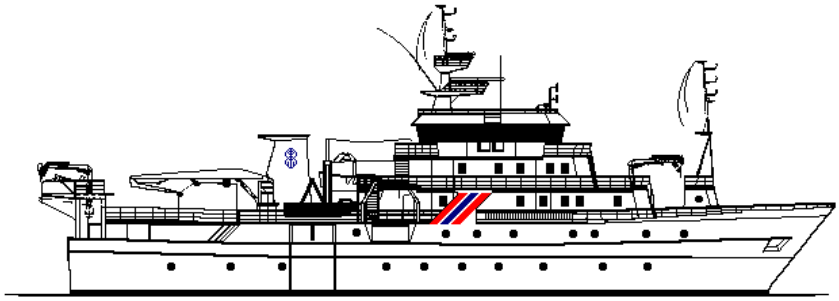
PRELIMINARY

Cruise Report "Dr. Fritjof Nansen"



Survey of the living marine resources of North Mozambique

(SWIOFP/ASCLME 2009 Cruise 1)

6 August – 20 August 2009

By

E. Olsen[2], M. Padera[1], M. Funke[3], P. Pires[1], T. Wenneck[2], L. Zacarias[1],

[1)]Instituto Nacional de Investigação Pesqueira
Mao Tse Tung Av. 389
P.O. Box 4307
Maputo, Mozambique

[2)]Institute of Marine Research
P.O.Box 1870 Nordnes
N-5817 Bergen, Norway

[3)]University of Cape Town
Private Bag X3
Rondebosch 7701, South Africa

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1. INTRODUCTION

This is a ***preliminary*** cruise report made at the end of the 2009 FAO / ASCLME /SWIOFP survey of the living marine resource of North Mozambique. Not all results (eg. Zooplankton data) are ready at the time of writing and the analyses presented are *initial* and conclusions may therefore change as the data is analyzed more thoroughly.

1.1 Background and rationale

Most of our understanding of the Agulhas Current system is based on research from south of the African coast. Far less is known about its highly complex region of origin in the Mozambique Channel. A number of recent exploratory cruises, satellite tracking and remote sensing studies have shown the Mozambique Channel to be a generally oligotrophic environment that nonetheless supports a large number of fisheries, a high biodiversity and high densities of ecologically important top predators. To date, the processes that sustain the biomass and diversity of this ecosystem are not well understood. It has been acknowledged, however, that the region at a global scale, is physically unusually dynamic and it has been suggested that the observed spatial and temporal variability of the physical environment may well play an important role in enhancing both pelagic and coastal production.

In December 2008 the R/V Dr Fritjof Nansen in collaboration with the ASCLME undertook a 3 week oceanographic survey in the northern Mozambique Channel to determine the role of mesoscale eddies in this ecosystem. The cruise was multidisciplinary collecting data from the ocean physics, through the various trophic levels, to top predators. Results indicated that the greatest effect of eddies is against the northern Mozambique slope where strong anticyclonic circulation was found to drive shelf edge upwelling along the Mozambique shelf between P. Ta Macalonga and Mozambique Island. Time did not allow sampling of the shelf itself and hence the impact of this upwelling on the coastal ecosystem remains unknown. Moreover, the occurrence of shelf edge upwelling in this region is unknown. It is hypothesised that the on-shelf production is driven by terrestrial input (via rivers) and upwelling events, especially off the coast of Angosche.

1.2 Objectives

1. To carry out a multi-disciplinary cruise that investigates the physico-chemical processes along the Mozambican Shelf.
2. To establish the distribution and composition of organisms at a number of trophic levels along the shelf.
3. To establish, as far as possible, the productivity, diversity and biomass of the pelagic ecosystem.
4. To survey for bottom suitable for demersal trawling and investigate the demersal fish biodiversity from bottom trawl samples.
5. To establish the role of the shelf region and terrestrial input in linking coastal and pelagic biomes (coupling).
6. To investigate the role of coastal currents as dispersal agents.
7. To investigate mesopelagic fish species diversity and abundance.
8. To link various sources of energy and nutrition to different food-web compartments.
9. Capacity building of ASCLME and SWIOFP trainees & young scientists.

1.3 Survey design

The survey was designed around a pelagic survey track with east – west tracklines approximately 10 nmi apart meandering soutward from the border to Tanzania to 17° 18' S. Along 6 transects approximately 30 nmi long starting at the coast and continuing straight offshore 7 environmental stations were made along each transect. At each environmental station CTD stations and Nisikon water sampling was carried in addition to a multinet haul for zooplankton sampling. In coastal shallow water areas the bottom was continually assessed using a multi-beam echosounder to identify potentially trawlable grounds. If trawlable grounds were found bottom trawling was conducted. After finishing the pelagic survey track, environmental stations and search for trawlable ground effort was dedicated to observing for cetaceans and seabirds.

1.4 Participation

Table 1.1 List of participants

	Name	Role	Affiliation
1	Erik Olsen	Cruise Leader	IMR
2	Martinho Padera	Cruise Leader (Local)	IIP
3	Michael Funke	Physical Oceanography	UCT
4	Celso Montanha	Physical Oceanography	IIP
5	José Chamusse	Physical Oceanography	IIP
6	Paulo Sigauque	Bathymetric mapping	INAHINA
7	Fernandes Nobre	Chemical Oceanography	UEM
8	Mauricio Lipassula	Phytoplankton	UEM
9	Riaan Cedras	Zooplankton	UWC
10	Pedro Pires	Fisheries / pelagic trawls	IIP
11	Lourenzo Zacarias	Fisheries / pelagic trawls	IIP
12	Isaias Tembe	Fisheries observer	IIP
13	Mark Lisher	Fish Biodiversity / Genetics	SAIAB
14	Moqebelo Morallana*	Fish Biodiversity / Genetics	SAIAB
15	Thomas de Lange Wenneck	Technician	IMR
16	Terje Hovland	Instrument Chief	IMR
17	Terje Svoren	Instrument Operator	IMR

Abbreviations :

ASCLME : Agulhas & Somali Current Large Marine Ecosystems project
SWIOFP: South West Indian Ocean Fisheries Project
IIP: Instituto Nacional de Investigação Pesqueira
INAHINA: Instituto Nacional de Hidrografiae Navegaçao
UEM : Universidade Eduardo Mondlane
UWC : University of the Western Cape
UCT : University of Cape Town
IMR: Institute of Marine Research
SAIAB: South African Institute for Aquatic Biodiversity

1.5 Narrative

The R/V Dr. Fritjof Nansen departed from Pemba on the evening of 6 August 2009 heading for the Northernmost waypoint of the pelagic survey track (Figure 1.1). The vessel arrived at the first waypoint on the morning of 7 August and worked southward until arriving at the northernmost environmental transect on the afternoon of 10 August. Work on the environmental transects and pelagic survey track continued intermittently until the southernmost waypoint of the pelagic survey track was reached on the 17 August. From 17 August to 18 August work focused on finding bottom suitable for trawling and making demersal trawl hauls. On the evening of 18 August trawling operations were stopped and a course was set for Pemba. The 19 August observations of cetaceans and seabirds were made along the course track close to shore to cover bays and inlets. On the 20 August the vessel called in Pemba and the scientific personnel left, while the vessel and crew continued on to Madagascar to pic up a new crew and scientific personnel for the continued ASCLME survey.

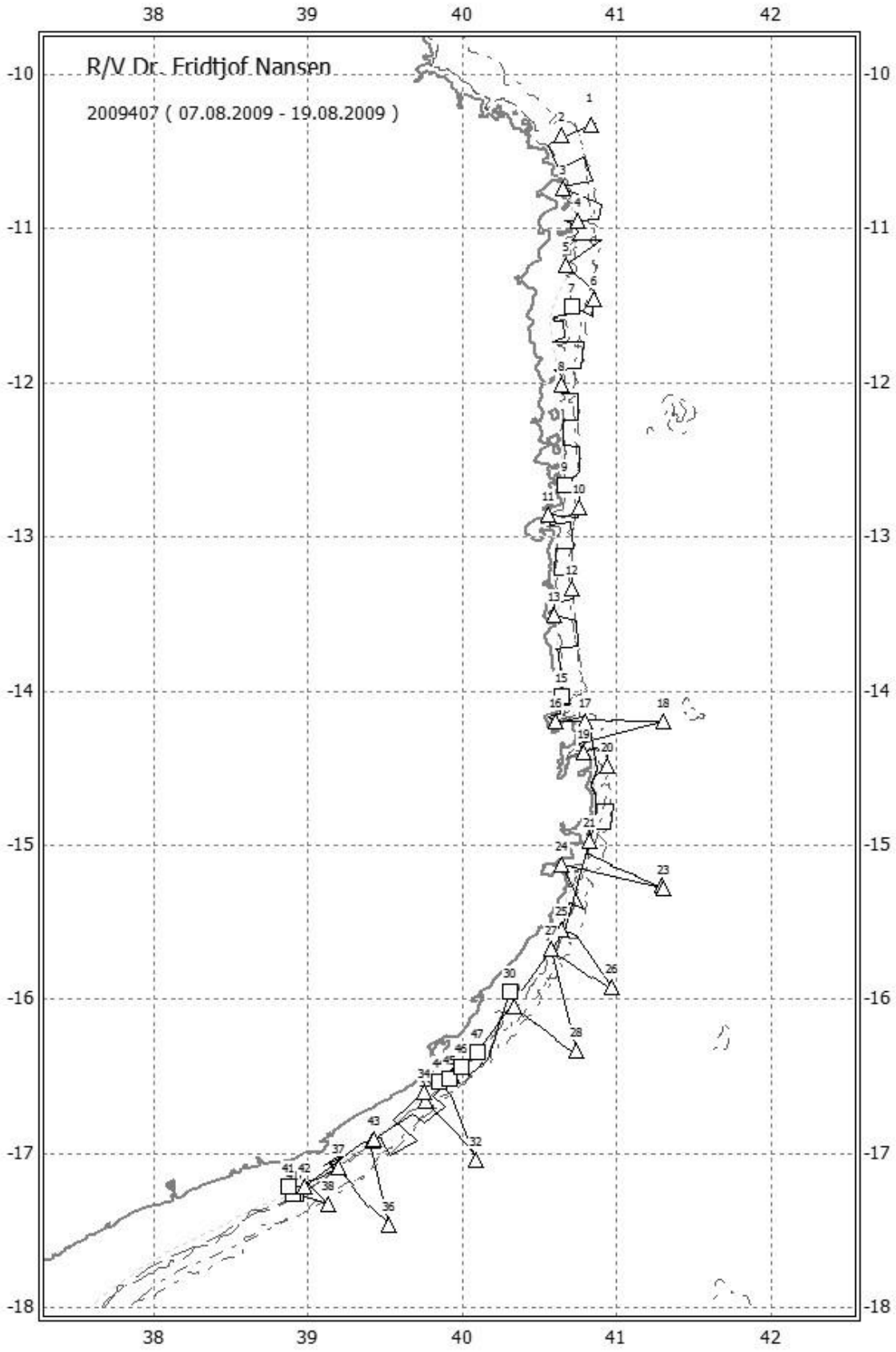


Figure 1.1 Survey track with bottom trawl (☐) and pelagic trawl (△) stations shown. The 50, 200 and 1000 meter depth contours are also shown.

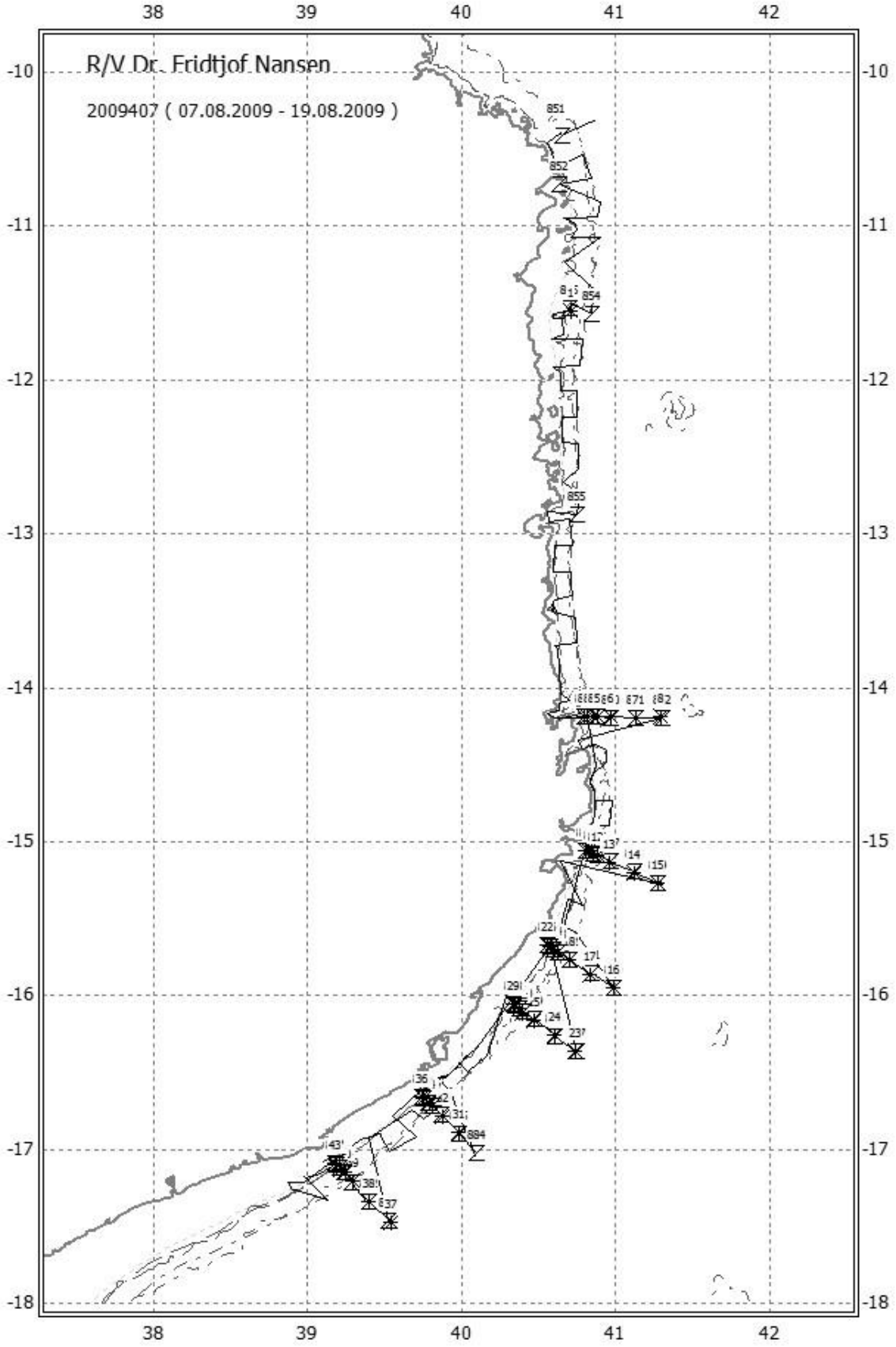


Figure 1.2 Survey track with CTD (Z) and zooplankton multinet (✳) stations. The 50, 200 and 1000 meter depth contours are also shown.

1.6 Survey effort

Table 1.2 Number of hydrographic (CTD), phytoplankton (P), zooplankton (Z), pelagic trawl (PT) and bottom trawl (BT) stations

Region	CTD	P	Z	PT	BT
Tanzania border – Pemba (10°-13°S)	5	5	1	9	2
Pemba – Mocambique (13°-15°S)	7	7	7	9	1
Mocambique – Ponta Almandia (15°-18°S)	35	35	34	18	8

2 METHODS

2.1 Meterological and hydrographical sampling

2.1.1 CTD profiles

CTD stations were taken on 6 predefined transects from the coast to deep waters from 14° - 18° S . IN addition 5 CTD casts were performed to the north of the transects (Figure 1.2) A Seabird 911 CTD plus was used to obtain vertical profiles of temperature, salinity and oxygen. Real time plotting and logging was done using the Seabird Seasave software installed on a PC. The profiles were usually taken down to a few metres above the bottom, but down to maximum of 1500 m in deeper waters at the hydrographic transects. The oxygen sensor has shown to be very stable, and no calibration was conducted during the survey. The average differences between the salinometer and CTD values have also been very small in the previous surveys and the CTD values were accepted.

Attached to the CTD was also a Chelsea flourometer of the type Mk III Aquatracka. It measures chlorophyll A in microgrammes per liter with an uncertainty of 3%. Factory slope and offset was 0.921 and -0.02.

2.1.2 Thermosalinograph

The SBE 21 Seacat thermosalinograph was running routinely during the survey, obtaining samples of sea surface salinity and relative temperature and fluorescence (5 m depth) every 10 sec. An attached in-line Turner Design SCUFA Fluorometer was continuously measuring Chlorophyll levels [RFU] at -5m below the sea surface while underway during the entire cruise. The instrument was configured with a bright blue photodiode, a 420 NM Excitation filter and a 680 NM Emission filter. It was calibrated against the secondary orange standard dye. The maximum output was equivalent to 5Volt = 100%. It had a linear temperature compensation of 2.14%/°C.

2.1.3 Current speed and direction measurement

A vessel-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments was run continuously during the survey in broadband mode shallower than about 400 m and in narrow band mode in deeper waters. The frequency of the VMADCP is 150 kHz, and data were averaged and stored in 3 m or 4 m vertical bins. All data were stored on files for post survey processing.

2.1.4 Meterological observations

Wind direction and speed, air temperature, global radiation and sea surface temperature (5 m depth) were logged automatically every nautical mile on an Aanderaa meteorological station.

2.2 Zooplankton sampling

Zooplankton samples were collected with the Hydrobios Multinet zooplankton sampler that takes up to five discrete samples at predefined depths while measuring the water flow through the net. The samples collected were rinsed into the codend and preserved with buffered formaldehyde in plastic bottles labelled with date, station number and sample depth and stored for analyses on-shore.

2.3 Biological fish sampling

The trawl catches were sampled for species composition by weight and numbers. The deck sampling procedure is described in more detail by Strømme (1992). Length measurements were taken for most target species on most stations. The Electronic Fish Meter (SCANTROL) coupled to windows version computer software (Nansis) was used for length measurement. The total length of each fish was recorded to the 1 cm below. The carapace length was measured to the 0.1 cm below for shrimp. Basic information recorded at each fishing stations, i.e. trawl hauls, is presented in Annex 2. Pooled length frequency distributions, raised to catch per hour, of selected species by area are shown in Annex 3.

2.4 Multibeam echosounder for bottom mapping

The EM 710 multibeam echo sounder is a high to very high-resolution seabed mapping system. Acquisition depth is approximately 3 m below the transducers, and the maximum acquisition depth is in practice limited to 1500 m on Dr. Fridtjof Nansen. Across track coverage (swath width) is up to 5.5 times water depth and may be limited by the operator either in angle or in swath width without reducing the number of beams. The operating frequencies are between 70 to 100 kHz. The numbers of beams are 128 with dynamic focusing employed in the near field. The transmitting fan is divided into three sectors to maximize range capability and to suppress interference from multiples of strong bottom echoes. The sectors are transmitted sequentially within each ping, and uses distinct frequencies or waveforms. The along-track beam width is 1 degree. Ping rate is set manually according to depth. The receiving beam width is 1 degree.

2.5 Acoustic Abundance estimation

A SIMRAD ER 60 Echo sounder was used and the echograms were stored on files. The acoustic biomass estimates were based on the integration technique. The Large Scale Survey System (LSSS) from MAREC was used for integration and allocation of the integrated s_A-values (average area back scattering coefficient in m^2/NM^2) The splitting and allocation of the integrator outputs (s_A-values) was based on a combination of a visual scrutiny of the behaviour pattern as deduced from echo diagrams, LSSS analysis and the catch composition. Previous surveys have shown that the recordings occur in widreaching distinct layers with little acoustic backscattering. In addition these layers were mixed so differentiation by species purely by examining the acoustic recordings and trawl catches was difficult. Pascal Cotel of IRD analyzed the acoustic data from the 2008 Mozambique Channel survey in detail and gave advice on how to define the layers and threshold for different categories of species:

The water column was split, regarding the diel changes, as followed :

- one surface layer, from 0 to 150 m (phyto+juveniles by day)-one mid layer, from 150 to 375 m (schools of myctophids and cubiceps by day, top of the DSL included)
- one deep layer, from 375 to 1000 m (part of the DSL relatively stable with myctophids and cubiceps)

Based on multispecies processing of all four channels (18, 38, 120 and 200khz, using Movies+ software) Cotel suggest using the following threshold levels:

-55.2 dB and up: fish

-57.5 to -55.2 dB: micronekton (juveniles, etc)

-63 to -57.5 dB: macrozooplankton, fish larvae

-80 to -63 dB: mesozooplankton

We did not differentiate between macro- and mesozooplankton, so all zooplankton were categorized based on a -57.5 dB threshold.

The mean integrator value in each sampling unit (s_A-values) was divided between the following standard categories/groups of fish: Pel 1 (Clupeoid species), Pel 2 (Carangids, Scombrids and associated pelagic), Dem (Demersal species, Meso (Meseopelagic species), Plank (Plankton).

