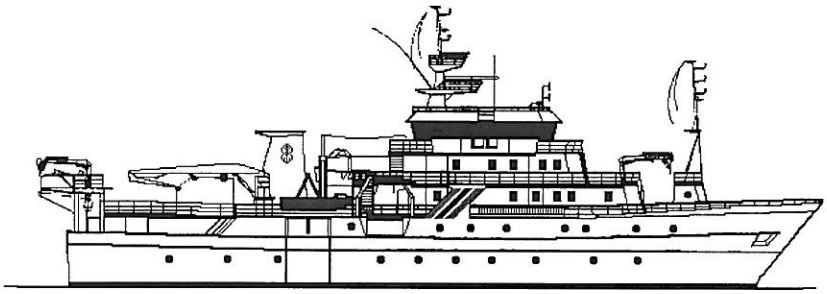

BENEFIT SURVEYS

Diel vertical migration in horse mackerel

21 – 30 August 2001

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CRUISE REPORTS "DR. FRIDTJOF NANSEN"

BENEFIT SURVEYS

Cruise Report No 3/2001

Diel vertical migration in horse mackerel

21 - 30 August 2001

By

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CHAPTER 1. INTRODUCTION

1.1. Background

Horse mackerel *Trachurus trachurus capensis* undertake extensive diel vertical migrations in South African and Namibian waters. In the southern Benguela they form dense daytime shoals near the bottom during the day and ascend into midwater at night. This nocturnal excursion into midwater appears to be for reasons other than feeding, because the fish feed near the bottom before their upward migration. Predator avoidance does not seem to be the reason for these nocturnal migrations as this behaviour has been shown in the absence of their main predator, the Cape hake *Merluccius capensis* and *M. paradoxus*. In the northern Benguela, horse mackerel commonly form dense shoals in midwater during the day rather than on the bottom like their South African counterparts. This phenomenon may be linked to different food (e.g. dense midwater zooplankton scattering layers) and hydrographic conditions (e.g. low oxygen water) in the northern Benguela.

The aim of this study is to investigate the pattern of diel migration of horse mackerel when they are in midwater during the day in Namibian waters. Various abiotic and biotic factors will be examined in an attempt to explain this behaviour. Also, their feeding periodicity will be investigated to explore possible differences in the feeding pattern between the Northern Benguela and South African populations.

1.2. Diel migrations in relation to abundance estimation

Hydro acoustic surveying is a foremost means of estimating the abundance of pelagic fish, and is applied for a number of species world-wide. The main advantages of the method are the ability of sampling large volumes of water with relatively low effort and the high sample resolution in both the horizontal and the vertical planes. Acoustic surveying has the last decade been utilised in the direct assessment of the commercially important pelagic fish species of Namibia and Angola, specifically horse mackerel (*T. trachurus capensis*, *T. trecae*), sardinella (*Sardinella madarensis*, *S. aurita*), anchovy (*Engraulis capensis*) and sardine (*Sardinops sagax*). The method relies, however, on the fundamental assumptions that 1) unbiased returns from all targets are recorded, 2) that the recorded acoustic intensity can be correctly allocated among the taxons present, and 3) that the acoustic intensities of each taxon can be correctly converted to actual animal densities. Assumption 1 may, however, be violated under the following conditions:

- If targets inhabit volumes not covered by the acoustic beam, i.e. if they occupy the acoustic blind zones, at the time of sampling. Specifically, if these are in the near-bottom dead zone, in which targets are masked by the first bottom returns, and the upper blind

zone, or between the surface and the upper integration limit of the transducer (transducer near field + the narrowest part of the beam). This is a problem in species that are distributed close to the bottom (e.g. horse mackerel) or the surface (sardinella) during surveying.

- If the recorded back-scattering area s_A (m^2/nm^2) of scatters is affected by the presence of the vessel, i.e. avoidance behaviour. Vessel avoidance may cause fish to move out of the acoustic beam, in which case they are not recorded, or change their angular orientation within the beam and/or swimbladder compression (i.e. to dive), and hence their scattering properties. Bias in acoustic abundance estimates due to vessel avoidance is reported for a range of pelagic fish species.
- Attenuation of the acoustic signal due to absorption in dense scattering layers may cause a range- and density dependent non-linear reduction in recorded density.

Assumption 2 entails that the different taxons of the ensonified population can be recognised. Combining visual scrutiny of the scattering patterns and independent trawl samples from the ensonified population usually identifies the targets, but problems are frequently encountered due to:

- spatial and/or temporal changes in scattering properties of taxons due to changes in behaviour (e.g. schooling/shoaling, dispersing, vertical migration)
- overlapping distributions, masking acoustic characteristics of different targets (e.g. horse mackerel mixed with aggregations of prey items like euphausiids and/or copepods).

Representative biological samples are prerequisite also for obtaining mean size and mean weight estimates needed to convert acoustic density to total number of individuals and to total biomass, respectively. For splitting the biomass on size groups, size distribution and size-weight keys are required as well. Commonly used in acoustic surveying for this purpose are sampling trawls that are specially designed to catch representatively. There are, however, certain limitations related to trawl performance, mainly:

- Availability – the extent to which the targets were present in the sampled volume (trawl sample volume is always very small compared to the acoustic sample volume)
- Catchability – the extent to which the targets encountered in the trawl path are caught (usually both size- and species dependent)
- Compatibility – the extent to which the acoustically and biologically sampled volumes can be compared to (knowledge of trawl position, depth and geometry, and contamination of biological sample from other depths).

Consequently, reliable estimates depend on the researchers' ability to identify target species

from non-target species, and ultimately therefore on their vertical movements in the water column. During routine resource surveys non-target groups of plankton (e.g. euphausiids, copepods), ichtyoplankton (egg and larvae of any species) and nekton (mesopleagic fish such as lanternfish) often represent considerable challenges when allocating backscatter energy to target taxons. Knowledge of the vertical movements of targets is then of obvious importance both for acoustic and biological sampling.

The calculation of absolute fish densities requires that the dorsal aspect acoustic target strength (TS) at the given frequency can be predicted (see e.g. BENEFIT Cruise Report 2/2001 for formulas). Angular orientation of targets introduces variation in the backscatter at the level of several orders of magnitude. Systematic changes in angular orientation, e.g. between day and night, warm and cold seasons and between shelf and slope habitats, may consequently introduce bias to acoustic abundance estimates. Another important reason to study the behaviour, and in particular systematic vertical movements, of target species is therefore to build up the knowledge of how angular orientations and degrees of polarisation can be expected to vary at different times of day and night, and in different environmental regimes. This information can then, in turn, be used for evaluation and ideally for *ad-hoc* correction of echo-integration values.

1.3. Objectives of the survey

The overall survey objective was to study the vertical migration of horse mackerel and other scattering organisms *in situ* at a deep slope-environment in the Namibian Benguela, where horse mackerel would be distributed in mid-water during daytime. Specific objectives were:

- To conduct calibrated acoustic measurements of Cape horse mackerel (*Trachurus trachurus caensis*) at 18, 38, 120 and 200 kHz during two consecutive 24 hrs stations.

- To identify the different main groups of planktonic scatterers in the ecosystem, mainly euphausiids and copepods using multinet plankton samplers.

- To identify the different main groups of nektonic scatterers in the ecosystem, which was mainly horse mackerel, but also some round herring and predatory fish, using pelagic trawl fitted with codend multisampler.

- To study the diurnal variations in recorded acoustic volume density s_V (dB ref. 1m @ 1 γPa) and area density s_A (m^2/nm^2) of the horse mackerel and related species.

- To collect stomach samples from the horse mackerel to map the stomach contents and, if feasible, to establish feeding periodicities.

- To conduct *in situ* experiments to determine oxygen tolerance level in horse mackerel and other species and to relate this information to the observed migratory behaviour of horse mackerel and related species.

- To log meteorological (air and sea surface temperature, wind strength and direction), hydrographical (temperature, salinity, oxygen) and current (ADCP profiling) conditions.

1.4. Participation

The scientific staff consisted of:

From IIM:	Filomena VAZ-VELHO and Fransisco DE ALMEIDA.
From NatMIRC:	Graca D'ALMEIDA, Jens-Otto KRAKSTAD, Bronwen CURRIE, Kathi NOLI, Hilma ASINO and Justina SHITINDI.
From MCM:	Stan PILLAR, Granville LOUW and Charlene ROGERS.
From IMR:	Bjørn Erik AXELSEN (Cruise leader), Thor Egil JOHANSSON, Roar SKEIDE and Jan-Frode WILHELMSEN.

1.5. Narrative

The RV "Dr. Fridtjof Nansen" departed from Walvis Bay 21 August 15:00 (local time) and headed northwards towards Cunene to search for offshore aggregations of horse mackerel in midwater. From 18°00'S the area between the 500 and 2000 m isobaths was surveyed, following a triangular transect grid. A scattering layer consisting mostly of euphausiids and calanoids was found at 17°24 S 11°09 E around 1000 m depth on the shelf slope. This aggregation was monitored acoustically continuously for duration of 76 hrs. 11 cycles of ADCP, CTD, plankton multi-sampler, multinet and ordinary midwater trawls were conducted during the experiment. After having washed the trawls, the ship headed back for Walvis Bay, and docked in the afternoon 30 August 2001.

CHAPTER 2. METHODS

2.1. Survey area

The continental shelf and slope in northern Namibia from about 18°00' S and north to Cunene at 17°14' S was surveyed in order to find suitably dense aggregations of Cape horse mackerel (*Trachurus trachurus capensis*) for diel cycle experiments. The slope was the main searching area, as the target for the experiments was aggregations of horse mackerel that occupied midwater during daytime, for mapping their diurnal vertical migration without reaching bottom and, preferably, where food availability (i.e. euphausiids and copepods) would be good. The area between the 500 and 2000 m isobaths was surveyed, following a triangular transect grid. A suitable location with a scattering layer consisting mostly of euphausiids and calanoid copepods was found at the outer slope, at about 17°15' S 11°09' E. The bottom depth in the area was about 1000 m.

2.2. Hydrography and weather data

Meteorological information such as air and surface temperature, wind speed and direction and solar intensity was logged continuously from the ANDREAA weather station. CTD casts from the Seabird 911+ CTD were conducted to obtain profiles of temperature, salinity and oxygen. Water samples for calibration of the oxygen and salinity sensors were collected and analysed on board. Current measurements were carried out continuously using a 150 kHz RDI ADCP (Acoustic Doppler Current Profiler). that provides depth specific current speed and direction, including vertical and error components.

2.3. Multifrequency acoustic sampling and analysis

Two EK 500 echosounders equipped with four acoustic transducers mounted on the submersible keel (Figure 1) operating at nominal frequencies of 18, 38, 120 kHz (split-beam, EK1) and 200 kHz (single-beam, EK 2) were operated throughout the survey. Integration limits were set to 5 m below the transducer and 0.5 m off the bottom. The keel was in the lowered position during the entire survey.

Recently, several modifications have been made to the transducer arrangement of the drop keel. The modifications were done during a refit in Cape Town in January 2001. See the Cruise report from the Benefit 2/2001 Cruise on acoustic survey errors for details about the refit. The modifications of the transducer arrangement have effectively ensured optimal configuration of the transducers, as they are now positioned on the same acoustic axis giving approximately vertical transmission at normal ship trim and with minimal horizontal spacing of the transducers. The new transducer arrangement on the drop keel is illustrated in Figure 1.

a)

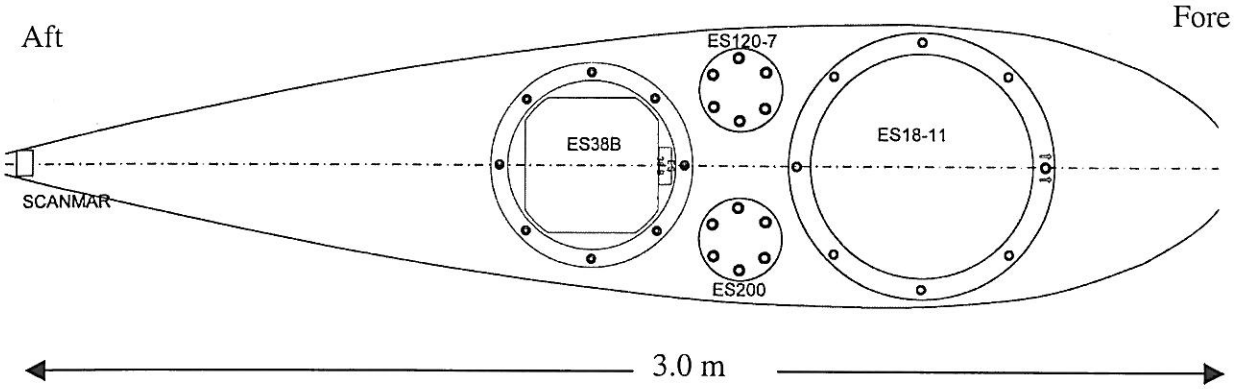


Figure 1. Transducer arrangement of the drop keel of R/V "Dr. Fridtjof Nansen" showing schematic illustration of the new orientation of the transducers on the keel (scale 1:10) (a) after the refit in Cape Town in January 2001.

The technical specifications and operational settings of the echosounders applied during the survey are given in Annex I and the calibration reports from the calibration done after the survey are given in Annex II. The 38 kHz transducer was calibrated in Baía dos Elephantes 9 August (Survey report 2/2001 of the Pelagic Resources of Angola). The s_V transducer gain was recorded at 27.30 dB, compared to 27.37 dB on the last calibration, while the TS transducer gain was recorded at 27.47 dB, compared to 27.49 dB. All four transducers were also calibrated both some time before (18 April 2001, see BENEFIT Cruise Report 2/2001) and shortly after the survey (8-9 September 2001, Annex II). The latest settings, established after the survey will be implemented retrospectively during post-processing.

To minimise differences in sampling resolution, the pulse length and band width setting of the 18 and 120 and 200 kHz transducer were set to short/wide (18 kHz) and long/narrow respectively. Logging of acoustic raw data was done using both the Sun-Unix based Bergen Echo Integrator (BEI) (Knudsen 1996) and the Windows based SonarData_Echolog® Version 2.0. Analysis and post processing of logged data was done using Sonardata_Echoview® version 2.1.

2.4. Trawl sampling

Sampling trawls used included the large pelagic trawl (30 m vertical opening) with the cod end multisampler (Skeide 2003) attached, and the small pelagic trawl (10 m vertical opening).

Floats were used on the headline when trawl depth was less than 20 m. No bottom trawl was used .The cod end multisampler was equipped with three cod ends, which were remotely opened and closed to obtain discrete, uncontaminated samples from layers at different depths or from individual schools. Thyborøn' Kombi 6.7 m^2 1,670 kg trawl doors were used in all hauls.

Random sub-samples of fish representative of the total catch were taken from the trawl catches when the total catch was not sampled. The sizes of the samples were determined from the degree of mixing of the catch. In cases where the catch was small, the total catch was always sampled. The number and total weight for each species were recorded in each sample and raised to the total catch. A random sub-sample of about 100 specimens of horse mackerel and, when present, round herring (*Etrumeus whiteheadii*), were measured to the nearest 1 mm below total length in order to obtain the size composition of the catch. These sub-samples were also analysed for biological parameters including individual total wet weight (± 0.1 g), sex, gonad maturity stage and stomach fullness (0-4; 0=empty, 4=completely filled). Horse mackerel stomach contents were analysed for freshness and were preserved in 4 % buffered formaline together with the stomachs for further analyses onshore. Formaline was also injected directly into the stomachs to accelerate the fixation process.

A total of 65 pelagic trawls were completed during the survey. All catches were sorted for species composition and entered into the NAN-SIS trawl database. A summary of all catches is shown in ANNEX III

2.5. Plankton multinet

The Hydrobios plankton multinet (Figure 2) was deployed during every trawl cycle to collect discrete samples of zooplankton at different depths. Five samples can be collected from each deployment. The plankton samples made it possible to identify acoustic scattering layers from zooplankton at all depths during the survey and to identify available food items for the horse mackerel in the survey area. The sampler was equipped with 5*405 γm nets, each fitted with flowmeters, and it was hauled obliquely at a speed of 0.5 $m.s^{-1}$ while the ship towed at 2 knots (1 $m.s^{-1}$) towing speed, giving an approximate speed of 1.5 $m.s^{-1}$ through the water.

Figure 2. The Hydrobios multinet plankton sampler in the surface

2.6. Diel cycle experiments

Three consecutive 24 hrs diel cycle experiments were completed for identification of different scattering layers, and examination of structural patterns and trophic relations. The experiment consisted of a number of continues cycles, each consisting of a pelagic trawl station, depth-discrete plankton- and nekton tows with the Hydrobios plankton multinet, and hydrographic profiles (CTD casts). Hydro acoustic data from all four frequencies and ADCP recordings were logged continuously throughout the experiments. All sampling activities during the experiments were restricted to a 5 nm long study track while the sampling depth at stations was selected in order to target vertically separated scattering layers, whenever present.

The species and size compositions of the scattering layers (fish and zooplankton) were determined using the trawl- and plankton samples (the size of copepods will be measured ashore). The hydrographical sampling (CTD) of water temperature, salinity and dissolved oxygen provided profiles of changes in hydrographical conditions over time while the ADCP recordings provided information on changes in current speed and direction at different depth during the experiment. A total of 11 cycles were completed, constituting a total of 37 trawl samples using the codend multisampler and 22 trawls with the small pelagic trawl, 11 multinet plankton samples and 8 CTD casts. Annex V provides the details about each diel cycle including station number, sampling depth, time and duration.

