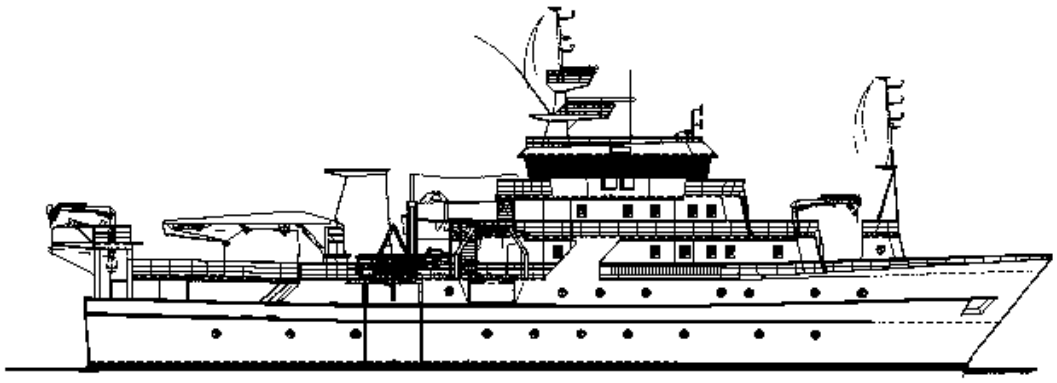
NORAD/FAO PROJECT GCP/INT/003/NOR **CRUISE REPORTS DR. FRIDTJOF NANSEN**
BCC PROJECT: LMR/NANSEN/1/10



A TRANSBOUNDARY STUDY OF THE PELAGIC FISH STOCKS OF SOUTHERN ANGOLA AND NORTHERN NAMBIA

BCC Cruise Report No 2/2012

Institute of Marine Research
IMR
Bergen

Instituto Nacional de Investigação Pesqueira
INIP
Luanda

A TRANSBOUNDARY STUDY OF THE PELAGIC FISH STOCKS OF SOUTHERN ANGOLA AND NORTHERN NAMBIA

BCC Cruise Report No 2/2012

22 September – 06 October 2012

by

Jens-Otto Krakstad[1], Aristóteles P. da S. Amaro[2] and Vaino Shigwedha[3]

[1)] Institute of Marine Research, Bergen, Norway
[2)] Instituto Nacional de Investigação Pesqueira, Luanda, Angola
[3)] National Marine Information and Research Centre, Swakopmund, Namibia

Bergen 2012

TABLE OF CONTENTS

Annex:

CHAPTER 1. INTRODUCTION

1.1. Objectives

The transboundary pelagic survey is a dedicated research survey covering the pelagic fish resources and hydrographical conditions in the region ranging from southern Angola to northern Namibia. The main focus of the work was to assess the biomass of all commercially important pelagic fish stocks in the transboundary region, with emphasis on the horse mackerel stocks. The overall ship time available, of twelve days, was integrated into the yearly pelagic survey of Angola conducted by the 'R/V Dr Fridtjof Nansen'. In order to be able to continue the coverage carried out as part of the Angolan effort and to utilize the ship time optimally, the survey was extended southwards in central Namibia to Dune Point at 20°15' S.

The overall transboundary area is defined from Ponta Albina, near Tombua (Angola), in the north (15°50' S) to the Cape Frio upwelling cell (Namibia) in the south (at around 19°00' S). The northern boundary is located at the northernmost part of the Tiger Bank, from where the continental shelf starts widening while the southern boundary represents a natural biological boundary in Namibian waters due to the presence of the massive upwelling cell near Cape Frio. Ecological delimiters also included the distributions of the species, *Sardinella* sp. and *Trachurus* sp. Based on these ecological delimiters, the northern boundary of the transboundary area could be described as the northern limits of the distribution of Cape horse mackerel, while the southern limits of the distribution of the Sardinellas and/or Cunene horse mackerel indicates its southern extend. The definition of the transboundary area here applied is expected to be wide enough as to cover the likely distribution area of fish migrating between Namibian and Angolan waters, at both warm and cold seasons.

The zone across the Angolan-Namibian border is particularly important as this area hosts co-occurring population of carangids, *i.e*. Cape horse mackerel, *Trachurus capensis,* and Cunene horse mackerel, *Trachurus trecae*, as well as clupeids, including sardine (Pilchard) *Sardinops sagax*, round herring (Redeye) *Etrumeus whiteheadi* and anchovy *Engraulis* spp. There is special concern about the situation in the transboundary area since these stocks are known to be in low abundance, while they are intensively fished in the border area. Cunene horse mackerel, *Trachurus trecae,* is said to be moving further south into the Namibian water than before and it also appears to be the same for Cape horse mackerel, *Trachurus capensis,* therefore this survey might confirm the suggested movement.

