SIBEX-II: Report of the South African study in the sector (48 – 64°E) of the Southern Ocean

D G M Miller (Editor)

A report on a research voyage to the Southern Ocean organized under the auspices of the Southern Ocean Committee of the South African Scientific Committee for Antarctic Research (SASCAR)

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PREFACE

South Africa has participated in the SCAR/SCOR BIOMASS Programme since its inception in 1976, and has undertaken a series of five research cruises which have been dedicated to this programme. These were undertaken by the S.A.S. PROTEA (10 February - 12 April 1978), the M.V. SA AGULHAS (pre-FIBEX, 28 February - 2 April 1980; FIBEX, 16 February - 10 March 1981; SIBEX-I, 24 March - 26 April 1984) and the R.S. AFRICANA (SIBEX-II, 20 February - 23 March 1985).

This report summarises South Africa's participation in SIBEX-II and outlines some of the results obtained. The preliminary results of the South African SIBEX I cruise were published in the South African Journal of Antarctic Research (SAJAR) 15 (1985). In order to bring the preliminary findings of the SIBEX-II cruise, and the report on the cruise, to public notice as soon as possible, it was decided to publish these in this series rather than in SAJAR as in the case of SIBEX-I. In addition, since the cruise was abandoned at its midway stage on account of technical problems with the cruise vessel, the data collected were of such a nature that they could not be developed sufficiently for publication in SAJAR. Instead they are presented here in the form of an overall cruise synopsis and data listing.

ABSTRACT

This document summarises South Africa's participation in SIBEX-II and outlines some of the results obtained. South Africa's participation in SIBEX-II was aimed at providing a temporal comparison with an Australian oceanographic overview of the area 48-85°E, and a meso- and fine-scale survey of krill swarm dynamics. The cruise was planned for the period 20 February to 5 April 1985, but had to be prematurely curtailed as a result of a rudder malfunction. Nevertheless, the data collected, and a preliminary analysis of some of these, are reported on here.

SAMEVATTING

Hierdie verslag bevat 'n opsomming van Suid-Afrika se deelname aan SIBEX-II en gee 'n beskrywing van sommige van die resultate verkry. Suid-Afrika se deelname aan SIBEX-II was gerig op die voorsiening van 'n vergelyking in tyd met die Australiaanse oseanografiese oorsig van die area 48-85°E, tesame met 'n meso- en klein-skaal opname van krilswerm-dinamika. Die vaart was beplan vir die periode 20 Februarie tot 5 April 1985, maar is verkort weens stuur probleme. Die data versamel, sowel as 'n voorlopige analise van sommige van die data, word nietemin in die verslag beskryf.

KEYWORDS

Prydz Bay, krill survey, SIBEX-II survey, hydrocoustics, primary productivity, oceanographic data, ornithological data, Southern Ocean, R/S Africana.

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LIST OF ACRONYMS

BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks
CTD	Conductivity, Temperature and Depth Monitor
FIBEX	First International BIOMASS Experiment
MVBS	Mean Volume Backscattering Strength
SIBEX	Second International BIOMASS Experiment
SL	Source-level
SAJAR	South African Journal of Antarctic Research
TVG	Time-varied-gain
VRS	Voltage Receiving Sensitivity

INTRODUCTION

Following results obtained by the First International Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS) Experiment (FIBEX) in 1981, it was recommended that the Second International BIOMASS Experiment (SIBEX) should comprise a study of meso-scale processes in the Southern Ocean rather than estimation of circumpolar krill (Euphausia superba Dana) abundance.

The BIOMASS Technical Group on Programme Implementation and Co-ordination therefore proposed three SIBEX study areas based on FIBEX results. These were centred on the Bransfield Strait region in the south-west Atlantic, Prydz Bay in the south Indian Ocean and along 160°E in the Pacific Ocean.

The south Indian Ocean research plan was structured around the proposed existence of a semi-permanent gyral feature thought to influence water circulation in the region 50-85°E. This in turn is considered to influence krill distribution in the area. The four nations involved (Australia, France, Japan and South Africa) agreed to implement SIBEX in consecutive stages over two summer seasons. The first phase (1983/84) comprised an attempt to identify the dominant physical, chemical and biological oceanography of the little studied area between 50-85°E and from 60°S to the ice-edge. South African results from this first phase (SIBEX-I) found little to indicate the persistence of the gyre in the region 52-64°E and no large regional concentrations of krill.

On reviewal of SIBEX-I results, the three nations involved in SIBEX-II (Australia, France and South Africa) agreed that the latter should comprise a three-phased initiative. In keeping with the overall objectives of SIBEX and in accordance with national priorities, South Africa's contribution was divided into two parts.

Initially two survey transects (along 48 and 52°E) would be repeated in order to provide a temporal comparison with an Australian oceanographic overview of the area 48-85°E undertaken earlier in the summer of 1984/85. The second part of South Africa's contribution would utilise the unique capabilities of R.S. AFRICANA for a meso- and fine-scale survey of krill swarm dynamics, particularly of the interrelationship between krill and phytoplankton in so far as it is affected by bio-oceanographic variability. This report summarises South Africa's participation in SIBEX-II and outlines some of the results obtained.

D Miller

CRUISE OBJECTIVES AND STRATEGY

South Africa's SIBEX-II cruise had five main objectives. These were:

1. To obtain a broad picture of krill swarm distribution in relation to prevailing meso-scale environmental features in the Prydz Bay environs and off the Mac Robertson Land coast;

2. To investigate krill swarm dynamics in relation to food supply and feeding activity;

3. To investigate krill swarm dynamics in relation to prominent environmental gradients (both vertical and horizontal) close to the ice-edge, near the Antarctic Divergence and in the open-ocean;

4. To expand existing research initiatives concerning the role of fish/seabirds in relation to krill swarm dynamics and with respect to environmental, oceanological and topographic variability;

5. To re-occupy, and provide a temporal comparison for, a series of stations situated along two transects at 48 and 52°E.

The cruise was planned for the period 20 February to 5 April 1985 and was divided into three phases. These were:

Phase 1 - Australian Leg (27/2-5/3)

A series of 13 stations were occupied (Fig.1). Each station consisted of an oblique Bongo net haul from 300m to the surface and a CTD/rosette dip to sample the following standard depths - 0, 10, 20, 50, 75, 100, 150, 200, 500, 1000 and 2000m. Stations close to local apparent noon ("productivity stations") included a second CTD/rosette dip to 150m with a vertical fluorometer attached, a vertical incident spectroradiometer dip to 150m and a vertical plankton net (3,5 µm mesh) haul to 200m. Continuous hydroacoustic records were collected between stations. (See section on Hydroacoustics).

Phase 2 - Extensive Grid (5/3-8/3)

The fundamental objective of this phase of the survey was to locate areas of high krill abundance and so set the boundaries of fine-scale studies to be undertaken during Phase 3. Two north-south transects (Fig. 1) were completed to obtain a representative transgression of the near-ice, East Wind Drift, Antarctic Divergence and West Wind Drift zones between 53 and 64°E. Continuous acoustic records and ad hoc trawls (both blind and aimed) were used for the identification of krill concentrations.

Standard oceanographic stations (as in Phase 1) were occupied at the beginning and end of each transect leg. A productivity station was occupied at local apparent noon and samples collected from depths corresponding to 85, 40, 20, 10, 1.0 and 0.1% incident light levels.

Phase 3 - Intensive Leg (8/3)

During Phase 2 an area of relatively high krill abundance was located at 66°25'S; 62°00'E (Fig. 1). A fine-scale intensive sampling grid was commenced around this position (Fig. 2) in order to investigate the spatial relations and environmental associations of selected swarm groups. The grid consisted of seven north-south transects; transect legs being 30 miles in length and spaced five miles apart. A CTD/rosette station was sited every 40 miles (Fig. 2). As a result of a rudder malfunction and inclement weather, this phase of the survey was prematurely curtailed when the R.S. AFRICANA returned to Cape Town, arriving 23/3/85.

D Miller

HYDROACOUSTICS

It has come to be accepted that because of its relatively large size, swarming behaviour and general shallow depth distribution, krill is eminently suitable for acoustic study. In recent years there have been several large-scale echo-integrator surveys of krill distribution and abundance along with several small-scale studies of krill swarm dynamics. Results from acoustic studies of krill during SIBEX-II are presented and krill distribution/biomass in the survey area estimated. Acoustic data on the depth, size and density of 166 individual krill swarms are also presented.

Methods

The survey cruise track is shown in Fig. 1. Apart from time spent on station or towing nets, the acoustic survey ran continuously. Krill were detected and assessed using a hull-mounted Simrad EKS 120 kHz echo-sounder interfaced with a custom-built digital echo-integrator. Echoes from the top 100m of the water column were integrated in 10m depth channels, or at a finer level of resolution (1m) at depths where krill concentrations were present. The echo-sounder was calibrated immediately before and after the cruise using a steel sphere of known acoustic properties (Foote 1983). Calibration was also carried out during the cruise with an on-board hydrophone calibration monitoring system following procedures outlined in Anon. (1980). Parameters measured were source-level (SL), voltage receiving sensitivity (VRS), effective pulse length and the transducer beam pattern.