2.7. In situ oxygen and sulphide tolerance experiments

2.7.1. Background

Nursery grounds of several commercially important fish species coincide with areas overlying the hydrogen sulphide-producing mud belt along Namibia's inner continental shelf. Recent research has led to interest in the role this diatomaceous mud plays in affecting the overlying water column, as emissions of hydrogen sulphide are not only toxic in themselves - hydrogen sulphide being a potent respiratory toxin - but also lead rapidly and directly to anoxic or hypoxic conditions as the hydrogen sulphide reduces oxygen in the overlying water column. Even surface water can be severely hypoxic (0.7 ml/l dissolved oxygen, DO) following an intense hydrogen sulphide event.

While adult fish are able to detect and in time swim away from these unfavourable conditions, young fish (larval and pre-recruit stages) may be trapped during such events. Knowledge of the survival time of young fish exposed to such conditions is complementary to the biogeochemical and water column investigations of the area, presently being carried out at NatMIRC.

2.7.2. Methods

Two experimental aquaria 60 cm x 40 cm x 40 cm were secured in a wooden frame mounted on deck (Figure 3). They were sealed with a small circular glass roof-window, and fitted with stopcock inlets and outlets for nitrogen gas and water sampling, respectively. A nitrogen gas bottle was secured next to the aquariums with a regulated flow to both aquariums. A holding container was kept next to the aquariums to receive and hold the experimental fish. This container also served as a control tank. Water supply for all the experiments was the same: ambient subsurface water pumped on board to the fish deck. Control water was aerated using the deck air supply.

Figure 3. Aquariums used for the tolerance experiments on juvenile horse mackerel

Bubbling nitrogen gas deoxygenated the water in the aquariums. The dissolved oxygen content was accurately determined at any stage of the experiment by tapping off a sample for Winkler analysis. A stock solution of sodium sulphide dissolved in deoxygenated seawater was used to add sulphide as required to the tanks. The ambient sulphide concentration of sulphide in the tanks, as with oxygen, could be sampled at any time. Sulphide analyses were carried out onboard using the Kline method.

Horse mackerel were retrieved from trawls immediately after they came on board and acclimatised for at least 30 minutes in the holding container. Any weak or dying fish were discarded. The fish were one-year-old juveniles of uniform size, averaging 16 cm total length. Between 6 and 13 fish per tank were used in the experiments. Altogether 11 experiments and two control trials using varied combinations of hypoxia, anoxia and sulphide were carried out.

CHAPTER 3. RESULTS

3.1. Oceanographic conditions

Eight CTD stations were carried out during the diel experiments. The station depth was generally 950 m but the CTD was lowered to 500 m since the focus of the experiments was in the upper 300 m. At station 694 (24 August 17:22) the whole water column was sampled. Water bottles were fired at the bottom and surface of the profile for calibration of the oxygen sensor and additional samples were taken at selected depths e.g. oxygen minimum. Samples from these depths were preserved for oxygen, sulphide and methane determinations. Oxygen samples were analysed on board using the standard Winkler method. No sulphide was detected in the water column from on-board analyses using the Kline method. Time serie figures for the recorded levels were prepared using Surfer and are shown in Figure 3. Complete overviews of all profiles are given in ANNEX IV.

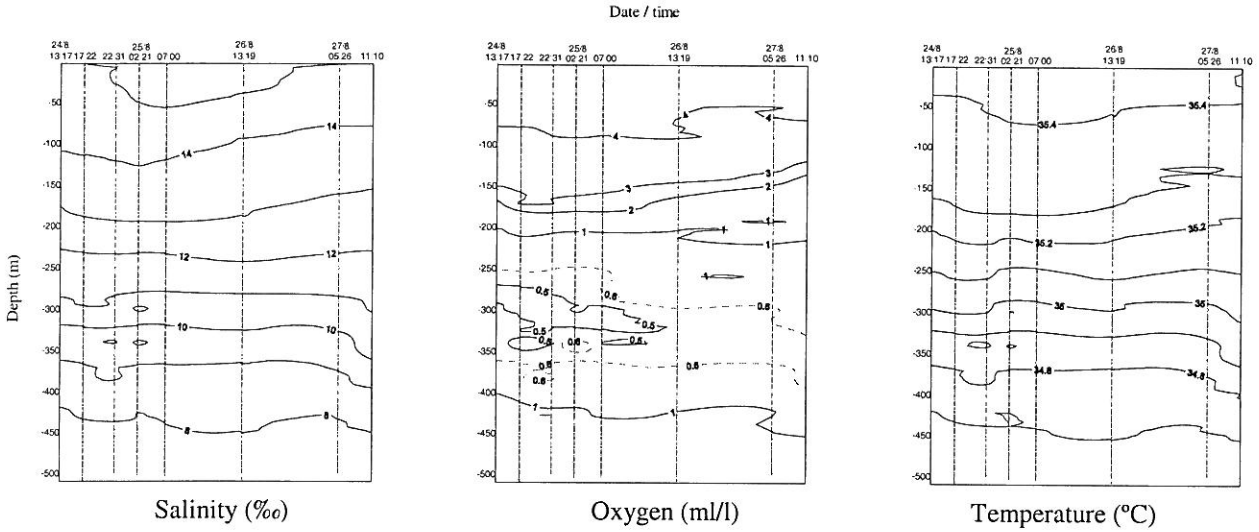


Figure 4. Time series composites of recorded salinity, oxygen and temperature during the diel cycle experiments.

3.1.1. Temperature

The hydrographic time series composites of the temperature recordings (Figure 4) show that the water column was relatively stable throughout the sampling period. A slight uplift of the isotherms from a depth of approximately 200 m is evident from the 26th August. This was most probably caused by increased upwelling induced by stronger southerly wind conditions. The individual station profiles (Appendix IV) show the absence of a well-defined thermocline throughout the sampling period. The upper 50 m of the water column was well mixed (∂T 0.5°C between 50 m and surface) but even at 150 m ∂T was generally just above 1°C. Below this depth the temperature decreased gradually to about 7°C at 500 m.

3.1.2. Oxygen

The dissolved oxygen profiles showed more dramatic changes with depth than did temperature and salinity. The individual station profiles (Appendix IV) show in general a decrease from 5 ml/l in surface waters to about 3 ml at 150 m. Between 150 and 200 m there was a strong oxycline with a 2 ml/l drop in the concentration of dissolved oxygen (DO) to around 1 ml/l at 200 m. An oxygen minimum of 0.3 - 0.5 ml/l DO was evident at around 300 m from 24 to 25 August. This tongue of low oxygen water could be advected by the polar undercurrent from the north (Angolan dome). Beneath this layer, oxygen levels increased with depth to 4 ml/l at 900 m (Station 694). The depth of the oxycline moved higher in the water column from 26 to 27 August with active upwelling (of water above the oxycline) as seen from the temperature profiles. At the final station on 27 August the base of the oxycline was at 140 m (1.2 ml/l DO) compared with 2.8 ml/l DO at this depth in the beginning of the series.

3.1.3. Salininity

Salinity profiles showed similar non-stratified trends to temperature with salinities of about 35.4‰ in surface waters, 35.3 ‰ at 150 m depth slowly decreasing to 34.6 ‰ at 500 m.

3.1.4. ADCP data

The ADCP data will be analysed at a later stage.

3.2. Diel cycle experiments

Acoustic observations on juvenile horse mackerel off the continental shelf of northern Namibia were conducted at operating frequencies 18, 38, 120 (split-beam transducers, EK1) and 200 kHz (single-beam, EK2). A suitable area with scattering layers consisting mainly of euphausiids, shrimps and juvenile horse mackerel was monitored acoustically continuously over a period of 72 hrs. Figure 5 shows a composite presentation of the three days of acoustic sampling from 07:00 on 24th August to 00:30 on 27th August. Throughout the study, the scattering layers generally remained within the upper 250 m of the water column (1000 m water depth) throughout day and night. The composites were made by resample the Echolog raw data files (EK5-files) for the 38 kHz transducer per time interval using the virtual variable module in Echoview. This operator in Echoview resample the input variable using a fixed time interval in the time/distance domain, and a specified upper depth, lower depth and number of data points in the depth domain. The raw variable was re-sampled every 90 sec (~1 sample for every 35 ping), with the resolution set to 5000 data points in the depth domain and an upper display depth at 0 m and a lower display depth of 350 m. The displayed echograms all have a colour minimum of –70 dB, with standard EK 500 colours.

The bottom limit of the daytime depths of the scattering layers in Figure 5 coincided with the depth of the oxycline which remained at around 200 m depth throughout the study. Three

distinct scattering layers are identifiable, consisting mainly of horse mackerel, a zooplankton layer dominated by euphausids (*Euphausia Hanseni*), and shrimp (*Glyphus marsupialis*) and lanternfish (*Diaphus spp*). Horse mackerel and euphausiids exhibited a clear migratory diurnal pattern, moving from a daytime position of between 150 and 250 m to the upper 100 m at night, while the shrimp did not migrate as extensively, and remained between 150 and 250 m around the clock. It is noteworthy that during the three diel cycles, the times of ascent (around 17:00) and decent (around 05:00) of horse mackerel coincided with those for euphausiids, this trend was consistent during the three diel cycles (Figure 5 and 6). At daytime they aggregated in dense schools, often visible as red knots on top of the euphausiid layer. (Figure 6a show a selected daytime situation where small, dense schools of horse mackerel aggregate on top of the euphausiid layer. Stomach content analyses showed that the horse mackerel were feeding on the euphausiids, but few full stomachs were found (see Chapter 3.3 on feeding). The euphausiids lifted towards the surface in the evening and the horse mackerel followed (Figure 6b). The migration started at approximately 200 m depth and the fish ascended to 30 m below the surface, the vertical migration took about 25 min. giving an average ascend of 6.8 m/min. The horse mackerel could at night be seen as denser regions inside the euphausiid layer (Figure 6c), while mesopleagic fish, mostly lanternfish *Maurolicus mülleri*, lifted up from deeper water and got mixed with copepods at the depth that the euphausiids had occupied at daytime. In the morning horse mackerel and euphausiids descended to the depth they had occupied the previous day (Figure 6d). The fish used approximately the same time to descend as they used to ascend the previous night. Some day-to-day variation in the time used to ascend and descend was observed. This was probably caused by variation in the solar irradiance caused by variable mist and cloud cover.

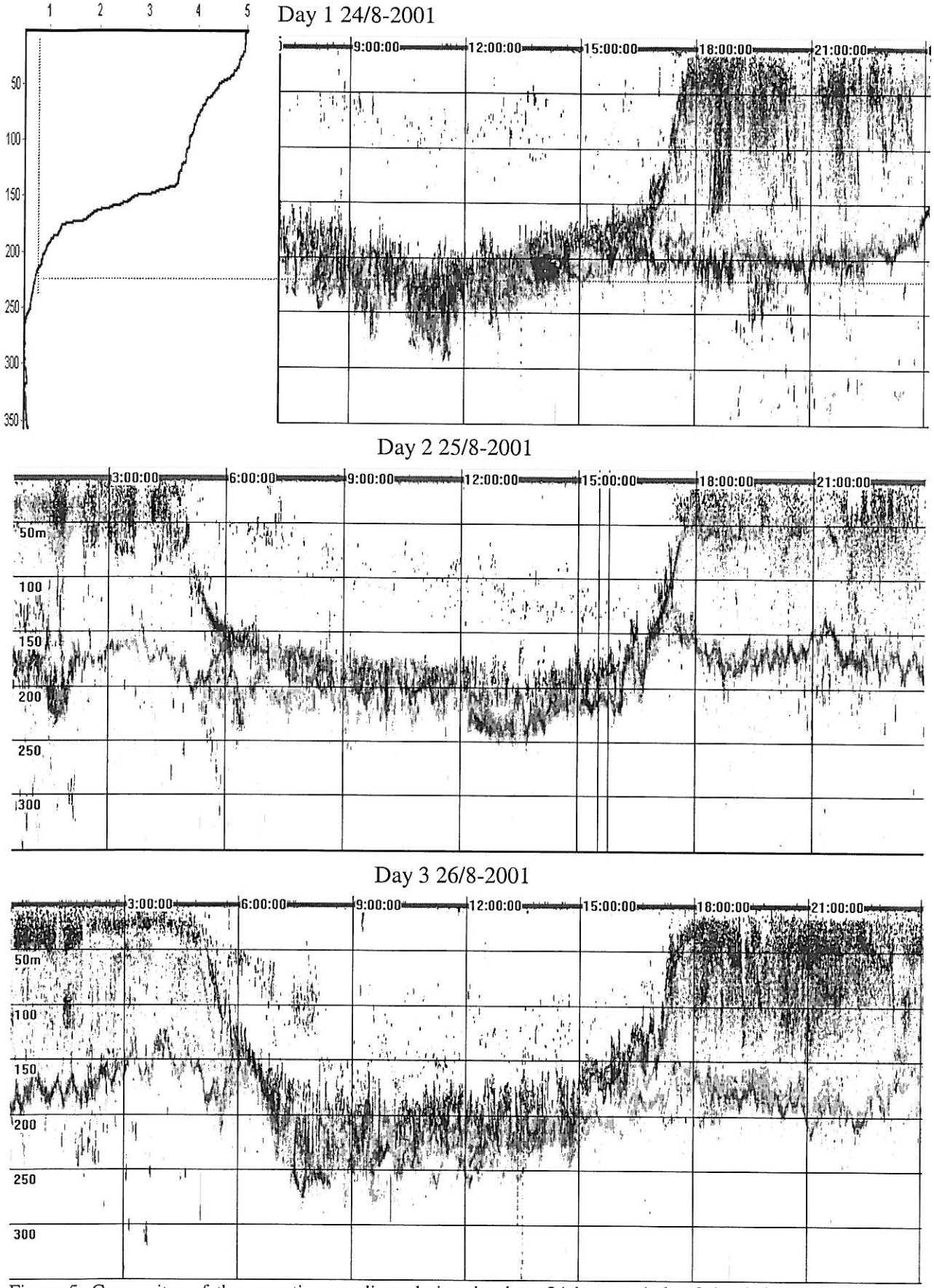


Figure 5. Composites of the acoustic recordings during the three 24 hour periods of the diel experiment. A oxygen profile is shown at the start of the first cycle to depict the level where the horse mackerel stopped the vertical decent at night

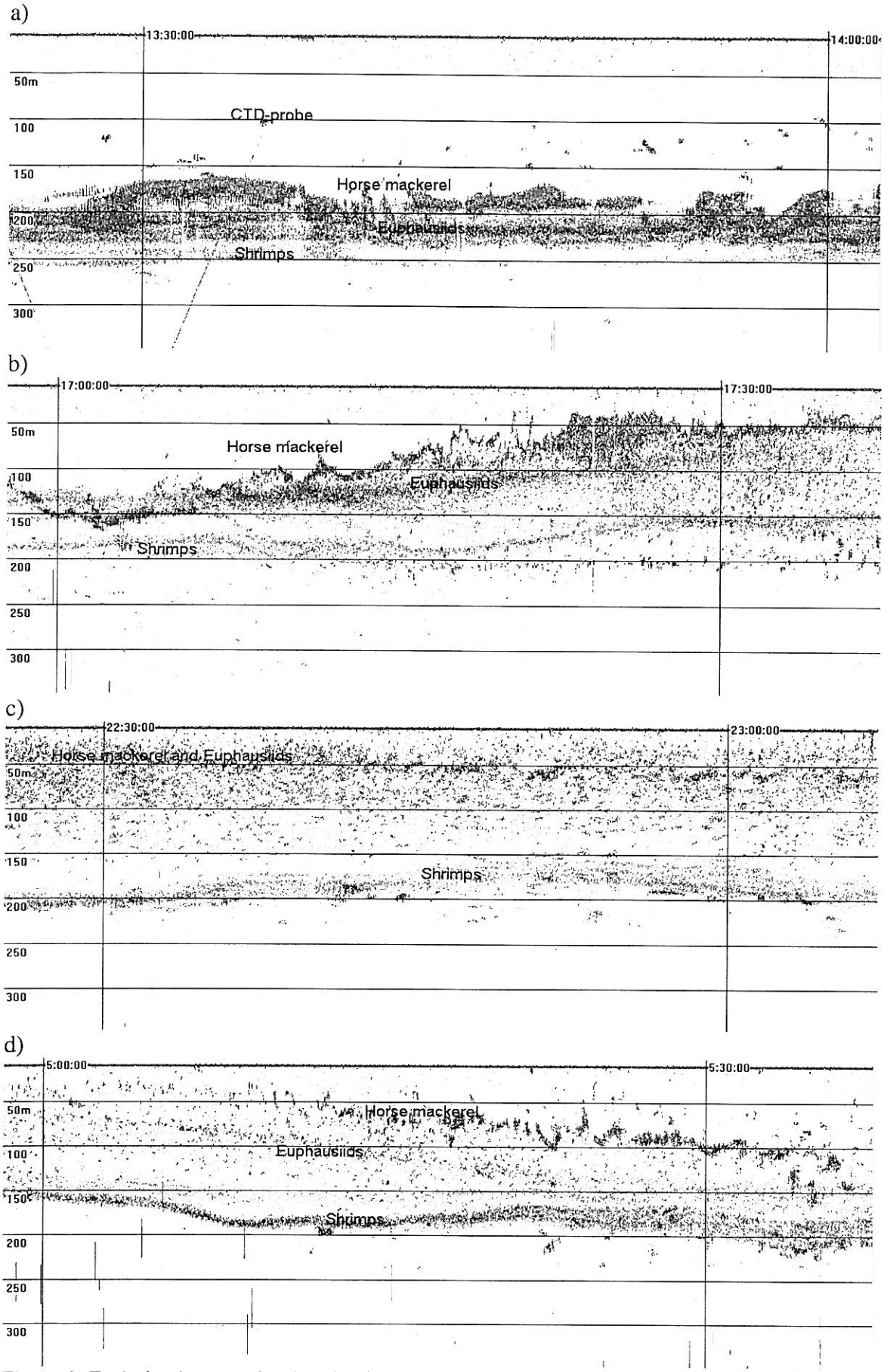


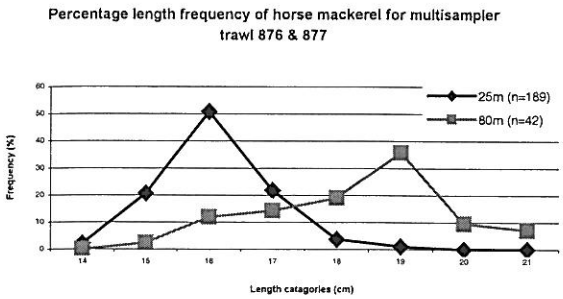
Figure 6. Typical echogram showing the day a), evening b), night c) and morning d) situation during the experiments. The different identified layers are shown in the echograms

A common feature throughout the study was that horse mackerel generally shoaled on or just above the euphausiid layer during the day, and even during the night individual fish appeared to remain closer to the surface than euphausiids. Figure 5 and Figure 6b illustrate the daytime position of horse mackerel shoals relative to the euphausiid scattering layer and should be compared with the oxygen concentration throughout the water column. Inspection of the hydrographic profiles revealed that the horse mackerel descent was limited by the presence of a steep oxycline that ranged from about 180 m (4.15 ml/l O_2) to 210 m (1.00 ml/l O_2) (Figure 5). An anoxic (<0.50 ml/l O_2) pocket of water extended further from 245-370 m, while the water between 370 and 500 m contained somewhat higher values (0.5-2.0 ml/l O_2). The profiles of salinity and temperature showed a fairly stable pattern (Chapter 3.1, Annex IV). Horse mackerel clearly avoided low oxygen concentrations by remaining above the oxycline whereas euphausiids concentrated within and just below that region, within a relatively narrow layer (50 m) during the day. This layer worked as an effective refuge from horse mackerel predation.