The main purpose of this survey was to map the distribution and estimate the abundance of the most commercially important pelagic species in the Namibia-Angola transboundary area during the cold season. The study complemented the pelagic survey carried out in Angola by extending the survey grid into Namibian waters. The survey and fish sampling strategy (pelagic and demersal trawling on acoustic targets) as well as the hydrographical mapping in the transboundary area follow the established standard for the yearly pelagic surveys in Angolan waters (Dr. Fridtjof Nansen Survey Report of the Angolan Pelagic Resources No. 2/2007), thus the transboundary survey provide a complete coverage of the Cunene horse mackerel, including the proportion of the stock present in Namibian waters at the time of the pelagic survey in Angola. For sardine and the other clupeids as well as Cape horse mackerel, however, the survey would not cover the entire distribution area of the species.

The estimates presented are relative indices of the proportion of the stock units distributed within the transboundary area at the time of the survey, not absolute estimates of abundance, and so the population estimates should not be interpreted in absolute terms. For sardine, Cape horse mackerel and other pelagic (clupeids) the estimates do not cover the entire distribution of the sardine stock, of which *e.g*. sardine is known to migrate between Angolan and Namibian waters, and differences from one year to another may well be caused by migration patterns rather than population changes. As for all acoustic estimates, the indices presented here are prone to survey errors such as statistical sampling errors, vessel avoidance and the availability to acoustic sampling (Anon. 2003, 2004).

1.2. Objectives

The main objectives of the survey were the following:

- To map the distribution and estimate the abundance of the most commercially important pelagic species in the Namibia-Angola transboundary area (15°50-19°00'), following the survey design utilized in Angolan waters (6 n.mi spacing between transect lines), with special emphasis on the two horse mackerel Cunene horse mackerel (*Trachurus trecae)* and Cape horse mackerel (*Trachurus capensis)*, sardine "Pilchard" (*Sardinops sagax)* and other small pelagic species, including anchovy (*Engraulis capensis)* and round herring (*Etrumeus whiteheadi)*.

- To map the distributions and estimate the abundance of the same species in central Namibia south to Dune Point (20°15' S), following the established survey design with 10 n.mi spacing between the transect lines.

- To study and analyse the biological state of the main species, including length frequencies, length-weight relationships, reproductive stages and length-at-maturity.

- To map the meteorological and hydrographical conditions in the survey area by means of continuous recordings of weather data such as Sea-surface temperature (SST), Sea-surface salinity (SSS), wind speed and direction, using CTD-casts (Temperature, Salinity and Oxygen).

1.3. Participation

The following scientific staff participated in the survey:

From INIP, Angola:
Aristoteles P. Da S. Amaro (Angolan team leader), Bomba Basíca Nsangolay, João Morais Domingos, Antonio Buco, Eridson Saquenha, Marisa F. De N. Macueria, Fátima Delicado, Geraldina Salvador and Eusébio Dos Santos.

From NatMIRC, Namibia:
Vaino Shigwedha (Namibian team leader) and Justine Kakuuai.

From IMR, Norway:
Jens Otto Krakstad (cruise leader), Diana Zaera, Tore Mørk and Jarle Kristiansen.

1.4. Survey schedule and effort

A full transceiver calibration of the 18, 38 and 120 and 200 kHz transducers was carried out prior to the survey. The calibration was done in Baía dos Elephantes, Angola, on 18th of September. The 200 kHz transducer was malfunctioning and no calibration was attempted. The vessel completed the pelagic survey in Angola, including the Angolan part of the transboundary area, and reached the Angolan-Namibian border at the Cunene River (17°15' S) on the 25th of September. The coverage of the transboundary area south to Rocky Point at 19°00'S was completed on 3nd October. The survey was extended southwards and it ended at 20°15'S the 4th October, where the course track was then completed. The vessel docked in Walvis Bay 5th October in the evening.

Figure 1 shows the cruise track with pelagic and demersal trawl stations and CTD stations in the transboundary survey area (15°50'-19°00' S) and Northern Namibia (19°00'S -20°15' S). The survey effort in terms of distance sailed, stations trawled and CTD stations are summarised in Table 1 below.

Table 1. Summary of survey effort, including number of demersal (BT) and pelagic (PT) trawl haul deployments, CTD casts and distance surveyed (Log, in n.mi).

Area	BT trawls	PT trawls	Total trawls	CTD casts	Log distance (n.mi)
Transboundary Angola (15°50'S - 17°15' S)	8	7	15	25	181.04
Transboundary Namibia (17°15'S -19°00' S)	13	12	25	28	957.54
Northern Namibia (19°00'S -20°15' S)	5	1	6	8	523.54
Total	**26**	**20**	**46**	**61**	**1662.12**