Integrated echo intensities in each depth channel were corrected during real-time processing for time-varied-gain (TVG) errors in the receiver by applying a correction factor appropriate to the TVG error at the mid-point of the channel. Custom designed software calculated the mean volume backscattering strength (MVBS) in dB for each depth channel. MVBS for each integration interval and all depth channels was also calculated. The following algorithm was used:

$$\bar{s}_v = 10 \log \sum_{j=1}^{N} \frac{\Delta R_j \, 10^{0.1(\bar{s}_v)_j}}{\Delta R}$$

where:

$\bar{s}_v$ = the MVBS for the interval $\Delta R = R_2 - R_1 = \sum_{j=1}^{N} \Delta R_j$

ΔR_j = the width of channel j

$(\bar{s}_v)_j$ = the MVBS for channel j

N = No. of channels.

$(\bar{s}_v)_j$ was calculated from the common form for one depth channel and a TVG of $20\log R+2\alpha R$. The algorithm used was:

$$(\bar{s}_v) = 10\log \left[\frac{\bar{V}^2_{rms}\, R_o^2\, 10^{0.2\alpha R_o}}{(G_o r_x)^2\, P_o^2 \bar{b}^2 c\pi T_p}\right]$$

where:

$\bar{V}^2_{rms}$ = the mean squared rms-detected echo voltage for the channel, derived by numerical integration;

r_x = the transducer voltage receiving sensitivity;

G_o = gain of receiver measured at reference range R_o on the TVG curve;

P_o = rms pressure output from the transducer;

$\bar{b}^2$ = equivalent beam factor ($\int_o^{\pi/2} b^2(\theta)\mathrm{Sin}\theta\delta\theta$ for a piston transducer);

T_p = pulse length;

α = absorption coefficient in dB/m;

c = speed of sound in seawater.

$\bar{A}_i$, the mean number of krill per unit area for each integration interval i, was estimated from the following standard expression which takes the length distribution of krill in the linked sample into account:

$$\bar{A}_i = \frac{\Delta R_i n_T 10^{0.1[(\bar{s}_v)_i - D]}}{\sum_{j=1}^{N} n_j L_j^{0.1B}} \qquad (1)$$

where:

n_j = number of animals in length class j in the linked net sample;

n_T = total number of animals in the sample;

ℓ_j = length of the jth length class;

N = number of length classes in the sample;

$(\bar{s}_v)_i$ = the MVBS for interval i.

B and D are constants in the target strength/length expression:

$$TS = B \log \ell_j + D$$

Krill length frequency distributions were derived from samples collected by aiming a Polish 16/41 commercial krill trawl into areas of acoustic scatter (Fig. 1). Sub-samples of each catch were also sexed (Makarov and Denys 1981) and indexed for gut fullness (Morris and Ricketts 1984). The derivation of Eqn. (1) is given in Anon. (1986). The mean weight density for the interval $\bar{\rho}_i$, was then calculated using the expressions given in Anon. (1984a) and Hampton (1985):

$$\bar{\rho}_i = \bar{w}\,\bar{A}_i$$

$$= \frac{c\bar{A}_j}{n_T} \sum_{j=1}^{N} n_j \ell_j^a \qquad (2)$$

where $\bar{w}$ is the mean weight of krill in the linked sample, and a and c are constants in the length/weight expression:

$$w = c\,\ell_j^a$$

The mean weight density for the whole survey area $\bar{\rho}_A$ was estimated using the expression:

$$\bar{\rho}_a = \frac{\sum_{i=1}^{N} \bar{\rho}_i D_i}{\sum_{i=1}^{N} D_i}$$

where the summation runs over all N intervals in the survey, and where:

$\bar{\rho}_i$ = mean weight density for interval i

D_i = length of ith interval.

The biomass of krill, $\bar{B}_w$, in the survey area, A, was computed in tonnes from:

$$\bar{B}_w = A\bar{\rho}_A$$

To investigate differences in abundance of krill detected by day and by night, "night" and "day" were strictly defined. The time of sunrise and sunset was calculated for a central position and date in the survey. A FORTRAN routine ("QLIGHT") developed by D S Collins of the National Environmental Research Council Computing Service in the United Kingdom was used. In addition, the depth, height and intercepted lengths of individual krill swarms were measured off the echo-charts.

Results

Krill abundance was low (0.48 g/m^2) and the survey areal biomass was 1.24×10^5 tonnes. However, an area of enhanced krill abundance (12.89 g/m^2) was observed close to the edge of the continental shelf break (Fig. 3). The mean krill biomass detected during the day (3.31×10^5 tonnes or 1.18 g/m^2) was ten times greater than that at night (3.0×10^4 tonnes or 0.11 g/m^2). Most of the krill swarms observed were small with a mean intercept length of 37.63 m and a mean thickness of 15.81 m.

D Miller

NET HAUL RESULTS

Net hauls during Phase 1 were aimed at providing systematic information about the distribution and abundance of zoo-plankton (especially krill larvae) in a region of supposedly variable oceanic circulation. As already indicated, the Polish krill trawl was used for acoustic target identification and to provide representative samples for body length analyses and sex determination.

Methods

At each Phase 1 station, a paired B57 (Bongo) net was deployed to a depth of 300m. The Bongo was fitted with 500 and 300 μm mesh and was shot/recovered at 1m/sec. Ship's speed was maintained at 2.0 knots during each haul. The displacement volume of each catch was measured immediately and the catches preserved in 10% buffered formalin for later analysis ashore. A total of 13 Bongo net hauls were made (Appendix IIa). At present Bongo net data are still being analysed.

The midwater trawl (Polish 16/41) was aimed into areas of acoustic scatter on five occasions and allowed to fish for varying lengths of time (usually in the order of c.20 mins) (Appendix II). An additional two hauls were deployed to collect fish. One of these hauls was to a depth of 500 m. Trawl catches were sorted and krill extracted for routine analysis (i.e. assessment of length frequency distributions, determination of proportionate maturity stage distributions and gut analysis).

Results

A preliminary impression of the Bongo net catches during Phase 1 indicated low abundance of both krill adults and larvae. A number of fish larvae and post-larvae was also collected. (See section on Ichthyology).

All five midwater trawls yielded krill. Catches were predominantly of mature female animals (Maturity Stages 3A-3C) and only small numbers of mature males (Stages 3A and 3B) and gravid/spent females (3D-3E) were present (Fig. 4). Four of the above catches contained satiated animals with undigested food material in both the fore-gut and hepato-pancreas.

Results from the two trawls to collect fish are discussed later in the report.

D Miller

PHYTOPLANKTON

One of the main survey objectives was to study the distributional relationship between krill and phytoplankton. Specific objectives were to study horizontal and vertical distribution of the phytoplankton standing crop and primary productivity, the relative contribution of net, nano and pico-plankton to the standing crop, and how these patterns are related to the physical and chemical environments.

Methods

At each productivity station a number of separate sampling procedures were carried out. These included determination of light penetration using a Sechi disc and a study of the spectral distribution of light in the upper 100m with a submersible incident spectroradiometer. Water samples from the various light penetration depths were used for nutrient salt analysis, for determination of chlorophyll-a and phaeopigment concentrations as well as the estimation of net, nano, and pico-plankton size-fractions. Samples were also used for the quantitative determination of phytoplankton species composition and estimation of primary production (using the C_{14} method and simulated in situ incubation - O'Reilly and Thomas 1983) for the net, nano and pico-size fractions.

In vivo fluorescence in the upper 150m was measured using a Sea Mar Tech submersible fluorometer mounted on the CTD/rosette. Phytoplankton from the upper 200m was collected with a 3,5µm net. The relative abundance of various phytoplankton species was determined microscopically.

Results

Conspicuous chlorophyll maxima were discernible at depths between 50 and 60m at most stations (Fig. 5). This corresponded with the depth of the euphotic zone.

With the exception of a marked elevation in phytoplankton standing crop and primary production at Station 03-05 (Fig. 1), the levels of both these parameters fell within ranges normally associated with such latitudes in the Southern Ocean. Results from oceanographic stations are given in Appendix III.

Substantial quantities of chlorophyll-a occurred below the euphotic zone (Fig. 5) although C_{14} assimilation was substantially reduced at these depths.

Most of the chlorophyll-a and C_{14} uptake was attributable to cells larger than 20 μm. Nanoplankton (<20 μm but >1 μm) contributed only a relatively small percentage of the total phytoplankton biomass (29%) and primary productivity (43%). The amounts of either chlorophyll-a or C_{14} uptake detected in cells less than 1 μm in size were, in most cases, insignificant.

