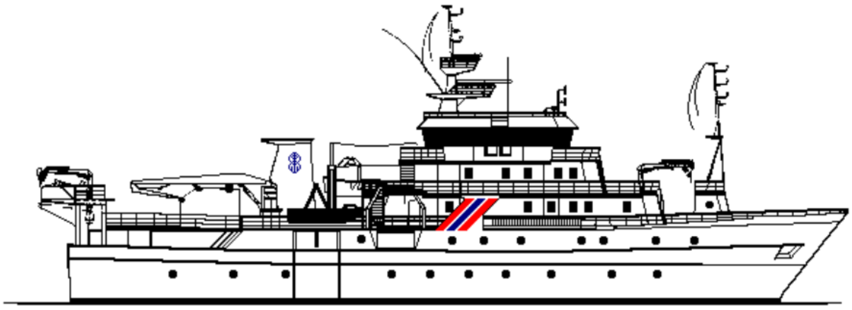

BENEFIT SURVEYS

SURVEY ERRORS IN CLUPEOIDS
Sardine acoustic attenuation and target strength experiments

21 - 29 April 2002

Ministry of Fisheries and Marine Resources
Swakopmund
Namibia

Instituto de Investigação Marinha
Luanda
Angola

Marine and Coastal Management
Cape Town
South-Africa

Institute of Marine Research
Bergen
Norway

CRUISE REPORTS "DR. FRIDTJOF NANSEN"

BENEFIT SURVEYS

SURVEY ERRORS IN CLUPEOIDS
Sardine acoustic attenuation and target strength experiments

21 – 29 April 2002

by

Dave Boyer[1], Ian Hampton[2], Helen Boyer[1], Reidar Toresen[4], Beau M. Tjizoo[1], Agostinho D. Caholo Duarte[3], Martha Uumati[1], Victor Hashoongo[1], Nandipa Twatwa[2], Dagmar Merkle[2], Johann Rademan[2], Tore Mørk[4] and Jarle Kristiansen[4]

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Institute of Marine Research
Bergen, 2002

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CHAPTER 1 INTRODUCTION

1.1 Background

Acoustic surveys are used throughout the region to derive biomass estimates on which TAC recommendations are based. An important question in all of these surveys is their accuracy, both as absolute measures of abundance and as relative indices of changes in biomass. Attempts to quantify survey errors to date have concentrated on estimating the random sampling error arising from the finite size of the sample. Other sources of random and systematic error arising, for example, from target strength uncertainty, the undetectability of a proportion of the population at the time of the survey, and the variation in this proportion, have not been quantified to any meaningful extent. For many of the surveys these errors can be large, potentially outweighing the random sampling error in importance. The estimates of accuracy quoted for these surveys, which reflect only the random sampling errors, are therefore likely to give an over-optimistic impression of survey accuracy, and consequently, of the worth of the biomass estimates, with potentially serious consequences for management measures based on these estimates.

The BENEFIT Workshop on Survey Errors in December 2000 identified a number of sources of error in acoustic and trawl surveys in the region, and made a first attempt to quantify their individual and combined effect on estimates of absolute abundance. A project was recommended to examine, through field experiments and analysis of existing data, the major sources of random and systematic error in acoustic surveys of the most important commercial clupeiform resources in the region (sardine, anchovy and sardinella), as currently practiced. The objective is to obtain more realistic estimates of survey accuracy and precision, and ultimately, to reduce survey error through the application of corrections and/or improvement in survey methodology.

This survey was planned to take place in Namibia using both the *R.V. Dr. Fridtjof Nansen* and *R.V. Welwitchia*, however, the low biomass estimated on the sardine survey in March 2002 (SSB = 5 000 tonnes) meant that the likelihood of finding suitable schools would be negligible. Thus, following consultations with the regional participants and the Coordinating Unit in Bergen, the survey was transferred to South Africa where more schools were expected as a result of the high abundance of sardine currently occurring in the southern Benguela. Therefore the original objectives of the survey were necessarily changed as work relevant only to the Namibian situation was either no longer possible or relevant. Thus experiments to investigate vessel avoidance using two vessels were dropped, as were all investigations into the dynamics of school-groups.

1.2 Objectives of the survey

The primary objective of the survey was to improve estimates of the accuracy and/or precision of survey estimates for sardine. A number of errors associated with surveys were identified following the BENEFIT Survey Errors Workshop (2000) and investigations into these errors were proposed as a project (2002/003), which was subsequently approved. The following objectives were prioritised for this survey:

1. Investigation of attenuation of the signal in dense, vertically extensive schools of sardine was identified as a potentially large source of negative bias in sardine surveys, particularly in Namibia, where the surveys are restricted to daytime, when school densities are highest. Degree of attenuation will be derived from measurements of the reduction in the strength of the bottom echo below schools, and compared with theoretical corrections based on first-order absorption theory.

2. Estimation of target strength *in situ* for sardine using new multi-frequency single target recognition methods now available in the region.

3. Sonar experiments on surface schooling and reactions of sardine to the vessel.

1.3 Participation

The scientific staff consisted of:

Namibia: Dave BOYER, Helen BOYER, Beau M. TJIZOO, Martha UUMAATI, Victor HASHOONGO

Angola: Agostinho D. CAHOLO DUARTE

South Africa: Ian HAMPTON, Nandipha TWATWA, Dagmar MERKLE, Johann RADEMAN

Norway: Reidar TORESEN, Tore MØRK, Jarle KRISTIANSEN

The cruise leader was Reidar TORESEN. The cruise report was compiled by Beau TJIZOO and Dave BOYER and was edited by Ian HAMPTON, Reidar TORESEN and Helen BOYER.

Agostinho D. CAHOLO DUARTE was responsible for NAN-SIS, while Beau TJIZOO, Martha UUMAATI, Victor HASHOONGO, Agostihno D. CAHOLO DUARTE, Nandipha TWATWA, Dagmar MERKLE and Johann RADEMAN operated the SA950 sonar.

The vertical acoustical work was overseen by Dave BOYER, Helen BOYER, Beau M. TJIZOO, Martha UUMATI, Ian HAMPTON, Johann RADEMAN, Dagmar MERKLE, Reidar TORESEN, Tore MORK and Jarle KRISTIANSEN.

Deck sampling was done by Beau M. TJIZOO, Martha UUMATI, Victor HASHOONGO, Agostihno D. CAHOLO DUARTE, Nandipha TWATWA and Dagmar MERKLE.

1.4 Narrative

The R.V. *Dr. Fridtjof Nansen* left Cape Town on the 21st April 2002 at 17h00 local time and steamed southwards into False Bay where local scientists reported the greatest likelihood of finding suitable concentrations of sardine in the vicinity of Cape Town existed.