3.3. Size distribution of the sampled horse mackerel

The horse mackerel consisted mostly of juveniles, ranging from 14 to 23 cm total length. Two cohorts were present, one with a modal peak around 16 cm and one peaking around 18 cm total length. The cod end multisampler trawls indicates that the cohorts were separated and had different trends in the migration patterns (Figure 7). The graphs show the length frequency of horse mackerel caught in the cod end multisampler, and show that the cohorts are separated during the vertical migration to the surface at night, Figure 7a), at 24/8/2001 02:51 am. Some separation is evident in the morning, Figure 7b), at 8:04 am. The two cohorts are then more mixed in the afternoon before they ascend to the surface, Figure 7c), 26/08/2001 at 3:53 pm and, Figure 7d), clearly separated again when the vertical migration to the surface starts 26/08/2001 at 06.47 pm. Note that these trawls were not selected on random, but because they matched critical times in the migration cycle. Time is GMT.

a)



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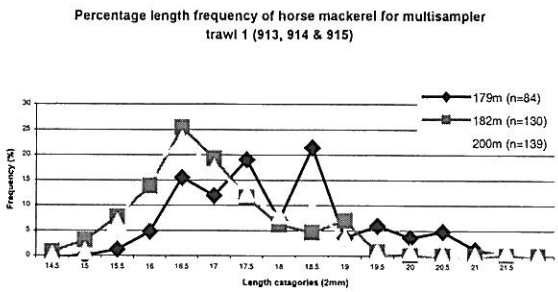
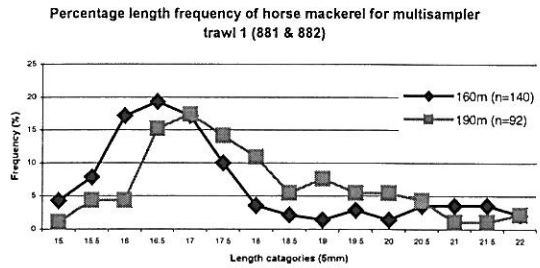


b)



d)

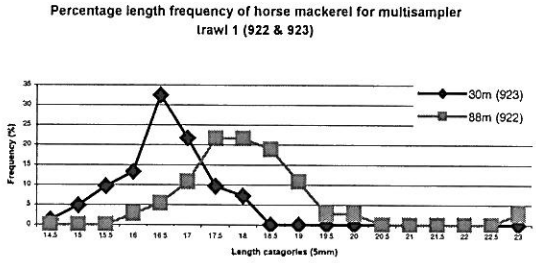


Figure 7. Graph show the length frequency of horse mackerel trawled on with the cod end multisampler on a) 24/08/2001 at 2:51 am, b) 24/08/2001 at 3:53 pm, c) 26/08/2001 at 8:04 am and d) 26/08/2001 at 06.47 pm. The different lines corresponds to the separate trawls at the depths were the multinet trawl was opened.

3.4. Feeding and food availability

From preliminary analysis of the stomachs an plankton samples collected during the survey, it was evident that horse mackerel were feeding selectively on euphausiids (Figure 8), despite copepods being the numerically dominant zooplankton available to them. Copepods were also found in some stomachs. Detailed analyses of the horse mackerel diet from stomach samples and a comparison with available prey from the plankton multinet will be completed during a workshop in Cape Town in 2002.

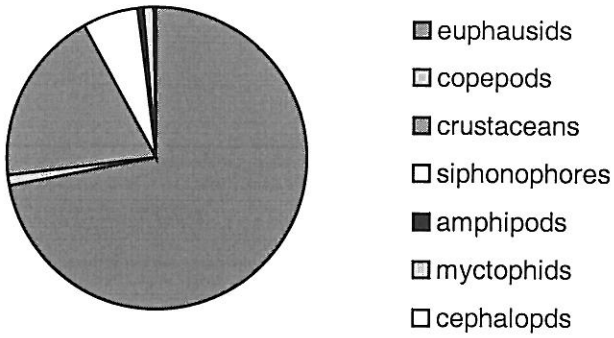


Figure 8. Preliminary diet of horse mackerel from the diel experiment. All stomachs were cod end feeding was suspected were removed before the analyses

3.5. Codend feeding

During the first diel cycle the codends of the cod end multisampler was consistently clogged with euphausiids and an unrealistically high proportion of horse mackerel had fresh euphausiids in their stomachs. Because of this, codend feeding was suspected. The liner was removed from the codend 26/8 08:00 (the small pelagic trawl was used periodically before and while this was done, ANNEX V) and this reduced both the catch rates of euphausiids in the trawl and the proportion of fresh euphausiids in the horse mackerel stomachs. To determine the trawls in which codend feeding may have occurred, the frequency of full stomachs (Stages 3 and 4) were examined with respect to those trawls that had euphausiids in the codend. The data were divided into two series (before and after 26/8 08:00): Series 1 when collections were taken with the cod end multisampler using a 6-mm meshed liner in the codend and Series 2 when the liner was removed (Figure 9). All the trawls conducted with the small pelagic trawl were included in Series 2 because this trawl was not fitted with the 6-mm meshed liner. It is evident that euphausiids were retained in greater concentrations during Series 1 than in Series 2, the weights being different by two orders of magnitude. Therefore, the stomach fullness indices for the former series must be considered erroneous as a result of codend feeding. Although codend feeding appears to be less problematic in Series 2, the fact that there was a high proportion of full stomachs in the same sample as those containing empty stomachs is worrying, given the synchronous feeding behaviour previously shown for horse mackerel. Therefore, laboratory analysis of the gut contents of certain trawls in both Series 1 and 2 should be carefully scrutinised for codend feeding.

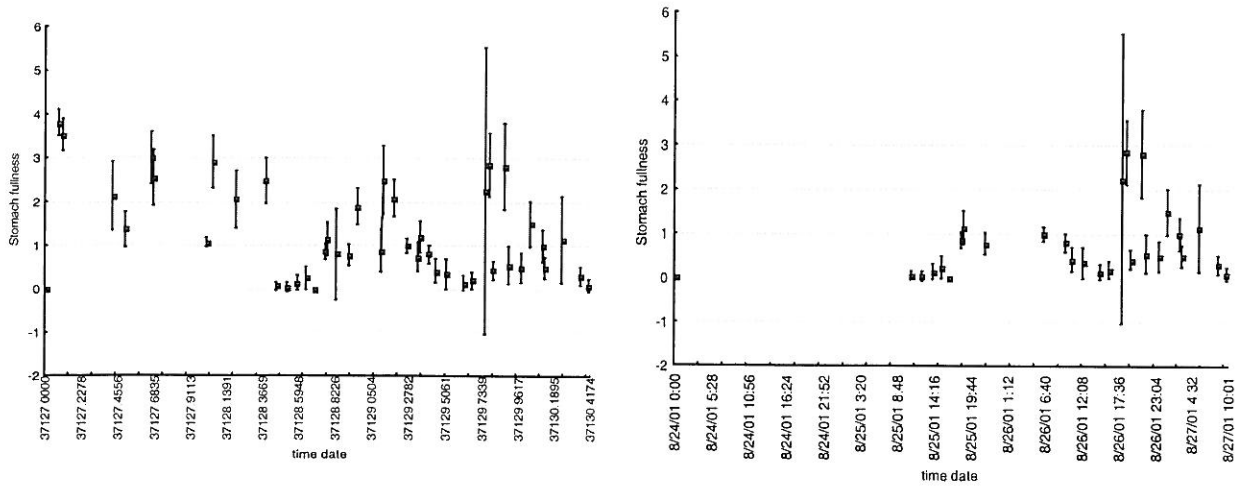


Figure 9. Stomach fullness of horse mackerel during the diel cycle. Data show mean and 95 % confidence interval a) for all trawls including multisampler trawls with 6-mm meshed liner, b) without liner in trawls.

3.6. Multifrequency acoustic analysis

The s_V ratios for the different a scattering layer of Horse mackerel euphausiids and shrimps were analysed. The result is preliminary and the calibration constants from after the survey has not been applied. The ADCP was running throughout the survey and has among others created acoustic noise, especially at 120 and 200 kHz frequency. To compare backscattering values at different frequencies resolvable pulse volumes must also be comparable. The resolving distance ($c\tau/2$), and hence resolvable volume, depends on the pulse length, which therefore ideally should be identical on all frequencies. However, the EK 500 only facilitates relative standard settings (Short/ Medium/ Wide), which differ between frequencies. Vertical bins must therefore be averaged to obtain comparable resolvable pulse volumes between frequencies. This will be done after the data has been cleaned. It is also important to ensure that the data sampled contains backscattering from one species only. The results here are therefore meant only as an example.

The s_V ratios obtained are shown in Figure 10. The results show a clear overlap between the different targets at all three frequencies and it is evident at they cannot be separated with multi frequency at this stage. However this pattern may change when calibrated and noise filtered outputs are applied.

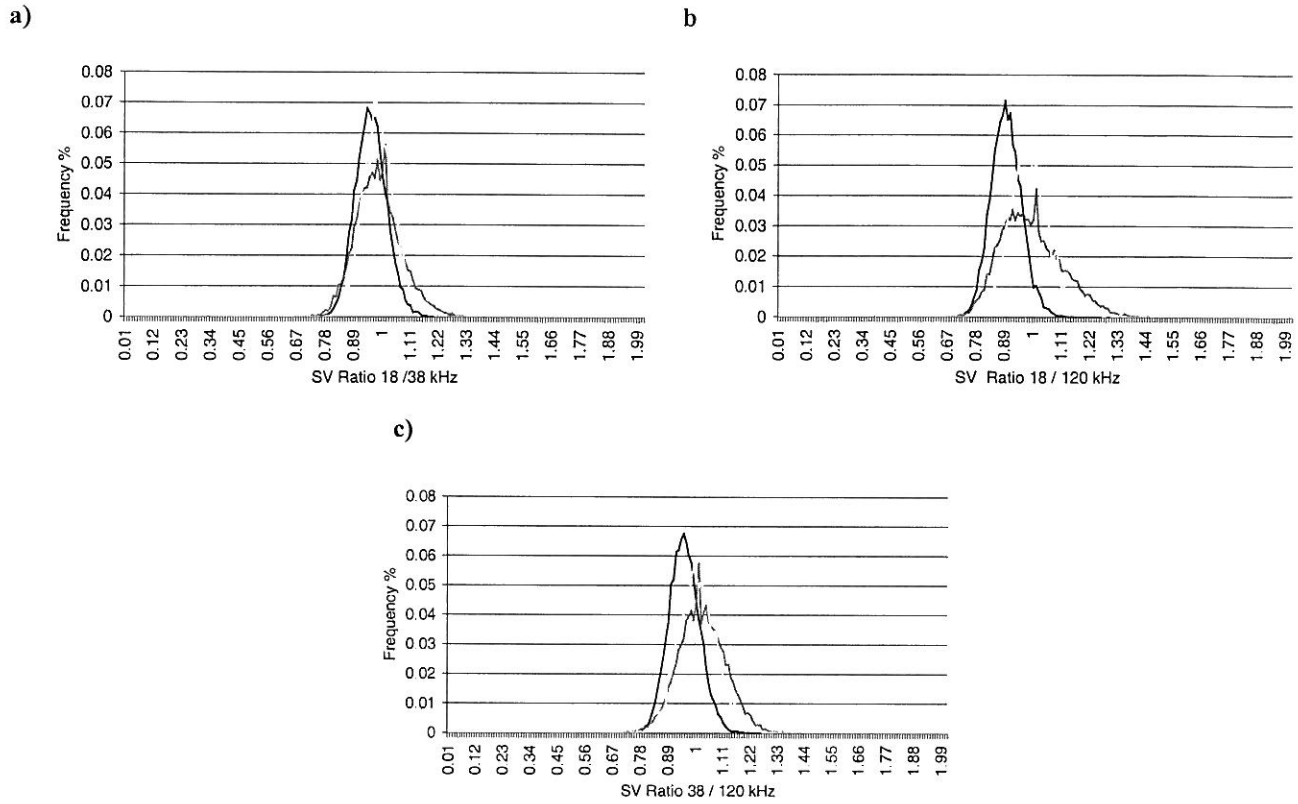


Figure 10 s_V ratios for horse mackerel (red line), euphausiids (yellow line) and shrimp (blue line) at 18 /120 (a), 18/38 (b)and 38/120 (c) kHz

3.7. *In situ* tolerance to hypoxia, anoxia and sulphide

The results from the experiments with horse mackerel in situ tolerance to hypoxia, anoxia and sulphide are shown in Table 1. The preliminary results show a sharp decline in survival time with reduced oxygen and increased sulphide concentrations. Note: "survival time" refers to 50 % mortality.

- Disolved Oxygen (DO) <0.8 ml/l limits the survival time of juvenile fish to <100 minutes.
- Anoxic conditions, at DO concentration levels below a critical level of approximately 0.6 ml/l or less limits survival to 23 minutes.
- Hypoxic conditions of 0.8-2.5 ml/1 markedly decreased the impact on mortality as compared to anoxic conditions, with survival time more than doubled.
- Sulphide added in high concentrations to hypoxic water (1-2.5 ml/l DO) decreased survival time to a maximum of 65 minutes.
- Sulphide added to normoxic water (start concentration of 4.8 ml/l DO) decreases survival time despite the DO levels remaining well above the critical and limiting concentrations mentioned above, showing independent impact by sulphide.

- Behavioural observations revealed that the fish made desperate escape movements, both rapid dashes and gasping at the surface, when critical levels of DO or sulphide were encountered.

The observations suggest that juvenile (1 year old) horse mackerel show a remarkably high tolerance to low concentrations of dissolved oxygen. Concentration levels <0.8 ml/l DO is expected to limit their distribution, while survival times at levels <0.6 ml/l DO is about 23 minutes. However, the combined effects of high sulphide concentrations and hypoxic water increased the mortality, and even if dissolved oxygen remain at acceptable levels for survival the presence of sulphide in the water causes mortality.

The sampling depths of the fish (above the oxycline which marked oxygen concentrations rising steeply from 0.9 to 1.2 ml/l DO: see Annex IV and V) support these findings. The juvenile horse mackerel observed during the survey were most probably "safe" in terms of mortality caused by anoxia as they occupied water volumes with oxygen concentrations between 0.8 and 1.0 ml/l DO. As should be expected from this, these juveniles were not found beneath the oxycline, where DO concentrations dropped sharply to <0.6 ml/l DO.

Table 1. Summary of tolerance experiments on juvenile horse mackerel exposed to hypoxia, anoxia and sulphide.

