
620	Wandering Albatross	Diomedea exulans	428
690	Sooty Albatross	Phoebetria fusca	1
700	Light-mantled Albatross	Phoebetria palpebrata	43
710	mollymawk	Thalassarche spp.	501
760	Grey-headed Mollymawk	Thalassarche chrysostoma	365
790	Black-browed Mollymawk	Thalassarche melanophrys	2154
920	Cape Petrel	Daption capense	129
960	Blue Petrel	Halobaena caerulea	474
980	giant petrel	Macronectes spp.	668
990	Southern Giant Petrel	Macronectes giganteus	262

1000	Northern Giant Petrel	Macronectes halli	364
1030	White-chinned Petrel	Procellaria aequinoctialis	5665
1370	Soft-plumaged Petrel	Pterodroma mollis	249
1560	Great Shearwater	Puffinus gravis	23
1570	Sooty Shearwater	Puffinus griseus	5
1760	unidentified prion	Pachyptila spec.	27923
1770	Slender-billed Prion	Pachyptila belcheri	4
1790	Antarctic Prion	Pachyptila desolata	761
1810	Fairy Prion	Pachyptila turtur	246
1850	Black-bellied Storm-petrel	Fregetta tropica	622
1860	Grey-backed Storm-petrel	Garrodia nereis	11
1920	Wilson's Storm-petrel	Oceanites oceanicus	3345
2080	diving-petrel	Pelecanoides	375
2100	South Georgia Diving-petrel	Pelecanoides georgicus	12
2120	Common Diving-petrel	Pelecanoides urinatrix	27
2650	South Georgia Shag	Phalacrocorax georgianus	2
8960	Southern Skua	Catharacta antarctica	82
9460	Kelp Gull	Larus dominicanus	1
10620	Antarctic Tern	Sterna vittata	36
14480	Alder Flycatcher	Empidonax alnorum	1
25070	Minke Whale	Balaenoptera acutorostrata	8
25080	Sei Whale	Balaenoptera borealis	3
25140	Fin Whale	Balaenoptera physalus	18
25300	Southern Right Whale	Eubalaena australis	6
25420	Southern Bottlenose Whale	Hyperoodon planifrons	25
25500	Hourglass Dolphin	Lagenorhynchus cruciger	47
25570	Humpback Whale	Megaptera novaeangliae	8
25700	beaked whale	Mesoplodon spec.	5
25750	Killer Whale	Orcinus orca	23
26080	large Balaenoptera spec.		1
26120	medium whale		1
26170	whale		2
26320	Antarctic Fur Seal	Arctocephalus gazella	19520
26460	Southern Elephant Seal	Mirounga leonina	2

TABLE 19: BEHAVIOUR AND OTHER ASPECTS OF ALBATROSSES DURING SYSTEMATIC SURVEYS IN SOUTH GEORGIAN WATERS AND WITHIN THE WESTERN BOX AREA, 6TH JANUARY-3RD FEBRUARY 2002 (INCLUDING BIRDS OUTSIDE TRANSECT).

		Wandering	mollymawk'	Grey-headed	Black-browed
39	Pattering	1			
41	Scavenging at fishing vessel	40	500		
44	Surface pecking	3			28
49	Actively searching	1		33	215
60	Resting or apparently asleep	1		1	10
61	Courtship display	6			
66	Preening or bathing	2			14
96	Entangled in plastics	1			
97	Oiled				1
99	Dead		1		
		55	501	34	268

TABLE 20: BEHAVIOUR AND OTHER ASPECTS OF ALBATROSSES DURING SYSTEMATIC SURVEYS IN SOUTH GEORGIAN WATERS AND WITHIN THE WESTERN BOX AREA, 6 JANUARY-3 FEBRUARY 2002 (INCLUDING BIRDS OUTSIDE TRANSECT)

		Blue Petrel	'giant'	S Giant	N Giant	Wh-ch Petr	Soft-plum	
39	Pattering	6				41		
40	Scavenging		1					
41	Scavenging at fishing vessel		80			200		
42	Dipping	7				1		1
43	Surface seizing	2	1					
44	Surface pecking		3			86		
48	Pursuit diving					24		
49	Actively searching	27	38		3	549		1
60	Resting or apparently asleep		8	3	47	131		
66	Preening or bathing			1		10		1
	totals	42	131	4	50	1042		3

TABLE 21: BEHAVIOUR AND OTHER ASPECTS OF PRIONS AND STORM-PETRELS DURING SYSTEMATIC SURVEYS IN SOUTH GEORGIAN WATERS AND WITHIN THE WESTERN BOX AREA, 6 JANUARY-3 FEBRUARY 2002 (INCLUDING BIRDS OUTSIDE TRANSECT)

		prion	Ant Prion	Fairy Prion	Bl-b. Stp	Grey-b. Stp	Wilson's
38	Hydroplaning	5656	8	4	1		
39	Pattering	14			262	5	2430
41	Scavenging at fishing vessel	25					
42	Dipping	7	1				
44	Surface pecking	15	4				
49	Actively searching	6160	67	3	16		30
60	Resting or apparently asleep	64					23
61	Courtship display	2	2				
66	Preening or bathing	703	3				
99	Dead	1					
	Totals	12647	85	7	279	5	2483

TABLE 22:BEHAVIOUR OF ANTARCTIC FUR SEALS DURING SYSTEMATIC SURVEYS IN SOUTH GEORGIAN WATERS AND WITHIN THE WESTERN BOX AREA, 6 JANUARY-3 FEBRUARY 2002.

		All South Georgian waters				WBox area				
	transect indicator:	in	%	out	%	in	%	out	%	
70	Wheeling or swimming slowly	7286	68.8	1912	51.8	6398	69.3	1733	51.6	
71	Escape from ship	255	2.4	46	1.2	191	2.1	36	1.1	
72	"Swimming fast	not avoiding ship"	1873	17.7	1265	34.2	1548	16.8	1176	35
76	Apparently feeding: other behaviour	699	6.6	313	8.5	693	7.5	272	8.1	
79	"Basking	afloat"	477	4.5	158	4.3	407	4.4	140	4.2
88	Play	1	0		0	1	0		0	
		10591		3694		9238		3357		

TABLE 23:KM STEAMED FOR SEABIRD SURVEYS NORTH OF BIRD ISLAND (BETWEEN 53.8ØS AND THE COAST OF BIRD ISLAND, BETWEEN 38.5ØW AND 37ØW) IN RELATION TO TIME OF DAY (GMT) AND NUMBERS OF SMALLER PENGUINS SEEN SWIMMING AND TRAVELLING PER CLOCK-HOUR.

GMT	km steamed	not travelling	travelling	not travelling/km	travelling/km	% effort
6	13.4			0	0	7.2
7	10.9	1	8	0.09	0.73	5.9
8	30.3	22	105	0.73	3.47	16.3
9	13.5	18	51	1.33	3.78	7.3
11	8.5	8		0.95	0	4.6
12	26.5	259	43	9.77	1.62	14.3
13	10.9	18	15	1.65	1.38	5.9
14	10.1	46	8	4.57	0.8	5.4
15	12.4	317	597	25.48	47.99	6.7
16	9	20	28	2.23	3.13	4.8
17	23.9	56	133	2.34	5.56	12.9
18	16.5		75	0	4.54	8.9
	185.8	765	1063			

PENGUINS

Of 3215 penguins observed, 57.7% were identified as Macaroni Penguins Eudyptes chrysolophus, 30.7% as Gentoo Penguin Pygoscelis papua, 8.7% as King Penguins Aptenodytes patagonicus, 1.2% as Chinstrap Penguins Pygoscelis antarctica and the remaining 1.6% were unidentified (small) penguins. Chinstrap Penguins were the most difficult species to detect and the stationary vessel would often attract some Chistraps in offshore areas were none were recorded during the surveys. The King Penguin was the most widely distributed species, but larger congregations were a typical inshore phenomenon, particularly off NE South Georgia. Macaroni and Gentoo Penguins occurred mainly within the 500m depth contour and appeared to have a very clear diurnal rhythm (leaving the colony in the morning, returning in the afternoon), making the set-up of the cruise far from ideal to be able to properly assess foraging numbers and feeding distribution at sea (see general remarks). A remarkable sighting was a brown juvenile King Penguin swimming well offshore at 18 January 2002, 54.37°S, 35.94°S (DR, CJC).

Estimated total numbers of penguins within the western box area, using average densities and without corrections for detectability in different conditions, would amount to 2100 King Penguins (0.19/km²), 22,000 Macaroni Penguins (2.05/km²) and 10,000 Gentoo Penguins (0.92/km²). See, however, general remarks regarding the penguins surveys later in this cruise report.

ALBATROSSES

Of 3492 albatrosses observed, 61.7% were identified as Black-browed Albatross or Black-browed Mollymawk Thalassarche melanophrys, 12.3% as Wandering Albatross Diomedea exulans, 10.5% as Grey-headed Mollymawk Thalassarche chrysostoma, only 1.2% as Light-mantled Sooty Albatross Phoebetria palpebrata and 14.3% as unidentified mollymawk Thalassarche spp. (mainly birds behind a distant trawler). One adult Sooty Albatross Phoebetria fusca was observed, photographed and videod off Bird Island, at 25 January 2002, 54.0°S, 38.7°W. As keen ship-following or certainly ship-interested seabirds, albatrosses are notoriously difficult to census from ships. Natural feeding concentrations, however, will not be overlooked and therefore foraging areas can be easily found during ship-based surveys. Black-browed Albatrosses, but also Wandering Albatrosses, are known for their participation in multi-species feeding frenzies with Antarctic Fur Seals and Macaroni Penguins over rich krill patches around South Georgia (Harrison et al. 1991). Two commercial deep-water trawlers attracted a fair number of albatrosses. Some 'naturally feeding' (surface pecking) Black-browed Albatrosses were observed locally along the shelf edge (Table 19), notably to the west en north of Bird Island (searching and surface pecking). However, although several multi-species feeding associations have been observed, occasionally including albatrosses, it was clear that very few were actually feeding within the western box area. Most Black-browed Albatrosses were seen to travel beyond the areas of the western boundary box, mostly in a WNW direction. As such, the results agree with tracking data from Bird Island Black-browed Albatrosses, but this underpins the thought that the study area was too small to fully appreciate and investigate the whereabouts of albatrosses during this survey. Previous surveys in the area revealed substantial numbers of foraging albatrosses within the area now studied.

Estimated total numbers of albatrosses within the western box area, using average densities, would amount to 700 Wandering Albatrosses (0.07/km²), 1000 Grey-headed Albatrosses (0.09/km²) and 6000 Black-browed Albatrosses (0.56/km²). These figures should be treated as rather speculative, despite our attempts to exclude ship-followers or ship-visitors in the transect data, given the immense attraction of a vessel to these seabirds.

PETRELS AND SHEARWATERS

Of 7839 petrels and shearwaters observed, 72.3% were identified as White-chinned Petrels Procellaria aequinoctialis, 16.4% as giant petrels Macronectes giganteus (including 262 Southern Giant Petrel Macronectes giganteus and 364 Northern Giant Petrel Macronectes halli), 6.0% as Blue Petrel Halobaena caerulea, 3.2% as Soft-plumaged Petrels Pterodroma mollis, 1.6 % as Cape Petrels Daption capense and small numbers of Great Shearwaters Puffinus gravis (0.3 %) and Sooty Shearwaters Puffinus griseus (0.1%). Northern Giant Petrels clearly predominated as ship-followers in the western box area (offshore), while Southern Giant Petrels were the common type in Stromness (inshore). However, along the eastern long transect EP059, Southern Giant Petrels were clearly outnumbering Northern Giant Petrels, even at greater distances away from the coast. Soft-plumaged Petrels seemed to be comparatively numerous during these surveys (249 individuals recorded, 391 records within the SGMZ listed in Prince & Croxall 1996), perhaps as a consequence of the relatively warm waters around South Georgia this year.