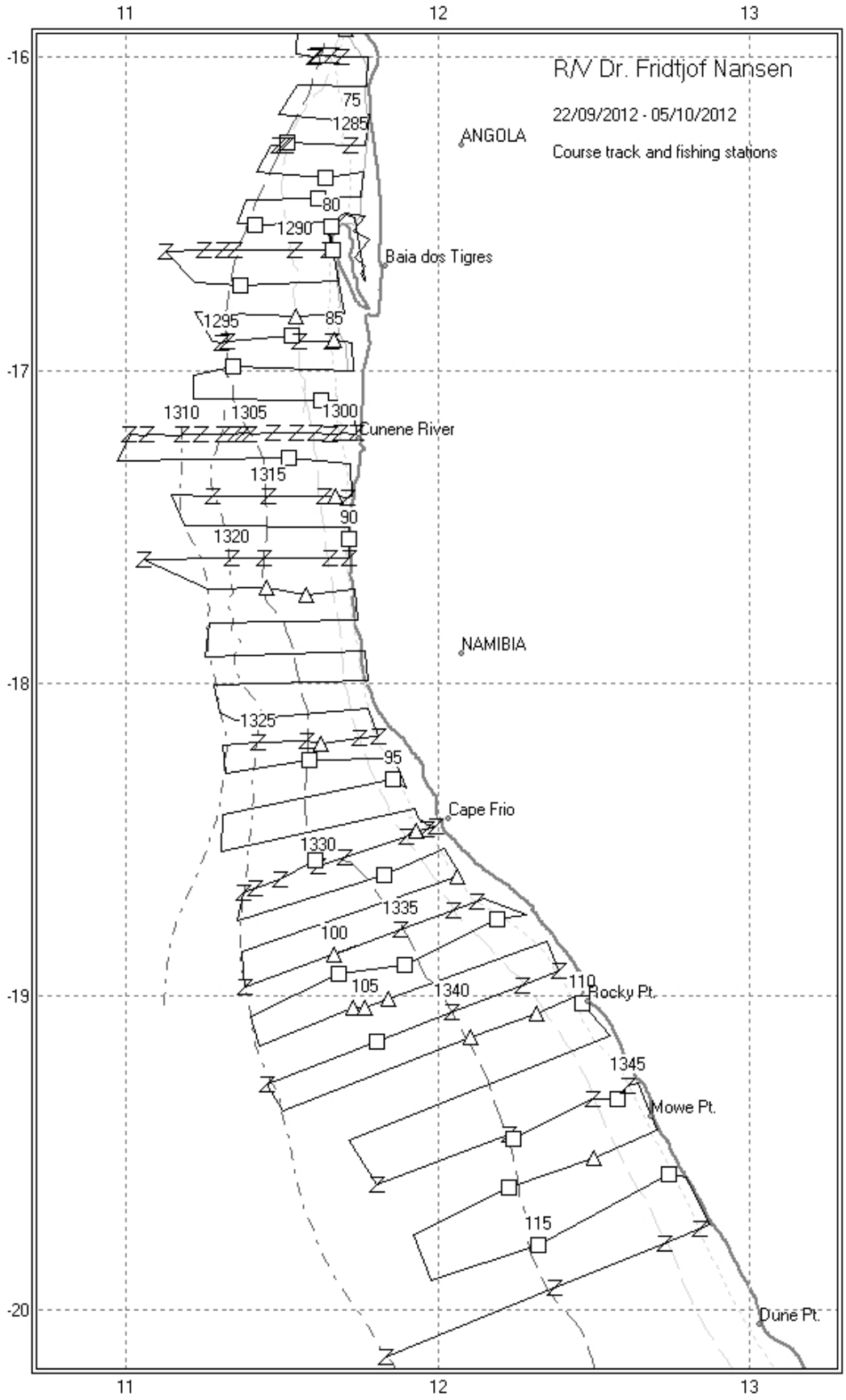


Figure 1 Course track with pelagic and demersal trawl stations and CTD stations in the trans-boundary area (15°50'-19°00' S) and Northern Namibia (19°00'S -20°15' S)

CHAPTER 2. MATERIALS AND METHODS

2.1. Survey grid

The survey design of equidistant pseudo-parallel transects (6 nautical miles apart) perpendicular to the coastline, as applied in Angola, was also followed in the extension into Namibian waters (Fig. 1), following the established practice for the transboundary surveys. Transects generally covered a depth range of 20-500 meters. As in previous surveys, some of the lines had to be stopped at 30-35 m depth due to the steeply inclining bottom near the shoreline. A few transect lines in the border area from the Cunene River to Cape Frio were extended to the 2000 m isobaths in order to check for possible offshore aggregations of horse mackerel. This strategy ensured that the Namibian component of the transboundary area was covered in a way that was comparable to the data already collected in Angola. In this way, distribution maps and biomass estimates could be drawn across the border area.

2.2. Acoustical sampling

A standard sphere calibration was carried out at Baía dos Elephantes in Angola, on 18th of September 2012, before commencement of the survey. Standard calibration procedures were followed using the appropriate calibration spheres (18, 38 and 120 and kHz). The 200 kHz transducer was malfunctioning during the survey and no calibration was attempted. There were no significant deviations from the previous calibrations and subsequently no changes in the calibration parameters were made prior to the survey. The acoustic recordings were conducted using two Simrad ER 60 echosounders with keel mounted transducers at nominal operating frequencies of 18, 38 and 120 kHz. The technical specifications and operational settings of the echosounder used during the survey are given in Annex III.