The following target strength (TS) function was applied to convert s_A-values (mean integrator value for a given area) to number of fish (sardinella, anchovy, Pel 2):

$$TS = 20 \log L - 72 \, dB \qquad (1)$$

or in the form

$$C_F = 1.26 \cdot 10^6 \cdot L^{-2} \qquad (2)$$

where L is the total length and C_F is the reciprocal back scattering strength, or the so-called fish conversion factor. Generally, in order to split and convert the allocated s_A-values (m^2/NM^2) to fish densities (number per length group per NM^2) the following formula was used

$$N_i = A \cdot s_A \cdot \frac{p_i}{\sum_{i=1}^{n} \frac{p_i}{C_{Fi}}} \qquad (3)$$

where: N_i = number of fish in length group i

A = area (NM^2) of fish concentration

s_A = mean integrator value (echo density) in area A (m^2/NM^2)

p_i = proportion of fish in length group i in samples from the area
C_{Fi} = fish conversion factor for length group i

$$N = \sum_{i=1}^{n} N_i \qquad (4)$$

Further, the traditional method is to sum the number per length group (N_i) to obtain the total number of fish:

The length distribution of a given species within an area is computed by simple adding of the length frequencies obtained in the pelagic trawl samples within the area. In the case of co-occurrence of target species, the s_A value is split in accordance with length distribution and catch rate in numbers in the trawl catches. Biomass per length group (B_i) is estimated by applying measured weights by length (W_i) when available or theoretical weights (calculated by using condition factors), multiplied with number of fish in the same length group (N_i). The total biomass in each area is obtained by summing the biomass of each length group:

$$B = \sum_{i=1}^{n} N_i \overline{W}_i \qquad (5)$$

The number and biomass per length group in each concentration are then added up to obtain totals for each region.

However, the combination of low s_A value recorded, few PEL1 and PEL2 in the bottom trawl catch and few pelagic trawls made the splitting by length groups unreliable. Therefore, a theoretic mean length of 23.5 cm was used to convert the s_A values by stratum (Equation 3) to number of fish. Equation 5 was used to convert the number of fish in the defined average length class (23.5 cm) to total estimated biomasses of PEL1 and PEL2.

2.6 Visual observations of cetaceans and seabirds

During 19 August two dedicated observers were on watch from 06:10 to 17:38 registering all cetaceans and seabirds as the vessel followed the coast northwards to Pemba. Every two hours the observers were changed so concentration could be kept. The observers were stationed on the wheelhouse roof and each observer made naked-eye observations in a 90° arc from the bow and to either side. Animals were registered based on the first sighting and time, position, species, group number were recorded in a form.

3 OCEANOGRAPHIC CONDITIONS

3.1 Hydrographic sections

All transects (Figure 3.1-3.6) exhibited stratified waters from the coast offshore, with no major sloping isotherms along the shelf being observed. On the same transect a subsurface salinity maximum was observed, which proved to be present in all transects. Contrary to temperature and salinity, more variation was observed in the dissolved oxygen and fluorescence values along the different transects. Generally an oxygen maximum existed throughout the transects at an averge depth of 400m, but this was less prominent in transects 4 and 6. In transect 4 the usual values associated with the oxygen maximum where only present in the last station (4.6), furthest offshore. In Transect 6 the associated values where only found in station 5 on that transect (6.5). Fluorescence, restricted to the top 150m in the graphs, showed to be inconsistant from station to station with different flourescence maximum values observed at different depths. This could prove for interesting analysis with repsect to potential temporal changes affecting the fluorescence maximum values through out the day.

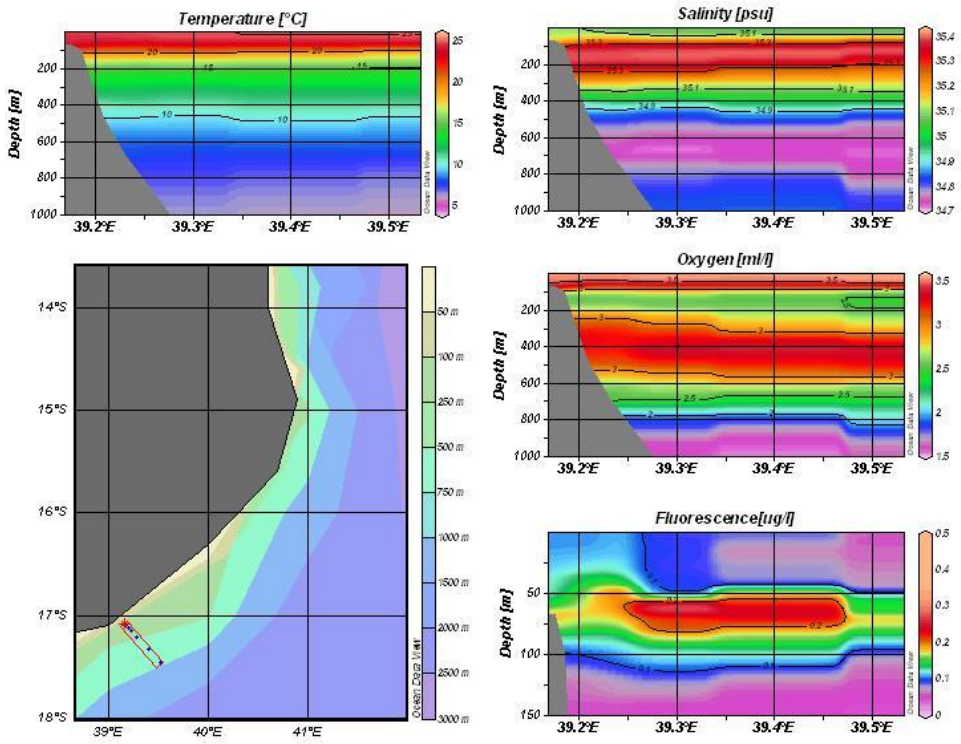


Figure 3.1 Temperature, salinity, dissolved oxygen and fluorescence observed on Transect 1

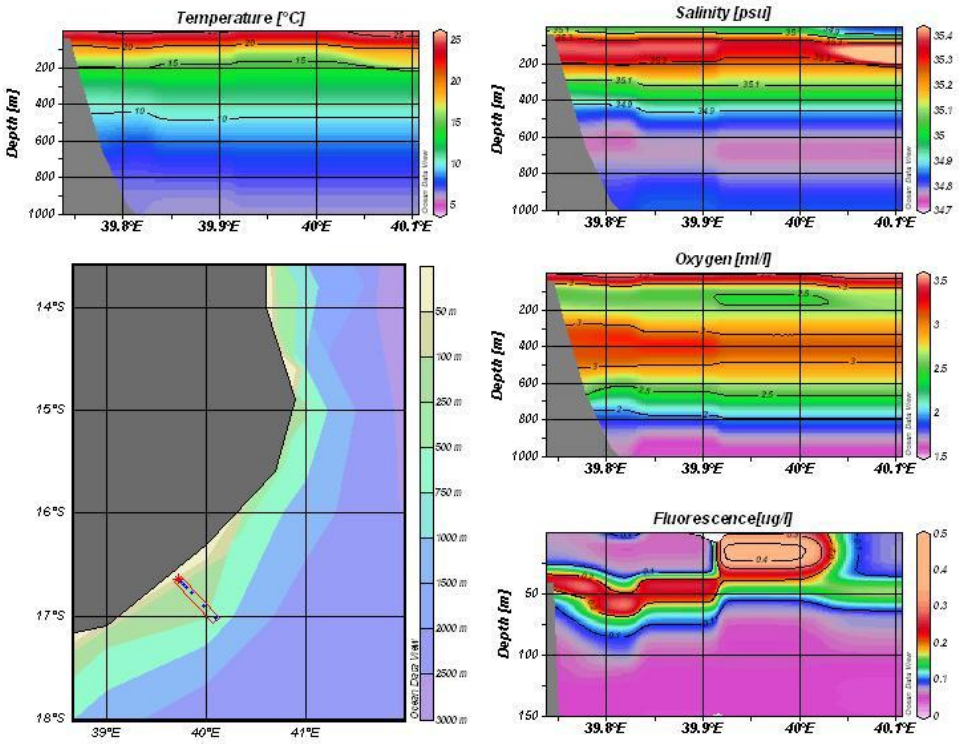


Figure 3.2 Temperature, salinity, dissolved oxygen and fluorescence observed on Transect 2

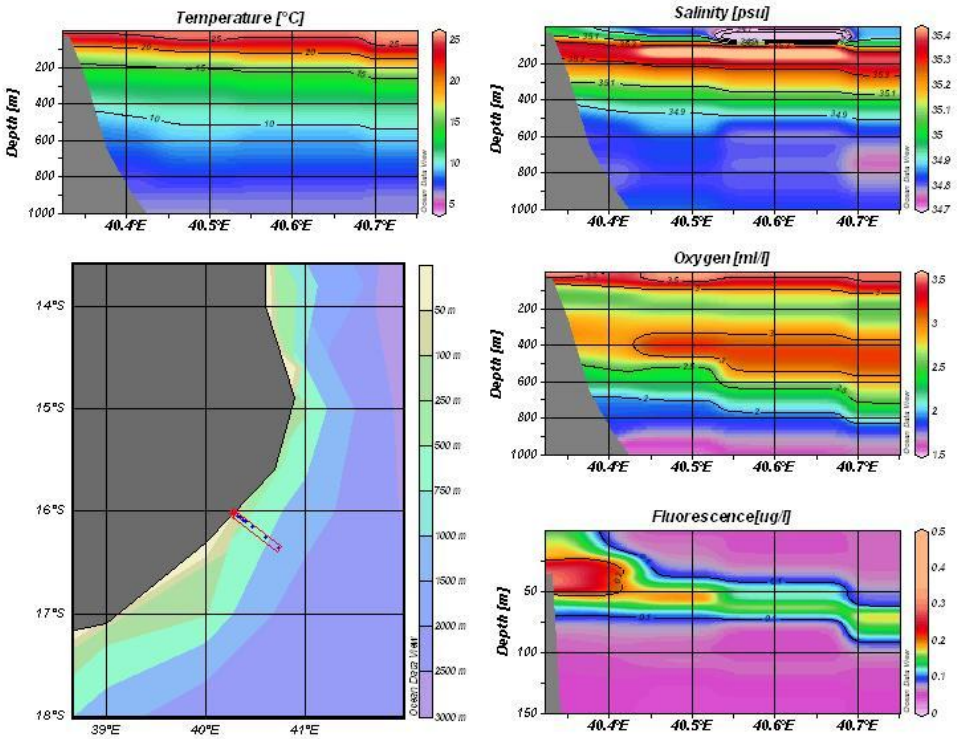


Figure 3.3 Temperature, salinity, dissolved oxygen and fluorescence observed on Transect 3

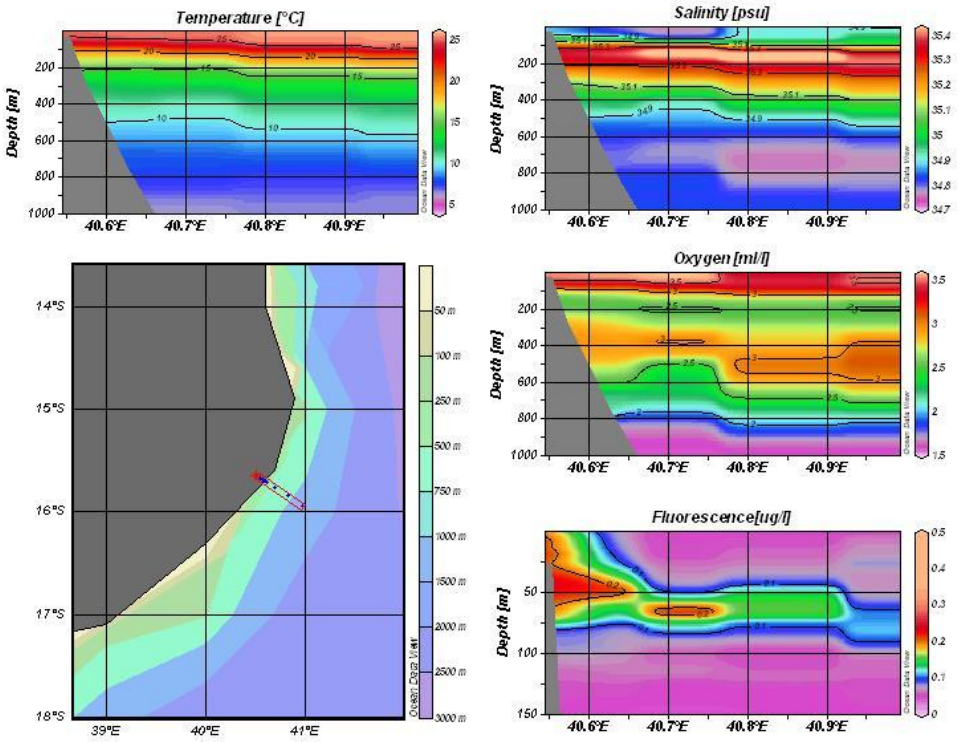


Figure 3.4 Temperature, salinity, dissolved oxygen and fluorescence observed on Transect 4

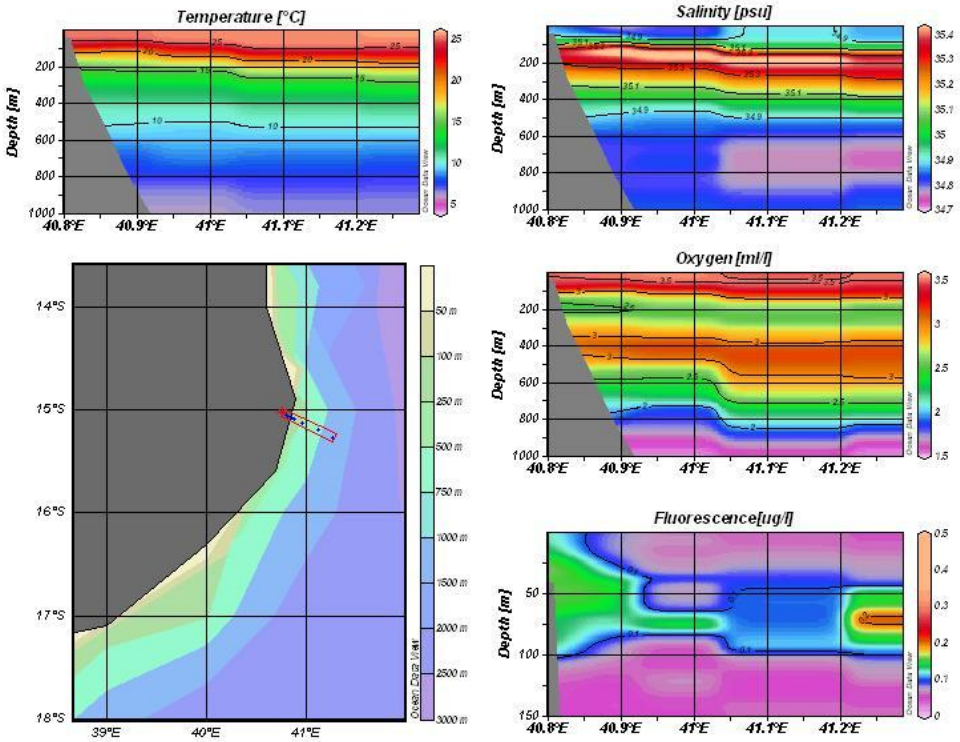


Figure 3.5 Temperature, salinity, dissolved oxygen and fluorescence observed on Transect 5

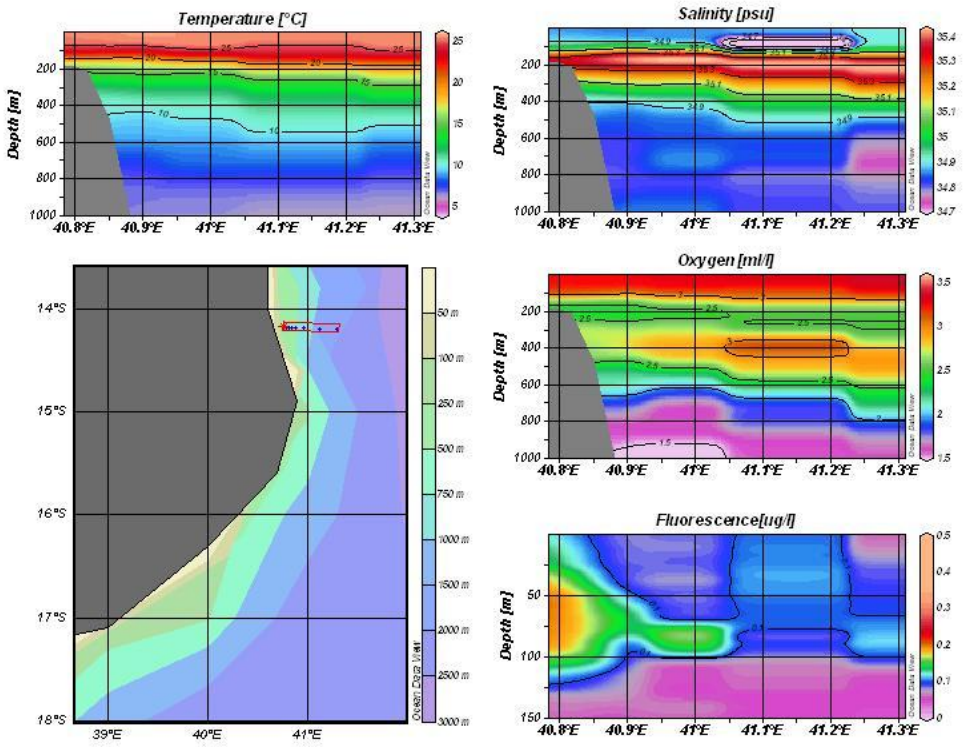


Figure 3.6 Temperature, salinity, dissolved oxygen and fluorescence observed on Transect 6

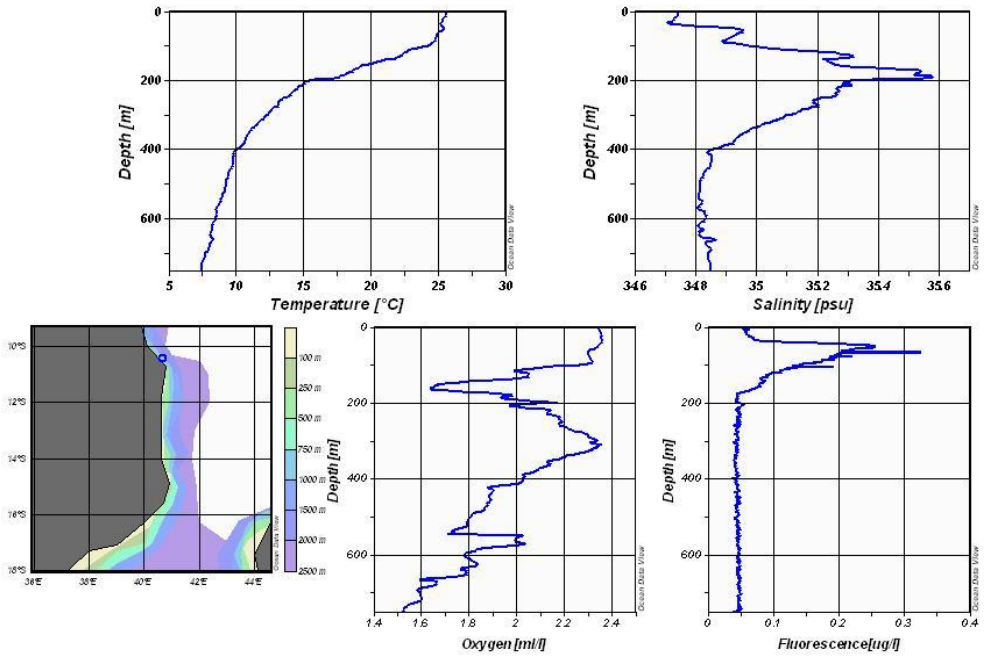


Figure 3.7 Vertical profiles of temp., salinity, dissolved O^2 and fluorescence at the northern most station

Figure 3.7 shows vertical profiles of temperature, salinity, dissolved oxygen and fluorescence. No temperature inversion was evident, with values decreasing steadily from 25.6°C at the surface to 7.5°C at 750m depth. A salinity maximum is observed at 180m depth with values of 35.5 psu. The dissolved oxygen trace exhibited minima and maxima at 156m and 311m respectively in the upper 500m, with associated values of 1.65ml/l and 2.35ml/l. A fluorescence maxima of 0,2221 ug/l was observed at 78m depth

3.2 Sea Surface temperature

Moving southwards along the coast of Mozambique a gradual decrease in temperature as well as increase in salinity and dissolved oxygen where observed, highlighting the dynamic oceanographic environment present in this region. North of 15°S the sea surface temperature was in excess of 25.5°C, whereas further south, south of 17°S, the temperature was below 25°C. Salinity values where higher in the southern regions, consistent with results found in previous hydrographic surveys of this region. Along transect 4 and 5 in the northern half of the surveyed region, the lowest recorded surface salinity values of 35.8 psu and lower were found inshore between 15° and 16°S. Surface oxygen values only showed low values of below 3.4ml/l in the northern most transect, transect 6, with all transects to the south of it showing homogenous characteristics at around 3.5ml/l. Fluorescence showed no real organisation in its surface extent, with transect 2 and inshore stations of transect 3 and 4 having the highest values of over 1ug/l. All other stations were below 1ug/l.