Estimated total numbers of petrels within the western box area, using average densities and without corrections for detectability in different conditions, would amount to 1035 giant petrels (0.09/km^2), 3225 Blue Petrels (0.30/km^2), and 25,000 White-chinned Petrels (2.31/km^2) and 400 Soft-plumaged Petrels (0.04/km^2). Certainly, the number of giant petrels seems to be on the low side, but as in albatrosses, this figure should be treated as rather speculative given the immense attraction of a vessel to these giant petrels.

PRIONS

Of 28,934 prions observed, 2.6% were identified as Antarctic Prion Pachyptila desolata, 0.9% as Fairy Prion Pachyptila turtur, and <0.1% as Slender-billed Prion Pachyptila belcheri (4 individuals). The majority remained unidentified (96.5%), but the greater majority of these had characteristics of Antarctic Prions. The sample of identified prions certainly ‘overestimates’ the presence of two other species in the area (Fairy and Slender-billed Prion), because most of the unidentified prions had characteristics of Antarctic Prions. Since ID at sea is notoriously difficult, if at all conclusive, an accurate count or guesstimate of foraging flocks was given priority over specific identifications after initial attempts in the beginning of the cruise.

Estimated total numbers of prions within the western box area, using average densities and without corrections for detectability in different conditions, would amount to nearly 220,000 individuals (20.23/km^2).

STORM PETRELS

Of 3978 storm-petrels observed, 84.1% were identified as Wilson’s Storm-petrel Oceanites oceanicus, 15.6% as Black-bellied Storm-petrel Fregetta tropica and the remaining 0.3% as Grey-backed Storm-petrel Garrodia nereis. Nearly all observed storm-petrels were actively feeding (pattering), and therefore, the distribution maps are an accurate description of their feeding areas. Most Wilson’s Storm-petrels have been checked carefully, but especially in areas where large numbers occurred, not each and every individual has been looked at sufficiently carefully to confirm its specific identity. There were no ‘problem’ birds which seemed to show characteristics of other ‘black’ storm-petrels, however.

Estimated total numbers of storm-petrels within the western box area, using average densities and without corrections for detectability in different conditions, would amount to 4400 Black-bellied Storm-petrels (0.40/km^2) and 34,000 Wilson’s Storm-petrels (3.17/km^2). Given our sparse observations of Grey-backed Storm-petrels, this species should perhaps have numbered a few hundreds of individuals at most.

DIViNG PETRELS

Of 414 diving petrels observed, 6.5% showed characteristics of Common Diving-petrel Pelecanoides urinatrix, 2.9% had white-fringed scapulars as in South Georgia Diving-petrel Pelecanoides georgicus, and the remaining 90.6% remained unidentified. The identifications were based on the absence/presence of white in the tertials sections, but should not be treated as fully conclusive. Analysis should be done after combining all data, particularly so, while both types of birds were usually seen in the same areas and there were no indications at all for 'specific' segregation at sea in our small sample.

Diving petrels were not particularly abundant during most of our surveys. Estimated total numbers of diving-petrels within the western box area, using average densities and without corrections for detectability in different conditions, would amount to 2700 individuals at most (0.25/km^2).

OTHER SEABIRDS

Other seabirds, 121 in total, included South Georgia Shag Phalacrocorax georgianus (1.7%), Southern Skua Catharacta antarctica (67.8 %), Kelp Gull Larus dominicanus (0.8%), and Antarctic Tern Sterna vittata (29.8%). South Georgia Shag, Kelp Gull and Antarctic Tern were all inshore sightings, although some terns were foraging far offshore along the eastern long transect. Two adult breeding Antarctic Terns accompanying recently fledged juveniles have been observed.

BALEEN WHALES

Of 44 baleen whales observed, 18.2% (8) were identified as Humpback Whales Megaptera novaeangliae, 18.2% (8) as Minke Whale Balaenoptera acutorostrata, 6.8% (3) as probable Sei Whales Balaenoptera borealis, 40.9% (18) as Fin Whales Balaenoptera physalus, 13.6% (6) as Southern Right Whales Eubalaena australis, and 2.3% (1) as unidentified large Balaenoptera spp.

TOOTHED WHALES AND DOLPHINS

Of 100 toothed whales and dolphins observed, 25(%) were identified as Southern Bottlenose Whales Hyperoodon planifrons, 23 as Killer Whales Orcinus orca, 5 as unidentified beaked whales Mesoplodon spec and the remaining 47 as Hourglass Dolphins Lagenorhynchus cruciger.

PINNIPEDS

Practically all of 19,520 pinnipeds observed at sea were identified as Antarctic Fur Seals Arctocephalus gazella. Only two Southern Elephant Seals Mirounga leonina have been observed, one of which could not be identified with certainty.

Estimated total numbers of Antarctic Fur Seals petrels within the western box area, using average densities and without corrections for detectability in different conditions, would amount to nearly 210,000 individuals (19.36/km^2), making this by far the most important air-breathing krill predator in the area during the cruise. Fur seals were widespread in our study area, ranging well beyond the western box (satellite tracking data, western and eastern long transect data), but concentrating around the shelf edge where they showed behaviour that was most likely active feeding during daytime Travelling groups, sometimes numbering over a 100 individuals, were most frequently observed in nearshore areas, but occurred at the far end of the western box area just as well. Several different types of surface behaviour have been described and coded: play (Behav. code 88), basking/sleeping (characteristic position with one fore-flippers holding the hind-flippers in an arc above the surface; code 79), slowly swimming at surface, perhaps spy-hopping (looking at passing vessel mainly; code 70), fast swimming and porpoising in a clearly set direction (code 72), escape behaviour for the ship, torpedoing away (usually by sleeping/basking or slow swimming individuals; code 71),and 'apparently feeding', in which a frenzy of individuals were actively diving and occasionally rolling at the surface on one place, usually attracting surface foraging seabirds (Behav. 76). It is clear that it was not always obvious to choose between any of these types of behaviour, but attempts to categorise were always made. The fast-travelling category are thought to not necessarily relate to the area where they have been observed (as a potential foraging ground), and these animals could be set aside in further analysis of feeding areas.

The travelling fur seals, as a much more 'visible category' than most of the other behaviour types, is overrepresented outside the 300m transect. From transect data it may be concluded just that over 15% of the fur seals observed were travelling from one place to another during our encounters. Away from the western box area, where densities of Antarctic Fur Seals were generally considerably lower, this figure amounted to 24% (n = 1353 fur seals in transect).

GENERAL REMARKS

PENGUINS

If the project was to assess foraging numbers of (smaller) penguins north of Bird Island, it needs to be stressed that the position of the transects and the timing of the surveys were inadequate. Although the distribution maps of Macaroni penguins based on the small number of satellite tracks and the birds seen during our ship-based surveys have a great deal of overlap (mainly indicating relatively nearshore activities of these birds), the numbers cannot be used to quantify them as predators in the study area. Chick-rearing penguins leave the colony in the morning and return in the course of the afternoon, each parent (if both perform foraging trips) delivering one meal for the chick each day. The set-up of the paired transects in the western box area was such that a start in the potential feeding area at first light was to early to be able to see (m)any penguins, simply because the on-duty birds were still on their way. Alternatively, if the presumed feeding grounds were surveyed at the end of the paired transects, we may have been too late to fully appreciate foraging numbers because most had returned or were on their way back to the colony. The transects were roughly perpendicular to the coast, so that travelling penguins would follow roughly the same or just the opposite course, so that only the connecting steam in nearshore waters between the two transects, if visited early in the afternoon, would result in substantial numbers of (mainly travelling) penguins. To be able to map the foraging areas of penguins, a finer scaled grid would have been needed, at the appropriate time of day; in fact a separate programme. Following the present set-up, North of Bird Island, where 1828 smaller penguins were seen within an area south of 53.8°S to the coast of Bird Island, between 38.5°W and 37°W, most penguins per unit effort were seen between 15:00 and 16:00 GMT, with smaller 'resident' peaks around noon and a small 'travellers' peak around 08:00 and 09:00 GMT (Table 21).

FUR SEALS

With respect to Fur Seals, the data need to be corrected for at least two factors: (1) diving time (time spent under water and the associated chance to miss individuals during transects) and (2) weather and distance strata. The band transect has been subdivided into four distance strata: 0-50 to the side, 50-100m, 100-200m and 200-300m. In the distant strata, numbers of recorded seals are distinctly lower than in the nearby strata. Once this has been completed, a rather accurate estimate for seal numbers in the box area can be made, and I would recommend that the consumption of the mean number over the two BIOMASS surveys is to be used as an indicator of fur seal impact on the krill stocks. Optional, travelling seals could be omitted from the analysis, but this will not result in a major difference.

ALBATROSSES

The number of foraging albatrosses within the box area was marginal. Biomass estimates of albatrosses in the box area, already flawed by the ship-attraction in the absence of natural attractions (feeding frenzies) will make a krill consumption estimate of this group quite inaccurate. Both the satellite tracks and the ship-survey data suggest that the albatrosses obtained most their food outside the box area in January 2002. It is clear that in previous years this may have been a very different situation.

FIGURES

FIGURE 15: DISTRIBUTION OF KING PENGUINS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

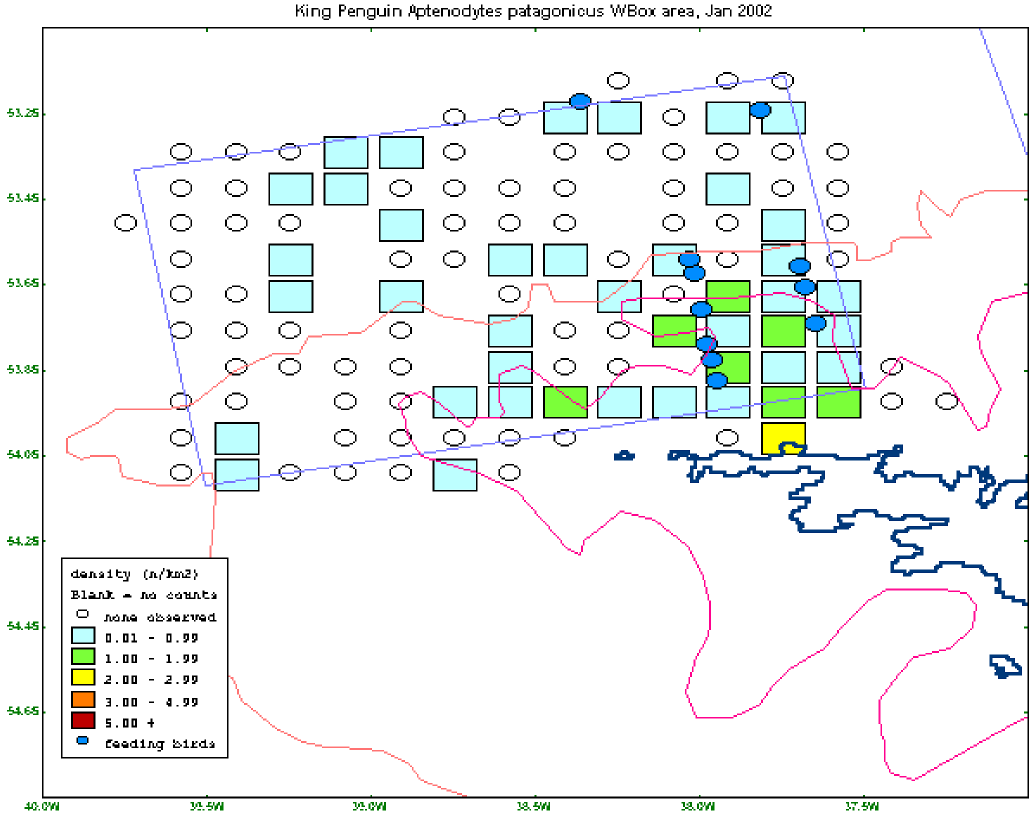


FIGURE 16: DISTRIBUTION OF GENTOO PENGUINS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS.