As with all such methodological surveys, the behaviour of the sardine determined the type of experimental work that could be conducted. In general, dense schools formed during daytime, but these dispersed into a scattering layer at night. Therefore the schedule followed most days was to actively search for dense schools of sardine from just before sunrise until after sunset each day and then during the night to either drift or move slowly while collecting data on three different frequencies for target strength determination. Trawling during the day was frequently unsuccessful due to vessel/trawl avoidance. Therefore most species identification was conducted just after sunset or immediately before sunrise.

The type of schools required for the signal attenuation experiments (dense, monospecific schools over an even seabed) were rarely encountered and therefore much time was spent searching for regions with the requisite conditions. Initially several days were spent in False Bay, before moving eastwards to the next bay, Walker Bay, for two days, as commercial vessels operating from Gansbaai were working on schools of large sardine in this area. Finally we returned to False Bay for the last two days of the survey.

An example of the types of schools required, but rarely found, is shown in Figure 1

A summary of the survey activities follows:

- On arrival in False Bay (on 21st) a series of north-south parallel transects with approximately 2 nautical miles (NM) spacing was followed to obtain an indication of the distribution of pelagic fish.

- At 08h00 on the morning of 22nd all echosounder frequencies (18, 38, 120 and 200 kHz) were calibrated using standard sphere calibration techniques. This was completed by 14h00.
- During the next two days a series of north-south transects were followed within False Bay in order to obtain signal attenuation data.
- During many nights the vessel steamed slowly or drifted in areas of scattered sardine in order to collect data for target strength determination.
- On 23rd April the vessel was anchored with the –33.6 dB sphere deployed at about 30 m depth in a region of sardine in order to collect attenuation data using the sphere as the reference rather than the seabed. However few fish approached the vessel and so this experiment was not repeated.
- On 25th April 2002, *Dr. Fridtjof Nansen* steamed to Hermanus Bay where there had been reports of good fishing by the industry. At 09h00 a transhipment of several of the South African personnel was made in Gordons Bay using the MOB to transport them between the vessel and the harbour.
- Sampling in this area was carried out during the day of 25th April when dense schools were expected. During the night, when the fish had dispersed, sampling for target strength was conducted.
- During the evening of 26th April 2002, the *Nansen* steamed back to False Bay. More sampling on target strength was done.
- On 27th & 28th April, pure sardine schools were searched for during the day for attenuation experiments and target strength experiments were continued during the night.

The *Dr. Fridtjof Nansen* docked in Cape Town on 29th April 2002 at 08h00.

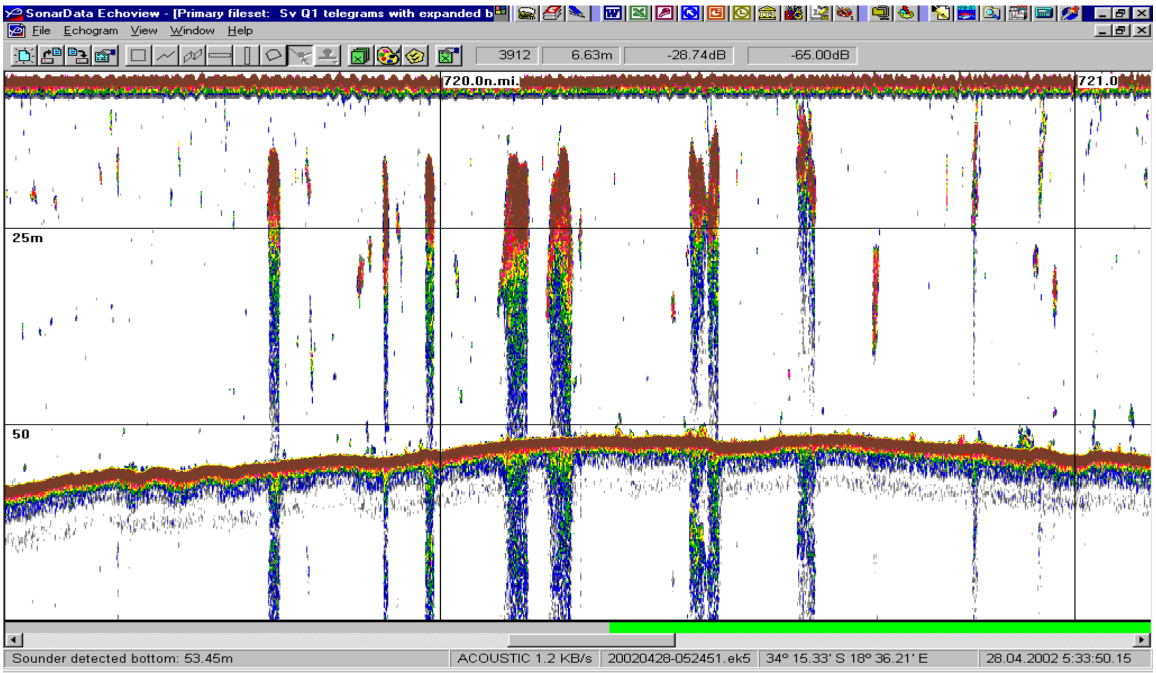

Figure 1: Dense schools of sardine found in False Bay on 28th April 2002. Note that the vessel actively searched for these schools using the Simrad SA950 sonar to maximise the number of interceptions.

CHAPTER 2 METHODS

2.1 Acoustic sampling

Two EK500 echosounders (Ver. 5.30) firing through the keel-mounted split-beam transducers operating at nominal frequencies of 18, 38, 120 kHz (EK1) and a single-beam transducer at 200 kHz (EK2) were utilized. Data were logged continuously during the experiments utilizing both Sonardata Echolog (Ver. 2.00.21) and Bergen Echo Integrator (BEI) (Sun Unix) logging platforms. The settings used in the EK500 transceiver menus are presented in Annex I. Post-processing was done using Sonardata Echoview (Ver. 2.10.39).

Calibration of all four transceivers was carried out on 22nd April 2002.

Raw EK500 exported data were copied onto CD and distributed to IIM, MCM and MFMR personnel for deposition in their relevant data centres. A copy of all data were also stored in the on-board BEI database, while a summary of the survey and data collected has been deposited in the BENEFIT metadata-base.

Echoview files were constructed from all data, largely in the form of several files for each day (approximately 5 hours survey time per file) using the file-naming format e.g. "*Transect searching 27th 1.EV*" for the first period on 27th April, etc.