Acoustic data were post-processed using the latest acoustic data post-processing software, the Large Scale Survey System (LSSS) Version 1.61. The mean 5 n.mi area backscattering coefficients s_A (m^2/n.mi^2) were allocated to a predefined set of acoustic target groups on the basis of characteristic echogram features in conjunction with information about the species - and size compositions - as derived from the trawl catches. Definitions of the acoustic target groups are given in Table 2 below.

Table 2. Allocation of acoustic backscattering coefficients to acoustic target groups and their definitions. Note that for horse mackerel and pilchard all encountered species are listed, while only examples are listed for the remaining groups.

Acoustic group	Taxonomical group	Species
Horse mackerel	*Trachurus* sp.	*T. trecae* *T. capensis*
Sardinella	*Sardinella* sp.	*S. aurita* *S. maderensis*
Pilchard	Sardinops	*Sardinops sagax*
Pelagic species 1	Clupeiformes$_1$	*Engraulis capensis* *Etrumeus whiteheadi*
Other demersal species	Sparidae$_2$	*Dentex macrophthalmus* *Pagellus bellottii*
	Others	*Merluccius spp.* *Brama brama* *Chelidionichthys capensis*
Mesopelagic species	Myctophidae$_3$ Lantern fish$_3$	
	Other mesopelagic fish	
Plankton		

$_1$: other than *Sardinops* sp.; $_2$: other than *Trachurus* sp.; $_3$: main species group.

2.3. Estimation of fish abundance

The following target strength (TS) to length relationship was used to convert mean area backscattering coefficient s_A (m^2/n.mi^2) at 38 kHz to number of fish:

$$TS = 20 \log L - 72 \text{ (dB)} \quad (1)$$

Or

$$C_F = \frac{10^{7.2}}{4\pi} \cdot L^{-2} \quad (2)$$

where C_F is the conversion factor from acoustic density to fish biomass and L is the mean total fish length. This target strength function was originally established for North Sea herring, but has later been attributed to clupeids in general (Foote *et al.* 1986, Foote 1987). No specific target strength relations presently are available for the species at hand, and equation (2) has therefore been applied consequently for all targeted species in this time series, following the established practice in the Namibian and Angolan national surveys. All estimates should consequently be considered as relative indices of abundance. The biomass was calculated by multiplying the number of fish by the expected length at weight, as estimated by regression of the log-length (total) against total weight.

The boundaries of encountered fish aggregations (post strata) were determined by means of contouring within the inner and outer zero-value limits of the transect lines using the Nansis

Maptool software. Unfortunately, severe problems with the Nansis Maptool software precluded the definition of the aggregation polygons which considerably delayed the process of finalizing the abundance estimates. Distribution plots and areal calculations on the strata were carried out using IDL 5.6 for MS Windows. Sub-stratification was used to isolate areas of similar densities, using the following pre-defined, standard categories: 1: s_A = 0-300; 2: s_A = 300-1,000; 3: s_A = 1,000-3,000; 4: s_A > 3,000. Mean 5-n.mi integrator values (s_A) computed along the transect lines were re-averaged for each stratum. The overall length frequency distributions within strata were estimated by weighting the sample-distributions with the nearest valid 5 n.mi integrator value, or the average of two adjacent values. The total number of fish in each length group was estimated as:

$$\rho_i = \frac{< s_A > t_{i,j} \cdot u_i}{\sum_i \frac{u_i}{C_{Fi}}} \cdot A_s = \frac{10^{7.2} \cdot t_{i,j} \cdot u_i \cdot < s_A > \cdot A_s}{4\pi \sum_i u_i \cdot (L_i + 0.5)^2} \qquad (3)$$

where:

ρ_i	=	estimated number of fish in length group i
$<s_A>$	=	mean recorded area backscattering coefficient (m^2/n.mi^2)
$t_{i,j}$	=	proportion of species j sampled in length group i
u_i	=	proportion of fish sampled in length group i
A_s	=	horizontal area of stratum s
C_{Fi}	=	conversion factor for length group i
L_i	=	length group i (nearest full cm below total length)
L_i+0.5	=	mean length in L_i.

2.4. Trawl sampling procedures

Targeted trawling was carried out on identified acoustic targets using the smallest pelagic sample trawl (10 m vertical opening), the mid-sized pelagic sample trawl (12 m) and the demersal sample trawl (5 m). Samples were taken in baskets on deck and weighed, and the number of fish of each species was determined from a subsample of the collected sample.

Scanmar sensors provided real-time information of the depth of the head rope, the vertical opening of the mouth of the trawl and the clearance between the ground gear and the bottom. The trawl eye and catch sensor gave information of fish entering into the trawl and the catch retained in the codend, respectively.