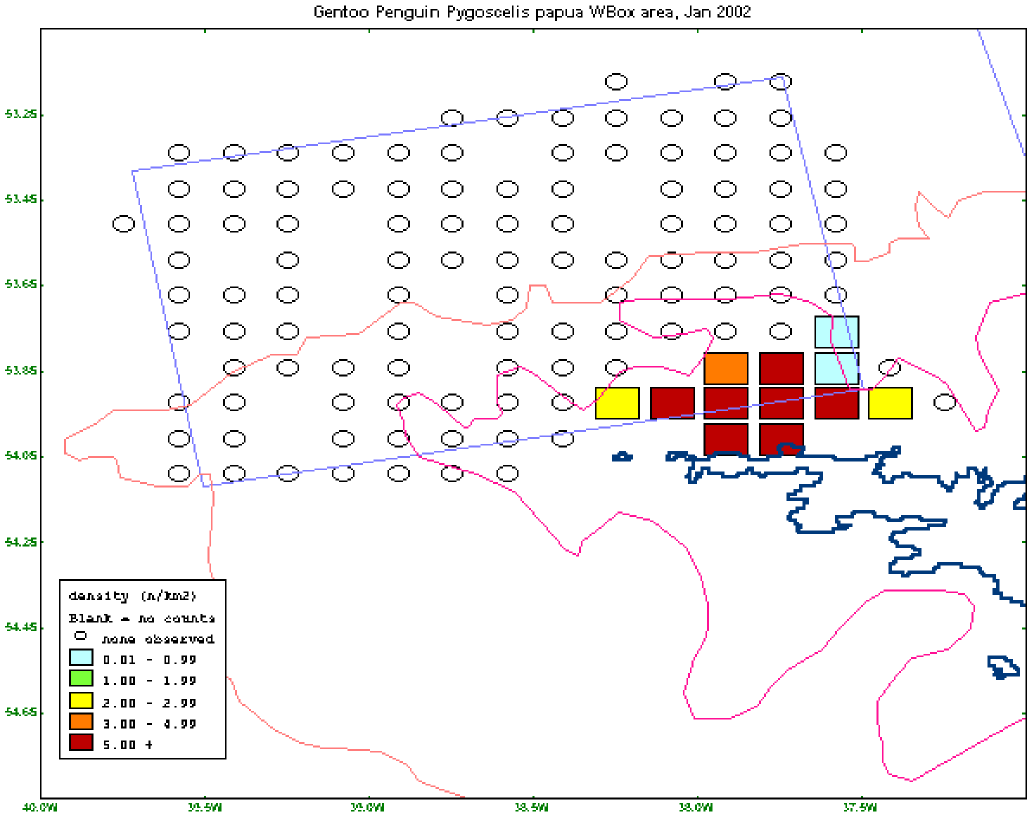


FIGURE 17: DISTRIBUTION OF MACARONI PENGUINS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

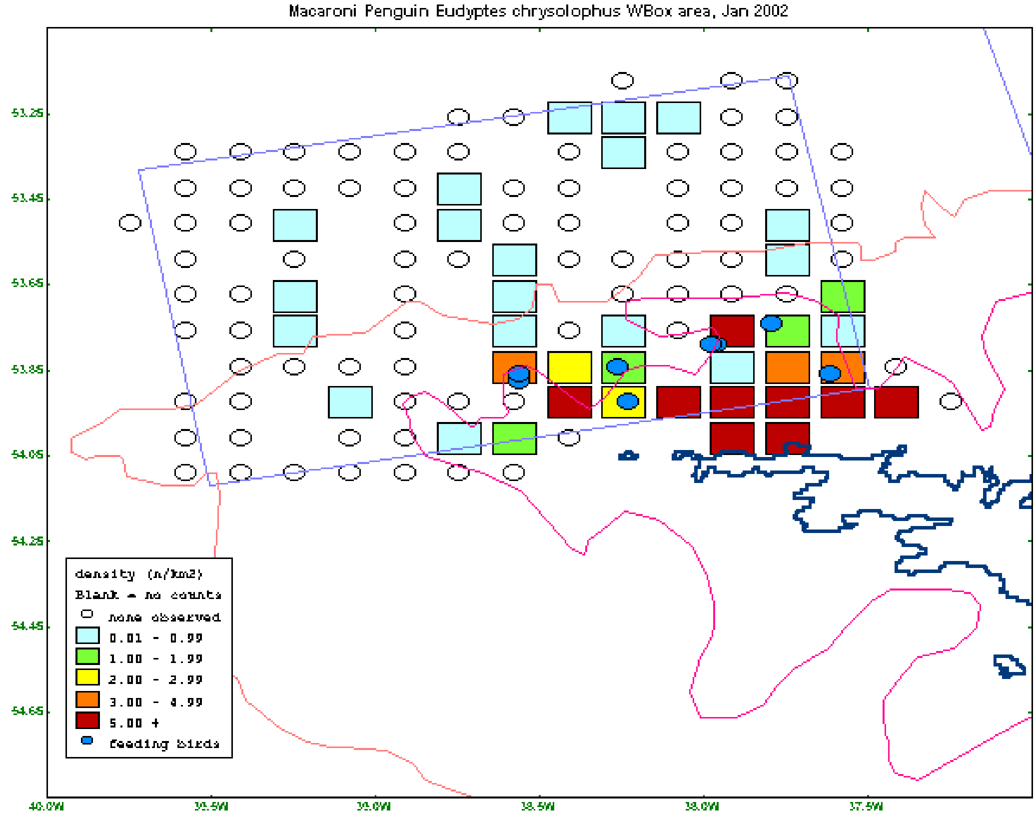


FIGURE 18: SATELLITE TRACKS OF MACARONI PENGUINS TAGGED AT BIRD ISLAND, AS NUMBER OF SIGNALS PER KM², JANUARY 2002. THE DATA WERE SUMMARISED FOR THE SAME 5'X10' GRID AS THE SURVEY DATA.