Diatoms predominated in the phytoplankton samples and the silicoflagellate *Dictyocha speculum* occurred in moderate quantities at most stations. In terms of relative abundance, the most abundant and ubiquitous diatom species were (in descending order) *Nitzschia kerquelensis*, *Thalassiothrix longissima* (var. *antarctica*), *Nitzschia seriata*, *Rhizosolenia hebetata* (f. *semispina*) and *Chaetoceros criophilus*.

S El-Sayed & L Weber

ICHTHYOLOGY

The ichthyological component of the survey was aimed at a preliminary assessment of the fish fauna of the area, particularly the meso-pelagic species. It was also hoped to expand current efforts to study the role of fish in the overall trophodynamics of krill swarm formation.

Results

A total of 127 fish larvae representing seven species were collected during Phase 1. The most abundant species were *Notolepsis coatsi* (38% of the total catch), *Electrona antarctica* (28%) and *Electrona* sp. *N. coatsi* or *E. antarctica* dominated individual catches and both these species were present at all but two of the Phase 1 stations. Three adult myctophids were collected - two *Electrona antarctica* and one *Gymnoscophelus braueri*. It should be noted that larvae collected during Phase 1 were qualitatively comparable with catches taken in the same area during SIBEX-I and with larvae from the Lasarev Sea as reported by Efremenko (1983).

The five 15/41 samples yielded *E. antarctica*, a juvenile *Dissoticlus mawsoni*, two nototheniid larvae, five channichthyid post-larvae and one unidentified bathydraconid, all mixed with krill. The first blind haul for fish (depth 55m) yielded *E. antarctica* and six specimens of the unidentified species described above. The second haul (to 500m) was dominated by *E. antarctica* and *Bathylagus antarcticus*. Apart from these, specimens of three lanternfish species (genus *Gymnoscopelus*), 14 adult *N. coatsi*, one adult *Pleurogramma antarcticum*, one flat fish of the species *Mancopsetta maculata*, a single *Benthalbella elongata*, one *Paradiplospinus gracilis* and another specimen of the bathydraconid species mentioned above were collected. Of the eleven species collected in this haul, the most surprising record was that of the typically benthic flatfish *M. maculata* 1200m above the sea bottom. Other uncommon species included *P. gracilis* and *B. elongata* and this represents the southernmost (66°22' S; 62°04'E) record for all three species in the Indian Ocean.

O Gon

ORNITHOLOGY

The primary objective of the ornithological component of the cruise was to estimate composition and abundance of seabird species with respect to krill, oceanographic and environmental parameters. Additional observations were also planned to study foraging methods and diet whenever possible.

Methods

During both Phases 1 and 2, underway observations were made using the ten-minute card/one hour block technique recommended by BIOMASS (Anon. 1984b). When the ship was stopped on station, instantaneous scans through 360° and of ten minutes duration were made every half an hour (Cooper 1985) for up to six replicates. The maximum number of each species seen at any one time was recorded.

Results and Discussion

During the transit journey from Cape Town to the survey area (20/2-28/2), a total of 24 hours of ten-minute cards was completed. Twenty-seven species of seabirds were recorded.

From 1/3-5/3 (Phase 1), a total of 14 hours of cards was completed while underway and a further eight hours was completed between 6/3-8/3 (Phase 2). Between 1/3-7/3, a total of 35 ten-minute cards was completed while the ship was on station. The range of cards per station varied between 3-6 with a mean of 4,4. The number of species per station varied from 0 to 8; the number of individuals from 0 to 134. During Phase 1 the most consistently numerous species observed were Prions (*Pachyphila* sp) Sooty Shearwaters (*Puffinus griseus*) and Whitechinned Petrels (*Procellaria aequinochialis*) as shown by the results obtained from on-station observations (Table 1). Diving Petrels (*Pelecanoides* sp.) were also common and these observations extend the southerly range of this group of species (Harrison 1983).

During Phase 2, eleven species were observed with the Sooty Shearwater again predominant. For a variety of reasons (e.g. ship's speed, mist, etc.) no ten-minute cards were completed on the return journey to Cape Town. However, daily observations continued and these documented the disappearance of "southern" species along

with the appearance of "northern" species by latitude. A white Southern Giant Petrel (*Macronectes giganteus*) (c. 65°S; 60°E) and a colour-dyed Greyheaded Albatross (*Diomedea chrysostoma*) (c. 60°S; 52°E) were observed. The latter almost certainly originated from South Georgia, some 4000 nautical miles to the west.

J Cooper

CONCLUSION

Within the time constraints imposed by the cruise's premature termination, a number of the primary objectives were fulfilled. Unfortunately, the process-orientated component of the survey was not fully implemented. It was in this phase of the survey that R.S. AFRICANA's unique multi-purpose capability was expected to make the most substantial contribution to SIBEX-II.

D Miller

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APPENDIX I

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APPENDIX II

STATION DATA LIST

Net haul data

Station	Net	Position	Date	Time SAST	Haul Depth (m)
A001	Bongo	66°00' S 48°00' E	28/2	19h15	300
A002	Bongo	65°55' S 47°59' E	1/3	02h55	300
A003	Bongo	64°01' S 48°00' E	1/3	09h50	300
A004	Bongo	63°01' S 48°01' E	1/3	19h44	300
A005	Bongo	62°00' S 47°57' E	2/3	04h30	300
A006	Bongo	61°00' S 47°59' E	2/3	15h45	300
A007	Bongo	60°02' S 47°59' E	2/3	19h26	300
A008	Bongo	60°00' S 53°00' E	3/3	10h45	300
A009	Bongo	60°59' S 52°59' E	3/3	21h45	300
A010	Bongo	61°59' S 52°59' E	4/3	07h30	300
A011	Bongo	62°48' S 53°01' E	4/3	16h45	300
A012	Bongo	63°59' S 52°59' E	5/3	01h20	300
A013	Bongo	64°43' S 52°54' E	5/3	12h40	300
01-01	15/41	65°35' S 53°32' E	5/3	14h17	35-65
02-02	15/41	65°26' S 60°51' E	7/3	06h35	22-30
03-01	15/41	65°37' S 61°14' E	7/3	13h14	58-74

Trawl data/cont.

Station	Net	Position	Date	Time SAST	Haul Depth (m)
03-02	15/41	66°11' S 61°38' E	7/3	15h15	17-25
03-03	15/41	66°23' S 61°59' E	7/3	17h47	55
03-04	15/41	66°26' S 62°04' E	7/3	18h47	±500
I-001	15/41	66°28' S 62°42' E	8/3	16h30	33

APPENDIX III

STATION DATA LIST

Oceanographic station data

Station: A001

Date: 28/2/85

Time: 19h15

Position: 66°00'E; 48°00'E

Sounding: 2128m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
		(UG AT/L)						
10	44,49	1,82	0,73	1,14	23,83	8,06	--	34,14
20	43,04	1,86	0,67	1,17	23,24	8,01	--	34,12
50	45,04	2,38	0,59	1,18	24,78	7,97	--	34,11
75	44,26	2,01	0,66	1,17	23,87	8,13	--	34,11
100	49,96	2,18	0,66	1,15	25,95	7,95	--	34,23
150	58,08	2,07	0,61	1,03	26,66	7,39	--	34,26
200	66,28	2,02	0,73	1,01	26,72	7,13	--	34,29
300	79,52	2,00	0,68	0,97	26,99	5,24	--	34,74
1000	95,37	2,07	0,72	0,95	29,43	5,17	--	34,75
2000	97,02	1,86	0,58	0,96	25,92	5,62	--	34,47

DEPTH	CHLOROPHYLL (UG/L) (TOTAL ONLY)	PHAEOPIGMENTS (UG/L) (TOTAL ONLY)
10	0,253	0,033
20	0,397	0,053
50	0,390	0,078
75	0,448	0,038
100	0,448	0,020
150	0,060	0,051
200	0,041	0,053

Station: A002

Date: 1/3

Time: 02H55

Position: 65°55′ S; 47°59′ E

Sounding: 3000m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
3	--	2,08	--	--	23,77	--	--	--
10	44,71	2,07	1,11	1,05	23,49	7,06	0,00	34,13
20	45,20	1,89	1,16	1,02	23,45	8,01	0,01	34,14
50	50,32	2,06	1,09	1,04	25,95	8,27	0,00	34,13
70	45,00	2,01	1,07	1,10	23,33	8,06	-0,09	34,16
100	55,60	2,38	0,93	0,97	26,08	7,95	-1,28	34,27
160	62,60	2,33	1,10	1,01	27,75	7,71	-1,48	34,31
200	70,60	2,37	1,10	1,00	29,76	6,84	-0,93	34,38
300	81,40	2,46	0,90	0,85	29,96	5,46	0,35	34,75
1000	106,1	2,45	0,95	0,91	30,05	5,30	0,32	34,77
2000	107,4	2,44	1,27	0,77	28,36	5,60	-0,15	34,72