A Hewlett Packard DeskJet printer was set to print the 38 kHz output. Colour S_V minimum was set to -65 dB.

2.2 Trawl sampling

Fifteen midwater trawls were conducted during this survey. For each trawl station, size of catch, species composition and length frequency was determined and entered into the NAN-SIS database following the standard procedure. Summery of trawl data are shown in Table 1 and details are given in Annex II.

Table 1: Summary of trawl data.

Station no.	Date	Time		Position		Composition
		Start. time	Duration	Lat	Long	Sardine (%)
1076	22-apr-02	18:56	23	3412	1832	99.34
1077	23-apr-02	5:12	6	3416	1833	98.96
1078	24-apr-02	16:27	22	3417	1838	81.26
1079	25-apr-02	17:01	15	3438	1912	13.4
1080	25-apr-02	18:32	19	3434	1915	93.26
1081	25-apr-02	19:57	20	3432	1919	86.3
1082	26-apr-02	3:55	23	3433	1913	99.83
1083	26-apr-02	19:52	17	3418	1847	61.39
1084	26-apr-02	21:32	20	3417	1847	76.27
1085	26-apr-02	23:34	25	3412	1845	54.03
1086	27-apr-02	8:12	26	3416	1838	56.38
1087	27-apr-02	10:32	32	3417	1838	0
1088	27-apr-02	17:21	23	3417	1836	90.33
1089	27-apr-02	18:27	14	3416	1838	65.58
1090	28-apr-02	3:56	9	3417	1835	97.69

2.3 Experiments

2.3.1 Attenuation

The data used in this experiment were collected by actively searching for suitable schools within areas where concentrations of sardine had been observed. The Simrad SA950 sonar was manned throughout much of the survey and the vessel was manoeuvred over schools. On several occasions when a number of suitable schools were found the vessel returned repeatedly along the same course track in order to obtain as many samples as possible.

Sardine tend to form compact, dense schools that are relatively easy to identify from their characteristic acoustic signature. Midwater trawling was used to confirm the identity of the target and provide information on the length distribution of the fish. Trawling during the day was largely unsuccessful, seemingly due to vessel/trawl avoidance. Therefore most sampling was conducted immediately after sunset.

The schools used in the analysis were discrete and mono-specific and in areas where no significant amounts of scattered fish occurred. This was confirmed by raising the S_V threshold to –50 dB, the level which represented approximately a 5% reduction in the bottom echo, and ensuring that all acoustic scatterers were no longer detectable. A school was defined as the area encompassed by echoes when the S_V threshold was raised to –65 dB, i.e. all weak echoes emanating from fish or other organisms at the periphery of the schools were excluded. The signal below the school was not removed, as this was likely to contain part of the multiple scattering echo or "tail". The S_V used for integration of the schools was –65 dB. The vertical resolution of the sample data was 0.20 m.

The bottom echo in the vicinity of the school was analysed to determine whether there was a significant reduction in the bottom echo under the school compared to either side of the school. The bottom was defined and integrated at –65 dB. In order to eliminate the possibility of swell or roll induced changes in bottom signal, the distance of bottom analysed included several cycles of swell/role; approximately 100 pings. Where possible an equal distance each side of the school was integrated. Areas where there were visible variations in the appearance of the bottom echo were not used. Unlike previous attenuation experiments, the mean difference in bottom integration values before and after schools was not tested for significant differences as it was found that when large numbers of pings were analysed these differences were almost always significant. Thus many schools that were situated over fairly constant density substrates that were apparently ideal for this analysis were being excluded. One clear ping between the areas of bottom before, under and after the school was left to ensure no partial contamination of this ping by the fish above. The bottom was integrated to include the entire bottom signal to a depth equivalent to the depth of the water column from the surface to the top of the school. This was to ensure that the entire first bottom echo was integrated, but that the second echo was excluded. The bottom was integrated to the same depth in areas below the school and on each side of the school.

All data collected up to 08h00 on 28th April were analysed during the survey and the preliminary results are presented in the following chapter.

Table 2. The periods when attenuation data were collected follow:

Date	Time	Area	Suitable schools
22nd April	00h00 – 06h00	False Bay	Few
22nd April	14h00-19h00	False Bay	None
22/23rd April	20h00-04h00	West side of False Bay	Few
23rd April	07h00-10h00	West side of False Bay	Some
23/24th April	18h00-07h00		None
24th April		East side of False Bay	Few
25th April	05h00-08h00	East side of False Bay	None
25th April	13h00-19h00	Walker Bay	Few
26th April	07h00-19h00	Walker Bay	Few
27th April	06h00-19h00	False Bay	Some
28th April	07h00-19h00	False Bay	Some

2.3.2 Target strength

Target strength data were collected opportunistically when the schools of sardine had dispersed, and hence were no longer suitable for signal attenuation experiments. This occurred each night and so many of the night periods were used for collecting these data.

Prior to collecting target strength data a trawl was conducted to ensure that the species composition was largely sardine. Up to about 10% of other species was permitted in the sample, otherwise the vessel moved to another site where the species composition was closer to monospecific.

Data on sardine target strength were collected at three frequencies; 38 kHz, 120 kHz and 200 kHz. These data were logged in Echoview; the first two frequencies through the EK500 (1) and stored in the sub-directory EK1, while the 200 kHz data were captured through the EK500 (2) and were thus stored in a separate directory, namely EK2. These data were also stored in the on-board BEI database.

No data analysis was conducted on board, apart from a brief examination of the data to check on its validity.

2.3.3 Behaviour

Investigations into the reaction of sardine schools in the vicinity of the *Nansen* were considered, using the Simrad SA 950 and EK500 to observe the behaviour of fish as the vessel approached and passed over schools. It was also planned to make use of the “man-over-board” dinghy and the portable Simrad EY500 to monitor the reaction of fish to a passing vessel (the *Nansen*). However, as relatively few schools of sardine were found during the survey period, all effort was put into the higher priority objectives, namely to collect attenuation and target strength data.

2.4 Weather data

Air and sea surface temperature (SST), wind speed and direction, and incident solar intensity recorded with the AANDEREAA weather station were logged in 10 minute intervals.

CHAPTER 3 RESULTS

3.1 Weather conditions

Weather conditions were generally fair to good, with moderate winds, ranging from 0 to 32 m/s (Figure 2). A strong wind developed during the final day, which prevented an experiment that had been planned; using the vessel anchored with the calibration sphere deployed to study signal attenuation by sardine schools. It was frequently cloudy, and a few showers occurred during the cruise. The temperature at the sea surface and in the air ranged from 11.8 to 19.2°C and from 12.7 to 22.4°C, respectively.