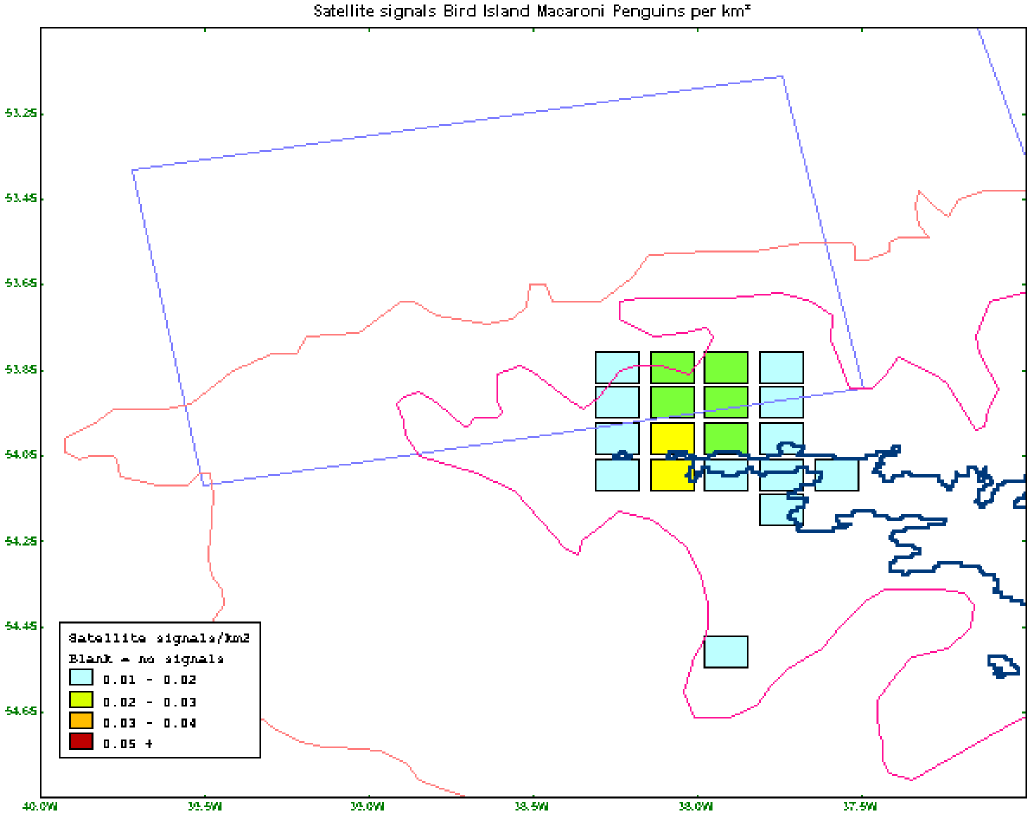


FIGURE 19: DISTRIBUTION OF WANDERING ALBATROSSES (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

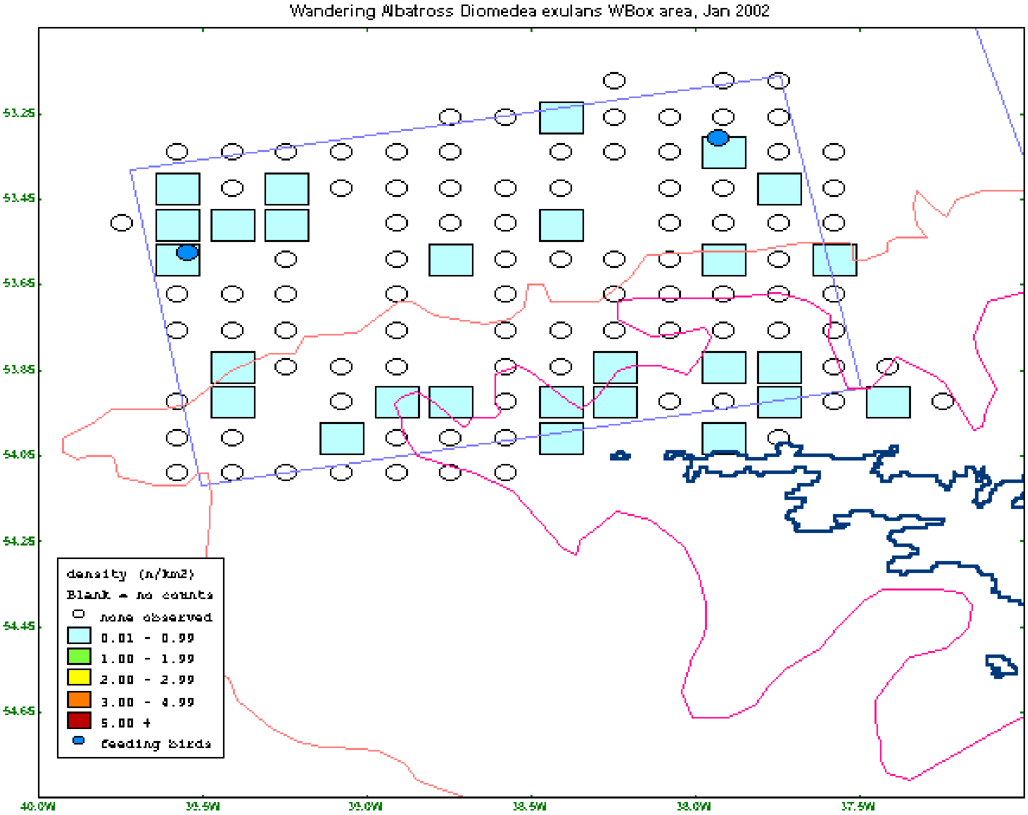


FIGURE 20: DISTRIBUTION OF GREY-HEADED ALBATROSSES (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

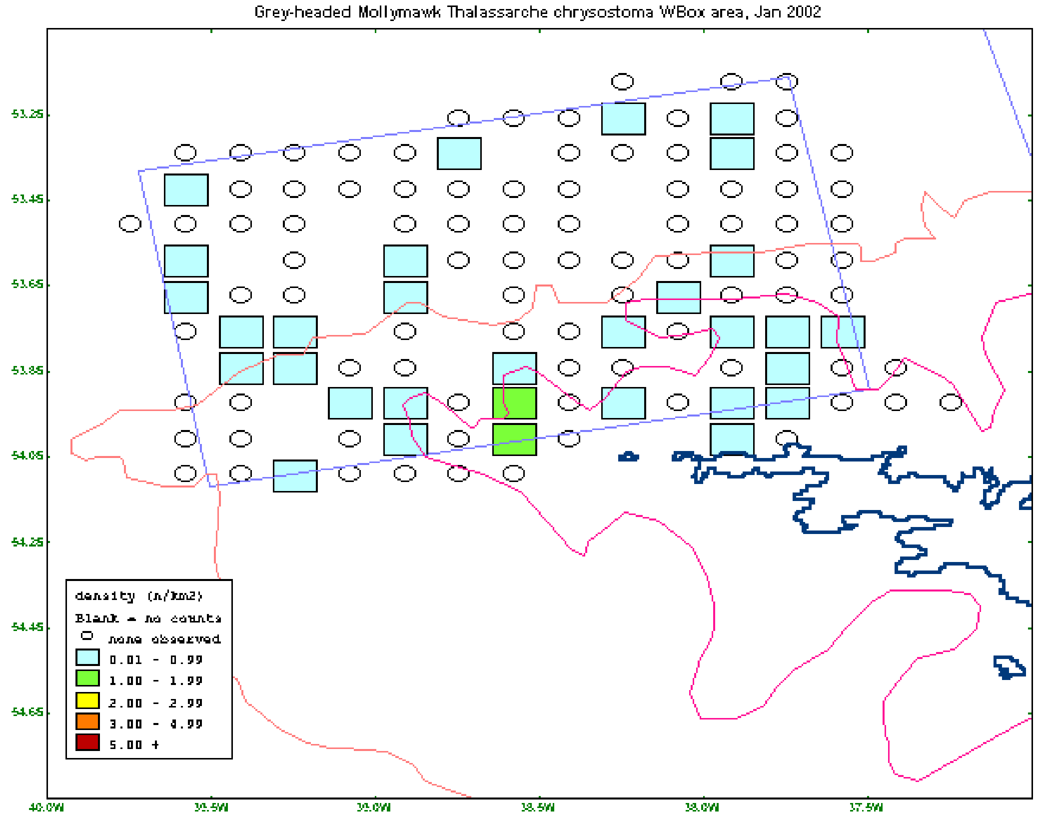


FIGURE 21: DISTRIBUTION OF BLACK-BROWED ALBATROSSES (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS (EXCLUDING SCAVENGERS AT TRAWLERS)

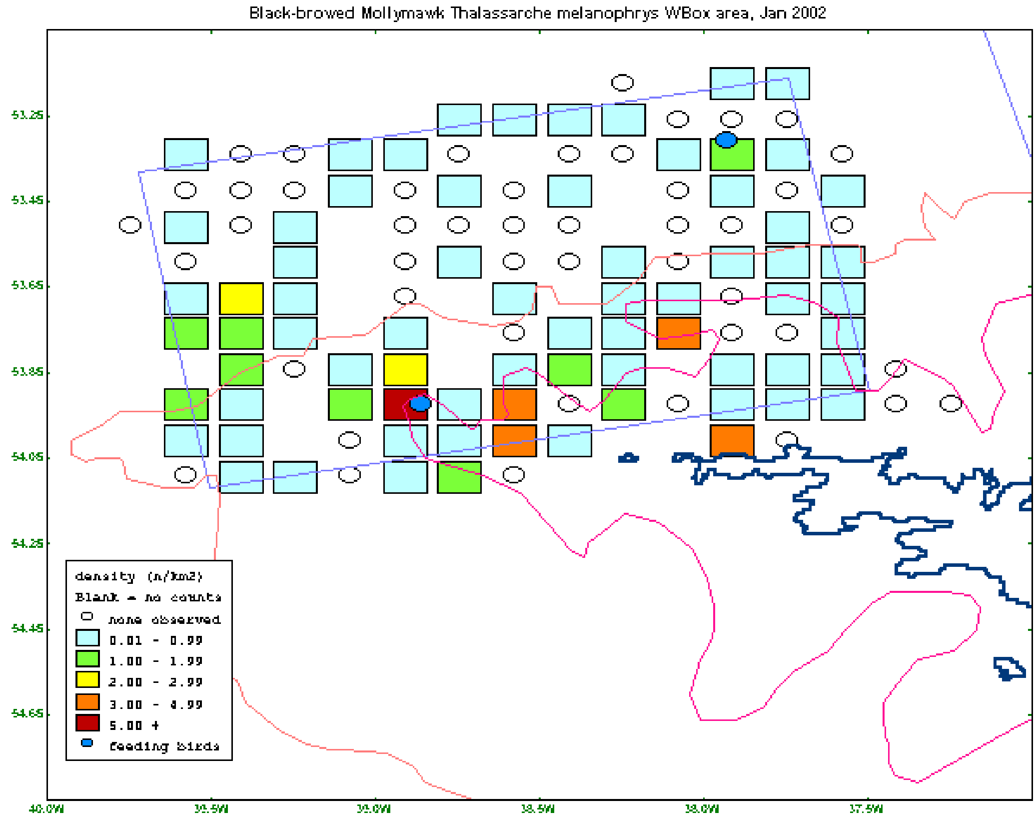


FIGURE 22: SATELLITE TRACKS OF BLACK-BROWED ALBATROSSES TAGGED AT BIRD ISLAND, AS NUMBER OF SIGNALS PER KM², JANUARY 2002. THE DATA WERE SUMMARISED FOR THE SAME 5'X10' GRID AS THE SURVEY DATA.

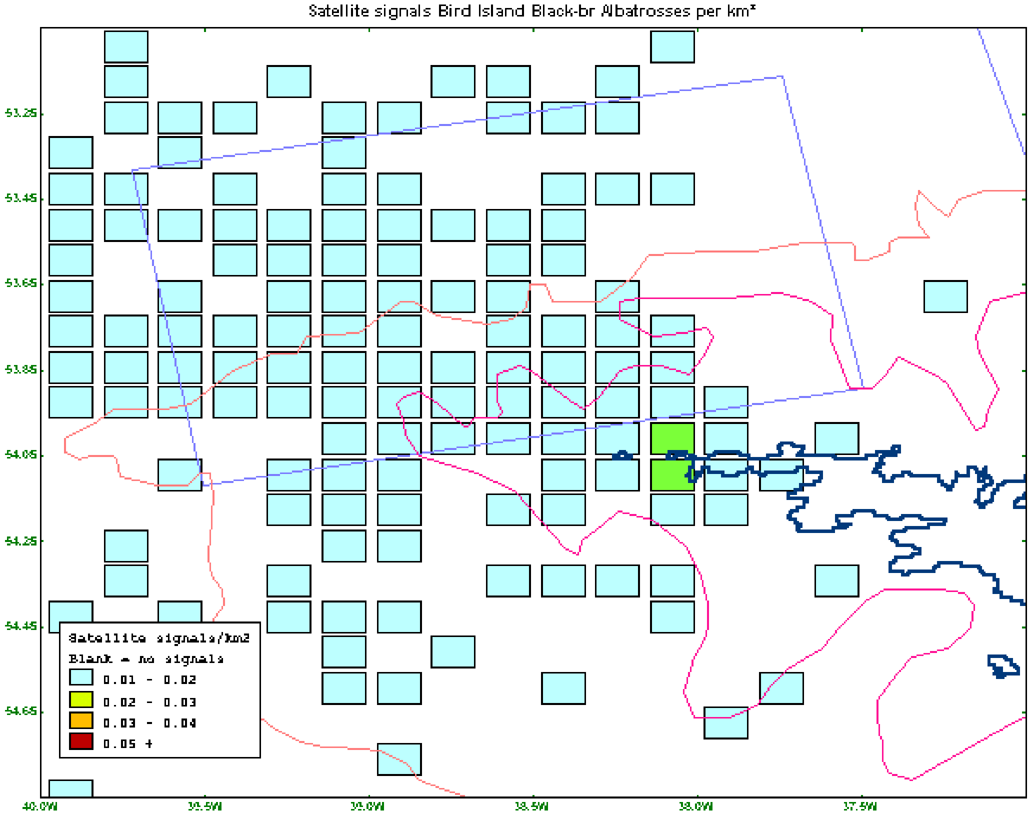


FIGURE 23: DISTRIBUTION OF GIANT PETRELS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