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
10	0,046	0,123	---	0,005	0,025	---
20	0,055	0,112	---	0,006	0,018	---
50	0,055	0,123	---	0,006	0,025	---
75	0,052	0,123	---	0,008	0,025	---
100	0,034	0,057	---	0,007	0,021	---
150	0,007	0,020	---	0,010	0,030	---
300	0,014	0,015	---	0,021	0,018	---
2000	0,002	0,001	---	0,002	0,011	---

Station: A003

Date: 1/3

Time: 09h50

Position: 64°01'S; 48°00'E

Sounding: 3190m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
3	51,10	2,20	--	--	23,32	--	1,23	33,98
10	51,10	2,24	--	--	23,58	--	1,22	34,00
20	53,85	2,08	1,29	0,95	27,38	7,91	1,23	33,99
50	53,00	2,10	1,25	0,83	26,45	8,05	-1,36	34,19
75	--	--	--	--	--	--	-0,99	34,36
100	--	--	--	--	--	--	0,72	34,58
200	93,12	2,39	1,39	--	31,61	4,43	1,63	34,77
300	91,56	2,51	1,32	0,81	30,55	4,69	1,65	34,74
1000	85,81	2,17	1,37	0,92	26,17	4,86	0,98	34,83

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,264	0,047	0,050	0,018	0,003	0,034
10	0,242	0,078	0,000	0,018	0,015	0,031
20	0,274	0,069	0,061	0,038	0,003	0,005
50	0,152	0,108	0,029	0,039	0,056	0,032
75	0,282	0,130	0,094	0,039	0,078	0,053
100	0,123	0,119	0,076	0,033	0,084	0,085
150	0,031	0,031	0,009	0,013	0,033	0.000

DEPTH	C UPTAKE (MG/M /HR)			
	Net	Nano	Pico	Total
0	0,425	0,107	0,009	0,541
10	0,411	0,075	0,000	0,486
20	0,213	0,031	0,005	0,249
50	-----	-----	-----	-----

Station: A004

Date: 1/3

Time: 19h44

Position: 63°01'S; 48°01'E

Sounding: 4900m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
7	40,10	1,93	1,23	1,64	26,5	--	1,61	33,70
10	40,00	1,76	1,43	1,14	22,78	7,50	1,61	33,70
20	43,21	1,92	1,17	1,10	24,56	7,43	1,62	33,70
50	48,98	2,07	1,24	1,01	25,72	7,65	-0,72	33,98
75	53,35	2,16	1,11	1,00	26,44	6,52	-1,51	34,10
100	60,35	2,29	1,04	1,01	28,55	7,34	-1,29	34,16
145	82,48	2,51	0,89	0,86	34,05	5,37	0,82	35,47
200	94,78	2,68	0,87	0,78	36,81	5,05	1,43	34,63
300	88,59	2,35	1,13	0,73	32,01	4,24	1,65	34,69
1000	99,42	2,12	0,98	0,74	29,76	4,71	1,06	34,75
2000	115,7	2,35	0,88	--	31,19	4,78	0,37	34,76

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
10	0,266	0,092	0,031	0,067	0,014	0,002
20	0,220	0,074	0,018	0,051	0,020	0,004
50	0,196	0,104	0,017	0,067	0,053	0,004
75	0,111	0,097	0,018	0,026	0,040	0,009
100	0,095	0,065	0,029	0,014	0,050	0,014
150	0,043	0,051	0,023	0,032	0,053	0,014
200	0,006	0,012	0,004	0,005	0,019	0,003

Station: 005

Date: 2/3

Time: 04h30

Position: 62°00′S; 47°57′E

Sounding: 4130m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
0	41,92	1,85	0,52	1,14	23,96	7,00	1,96	33,73
10	39,85	1,97	0,57	1,18	24,40	7,20	1,97	33,73
20	40,73	1,89	0,59	1,12	24,95	7,10	1,96	33,73
50	45,78	2,13	0,50	0,89	27,42	7,81	-0,66	34,04
75	45,43	1,98	0,49	0,88	26,80	7,73	-0,97	34,07
100	47,67	2,01	0,49	0,94	26,96	7,50	-1,24	34,10
175	70,84	2,45	0,65	0,62	33,90	5,10	1,03	34,47
200	70,94	2,31	0,50	0,62	32,12	4,51	1,33	34,54
300	80,72	2,44	0,57	0,63	35,22	4,27	1,74	34,65
1000	87,34	2,24	0,65	0,62	31,03	4,56	1,29	34,78
2000	115,7	2,05	0,66	0,59	30,02	4,91	0,47	34,74

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,196	0,071	0,011	0,039	0,023	0,001
10	0,139	0,078	0,018	0,029	0,018	0,004
20	0,141	0,106	0,009	0,017	0,012	0,001
50	0,191	0,086	0,019	0,031	0,017	0,005
75	0,120	0,079	0,018	0,029	0,026	0,004
100	0,071	0,075	0,027	0,021	0,050	0,005
150	0,009	0,034	0,010	0,006	0,013	0,003
200	0,004	0,008	0,003	0,002	0,011	0,001

Station: A006

Date: 2/3

Time: 15h45

Position: 61°00'S; 47°59'E

Sounding: 4660m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
4	40,06	1,10	0,24	1,22	23,84	7,05	2,17	33,85
10	40,99	1,40	0,74	1,10	24,46	7,10	2,15	33,86
20	40,76	1,47	0,20	1,08	24,91	7,02	2,15	33,86
50	41,19	1,52	0,63	1,07	25,37	7,20	2,15	33,86
75	43,71	1,39	0,47	0,85	25,63	7,11	-0,71	34,06
100	45,27	1,47	0,29	0,73	26,27	7,70	-0,99	34,09
150	52,88	1,47	0,79	0,66	28,12	6,48	-0,25	34,24
200	69,27	1,62	0,67	0,57	30,88	4,78	1,31	34,51
300	60,98	1,32	0,56	0,47	24,11	4,15	1,76	34,56
1000	76,40	1,33	0,52	0,42	25,95	4,34	1,47	34,71
1500	78,22	1,25	0,36	0,62	23,76	4.64	--	34,78

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,105	0,076	0,029	0,000	0,001	0,003
10	0,094	0,066	0,029	0,008	0,002	0,002
20	0,098	0,078	0,021	0,003	0,004	0,002
50	0,123	0,084	0,018	0,007	0,004	0,002
75	0,078	0,064	0,045	0,001	0,014	0,007
100	0,093	0,068	0,037	0,015	0,022	0,007
150	0,032	0,071	0,052	0,012	0,049	0,008

Station: A007

Date: 2/3

Time: 19h26

Position: 60°02'S; 47°59'E

Sounding: 5320m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
3	37,23	1,35	0,71	0,57	23,98	7,22	2,36	33,92
10	41,56	1,12	0,76	0,54	22,08	7,25	2,36	23,92
20	42,27	1,40	0,65	0,80	24,51	7,16	2,36	33,90
50	43,44	1,39	0,69	0,56	24,74	7,21	2,35	33,91
75	50,72	1,50	0,82	0,39	26,75	7,77	-0,78	34,04
100	52,13	2,03	0,75	0,37	27,24	7,69	-0.93	34,07
150	46,85	1,99	0,73	0,47	26,96	7,11	-0.86	34,19
200	69,28	2,61	0,68	--	34,66	5,03	1,14	34,45
300	71,27	2,15	0,63	0,11	30,09	4,22	1,83	34,62
1000	80,57	2,05	0,62	0,12	27,14	4,49	1,57	34,79
2000	110,6	2,25	1,20	0,30	31,18	4,70	0,57	34,75

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,188	0,093	0,030	0,029	0,010	0,000
10	0,184	0,074	0,037	0,011	0,008	0,000
20	0,159	0,101	0,020	0,014	0,006	0,001
50	0,159	0,073	0,029	0,023	0,006	0,001
75	0,166	0,103	0,035	0,033	0,016	0,004
100	0,099	0,073	0,035	0,023	0,032	0,004
150	0,034	0,078	0.029	0.014	0,055	0,010
200	0,034	0,078	0,029	0,014	0,055	0,010

Station: A008

Date: 3/3

Time: 10h45

Position: 60°00'S; 53°00'E

Sounding: 5240m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
		(UG AT/L)						
0	33,69	1,50	0,64	0,28	21,06	7,13	2,21	33,83
10	39,07	1,67	0,70	0,42	24,65	7,69	2,21	33,82
20	37,04	1,50	0,58	0,40	22,72	7,10	2,22	33,81
50	32,86	1,49	0,65	0,63	22,39	7,12	1,97	33,81
75	37,95	1,67	0,54	0,40	23,43	7,48	-1,31	34,09
100	47,91	1,79	0,56	0,42	25,69	7,43	-1.32	34,13
150	56,56	1,91	0,52	0,20	29,33	5,86	0.22	34,45
200	63,51	1,79	0,55	0,23	29,51	4,46	1,45	34,62
300	61,84	1,64	0,52	0,23	27,74	3,97	1,44	34,46
1000	68,41	1,59	0,48	0,22	25,23	4,35	1,46	34,72
2000	78,20	1,61	0,34	0,23	24,47	4,56	--	34,70