All trawl catches were sampled for species composition by weight and numbers. Records of catch rates are given in Annex II. Other species (mostly of commercial value) were collected and identified to species level and length measurements were taken (Table 2).

2.5. Biological sampling

Samples of the main target species *Trachurus capensis*, *Trachurus trecae* and *Sardinops sagax*, as well as *Etrumeus whiteheadi* and *Engraulis capensis* were collected and measured for length and weight. Total length and body weight were determined to the nearest cm and g below, respectively. Sex and reproductive stages were determined by means of macroscopic examination, scoring each fish according to the six-point classification scale used during Angolan national surveys (Annex IV). Length-weight relationships of target species were

determined from the regression analysis (power fit, a, b) of the total weight to the total length recorded for all sampled specimens.

$$\mathbf{W} = a\,\mathbf{L}^{b}$$

2.6. Meteorological and hydrographical sampling

Wind direction and speed, air temperature, global radiation and sea surface temperature (at 5 m depth) were recorded using the Norwegian Meteorological Institute's (DNMI) meteorological station on board. Values averaged over 10 min intervals were logged continuously. The weather station data were logged continuously throughout the survey. The results presented in this report are based on a standard output from the logging system, *i.e*. one nautical mile averages along the ship's track.

A Seabird 911+ CTD probe was used to obtain vertical profiles of the temperature, salinity and oxygen. Real time logging was carried out using the PC based Seabird Seasave software. CTD casts were conducted along the cruise track in transects at CTD lines with 60 n.mi distance and on every 2nd transect at 200, 100 and 50 m depths. The casts were stopped a few meters above the bottom.

Hydrographical sections were carried out at Pta. Albina, Baía dos Tigres, Cunene River (17°15' S), Cape Frio and at standard sections.

CHAPTER 3. OCEANOGRAPHIC CONDITIONS

3.1. Wind

The wind field in the southern region (Figure 2) was dominated by north-eastwards winds parallel to the coast, and condition were favourable for upwelling, except in the areas of southern Namibe where the winds took a deflection to the coast. In the area between Namibe and northern Baía dos Tigres, the winds were moderate with an average speed of around 10m/s (20 knots). The weakest winds (≥ 3 m/s on average) with variable direction and speed were recorded in the vicinity of Baía dos Tigres. The strongest winds were recorded from Cunene River to Rocky Point with an average speed at around 20-22 m/s (40-45 knots), except in the Cape Frio area where wind stress were weak (5 m/s) however permanently parallel to the coast.