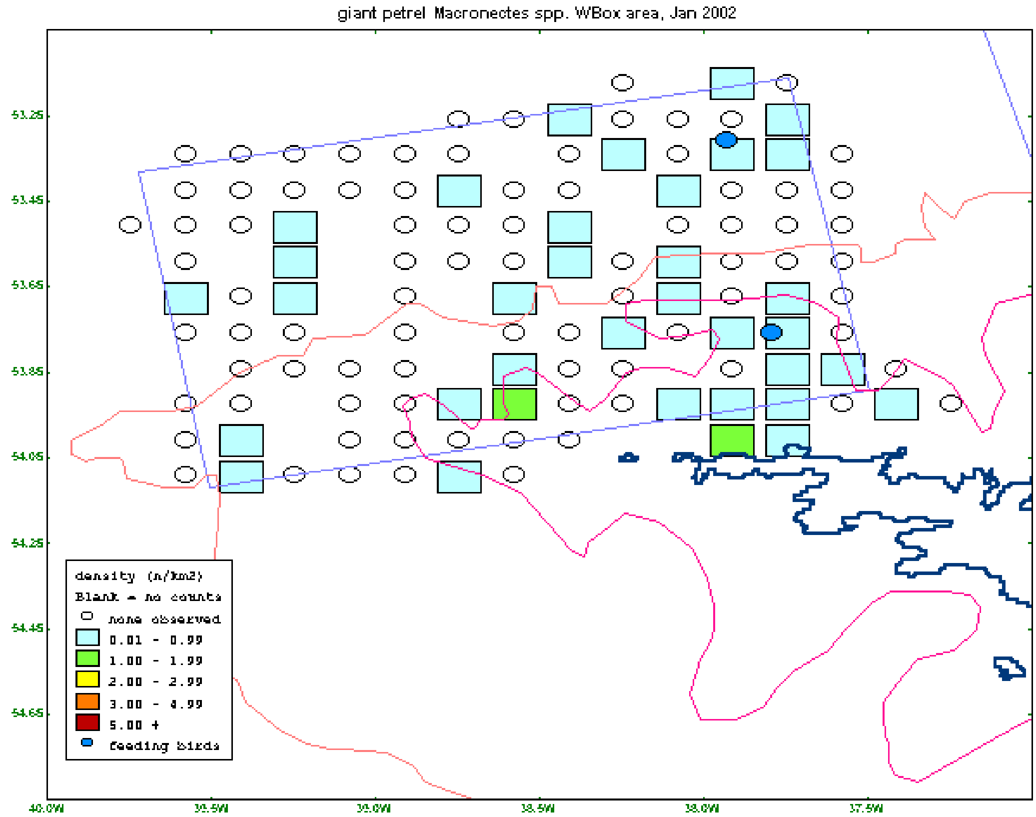


FIGURE 24: DISTRIBUTION OF WHITE-CHINNED PETRELS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

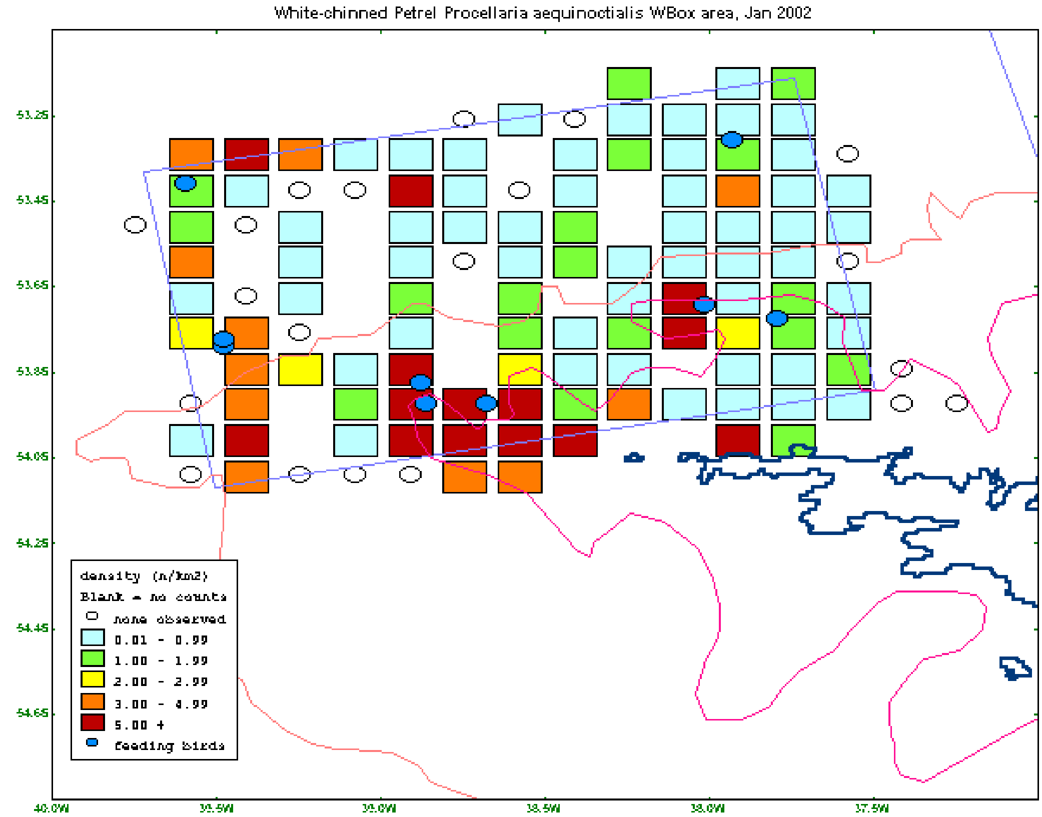


FIGURE 25: DISTRIBUTION OF BLUE PETRELS (N/KM^2) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

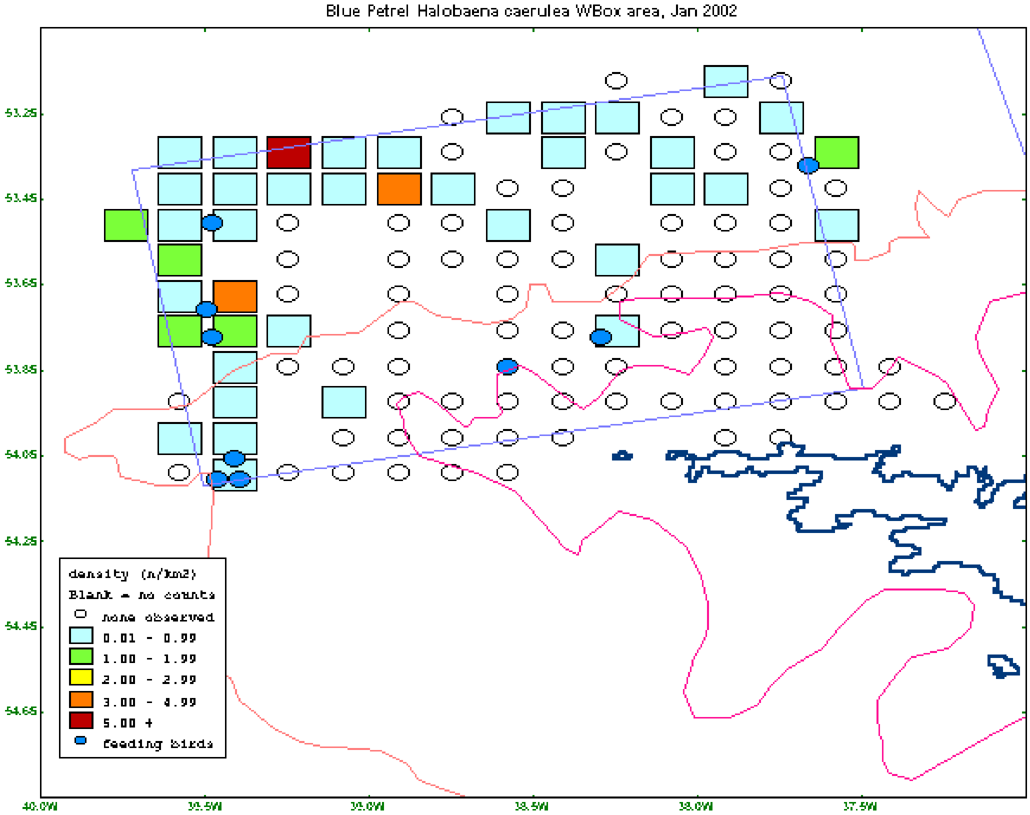


FIGURE 26: DISTRIBUTION OF SOFT-PLUMAGED PETRELS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

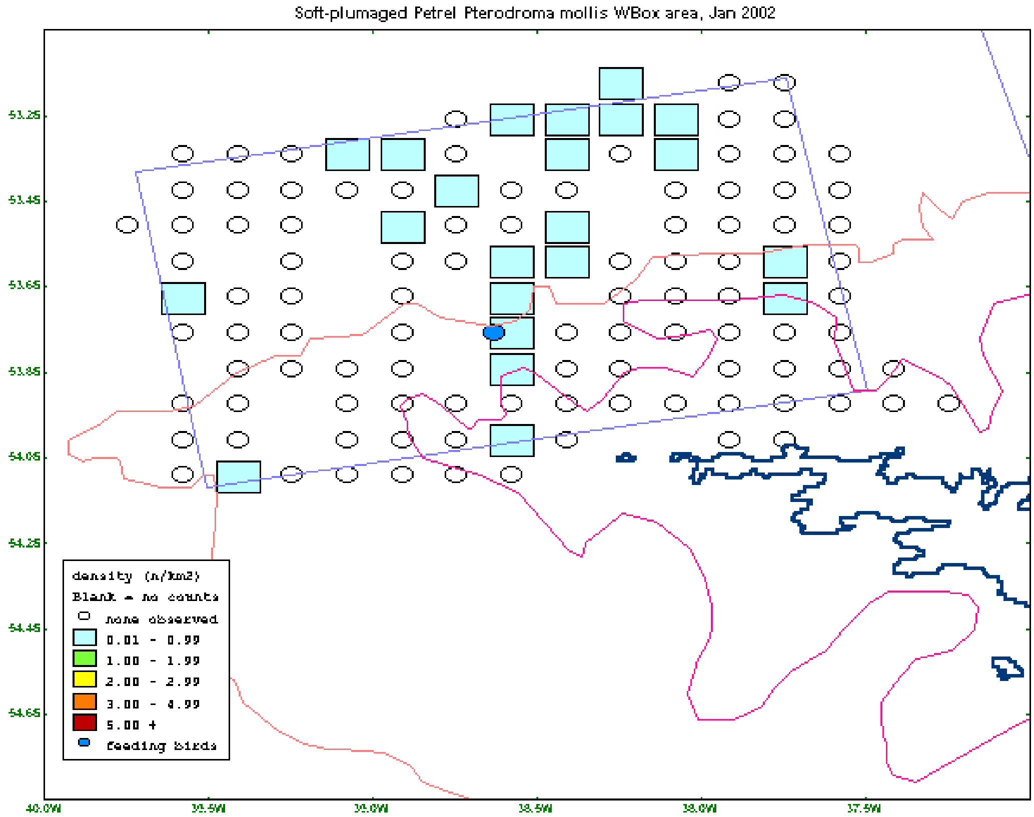


FIGURE 27: DISTRIBUTION OF PRIONS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

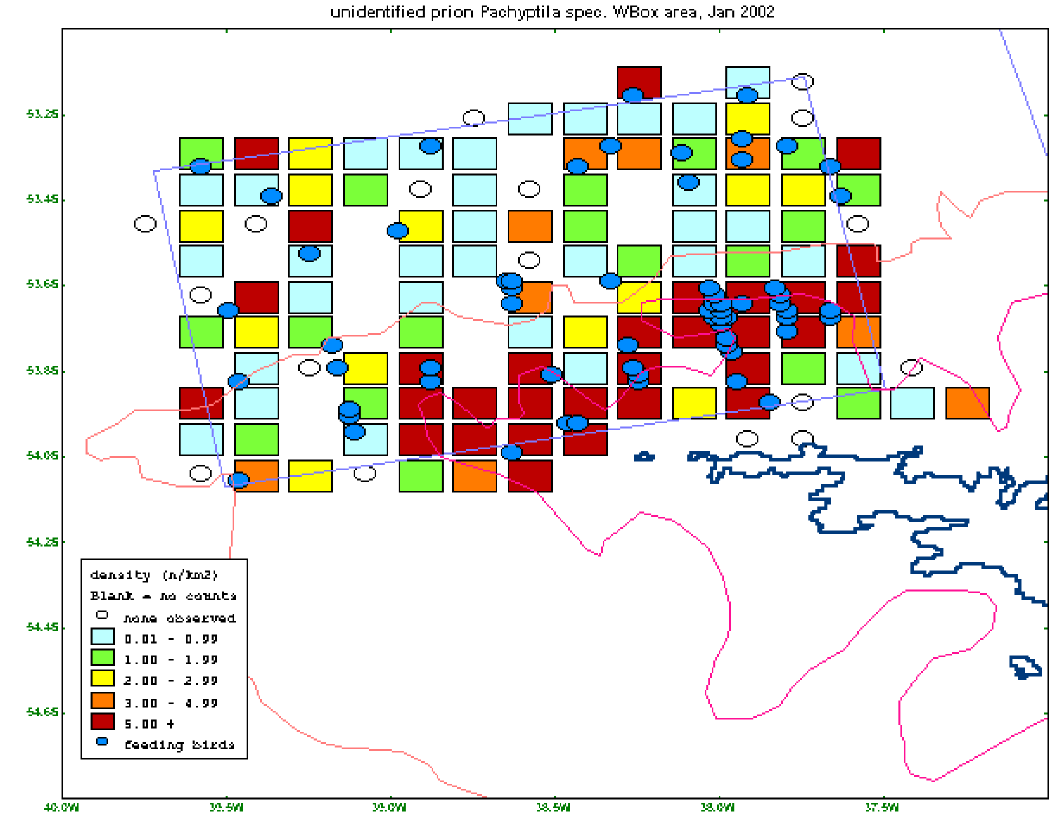


FIGURE 28: DISTRIBUTION OF DIVING PETRELS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

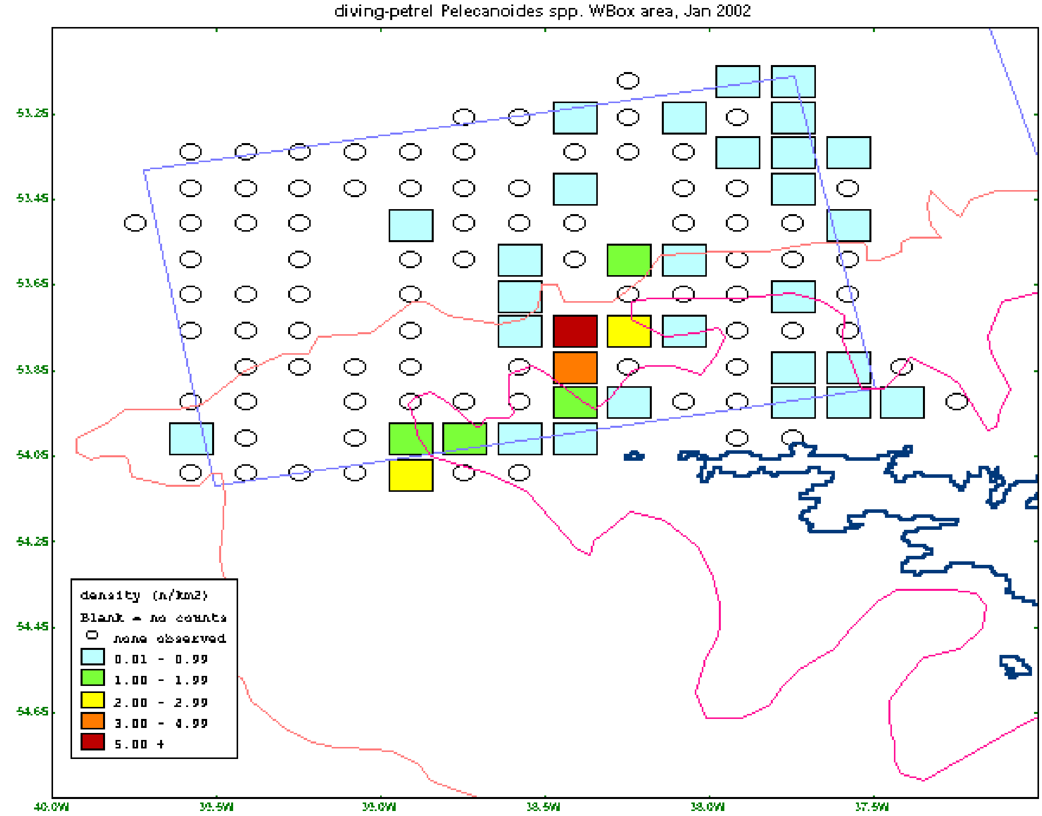


FIGURE 29: DISTRIBUTION OF BLACK-BELLIED STORM-PETRELS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. NEARLY ALL OBSERVED STORM-PETRELS WERE ACTIVELY FEEDING