Experiment number	Experiment type	Number of fish n	Oxygen range (start-end) ml/l DO	Sulphide (start – end) $\mu l.l^{-1}$	Time at 50 % mortality min.	Time 100 % mortality min.	Control mortality n
1	Experiment	10	1.76 - 0.28	43 - 84	65	97	zero
2	Experiment	7	0.55 - 0.11	-	23	48	zero
3	Experiment	6	0.84 - 0.55	-	100	215	zero
4	Experiment	12	1.34 - 0.11	43 –58	43	60	zero
5	Experiment	14	1.01 - 0.00	46 - 61	42	60	zero
6	Experiment	13	4.70 - 1.58	43 - 67	150	181	zero
7	Experiment	12	4.66 - 2.43	58 - 104	145	190	zero
8	Experiment	12	** 1.51 - 0.45	40 - 93	** 120	**	zero
9	Experiment	12	2.49 - 0.07	45 - 71	75	105	zero
10	Experiment	10	0.43	-	23	37	zero
11	Experiment	10	0.62	-	23	35	zero
A	Control	13	4.8 - 0.39	-	540	1 alive after 855 mins	1
B	Control	12	4.3 - 2.87	-	675	3 alive after 855 mins	1

* Accurate standardisation required

** Not timed further

ACKNOWLEDGEMENTS

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REFERENCES

Skeide, R. 2003. Multisampler Manual, Internal Report. Institute of Marine Research. 2003. 31p + annex.

Annex I Transceiver menu settings during survey

Table 1. SIMRAD EK 500 Transceiver menu settings during the survey e.g. before acoustic calibration.

Echosounder	EK 1	EK 1	EK 1	EK 2
Transceiver	1	2	3	1
Carrier frequency	38 kHz	120 kHz	18 kHz	200 kHz
Mode	Active	Active	Active	Active
Transducer type	ES 38B	ES 120-7	ES 18-11	ES 200-F7
Transducer sequence	Off	Off	Off	Off
Transducer depth (m)	8	8	8	8
Absorption coeff. (dB/km)	10	38	3	53
Pulse Length	Medium	Long	Short	Long
Bandwidth	Wide	Narrow	Wide	Narrow
Max. Power (W)	2000	1000	2000	1000
2-Way Beam Angle	-21.0	-20.6	-17.2	-20.5
Sv. Transducer Gain	27.37	26.01	23.95	25.51
TS. Transducer Gain	27.49	26.42	23.74	26.20
Angle sens. Along.	21.9	21.0	13.9	0
Angle sens. Athw.	21.9	21.0	13.9	0
3 dB Beamwidth Along	7.0	7.52	11.2	0
3 dB Beamwidth Athw.	6.7	7.31	10.8	0
Alongship offset	0.14	-0.04	-0.10	-0.04
Athwartship offset	-0.02	-0.16	-0.05	0.03
Sound velocity (ms^{-1})	1498	1498	1498	1498

Table 2. SIMRAD EK 500 TS detection menu settings used during the survey.

Echosounder	EK 1	EK 1	EK 1	EK 2
Transceiver	1	2	3	1
Minimum value	-80 dB	-80 dB	-80 dB	-80 dB
Min. length	0.8	0.8	0.8	0.8
Max. length	1.8	1.8	1.8	1.8
Max. gain compensation	6.0	6.0	6.0	6.0
Max. phase deviation	5.0	5.0	5.0	5.0

Annex II Calibration report

The R.V. *Dr. Fridtjof Nansen* did a calibration of the scientific echo sounders 18 kHz, 38 kHz, 120 kHz (EK1) and 200 kHz (EK2) at Lang Strand (Walvis Bay) on 8/9-2001 at the start of the BENEFIT 5 Survey.

Vessel: Dr. Fridtjof Nansen	Date: 8/9-2001	Place: Langstrand, Namibia
Echosounder: EK-500-2	Prev. calib. 19/4-2001	Sphere depth: 12.0 m
Transducer ES200-7F	Bottom depth: 30 m	T, Sphere depth 11.2 °C
Sound velocity: 1495 m/s	Sphere: WC 38.1	S, Sphere depth 34.9 ‰
		TS sphere –39.2 dB

Parameter	Previous values	Values after calibration
Transducer depth	0.0	8
Absorption coefficient (dB/km)	53	53
Pulse duration (ms)	Long	Long
Bandwidth (kHz)	Narrow	Narrow
Transmission effect re. Terminals (W)	1000	1000
Equivalent beam width (10 log ψ) (dB)	-20.5	-20.5
Sv transducer gain (dB)	25.51	24.72
TS transducer gain (dB)	26.20	
Angle sensitivity alongship	0	0
Angle sensitivity atwardship	0	0
3 dB beamwidth Alongship (deg)	0	0
3 dB beamwidth Atwardship (deg)	0	0
Alongship deviation from centre (deg)	-0.04	
Atwardship deviation from centre (deg)	0.03	

TS reading Sphere before Calibration	-39.2 dB
Read s_A before calibration (m^2/nm^2)	2802
Theoretical s_A at sphere depth (m^2/nm^2)	4038
S_A sphere after calibration (m^2/nm^2)	3987

Vessel: Dr. Fridtjof Nansen	Date: 8/9-2001	Place: Langstrand, Namibia
Echosounder: EK-500-1	Prev. calib. 19/4-2001	Sphere depth: 12.0 m
Transducer ES120-7	Bottom depth: 30 m	T, Sphere depth 11.2 °C
Sound velocity: 1495 m/s	Sphere: WC 38.1	S, Sphere depth 34.9 ‰
		TS sphere –39.5 dB

Parameter	Previous values	Values after calibration
Transducer depth	0.0	8
Absorption coefficient (dB/km)	38	38
Pulse duration (ms)	Long	Long
Bandwidth (kHz)	Narrow	Narrow
Transmission effect re. Terminals (W)	1000	1000
Equivalent beam width (10 log ψ) (dB)	-20.6	-20.6
Sv transducer gain (dB)	26.01	26.06
TS transducer gain (dB)	26.42	26.05
Angle sensitivity alongship	21.0	21.0
Angle sensitivity atwardship	21.0	21.0
3 dB beamwidth Alongship (deg)	7.5	7.55
3 dB beamwidth Atwardship (deg)	7.3	7.22
Alongship deviation from centre (deg)	-0.04	-0.04
Atwardship deviation from centre (deg)	-0.16	0.16

TS reading Sphere before Calibration	-39.5 dB
Read s_A before calibration (m^2/nm^2)	3939
Theoretical s_A at sphere depth (m^2/nm^2)	3856
S_A sphere after calibration (m^2/nm^2)	3841

Vessel: Dr. Fridtjof Nansen	Date: 8/9-2001	Place: Langstrand, Namibia
Echosounder: EK-500-1	Prev. calib. 9/8-2001	Sphere depth: 12 m
Transducer ES38B	Bottom depth: 30 m	T, Sphere depth 11.2 °C
Sound velocity: 1495 m/s	Sphere: Cu 60	S, Sphere depth 34.9 ‰
		TS sphere –42.3 dB

Parameter	Previous values	Values after calibration
Transducer depth	0.0	5.5
Absorption coefficient (dB/km)	10	10
Pulse duration (ms)	Medium	Medium
Bandwidth (kHz)	Wide	Wide
Transmission effect re. Terminals (W)	2000	2000
Equivalent beam width (10 log ψ) (dB)	-21.0	-21.0
Sv transducer gain (dB)	27.30	27.16
TS transducer gain (dB)	27.47	27.26
Angle sensitivity alongship	21.9	21.9
Angle sensitivity atwardship	21.9	21.9
3 dB beamwidth Alongship (deg)	6.8	7.05
3 dB beamwidth Atwardship (deg)	6.7	6.9
Alongship deviation from centre (deg)	-0.08	0.07
Atwardship deviation from centre (deg)	0.04	0.03

TS reading Sphere before Calibration	-42.3 dB
Read s_A before calibration (m^2/nm^2)	2063
Theoretical s_A at sphere depth (m^2/nm^2)	2209
S_A sphere after calibration (m^2/nm^2)	2212

Vessel: Dr. Fridtjof Nansen	Date: 8/9-2001	Place: Langstrand, Namibia
Echosounder: EK-500-1	Prev. calib. 19/4-2001	Sphere depth: 16.0 m
Transducer ES18-11	Bottom depth: 30 m	T, Sphere depth 11.2 °C
Sound velocity: 1495 m/s	Sphere: Cu 60	S, Sphere depth 34.9 ‰
		TS sphere –35.3 dB

Parameter	Previous values	Values after calibration
Transducer depth	0.0	5.5
Absorption coefficient (dB/km)	3	3
Pulse duration (ms)	Short	Short
Bandwidth (kHz)	Wide	Wide
Transmission effect re. Terminals (W)	2000	2000
Equivalent beam width (10 log ψ) (dB)	-17.2	-17.2
Sv transducer gain (dB)	23.86	23.95
TS transducer gain (dB)	23.89	23.74
Angle sensitivity alongship	13.9	13.9
Angle sensitivity atwardship	13.9	13.9
3 dB beamwidth Alongship (deg)	11.2	11.05
3 dB beamwidth Atwardship (deg)	10.8	10.69
Alongship deviation from centre (deg)	-0.10	0.07
Atwardship deviation from centre (deg)	0.05	-0.09

TS reading Sphere before Calibration	-35.3 dB
Read s_A before calibration (m^2/nm^2)	2177
Theoretical s_A at sphere depth (m^2/nm^2)	2608
S_A sphere after calibration (m^2/nm^2)	2585

Annex III Records of fishing stations

PROJECT STATION: 871

DATE:22/ 8/01 GEAR TYPE: BT No:8 POSITION:Lat S 2151
start stop duration Long E 1244
TIME :11:03:08 11:33:40 31 (min) Purpose code: 1
LOG :5572.02 5573.56 1.52 Area code : 1
FDEPTH: 359 363 GearCond.code:
BDEPTH: 359 363 Validity code: 1
Towing dir: 360ø Wire out:1000 m Speed: 30 kn*10

Sorted: 130 Kg Total catch: 380.00 CATCH/HOUR: 735.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	483.87		65.79	
Helicolenus dactylopterus	118.16	809	16.07	5612
Merluccius paradoxus	52.16	261	7.09	5610
Merluccius capensis	37.35	33	5.08	5611
Trachurus capensis	24.48	72	3.33	5609
R A Y S	5.40	4	0.73	
C E P H A L O P O D A	4.61	10	0.63	
S H A R K S	3.83	31	0.52	
AULAU01	3.56	120	0.48	
Trachipterus sp.	0.60	2	0.08	
BERYCIDAE	0.58	2	0.08	
MACROURIDAE	0.31	14	0.04	
MYCTOPHIDAE	0.27	54	0.04	
Total	735.18		99.96	

PROJECT STATION: 872

DATE:23/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1900
start stop duration Long E 1143
TIME :10:31:07 14:00:00 809 (min) Purpose code: 1
LOG :5780.85 5780.85 Area code : 1
FDEPTH: 0 0 GearCond.code:
BDEPTH: 306 306 Validity code:
Towing dir: 340ø Wire out: 800 m Speed: 30 kn*10

Sorted: 4 Kg Total catch: 33.57 CATCH/HOUR: 2.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
C R U S T A C E A N S	2.40		96.39	
Diaphus sp.	0.09	129	3.61	
Total	2.49		100.00	

PROJECT STATION: 873

DATE:23/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1857
start stop duration Long E 1142
TIME :11:29:00 11:47:26 18 (min) Purpose code: 1
LOG :5783.91 5784.86 0.94 Area code : 1
FDEPTH: 225 225 GearCond.code: 1
BDEPTH: 297 294 Validity code: 1
Towing dir: 340ø Wire out: 680 m Speed: 35 kn*10

Sorted: 8 Kg Total catch: 100.00 CATCH/HOUR: 333.33

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	252.03		75.61	
C R U S T A C E A N S	76.67		23.00	
Brama brama	4.63	3	1.39	
Total	333.33		100.00	

PROJECT STATION: 874

DATE:23/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1855
start stop duration Long E 1142
TIME :12:05:56 12:33:53 28 (min) Purpose code: 1
LOG :5785.84 5787.56 1.72 Area code : 1
FDEPTH: 75 75 GearCond.code:
BDEPTH: 293 291 Validity code:
Towing dir: 340ø Wire out: 250 m Speed: 35 kn*10

Sorted: 4 Kg Total catch: 4.40 CATCH/HOUR: 9.43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	9.43	4	100.00	
Total	9.43		100.00	

PROJECT STATION: 875

DATE:24/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1722
start stop duration Long E 1112
TIME :02:07:42 02:29:34 22 (min) Purpose code: 1
LOG :5920.34 5921.43 1.08 Area code : 1
FDEPTH: 150 150 GearCond.code: 1
BDEPTH: 779 846 Validity code: 3
Towing dir: 230ø Wire out: m Speed: kn*10

Sorted: 3 Kg Total catch: 33.81 CATCH/HOUR: 92.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	86.05	18232	93.32	
Trachurus capensis	2.32	30	2.52	5613
Illex coindetii	1.45	3	1.57	
MYCTOPHIDAE	1.20	175	1.30	
Yarrella blackfordi	1.20	14	1.30	
Total	92.22		100.01	

PROJECT STATION: 876

DATE:24/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1723
start stop duration Long E 1111
TIME :02:51:26 03:13:05 22 (min) Purpose code: 1
LOG :5922.87 5924.18 1.16 Area code : 1
FDEPTH: 80 80 GearCond.code: 1
BDEPTH: 801 858 Validity code: 3
Towing dir: 230ø Wire out: 250 m Speed: 35 kn*10

Sorted: Kg Total catch: 22.99 CATCH/HOUR: 62.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	46.83	12175	74.69	
Trachurus capensis	5.86	115	9.35	5614
MYCTOPHIDAE	2.73	202	4.35	
Mustelus palumbes	2.24	3	3.57	
Yarrella blackfordi	1.45	14	2.31	
Illex coindetii	1.25	25	1.99	
Photichthys sp.	1.20	25	1.91	
Malacocephalus laevis	1.15	5	1.83	
Total	62.71		100.00	

PROJECT STATION: 877

DATE:24/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1724
start stop duration Long E 1110
TIME :03:23:02 03:45:24 22 (min) Purpose code: 1
LOG :5924.70 5926.33 1.62 Area code : 1
FDEPTH: 25 25 GearCond.code: 1
BDEPTH: 888 1006 Validity code: 3
Towing dir: 230ø Wire out: 100 m Speed: 35 kn*10

Sorted: Kg Total catch: 47.27 CATCH/HOUR: 128.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	94.12	41482	73.01	
Trachurus capensis	28.09	1020	21.79	5615
Trachipterus jacksonensis	3.14	8	2.44	
MYCTOPHIDAE	2.24	387	1.74	
Illex coindetii	1.34	3	1.04	
Total	128.93		100.02	

PROJECT STATION: 878

DATE:24/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1723
start stop duration Long E 1110
TIME :10:16:56 10:31:35 15 (min) Purpose code: 1
LOG :5967.57 5968.40 0.83 Area code : 1
FDEPTH: 296 296 GearCond.code: 1
BDEPTH: 922 851 Validity code: 3
Towing dir: 50ø Wire out: 800 m Speed: 30 kn*10

Sorted: Kg Total catch: 6.34 CATCH/HOUR: 25.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	6.40	556	25.24	
Yarrella blackfordi	4.80	324	18.93	
Triplophos sp.	3.20	684	12.62	
Trachurus capensis	2.80	60	11.04	5616
S H R I M P S	2.56		10.09	
Trachipterus jacksonensis	2.40	4	9.46	
MYCTOPHIDAE	1.20	720	4.73	
Chrysaora hysoscella	0.96	12	3.79	
LOLIGINIDAE	0.64	64	2.52	
Diaphus sp.	0.44	44	1.74	
Nemichthys scolopaceus	0.32	80	1.26	
Zeus capensis	0.04	20	0.16	
Total	25.76		101.58	

PROJECT STATION: 879

DATE:24/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1722
start stop duration Long E 1111
TIME :10:44:47 11:01:33 17 (min) Purpose code: 1
LOG :5969.02 5970.07 1.05 Area code : 1
FDEPTH: 160 160 GearCond.code: 1
BDEPTH: 819 772 Validity code: 1
Towing dir: 50ø Wire out: 400 m Speed: 35 kn*10

Sorted: Kg Total catch: 0.78 CATCH/HOUR: 2.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
S H R I M P S	1.06	5294	38.55	
LOLIGINIDAE	0.78	78	28.36	
Triplophos sp.	0.39	32	14.18	
Trachurus capensis	0.28	7	10.18	
Nemichthys scolopaceus	0.18	32	6.55	
Zeus capensis	0.04	7	1.45	
MYCTOPHIDAE	0.04	25	1.45	
Total	2.77		100.72	

PROJECT STATION: 880

DATE:24/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1723
start stop duration Long E 1109
TIME :12:08:48 12:37:54 29 (min) Purpose code: 1
LOG :5974.49 5975.96 1.46 Area code : 1
FDEPTH: 190 190 GearCond.code:
BDEPTH: 934 953 Validity code:
Towing dir: 180ø Wire out: 600 m Speed: 35 kn*10

Sorted: 51 Kg Total catch: 50.95 CATCH/HOUR: 105.41

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	105.41	3286	100.00	5617
Total	105.41		100.00	

PROJECT STATION: 881

DATE:24/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :15:53:03 16:08:37 16 (min) Purpose code: 1
LOG :5983.59 5984.61 1.02 Area code : 1
FDEPTH: 190 190 GearCond.code: 1
BDEPTH: 964 962 Validity code: 1
Towing dir: 360ø Wire out: m Speed: kn*10

Sorted: 22 Kg Total catch: 63.74 CATCH/HOUR: 239.03

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	232.43	5344	97.24	5620
Krill	2.66	17366	1.11	
MYCTOPHIDAE	2.55	1838	1.07	
Illex coindetii	1.05	11	0.44	
Yarrella blackfordi	0.19	53	0.08	
Glyphus marsupialis	0.08	214	0.03	
Trachipterus jacksonensis	0.08	11	0.03	
Total	239.04		100.00	