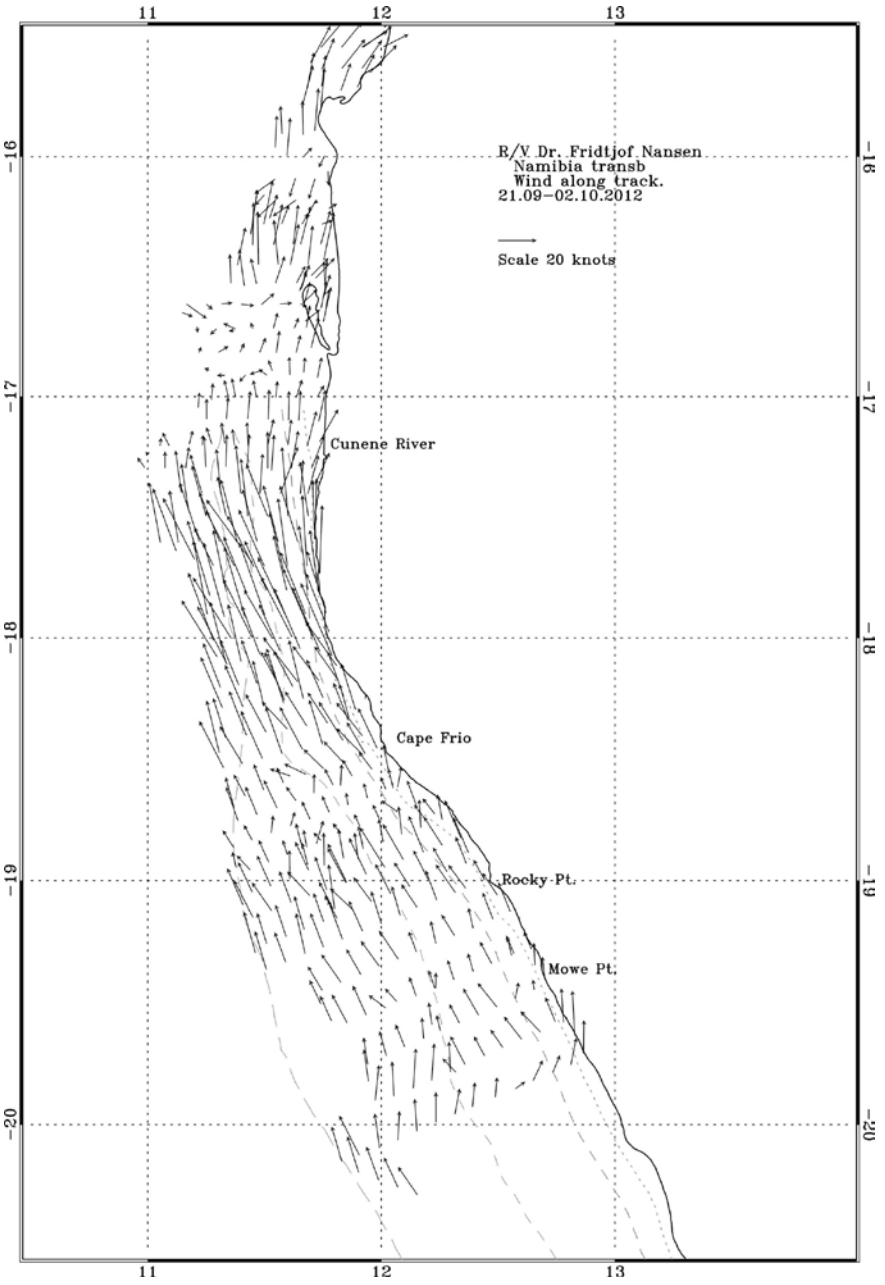


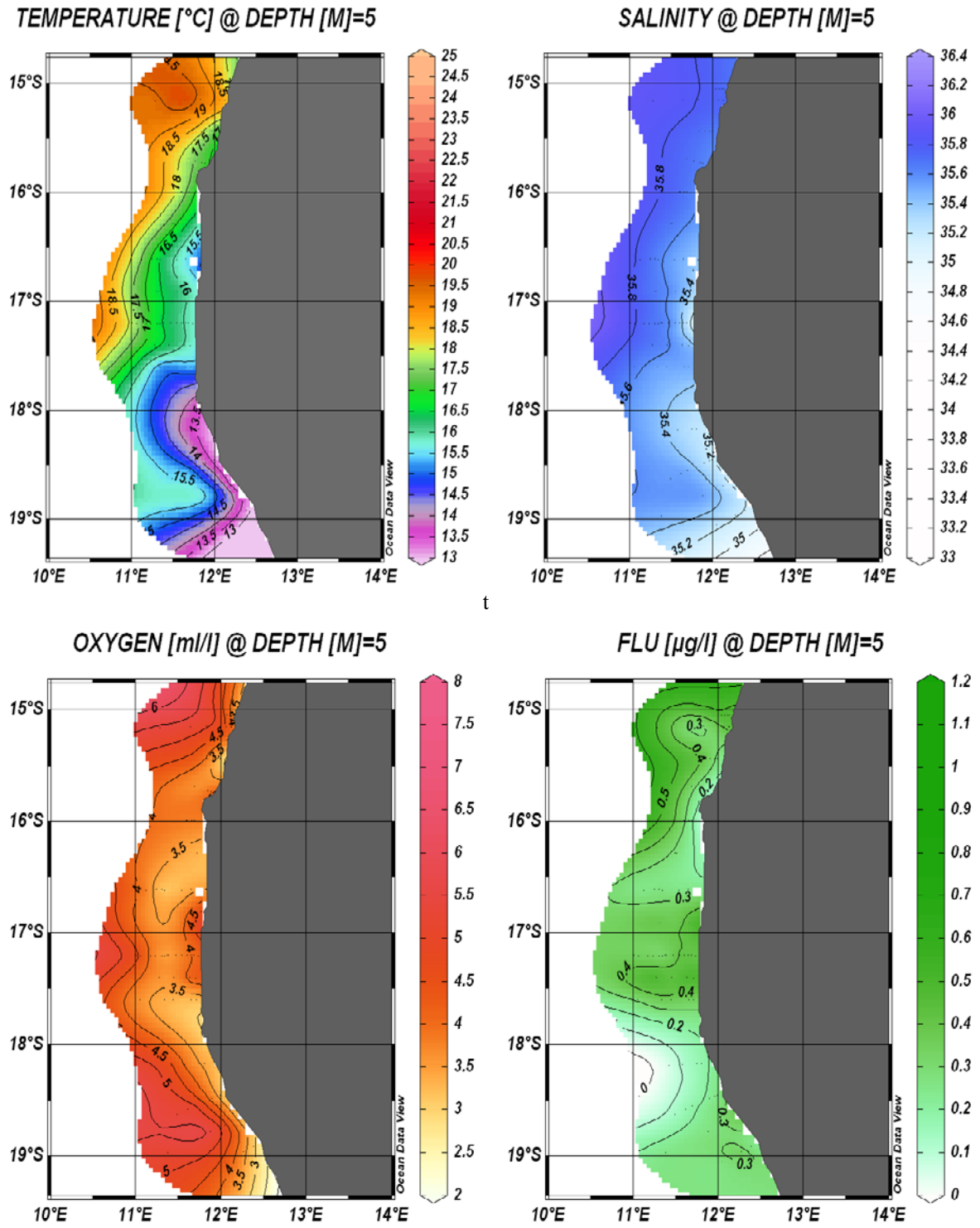
Figure 2 Wind stress recorded in the transboundary area (15°50'-19°00' S) during the survey.