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,179	0,139	0,024	0,015	0,000	0,002
10	0,176	0,110	0,026	0,018	0,005	0,001
20	0,225	0,110	0,017	0,024	0,001	0,002
50	0,272	0,121	0,033	0,020	0,017	0,003
75	0,194	0,069	0,035	0,042	0,055	0,066
100	0,142	0,107	0,025	0,049	0,084	0,009
150	0,061	0,060	0,025	0,016	0,054	0,011

DEPTH	C UPTAKE (MG/M /HR)			
	Net	Nano	Pico	Total
0	0,453	0,076	0,024	0,553
10	0,324	0,094	0,028	0,446
20	0,156	0,029	0,011	0,196

Station: A010

Date: 4/3

Time: 07h30

Position: 61°59'S; 52°59'E

Sounding: 5170m

DEPTH	NUTRIENTS (UG AT/L)					OXYGEN (ML/L)	TEMP (°C)	SAL (0/00)
	Sil	Pho	Amm	Nri	Nra			
2	48,16	2,96	2,28	0,70	24,70	7,25	1,49	33,83
10	52,30	3,26	1,92	0,68	28,95	7,25	1,49	33,83
20	52,54	3,16	2,64	0,70	29,04	7,19	1,48	33,84
50	51,54	3,47	2,28	0,46	29,22	7,51	-0,78	34,00
75	59,26	3,13	2,55	0,43	29,58	7,40	-1,56	34,11
100	65,22	3,52	2,20	0,46	29,48	3,68	-1,56	34,14
150	89,85	3,64	2,07	0,25	31,61	4,77	1,10	34,52
200	91,97	3,39	2,20	0,20	30,08	4,04	1,66	34,63
300	98,76	3,60	2,04	0,20	33,19	3,89	1,84	34,72
1000	108,4	3,18	2,09	0,20	32,58	3,70	1,42	34,80
2000	132,1	3,45	2,07	0,22	31,59	2,69	0,56	34,79

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,237	0,107	0,027	0,027	0,008	0,004
10	0,222	0,095	0,027	0,024	0,016	0,001
20	0,240	0,124	0,020	0,013	0,004	0,000
50	0,283	0,127	0,022	0,036	0,025	0,000
75	0,246	0,110	0,031	0,087	0,057	0,006
100	0,217	0,162	0,032	0,085	0,122	0,001
150	0,029	0,024	0,014	0,014	0,029	0,003

DEPTH	C UPTAKE (MG/M /HR)			
	Net	Nano	Pico	Total
0	0,377	0,159	0,021	0,557
20	0,414	0,150	0,021	0,585
50	0,260	0,116	0,170	0,546
75	0,009	0,004	0,000	0,013
100	0,004	0,011	0,003	0,018

Station: A011

Date: 4/3

Time: 16h45

Position: 62°48'S; 53°01'E

Sounding: 4860m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
2	42,83	1,67	-	0,32	20,86	6,00	1,31	33,87
10	51,17	1,92	-	0,41	25,96	7,43	1,30	33,89
20	50,80	1,87	-	0,39	25,37	7,40	1,31	33,88
50	51,53	1,87	-	0,37	25,45	7,66	0,84	33,91
75	54,74	1,77	-	0,26	23,12	7,50	-1,49	34,15
100	84,59	2,49	-	0,13	33,28	6,13	0,17	34,39
150	83,36	2,49	-	-	30,30	4,87	1,46	34,59
200	96,55	2,45	-	-	31,96	4,24	1,64	34,69
300	97,86	2,45	-	-	30,57	4,09	1,75	34,72
1000	103,6	2,01	-	-	25,74	4,76	1,23	34,81
2000	132,9	2,59	-	-	31,39	5,01	0,46	34,78

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,231	0,110	0,026	0,032	0,000	0,000
10	0,237	0,086	0,024	0,013	0,002	0,000
50	0,248	0,104	0,028	0,008	0,014	0,000
75	0,150	0,104	0,032	0,065	0,066	0,007
100	0,165	0,116	0,056	0,057	0,113	0,010
150	0,030	0,042	0,014	0,015	0,032	0,004
200	0,007	0,009	0,003	0,009	0,018	0,002

Station: A012

Date: 5/3

Time: 01h20

Position: 63°59'S; 52°59'E

Sounding: 588m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
		(UG AT/L)						
2	51,47	1,75	0,82	0,55	25,96	7,55	0,95	33,82
10	49,86	1,90	0,77	0,55	25,16	7,51	0,95	33,82
20	46,75	1,81	0,89	0,51	22,96	7,35	0,95	33,87
50	45,04	1,71	0,86	0,48	22,06	7,42	0,53	33,92
75	64,60	2,33	0,78	0,78	27,79	7,38	-1,52	34,18
100	75,03	2,31	1,17	0,42	29,64	6,06	0,06	34,40
150	90,60	2,45	1,18	0,71	31,47	4,35	1,42	34,62
200	93,04	2,55	1,18	0,80	31,10	4,22	1,57	34,68
300	103,6	2,68	1,32	0,40	33,65	4,18	1,74	34,77
500	107,3	2,53	1,42	0,68	30,86	4,36	1,53	34,78

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,173	0,085	0,026	0,007	0,002	0,000
10	0,225	0,071	0,020	0,003	0,000	0,000
20	0,199	0,071	0,029	0,009	0,000	0,000
50	0,168	0,081	0,024	0,020	0,001	0,000
75	0,173	0,142	0,046	0,035	0,042	0,009
100	0,185	0,144	0,078	0,037	0,105	0,016
150	0,100	0,021	0,009	0,009	0,018	0,004
200	0,005	0,009	0,003	0,003	0,014	0,002

Station: A013

Date: 5/3

Time: 12h40

Position: 64°43′S; 52°54′E

Sounding: 2800m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
1	47,00	2,15	1,11	0,91	19,98	6,95	0,46	33,95
10	47,47	2,63	1,04	0,89	20,77	7,35	0,46	33,96
20	54,51	2,26	0,99	0,92	23,64	7,06	0,35	33,98
50	43,00	1,90	0,95	0,86	18,93	7,32	0,33	34,00
70	58,00	2,25	0,95	0,79	23,67	7,13	0,23	34,06
100	65,07	2,23	1,02	0,66	23,24	6,12	-0,78	34,53
150	83,19	2,47	1,20	0,58	28,08	5,49	-0,12	34,63
200	82,38	2,50	1,18	0,58	26,36	3,80	0,25	34,69
300	84,83	2,02	1,25	0,57	26,65	3,09	1,04	34,79
1000	75,84	1,93	1,22	0,64	20,57	4,51	0,43	34,80
2000	119,9	2,14	1,30	0,58	28,11	2,10	-0,08	34,77

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,113	0,098	0,038	0,005	0,006	0,001
10	0,121	0,087	0,039	0,003	0,008	0,001
20	0,113	0,095	0,042	0,005	0,009	0,000
50	0,090	0,095	0,038	0,000	0,016	0,001
75	0,130	0,147	0,092	0,023	0,047	0,025
100	0,026	0,065	0,041	0,005	0,027	0,013
150	0,011	0,015	0,009	0,004	0,012	0,003

DEPTH	C UPTAKE (MG/M /HR)			
	Net	Nano	Pico	Total
0	0,246	0,149	0,410	0,436
10	0,229	0,124	0,029	0,382
20	0,125	0,076	0,019	0,220
50	0,000	0,000	0,014	0,014
75	0,000	0,000	0,004	0,004

Station: 021

Date: 6/3

Time: 10h40

Position: 63°36′S; 56°45′E

Sounding: 4780m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho (UG AT/L)	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
5	36,25	2,71	4,63	2,86	15,56	7,15	1,12	33,91
10	38,56	2,72	4,63	2,71	16,48	7,27	1,12	33,92
15	33,33	2,62	4,50	2,67	17,69	7,39	1,12	33,92
20	46,76	2,97	4,66	2,10	19,47	7,25	1,12	33,91
30	39,44	2,65	4,32	2,08	16,01	7,46	1,12	33,91
60	47,91	2,87	4,47	2,03	17,55	6,44	1,10	33,91
85	64,14	3,06	4,73	1,86	18,60	4,41	-0,69	34,30
150	76,60	--	5.05	--	--	--	1,35	34,66

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
2	0,159	0,063	0,021	0,014	0,000	0,000
11	0,079	0,032	0,010	0,000	0,001	0,001
15	0,107	0,063	0,023	0,000	0,000	0,000
20	0,127	0,051	0,022	0,012	0,000	0,000
28	0,104	0,049	0,023	0,007	0,000	0,000
57	0,133	0,064	0,028	0,005	0,002	0,000
85	0,231	0,107	0,098	0,067	0,115	0,020
150	0,013	0,025	0,006	0,011	0,018	0,001