PROJECT STATION: 882

DATE:24/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :16:15:47 16:30:14 14 (min) Purpose code: 1
LOG :5985.03 5985.99 0.96 Area code : 1
FDEPTH: 160 160 GearCond.code: 1
BDEPTH: 961 940 Validity code: 3
Towing dir: 360ø Wire out: 500 m Speed: 35 kn*10

Sorted: 1 Kg Total catch: 39.35 CATCH/HOUR: 168.64

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	119.14	3034	70.65	5621
MYCTOPHIDAE	22.24	23713	13.19	
Krill	12.64	66891	7.50	
J E L L Y F I S H	8.57	429	5.08	
Illex coindetii	6.04	150	3.58	
Total	168.63		100.00	

PROJECT STATION: 883

DATE:24/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1723
start stop duration Long E 1109
TIME :19:22:13 19:40:12 18 (min) Purpose code: 1
LOG :5992.80 5993.67 0.86 Area code : 1
FDEPTH: 200 210 GearCond.code: 1
BDEPTH: 960 984 Validity code: 3
Towing dir: 180ø Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: 8.67 CATCH/HOUR: 28.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	13.23	370	45.78	
Diaphus sp.	4.13	2297	14.29	
Glyphus marsupialis	3.57	4857	12.35	
Tetragonurus cuvieri	2.57	7	8.89	
Krill	1.93	6297	6.68	
Octopus vulgaris	1.70	3	5.88	
MYCTOPHIDAE	0.83	827	2.87	
Total	27.96		96.74	

PROJECT STATION: 884

DATE:24/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :19:54:31 20:13:16 19 (min) Purpose code: 1
LOG :5994.22 5995.10 0.88 Area code : 1
FDEPTH: 115 100 GearCond.code: 1
BDEPTH: 992 1017 Validity code: 3
Towing dir: 180ø Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: 21.60 CATCH/HOUR: 68.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	65.24	494258	95.65	
Diaphus sp.	2.97	7421	4.35	
Total	68.21		100.00	

PROJECT STATION: 885

DATE:24/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :20:01:12 21:40:47 20 (min) Purpose code: 1
LOG :6000.64 6002.00 1.35 Area code : 1
FDEPTH: 32 36 GearCond.code: 1
BDEPTH: 991 985 Validity code: 3
Towing dir: 360ø Wire out: 120 m Speed: 30 kn*10

Sorted: Kg Total catch: 7.09 CATCH/HOUR: 21.27

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachipterus sp.	12.00	15	56.42	
Trachurus capensis	8.40	249	39.49	5622
Diaphus sp.	0.42	435	1.97	
J E L L Y F I S H	0.24	9	1.13	
Lolliguncula sp.	0.18	72	0.85	
Brama japonica	0.03	3	0.14	
Total	21.27		100.00	

PROJECT STATION: 886

DATE:25/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :00:18:14 00:36:34 18 (min) Purpose code: 1
LOG :6011.51 6012.71 1.17 Area code : 1
FDEPTH: 150 160 GearCond.code: 1
BDEPTH: 982 951 Validity code: 3
Towing dir: 360ø Wire out: m Speed: kn*10

Sorted: Kg Total catch: 2.52 CATCH/HOUR: 8.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	3.20	5920	38.10	
Krill	1.67	10000	19.88	
Trachurus capensis	1.03	23	12.26	5624
Glyphus marsupialis	0.90	1457	10.71	
Aequorea aequorea	0.83	33	9.88	
LOLIGINIDAE	0.37	123	4.40	
Triplophos sp.	0.33	10	3.93	
Nemichthys scolopaceus	0.07	3	0.83	
Total	8.40		99.99	

PROJECT STATION: 887

DATE:25/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :00:43:35 00:59:15 16 (min) Purpose code: 1
LOG :6013.15 6014.19 1.03 Area code : 1
FDEPTH: 115 115 GearCond.code: 1
BDEPTH: 949 928 Validity code: 3
Towing dir: 360ø Wire out: 350 m Speed: 35 kn*10

Sorted: Kg Total catch: 7.95 CATCH/HOUR: 29.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	28.50	171000	95.61	
Aequorea aequorea	0.71	34	2.38	
MYCTOPHIDAE	0.45	1193	1.51	
Yarrella blackfordi	0.15	4	0.50	
Total	29.81		100.00	

PROJECT STATION: 888

DATE:25/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1722
start stop duration Long E 1109
TIME :01:13:52 01:32:16 18 (min) Purpose code: 1
LOG :6015.07 6016.38 1.30 Area code : 1
FDEPTH: 30 30 GearCond.code: 1
BDEPTH: 922 951 Validity code: 3
Towing dir: 360ø Wire out: 110 m Speed: 40 kn*10

Sorted: 28 Kg Total catch: 59.89 CATCH/HOUR: 199.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	154.00	924000	77.14	
Chrysaora hysoscella	14.20	40	7.11	
Trachipterus jacksonensis	10.67	13	5.34	
Trachurus capensis	10.10	220	5.06	5623
MYCTOPHIDAE	6.13	1533	3.07	
Octopus sp.	3.33	3	1.67	
Aequorea aequorea	0.53	53	0.27	
Glyphus marsupialis	0.47	933	0.24	
Yarrella blackfordi	0.20	20	0.10	
Total	199.63		100.00	

PROJECT STATION: 889

DATE:25/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :04:30:09 04:45:17 15 (min) Purpose code: 1
LOG :6029.66 6030.63 0.97 Area code : 1
FDEPTH: 160 170 GearCond.code: 1
BDEPTH: 985 965 Validity code: 3
Towing dir: 360ø Wire out: 470 m Speed: 35 kn*10

Sorted: Kg Total catch: 12.59 CATCH/HOUR: 50.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Krill	35.60	656824	70.69	
Yarrella blackfordi	7.00	140	13.90	
J E L L Y F I S H	2.20	68	4.37	
Neoscopelus macrolepidotus	1.40	348	2.78	
Trachurus capensis	1.40	36	2.78	
Tetragonurus cuvieri	1.12	8	2.22	
MYCTOPHIDAE	0.68	1508	1.35	
Glyphus marsupialis	0.68	6084	1.35	
Saurida undosquamis	0.28	4	0.56	
Total	50.36		100.00	

PROJECT STATION: 890

DATE:25/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :04:55:22 05:10:16 15 (min) Purpose code: 1
LOG :6031.17 6032.11 0.93 Area code : 1
FDEPTH: 75 72 GearCond.code: 1
BDEPTH: 964 953 Validity code: 3
Towing dir: 360ø Wire out: 210 m Speed: 30 kn*10

Sorted: Kg Total catch: 31.29 CATCH/HOUR: 125.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	72.00	2312	57.53	5624
Krill	43.56	832884	34.80	
S H A R K S	3.68	4	2.94	
Trachipterus jacksonensis	3.56	4	2.84	
MYCTOPHIDAE	1.36	1940	1.09	
Lolliguncula sp.	1.00	24	0.80	
Total	125.16		100.00	

PROJECT STATION: 891

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1722
start stop duration Long E 1109
TIME :05:26:15 05:45:14 19 (min) Purpose code: 1
LOG :6033.12 6034.52 1.38 Area code : 1
FDEPTH: 25 20 GearCond.code: 1
BDEPTH: 934 964 Validity code: 3
Towing dir: 360ø Wire out: 100 m Speed: 30 kn*10

Sorted: Kg Total catch: 1.78 CATCH/HOUR: 5.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
CLNET02	1.58	41	28.11	
Krill	1.52	9474	27.05	
J E L L Y F I S H	1.26	3	22.42	
Chrysaora hysoscella	0.92	95	16.37	
Trachurus capensis	0.19	3	3.38	
Diaphus sp.	0.13	98	2.31	
Glyphus marsupialis	0.03	22	0.53	
Total	5.63		100.17	

PROJECT STATION: 892

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :09:11:42 09:32:51 21 (min) Purpose code: 1
LOG :6048.81 6050.07 1.24 Area code : 1
FDEPTH: 195 195 GearCond.code: 1
BDEPTH: 1008 1009 Validity code: 3
Towing dir: 360ø Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: 2.58 CATCH/HOUR: 7.37

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	4.29	123	58.21	5625
Krill	3.03	72686	41.11	
Etrumeus whiteheadi	0.03	6	0.41	
MYCTOPHIDAE	0.03	57	0.41	
Total	7.38		100.14	

PROJECT STATION: 893

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1724
start stop duration Long E 1108
TIME :09:44:17 09:59:00 15 (min) Purpose code: 1
LOG :6050.73 6051.66 0.88 Area code : 1
FDEPTH: 150 155 GearCond.code: 1
BDEPTH: 1015 1019 Validity code: 3
Towing dir: 360ø Wire out: 400 m Speed: 30 kn*10

Sorted: 2 Kg Total catch: 43.30 CATCH/HOUR: 173.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	125.20	4216	72.29	5626
Krill	34.56	725760	19.95	
MYCTOPHIDAE	11.76	70560	6.79	
Etrumeus whiteheadi	0.96	24	0.55	
Halosaurus ovenii	0.72	72	0.42	
Total	173.20		100.00	

PROJECT STATION: 894

DATE:25/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1723
start stop duration Long E 1108
TIME :10:55:23 11:25:21 30 (min) Purpose code: 1
LOG :6054.67 6056.17 1.51 Area code : 1
FDEPTH: 210 190 GearCond.code: 1
BDEPTH: 1019 1007 Validity code: 3
Towing dir: 180ø Wire out: 550 m Speed: 40 kn*10

Sorted: Kg Total catch: 63.85 CATCH/HOUR: 127.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	127.70	9486	100.00	5627
Total	127.70		100.00	

PROJECT STATION: 895

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :12:39:46 13:09:40 30 (min) Purpose code: 1
LOG :6060.98 6062.49 1.51 Area code : 1
FDEPTH: 200 200 GearCond.code: 1
BDEPTH: 978 1022 Validity code: 3
Towing dir: 180ø Wire out: 600 m Speed: 32 kn*10

Sorted: Kg Total catch: 87.85 CATCH/HOUR: 175.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	175.70	5426	100.00	5228
Total	175.70		100.00	

PROJECT STATION: 896

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1726
start stop duration Long E 1109
TIME :14:03:19 14:33:16 30 (min) Purpose code: 1
LOG :6066.31 6068.19 1.86 Area code : 1
FDEPTH: 200 215 GearCond.code: 1
BDEPTH: 1000 968 Validity code: 3
Towing dir: 360ø Wire out: 620 m Speed: 40 kn*10

Sorted: Kg Total catch: 160.40 CATCH/HOUR: 320.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	320.80	9872	100.00	5229
Total	320.80		100.00	

PROJECT STATION: 897

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :15:25:04 15:55:09 30 (min) Purpose code: 1
LOG :6071.46 6073.03 1.58 Area code : 3
FDEPTH: 210 210 GearCond.code: 1
BDEPTH: 988 1037 Validity code: 1
Towing dir: 180ø Wire out: 600 m Speed: 35 kn*10

Sorted: 39 Kg Total catch: 474.70 CATCH/HOUR: 949.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	949.40	31646	100.00	5230
Total	949.40		100.00	

PROJECT STATION: 898

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1726
start stop duration Long E 1109
TIME :16:50:12 17:20:12 30 (min) Purpose code: 1
LOG :6076.64 6078.72 2.05 Area code : 3
FDEPTH: 150 135 GearCond.code: 1
BDEPTH: 1008 970 Validity code: 3
Towing dir: 180ø Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: 29.32 CATCH/HOUR: 58.64

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	26.80	812	45.70	5231
J E L L Y F I S H	11.30	370	19.27	
SQUL020	10.00	4	17.05	
Trachipterus jacksonensis	6.60	6	11.26	
MYCTOPHIDAE	4.00	3972	6.82	
Scopelosaurus meadi	0.08	6	0.14	
Total	58.78		100.24	

PROJECT STATION: 899

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :18:14:03 18:27:13 13 (min) Purpose code: 1
LOG :6081.59 6082.19 0.60 Area code : 3
FDEPTH: 154 166 GearCond.code: 1
BDEPTH: 984 991 Validity code: 3
Towing dir: 170ø Wire out: 410 m Speed: 30 kn*10

Sorted: Kg Total catch: 12.78 CATCH/HOUR: 58.98

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	49.85	1662	84.52	5232
MYCTOPHIDAE	4.94	1385	8.38	
Trachipterus jacksonensis	3.37	14	5.71	
J E L L Y F I S H	0.42	14	0.71	
Krill	0.37	2142	0.63	
Glyphus marsupialis	0.05	83	0.08	
Total	59.00		100.03	

PROJECT STATION: 900

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :18:46:49 19:00:34 15 (min) Purpose code: 1
LOG :6083.03 6084.25 1.15 Area code : 3
FDEPTH: 32 22 GearCond.code: 1
BDEPTH: 1015 1037 Validity code: 3
Towing dir: 170ø Wire out: 100 m Speed: 30 kn*10

Sorted: Kg Total catch: 1.45 CATCH/HOUR: 5.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	5.00	160	86.21	5233
Krill	0.64	628	11.03	
MYCTOPHIDAE	0.16	48	2.76	
Total	5.80		100.00	

PROJECT STATION: 901

DATE:25/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :20:01:09 20:21:44 21 (min) Purpose code: 1
LOG :6088.22 6089.42 1.20 Area code : 3
FDEPTH: 152 162 GearCond.code: 1
BDEPTH: 1010 991 Validity code: 3
Towing dir: 10ø Wire out: 400 m Speed: 30 kn*10

Sorted: Kg Total catch: 5.08 CATCH/HOUR: 14.51

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachipterus jacksonensis	6.17	3	42.52	
MYCTOPHIDAE	3.31	2300	22.81	
J E L L Y F I S H	3.06	89	21.09	
Squalus mitsukurii	1.31	3	9.03	
Trachurus, Juveniles	0.43	14	2.96	
Shrimps, small, non comm.	0.23	143	1.59	
Total	14.51		100.00	

PROJECT STATION: 902

DATE:25/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :21:52:16 22:22:15 30 (min) Purpose code: 1
LOG :6095.62 6097.16 1.53 Area code : 3
FDEPTH: 40 38 GearCond.code: 1
BDEPTH: 971 1013 Validity code: 3
Towing dir: 170ø Wire out: 120 m Speed: 30 kn*10

Sorted: Kg Total catch: 11.94 CATCH/HOUR: 23.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachipterus sp.	14.20	16	59.46	
Trachurus capensis	4.70	126	19.68	5234
J E L L Y F I S H	4.36	176	18.26	
MYCTOPHIDAE	0.60	278	2.51	
Scopelosaurus meadi	0.02	2	0.08	
Total	23.88		99.99	

PROJECT STATION: 903

DATE:25/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1726
start stop duration Long E 1109
TIME :23:13:57 23:33:57 20 (min) Purpose code: 1
LOG :6100.96 6102.35 1.37 Area code : 1
FDEPTH: 160 170 GearCond.code: 1
BDEPTH: 998 983 Validity code: 9
Towing dir: 360ø Wire out: 520 m Speed: 40 kn*10

Sorted: Kg Total catch: 4.30 CATCH/HOUR: 12.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	5.70	159	44.19	5235
Trachipterus sp.	4.20	3	32.56	
Aequorea aequorea	2.67	90	20.70	
Etrumeus whiteheadi	0.21	6	1.63	
MYCTOPHIDAE	0.12	75	0.93	
Total	12.90		100.01	

PROJECT STATION: 904

DATE:26/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :23:44:59 00:04:50 20 (min) Purpose code: 1
LOG :6102.96 6104.39 1.41 Area code : 1
FDEPTH: 40 40 GearCond.code: 1
BDEPTH: 980 962 Validity code: 9
Towing dir: 360ø Wire out: 125 m Speed: 40 kn*10

Sorted: Kg Total catch: 3.72 CATCH/HOUR: 11.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	5.61	162	50.27	
MYCTOPHIDAE	2.37	507	21.24	
LOLIGINIDAE	2.10	3	18.82	
Tetragonurus atlanticus	0.45	3	4.03	
Chrysaora hysoscella	0.33	3	2.96	
Trachurus capensis	0.27	6	2.42	
Glyphus marsupialis	0.09	132	0.81	
Small squids	0.03	21	0.27	
Total	11.25		100.82	

PROJECT STATION: 905

DATE:25/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1726
start stop duration Long E 1109
TIME :23:10:00 23:14:00 4 (min) Purpose code: 1
LOG : Area code : 3
FDEPTH: 0 0 GearCond.code: 1
BDEPTH: 904 Validity code: 1
Towing dir: 325ø Wire out: 520 m Speed: 4 kn*10

Sorted: Kg Total catch: 6.98 CATCH/HOUR: 104.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachipterus sp.	79.50	90	75.93	
Shrimps, small, non comm.	13.35		12.75	
Trachurus capensis	4.05	120	3.87	5236
MYCTOPHIDAE	3.90	2340	3.72	
LOLIGINIDAE	1.50	30	1.43	
Chrysaora hysoscella	0.90	15	0.86	
ARGONAUTIDAE	0.90	15	0.86	
Small squids	0.60	450	0.57	
Aequorea aequorea	0.00	180		
Total	104.70		99.99	