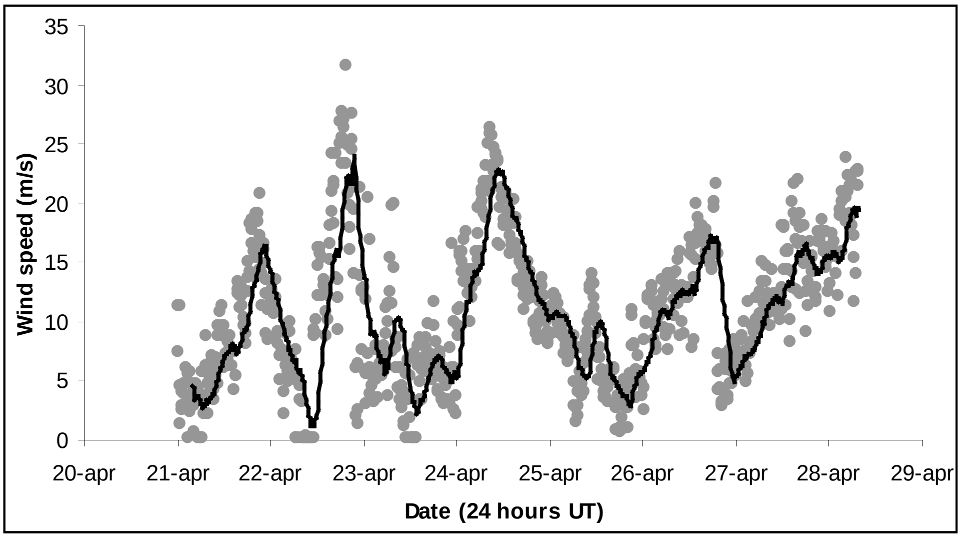

Figure 2: Wind speed recorded every 10 min throughout the cruise (•) with the Aanderaa weather station (—: moving average).

3.2 Trawl data

The length of sardine sampled during the survey ranged from 12.5 to 24.0 cm total length (Figure 3). Details of individual trawls are available in the NANSIS database.

3.3 Attenuation experiments

Approximately 100 schools were intercepted in areas where the seabed was of a reasonably constant density and hence could be used as a reference for assessing the amount of signal attenuation. Numerous schools occurred over rough seabed and therefore could not be used.

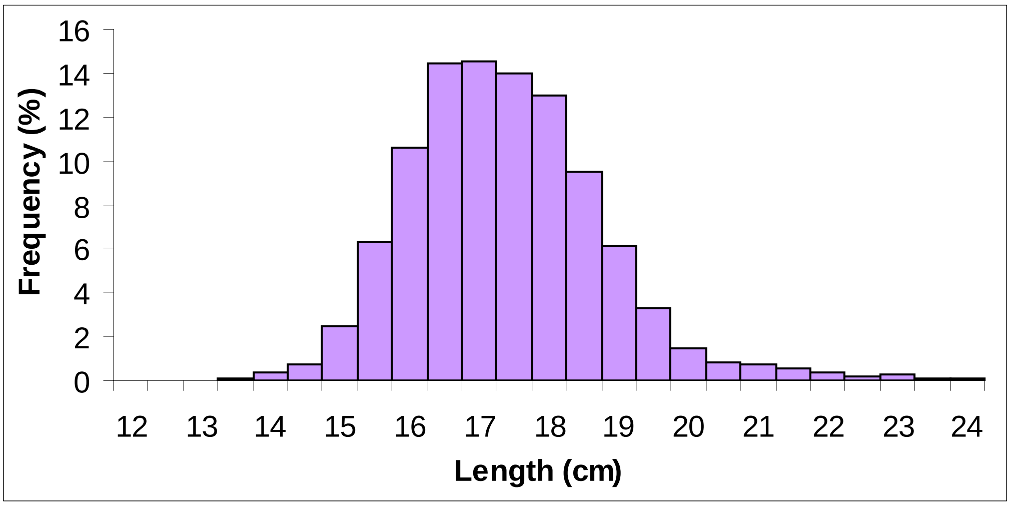

Figure 3: Length frequency of sardine sampled during the survey

The schools tended to be rather diffuse with S_A values frequently less than 500 000 m^2/NM^2. During the final day (28th) a number of dense schools were encountered with s_A values of up to almost 2 000 000 m^2/NM^2.

About 74 schools, and the associated bottom echoes, were analysed during the survey and the results are presented in Figure 4.

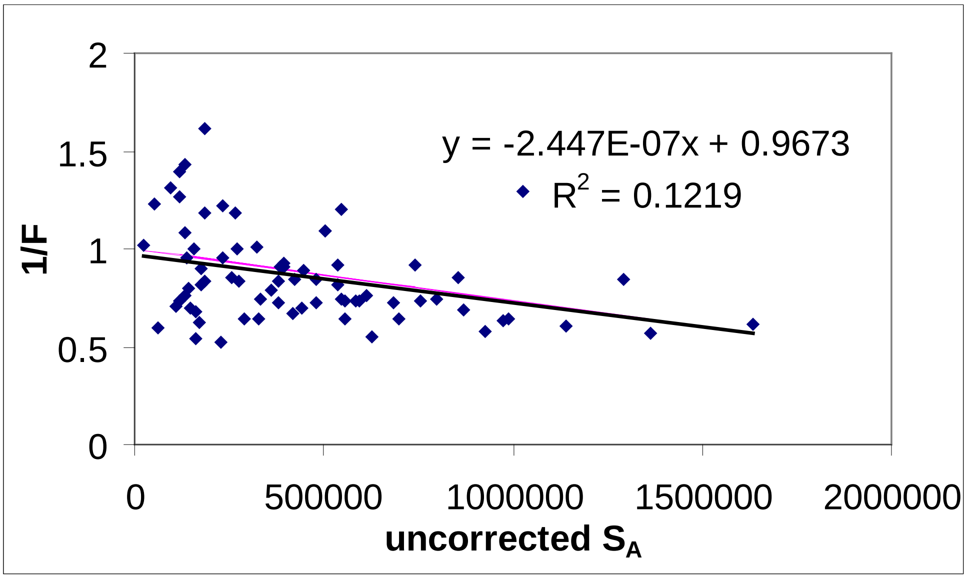

Figure 4: The relationship between bottom attenuation (1/F) and area back-scattering level (S_A) of 74 sardine schools analysed from the experiments conducted on the R.V. *Dr. Fridtjof Nansen* in April 2002. Approximately a further 30 schools remain to be analysed. The regression line obtained from 156 schools intercepted during surveys in South African and Namibian waters is also shown (in colour).