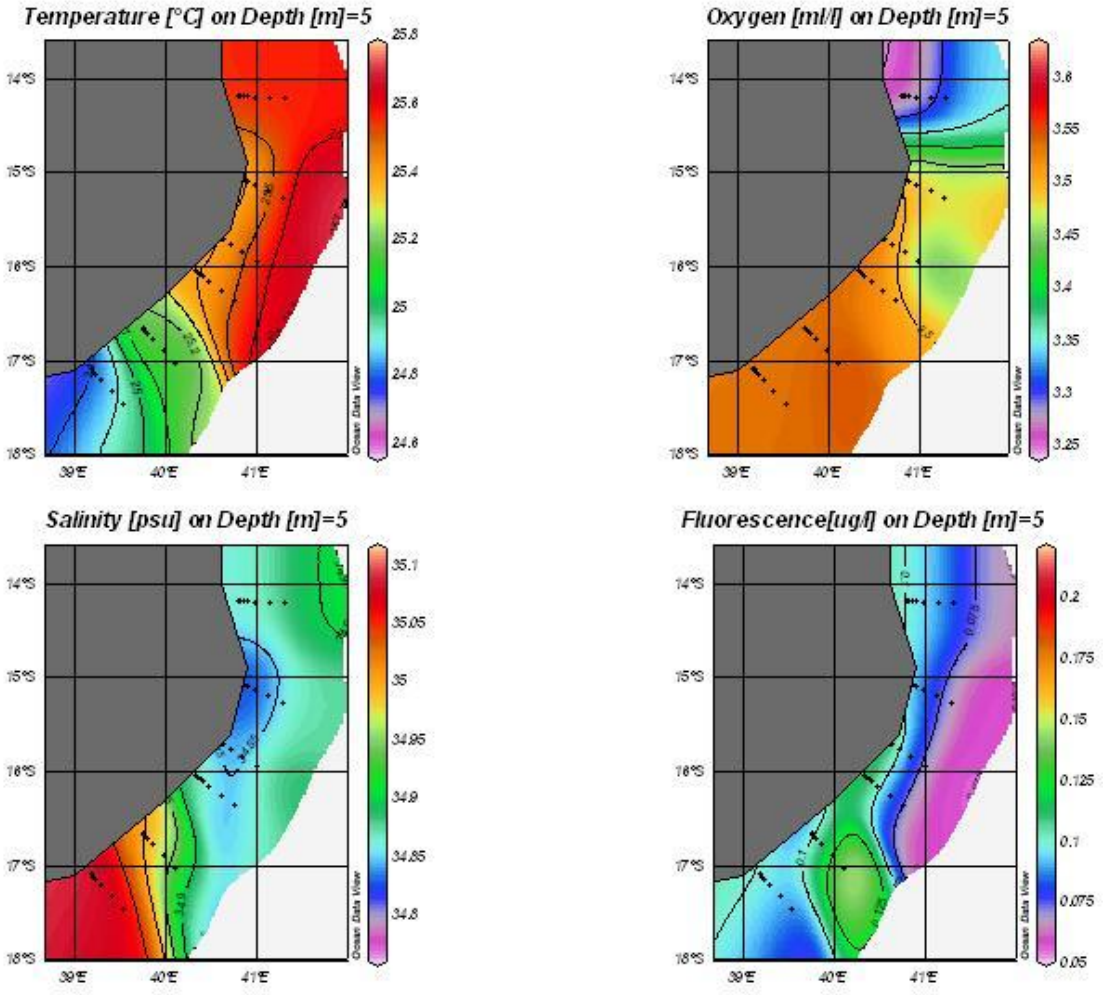


Figure 3.8 Temperature, salinity, dissolved oxygen and fluorescence observed at 5m along all transects

4 RESULTS FROM THE ACOUSTIC SURVEY

The hydroacoustic survey covered the shelf and slope to about 2500 m bottom depth. Continuous acoustic recording and analysis was carried throughout the survey. Pelagic trawling was carried out for pelagic species identification, mainly during dark hours, either as random blind trawl hauls close to the surface with pelagic trawl equipped with large floats, or on registrations. In addition blind hauls surface hauls were made at intervals and at the start and end of each environmental transect to determine the distribution and species composition of juvenile fish. The highest acoustic densities where found over the shelf and shelf break while further out the recordings were lower and the catches more dominated by plankton and mesopelagic fish towards deeper waters. The dispersed fish distribution and high abundance of plankton made acoustic detection and separation very difficult, and thresholding according to the Cotel methods described in 2.5 were used. Acoustic estimate

The acoustic estimates for the pelagic species groups PEL 1 (*Clupeidae)* and PEL 2 (*Carangidae*, *Sphyraenidae*, *Trichiuridae* and *Scombridae*) are shown in Table 4.1 and Table 4.2. The present PEL 1 and PEL 2 biomass estimates are 6.1× and 3.5× higher than the estimate presented in the 2007 Ecosystem Survey report for the whole Mozambique coast.

Table 4.1 Acoustic estimate of *Clupeidae* (PEL 1 acoustic category)

N (millions)	1064.2
Biomass (‘000 t)	121.5

Table 4.2 Acoustic estimate of *Carangidae*, *Sphyraenidae*, *Trichiuridae* and *Scombridae* (PEL 2 acoustic category)

N (millions)	1044.6
Biomass (‘000 t)	119.3

The differences between the 2007 and present survey acoustic estimates should not be taken as indications of large increases in species abundance. During the present survey new methods for analyzing and interpreting the acoustic data were used and these methodological differences are probably the major cause in the differences in abundance between 2007 and 2009.

4.1 Distribution and acoustic densities

Pelagic species were observed both acoustically and in trawl catches along the whole survey track. The PEL 1 group (Figure 4.1) was observed from 10° -13° 30’S, then from 14° S to the end of the survey. In 2007 no PEL 1 was observed in this region. The main distribution was over the shelf, but PEL1 were also observed over deeper (>1000m) waters.

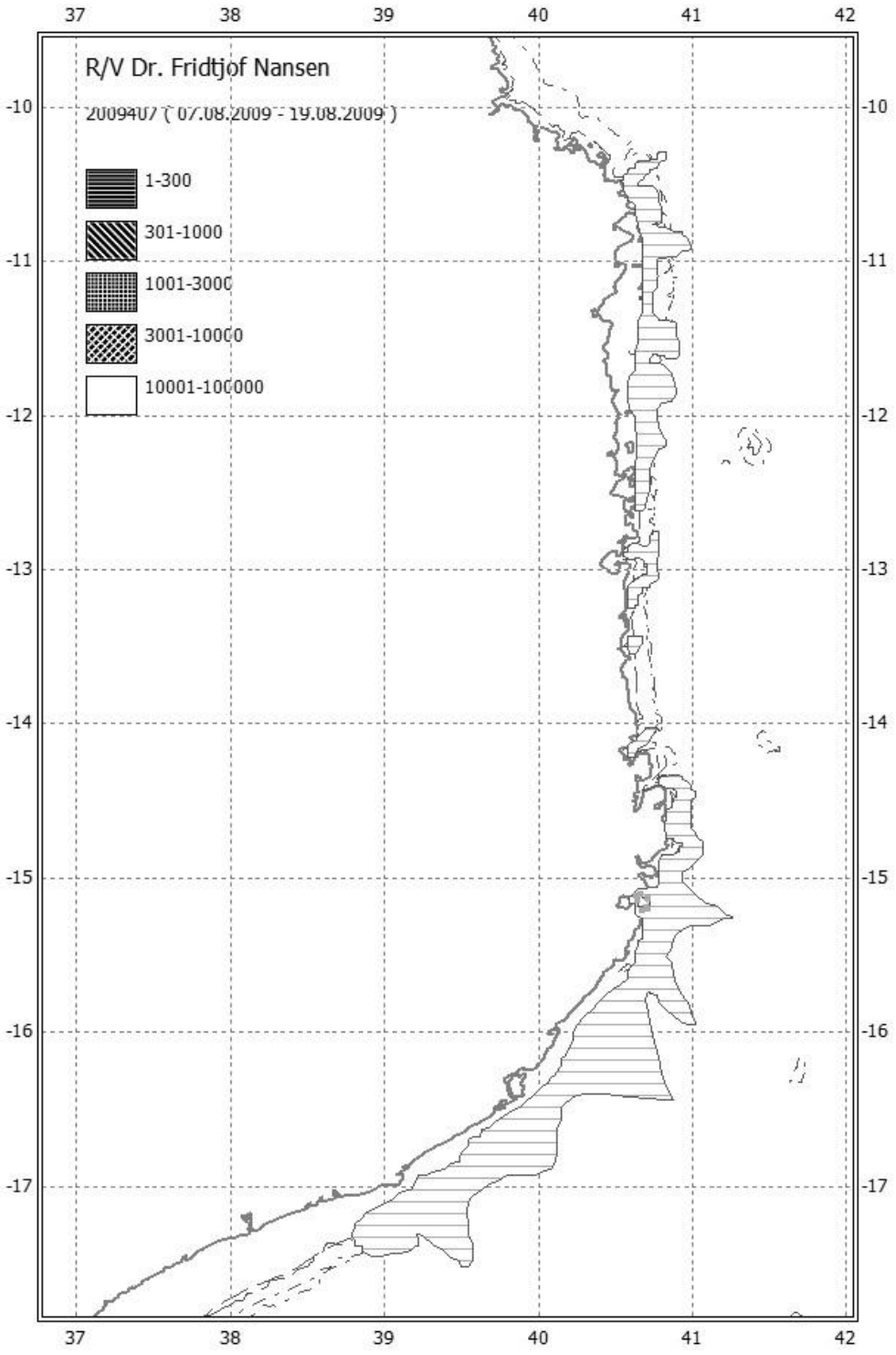


Figure 4.1 Distribution of the PEL 1 acoustic category (*Clupeidae).* The 50, 200 and 1000m depth contours are shown.

The PEL 2 group (*Carangidae*, *Sphyraenidae*, *Trichiuridae* and *Scombridae*) were found from 11° 30'S to the southern end of the survey (Figure 4.2). The main distribution area was over the shelf and shelf break, bu like the PEL 1 group the distribution extended into deeper (>1000m) waters. Compared to the 2007 survey the distribution was wider and extended further to the north.

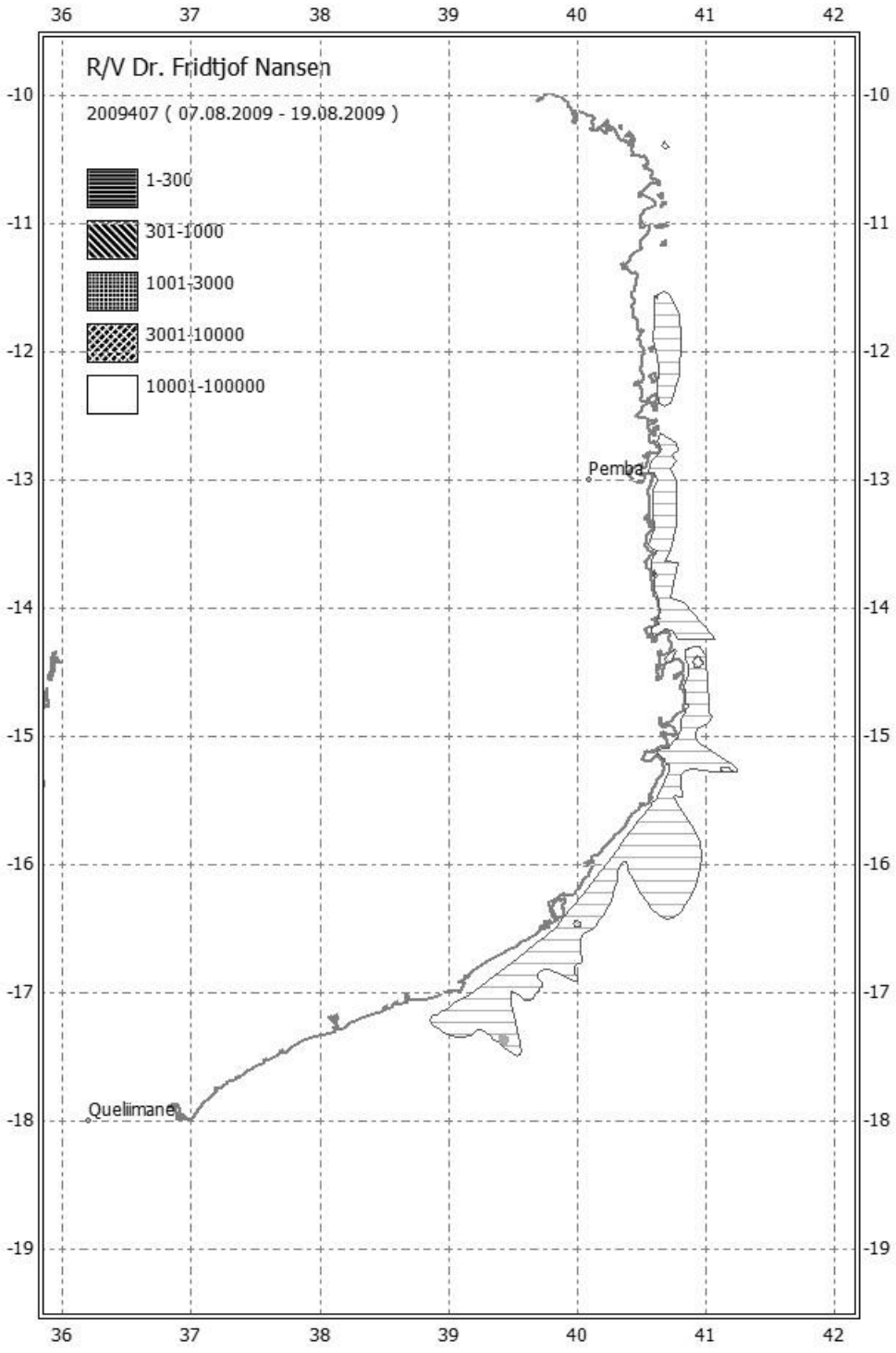


Figure 4.2 Distribution of the PEL 2 acoustic category (*Carangidae*, *Sphyraenidae*, *Trichiuridae* and *Scombridae).* The 50, 200 and 1000m depth contours are shown.

5 RESULTS FROM ZOOPLANKTON INVESTIGATIONS

Zooplankton was sampled at 42 stations using the multinet. The multinet was deployed after measuring the fluorescence profile using the fluorometer mounted on the CTD rosette. Nets were

deployed at different depths above and below the depth of highest fluorescence: two above f-max, one through f-max, two below f-max.

Samples for the multinet have been preserved in formalin solution but not analyzed in any way. Therefore no results from the zooplankton investigations can be reported in this preliminary survey report.

6 RESULTS FROM BIODIVERSITY STUDIES AND BOTTOM MAPPING

6.1 Species groups

During the survey a total of 213 species were identified. The fish species caught are grouped according to functional groups in Table 6.1

Table 6.1 List of fish species caught in the pelagic and demersal trawl hauls during the survey grouped by Family and functional groups

Groups	Family	*Taxon*
Demersal	Acropomatidae	*Synagrops japonicus*
	Argentinidae	*Argentina euchus*
	Ariommatidae	*Ariomma indica*
		Ariomma sp.
	Bothidae	*Bothus sp.*
		Bothus swio
		Laeops pectoralis
		Taeniopsetta ocellata
	Caesionidae	*Caesio caerulaurea*
		Dipterygonotus balteatus
		Gymnocaesio gymnoptera
	Caproidae	*Antigonia cf rubescens*
	Chauliodontidae	*Chauliodus minimus*
	Chaunacidae	*Chaunax sp.*
	Chlorophthalmidae	*Chlorophthalmus agassizi*
	Clupeidae	*Amblygaster sirm*
		Dussumieria acuta
		Pellona ditchela
		Sardinella gibbosa
	Congridae	*Ariosoma anago*
		Ariosoma sp.
		Bathyuroconger vicinus
	Cynoglossidae	*Cynoglossus attenuatus*
	Dactylopteridae	*Dactyloptena peterseni*
	Drepaneidae	*Drepane longimana*
		Drepane punctata
	Fistulariidae	*Fistularia petimba*
		Fistularia sp.
	Haemulidae	*Plectorhinchus gibbosus*
		Pomadasys kaakan
		Pomadasys maculatus

	Pomadasys multimaculatum
	Pomadasys sp.
	Pomadasys stridens
Lethrinidae	*Gnathodentex aurolineatus*
	Gymnocranius griseus
	Gymnocranius robinsoni
	Lethrinus lentjan
	Lutjanus argentimaculatus
	Lutjanus lutjanus
	Lutjanus sanguineus
	Lutjanus sp.
	Pristipomoides filamentosus
Melanostomiidae	*Bathophilus nigerrimus*
Menidae	*Mene maculata*
MONACANTHIDAE	*Aluterus monoceros*
	Cantherhines fronticinctus
	Paramonacanthus pusillus
	Thamnaconus fajardoi
	Thamnaconus modestoides
Monocentridae	*Monocentris japonicus*
Mullidae	*Mullidae 'RoundheadLateralspot*
	Parupeneus heptacanthus
	Upeneus bensasi
	Upeneus moluccensis
	Upeneus sp.
	Upeneus sulphureus
	Upeneus vittatus
Muraenidae	*Muraenesox bagio*
Nemichthyidae	*Nemichthys curvirostris*
Nemipteridae	*Nemipterus bipunctatus*
NETTASTOMATIDAE	*NETTASTOMATIDAE*
Ogococephalidae	*Halieutaea fitzsimonsi*
	Halieutaea spicata
Ostraciidae	*Ostracion cubicus*
	Ostracion meleagris
	Tetrosomus concatenatus
Paralepididae	*Lestidiops jayakari*
	Lestrolepis intermedia
Phosichthyidae	*Polymetme corythaeola*
Platycephalidae	*Cociella crocodila*
	Platycephalus indicus
Pleuronectidae	*Paralichthodes sp.*
Polynemidae	*Polynemus plebeius*
	Polynemus sextarius
Pomacanthidae	*Pomacanthus imperator*
Priacanthidae	*Priacanthus hamrur*
Psettodidae	*Psettodes erumei*
REGALECIDAE	*REGALECIDAE*

	SCARIDAE	*SCARIDAE*
		Scarus sp.
	Sciaenidae	*Argyrosomus inodorus*
		Atrobucca nibe
		Johnius dussumieri
		Otolithes ruber
	SCORPAENIDAE	*Apistus carinatus*
		Pterois miles
		Pterois russelii
		Scorpaena scrofa
		SCORPAENIDAE
	Serranidae (groupers)	*Anthias sp.*
		Epinephelus caninus
		Epinephelus tauvina
	Sillaginidae	*Sillago sihama*
	Sparidae (Seabreams)	*Argyrops filamentosus*
		Argyrops spinifer
		Chrysoblephus puniceus
		Pagellus natalenses
		SPARIDAE
	Sternoptychidae	*Argyropelecus aculeatus*
	Syngnathidae	*Hippocampus histrix*
		Hippocampus whitei
		Saurida tumbil
		Saurida undosquamis
	Tetraodontidae	*Arothron hispidus*
		Lagocephalus guntheri
		Lagocephalus lagocephalus
		Lagocephalus sceleratus
		Lagocephalus sp.
		Tylerius spinosissimus
	Trichiuridae	*Trichiurus lepturus*
	Triglidae	*Lepidotrigla alcocki*
	Uranoscopidae	*Uranoscopus archionema*
Pelagic	Acanthuridae	*Acanthurus sp.*
	Apogonidae	*Apogon cf. quadrifasciatus*
		Apogon quadrifasciatus
		Apogon sp.
		Apogon'pale-stripe'
		Epigonus robustus
	Ariidae	*Arius dussumieri*
	Balistidae	*Abalistes stellatus*
	Bramidae	*Brama orcini*
	Bregmacerotidae	*Bregmaceros sp.*
	Carangidae	*Alepes djedaba*
		Alepes kleinii
		Atule mate
		CARANGIDAE

	Carangoides armatus
	Carangoides cf. malabaricus
	Carangoides dinema
	Carangoides ferdau
	Carangoides malabaricus
	Caranx (Caranx) sexfasciatus
	Decapterus kurroides
	Decapterus macarellus
	Decapterus macrosoma
	Decapterus russelli
	Decapterus tabl
	Naucrates ductor
	Selar crumenophthalmus
Caristiidae	*Caristius groenlandicus*
Chirocentridae	*Chirocentrus dorab*
	Chirocentrus nudus
DIODONTIDAE	*DIODONTIDAE*
	Lophodiodon calori
Echeneidae	*Echeneis naucrates*
ENGRAULIDIDAE	*Encrasicholina punctifer*
	ENGRAULIDIDAE
	Engraulis cf capensis
	Stolephorus indicus
	Stolephorus sp.
	Thryssa vitrirostris
Gempylidae	*Promethichthys prometheus*
	Rexea prometheoides
Grammicolepidae	*Xenolepidichthys dalgleishi **
Hemiramphidae	*Hemiramphus far*
Leiognathidae	*Gazza minuta*
	Leiognathus elongatus
	Leiognathus equulus
	Leiognathus sp.
	Secutor insidiator
Microstomatidae	*Microstoma microstoma*
MYCTOPHIDAE	*Diaphus cf. thiollieri*
	Diaphus effulgens
	Diaphus sp.
	Electrona risso
	MYCTOPHIDAE
Nomeidae	*Cubiceps pauciradiatus*
	Cubiceps sp.
	Cubiceps whitleggi
Polymixiidae	*Polymixia berndti*
Scombridae (mackrels)	*Rastrelliger kanagurta*
	Scomberomorus commerson
	Scomberomorus plurilineatus
	Scomberoides tol

		Seriola dumerili
	Sphyraenidae (baracuda)	*Sphyraena acutipinnis*
		Sphyraena barracuda
		Sphyraena chrysotaenia
		Sphyraena flavicauda
		Sphyraena forsteri
		Sphyraena jello
		Sphyraena putnamie
		Sphyraena sp.
Shrimp		*Metapenaeus monoceros*
		Metapenaeus sp.
		PENAEIDAE
		Penaeus indicus
		Penaeus semisulcatus
		Penaeus sp.
Cephalopods		*Argonauta sp.*
		Loligo duvauceli
		Loligo forbesi
		Loligo sp.
		Loligo vulgaris
		Ommastrephes bartrami
		Sepia australis
		Sepia sp.
Rays and sharks		*Carcharhinus falciformis*
		Carcharhinus sorrah
		Carcharhinus sp.
		Galeorhinus galeus
		Heteronarce garmani
		Mobula sp.
		Raja lanceorostrata
		Sphyrna lewini

Pelagic trawl catches of fish were grouped according to fish depth of the trawl (Table 6.2). In the surface layer the 'Other' and 'Scombrids' groups dominated due to one or two very large catches. Down to 20 meters the 'Other' group still dominated but here hairtails as the second most important.