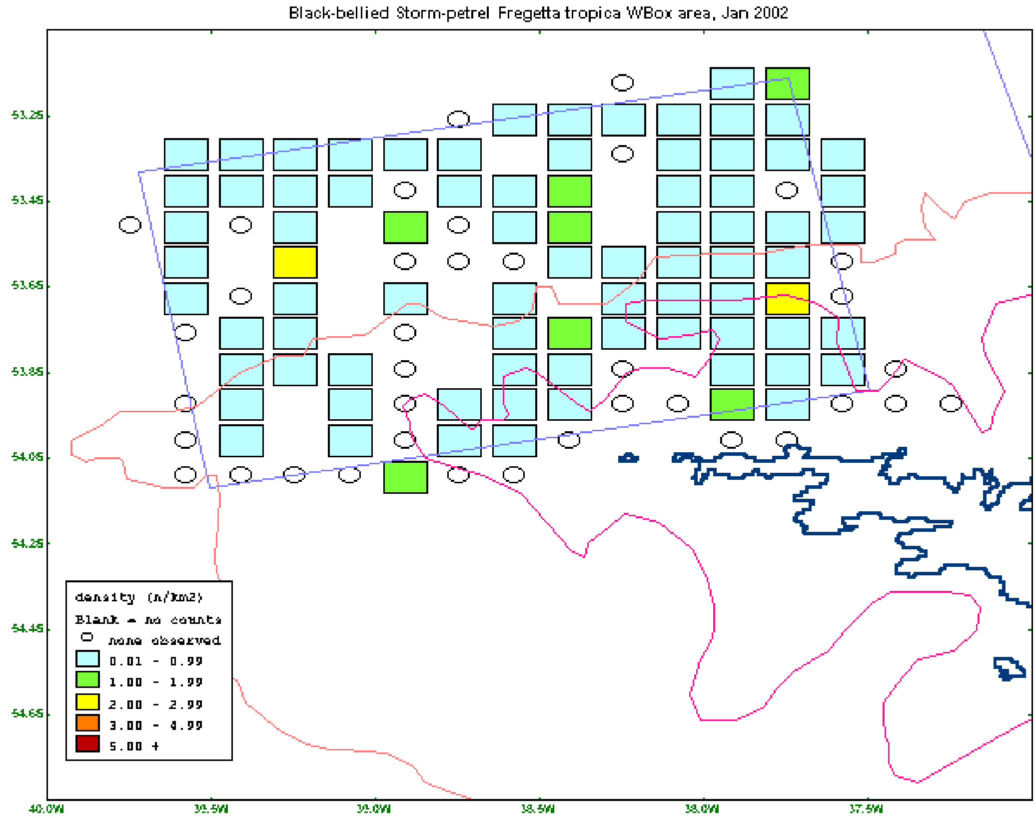


FIGURE 30: DISTRIBUTION OF WILSON'S STORM-PETRELS (N/KM²) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. NEARLY ALL OBSERVED STORM-PETRELS WERE ACTIVELY FEEDING

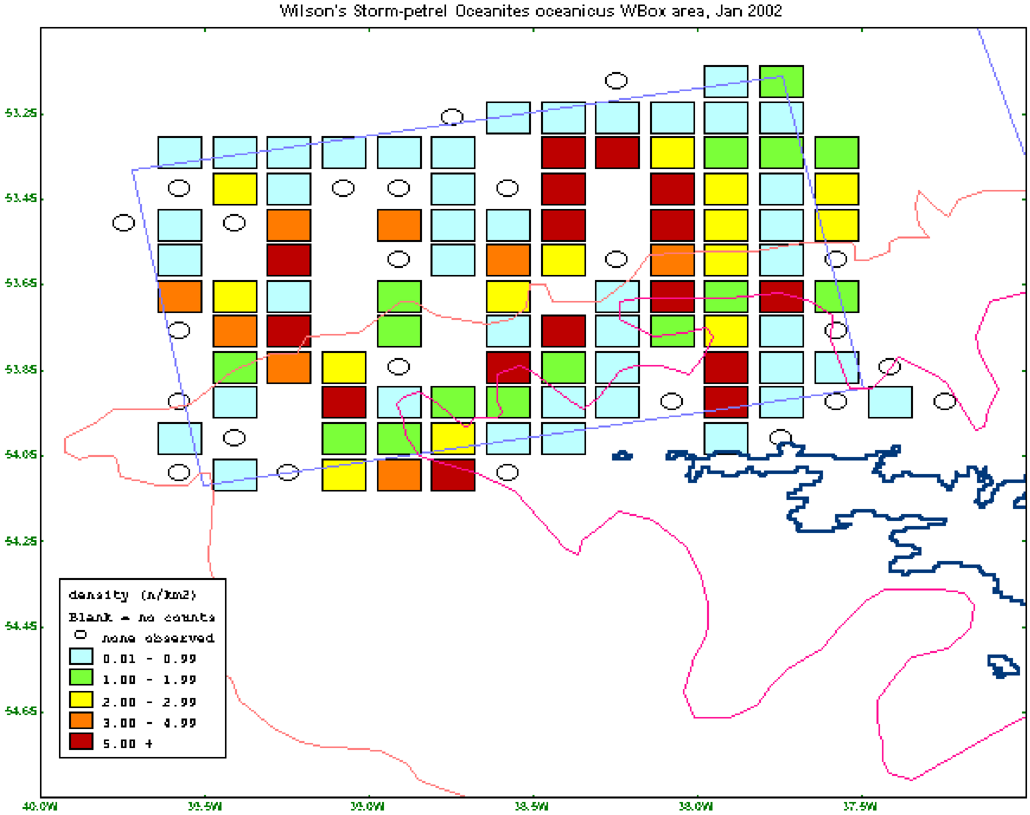


FIGURE 31: DISTRIBUTION OF ANTARCTIC FUR SEALS (N/KM^2) NW OF SOUTH GEORGIA, JANUARY 2002, BASED ON SHIP-BASED SURVEYS ON BOARD JC ROSS. NOTE DIFFERENT SCALE!! PRECISE LOCATIONS OF ACTIVELY FORAGING INDIVIDUALS ARE INDICATED AS BLUE DOTS

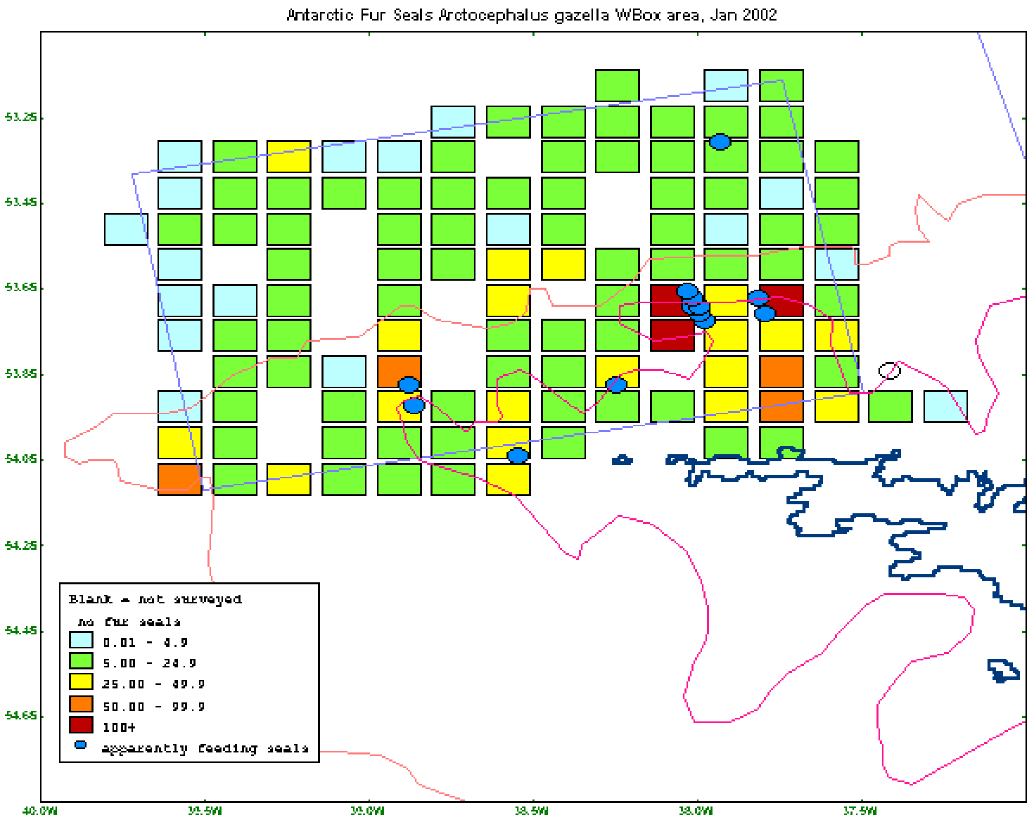


FIGURE 32: SATELLITE TRACKS OF ANTARCTIC FUR SEALS TAGGED AT BIRD ISLAND, AS NUMBER OF SIGNALS PER KM², JANUARY 2002. THE DATA WERE SUMMARISED FOR THE SAME 5'X10' GRID AS THE SURVEY DATA.