PROJECT STATION: 906

DATE:26/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1723
start stop duration Long E 1109
TIME :02:05:06 02:22:54 18 (min) Purpose code: 1
LOG :6109.60 6110.45 0.84 Area code : 3
FDEPTH: 170 170 GearCond.code: 1
BDEPTH: 974 973 Validity code: 1
Towing dir: ø Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: 30.14 CATCH/HOUR: 100.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	97.50	2787	97.04	5237
Squalus blainvillei	2.97		2.96	
Total	100.47		100.00	

PROJECT STATION: 907

DATE:26/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :02:34:37 02:50:16 16 (min) Purpose code: 1
LOG :6110.88 6111.55 0.67 Area code : 1
FDEPTH: 110 105 GearCond.code: 1
BDEPTH: 967 974 Validity code: 1
Towing dir: 180ø Wire out: 290 m Speed: 30 kn*10

Sorted: Kg Total catch: 14.00 CATCH/HOUR: 52.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	42.00		80.00	
Schedophilus huttoni	6.38	4	12.15	
Trachurus capensis	2.44	68	4.65	5238
Trachipterus sp.	1.50	4	2.86	
GONOSTOMATIDAE	0.11	11	0.21	
Small squids	0.04	4	0.08	
Yarrella blackfordi	0.04	4	0.08	
Total	52.51		100.03	

PROJECT STATION: 908

DATE:26/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :03:01:21 03:16:26 15 (min) Purpose code: 1
LOG :6111.99 6112.76 0.75 Area code : 3
FDEPTH: 30 22 GearCond.code: 1
BDEPTH: 1004 1013 Validity code: 1
Towing dir: 180ø Wire out: 80 m Speed: 30 kn*10

Sorted: Kg Total catch: 5.98 CATCH/HOUR: 23.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	13.00		54.35	
Trachipterus sp.	6.36	12	26.59	
Trachurus capensis	2.08	64	8.70	5239
Aequorea aequorea	0.72	4	3.01	
LOLIGINIDAE	0.56	4	2.34	
MYCTOPHIDAE	0.36		1.51	
Octopus sp.	0.24	4	1.00	
Small squids	0.24	12	1.00	
Yarrella blackfordi	0.20	4	0.84	
Glyphus marsupialis	0.16	300	0.67	
Total	23.92		100.01	

PROJECT STATION: 909

DATE:26/ 8/01 GEAR TYPE: PT No:2 POSITION:Lat S 1727
start stop duration Long E 1109
TIME :04:13:23 04:31:34 18 (min) Purpose code: 1
LOG :6117.13 6118.32 1.19 Area code : 3
FDEPTH: 130 155 GearCond.code: 1
BDEPTH: 1014 1005 Validity code: 1
Towing dir: 360ø Wire out: 450 m Speed: 35 kn*10

Sorted: Kg Total catch: 3.99 CATCH/HOUR: 13.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	7.00	213	52.63	
MYCTOPHIDAE	4.43	1820	33.31	
ASTRONESTHIDAE	0.97	10	7.29	
Trachurus capensis	0.33	7	2.48	
Glyphus marsupialis	0.27	427	2.03	
Lampanyctodes hectoris	0.13	23	0.98	
Tetragonurus cuvieri	0.10	10	0.75	
Yarrella blackfordi	0.03	7	0.23	
Scopelosaurus meadi	0.03	3	0.23	
Total	13.29		99.93	

PROJECT STATION: 910

DATE:26/ 8/01 GEAR TYPE: BT No:2 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :04:43:35 04:59:20 16 (min) Purpose code: 1
LOG :6119.07 6120.13 1.06 Area code : 3
FDEPTH: 75 75 GearCond.code: 1
BDEPTH: 75 75 Validity code: 1
Towing dir: 360ø Wire out: 210 m Speed: 35 kn*10

Sorted: Kg Total catch: 7.91 CATCH/HOUR: 29.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachipterus sp.	12.94	11	43.63	
Trachurus capensis	12.56	311	42.35	5240
Aequorea aequorea	2.63	83	8.87	
MYCTOPHIDAE	0.86	484	2.90	
Tetragonurus cuvieri	0.53	4	1.79	
S H R I M P S	0.08	71	0.27	
Yarrella blackfordi	0.04	4	0.13	
Scopelosaurus meadi	0.04	4	0.13	
Total	29.68		100.07	

PROJECT STATION: 911

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1723
start stop duration Long E 1109
TIME :05:11:32 05:27:17 16 (min) Purpose code: 1
LOG :6120.93 6122.10 1.17 Area code : 3
FDEPTH: 30 24 GearCond.code: 1
BDEPTH: 964 946 Validity code: 1
Towing dir: 360ø Wire out: 100 m Speed: 3 kn*10

Sorted: Kg Total catch: 1.73 CATCH/HOUR: 6.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	6.45	71	99.38	
MOSSC01	0.04	4	0.62	
Total	6.49		100.00	

PROJECT STATION: 912

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1721
start stop duration Long E 1109
TIME :06:27:32 06:37:37 16 (min) Purpose code: 1
LOG :6125.34 6125.84 0.50 Area code : 3
FDEPTH: 30 155 GearCond.code: 1
BDEPTH: 960 960 Validity code: 1
Towing dir: 160ø Wire out: 380 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 190.80 CATCH/HOUR: 715.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	710.10	19564	99.25	5241
Loligo vulgaris	5.40	68	0.75	
Total	715.50		100.00	

PROJECT STATION: 913

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1725
start stop duration Long E 1108
TIME :08:04:18 08:21:50 18 (min) Purpose code: 1
LOG :6133.59 6134.66 1.06 Area code : 3
FDEPTH: 179 190 GearCond.code: 1
BDEPTH: 1037 1040 Validity code: 1
Towing dir: 360ø Wire out: 420 m Speed: 30 kn*10

Sorted: Kg Total catch: 8.17 CATCH/HOUR: 27.23

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	15.50	277	56.92	5242
Aequorea aequorea	8.63	240	31.69	
Loligo vulgaris	2.50	33	9.18	
MYCTOPHIDAE	0.53	547	1.95	
Scopelosaurus meadi	0.07	7	0.26	
Total	27.23		100.00	

PROJECT STATION: 914

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1724
start stop duration Long E 1108
TIME :08:25:59 08:36:12 10 (min) Purpose code: 1
LOG :6134.93 6135.51 0.58 Area code : 3
FDEPTH: 200 220 GearCond.code: 1
BDEPTH: 1039 1038 Validity code: 1
Towing dir: 360ø Wire out: 540 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 189.18 CATCH/HOUR: 1135.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1096.20	28260	96.57	5243
NOMEIDAE	38.88	36	3.43	
Total	1135.08		100.00	

PROJECT STATION: 915

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1723
start stop duration Long E 1108
TIME :08:42:04 08:44:36 3 (min) Purpose code: 1
LOG :6135.92 6136.10 0.18 Area code : 3
FDEPTH: 182 185 GearCond.code: 1
BDEPTH: 1042 1043 Validity code: 1
Towing dir: 360ø Wire out: 520 m Speed: 30 kn*10

Sorted: 32 Kg Total catch: 817.44 CATCH/HOUR: 16348.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	16198.00	227760	99.08	5244
SEMSC01	150.80	1040	0.92	
Total	16348.80		100.00	

PROJECT STATION: 916

DATE:26/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1721
start stop duration Long E 1109
TIME :09:47:49 09:53:41 6 (min) Purpose code: 1
LOG :6140.03 6140.35 0.32 Area code : 3
FDEPTH: 155 195 GearCond.code: 1
BDEPTH: 950 937 Validity code: 1
Towing dir: 170º Wire out: 420 m Speed: 30 kn*10

Sorted: 33 Kg Total catch: 266.00 CATCH/HOUR: 2660.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2574.40	64880	96.78	5245
Etrumeus whiteheadi	85.60	2080	3.22	
Total	2660.00		100.00	

PROJECT STATION: 917

DATE:26/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1722
start stop duration Long E 1109
TIME :10:48:04 11:09:46 22 (min) Purpose code: 1
LOG :6144.21 6145.59 1.38 Area code : 3
FDEPTH: 195 195 GearCond.code: 1
BDEPTH: 974 1015 Validity code: 1
Towing dir: 360º Wire out: 600 m Speed: 37 kn*10

Sorted: 31 Kg Total catch: 378.60 CATCH/HOUR: 1032.55

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1032.55	25233	100.00	5246
Total	1032.55		100.00	

PROJECT STATION: 918

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1722
start stop duration Long E 1109
TIME :12:10:37 12:40:17 30 (min) Purpose code: 1
LOG :6149.03 6150.53 1.50 Area code : 3
FDEPTH: 200 200 GearCond.code: 1
BDEPTH: 965 955 Validity code: 1
Towing dir: 180º Wire out: 600 m Speed: 30 kn*10

Sorted: 34 Kg Total catch: 238.00 CATCH/HOUR: 476.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	476.00	14154	100.00	5247
Total	476.00		100.00	

PROJECT STATION: 919

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :14:56:40 15:26:34 30 (min) Purpose code: 1
LOG :6158.33 6160.33 2.00 Area code : 1
FDEPTH: 190 190 GearCond.code: 1
BDEPTH: 968 965 Validity code: 3
Towing dir: 360º Wire out: 600 m Speed: 40 kn*10

Sorted: Kg Total catch: 62.90 CATCH/HOUR: 125.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	125.80	2912	100.00	5248
Total	125.80		100.00	

PROJECT STATION: 920

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1722
start stop duration Long E 1109
TIME :16:19:50 16:50:16 30 (min) Purpose code: 1
LOG :6163.00 6164.44 1.44 Area code : 3
FDEPTH: 150 160 GearCond.code: 1
BDEPTH: 990 972 Validity code: 3
Towing dir: 180º Wire out: 460 m Speed: 30 kn*10

Sorted: 33 Kg Total catch: 591.30 CATCH/HOUR: 1182.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1182.60	26928	100.00	5246
Total	1182.60		100.00	

PROJECT STATION: 921

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1725
start stop duration Long E 1109
TIME :18:15:11 18:36:05 21 (min) Purpose code: 1
LOG :6171.20 6172.57 1.38 Area code : 3
FDEPTH: 160 165 GearCond.code: 1
BDEPTH: 1017 1016 Validity code: 3
Towing dir: 360º Wire out: 450 m Speed: 30 kn*10

Sorted: Kg Total catch: 2.43 CATCH/HOUR: 6.94

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2.06	11	29.68	
MYCTOPHIDAE	1.77	954	25.50	
J E L L Y F I S H	1.31	40	18.88	
Tetragonurus cuvieri	0.71	6	10.23	
Loligo vulgaris	0.51	3	7.35	
Triplophos sp.	0.26	20	3.75	
S H R I M P S	0.20	551	2.88	
GONOSTOMATIDAE	0.11	11	1.59	
Total	6.93		99.86	

PROJECT STATION: 922

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1723
start stop duration Long E 1108
TIME :18:47:06 19:07:34 20 (min) Purpose code: 1
LOG :6173.25 6174.64 1.38 Area code : 3
FDEPTH: 88 90 GearCond.code: 1
BDEPTH: 1019 1008 Validity code: 3
Towing dir: 360º Wire out: 260 m Speed: 30 kn*10

Sorted: Kg Total catch: 2.92 CATCH/HOUR: 8.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	4.95	108	56.51	5247
J E L L Y F I S H	1.59	57	18.15	
Krill	1.26	6489	14.38	
MYCTOPHIDAE	0.48	432	5.48	
Tetragonurus cuvieri	0.24	3	2.74	
Octopus vulgaris	0.24	3	2.74	
Total	8.76		100.00	

PROJECT STATION: 923

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1721
start stop duration Long E 1108
TIME :19:17:32 19:38:02 21 (min) Purpose code: 1
LOG :6175.28 6176.71 1.43 Area code : 3
FDEPTH: 30 30 GearCond.code: 1
BDEPTH: 1024 1070 Validity code: 3
Towing dir: 360º Wire out: 100 m Speed: 30 kn*10

Sorted: Kg Total catch: 5.68 CATCH/HOUR: 16.23

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	8.83	237	54.41	5248
Trachipterus jacksonensis	4.83	6	29.76	
MYCTOPHIDAE	1.49	1894	9.18	
Aequorea aequorea	0.60	17	3.70	
Krill	0.49	4226	3.02	
Total	16.24		100.07	

PROJECT STATION: 924

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1720
start stop duration Long E 1108
TIME :20:26:57 20:46:37 20 (min) Purpose code: 1
LOG :6178.70 6179.55 0.84 Area code : 3
FDEPTH: 190 178 GearCond.code: 1
BDEPTH: 1069 1052 Validity code: 3
Towing dir: 180º Wire out: 450 m Speed: 30 kn*10

Sorted: Kg Total catch: 1.30 CATCH/HOUR: 3.90

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	2.01		51.54	
Yarella blackfordi *	0.48		12.31	
Krill	0.42	24	10.77	
S H R I M P S	0.36		9.23	
Trachurus capensis	0.36		9.23	
GONOSTOMATIDAE	0.18	21	4.62	
Triplophos sp.	0.09		2.31	
Total	3.90		100.01	

PROJECT STATION: 925

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1721
start stop duration Long E 1108
TIME :21:01:12 21:21:00 20 (min) Purpose code: 1
LOG :6180.15 6181.08 0.90 Area code : 3
FDEPTH: 95 90 GearCond.code: 1
BDEPTH: 1048 1046 Validity code: 3
Towing dir: 180ø Wire out: 260 m Speed: 30 kn*10

Sorted: Kg Total catch: 1.76 CATCH/HOUR: 5.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	2.10		39.77	
Trachurus capensis	1.29	33	24.43	5249
MYCTOPHIDAE	0.99		18.75	
Krill	0.87		16.48	
Yarella blackfordi *	0.03	6	0.57	
Total	5.28		100.00	

PROJECT STATION: 926

DATE:26/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1723
start stop duration Long E 1108
TIME :21:31:19 21:51:02 20 (min) Purpose code: 1
LOG :6181.54 6182.47 0.93 Area code : 3
FDEPTH: 28 29 GearCond.code: 1
BDEPTH: 1054 1061 Validity code: 3
Towing dir: 180ø Wire out: 100 m Speed: 30 kn*10

Sorted: Kg Total catch: 14.34 CATCH/HOUR: 43.02

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	27.90	885	64.85	5250
Trachipterus sp.	13.11	21	30.47	
J E L L Y F I S H	0.72		1.67	
MYCTOPHIDAE	0.72		1.67	
Loligo reynaudi	0.63	9	1.46	
Total	43.08		100.12	

PROJECT STATION: 927

DATE:27/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1724
start stop duration Long E 1109
TIME :23:37:53 00:07:33 30 (min) Purpose code: 1
LOG :6188.15 6190.34 2.16 Area code : 3
FDEPTH: 90 90 GearCond.code: 1
BDEPTH: 958 961 Validity code: 3
Towing dir: 350ø Wire out: 280 m Speed: 40 kn*10

Sorted: Kg Total catch: 5.76 CATCH/HOUR: 11.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	10.20	334	88.54	
Trachurus capensis	1.14	36	9.90	5251
GONOSTOMATIDAE	0.14	22	1.22	
MYCTOPHIDAE	0.02	24	0.17	
Triplophos sp.	0.02	6	0.17	
Total	11.52		100.00	

PROJECT STATION: 928

DATE:27/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1722
start stop duration Long E 1109
TIME :00:59:18 01:29:17 30 (min) Purpose code: 1
LOG :6192.55 6194.09 1.53 Area code : 3
FDEPTH: 40 40 GearCond.code: 1
BDEPTH: 961 991 Validity code: 1
Towing dir: 180ø Wire out: 140 m Speed: 32 kn*10

Sorted: Kg Total catch: 9.78 CATCH/HOUR: 19.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	6.00	162	30.67	5252
Trachipterus sp.	5.62	6	28.73	
Schedophilus huttoni	2.72	2	13.91	
Aequorea aequorea	1.80		9.20	
LOLIGINIDAE	1.10	22	5.62	
Krill	1.10		5.62	
MYCTOPHIDAE	0.68	284	3.48	
C E P H A L O P O D A	0.40	150	2.04	
Brama brama	0.08	2	0.41	
GONOSTOMATIDAE	0.06	12	0.31	
Total	19.56		99.99	

PROJECT STATION: 929

DATE:27/ 8/01 GEAR TYPE: PT No:7 POSITION:Lat S 109
start stop duration Long E 9800
TIME :02:48:00 03:18:52 30 (min) Purpose code: 1
LOG :6196.90 6198.43 1.53 Area code : 3
FDEPTH: 20 20 GearCond.code: 1
BDEPTH: 997 Validity code: 3
Towing dir: 180ø Wire out: 80 m Speed: 32 kn*10

Sorted: Kg Total catch: 10.22 CATCH/HOUR: 20.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachipterus sp.	10.72	8	52.45	
Trachurus capensis	5.02	150	24.56	5253
J E L L Y F I S H	3.80		18.59	
Krill	0.46	160	2.25	
Small squids	0.42	546	2.05	
Argonauta sp.	0.02	2	0.10	
Total	20.44		100.00	

PROJECT STATION: 930

DATE:27/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1741
start stop duration Long E 1115
TIME :03:12:00 03:42:00 30 (min) Purpose code: 1
LOG :6200.90 6203.20 1.50 Area code : 1
FDEPTH: 20 20 GearCond.code: 1
BDEPTH: 993 Validity code: 3
Towing dir: 360ø Wire out: 90 m Speed: 30 kn*10