At 20-100 meters Clupeids were the dominant group with one catch 10× as large as the second largest. Deeper than 100 meters the mesopelagic fish dominated, although the catch rates were less than closer to the surface.

Table 6.2 Pelagic trawl catches grouped according to the fishing depth of the trawl (kg/hour trawling)
Trawl depth interval: Surface
Number of stations: 15

Station	Gear depth	Barracuda	Carangids	Cephalopods	Clupeoids	Hairtails	Mesopelagic	Scombrids	Other	Total
1	0	0	0	0	0	0.1	0	0	0.1	0.2
4	0	0	0	0.2	3.4	0	0.4	0	0.4	4.4
5	0	0	0	0.2	0	0	0	0	0.1	0.3
8	0	0	0	0	0	0	0	0	0	0.1
18	0	0	0	0	0	0.2	0	0	0.2	0.4
19	0	0	0	0	0	0	0	0	0.1	0.1
21	0	0	0	0.8	0	0	0.4	0	0.3	1.5
22	0	0	0	0	0.2	0	0	0	0.5	0.7
25	0	0	0	0.5	0	0	0.1	0	1.3	1.9
29	0	0	0	0.1	0	0	0	0	0.2	0.4
35	0	10.1	8.2	3.3	1.4	1.3	2	39.6	40.2	106.2
36	0	0	0.6	0.1	0	0.1	0	0	0.5	1.3
37	0	3.2	1	0.5	0.1	0.2	1.5	0.4	102.9	109.9
38	0	0	0.2	0.1	0	0	0	0	2.4	2.8
43	0	5.6	9.7	1.6	16.2	1.6	12.8	2.4	7.1	56.8
Sum		**18.9**	**19.7**	**7.4**	**21.3**	**3.5**	**17.2**	**42.4**	**156.3**	**287**

Trawl depth interval: 0 - 20 meter

Number of stations: 15

Station	Gear depth	Barracuda	Carangids	Cephalopods	Clupeoids	Hairtails	Mesopelagic	Scombrids	Other	Total
16	5	0	0	0	0	0	0	0	0.2	0.2
11	10	3.4	12.1	0.5	1.4	0.3	12	0	34.1	63.9
12	10	0.2	0	0.1	0.2	0	0.1	0	0.3	0.9
14	10	0	0	0	0	0	0.1	0	0	0.1
17	10	0.9	0	0.1	0	0	0.1	0	0	1.1
24	10	0.4	1.6	0.6	13.9	0.3	0.2	0	9.9	27
26	10	0	0.1	0.2	0	0	0	0.1	1.5	1.9
27	10	2.4	0.2	0.1	0.1	0	13.1	0	0.7	16.5
28	10	0	0	0.7	0	0	1.7	0	9.4	11.7
32	10	0	0	1.2	0	0	0	0	2.2	3.4
33	10	1.5	3.8	1	0.3	0	0	0	73.4	80
34	10	6.1	16.5	0	9.9	39.7	0	0	13.4	85.6
42	10	16.7	0	0.9	32.3	144.6	0	0	62.3	256.8
31	18.5	84.6	155.7	2.7	4.2	17.1	27.2	0	110.3	401.8
20	20	0	0	0	0	0	0.4	0	7.4	7.8
Sum		**116.2**	**190**	**8.1**	**62.3**	**202**	**54.9**	**0.1**	**325.1**	**958.7**

Trawl depth interval: 20 - 100 meter

Number of stations: 3

Station	Gear depth	Barracuda	Carangids	Cephalopods	Clupeoids	Hairtails	Mesopelagic	Scombrids	Other	Total
3	30	0	0	0	73.8	0	0	0	0	73.8
2	88	0	0	0	0	0	0	0	0.2	0.3
13	90.5	2	6.3	1.5	1	0.5	0.2	0	6.9	18.4
Sum		**2**	**6.3**	**1.5**	**74.8**	**0.5**	**0.2**	**0**	**7.1**	**92.5**

Trawl depth interval: 100 - 500 meter

Number of stations: 3

Station	Gear depth	Barracuda	Carangids	Cephalopods	Clupeoids	Hairtails	Mesopelagic	Scombrids	Other	Total
23	170	0	0	0.3	0	0	1.7	0	1.1	3.1
6	200	0	0	0	0	0	0.1	0	0.1	0.2
10	478	0	0	0	0	0	0.1	0	0.2	0.3
Sum		**0**	**0**	**0.3**	**0**	**0**	**1.9**	**0**	**1.4**	**3.6**

Trawl depth interval: Surface - 500 meter

Number of stations: 36

Station	Gear depth	Barracuda	Carangids	Cephalopods	Clupeoids	Hairtails	Mesopelagic	Scombrids	Other	Total
Total		**137.1**	**216**	**17.3**	**158.4**	**206**	**74.2**	**42.5**	**489.9**	**1341.8**

6.2 Length distribution by species

Length distribution for all species are shown in Annex 3.

6.3 SAIAB Fish Biodiversity, Taxonomy and Genetic sampling

Samples of various families with specific interest and reference being given to selected groups such as the rays and skates were collected from the trawls. Each specimen was measured, photographed, genetic samples taken as well as voucher specimens. A total of around 650 individual voucher specimens were taken along with around 70 DNA samples, of which 60 juvenile specimens were selected and preserved for DNA bar coding. Photographs were taken as a reference to voucher specimens and genetic samples. All samples will be reexamined and identified at The South African Institute for Aquatic Biology for fish biodiversity and taxonomy of the Northern Mozambique area. All voucher specimens, genetic samples and images will be placed in the SAIAB national fish collection for further studies and use internationally.

7 AREAS WITH TRAWLABLE BOTTOM

No-one onboard had the necessary skills to process multibeam data. Also, a proper multibeam survey needed dedicated coverage where the same area was systematically surveyed with overlap between multibeam transect lines. This would be similar to the multibeam mapping conducted during the special studies of the 2007 survey in Mozambique waters. This would be very time-consuming and a proper multibeam survey was therefore not given priority. Instead the multibeam data were only used qualitatively by the ships crew to identify trawlable bottom (see example in). Screen shots of the bottom topography of all areas where bottom trawling was carried out is shown in Annex 4.

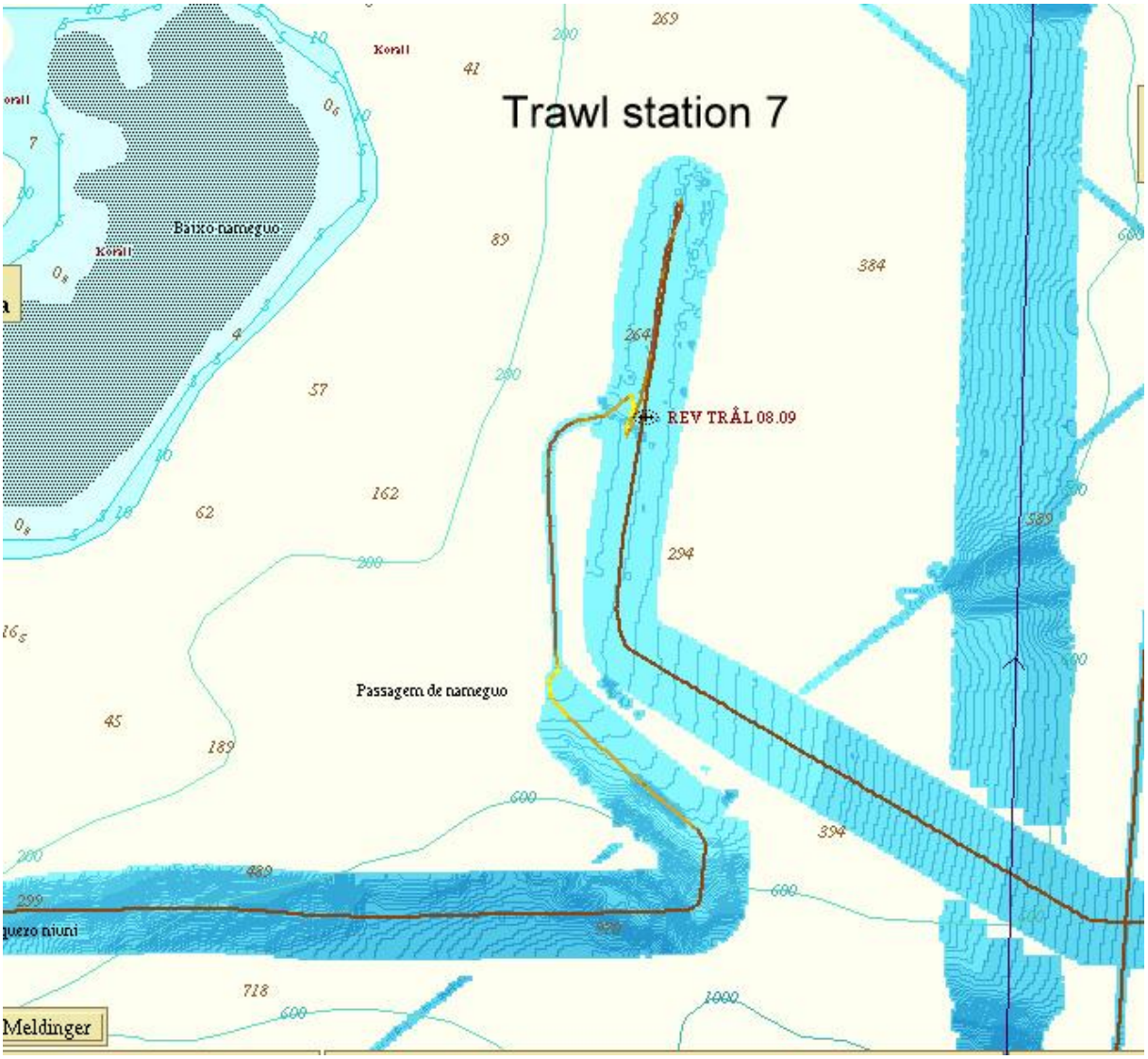


Figure 7.1 Screen shot from navigation computer showing trawl track and bottom conditions at bottom trawl station 11 (the northernmost bottom trawl station).

8 OBSERVATIONS OF CETACEANS AND SEABIRDS

Dedicated observations of marine mammals were carried out on 19 August along the coast while steaming towards Pemba. The course was set close to shore to cover bays where whales and birds had been observed during surveying southwards.

A total of 31 birds and 29 humpback whales were observed from 06:10 to 17:38. A large school of fish was seen feeding actively at the surface next to a mangrove forest. Feeding continued for over 15 minutes and the fish were repeatedly jumping out of the water. Observations are shown in Figure 8.1.

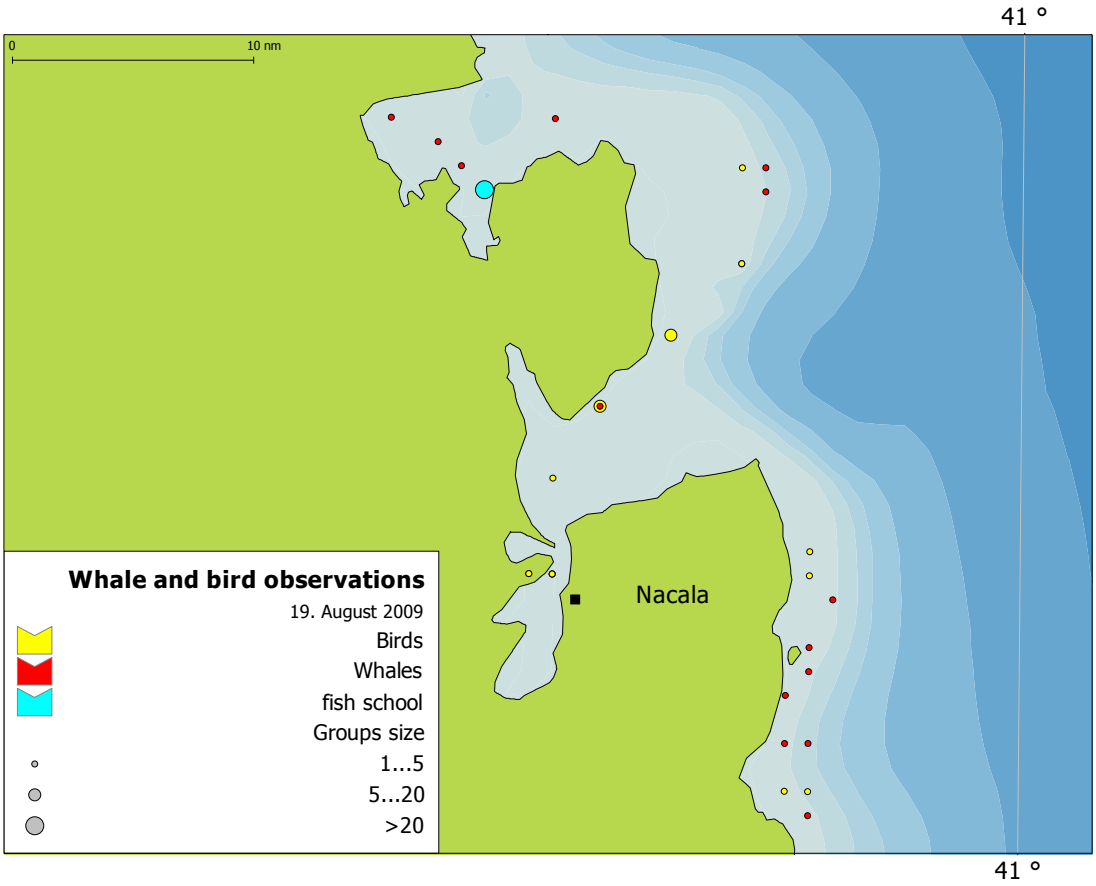


Figure 8.1 Observations of whales, seabirds and a large school of fish feeding at the surface near to a mangrove forest.

ANNEX 1 INSTRUMENTS AND FISHING GEAR USED

Echo sounder

The SIMRAD ER60/38 kHz scientific sounder was used during the survey for fish abundance estimation. The lowering keel was not submerged during the survey. The LSSS Integrator system was used to scrutinise the acoustic records. System calibration experiment using a standard copper sphere was performed 14.06.2009. The settings of 38 kHz echo sounder were as follows:

Transceiver-1 menu (38 kHz lowering keel)

Transducer depth	5.50 m
Absorbtion coeff.	8.7 dB/km
Pulse length	medium (1.02ms)
Bandwidth	wide (2.43 kHz)
Max power	4000 Watt
2-way beam angle	-20.6 dB
SV transducer gain	25.87 dB
TS transducer gain	26.50 dB
Angle sensitivity	21.9
3 dB beamwidth	6.9º alongship
	6.9º athwardship
Alongship offset	0.11º
Athwardship offset	0.03º

Display menu

Echogram	1 (38 kHz)
Bottom range	15 m
Bottom range start	10 m

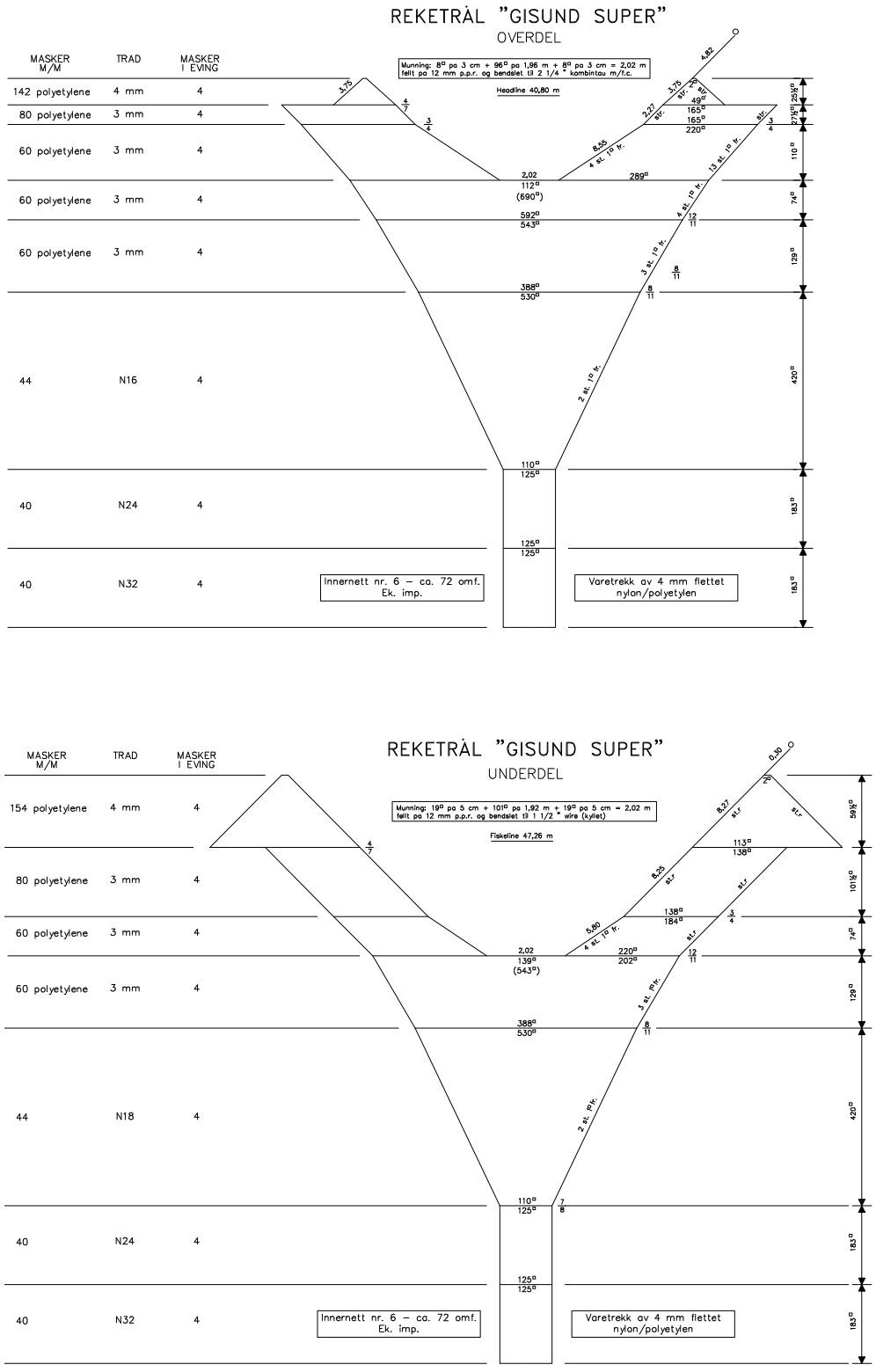
Fishing gear

The vessel has “Harstad” and "Åkrahamn" pelagic trawls and "Gisund super bottom trawl".

The bottom trawl has a headline of 31 m, footrope 47 m and 20 mm meshsize in the codend with an innernet of 10 mm meshsize (Appendix Figure 1). The estimated opening is 6 m (observed 5.7) and distance between wings during towing about 18 m. The sweeps are 40 m long. The trawl is equipped with a 12" rubber bobbins gear. The doors are of 'Thyborøn' combi type, 7.81 m^2, 1670 kg, their distance while trawling about 45 - 55 m in average, depending on the depth (least distance at low depths). This distance can be kept constant (about 50 m) at all depths by the use of a 9.5 m strap between the wires at 130 m distance from the doors, normally applied at depths greater than 80 m.