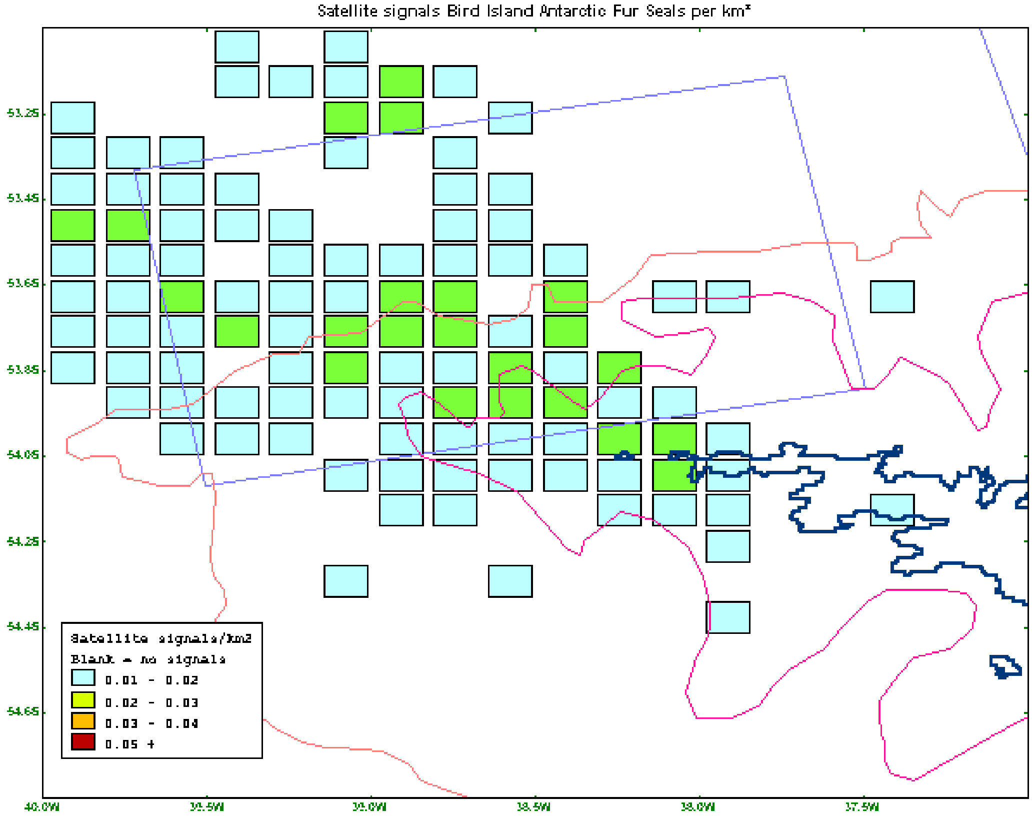


FIGURE 33: ANTARCTIC FUR SEALS PER KM² DURING BIOMASS 1 (13-15 AND 23 JANUARY 2002) FOR EACH 5-MINUTE PERIOD IN THE WESTERN BOX AREA.

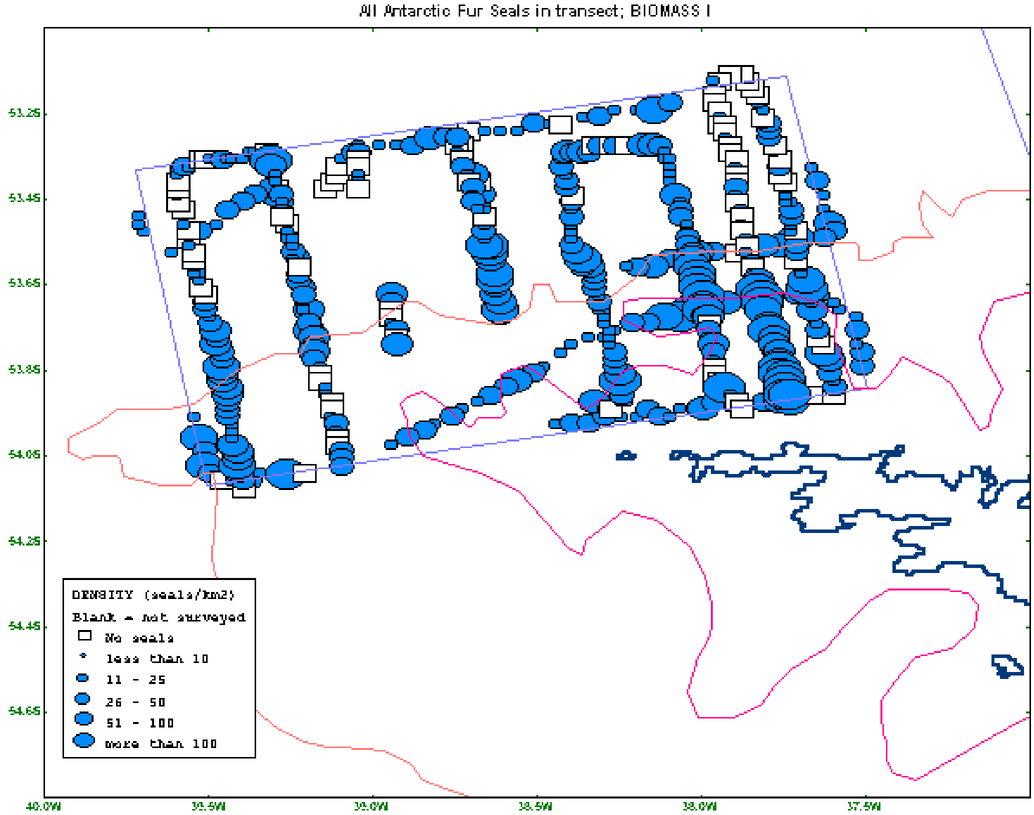
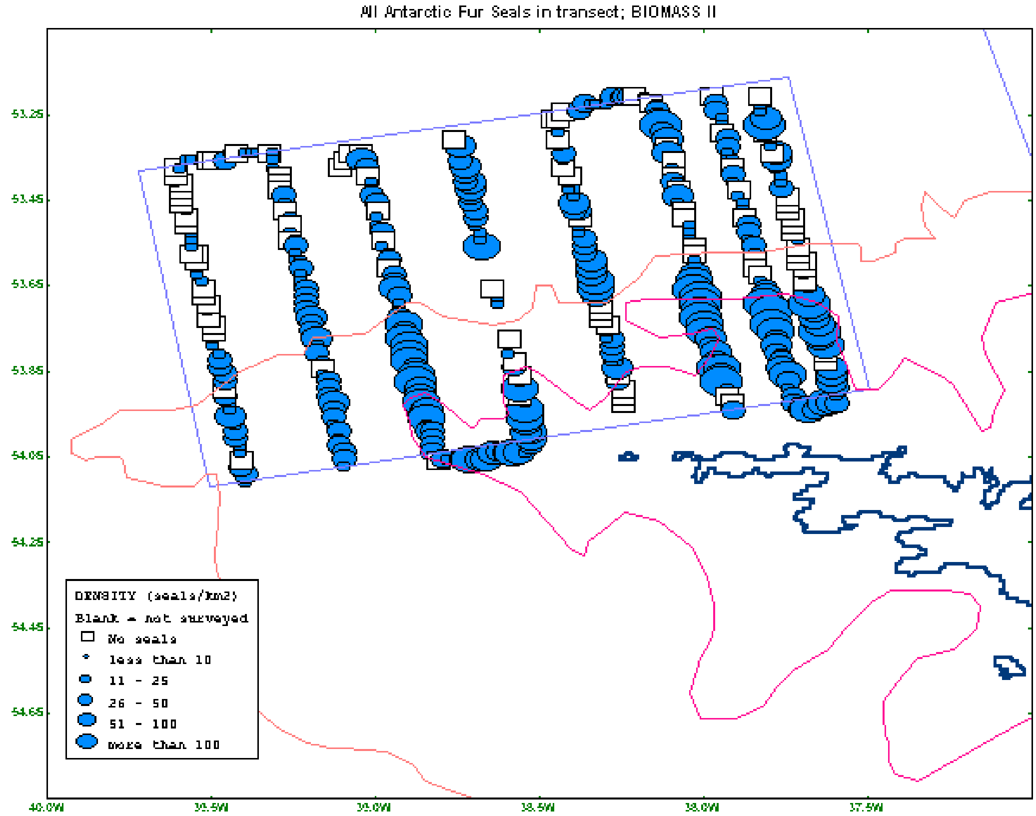


FIGURE 34: ANTARCTIC FUR SEALS PER KM DURING BIOMASS 2 (24-27 JANUARY 2002) FOR EACH 5-MINUTE PERIOD IN THE WESTERN BOX
AREA.



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SCIENTIFIC GEAR

(DOUG BONE, SHARON GRANT, JON WATKINS)

UNDULATING OCEANOGRAPHIC RECORDER (CHELSEA INSTRUMENTS LTD NUSHUTTLE)

The Nushuttle was deployed 12 times for a total recorded time of 54 hrs 39 mins 38 secs. This is somewhat less than we would have expected for the cruise. The loss of time was due to two causes. Poor visibility combines with a high incidence of ice caused one deployment to be aborted and a second cancelled. Technical problems caused further losses, towing around the Boundary Box survey was aborted after 4 hours and transect ER365 was lost when communications failed as soon as the vehicle was in the water. On the plus side, for transect TP059, we recorded the deepest continuous undulations that we have ever made, the vehicle was consistently going down to 150 m. At the end of the transect the flight parameters were set to keep the shuttle at depth until an XBT deployment was completed this allowed the vehicle to get down to 160m; the speed was 10 knots and the cable strain not undue. The technical problems are discussed in detail below.

Last season (cruise JR57) we experienced great difficulty with the Power Line Modem used to communicate with the vehicle's servo drive for the 'wing'. It is this that drives the undulations. The cause could not be ascertained on board but the towing cable was suspected. Back in UK the system was tried through a new cable; the same problem was still present. Chelsea Instruments investigated and discovered that the modem was being interrupted by noise generated on the power line by the Flourometer flash lamp. A 'cure' for this was engineered. Testing, back in UK, and on deck at the start of the cruise, indicated that the problem had gone away.

The software for the shuttle, including the Optical Plankton Counter, was transferred to new, rack mounted PC's.

An initial trial tow was carried out on 04.01.02, during this the communications appeared to be working satisfactorily but the vehicle failed to respond to commands, and so it was recovered. Investigations on deck revealed that the Primary Servo Parameters of 'servo wing max' and 'servo wing min' were both set at zero. This would prevent the wing from moving in response to differences between actual and 'command' depth. We did not have a record of the previous settings, but were aware that they were close to the maximum and minimum values for wing position displayed on the NSHUTTLE screen. The wing was moved by hand to each of these positions in turn, the figures recorded and entered as 'servo max and min' respectively.

A second trial tow on 06.01.02 also resulted in apparent satisfactory communications but still no response from the vehicle. The Primary Servo Parameters were checked with the vehicle still in the water, it was discovered that the values for 'p','i', and 'd' were also set at zero. Reference to handbook 167 gave the values of 3.0x10-1; 1.0x10-2 and 0 respectively, these were installed and the shuttle responded immediately. The settings must have been set to zero while the equipment was with Chelsea Instruments Ltd during the summer of 2001.

Some problems were experienced with the modem right from the first data gathering deployment, with the software having to be re-started at some point in nearly every deployment. This appeared to be a recurrence of last year's problem. However subsequent events suggest that there may have been other contributory factors.

On the 7th deployment the vehicle suddenly dived deep, setting off the cable tension alarm, and would not respond to commands. On recovery it was found that the screw securing one end of the wing pivot bar had worked loose and been lost. This is the second time that this problem has occurred. We are not alone in having it happen and Chelsea Instruments have modified the design in order to prevent the problem. Their modification is not possible on our vehicle but an 'in house' solution has been designed and will be implemented on return to UK.

On the 9th deployment communications were lost, restarted, and lost again. Further efforts to restart the modem failed, and the vehicle was recovered. Investigation revealed that at least three of the conductors in the pigtail of the rubber connector terminating the tow cable had fatigued through. The cable was re-terminated. It was also discovered that the cross bar of the towing bridle had fractured where welded to the main frame. A spare tow bar is carried so this was fitted.

On deployment 11 the modem stopped working after 4 hours and it was not possible to re-establish communication. Initial investigations after recovery suggested that the problem lay, once again in the cable termination. (A new connector had been employed). The cable was re-terminated again and the system tested on deck; where it did work. However the system broke down completely immediately the vehicle was next deployed. Further investigation gave conflicting indications. At one point it appeared that the Chelsea Instruments 'fix' for the modem problem had broken down and they were contacted for advice. However, further investigation implicated the wiring between the Servo unit and the housing of the underwater end of the Modem. This housing was opened to check for water ingress, which has happened before, but this was dry. Although no break could be demonstrated in the wiring, the fact that the modem could not be made to work at all after re-assembly, indicates strongly that the problem lies here. We have no spare connectors with which to test this hypothesis.

CONCLUSIONS

The problems that led to the final breakdown of the modem could have been present earlier in the cruise, so we cannot be sure that Chelsea Instruments did not fix the fault experienced last year.

The first rubber pigtail to fail lasted much less time than is normal, we may need to look at the routing of the cable from the tow bar to the body.