3.2. Surface distributions of temperature, salinity, oxygen and fluorescence

Figure 3 describes the sea surface of temperature (°C), salinity, the dissolved oxygen and fluorescence recorded at 5 m depth. The Angola-Benguela Frontal Zone (A-BF) was located between Namibe and south off Cunene River area (15° - 17°50S).

The sea surface temperature and sea surface salinity in the north off transboundary area (15° - 17° 25'S) were characterized by high values, T>19.5 ºC and S>35.6, respectively. The offshore sea surface waters were richer in oxygen content than the inshore water. The coolest waters (13 °C) were found inshore from 17º 50'S to Rocky Point (19°20' S), indicating an intensive upwelling. In this parcel off the transboundary area, oxygen levels were lowest (3-3.5ml/l) inshore and also showed the lowest surface fluorescence (< 1 µg/l) offshore off Cape Frio. In the same area it was recorded the lowest salinity (35.2). The major biological activities were recorded off the northern part of the transboundary area, with values around 0.4-0.5 µg/l.

The spatial distribution of the oceanographic parameters (Figure 4) tends to present a scenario of coastal waters very homogeneous, and this homogeneity is mirrored by a value representative of temperature, salinity and fluorescence in a very wide radius. Most of the continental shelf was represented by isolines of temperature around 13.5 °C, salinity of 35.2 and fluorescence of 0.3µg/l. The lowest fluorescence value (0.1µg/l) was recorded in the southern part of the area investigated



t

Figure 3 Sea surface temperature (°C), salinity, oxygen content and fluorescence, at 5 m depth, in the transboundary area (15°50'-19°00' S) derived from the CTD stations.