Sorted: Kg Total catch: 3.10 CATCH/HOUR: 6.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	4.00	120	64.52	5254
MYCTOPHIDAE	0.88		14.19	
Chrysaora hysoscella	0.44		7.10	
Aequorea aequorea	0.34		5.48	
Krill	0.28		4.52	
Small squids	0.26		4.19	
Total	6.20		100.00	

PROJECT STATION: 931

DATE:27/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1722
start stop duration Long E 1109
TIME :05:47:51 06:14:53 27 (min) Purpose code: 1
LOG :6206.01 6207.35 1.33 Area code : 3
FDEPTH: 207 207 GearCond.code: 1
BDEPTH: 978 997 Validity code: 3
Towing dir: 180ø Wire out: 500 m Speed: 30 kn*10

Sorted: Kg Total catch: 9.54 CATCH/HOUR: 21.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Octopus sp.	6.36	2	30.00	
Aequorea aequorea	6.36	171	30.00	
Chrysaora hysoscella	2.87	4	13.54	
S H R I M P S	1.44	1373	6.79	
Etrumeus whiteheadi	1.11	27	5.24	
MYCTOPHIDAE	0.76	398	3.58	
Trachipterus jacksonensis	0.71	2	3.35	
Trachurus capensis	0.62	16	2.92	
Lampadena sp.	0.29	29	1.37	
Illex coindetii	0.20	2	0.94	
Small squids	0.20	73	0.94	
Argyropelecus affinis	0.11	73	0.52	
Scopelosaurus meadi	0.07	4	0.33	
Yarrella blackfordi	0.07	11	0.33	
GONOSTOMATIDAE	0.04	4	0.19	
Total	21.21		100.04	

PROJECT STATION: 932

DATE:27/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1717
start stop duration Long E 1109
TIME :08:26:38 09:03:49 37 (min) Purpose code: 1
LOG :6217.50 6219.28 1.77 Area code : 1
FDEPTH: 170 180 GearCond.code: 1
BDEPTH: 1085 1012 Validity code: 3
Towing dir: 180ø Wire out: 480 m Speed: 30 kn*10

Sorted: 31 Kg Total catch: 94.14 CATCH/HOUR: 152.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	131.11	3994	85.88	5255
Aequorea aequorea	9.92	350	6.50	
Chrysaora hysoscella	8.66	5	5.67	
MYCTOPHIDAE	2.43	1286	1.59	
Shrimps, small, non comm.	0.29	598	0.19	
Argyropelecus affinis	0.24	122	0.16	
Total	152.65		99.99	

PROJECT STATION: 933

DATE:27/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1722

	start	stop	duration			Long E 1109
TIME	:10:01:26	10:23:51	22 (min)	Purpose code:	1	
LOG	:6222.39	6223.46	1.07	Area code :	1	
FDEPTH:	190	185		GearCond.code:	1	
BDEPTH:	972	994		Validity code:	3	

Towing dir: 180º Wire out: 460 m Speed: 30 kn*10

Sorted: 4 Kg Total catch: 32.25 CATCH/HOUR: 87.95

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	87.95	2168	100.00	5256
Total	87.95		100.00	

PROJECT STATION: 934

DATE:27/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1730

	start	stop	duration			Long E 1128
TIME	:13:54:53	14:37:17	42 (min)	Purpose code:	1	
LOG	:6248.29	6250.74	2.44	Area code :	3	
FDEPTH:	150	190		GearCond.code:	1	
BDEPTH:	189	231		Validity code:	3	

Towing dir: 285º Wire out: 540 m Speed: 35 kn*10

Sorted: 33 Kg Total catch: 429.91 CATCH/HOUR: 614.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
J E L L Y F I S H	289.71	446	47.17	
Aequorea aequorea	252.57	6834	41.12	
Trachurus capensis	71.87	2377	11.70	5257
Total	614.15		99.99	

PROJECT STATION: 935

DATE:28/ 8/01 GEAR TYPE: PT No:1 POSITION:Lat S 1710

	start	stop	duration			Long E 1124
TIME	:00:35:50	00:50:31	15 (min)	Purpose code:	1	
LOG	:6346.31	6347.23	0.90	Area code :	1	
FDEPTH:	40	30		GearCond.code:	1	
BDEPTH:	174	196		Validity code:	3	

Towing dir: 270º Wire out: 110 m Speed: 40 kn*10

Sorted: Kg Total catch: 38.11 CATCH/HOUR: 152.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	92.60	4628	60.75	
Etrumeus whiteheadi	47.00	4700	30.83	
Krill	7.40	59200	4.85	
J E L L Y F I S H	3.04	4	1.99	
Thyrsites atun	1.76	4	1.15	
Trachipterus trachypterus	0.28	8	0.18	
MYCTOPHIDAE	0.28	868	0.18	
Aequorea aequorea	0.04	8	0.03	
LOLIGINIDAE	0.04	8	0.03	
Total	152.44		99.99	

PROJECT STATION: 936

DATE:28/ 8/01 GEAR TYPE: PT No:3 POSITION:Lat S 1710

	start	stop	duration			Long E 1126
TIME	:17:20:10	17:50:02	30 (min)	Purpose code:	1	
LOG	:6430.83	6432.56	1.73	Area code :	3	
FDEPTH:	110	105		GearCond.code:	1	
BDEPTH:	149	160		Validity code:	3	

Towing dir: 180º Wire out: 270 m Speed: 30 kn*10

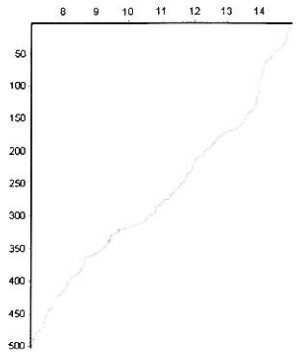
Sorted: Kg Total catch: 20.94 CATCH/HOUR: 41.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	39.50	2002	94.32	5259
Chelidonichthys capensis	2.28	28	5.44	5260
Dentex macrophthalmus	0.10	2	0.24	
Total	41.88		100.0	

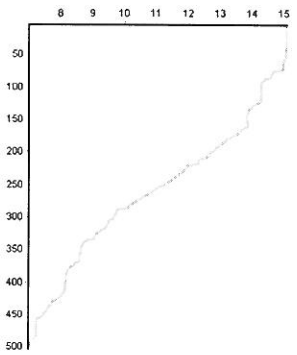
Annex IV Ctd stations

Temperature profiles

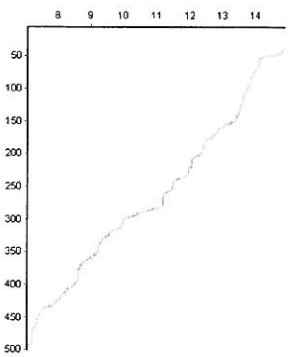
Station 693



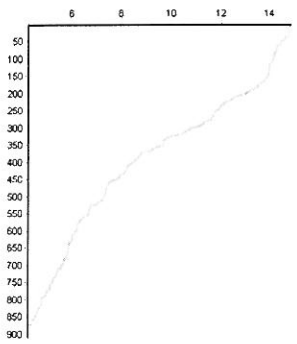
Station 696



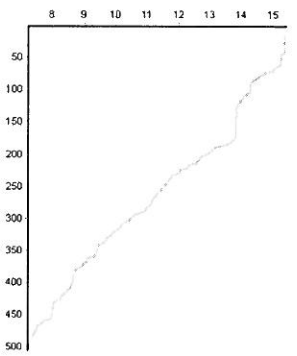
Station 700



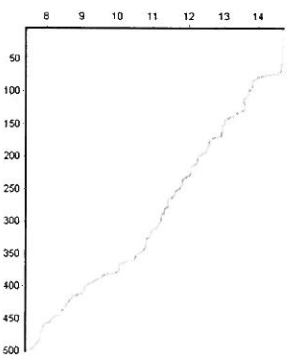
Station 694



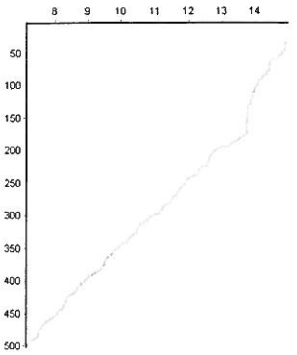
Station 697



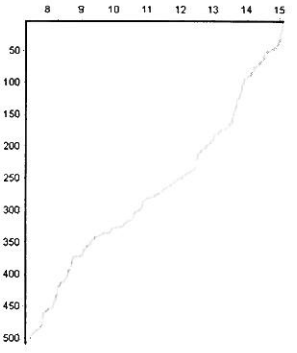
Station 701



Station 695

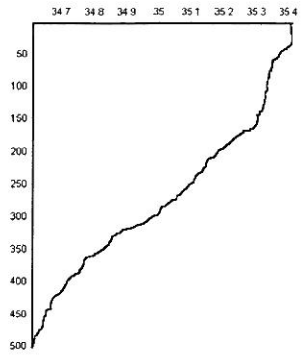


Station 699

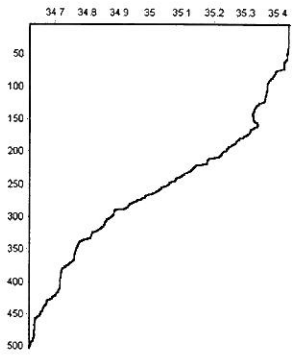


Salinity profiles

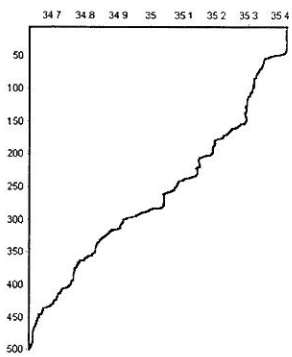
Station 693



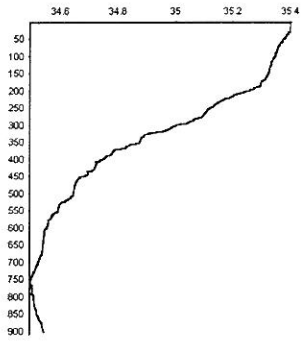
Station 696



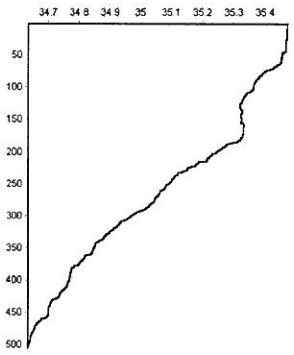
Station 700



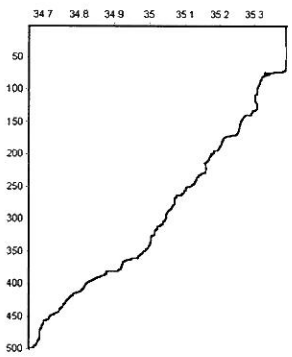
Station 694



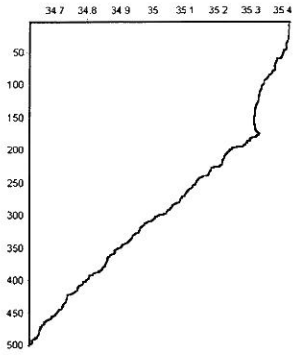
Station 697



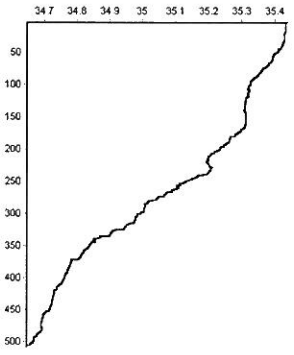
Station 701



Station 695

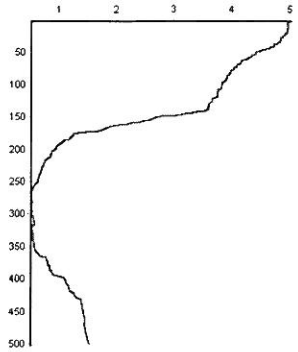


Station 699

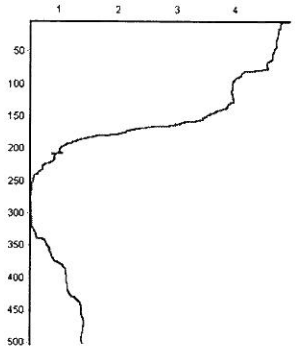


Oxygen profiles

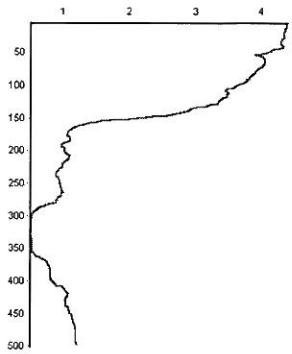
Station 693



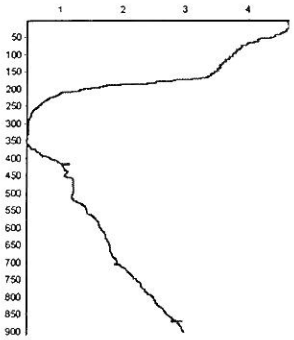
Station 696



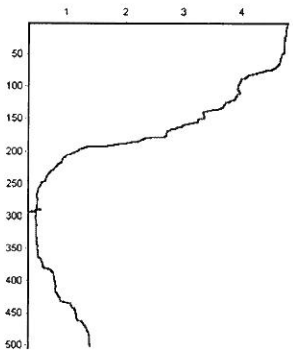
Station 700



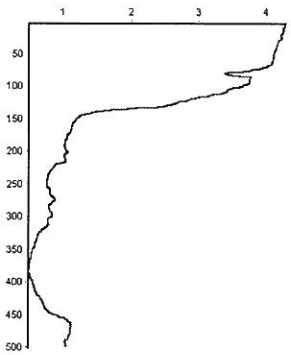
Station 694



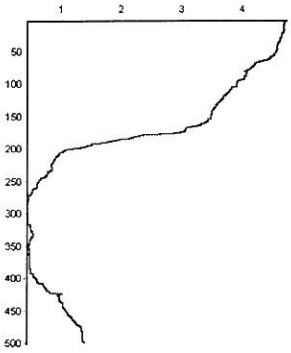
Station 697



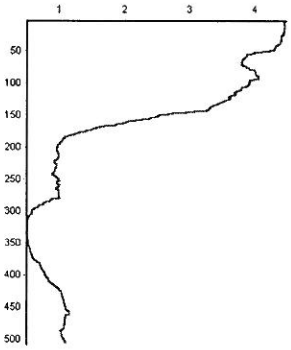
Station 701



Station 695



Station 699



Annex V Diel cycle log-sheet

Cycle 1			
Multisampler	Station	Time	Depth
MS 1	(MS 875)	02:07	150
MS 2	(MS 876)	02:51	80
MS 3	(MS 877)	03:23	25
Echolog file			
CTD Station	no		
Initial trial	MS haul (PT875-7) initiated for initial ground truthing of scattering layer. NB! The ship continued inshore (NE) after haul but returned (SW) to this position at 07:51 and start the diel cycle with multinet plankton samling (PL1)		
Echolog file			
ADCP	(continuous)		
Time (UTC)			
ADCP file			
Multinet sample no:	PL 1		Difference
Pos. S	-17.4142		
Pos. E	11.1203		
Date:	24.08	2001	
Time (UTC):	07:51		
Revolutions	Open	close	
Depth 1	34244	34771	
Depth 2	79834	80432	
Depth 3	00726	02378	
Depth 4	45875	47391	
Depth 5	52059	53876	
Echolog file			

Cycle 2			
Multisampler	Station	Time	Depth
MS 1	MS 878	10:17	296
MS 2	MS 879	10:45	160
MS 3	MS 880	12:08	190
Echolog file			
CTD Station	HD 693	13:16	500
Pos. S	-17.4155		
Pos. E	11.1523		
CTD file	sta0693.cnv		
Echolog file			
ADCP			
Time (UTC)			
ADCP file	0004		
Multinet sample no:	PL 2		Difference
Pos. S	-17.4155		
Pos. E	11.1523		
Date:	24.08		
Time (UTC):	13:30		
Revolutions	Open	close	
Depth 1	34771	35524	
Depth 2	80432	81117	
Depth 3	02378	02962	
Depth 4	47391	47680	
Depth 5	53876	54308	
Echolog file			

Cycle 3			
Multisampler	Station	Time	Depth
MS 1	MS 881	15:53	190
MS 2	MS 882	16:15	160
MS 3	-	-	-
Echolog file			
CTD Station	HD694	17:14	500
Pos. S	-17.3675		
Pos. E	11.1510		
Echolog file			
CTD file	sta0694.cnv		
ADCP			
Time (UTC)			
ADCP file	0006		
Multinet sample no:	PL 3		Difference
Date/UTC:	24.08	18:07	
Pos. S	-17.3675		
Pos. E	11.1510		
Revolutions	Open	Close	
Depth 1	35524	36512	
Depth 2	81117	82988	
Depth 3	02962	04377	
Depth 4	47680	48567	
Depth 5	54308	55293	
Echolog file			

Cycle 4			
Multisampler	Station	Time	Depth
MS 1	MS 883	19:22	200
MS 2	MS 884	19:54	115
PT 1	PT 885	21:27	320
Echolog file	NB 885 was a surface trawl with the small pelagic trawl, NOT MS		
CTD Station	HD695	22:31	500
Pos. S	-17.4168		
Pos. E	11.1495		
Echolog file			
CTD file	sta0695.cnv		
ADCP			
Time (UTC)			
ADCP file			
Multinet sample no:	PL 4		Difference
Date/UTC:	24.08	23:31	
Pos. S	-17.4077		
Pos. E	11.1583		
Revolutions	Open	close	
Depth 1	36512	37259	
Depth 2	82988	83623	
Depth 3	04377	05025	
Depth 4	48567	48982	
Depth 5	55293	56062	
Echolog file			