The SCANMAR system was used on all trawl hauls. This equipment consists of sensors, a hydrophone, a receiver, a display unit and a battery charger. Communication between sensors and ship is based on acoustic transmission. The doors are fitted with sensors to provide information on their distance and a height sensor is fitted to the bottom trawl to measure the trawl opening and provide information on clearance and bottom contact.

The pelagic trawl can be equipped with a trawleye that provides information on the trawl opening and the distance of the footrope to the bottom.



Appendix Figure 1. Design of the trawl used

ANNEX 2 RECORDS OF FISHING (TRAWL) STATIONS

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 1

11:25:17 11:55:18 30.0 (min) Purpose : 1
LOG : 5613.91 5615.94 2.0 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 1454 1336 Validity : 0
Towing dir: 0° Wire out : 70 m Speed : 4.1 kn
Sorted : 0 Total catch: 0.11 Catch/hour: 0.22

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Decapterus macarellus	0.02	4	0.00
Decapods	0.00	72	0.00
Xenolepidichthys dalgleishi *	0.01	2	0.00
Chrysoblephus puniceus	0.00	16	0.00
Loligo sp.	0.04	20	0.00
Lagocephalus sp.	0.06	12	0.00
Trichiurus lepturus	0.06	4	0.00
Microstoma microstoma	0.02	116	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 2
DATE :07.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°23.77
start stop duration Lon E 40°38.41
TIME :14:32:07 15:02:31 30.4 (min) Purpose : 1
LOG : 5629.55 5630.48 0.9 Region : 7410
FDEPTH: 96 80 Gear cond.: 0
BDEPTH: 769 758 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 1.8 kn
Sorted : 0 Total catch: 0.13 Catch/hour: 0.25

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Decapods	0.08	162	0.00
Decapods	0.01	83	0.00
0			
Lophodiodon calori	0.02	16	0.00
JUVENILE FISHES	0.00	2	0.00
Xenolepidichthys dalgleishi *	0.01	47	0.00
SPARIDAE	0.00	2	0.00
Pagellus natalenses	0.04	12	0.00
Loligo sp.	0.00	10	0.00
Arothron hispidus	0.01	28	0.00
Lagocephalus lagocephalus	0.08	6	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 5
DATE :08.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 11°14.33
start stop duration Lon E 40°40.16
TIME :07:53:08 08:24:20 31.2 (min) Purpose : 1
LOG : 5770.72 5772.59 1.9 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 442 69 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 3.6 kn
Sorted : 0 Total catch: 0.17 Catch/hour: 0.33

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Ariosoma sp.	0.13	58	0.00
Lophodiodon calori	0.00	2	0.00
Gazza minuta	0.01	25	0.00
MYCTOPHIDAE	0.00	113	0.00
Priacanthus hamrur	0.00	2	0.00
Loligo duvauceli	0.17	23	0.00
Lagocephalus sp.	0.00	2	0.00
Carangoides ferdau	0.00	2	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 6
DATE :08.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 11°27.28
start stop duration Lon E 40°51.40
TIME :11:51:56 12:21:59 30.0 (min) Purpose : 1
LOG : 5801.67 5804.06 2.4 Region : 7410
FDEPTH: 220 180 Gear cond.: 0
BDEPTH: 1520 1074 Validity : 0
Towing dir: 0° Wire out : 600 m Speed : 4.8 kn
Sorted : 0 Total catch: 0.11 Catch/hour: 0.22

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
JUVENILE FISHES	0.02	50	0.00
Leiognathus sp.	0.00	2	0.00
LUTJANIDAE	0.00	6	0.00
MYCTOPHIDAE	0.07	312	0.00
Priacanthus hamrur	0.01	2	0.00
SPARIDAE	0.00	4	0.00

DATE :07.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°19.79
start stop duration Lon E 40°49.98

TIME :

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 3
DATE :07.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°44.10
start stop duration Lon E 40°39.06
TIME :21:47:38 22:17:44 30.1 (min) Purpose : 1
LOG : 5682.14 5684.06 1.9 Region : 7410
FDEPTH: 32 28 Gear cond.: 0
BDEPTH: 370 586 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.8 kn
Sorted : 4 Total catch: 37.00 Catch/hour: 73.78

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Amblygaster sirm	73.78	2640	100.00
1			
Total	73.78		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 4
DATE :08.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 10°56.85
start stop duration Lon E 40°45.07
TIME :02:02:43 02:32:48 30.1 (min) Purpose : 1
LOG : 5718.21 5719.98 1.8 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 877 689 Validity : 0
Towing dir: 0° Wire out : 95 m Speed : 3.5 kn
Sorted : 2 Total catch: 2.20 Catch/hour: 4.39

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Amblygaster sirm	3.39	112	77.27
2			
Lestidiops jayakari	0.40	6	9.09
MYCTOPHIDAE	0.40	128	9.09
Loligo sp.	0.20	12	4.55
Total	4.39		100.00

Loligo duvauceli	0.05	12	0.00
Trichiurus lepturus	0.00	4	0.00
UNIDENTIFIED FISH	0.06	58	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 8
DATE :09.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 12°0.59
start stop duration Lon E 40°38.61
TIME :00:31:15 01:01:15 30.0 (min) Purpose : 1
LOG : 5891.10 5894.14 3.0 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 195 565 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 6.1 kn
Sorted : 0 Total catch: 0.03 Catch/hour: 0.07

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
JUVENILE FISHES	0.02	12	0.00
MYCTOPHIDAE	0.04	8	0.00
SPARIDAE	0.00	2	0.00
DIODONTIDAE	0.00	4	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 10
DATE :09.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S 12°48.51
start stop duration Lon E 40°45.69
TIME :10:53:56 11:23:13 29.3 (min) Purpose : 1
LOG : 5983.80 5985.84 2.0 Region : 7410
FDEPTH: 420 536 Gear cond.: 0
BDEPTH: 1384 1167 Validity : 0
Towing dir: 0° Wire out : 1550 m Speed : 4.2 kn
Sorted : 0 Total catch: 0.16 Catch/hour: 0.34

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
JUVENILE FISHES	0.00	2	0.00
Electrona risso	0.09	20	0.00
Polymetme corythaeola	0.07	27	0.00
PENAEIDAE	0.04	61	0.00
Argyropelecus aculeatus	0.11	57	0.00

Caristius groenlandicus	0.03	4	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 11
DATE :09.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
12°51.18
start stop duration Lon E
40°33.46
TIME :15:52:09 16:21:54 29.7 (min) Purpose : 1
LOG : 6014.28 6016.08 1.8 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 199 403 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.6 kn
Sorted : 32 Total catch: 31.66 Catch/hour: 63.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
C SAMP			
J E L L Y F I S H	27.44	50	42.96
MYCTOPHIDAE	11.90	14526	18.64
Selar crumenophthalmus	11.80	107	18.48
4			
Sphyraena jello	3.45	24	5.40
5			
Penaeus sp.	3.03	3026	4.74
Lestrolepis intermedia	3.03	625	4.74
Amblygaster sirm	1.37	18	2.15
6			
Loligo vulgaris	0.52	12	0.82
Dipterygonotus balteatus	0.44	26	0.69
Trichiurus lepturus	0.32	2	0.51
Decapterus russelli	0.30	2	0.47
Promethichthys prometheus	0.18	4	0.28
Diaphus effulgens	0.07	10	0.11
Total	63.86		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 12
DATE :09.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
13°19.77
start stop duration Lon E
40°42.66
TIME :21:51:12 22:24:25 33.2 (min) Purpose : 1
LOG : 6066.49 6069.89 3.4 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 1021 966 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 6.2 kn
Sorted : 1 Total catch: 0.51 Catch/hour: 0.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
C SAMP			
JUVENILE FISHES	0.23	159	24.75
Sphyraena chrysotaenia	0.21	2	22.99
Amblygaster sirm	0.19	2	20.63
Loligo sp.	0.12	13	13.56
Lestrolepis intermedia	0.09	20	9.63
MYCTOPHIDAE	0.07	92	7.27
PENAEIDAE	0.01	16	0.98
UNIDENTIFIED FISH	0.00	4	0.20
Total	0.92		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 13
DATE :10.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
13°30.16
start stop duration Lon E
40°35.76
TIME :00:34:46 01:05:08 30.4 (min) Purpose : 1
LOG : 6087.00 6089.05 2.1 Region : 7410
FDEPTH: 90 91 Gear cond.: 0
BDEPTH: 325 182 Validity : 0
Towing dir: 0° Wire out : 315 m Speed : 4.1 kn
Sorted : 8 Total catch: 9.40 Catch/hour: 18.58

SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
C SAMP			
Decapterus kurroides	4.05	40	21.81
Not found	2.47	1492	13.30
Alepes kleinii	2.20	20	11.86
Sphyraena putnamie	2.05	10	11.01
Sepia sp.	1.46	227	7.87
PENAEIDAE	1.42	7609	7.66
Lestrolepis intermedia	1.18	514	6.33
Amblygaster sirm	0.99	40	5.32
Argyropelecus aculeatus	0.57	603	3.09
Trichiurus lepturus	0.54	168	2.93
Secutor insidiator	0.30	534	1.60
Bregmaceros sp.	0.25	138	1.33
MYCTOPHIDAE	0.25	2668	1.33
Cubiceps sp.	0.22	10	1.17
JUVENILE FISHES	0.19	158	1.01
Rexea prometheoides	0.15	69	0.80
Polymetme corythaeola	0.11	10	0.59
Synagrops japonicus	0.01	30	0.05
Loligo sp.	0.01	69	0.05
Total	18.41		99.10

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 14
DATE :10.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
14°2.85
start stop duration Lon E
40°38.35
TIME :08:04:59 08:36:10 31.2 (min) Purpose : 1
LOG : 6158.38 6161.06 2.7 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 71 214 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 5.1 kn
Sorted : 0 Total catch: 0.06 Catch/hour: 0.11

SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
C SAMP			
Bothus sp.	0.00	2	0.00
Bregmaceros sp.	0.00	2	0.00
Fistularia sp.	0.00	2	0.00
Leiognathus elongatus	0.00	6	0.00
MYCTOPHIDAE	0.08	13	0.00
NETTASTOMATIDAE	0.01	4	0.00
SCORPAENIDAE	0.00	2	0.00
Trichiurus lepturus	0.00	2	0.00
UNIDENTIFIED FISH	0.01	73	0.00
UNIDENTIFIED FISH	0.00	2	0.00
0			

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 16
DATE :10.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
14°11.65
start stop duration Lon E
40°36.44
TIME :12:33:15 13:02:40 29.4 (min) Purpose : 1
LOG : 6191.51 6193.70 2.2 Region : 7410
FDEPTH: 10 0 Gear cond.: 0
BDEPTH: 614 333 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 4.5 kn
Sorted : 0 Total catch: 0.12 Catch/hour: 0.25

SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
C SAMP			
Leiognathus elongatus	0.07	755	0.00
Lestrolepis intermedia	0.02	27	0.00
Priacanthus hamrur	0.01	4	0.00
Loligo sp.	0.00	6	0.00
Lagocephalus sp.	0.00	2	0.00
UNIDENTIFIED FISH	0.03	110	0.00
JUVENILE FISHES	0.12	55	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 17
DATE :10.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
14°11.69
start stop duration Lon E
40°47.46
TIME :15:48:23 16:18:08 29.8 (min) Purpose : 1
LOG : 6216.11 6217.26 1.1 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 131 102 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 2.3 kn
Sorted : 1 Total catch: 0.54 Catch/hour: 1.09

SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
C SAMP			
Sphyraena putnamie	0.88	2	80.96
Ommastrephes bartrami	0.10	4	9.06
MYCTOPHIDAE	0.08	24	7.02
Lestrolepis intermedia	0.03	2	2.59
Aluterus monoceros	0.00	4	0.37
Total	1.09		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 18
DATE :11.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
14°11.99
start stop duration Lon E
41°18.25
TIME :08:32:21 09:01:25 29.1 (min) Purpose : 1
LOG : 6273.60 6275.60 2.0 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 2616 2640 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 4.1 kn
Sorted : 0 Total catch: 0.21 Catch/hour: 0.43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT.
C SAMP			
Ariomma indica	0.00	2	0.00
Naucrates ductor	0.01	2	0.00
Lophodiodon calori	0.00	4	0.00
JUVENILE FISHES	0.14	64	0.00
Monocentris japonicus	0.00	4	0.00
Aluterus monoceros	0.04	83	0.00
Cantherhines fronticinctus	0.01	4	0.00
Cubiceps pauciradiatus	0.01	19	0.00
Paralichthodes sp.	0.02	41	0.00
Priacanthus hamrur	0.01	39	0.00
REGALECIDAE	0.00	2	0.00
Loligo vulgaris	0.00	4	0.00
Lagocephalus guntheri	0.00	2	0.00
Trichiurus lepturus	0.18	116	0.00

UNIDENTIFIED FISH	0.00	8	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 19
DATE :11.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
14°23.96
start stop duration Lon E
40°46.88
TIME :14:24:51 14:57:05 32.2 (min) Purpose : 1
LOG : 6326.27 6328.05 1.8 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 378 208 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.3 kn
Sorted : 0 Total catch: 0.04 Catch/hour: 0.08

SPECIES	CATCH/HOUR weight	% OF TOT. numbers	C SAMP
Aluterus monoceros	0.00	2	0.00
Penaeus sp.	0.00	6	0.00
Lagocephalus guntheri	0.00	4	0.00
JUVENILE FISHES	0.07	121	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 20
DATE :11.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
14°29.07
start stop duration Lon E
40°56.25
TIME :17:02:41 17:32:26 29.8 (min) Purpose : 1
LOG : 6346.08 6349.35 3.3 Region : 7410
FDEPTH: 20 20 Gear cond.: 0
BDEPTH: 1239 1004 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 6.6 kn
Sorted : 4 Total catch: 3.88 Catch/hour: 7.83

SPECIES	CATCH/HOUR weight	% OF TOT. numbers	C SAMP
Cubiceps sp.	6.62	256	84.47
Ariosoma sp.	0.52	242	6.70
Diaphus effulgens	0.38	613	4.89
PENAEIDAE	0.15	131	1.93
UNIDENTIFIED FISH	0.13	30	1.65
Ommastrephes bartrami	0.01	2	0.13
Xenolepidichthys dalgleishi *	0.01	30	0.13
Hippocampus histrix	0.01	2	0.08
Nemichthys curvirostris	0.00	2	0.03
Total	7.83		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 21
DATE :11.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
14°58.14
start stop duration Lon E
40°49.54
TIME :22:33:44 23:03:46 30.0 (min) Purpose : 1
LOG : 6395.80 6397.88 2.1 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 213 130 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 4.1 kn
Sorted : 1 Total catch: 0.75 Catch/hour: 1.50

SPECIES	CATCH/HOUR weight	% OF TOT. numbers	C SAMP
Ommastrephes bartrami	0.82	20	54.65
MYCTOPHIDAE	0.36	94	23.94
JUVENILE FISHES	0.18	24	11.70
Gymnocaesio gymnoptera	0.15	2	9.71
Total	1.50		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 22
DATE :12.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
15°15.76
start stop duration Lon E
41°17.82
TIME :13:57:40 14:25:19 27.7 (min) Purpose : 1
LOG : 6450.74 6452.63 1.9 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 2648 2660 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 4.1 kn
Sorted : 0 Total catch: 0.30 Catch/hour: 0.66

SPECIES	CATCH/HOUR weight	% OF TOT. numbers	C SAMP
Ariomma sp.	0.38	98	0.00
Ariomma indica	0.00	2	0.00
CARANGIDAE	0.00	2	0.00
CARANGIDAE	0.00	4	0.00
ENGRAULIDIDAE	0.15	56	0.00
Xenolepidichthys dalgleishi *	0.00	9	0.00
LUTJANIDAE	0.04	195	0.00
Aluterus monoceros	0.00	2	0.00
Thamnaconus modestoides	0.01	7	0.00
Thamnaconus fajardoi	0.00	2	0.00
Cubiceps sp.	0.02	43	0.00
Priacanthus hamrur	0.00	4	0.00
Argonauta sp.	0.02	4	0.00
Ommastrephes bartrami	0.00	7	0.00
Lagocephalus sp.	0.00	2	0.00
Tylerius spinosissimus	0.00	2	0.00
Trichiurus lepturus	0.01	11	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 23
DATE :12.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
15°16.80
start stop duration Lon E
41°18.21
TIME :15:09:19 15:23:41 14.4 (min) Purpose : 1
LOG : 6455.35 6456.14 0.8 Region : 7410
FDEPTH: 140 200 Gear cond.: 0
BDEPTH: 2668 2668 Validity : 0
Towing dir: 0° Wire out : 650 m Speed : 3.3 kn
Sorted : 1 Total catch: 0.74 Catch/hour: 3.10

SPECIES	CATCH/HOUR weight	% OF TOT. numbers	C SAMP
MYCTOPHIDAE	1.72	2422	55.53
Ommastrephes bartrami	0.30	33	9.57
UNIDENTIFIED FISH	0.28	21	8.89
Paramonacanthus pusillus	0.25	21	8.22
MOLIDAE	0.25	8	7.95
Chauliodus minimus	0.22	8	7.01
Argyropelecus aculeatus	0.05	21	1.62
Lestrolepis intermedia	0.03	4	0.94
Lagocephalus sp.	0.00	4	0.13
Sepia australis	0.00	4	0.13
Total	3.10		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 24
DATE :12.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
15°7.38
start stop duration Lon E
40°38.55
TIME :20:16:14 20:46:22 30.1 (min) Purpose : 1
LOG : 6499.65 6501.44 1.8 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 495 333 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.6 kn
Sorted : 13 Total catch: 13.57 Catch/hour: 27.02

SPECIES	CATCH/HOUR weight	% OF TOT. numbers	C SAMP
Dussumieria acuta	13.62	2071	50.41
Cubiceps pauciradiatus	5.44	354	20.12
Lestrolepis intermedia	2.45	422	9.06
Selar crumenophthalmus	1.63	20	6.04
Dipterygonotus balteatus	0.60	159	2.21
Loligo vulgaris	0.60	60	2.21
Cubiceps sp.	0.40	10	1.47
Saurida undosquamis	0.40	24	1.47
Sphyraena acutipinnis	0.40	8	1.47
Trichiurus lepturus	0.32	26	1.18
Rexea prometheoides	0.32	28	1.18
Engraulis cf capensis	0.24	8	0.88
Ariosoma sp.	0.24	100	0.88
Diaphus effulgens	0.22	74	0.81
Stolephorus indicus	0.08	199	0.29
UNIDENTIFIED FISH, juvenile	0.06	100	0.22
Brama orcini	0.01	2	0.02
Leiognathus elongatus	0.01	4	0.02
Upeneus bensasi	0.00	2	0.01
Xenolepidichthys dalgleishi *	0.00	2	0.01
Bothus sp.	0.00	2	0.00
Total	27.02		99.99

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 25
DATE :13.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
15°32.91
start stop duration Lon E
40°38.57
TIME :00:23:31 00:53:33 30.0 (min) Purpose : 1
LOG : 6537.47 6539.99 2.5 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 74 584 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 5.0 kn
Sorted : 1 Total catch: 0.93 Catch/hour: 1.85

SPECIES	CATCH/HOUR weight	% OF TOT. numbers	C SAMP
J E L L Y F I S H	0.50	2	26.94
Ommastrephes bartrami	0.48	22	25.65
JUVENILE FISHES	0.31	14	16.92
Lestrolepis intermedia	0.23	26	12.50
Cubiceps sp.	0.18	2	9.70
MYCTOPHIDAE	0.09	100	5.06
JUVENILE FISHES	0.06	34	3.23
Total	1.85		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 26
DATE :13.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
15°55.33
start stop duration Lon E
40°57.97
TIME :03:45:50 04:16:41 30.9 (min) Purpose : 1
LOG : 6569.42 6572.00 2.6 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 2120 2162 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 5.0 kn
Sorted : 1 Total catch: 0.99 Catch/hour: 1.92

C	SPECIES / SAMP	CATCH/HOUR weight	numbers	% OF TOT.
	Ariosoma sp.	0.43	301	22.22
	UNIDENTIFIED FISH	0.33	262	17.17
	Loligo vulgaris	0.15	16	7.88
	Decapterus tabl	0.15	29	7.68
	Cantherhines fronticinctus	0.14	19	7.07
	Ariomma indica	0.13	10	6.77
	Rastrelliger kanagurta	0.12	6	6.16
	Aluterus monoceros	0.11	6	5.96
	Saurida undosquamis	0.11	14	5.86
	Bothus sp.	0.08	103	4.34
	Lutjanus sanguineus	0.08	148	4.14
	Cubiceps sp.	0.07	136	3.54
	Hippocampus whitei	0.01	2	0.30
	Sphyraena sp.	0.00	6	0.20
	SPARIDAE	0.00	21	0.20
	Xenolepidichthys dalgleishi *	0.00	6	0.20
	Fistularia petimba	0.00	4	0.20
	Lagocephalus sceleratus	0.00	6	0.20
	Priacanthus hamrur	0.00	6	0.20
	Lagocephalus sp.	0.00	2	0.10
	Total	1.93		100.40