While much analysis still needs to be done, the preliminary results show a large degree of variability in the relationship between the decrease in bottom signal and school density. However the relationship is very similar to that already described in Coetzee *et al*. (submitted *ICES J. Mar. Sci.*), as shown by the two regression lines in Figure 4.

3.4 Target strength

As noted earlier the target strength data were not analysed during the survey. However a preliminary scan of the data was made to ensure that it was of sufficient quality for future use. Examples of the TS distribution for short periods of the survey are shown below (Figure 5).

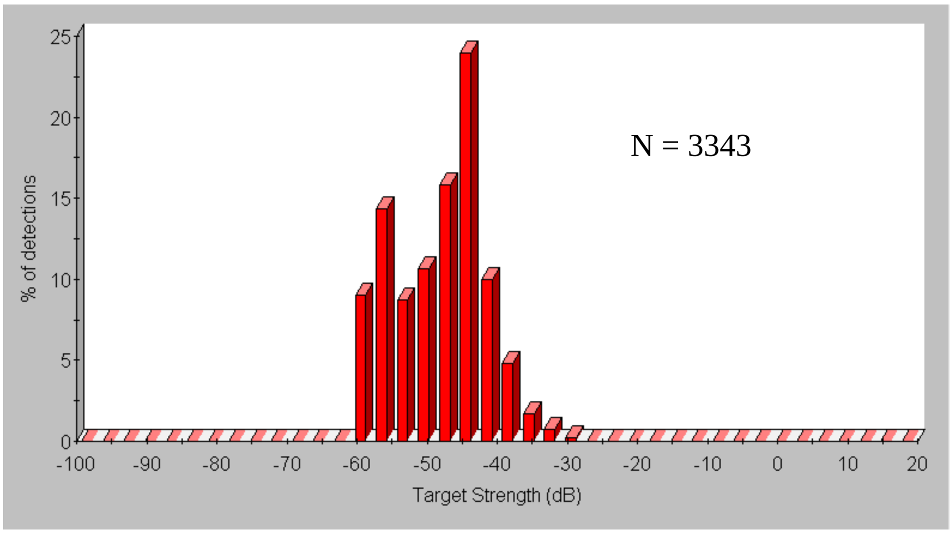

Figure 5a: Distribution of the target strength of single targets detected in the period immediately after Trawl 3 (1078) on 24th April 2002 at approximately 17h00. Note that Trawl 3 yielded 81% sardine, 13% anchovy and 5.5% round herring.

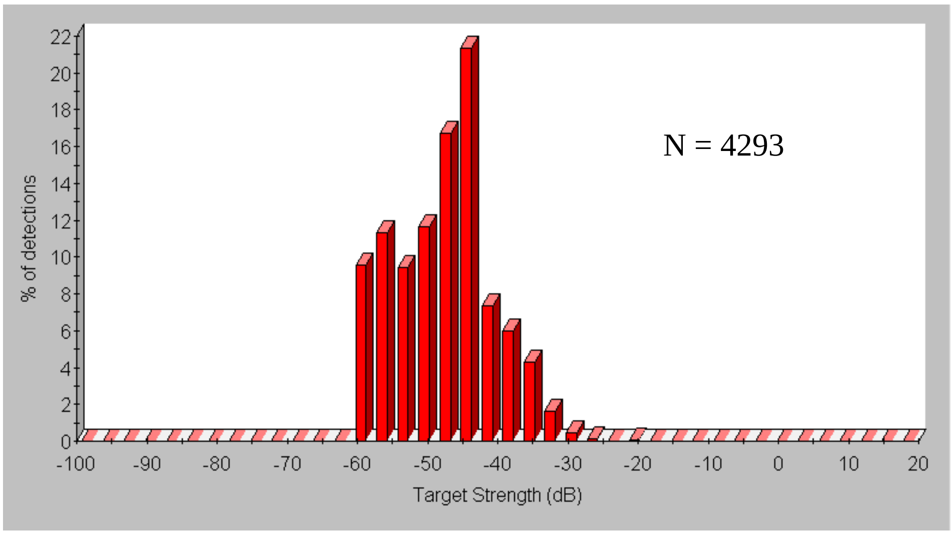

Figure 5b: Distribution of the target strength of single targets detected in the period from 17h46 to 19h15 on 25th April 2002 at approximately 17h00. Note that Trawls 1080 and 1081 were conducted in this area at

18h30 and 20h00 and yielded 93% and 86% sardine respectively, with small amounts of anchovy and some other species.

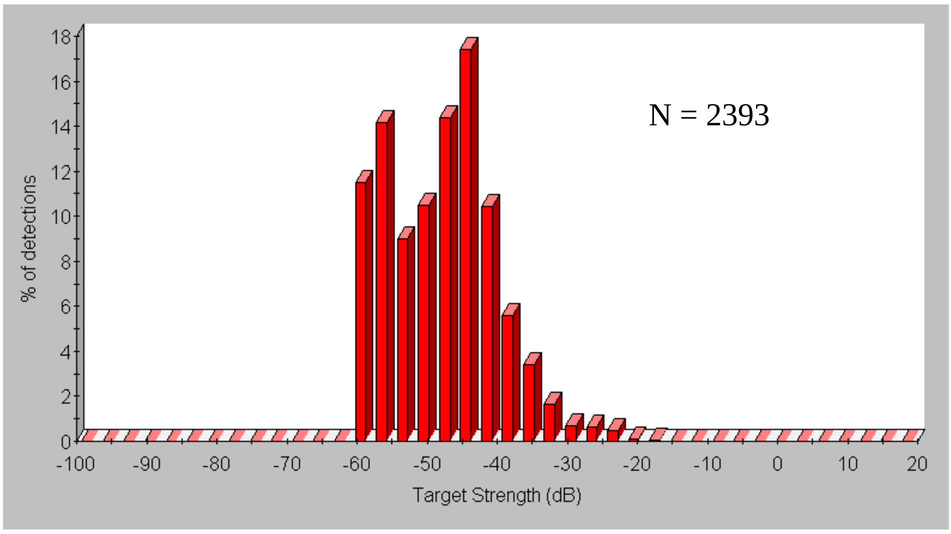

Figure 5c: Distribution of the target strength of single targets detected in the period from 03h03 to 03h45 on 28th April 2002. Note that Trawl 1090 was conducted in this area at 04h00 yielded 98% sardine, with a small amount of anchovy.

Figures 5a-c clearly show a peak in target strength values around -43 to -45 dB with a secondary mode at about -58 dB. These would seem to correspond to the the TS of single sardine and anchovy targets, but further analysis of these data needs to be conducted before any conclusions can be made.