DEPTH	C UPTAKE (MG/M /HR)			
	Net	Nano	Pico	Total
2	0,289	0,107	0,015	0,411
11	0,232	0,109	0,010	0,441
15	0,236	0,103	0,010	0,349
20	0,154	0,060	0,002	0,216
28	0,083	0,026	0,002	0,111

Station: 02-01

Date: 6/3

Time: 16h30

Position: 63°00'S; 58°00'E

Sounding: 1100m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
		(UG AT/L)						
1	26,86	1,83	--	1,37	16,73	7,27	1,53	33,85
10	29,70	2,54	--	1,25	--	7,38	1,54	33,85
20	28,25	2,02	--	1,36	16,40	7,31	1,54	33,83
50	44,55	2,35	--	1,27	20,57	7,51	-0,42	33,99
75	60,89	2,54	--	1,26	22,93	6,90	-1,44	34,18
100	66,80	2,35	--	1,15	22,99	5,99	-0,31	34,34
150	72,18	2,25	--	1,07	22,36	4,37	1,55	34,63
200	76,90	2,30	--	--	24,19	4,01	1,76	34,68
300	83,35	2,19	--	1,53	24,78	3,96	1,83	34,75
1000	87,26	2,09	--	--	22,06	4,34	--	34,76

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,279	0,056	0,021	0,010	0,000	0,002
10	0,254	0,066	0,015	0,023	0,004	0,001
20	0,266	0,051	0,033	0,025	0,000	0,000
50	0,153	0,068	0,020	0,031	0,019	0,002
75	0,060	0,054	0,045	0,016	0,031	0,011
100	0,048	0,037	0,040	0,009	0,032	0,013
150	0,014	0,020	0,009	0,005	0,017	0,003
200	0,009	0,011	0,003	0,006	0,013	0,002

Station: 02-03

Date: 7/3

Time: 11h15

Position: 65°26'S; 60°55'E

Sounding: 3950m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
		(UG AT/L)						
2	40,94	1,65	--	--	18,62	7,31	0,30	33,97
10	46,89	1,75	--	--	20,60	7,61	0,29	33,97
15	27,60	0,98	--	--	10,84	7,35	0,27	33,98
20	29,49	1,45	--	--	13,65	7,24	0,27	33,98
50	28,26	1,48	--	--	11,66	7,37	0,26	33,97
75	38,20	1,08	--	--	12,06	6,02	-0,44	34,41
150	51,72	1,12	--	--	14,40	4,31	1,40	34,57

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
2	0,011	0,046	0,064	0,002	0,005	0,003
10	0,010	0,042	0,061	0,002	0,003	0,001
13	0,012	0,08	0,027	0,002	0,006	0,001
18	0,011	0,045	0,033	0,002	0,002	0,000
26	0,013	0,053	0,063	0,003	0,002	0,001
52	0,015	0,041	0,057	0,002	0,004	0,005
77	0,060	0,072	0,077	0,017	0,066	0,014
150	0,009	0,034	0,018	0,006	0,015	0,006

DEPTH	C UPTAKE (MG/M /HR)			
	Net	Nano	Pico	Total
2	0,019	0,150	0,050	0,219
10	0,022	0,171	0,086	0,279
13	0,023	0,157	0,069	0,249
18	0,019	0,128	0,064	0,211
26	0,012	0,062	0,037	0,219
52	0,002	0,006	0,012	0,020
77	0,005	0,003	0,019	0,027

Station: 03-05

Date: 8/3

Time: 12h00

Position: 66°59'S; 63°00'E

Sounding: 336m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
		(UG AT/L)						
0	54,02	2,40	2,79	1,93	20,73	7,65	-0,97	34,20
10	52,35	2,66	2,74	2,02	20,74	7,64	-0,97	34,19
20	53,19	2,59	2,84	1,94	21,54	7,72	-0,96	34,21
50	52,55	2,48	2,59	1,91	20,50	7,54	-0,89	34,26
75	46,95	2,01	2,84	1,91	15,55	5,22	-0,91	34,27
100	57,56	2,47	3,09	2,03	20,28	7,22	--	34,29
150	61,88	2,20	3,49	1,67	16,19	6,21	-1,21	34,41
200	69,49	2,51	2,52	1,95	20,85	6,55	--	34,43
300	66,21	2,63	2,81	1,94	17,16	5,37	--	34,42

DEPTH	CHLOROPHYLL (UG/L)			PHAEOPIGMENTS (UG/L)		
	Net	Nano	Pico	Net	Nano	Pico
0	0,661	0,281	--	0,109	0,030	--
10	1,124	0,240	0,114	0,112	0,048	0,008
20	0,761	0,265	0,098	0,106	0,037	0,013
50	0,670	--	0,064	0,084	--	0,005
75	--	--	0,056	--	--	0,006
100	--	0,159	--	--	0,091	--
150	0,176	0,064	0,012	0,112	0,196	0,039

DEPTH	C UPTAKE (MG/M /HR)			
	Net	Nano	Pico	Total
0	0,661	0,281	---	0,942
10	1,124	0,240	0,114	1,478
20	0,761	0,265	0,098	1,120
50	0,670	---	0,064	0,121
75	---	---	0,056	0,056
100	---	0,159	---	0,159
150	0,176	0,064	0,012	0,252

Station: I002

Date: 8/3

Time: 23h35

Position: 66°00'S; 62°41'E

Sounding: 3200m

DEPTH	NUTRIENTS					OXYGEN	TEMP	SAL
	Sil	Pho	Amm	Nri	Nra	(ML/L)	(°C)	(0/00)
		(UG AT/L)						
3	47,21	2,27	--	--	17,33	--	-0,17	34,06
10	58,11	1,92	--	--	14,58	--	-0,12	34,06
20	56,08	1,51	--	--	15,50	--	-0,12	34,06
50	55,80	2,16	--	--	20,70	--	-0,12	34,06
75	56,72	1,64	--	--	11,34	--	-0,48	34,33
100	56,68	2,25	--	--	17,98	--	-0,82	34,49
150	61,57	2,39	--	--	20,01	--	0,72	34,64
195	108,6	2,81	--	--	26,83	--	1,12	34,71

TABLE 1. RELATIVE ABUNDANCE OF SEABIRDS DURING ON-STATION OBSERVATIONS, SIBEX-II.

SPECIES	NO. RECORDED	% RELATIVE ABUNDANCE
Whitechinned petrel *Procellaria aequinoctialis*	276	43,2
Sooty Shearwater *Puffinus griseus*	214	33,5
Prions *Pachyphila* sp.	92	14,4
Antarctic Petrel *Thalassoica antarctica*	18	2,8
Wilson's Stormpetrel *Oceanites oceanicus*	18	2,8
Snow Petrel *Pagodroma nivea*	6	0,9
Lightmantled Sooty Albatross *Phaebetria palpebrata*	4	0,6
Antarctic fulmar *Fulmarus glacialoides*	3	0,5
Greyheaded Albatross *Diomedea chrysostoma*	2	0,3
Blue Petrel *Halobaena caervlea*	2	0,3
Terns *Sterna* sp.	2	0,3
Wandering Albatross *Diomedea exulans*	1	0,2
Giant petrel *Micronectes* sp.	1	0,2
TOTAL	639	