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 27
DATE :13.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
15°40.09
start stop duration Lon E
40°34.33
TIME :17:26:23 17:55:48 29.4 (min) Purpose : 1
LOG : 6623.89 6625.02 1.1 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 71 80 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 2.3 kn
Sorted : 8 Total catch: 8.09 Catch/hour: 16.51

C	SPECIES / SAMP	CATCH/HOUR weight	numbers	% OF TOT.
	Diaphus cf. thiollieri	13.06	2101	79.09
	Sphyraena forsteri	2.36	2	14.31
	Lestrolepis intermedia	0.23	29	1.42
	Dipterygonotus balteatus	0.19	10	1.17
	Decapterus macrosoma	0.16	2	0.99
	Amblygaster sirm	0.13	2	0.80
	Ariosoma anago	0.11	61	0.68
	Rexea prometheoides	0.10	4	0.62
	Ommastrephes bartrami	0.09	4	0.53
	Loligo forbesi	0.05	4	0.28
	JUVENILE FISHES	0.01	2	0.05
	Cantherhines fronticinctus	0.00	2	0.02
	Priacanthus hamrur	0.00	2	0.01
	Saurida undosquamis	0.00	2	0.01
	Total	16.51		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 28
DATE :13.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
16°19.89
start stop duration Lon E
40°44.16
TIME :21:44:56 22:15:09 30.2 (min) Purpose : 1
LOG : 6668.59 6669.60 1.0 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 2012 2002 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 2.0 kn
Sorted : 6 Total catch: 5.99 Catch/hour: 11.89

C	SPECIES / SAMP	CATCH/HOUR weight	numbers	% OF TOT.
	Cubiceps sp.	5.84	228	49.08
11				
	J E L L Y F I S H	3.45	2	29.05
	Diaphus sp.	1.72	540	14.49
	Ommastrephes bartrami	0.65	60	5.48
	JUVENILE FISHES	0.06	32	0.53
	Lestrolepis intermedia	0.02	2	0.15
	Total	11.75		98.78

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 29
DATE :14.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
16°2.75
start stop duration Lon E
40°20.26
TIME :12:34:10 13:04:26 30.3 (min) Purpose : 1
LOG : 6725.12 6727.34 2.2 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 40 29 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 4.4 kn
Sorted : 0 Total catch: 0.18 Catch/hour: 0.35

C	SPECIES / SAMP	CATCH/HOUR weight	numbers	% OF TOT.
	Bothus sp.	0.00	14	0.00
	Ariosoma sp.	0.01	6	0.00
	DIODONTIDAE	0.00	4	0.00
	LUTJANIDAE	0.00	2	0.00
	SCARIDAE	0.00	2	0.00
	Loligo sp.	0.12	6	0.00
	Saurida undosquamis	0.07	159	0.00
	Lagocephalus sp.	0.00	2	0.00
	UNIDENTIFIED FISH	0.15	73	0.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 31
DATE :14.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
16°29.94
start stop duration Lon E
39°55.76
TIME :22:19:45 22:49:46 30.0 (min) Purpose : 1
LOG : 6798.54 6800.39 1.9 Region : 7410
FDEPTH: 17 20 Gear cond.: 0
BDEPTH: 57 74 Validity : 0
Towing dir: 0° Wire out : 0 m Speed : 3.7 kn
Sorted : 32 Total catch: 201.05 Catch/hour: 401.83

C	SPECIES / SAMP	CATCH/HOUR weight	numbers	% OF TOT.
	Decapterus kurroides	106.14	98	26.41
15				
	Sphyraena flavicauda	84.62	32282	21.06
14				
	Selar crumenophthalmus	49.57	634	12.34
13				
	Leiognathus elongatus	49.40	48	12.29
	Ariomma indica	48.91	1125	12.17
	MYCTOPHIDAE	27.20	783	6.77
	Trichiurus lepturus	17.12	977	4.26
	Lestrolepis intermedia	7.29	686	1.81
	Dussumieria acuta	3.96	6750	0.99
	Cubiceps sp.	3.57	48	0.89
	Loligo sp.	2.74	734	0.68
	Mene maculata	1.13	48	0.28
	Stolephorus sp.	0.20	15506	0.05
	Total	401.83		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 32
DATE :15.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
17°2.28
start stop duration Lon E
40°5.37
TIME :03:42:49 03:53:01 10.2 (min) Purpose : 1
LOG : 6844.52 6844.78 0.3 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 1832 1835 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 1.6 kn
Sorted : 1 Total catch: 0.59 Catch/hour: 3.47

C	SPECIES / SAMP	CATCH/HOUR weight	numbers	% OF TOT.
	Loligo sp.	1.21	265	34.92
	Decapods	0.80	882	23.05
	Ariosoma sp.	0.68	47	19.66
	Lestrolepis intermedia	0.65	212	18.64
	Brama orcini	0.04	6	1.02
	UNIDENTIFIED FISH	0.01	6	0.34
	Trichiurus lepturus	0.01	6	0.34
	Total	3.40		97.97

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 33
DATE :15.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
16°39.27
start stop duration Lon E
39°45.47
TIME :16:15:30 16:44:32 29.0 (min) Purpose : 1
LOG : 6896.16 6897.78 1.6 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 134 152 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.4 kn
Sorted : 37 Total catch: 38.70 Catch/hour: 79.96

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Mobula sp.	72.31	2	90.44
Selar crumenophthalmus	3.20	39	4.01
16			
Sphyraena forsteri	1.47	19	1.83
17			
Loligo sp.	0.95	83	1.19
Chirocentrus dorab	0.48	2	0.59
Decapterus russelli	0.29	6	0.36
18			
Cubiceps sp.	0.29	826	0.36
0			
Naucrates ductor	0.22	2	0.28
Cubiceps sp.	0.21	2	0.26
Encrasicholina punctifer	0.18	12	0.22
Dussumieria acuta	0.14	2	0.18
Lestrolepis intermedia	0.12	8	0.16
Decapterus macrosoma	0.10	2	0.13
Trichiurus lepturus	0.03	6	0.04
Echeneis naucrates	0.01	2	0.01
Lethrinus lentjan	0.01	2	0.01
Hemiramphus far	0.00	2	0.01
Total	80.01		100.07

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 34
DATE :15.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
16°36.21
start stop duration Lon E
39°44.98
TIME :17:58:02 18:30:03 32.0 (min) Purpose : 1
LOG : 6904.45 6906.48 2.0 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 26 59 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.8 kn
Sorted : 46 Total catch: 46.00 Catch/hour: 86.22

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Trichiurus lepturus	39.74	1799	46.09
Decapterus russelli	9.22	255	10.70
40			
Dussumieria acuta	9.00	247	10.43
38			
Ariosoma sp.	8.28	129	9.60
Sphyraena jello	4.27	17	4.96
39			
Selar crumenophthalmus	4.18	24	4.85
Dipterygonotus balteatus	2.19	60	2.54
Sphyraena flavicauda	1.78	30	2.07
41			
Carangoides malabaricus	1.27	9	1.48
Atule mate	1.16	9	1.35
Chirocentrus dorab	0.73	4	0.85
Carangoides armatus	0.69	6	0.80
Lestrolepis intermedia	0.69	52	0.80
Leiognathus elongatus	0.58	37	0.67
Stolephorus indicus	0.51	19	0.59
Priacanthus hamrur	0.36	2	0.41
Encrasicholina punctifer	0.36	92	0.41
Upeneus vittatus	0.26	2	0.30
Upeneus sulphureus	0.24	2	0.28
Loligo sp.	0.03	15	0.04
Ariomma indica	0.03	2	0.04
Decapterus macrosoma	0.01	4	0.01
Total	85.59		99.27

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 35
DATE :16.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
16°54.77
start stop duration Lon E
39°24.93
TIME :01:49:21 02:19:23 30.0 (min) Purpose : 1
LOG : 6962.16 6964.10 1.9 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 30 73 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.9 kn
Sorted : 51 Total catch: 53.15 Catch/hour: 106.16

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Scomberomorus commerson	32.16	4	30.29
Chirocentrus nudus	20.57	106	19.38
20			
Sphyraena putnamie	8.99	44	8.47
Lestrolepis intermedia	7.51	479	7.07
Scomberomorus plurilineatus	7.49	2	7.06
Selar crumenophthalmus	6.19	74	5.83
18			
Caesio caerulaurea	5.07	62	4.78
19			
Loligo sp.	3.29	320	3.10
Secutor insidiator	2.96	128	2.78
Galeorhinus galeus	2.70	2	2.54
MYCTOPHIDAE	1.98	575	1.87
Lutjanus lutjanus	1.38	20	1.30
Trichiurus lepturus	1.32	431	1.24
Sphyraena acutipinnis	1.14	14	1.07
Dussumieria acuta	1.06	32	1.00
Decapterus macarellus	0.76	4	0.71
Alepes kleinii	0.68	4	0.64
Decapterus russelli	0.59	10	0.55
Engraulis cf capensis	0.18	2	0.17
Thryssa vitrirostris	0.15	2	0.14
Total	106.16		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 36
DATE :16.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
17°27.43
start stop duration Lon E
39°31.52
TIME :07:18:54 07:47:55 29.0 (min) Purpose : 1
LOG : 7000.75 7002.56 1.8 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 2035 2036 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.8 kn
Sorted : 1 Total catch: 0.64 Catch/hour: 1.33

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Decapterus macrosoma	0.53	83	40.12
Ariosoma sp.	0.51	101	38.41
Decapterus macarellus	0.09	19	7.00
Trichiurus lepturus	0.09	12	6.53
Loligo sp.	0.08	17	6.22
Thamnaconus fajardoi	0.01	10	1.09
Saurida undosquamis	0.00	2	0.31
Acanthurus sp.	0.00	4	0.16
Priacanthus hamrur	0.00	4	0.16
Total	1.33		100.00

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 37
DATE :16.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
17°5.31
start stop duration Lon E
39°11.87
TIME :22:15:29 22:45:30 30.0 (min) Purpose : 1
LOG : 7061.46 7063.48 2.0 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 103 136 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 4.0 kn
Sorted : 54 Total catch: 54.02 Catch/hour: 107.94

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Cubiceps whitleggi	60.24	969	55.81
21			
Cubiceps pauciradiatus	41.66	1375	38.59
22			
Sphyraena jello	3.18	38	2.94
23			
MYCTOPHIDAE	1.53	887	1.42
Selar crumenophthalmus	1.02	10	0.94
JUVENILE FISHES	0.62	320	0.57
Loligo sp.	0.54	160	0.50
Rastrelliger kanagurta	0.42	4	0.39
Chirocentrus nudus	0.34	2	0.31
Trichiurus lepturus	0.22	2	0.20
Dussumieria acuta	0.10	2	0.09
Total	109.85		101.77

R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 38
DATE :17.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
17°19.45
start stop duration Lon E
39°7.71
TIME :06:08:19 06:37:46 29.5 (min) Purpose : 1
LOG : 7114.96 7116.73 1.8 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 1102 1124 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 3.6 kn
Sorted : 2 Total catch: 1.53 Catch/hour: 3.11

SPECIES	CATCH/HOUR		% OF TOT.
C SAMP			
	weight	numbers	
Ariomma sp.	1.47	652	47.15
LUTJANIDAE	0.46	799	14.80
Cubiceps sp.	0.29	24	9.17
Ommastrephes bartrami	0.14	57	4.65
Decapterus macrosoma	0.12	43	3.80
Cantherhines fronticinctus	0.08	65	2.49
Lagocephalus sp.	0.06	69	1.83
Decapterus macarellus	0.06	35	1.77
SPARIDAE	0.04	104	1.24
Paramonacanthus pusillus	0.02	53	0.72
Trichiurus lepturus	0.01	10	0.26
Xenolepidichthys dalgleishi *	0.01	4	0.20
Saurida undosquamis	0.00	8	0.13

Sphyraena sp.	0.00	8	0.13
Priacanthus hamrur	0.00	2	0.07
Total	2.75		88.41

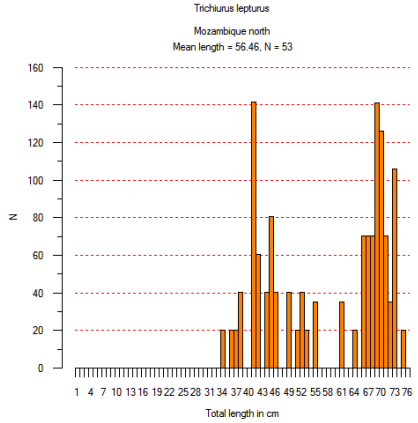
R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 42
DATE :17.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
17°12.88
start stop duration Lon E
38°58.68
TIME :17:47:23 18:23:11 35.8 (min) Purpose : 1
LOG : 7179.79 7182.18 2.4 Region : 7410
FDEPTH: 10 10 Gear cond.: 0
BDEPTH: 53 48 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 4.0 kn
Sorted : 153 Total catch: 153.25 Catch/hour: 256.84

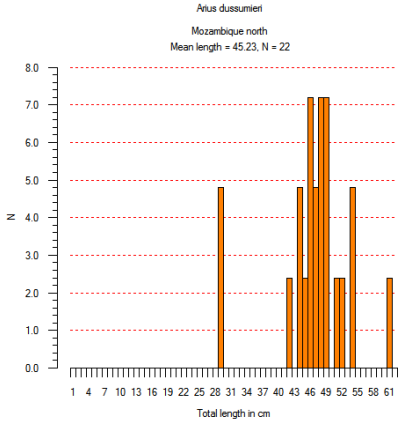
SPECIES C SAMP	CATCH/HOUR weight	numbers	% OF TOT.
Trichiurus lepturus 37	144.55	141	56.28
Secutor insidiator	31.84	546	12.40
Sphyraena jello	16.68	13	6.49
Pellona ditchela	16.09	149	6.26
Bathophilus nigerrimus	15.59	3	6.07
Thryssa vitrirostris	11.23	168	4.37
Carcharhinus sorrah	7.71	2	3.00
Sardinella gibbosa	5.03	12	1.96
Carcharhinus sp.	3.60	2	1.40
Chirocentrus dorab	2.60	5	1.01
Mene maculata	1.01	2	0.39
Loligo sp.	0.92	20	0.36
Total	256.84		100.00
Total	56.82		100.00

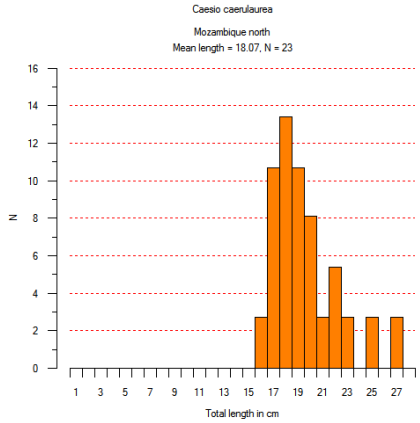
R/V Dr. Fridtjof Nansen SURVEY:2009407 STATION: 43
DATE :17.08.2009 GEAR TYPE: PT NO: 1 POSITION:Lat S
16°54.45
start stop duration Lon E
39°25.69
TIME :23:30:40 00:00:44 30.1 (min) Purpose : 1
LOG : 7214.01 7216.20 2.2 Region : 7410
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 64 80 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 4.4 kn
Sorted : 28 Total catch: 28.47 Catch/hour: 56.82

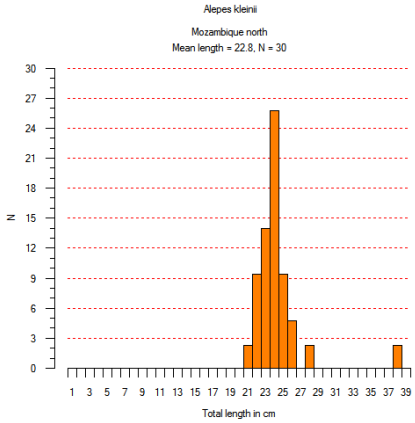
SPECIES C SAMP	CATCH/HOUR weight	numbers	% OF TOT.
Dussumieria acuta	14.57	439	25.65
MYCTOPHIDAE	12.77	14770	22.48
Alepes kleinii	6.97	64	12.26
Scomberomorus commerson	2.40	2	4.22
Sphyraena forsteri	2.38	16	4.18
Lestrolepis intermedia	2.20	539	3.86
Sphyraena jello	1.88	4	3.30
Stolephorus sp.	1.60	269	2.81
Loligo sp.	1.60	339	2.81
Trichiurus lepturus	1.58	8	2.78
Seriola dumerili	1.38	2	2.42
Sphyraena flavicauda	1.34	20	2.35
Selar crumenophthalmus	1.02	6	1.79
Leiognathus elongatus	1.00	1018	1.76
Polymetme corythaeola	0.99	240	1.74
Priacanthus hamrur	0.70	20	1.23
SPARIDAE	0.66	20	1.16
MONACANTHIDAE	0.66	20	1.16
Caesio caerulaurea	0.52	14	0.91
Chirocentrus dorab	0.34	2	0.60
Carangoides cf. malabaricus	0.20	2	0.35
Scomberoides tol	0.10	2	0.18

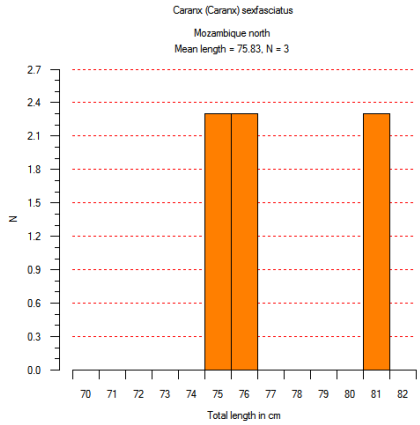
ANNEX 3 LENGTH DISTRIBUTION OF THE MAIN SPECIES

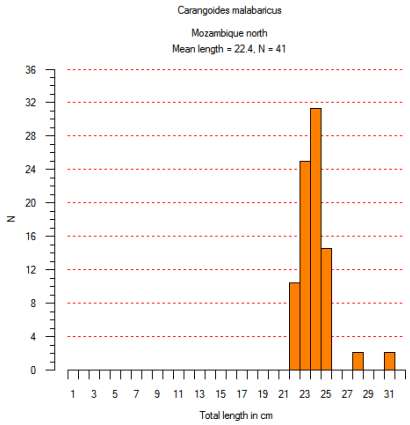


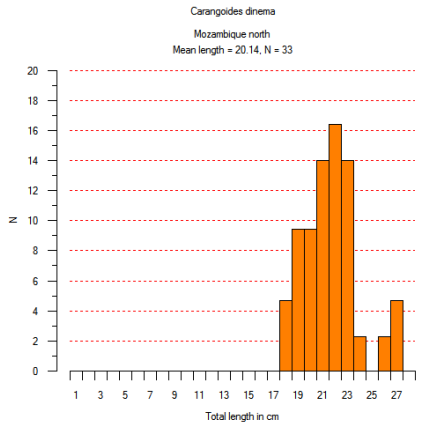


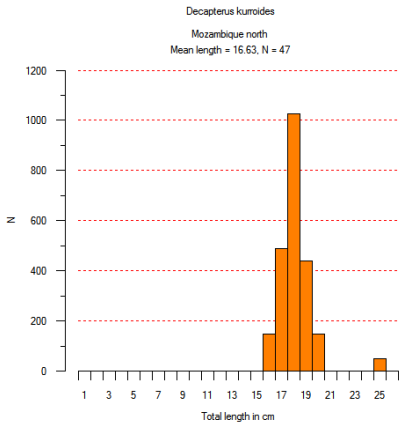


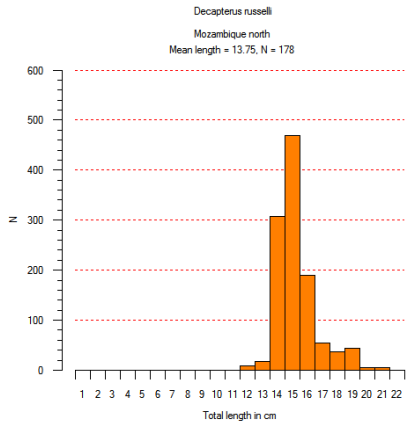


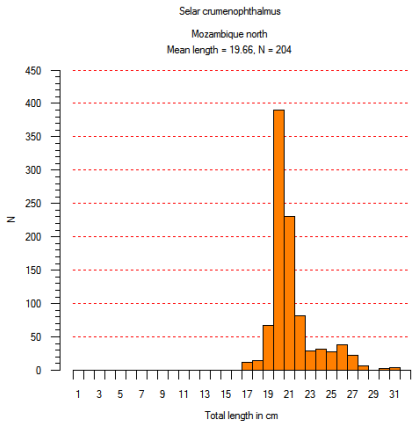


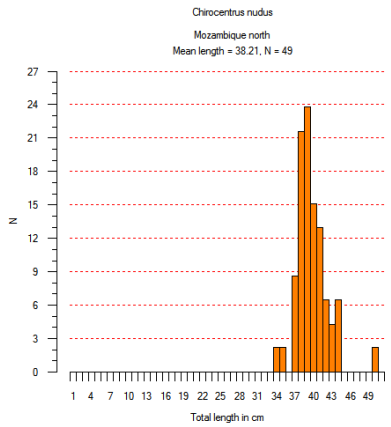


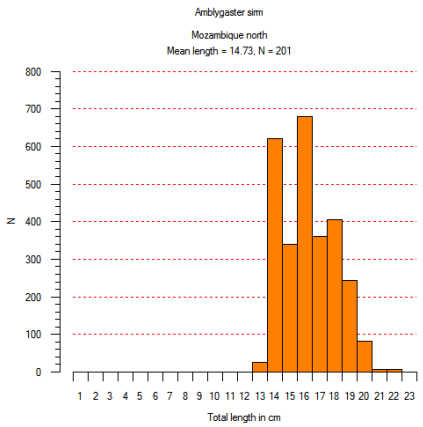

Carangoides dinema
Mozambique north
Mean length = 20.14, N = 33
N
Total length in cm