CHAPTER 4 DISCUSSION

The numbers of dense sardine schools found in False Bay and Walker Bay were not as high as had been hoped prior to the survey. Nonetheless, a fairly large number of schools were intercepted while scattered monospecific distributions of sardine at night allowed many hours of multi-frequency target strength data to be collected.

4.1 Attenuation experiments

Unfortunately the Simrad SA950 proved not very suitable for locating and tracking schools and it was often difficult to intercept schools. On a number of occasions a particularly suitable area of schools was intercepted, but it was very difficult to turn back and find these schools again.

However the preliminary analysis of the attenuation data provides a valuable confirmation of previously estimated attenuation levels. This work further indicates that attenuation in sardine schools during daylight periods results in a large negative bias in biomass estimations. However these analyses also indicate that the level of bias may not be as large as assumed during the BENEFIT Survey Errors workshop.

These data have been partially processed and further work will be conducted once the methodology proposed for this analysis has been peer-reviewed. A paper on this by Coetzee *et al.* has been submitted to the *ICES J. mar. Sci*. In addition, arrangements have been made for one of the participants of the cruise, Martha Uumati, to further utilise these data as part of her M.Phil. during in Bergen in 2003/4, possibly in a comparison with similar data from sardine in north-west Africa (Morocco).

4.2 Target strength experiments

Conditions were ideal for collecting these data and the vessel was put to productive use during many of the night periods when schools had dispersed and other experiments were not possible.

As the results show, the data that were collected appear to be well suited for calculations of an in situ length-based target strength expression for sardine. Attempts will be made to find a suitable person to conduct this work and to compare the results with other methods of determining target strength, especially swim-bladder directivity models developed by Jeth and Horne (2002) following a previous BENEFIT *R.V. Dr. Fridtjof Nansen* survey in June 1999 (Survey No. 1999-407).

4.3 Behavioural experiments

The shoaling behaviour of the sardine in South Africa was substantially different to that typically observed in Namibia. Many small scattered schools were encountered with only a few dense schools detected, and even these were much smaller than the sardine schools frequently observed in Namibian. This, together with the problem encountered using the suitable sonar for tracking individual shoals, and the lack of available time, meant that no progress was made on this aspect. It is planned to attempt this work in Namibian waters in 2003, providing sufficient sardine can be found.

REFERENCES

Correcting acoustic estimates of fish density for absorption in dense schools. J. Coetzee, D. Boyer, I. Hampton, H. Boyer and A. Kreiner. Submitted. *ICES J. mar. Sci*.

Three dimensional visualisation of fish morphometry and acoustic backscatter. Jech, J. M. and J. K. Horne. *Acoustical Society of America, Research Letters On-line (ARLO)* 3: 35. 2002.

Annex I EK 500 Transceiver Menu Settings

(A)

Havforskningsinstituttets kvalitetssystem

Seksjon elektronisk instrumentering

DRIFTSSKJEMA 1 - ekkolodd Revidert sept.-97

EK500-1		
Serienr: 3021	Programversjon:	Driftsansvarlig: Tore Mørk
Fartøy: Dr. Fridtjof Nansen	Toktnr: 2002404 - 2002405	Tidsrom: 02.04 - 29.04.2002
Formål for anvendelse: Målinger på skremmeeffekt og skyggeeffekt		
BEI stasjon tilknyttet: Arbeidsstasjon "senegal" m/BEI ver. 2000		
Ping Interval: 0,0 - 1,2	Transmit Power: Normal	Noise Margin: 0

Oppsett:	**Transceiver 1**	**Transceiver 2**	**Transceiver 3**
Frekvens:	38 kHz	120 kHz	18 kHz
Svinger tilknyttet:	ES38B SK	ES120-7 SK	ES18-11 SK

Transceiver menu:

Mode	Active	Active *)	Active *)
Transducer Type	ES38B	ES120-7	ES18-11
Transd. Sequence	Off	Off	Off
Transd Depth	5,5 m	5,5 m	5,5 m
Absorption Coeff.	10 dB/km	38 dB/km	3 dB/km
Pulse Length	Medium	Long	Short
Bandwidth	Wide	Narrow	Wide
Max. Power	2000 W	1000 W	2000 W
2-way Beam Angle	-21,0 dB	-20,6 dB	-17,2 dB
Sv Transd. Gain	27,16/27,01 dB**)	26,06/26,01 dB**)	23,56/23,67 dB**)
TS Transd. Gain	27,26	26,05	23,61
Angle Sens. Along	21,9	21,0	13,9
Angle Sens. Athw.	21,9	21,0	13,9
3 dB Beamw. Along	7,1	7,6	11,1
3 dB Beamw. Athw.	6,9	7,2	10,7
Alongship Offset	0,07	-0,04	0,07
Athw. ship Offset	0,03	0,16	-0,09

TS Detection menu

Min. Value	-60 dB	-55 dB	-55 dB
Min. Echo Length	0,8	0,8	0,8
Max. Echo Length	1,8	1,8	1,8
Max. Gain Comp.	6,0 dB	3,0 dB	3,0 dB
Max. Phase Dev.	5,0	5,0	2,0

(B)

Havforskningsinstituttets kvalitetssystem

Seksjon elektronisk instrumentering

DRIFTSSKJEMA 1 - ekkolodd Revidert sept.-97

EK500-2		
Serienr: 435	Programversjon: 5,30	Driftsansvarlig: Tore Mørk
Fartøy: Dr. Fridtjof Nansen	Toktnr: 2002404 - 2002405	Tidsrom: 02.04 - 29.04.2002
Formål for anvendelse: Målinger på skremmeeffekt og skyggeeffekt		
BEI stasjon tilknyttet: Arbeidsstasjon "senegal" m/BEI ver. 2000		
Ping Interval: 1,2	Transmit Power: Normal	Noise Margin: 0

Oppsett:	**Transceiver 1**	**Transceiver 2**	**Transceiver 3**
Frekvens:	200 kHz	38 kHz	
Svinger tilknyttet:	200-7F SK	ES38B	

Transceiver menu:

Mode	Active	Off	
Transducer Type	200-7F		
Transd. Sequence	Off		
Transd Depth	5,5 m		
Absorption Coeff.	53 dB/km		
Pulse Length	Long		
Bandwidth	Narrow		
Max. Power	1000 W		
2-way Beam Angle	-20,5 dB		
Sv Transd. Gain	24,72/24,61 dB*)		
TS Transd. Gain	25,95 dB		
Angle Sens. Along	0		
Angle Sens. Athw.	0		
3 dB Beamw. Along	0		
3 dB Beamw. Athw.	0		
Alongship Offset	0		
Athw. ship Offset	0		