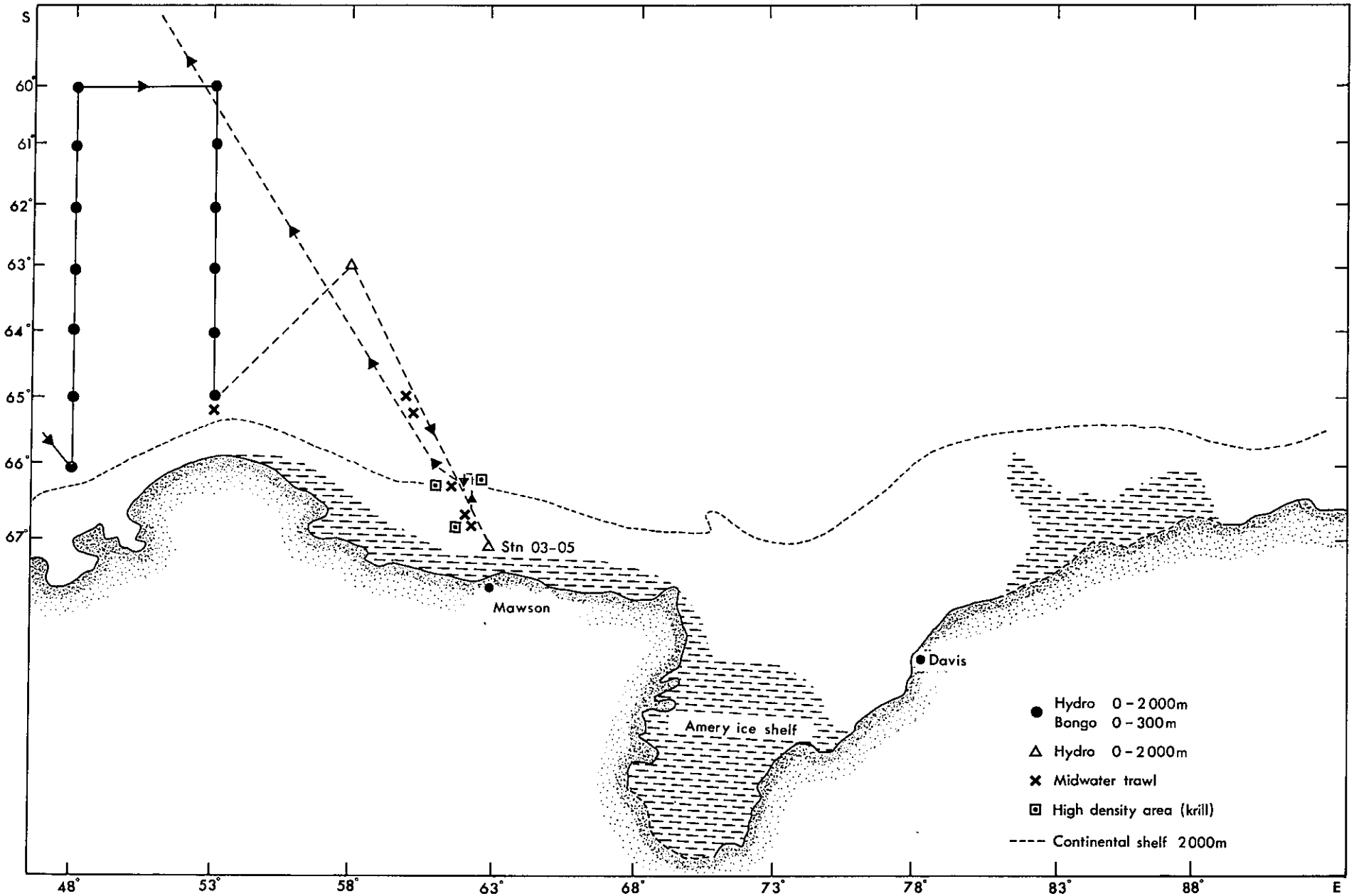

Fig. 1. Survey cruise track showing position of oceanographic and net stations. Bottom topography is also shown.

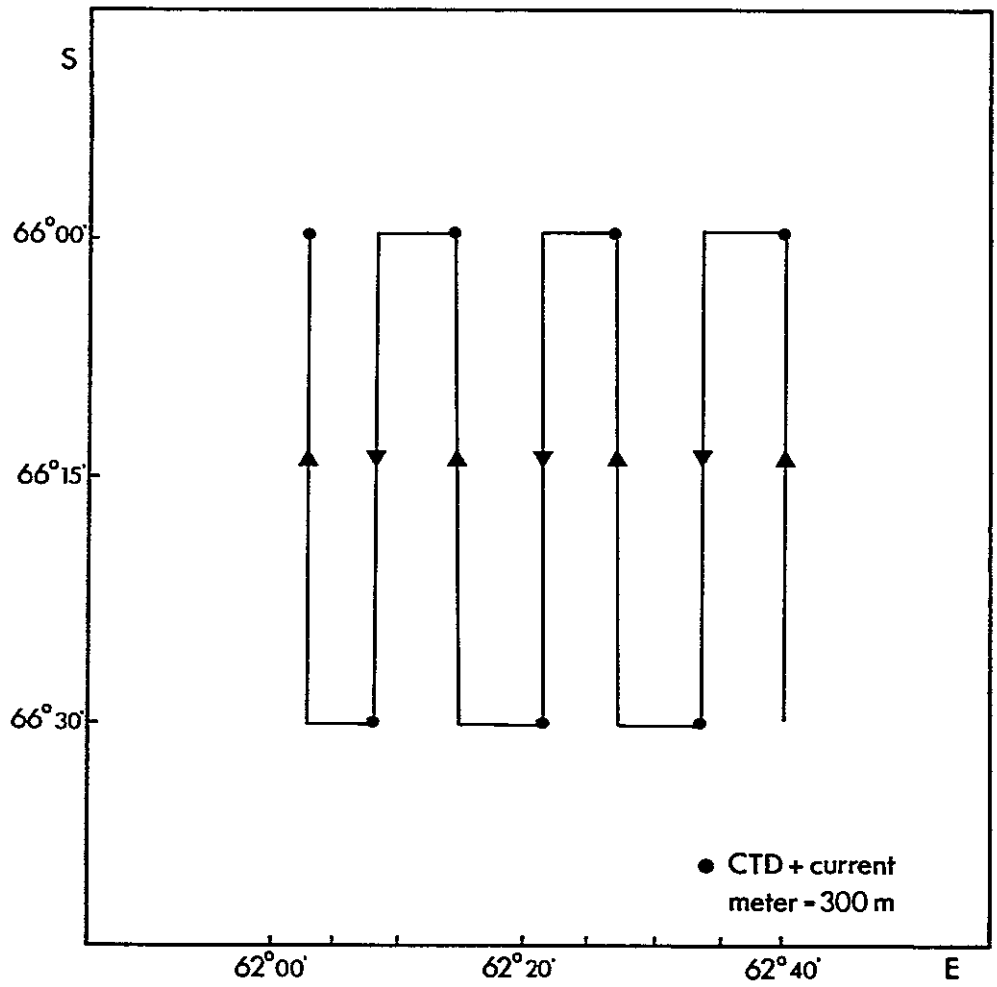

Fig. 2. Survey cruise track for Phase 3 (Intensive Grid).

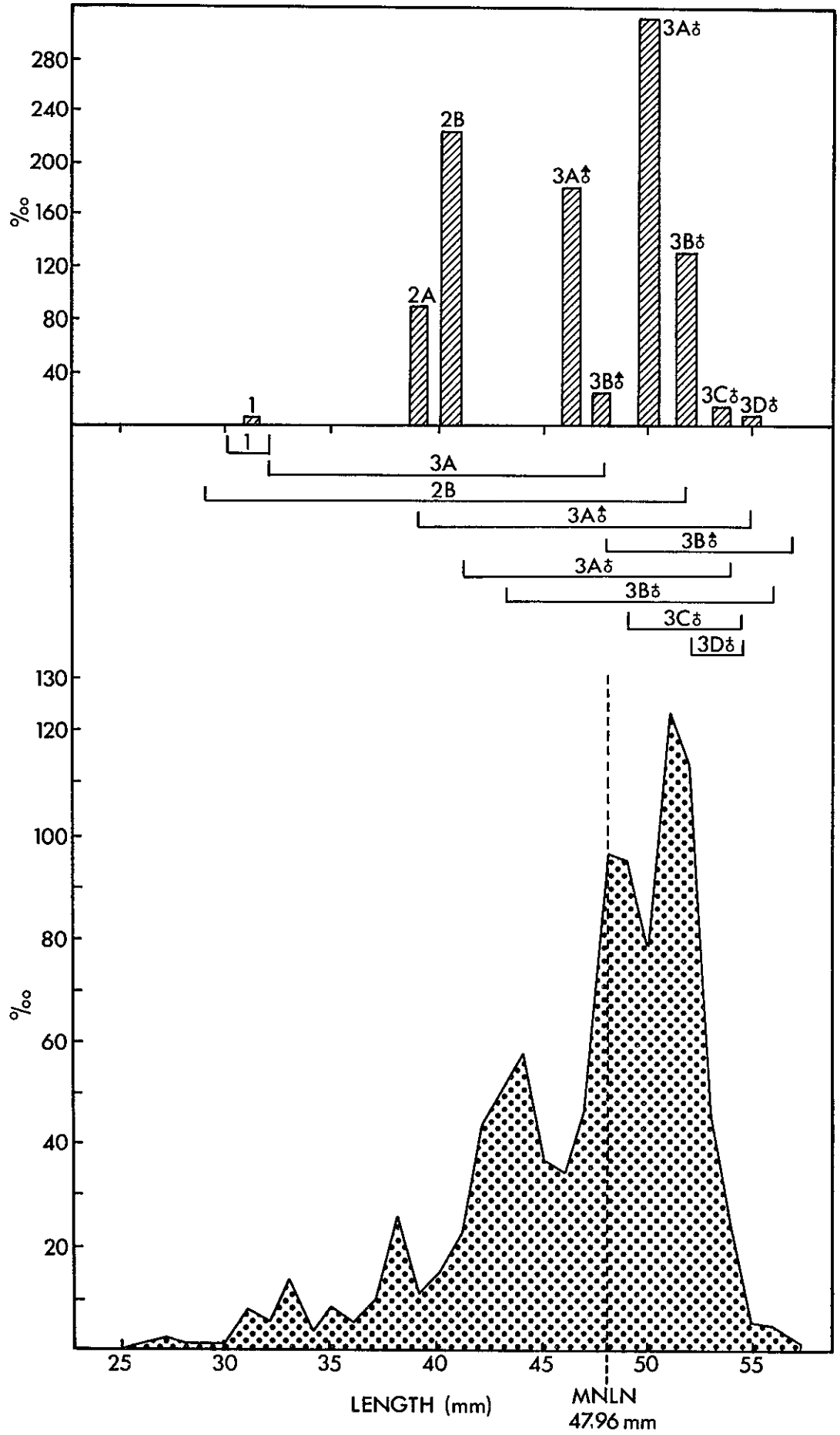

Fig. 3. Accumulated maturity stage and length frequency distributions of krill collected with the Polish 15/41 Commercial Krill Trawl during acoustic target identification.