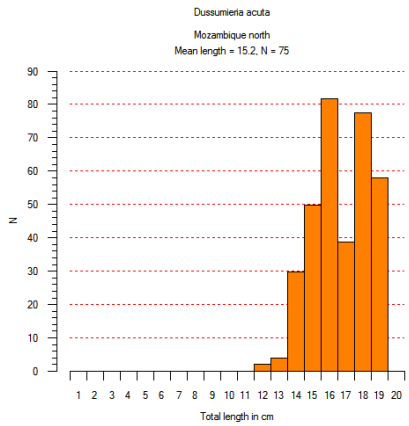

Decapterus kurroides
Mozambique north
Mean length = 16.63, N = 47
N
Total length in cm

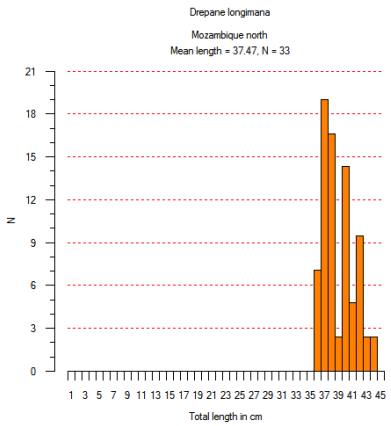

Decapterus russelli
Mozambique north
Mean length = 13.75, N = 178
N
Total length in cm

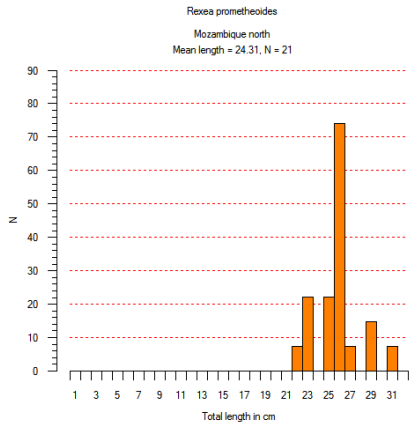

Selar crumenophthalmus
Mozambique north
Mean length = 19.66, N = 204
N
Total length in cm

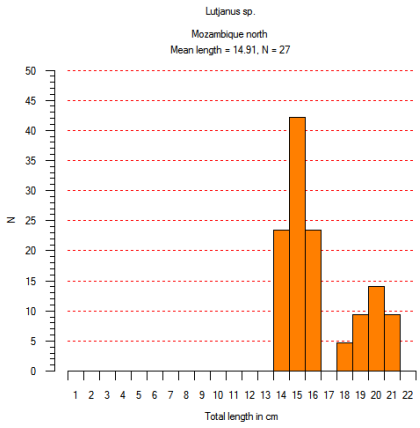

Chirocentrus nudus
Mozambique north
Mean length = 38.21, N = 49
N
Total length in cm

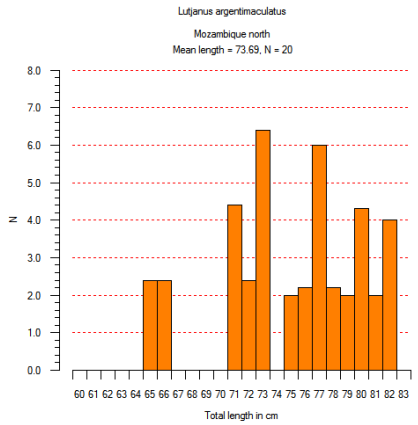

Amblygaster sirm
Mozambique north
Mean length = 14.73, N = 201
N
Total length in cm

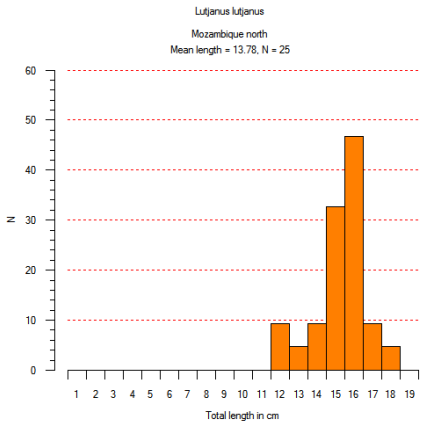

Dussumieria acuta
Mozambique north
Mean length = 15.2, N = 75
N
Total length in cm

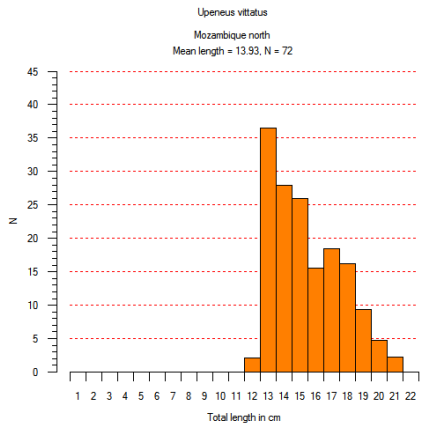

Drepane longimana
Mozambique north
Mean length = 37.47, N = 33
N
Total length in cm

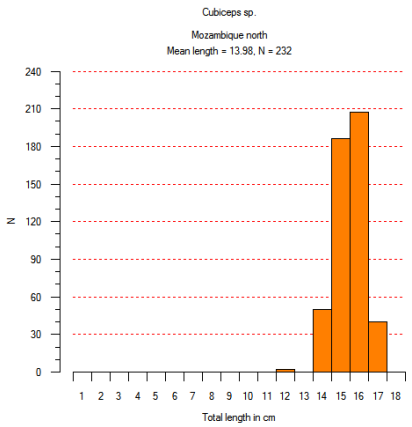

Rexea prometheoides
Mozambique north
Mean length = 24.31, N = 21
N
Total length in cm

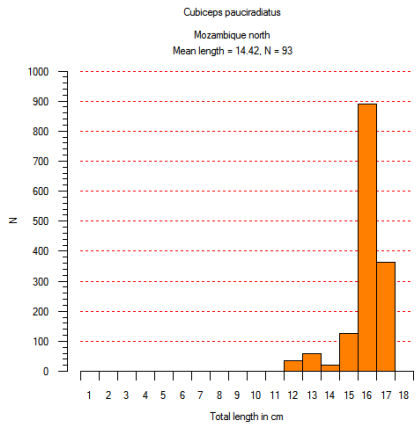

Lutjanus sp.
Mozambique north
Mean length = 14.91, N = 27
N
Total length in cm

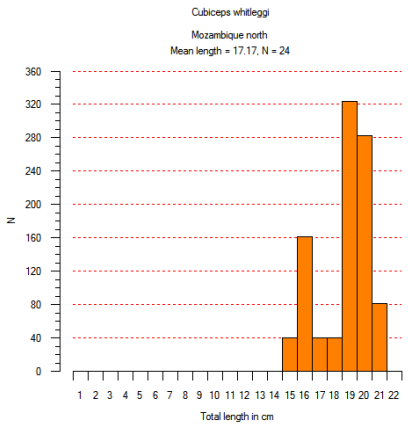

Lutjanus argentimaculatus
Mozambique north
Mean length = 73.69, N = 20
N
Total length in cm

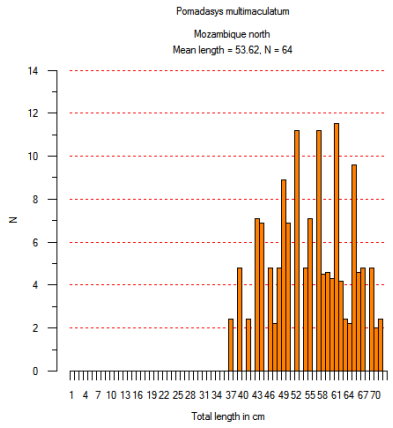

Lutjanus lutjanus
Mozambique north
Mean length = 13.78, N = 25
N
Total length in cm

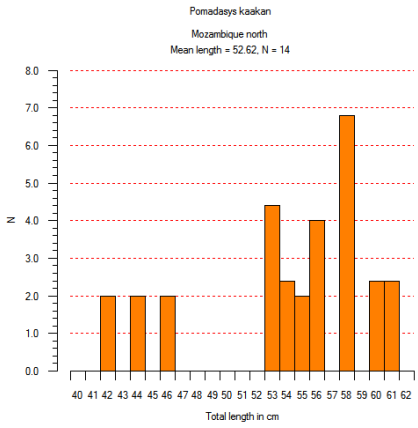

Upeneus vittatus
Mozambique north
Mean length = 13.93, N = 72
N
Total length in cm

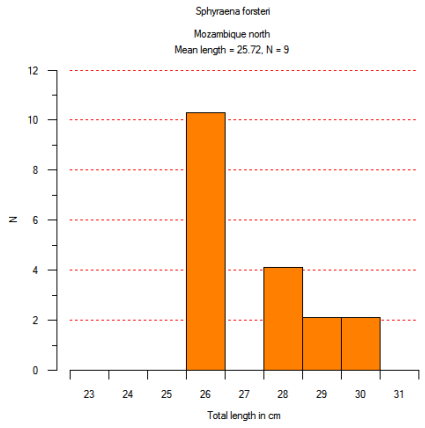

Cubiceps sp.
Mozambique north
Mean length = 13.98, N = 232
N
Total length in cm

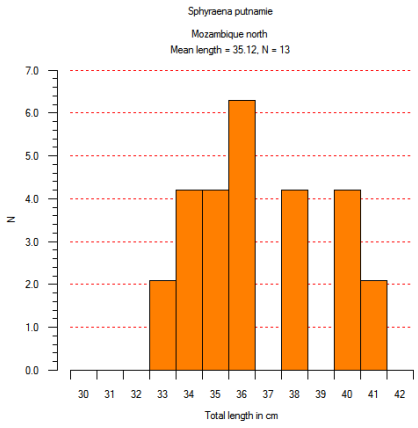

Cubiceps pauciradiatus
Mozambique north
Mean length = 14.42, N = 93
N
Total length in cm

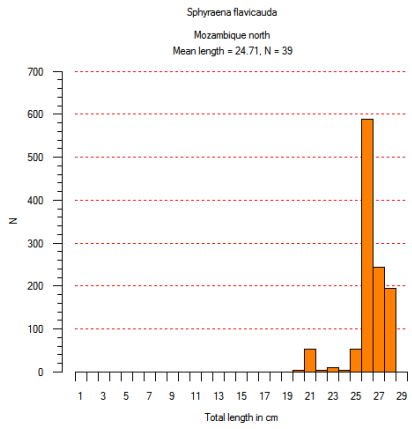

Cubiceps whitleggi
Mozambique north
Mean length = 17.17, N = 24
N
Total length in cm


Pomadasys multimaculatum
Mozambique north
Mean length = 53.62, N = 64
N
Total length in cm


Pomadasys kaakan
Mozambique north
Mean length = 52.62, N = 14
N
Total length in cm

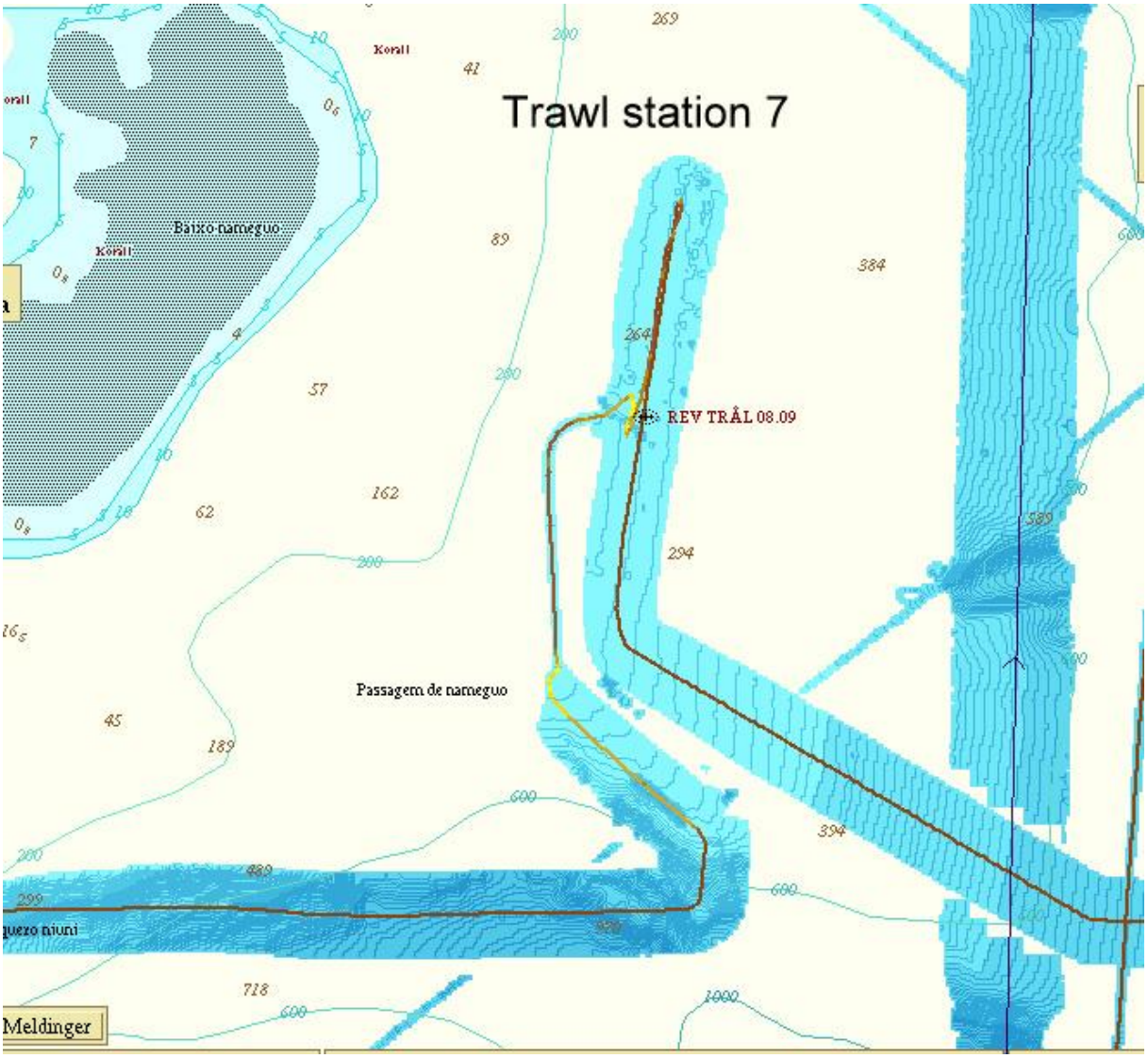

Sphyraena forsteri
Mozambique north
Mean length = 25.72, N = 9
N
Total length in cm


Sphyraena putnamie
Mozambique north
Mean length = 35.12, N = 13
N
Total length in cm

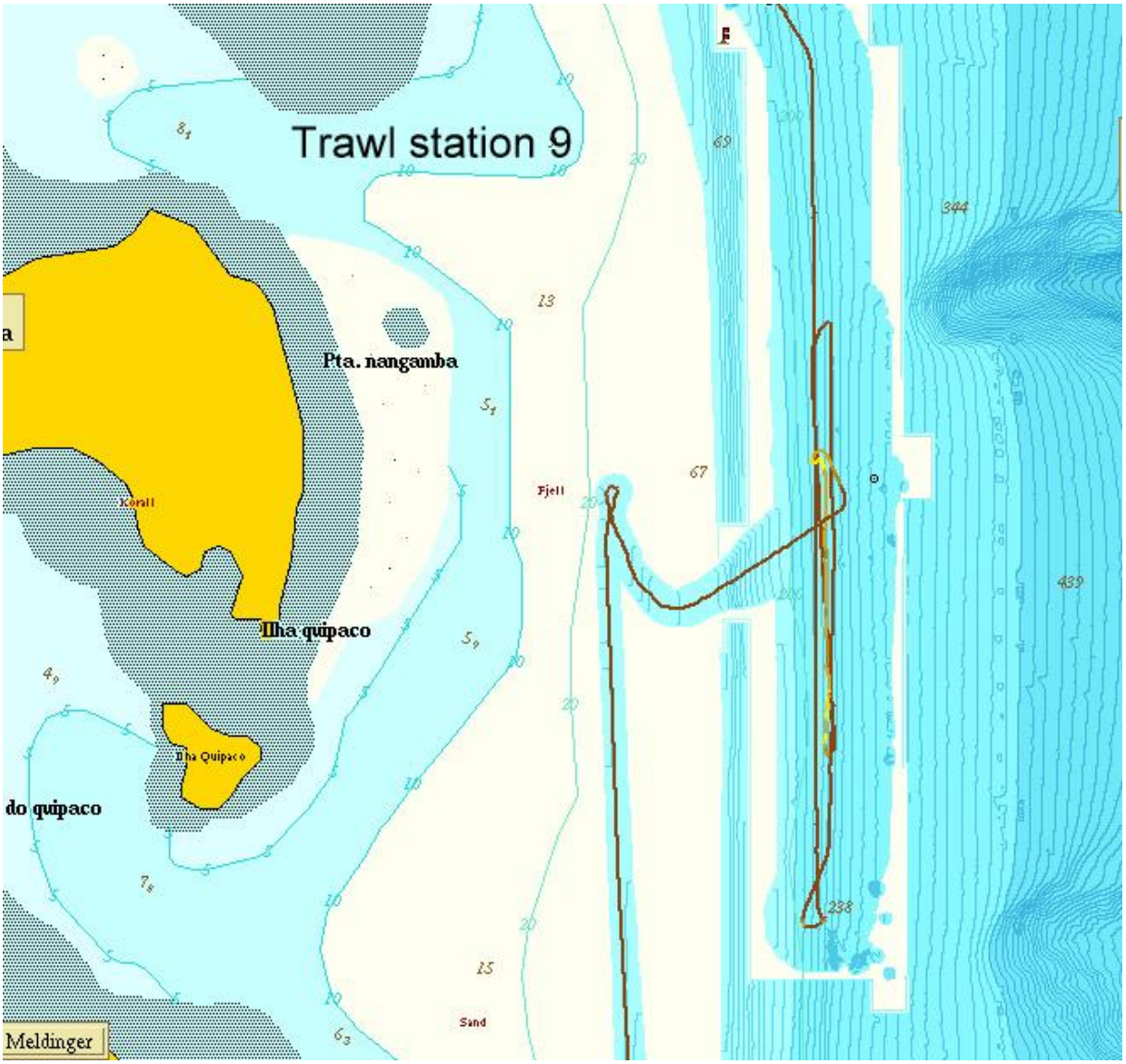

Sphyraena flavicauda
Mozambique north
Mean length = 24.71, N = 39
N
Total length in cm

ANNEX 4 BOTTOM MAPS AT BOTTOM TRAWL STATIONS

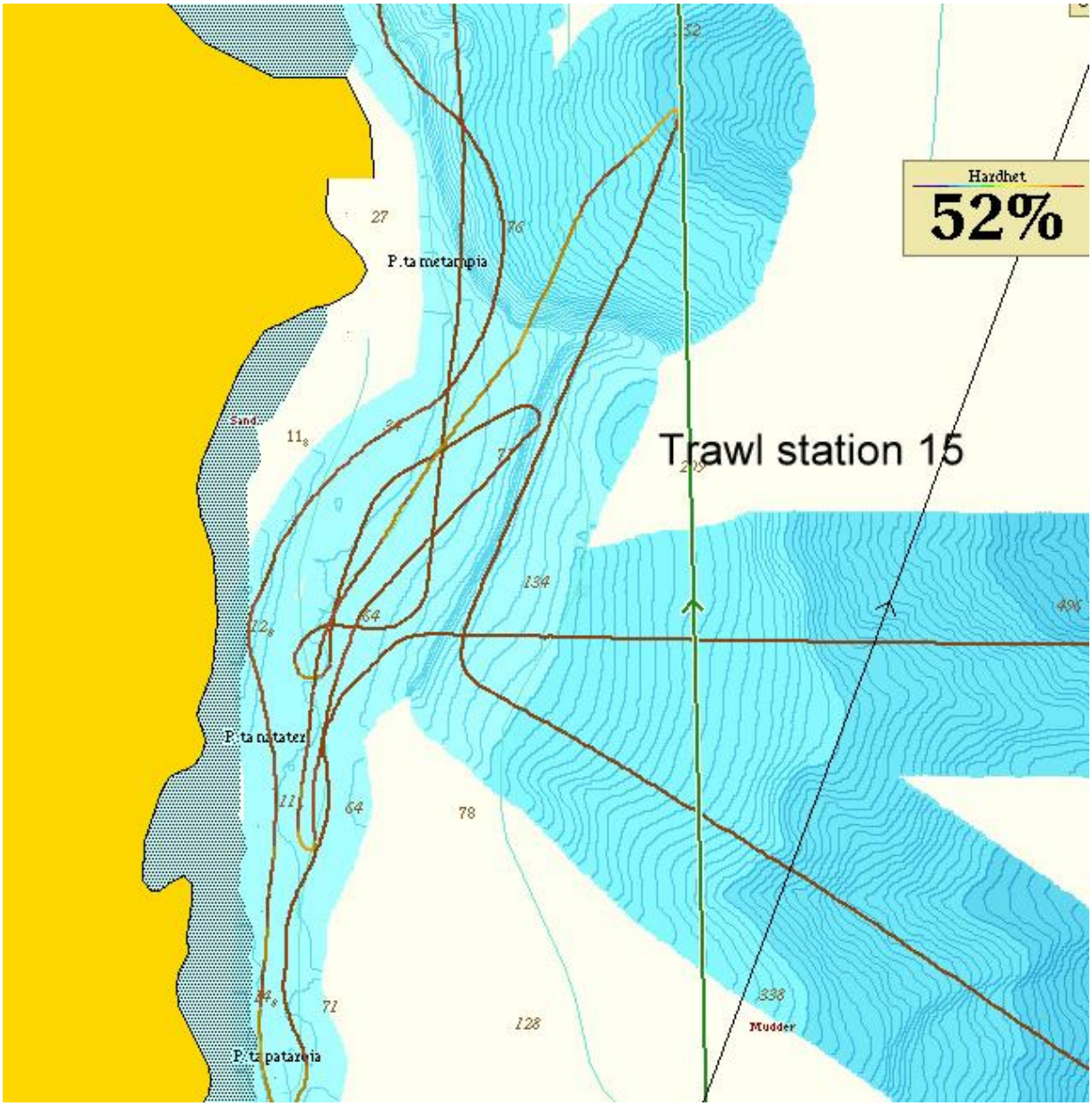
Stations where bottom trawling was carried out was noted in the bridge map computer. Printouts of the map-computer screen show the bottom conditions in the area of trawling.