TS Detection menu

Min. Value	-80 dB		
Min. Echo Length	0,8		
Max. Echo Length	1,8		
Max. Gain Comp.	6,0 dB		
Max. Phase Dev.	2,0		

Annex II Records of fishing stations

PROJECT STATION:1076

DATE:22/ 4/02 GEAR TYPE: PT No: 6 POSITION:Lat S 3412
start stop duration Long E 1832
TIME :18:56:12 19:18:53 23 (min) Purpose code: 1
LOG : 105.23 106.58 1.32 Area code :
FDEPTH: 10 10 GearCond.code:
BDEPTH: 38 40 Validity code:
Towing dir: 180ø Wire out: 150 m Speed: 35 kn*10

Sorted: 30 Kg Total catch: 5000.00 CATCH/HOUR: 13043.48

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sardinops ocellatus	12957.39	343510	99.34	5937
Engraulis capensis	86.09	15496	0.66	5938
Total	13043.48		100.00	

PROJECT STATION:1077

DATE:23/ 4/02 GEAR TYPE: PT No: 3 POSITION:Lat S 3416
start stop duration Long E 1833
TIME :05:12:03 05:17:34 6 (min) Purpose code: 1
LOG : 191.35 191.72 0.37 Area code :
FDEPTH: 25 25 GearCond.code:
BDEPTH: 52 52 Validity code:
Towing dir: 112ø Wire out: 120 m Speed: 40 kn*10

Sorted: 29 Kg Total catch: 5000.00 CATCH/HOUR: 50000.00

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sardinops ocellatus	49481.90	1255610	98.96	5939
Engraulis capensis	345.40	48360	0.69	5941
Trachurus capensis	172.70	6910	0.35	5940
Total	50000.00		100.00	

PROJECT STATION:1078

DATE:24/ 4/02 GEAR TYPE: PT No: 6 POSITION:Lat S 3417
start stop duration Long E 1838
TIME :16:27:49 16:49:45 22 (min) Purpose code: 1
LOG : 340.55 342.06 1.49 Area code :
FDEPTH: 40 20 GearCond.code:
BDEPTH: 65 74 Validity code:
Towing dir: 180ø Wire out: 180 m Speed: 40 kn*10

Sorted: 11 Kg Total catch: 30.95 CATCH/HOUR: 84.41

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sardinops ocellatus	68.59	1885	81.26	5942
Engraulis capensis	11.05	1339	13.09	5943
Etrumeus whiteheadi	4.77	164	5.65	5944
Total	84.41		100.00	

PROJECT STATION:1079

DATE:25/ 4/02 GEAR TYPE: PT No: 3 POSITION:Lat S 3438
start stop duration Long E 1912
TIME :17:01:22 17:16:50 15 (min) Purpose code: 1
LOG : 448.89 450.03 1.13 Area code :
FDEPTH: 20 20 GearCond.code:
BDEPTH: 76 75 Validity code:
Towing dir: 30ø Wire out: 150 m Speed: 40 kn*10

Sorted: 29 Kg Total catch: 116.40 CATCH/HOUR: 465.60

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Engraulis capensis	341.60	65216	73.37	5945
Sardinops ocellatus	62.40	1600	13.40	5946
Chelidonichthys capensis	52.00	368	11.17	
Etrumeus whiteheadi	9.60	336	2.06	5947
Total	465.60		100.00	

PROJECT STATION:1080
DATE:25/ 4/02   GEAR TYPE: PT No: 3 POSITION:Lat S 3434
start stop duration   Long E 1915
TIME :18:32:04 18:50:58 19 (min) Purpose code: 1
LOG : 456.95 458.14 1.18   Area code :
FDEPTH: 10 10   GearCond.code:
BDEPTH: 67 70   Validity code:
Towing dir: 212ø Wire out: 150 m Speed: 40 kn*10

Sorted: 30 Kg   Total catch: 2000.00   CATCH/HOUR: 6315.79

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	5889.79	141063	93.26	5949
Engraulis capensis	342.95	67342	5.43	5948
Etrumeus whiteheadi	51.79	3107	0.82	5950
Chelidonichthys capensis	31.26	208	0.49	
Total	6315.79		100.00	

PROJECT STATION:1081
DATE:25/ 4/02   GEAR TYPE: PT No: 3 POSITION:Lat S 3432
start stop duration   Long E 1919
TIME :19:57:43 20:17:41 20 (min) Purpose code: 1
LOG : 465.91 467.18 1.24   Area code :
FDEPTH: 10 10   GearCond.code:
BDEPTH: 44 47   Validity code:
Towing dir: 210ø Wire out: 150 m Speed: 40 kn*10

Sorted: 31 Kg   Total catch: 63.85   CATCH/HOUR: 191.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	165.30	3375	86.30	5952
Engraulis capensis	16.29	2832	8.50	5951
Chelidonichthys capensis	6.27	42	3.27	
Trachurus capensis	4.38	189	2.29	5954
Etrumeus whiteheadi	2.49	93	1.30	5953
LOLIGINIDAE	1.56	6	0.81	
MYLIOBATIDAE	0.63	6	0.33	
Total	196.92		102.80	

PROJECT STATION:1082
DATE:26/ 4/02   GEAR TYPE: PT No: 6 POSITION:Lat S 3433
start stop duration   Long E 1913
TIME :03:55:42 04:18:27 23 (min) Purpose code: 1
LOG : 482.11 483.65 1.52   Area code :
FDEPTH: 10 10   GearCond.code:
BDEPTH: 78 87   Validity code:
Towing dir: 270ø Wire out: 150 m Speed: 40 kn*10

Sorted: 30 Kg   Total catch: 5000.00   CATCH/HOUR: 13043.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	13021.91	338914	99.83	5955
LOLIGINIDAE	21.57	430	0.17	
Total	13043.48		100.00	

PROJECT STATION:1083
DATE:26/ 4/02   GEAR TYPE: PT No: 5 POSITION:Lat S 3418
start stop duration   Long E 1847
TIME :19:52:51 20:10:08 17 (min) Purpose code: 1
LOG : 583.42 584.57 1.15   Area code :
FDEPTH: 10 10   GearCond.code:
BDEPTH: 53 58   Validity code:
Towing dir: 180ø Wire out: 150 m Speed: 40 kn*10

Sorted: 29 Kg   Total catch: 428.75   CATCH/HOUR: 1513.24

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	928.94	24844	61.39	5957
Engraulis capensis	552.71	105434	36.52	5956
Etrumeus whiteheadi	28.94	2841	1.91	5958
Trachurus capensis	2.65	159	0.18	5959
Total	1513.24		100.00	