Problems such as those outlined above, would be much quicker to diagnose (and fix) if we had more spares, the connectors are expensive but lost sea time is even more expensive.

TOWFISH

The towfish formerly developed to carry transducers for 38, 120 and 200kHz, duplicating those in the hull, has been reconfigured for this cruise using only the 200 kHz transducer. The transducer was re-orientated to look out sideways, or sideways and upwards in order to detect targets in the surface waters above the level where the downward viewing hull mounted transducers can detect targets.

Previous use of this towfish has met with limited success owing to the difficulties of maintaining fairing on the 28mm diameter tow cable that is necessary with the three transducers, (two of which are split beam type requiring 8 conductors each). On this occasion we towed the fish on an 8mm diameter cable having 7 electrical conductors, (Rochester Corporation Type 7-H-314). The bottom 15m of this cable were fared with Fathom fairing, the utility of this setup was dramatically different from the previous one. The barrel of the PES type davit was below the theoretical minimum bend diameter for the fairing so it was increased as much as possible by covering it with wooden 'barrel staves' increasing the diameter by approximately 100mm. The fairing was very well behaved during deployment and recovery and no damage occurred. The drag of the entire system was so low that the fish could be towed at almost 20 m depth at 10 knots.

The electrical properties of this cable are not ideal, particularly the peak voltage limit, in order to avoid insulation breakdown, transformers were employed at either end of the 40 m length of Rochester cable. The transmission pulse was transformed down at the top and back up at the bottom. These transformers were kindly designed and built by Mr Andy Harris of Southampton Oceanography Centre. Calibration of this setup was carried out at Stromness along with the hull transducers the results are shown in the acoustic section.A depth transducer, operating on a 4-20 ma loop, used 2 of the 7 conductors in the cable.

The transducer mounting was designed to allow the beam to be directed between 100 down and 200 up, in 50 steps. Although there would be some advantages in having the fish tow close to the surface with the beam looking down, initial trials (with the beam horizontal) showed that at depths close to the ships draft the towfish was drawn under the hull by the flow of water around it. Towing much shallower than this would have left the fish vulnerable to clearing the water in heavy rolls, which would not be desirable. For these reasons it was decided to set the transducer at 200 Up. The set up is shown diagrammatically below, looking along the direction of travel.

For future seasons it will be possible to use a longer cable with more fairing which will allow the fish to be towed deeper still.

RECTANGULAR MIDWATER TRAWL. (RMT)

The RMT was used with two RMT8 nets only, rigged to allow independent fishing, as target fishing for live krill was to be a large part of the programme. A total of 25 hauls were made, the rig performed without problem. In previous seasons difficulty has been experienced in drawing the side wires up through the ends of the main spreader bar. This has been due to the ferrules forming the eyes at the top of the side wires 'hanging' on the rollers. This problem was much reduced by fixing a piece of heavy-duty rubber tube over the eye; this improvement can be carried further and will be implemented for next season. A number of repairs had to be made to the nets themselves. The mesh employed to make the fine mesh section toward the cod-ends of the two nets used has a tendency to 'ladder' this was known, and more recently made nets have employed a more durable fabric here. Other tears were found, almost certainly due to too vigorous recovery of nets in the dark, when cod-end tube catches caught unnoticed in the mesh. The nets will be examined thoroughly on their return to UK to assess if further repair would be economic.

As a large number of live krill were required this season, we experimented with non-filtering or 'solid' cod-ends. These were designed to hold about 50 l of water, reckoned to be the maximum that two people could safely haul up over the stern roller. To ease the strain on the net during this hauling up process ropes were attached to the cod-ends and led up to rings sewn onto the supporting tapes on the floor of each net. Although there is room for improvement in the method of rigging the system worked well and the krill caught this way were generally in better condition than those caught in the traditional style cod-ends. However the key to capturing krill in good condition is calm weather, short shallow hauls and avoiding overloading.

ANTARCTIC MULTIPLE PLANKTON SAMPLER (AMPS)

The AMPS net was deployed for one trial haul only, this was successful. A battery pack was fitted to overcome the problem of high current draw that made use of the AMPS net difficult last season.

DOWN WIRE NET MONITOR

Once again the down wire Net monitor began the cruise as a set of components that required assembly before they could be used. The new Printed circuit board based units were assembled and wired in by Mark Preston (ETS). Although the boards and the system generally had been working on the bench before despatch no time was available to check depth calibrations or work up the system generally.

A step forward was the fact that the two underwater units were now identical. In practice they did work but the problem of noise on the temperature and conductivity that has been experienced in previous seasons, has not been cured, nor has an offset on depth. The software, particularly the user interface, is very good, the best that we have had. In practice the system was usable but all the more frustrating because we could see just how good it could be.

Finding a cure for the noise problem has been protracted because it has only revealed itself on the ship and generally only when the underwater unit was submerged. To check the feasibility of testing the system immersed in seawater in Cambridge an underwater unit and set of instruments was immersed in a sink full of seawater run there. Further tests were run using a simulated towing cable. These tests showed that the problem could be demonstrated this way. Thus, we now know it is not necessary to run the system on the ship to generate the faults. Hopefully it will be possible to carry out full testing and elimination of the faults back in Cambridge. A full report on the test carried out and the operation of the Net Monitor has been prepared as a separate document for targeted distribution.

In order to facilitate the final elimination of these problems the Net Monitor equipment is being air freighted home to allow work to start long before the rest of the equipment is returned to the UK.

ETS REPORT
(MARK PRESTON)

OCEANLOGGER

The OceanLogger in it's present form was new to the ship in the summer of 2001 and was designed, built and installed by the outgoing ETS engineer, Richard Bridgeman. As with any new equipment, especially home-grown, there were some problems, some easy solutions and some problems still to be investigated. A list of known problems is shown below:

Time shown on the graph axis gradually drifts compared to 'real' time.

TIR values on a sunny day hit some sort of ceiling in either hardware or software

Inappropriate grouping of traces on a graph meant that the graphical display was less than informative

Flow meter reading is different on the meter itself compared to the Ocean Logger reading

Due to the desire to keep the machine running for the maximum time possible, modifications to the software on the machine itself were viewed undesirable as this would produce considerable 'holes' in the data. The machine was stopped (while on station) for just long enough to take a copy of the program for investigation elsewhere.

Points one and three in the above list were problems with the method of coding and were investigated, corrected and tested. Points two and four can only be investigated using the Ocean Logger itself as real data is needed.

Time shown on the graph axis gradually drifts compared to 'real' time

This was corrected by using a different type of graph routine where 'time' for each graph point is kept in an array and re-plotted each time a new point is added, rather that allowing a 'strip chart' keep tabs on time.

Inappropriate grouping of traces on a graph meant that the graphical display was less than informative

This was corrected by creating different 'Y' scales for each of the data plotted on the graphs and would allow each trace to 'autoscale' thereby providing much better display of information. The new upgraded software will be installed and tested alongside in Stanley in the break between JR70 and 71. Points one and three will also be investigated at this point.

Apart from the shortcomings mentioned above the new Ocean Logger worked well throughout the cruise

ITS REPORT

(RICHARD CABLE & JOHNNIE EDMONSTON)

DATA LOGGING SYSTEM

SCS

The SCS has performed well throughout the cruise. There was a problem with the level A. A different level a with a different daughter board for the gyro was used and has been ok since.

The netmonitor for the SCS seemed to have a problem with the output string and stopped logging the Netmon after approx 250k. When observed on the ITS laptop, it seemed to be overwriting the last field in the output string which represents the net type field. Andy Barker seemed to think it was the SCS that was causing the error. Andy has written a replacement Java program called genlog, which is a general logging program adapted for the Netmon. I deleted the instrument from the sensor file for JR70. Then ran the Netmon java program. It is started by running java genlog netmon.cfg from the C:\genlog directory on the SCS server. I ran it from com24 rather than com23 as the SCS was still using com23 and would have to have been stopped.

JAVA LOGGING SYSTEM.

The Java system has performed well throughout the cruise with no problems. Except for 2 things:

1) When a Windows95 machine tried to run the Datamon program externally. This caused the Datamon program and the gyro program to lock up.I am not sure if it was something to do with the version of Java that was used or whether it is because it was Windows 95. This may be something to investigate at Cambridge.

2) The Auqashut has to be patched and have the stream running before the UOR is started. The UOR also has to be started in a specific order, as follows:

- Switch on OPC pc
- Switch on Nshuttle pc
- Switch on Aquashuttle pc Switch on
- OPC deck unit ....
- Red data light flashes
- Switch on SIU
- SIU buzz's and red line ready light comes on

OPC

- Select OPC pc on CS-14

- Log in
- Set time to master clock
- Change directory = c:\OPC2002\
- Type "opc_das"
- Enter filename………………..Check directory Q:\jr70\tow_opc\
- Alt-A
  Start acquire
- Switch on data logging………Time starts to count as soon as screen appears

Nshuttle

- Set time to master clock
- Type nshuttle………Check directory C:nshuttle\
- Status message ="Sending parameters - Hello everybody – Idle"
- Red/Green/Yellow trace lines appear
- Set flight parameters to 10/10/50

Aquasoft

- Select Aquasoft pc on CS-14
- Type "aquasoft"
- Select "Utilities"
- Select "Utilities – Reset Station"……...Enter event number
- Select "Acquisition – Deploy Instrument now"……..
- Check nshuttle Status message ="Receiving header
- Hit space bar to start logging………."Aquiring aquapack data"
- "Logging aquapack data"
- Lines appear on graph
- Check Aquashut datastream is not all zeros.

READY TO DEPLOY!

UNIX SYSTEMS

JRUF

JRUF has performed well throughout the cruise. A new license was needed for Arcview and out version of Netscape is out of date for the help in Matlab.

JRUB

JRUB has performed with no problems throughout the cruise.

NETWARE SYSTEMS

The NetWare and GroupWise server has performed well throughout the cruise. The server required a reboot as it had run out of available memory as the new Sophos NLM would not load. Cache memory allocator out of memory.

This may be because of the increase in open programs on JRNA such as AMOSW.

Upgrade to the Sophos anti virus system. The antivirus of the PC's on board was upgraded to version 3.52 through SAVADMIN, with no problems.

AMOSW was upgraded along with the other ships and bases with no problem.

Sigma plot needed a licence code and serial number.

- SigmaPlot 2001
- S.No. 3748370
- Licence code: 46281146308727312822937771372252521645.

COMPUTER ROOM.

On leaving Montevideo the roof of the computer room was leaking water from an air conditioning unit. The water was cleared up and the unit was switched off.

DATA MANAGEMENT REPORT

(NATHAN CUNNINGHAM)

Data management was carried out in much the same way as on previous cruises. The SCS system, RVS system and level C all performed their function in logging the data. Progress on logging metadata was made with consideration and the initial implementation of XML schemas for the underway and station data. This is the start of the implementation of the two years metadata strategy. Exploratory work was undertaken for developing the RDBMS for the underway data collected by the SCS.

Long Term Archiving of Dartcom data:At present HRPT images from passing NOAA satellites are collected by the Dartcom dish on the Wheelhouse Top and archived to a PC on the Bridge. However, only 25 raw images are archived at any one time (approx. 2 days of data) and are constantly replaced by more images that are recent. As HRPT images comprise useful scientific data (sea surface temperature can be derived for example) it would make sense to archive all the images that are received to allow further analysis back at HQ. A simple solution would be an addition of a large capacity hard drive (100Gb would archive about 120 days) connected to the Bridge PC. This could be easily achieved by purchasing a relatively cheap snap network drive (approx. £350) and attaching it directly to the datacom logging system.

ACKNOWLEDGMENTS

(PETE WARD)

Cruises of this sort require an awful lot of planning, logistic and technical support before we even go South. Accordingly we extend our thanks to Logistics and Operations groups at BAS for getting us and our equipment into the field.Once onboard we received the highest possible level of assistance from Captain Burgan and his team who enabled us to use the resources of JCR to the full and carry out a very successful cruise. Your help, tolerance and unfailing good humour were much appreciated by all.