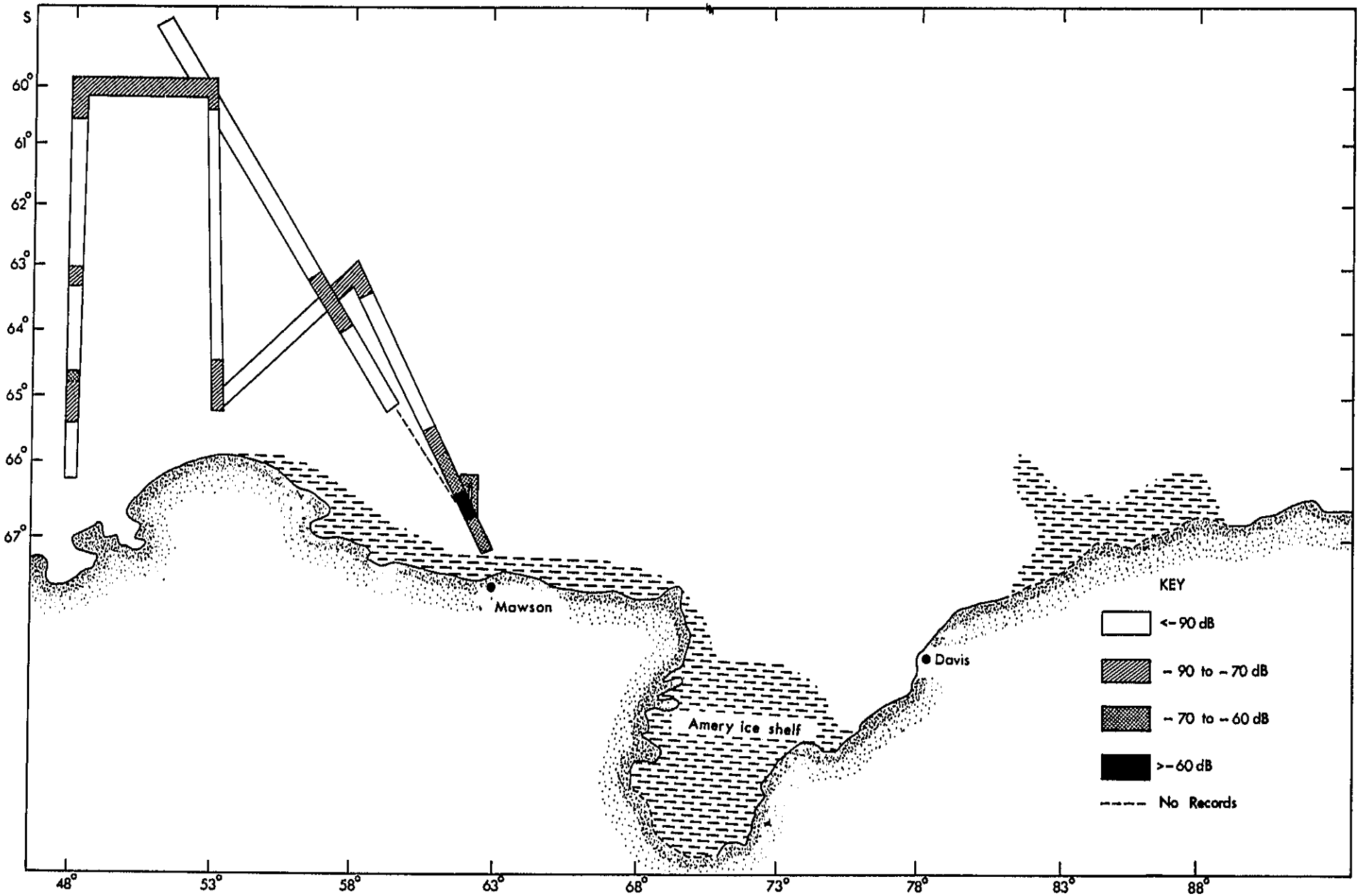

Fig. 4. Horizontal distribution of krill densities in the South African SIBEX-II survey area.

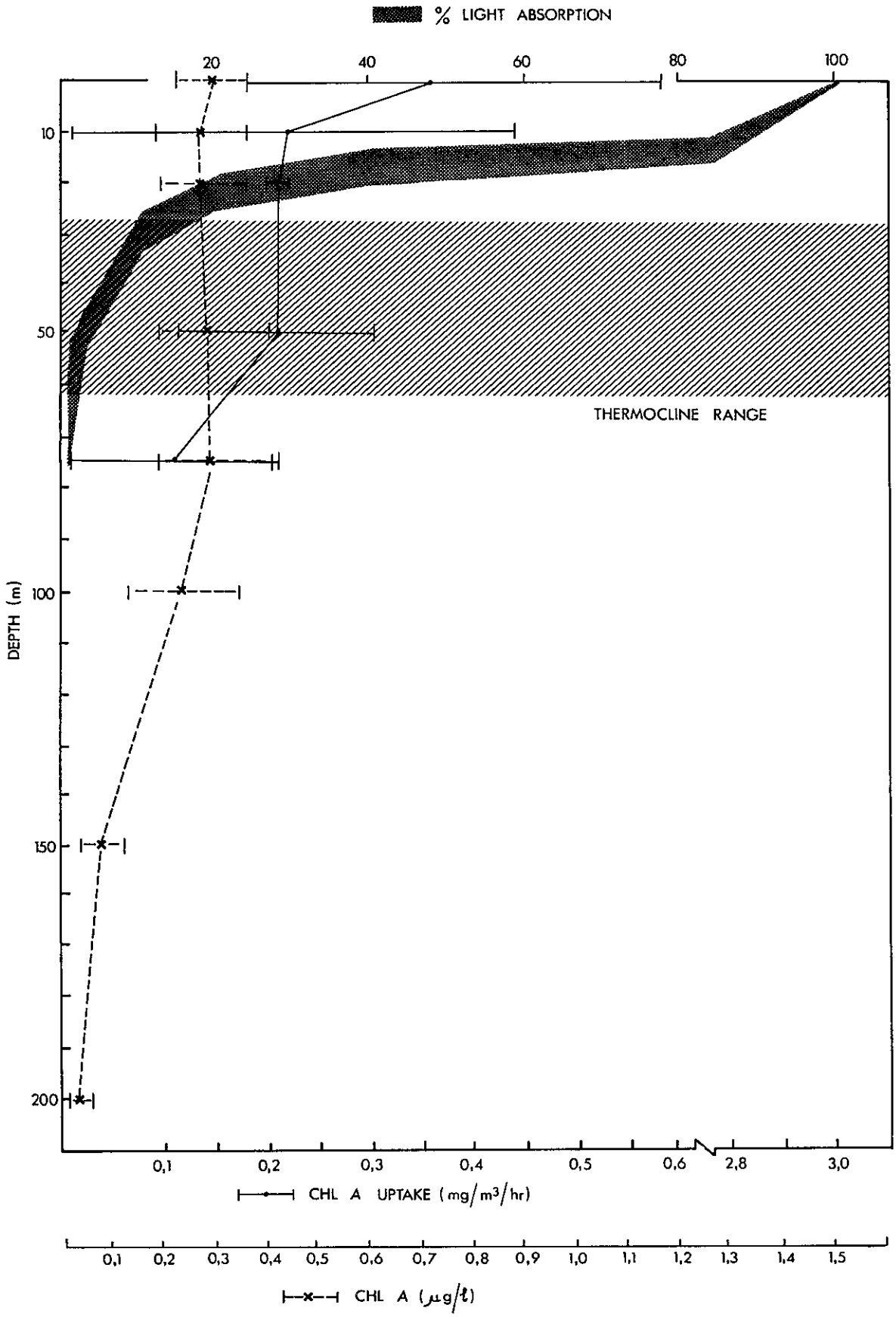

Fig. 5. Vertical distribution of chlorophyll a and primary production compared with euphotic depth.

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