PROJECT STATION:1084
DATE:26/ 4/02   GEAR TYPE: PT No: 4 POSITION:Lat S 3415
start stop duration   Long E 1847
TIME :21:32:52 21:52:34 20 (min) Purpose code: 1
LOG : 590.08 591.30 1.21   Area code :
FDEPTH: 10 10   GearCond.code:
BDEPTH: 41 39   Validity code:
Towing dir: 360ø Wire out: 150 m Speed: 40 kn*10

Sorted: 37 Kg   Total catch: 386.41   CATCH/HOUR: 1159.23

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	884.10	19908	76.27	5961
Engraulis capensis	262.41	50733	22.64	5960
Trachurus capensis	9.54	351	0.82	5963
Etrumeus whiteheadi	3.18	63	0.27	5962

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                                    _________            ________
Total                                 1159.23              100.00

                                                        PROJECT STATION:1085
    DATE:26/ 4/02             GEAR TYPE: PT No: 6  POSITION:Lat   S  3412
             start   stop  duration                           Long  E  1845
    TIME  :23:34:19 23:59:29  25  (min)  Purpose code:  1
    LOG   : 599.72   601.36  1.63        Area code    :
    FDEPTH:     10       10              GearCond.code:
    BDEPTH:     44       49              Validity code:
           Towing dir: 200ø  Wire out: 150 m  Speed:    kn*10

      Sorted:  33 Kg      Total catch:    400.00    CATCH/HOUR:    960.00

SPECIES                                  CATCH/HOUR    % OF TOT. C   SAMP
                                      weight   numbers
Sardinops ocellatus                    518.64    14830       54.03     5965
Engraulis capensis                     438.48   100865       45.68     5964
Trachurus capensis                       1.44       29        0.15     5967
Etrumeus whiteheadi                      1.44      144        0.15     5966
                                    _________            ________
Total                                  960.00              100.01


                                                        PROJECT STATION:1086
    DATE:27/ 4/02             GEAR TYPE: PT No: 3  POSITION:Lat   S  3416
             start   stop  duration                           Long  E  1838
    TIME  :08:12:09 08:38:01  26  (min)  Purpose code:  1
    LOG   : 654.47   656.25  1.76        Area code    :
    FDEPTH:     20       25              GearCond.code:
    BDEPTH:     58       68              Validity code:
           Towing dir: 180ø  Wire out: 150 m  Speed: 40 kn*10

      Sorted:  22 Kg      Total catch:     22.35    CATCH/HOUR:     51.58

SPECIES                                  CATCH/HOUR    % OF TOT. C   SAMP
                                      weight   numbers
Sardinops ocellatus                     29.08      944       56.38     5968
J E L L Y F I S H                       22.96                44.51
                                    _________            ________
Total                                   52.04              100.89


                                                        PROJECT STATION:1087
    DATE:27/ 4/02             GEAR TYPE: PT No: 4  POSITION:Lat   S  3417
             start   stop  duration                           Long  E  1838
    TIME  :10:32:36 11:05:03  32  (min)  Purpose code:  1
    LOG   : 659.84   662.27  2.43        Area code    :
    FDEPTH:     40       40              GearCond.code:
    BDEPTH:     65       51              Validity code:
           Towing dir: 360ø  Wire out: 220 m  Speed:    kn*10

      Sorted:  37 Kg      Total catch:     37.40    CATCH/HOUR:     70.13

SPECIES                                  CATCH/HOUR    % OF TOT. C   SAMP
                                      weight   numbers
JELLYFISH                               68.81                98.12
Etrumeus whiteheadi                      0.94        2        1.34     5970
Trachurus capensis                       0.19       21        0.27     5971
Engraulis capensis                       0.19        8        0.27     5969
                                    _________            ________
Total                                   70.13              100.00


                                                        PROJECT STATION:1088
    DATE:27/ 4/02             GEAR TYPE: PT No: 6  POSITION:Lat   S  3417
             start   stop  duration                           Long  E  1836
    TIME  :17:21:24 17:44:26  23  (min)  Purpose code:  1
    LOG   : 692.48   693.95  1.42        Area code    :
    FDEPTH:     10       10              GearCond.code:
    BDEPTH:     65       58              Validity code:
           Towing dir: 360ø  Wire out: 150 m  Speed: 40 kn*10

      Sorted:  34 Kg      Total catch:   5000.00    CATCH/HOUR:  13043.48

SPECIES                                  CATCH/HOUR    % OF TOT. C   SAMP
                                      weight   numbers
Sardinops ocellatus                  11781.84   381600       90.33     5972
Engraulis capensis                    1261.64   188275        9.67     5973
                                    _________            ________
Total                                13043.48              100.00


                                                        PROJECT STATION:1089
    DATE:27/ 4/02             GEAR TYPE: PT No: 6  POSITION:Lat   S  3416
             start   stop  duration                           Long  E  1838
    TIME  :18:27:49 18:41:19  14  (min)  Purpose code:  1
    LOG   : 696.07   696.88  0.79        Area code    :
    FDEPTH:     10       10              GearCond.code:
    BDEPTH:     61       65              Validity code:
           Towing dir: 180ø  Wire out: 150 m  Speed: 40 kn*10

      Sorted:  29 Kg      Total catch:    500.00    CATCH/HOUR:   2142.86

SPECIES                                  CATCH/HOUR    % OF TOT. C   SAMP
                                      weight   numbers
Sardinops ocellatus                   1405.29    45279       65.58     5974
Engraulis capensis                     715.71   113631       33.40     5975
Etrumeus whiteheadi                     21.86     1530        1.02     5976
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Total	2142.86	100.00

PROJECT STATION:1090

DATE:28/ 4/02 GEAR TYPE: PT No: 6 POSITION:Lat S 3417

Long E 1835

	start	stop	duration	
TIME	:03:56:16	04:05:33	9 (min)	Purpose code: 1
LOG	: 714.30	714.90	0.58	Area code :
FDEPTH:	10	10		GearCond.code:
BDEPTH:	61	65		Validity code:

Towing dir: 180ø Wire out: 150 m Speed: 40 kn*10

Sorted: 25 Kg Total catch: 8000.00 CATCH/HOUR: 53333.34

SPECIES	CATCH/HOUR weight	CATCH/HOUR numbers	% OF TOT. C	SAMP
Sardinops ocellatus	52100.07	1772007	97.69	5977
Engraulis capensis	1233.27	177420	2.31	5978
Total	53333.34		100.00	