Cycle 5			
Multisampler	Station	Time	Depth
MS 1	MS 886	00:18	150
MS 2	MS 887	00:43	115
MS 3	MS 888	01:13	30
Echolog file			
	Station no	Time	Depth
CTD	HD 696	02:21	500
Pos. S	-17.4065		
Pos. E	11.1575		
CTD file	sta0696.cnv		
Echolog file			
ADCP			
Time (UTC)			
ADCP file			
Multinet sample no:	PL 5		Difference
Date/UTC:	25.08	03:15	
Pos. S	-17.3955		
Pos. E	11.1637		
Revolutions	Open	Close	Depth
Depth 1	37259	38391	375
Depth 2	83623	85317	300
Depth 3	05025	06481	225
Depth 4	48982	49989	150
Depth 5	56062	57163	75
Echolog file			

Cycle 6			
Multisampler	Station	Time	Depth
MS 1	MS 889	04:30	
MS 2	MS 890	04:55	75
MS 3	MS 891	05:26	25
Two first MS samples (MS889-90) obtained from pealgic layers just before dawn, while still dark. The last MS sample (891) taken around dawn (06h00). The fish immediately start to descend and this sample is to check if any fish remain near the surface.			
Echolog file			
	Station no	Time	Depth
CTD	HD 697	06:55	500
Pos. S	-17.4147		
Pos. E	11.1490		
CTD file	sta0697.cnv		
Echolog file			
ADCP			
Time (UTC)			
ADCP file	BEN3012p		
Multinet sample no:	PL 6		Difference
Date/UTC:	25.08	06:59	
Pos. S	-17.3922		
Pos. E	11.1407		
Revolutions	Open	close	Depth
Depth 1	38391	39695	375
Depth 2	85317	86714	300
Depth 3	06481	08149	225
Depth 4	49989	51230	150
Depth 5	57163	58676	75
Echolog file			

Cycle 7	25/8		
Multisampler	Station	Time	Depth
MS 1	MS 892	09:11	195
MS 2	~~MS 893~~	~~09:44~~	150
PT 3	PT 894	10:55	210
PT 1	PT 895	12:39	200
PT 1	PT 896	14:03	200
PT 1	PT 897	15:25	210
PT 1	PT 898	16:50	150
PT 1	PT 899	18:14	154
PT 1	PT 900	18:46	32
MS 1	PT 901	20:01	152
PT 3	PT 902	21:52	40
MS 2	MS 903	23:13	160
MS 3	MS 904	23:44	40
MS 1	MS 905	23:10	200
MS1 has station no after MS3 (added after haul)			
MS 892 is taken inside the euphausiid layer. Schools were sitting on top of layer, but were herded into the layer by the trawl/ vessel. Some fish may also have been feeding inside the layer. PT894 was taken immediately after in the layer to compare catches with and without euphausiid in codend.(MS 893 is not used). Continued with multiple pelagic sample trawls. After sample PT 901 (MS) there was a problem with the MS, and PT902 is therefore with the pelagic trawl (at the surface). Problem with release mec. Multisampler MS1 (MS905) was only open 4 min.			
Multinet sample no:	PL 7		Difference
Date/UTC:	26.08	00:45	
Pos. S	-17.3615		
Pos. E	11.1457		
Revolutions	Open	Close	Depth
Depth 1	39695	40503	375
Depth 2	86714	87769	300
Depth 3	08149	09472	225
Depth 4	51230	52172	150
Depth 5	58676	59842	75

Cycle 8	26/8		
Multisampler	Station	Time	Depth
MS 1	MS 906	02:05	170
MS 2	MS 907	02:34	110
MS 3	MS 908	03:01	30
MS 1	MS 909	04:13	130
MS 2	MS 910	04:43	75
MS 3	MS911	05:11	30
PT 1	PT 912	06:12	30
MS 1	MS 913	08:04	179
MS 2	MS 914	08:25	200
MS 3	MS 915	08:42	182
PT 1	PT 916	09:47	155
PT 1	PT 917	10:48	195
PT 1	PT 918	12:10	200
CTD Station	Sta 699.cnv		
Time (UTC)	13:19		
Echolog file			
CTD file			
ADCP file			
Multinet sample no:	PL 8		Difference
Date/UTC:	26.08	14:19	
Pos. S	-17.XX		
Pos. E	11.XX		
Revolutions	Open	close	
Depth 1	40503	41399	
Depth 2	87769	89131	
Depth 3	09472	10670	
Depth 4	52172	53134	
Depth 5	59842	60895	
Echolog file			

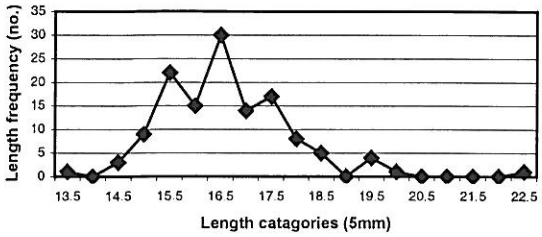
Cycle 9			
Multisampler	Station	Time	Depth
PT 1	PT 919	14:56	190
PT 2	PT 920	16:19	150
MS 1	MS 921	18:15	170
MS 2	MS 922	18:47	90
MS 3	MS 923	19:17	30
MS 1	MS 924	20:26	190
MS 2	MS 925	21:01	90
MS 3	MS 926	21:31	30
PT 2	PT 627	23:37	90
Two MS series after dark. NB!! NB!! MS 2 (90 m) showed signs of codend-feeding. Some euph. In catches, full stomachs with fresh euph. Testing with PT 627 (midwater trawl) to check if stomachs are still full, hence if the fish are actually feeding. RESULT: N.B. Innerlining taken out after MS 915			
Multinet sample no:	PL 9		Difference
Date:	27/8-2001		
Time (UTC):			
Revolutions	Open	Close	
Depth 1	41399	42498	FAULTY!!
Depth 2	89131	90109	FAULTY!!
Depth 3	10670	12498	FAULTY!!
Depth 4	53134	53202	FAULTY!!
Depth 5	60895	61008	FAULTY!!

Cycle 10			
Multisampler	Station	Time	Depth
PT 1	PT 928	00:59	40
Multinet sample no:	PL 10		Difference
Date:	27/8		
Time (UTC):	02:10		
Revolutions	Open	Close	
Depth 1	42498	43080	1.35
Depth 2	90109	90851	2.11
Depth 3	12498	13183	2.20
Depth 4	53202	53862	2.02
Depth 5	61008	61919	1.00
Echolog file			
Multisampler	Station	Time	Depth
PT 1	PT 929	02:48	20
PT 1	PT 930	03:12	25
	Fish is very dispersed, with low catches, but it seems like they are still feeding 03:00, or codend feeding?		
Echolog file			
CTD Station	HD 700		
Time (UTC)	05:26	27/8-2001	
Echolog file			
CTD file			
ADCP			
Time (UTC)			
ADCP file			

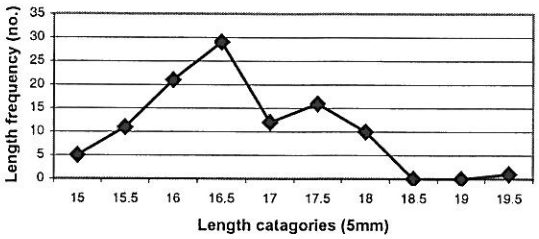
Cycle 11			
Multisampler	Station	Time	Depth
PT 1	PT 931	05:47	207
PT 1	PT 932	08:26	170
PT 1	PT933	10:01	40
Echolog file			
Multinet sample no:	PL 11		Difference
Date:	27/8-2001		
Time (UTC):			
Revolutions	Open	Close	
Depth 1	43080	43874	250
Depth 2	90851	91640	200
Depth 3	13183	13841	150
Depth 4	53862	54173	100
Depth 5	61919	62899	50
Echolog file			
CTD Station	HD 701		
Time (UTC)	11:10		
Echolog file			
CTD file			
ADCP			
Time (UTC)			
ADCP file			

Annex VI Horse mackerel length frequencies

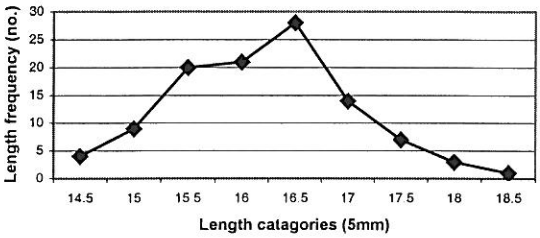
Length frequency for midwater trawl 894



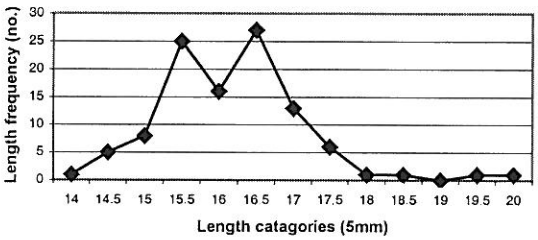
Length frequency for midwater trawl 895



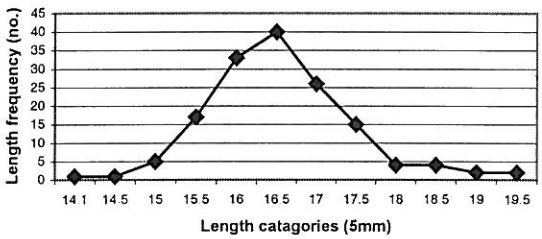
Length frequency for midwater trawl 896



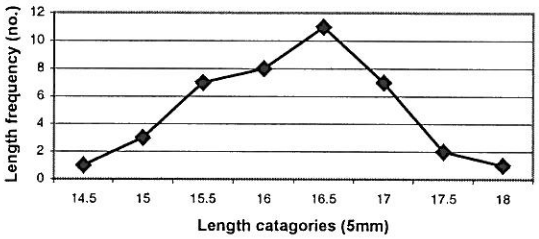
Length frequency for midwater trawl 897



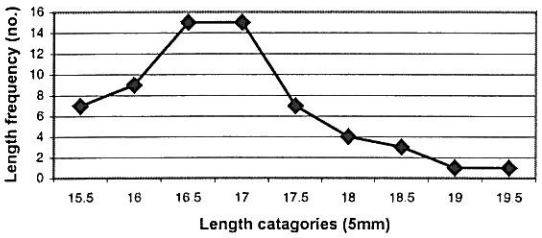
Length frequency for midwater trawl 898



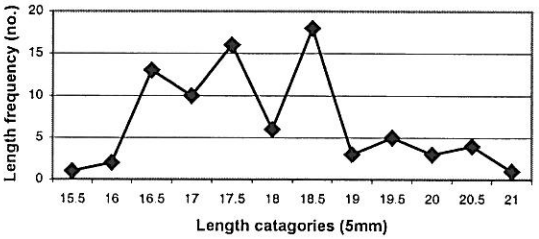
Length frequency for midwater trawl 900



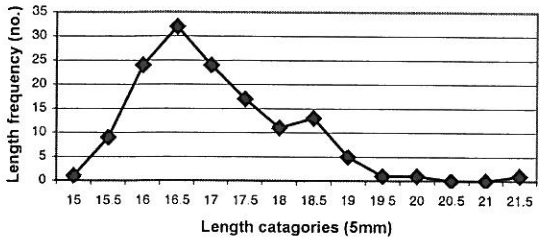
Length frequency for midwater trawl 901



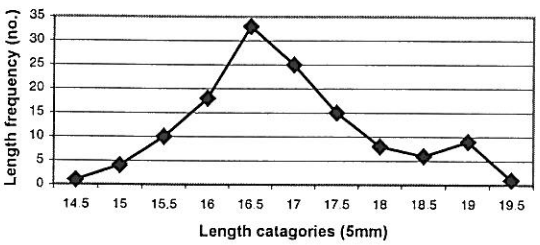
Length frequency for midwater trawl 913



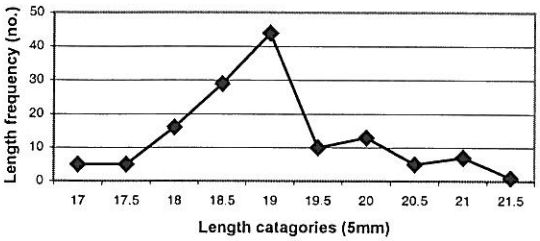
Length frequency for midwater trawl 914



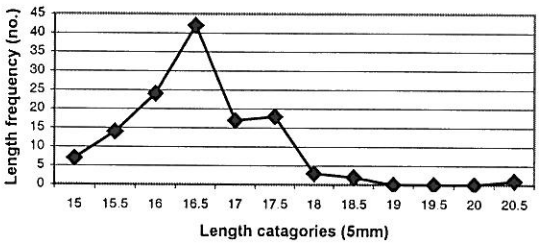
Length frequency for midwater trawl 915



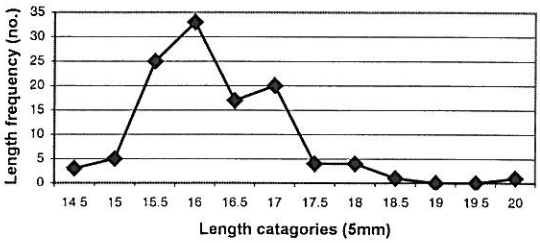
Length frequency for midwater trawl 916



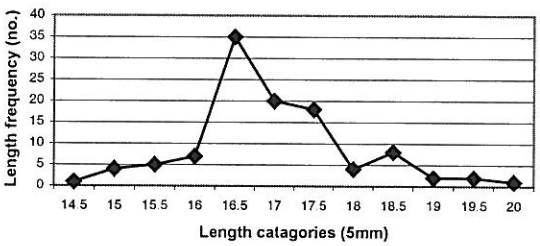
Length frequency for midwater trawl 917



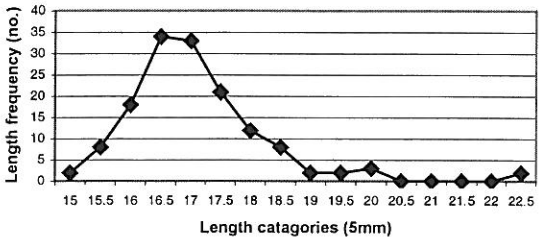
Length frequency for midwater trawl 918



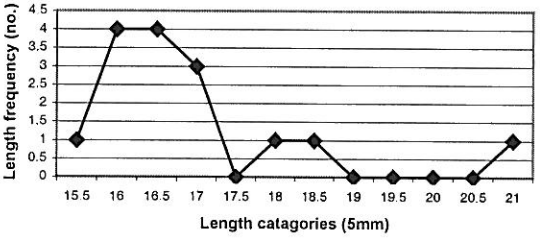
Length frequency for midwater trawl 919



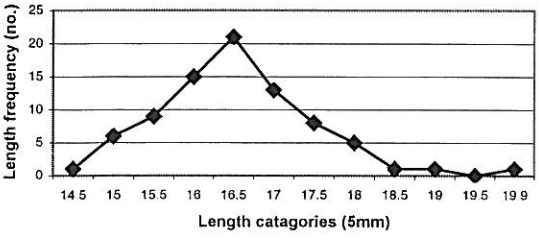
Length frequency for midwater trawl 920



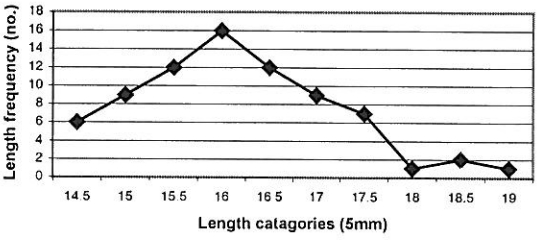
Length frequency for midwater trawl 927



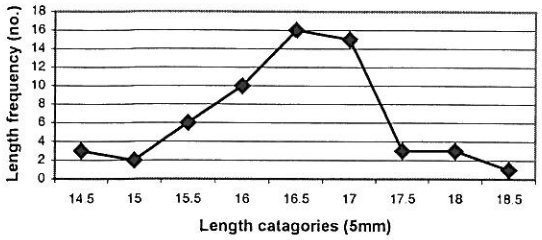
Length frequency for midwater trawl 928



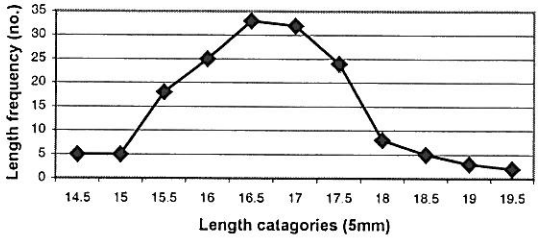
Length frequency for midwater trawl 929



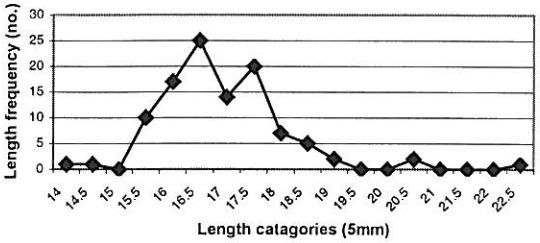
Length frequency for midwater trawl 930



Length frequency for midwater trawl 932



Length frequency for midwater trawl 933



Length frequency for midwater trawl 934