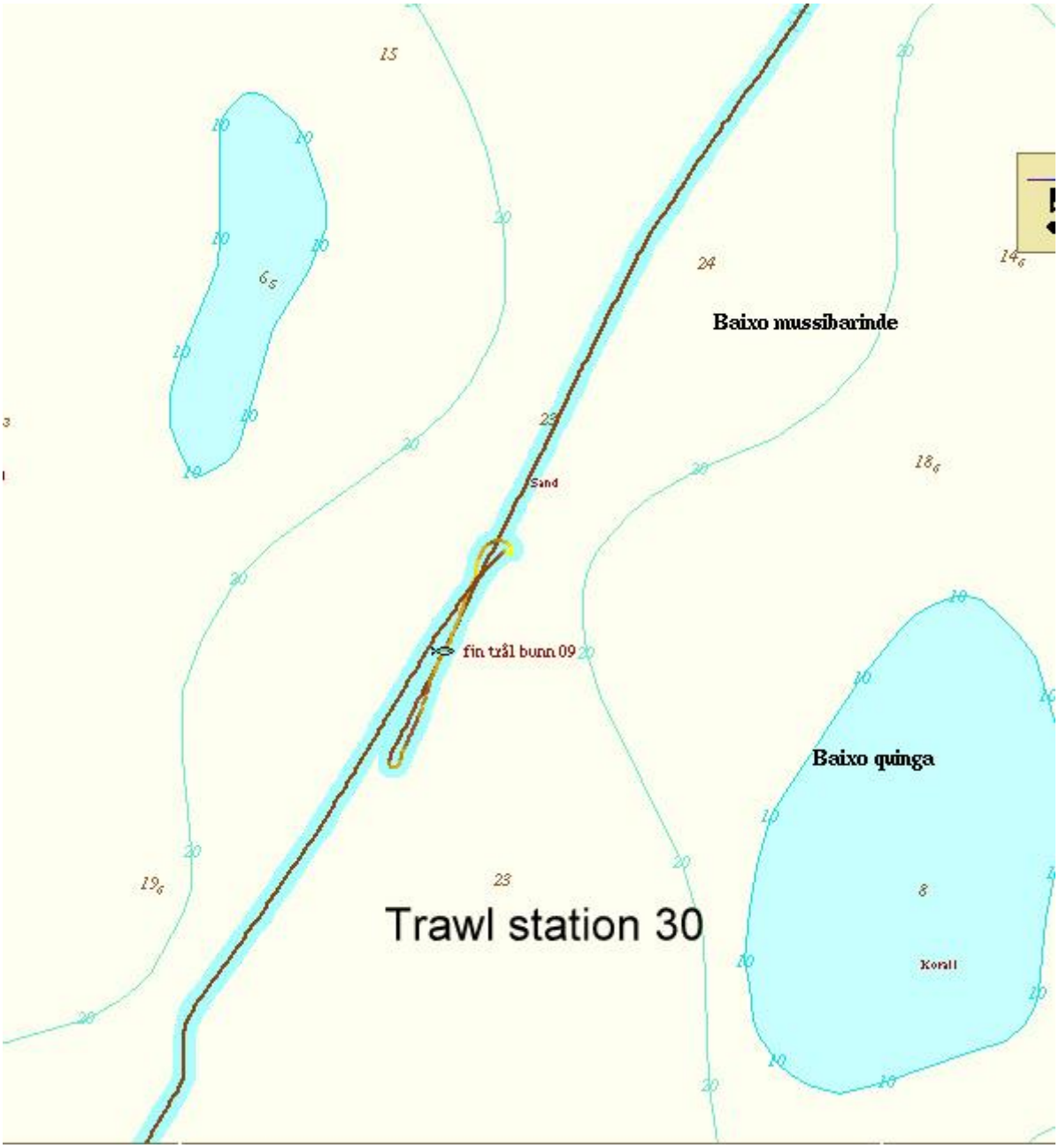
Annex Figure 1 Bottom trawl at station 7. Some rough ground was present and the trawl was torn towards the end of the haul. Future trawling may be possible with great care.



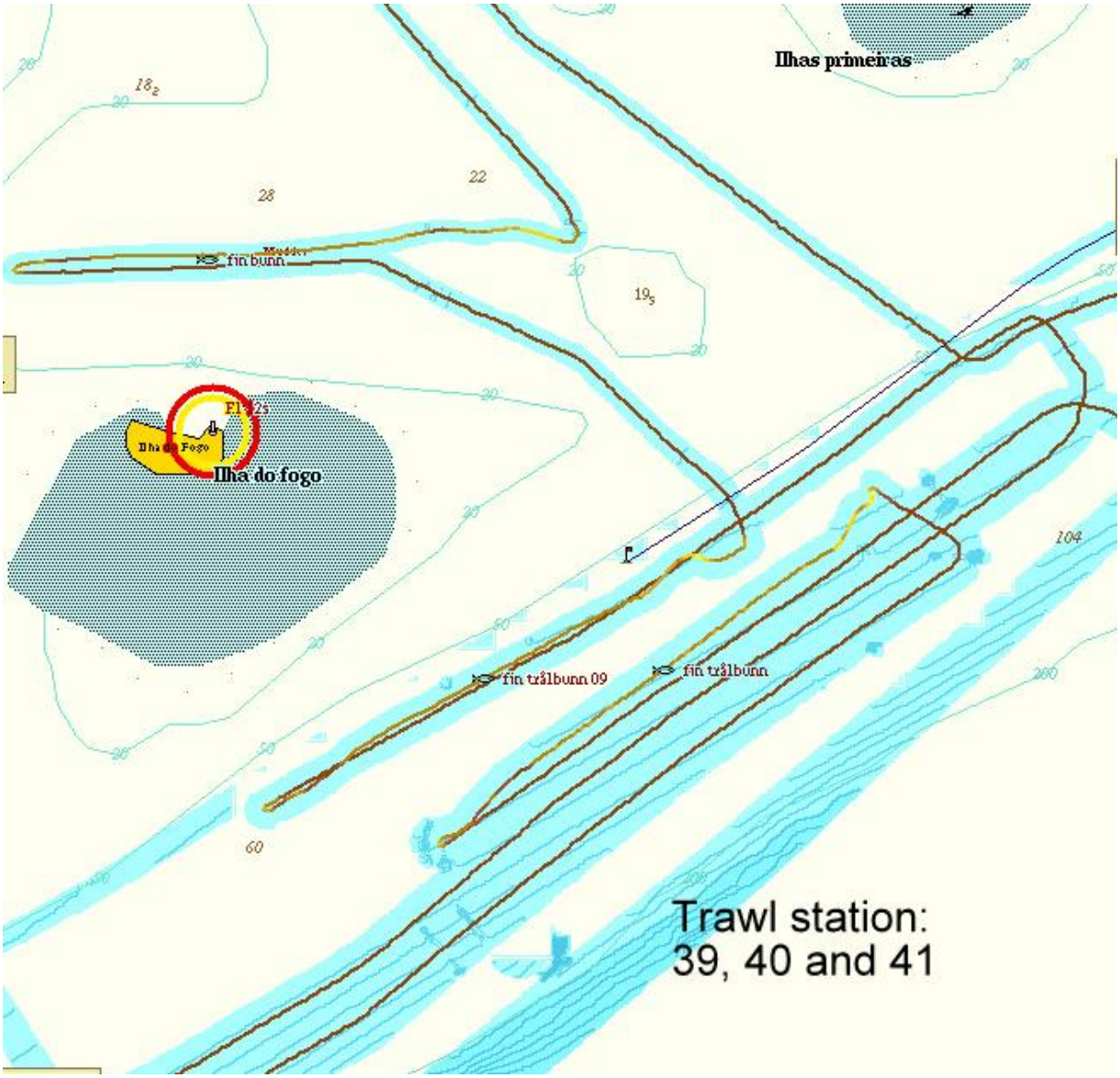
Annex Figure 2 Bottom trawl at station 9. Very hard bottom. No catch.



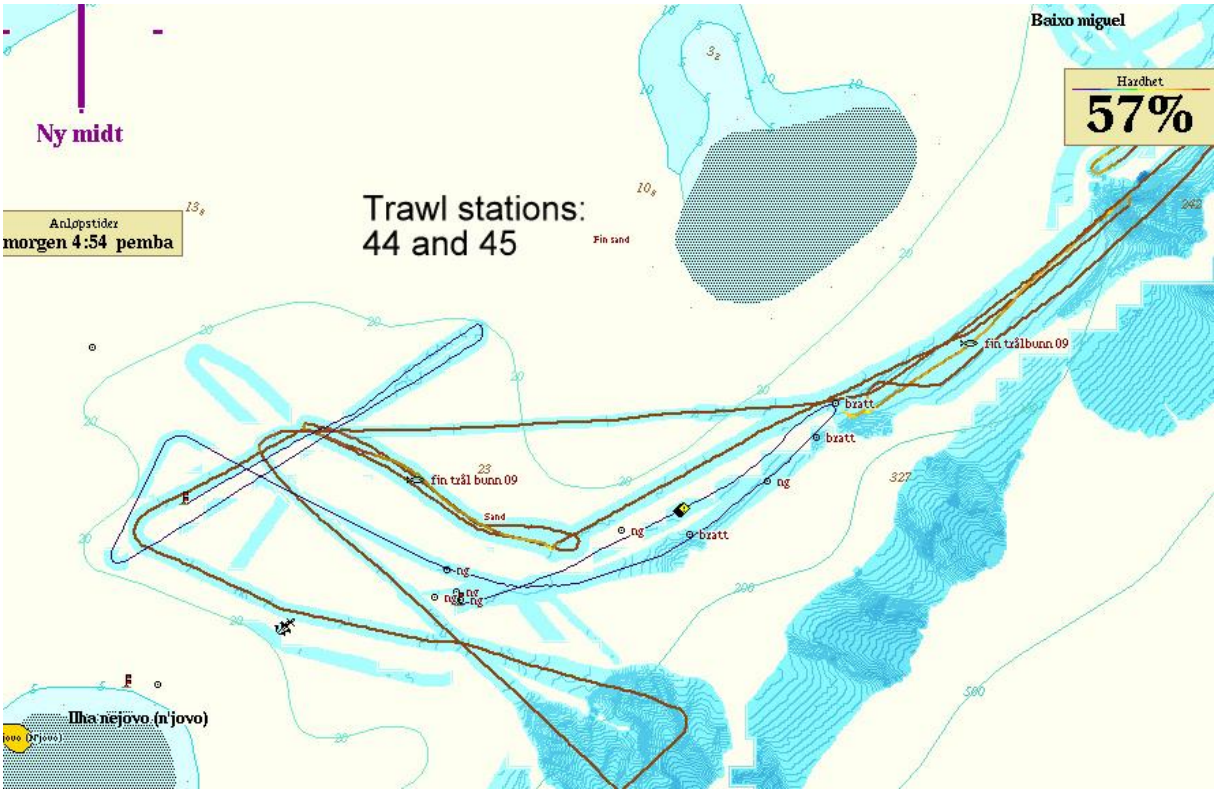
Annex Figure 3 Bottom trawl at station 15.



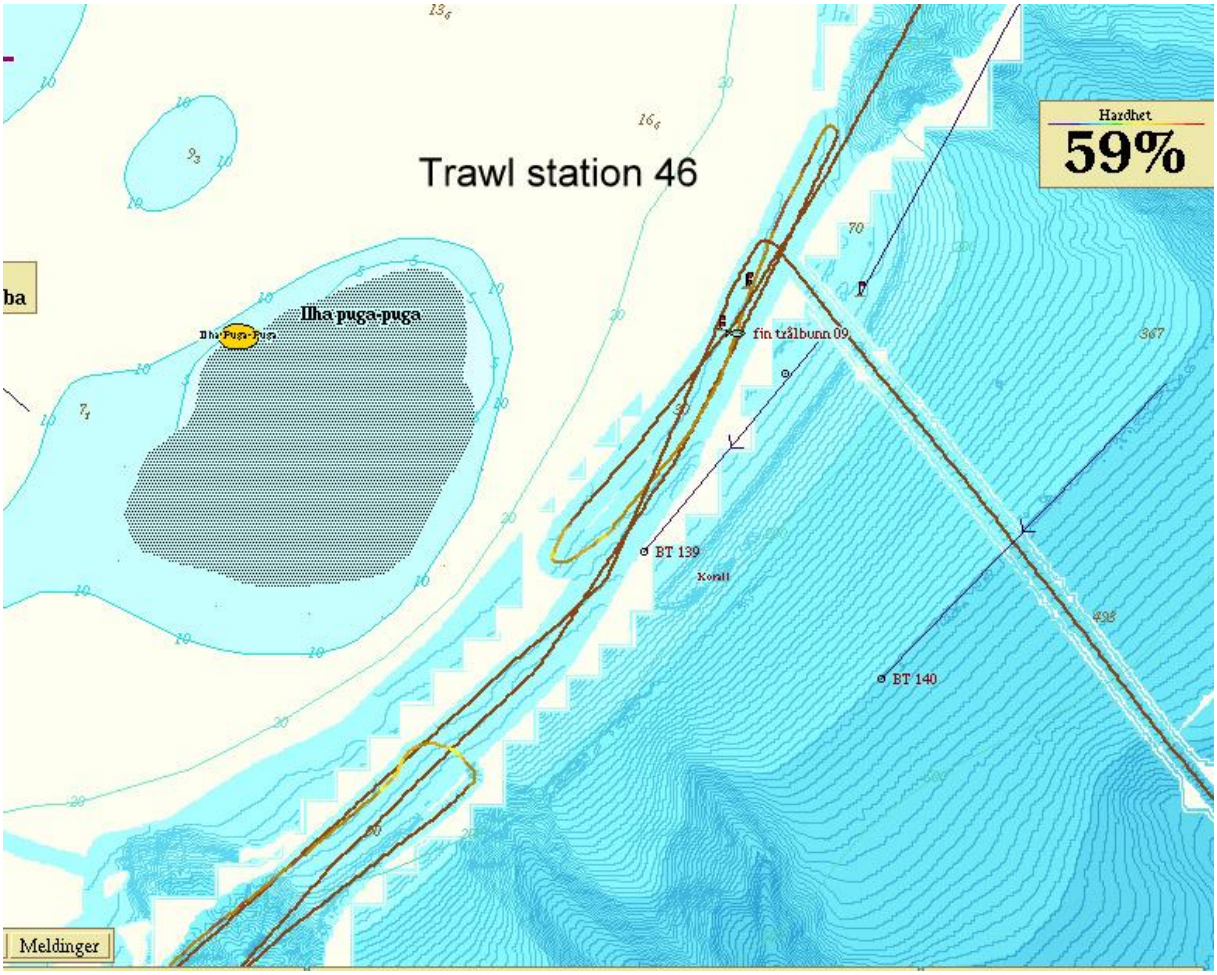
Annex Figure 4 Bottom trawl at station 30



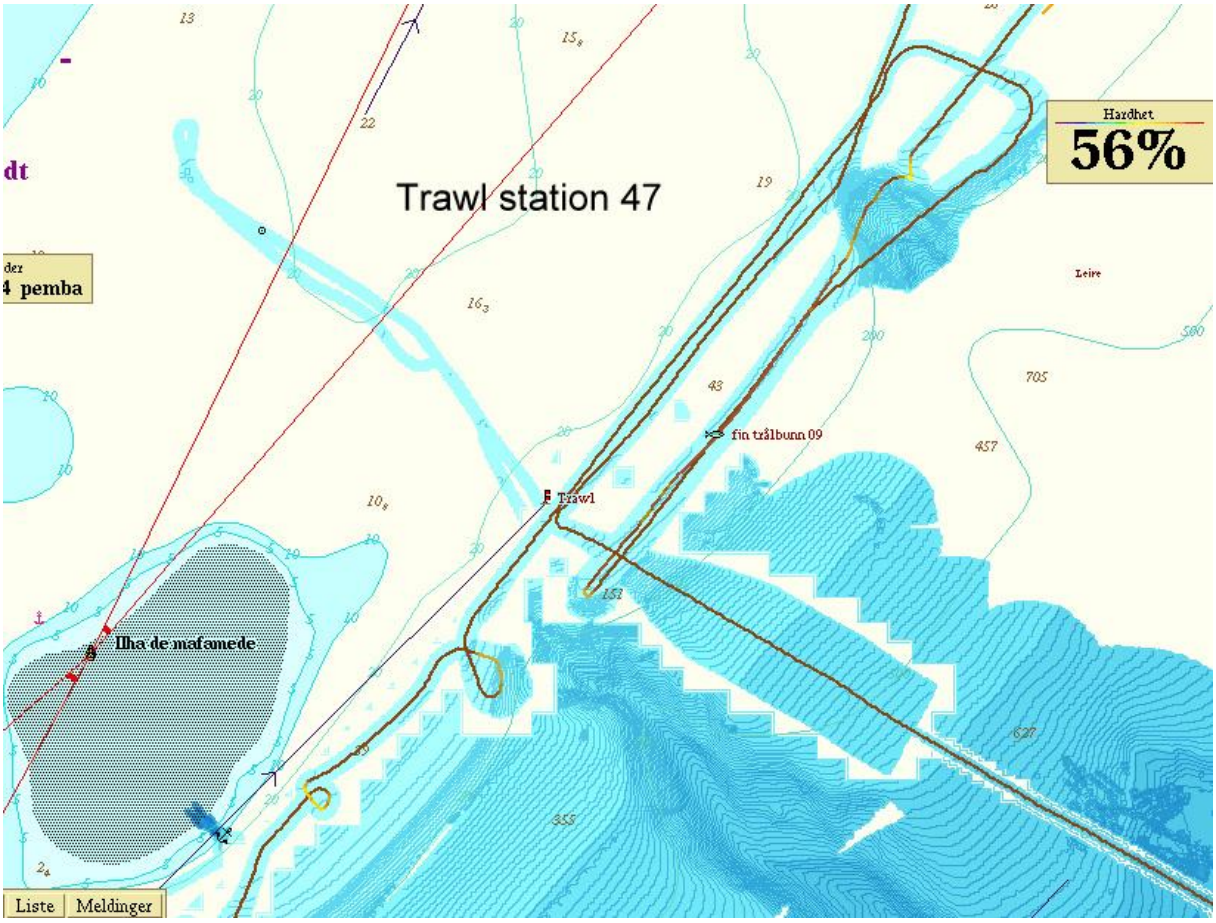
Annex Figure 5 Bottom trawl at stations 39, 40 and 41.



Annex Figure 6 Bottom trawl at stations 44 and 45.



Annex Figure 7 Bottom trawl at station 46.



Annex Figure 8 Bottom trawl at station 47.