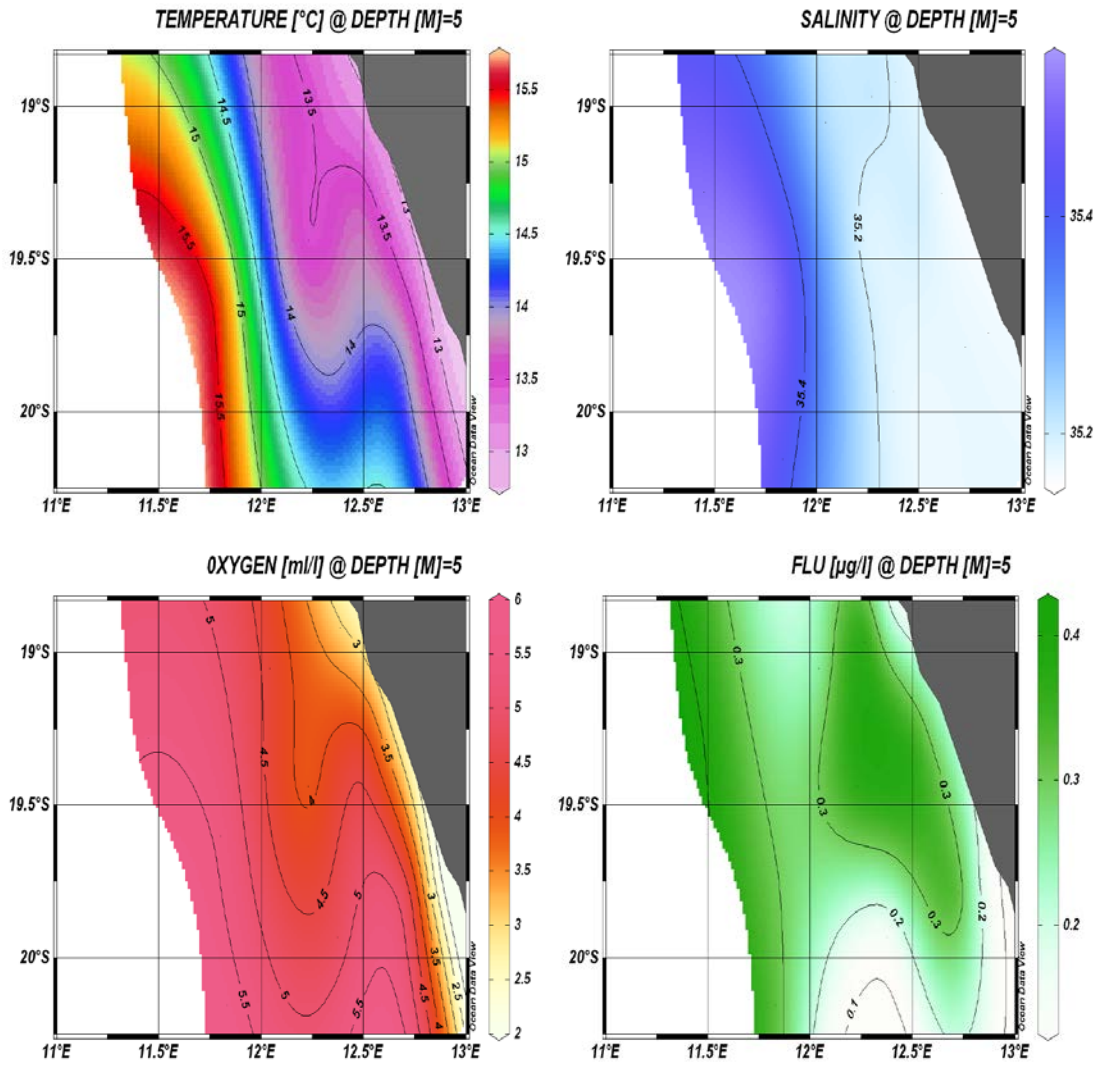


Figure 4 Sea surface temperature (°C), salinity, oxygen content and fluorescence, at 5 m depth, in the transboundary area (15°50'-19°00' S) derived from the CTD stations.

3.3. Vertical hydrographical sections

Namibe

The environmental parameters of the Namibe section showed the same distribution pattern as the section of Cabo Santa Marta, signs of upwelling and sinking isolines possibly caused by the shape of the seabed. The temperature decreased gradually in the water column from the surface (20^{0}C) to the bottom (10^{0}C). Salinity decreased also gradually with depth, with the highest salinity (35.8) offshore and lowest (34.8) at 500 m depth. The surface waters were rich in oxygen (5.5 ml/l) with high fluorescence values (0.4-0.5 µg/l). The minimum oxygen content (0.5 ml/l) was found in a layer at around 370-470 m.

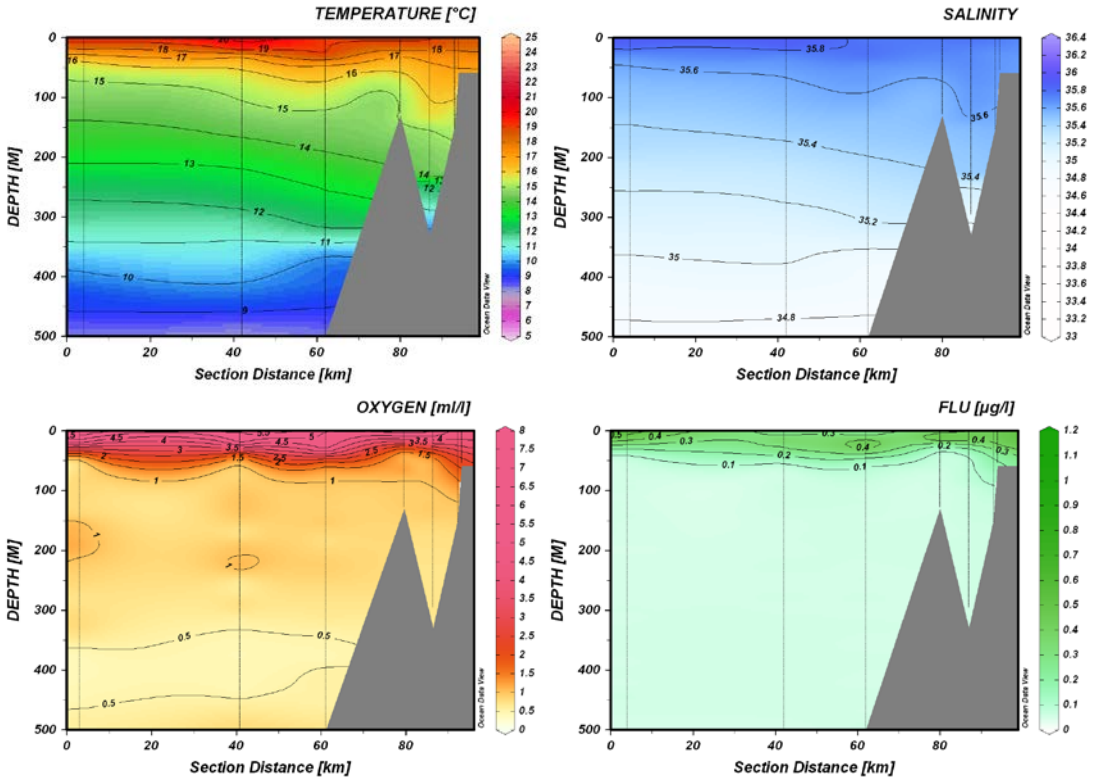


Figure 5 - Vertical sections of temperature, salinity and dissolved oxygen off Namibe.

Pta. Albina

There were few CTD stations for this area, therefore no plot was made.

Baía dos Tigres

The Baía dos Tigres section was the only section in the north part of transboundary area with low values of temperature (16 ^{0}C) and salinity (35.6) on the surface. The surface and subsurface layers were very homogeneous as noted in the Tombwa section. The areas with higher oxygen values were consistent with the areas of greatest biological activity.

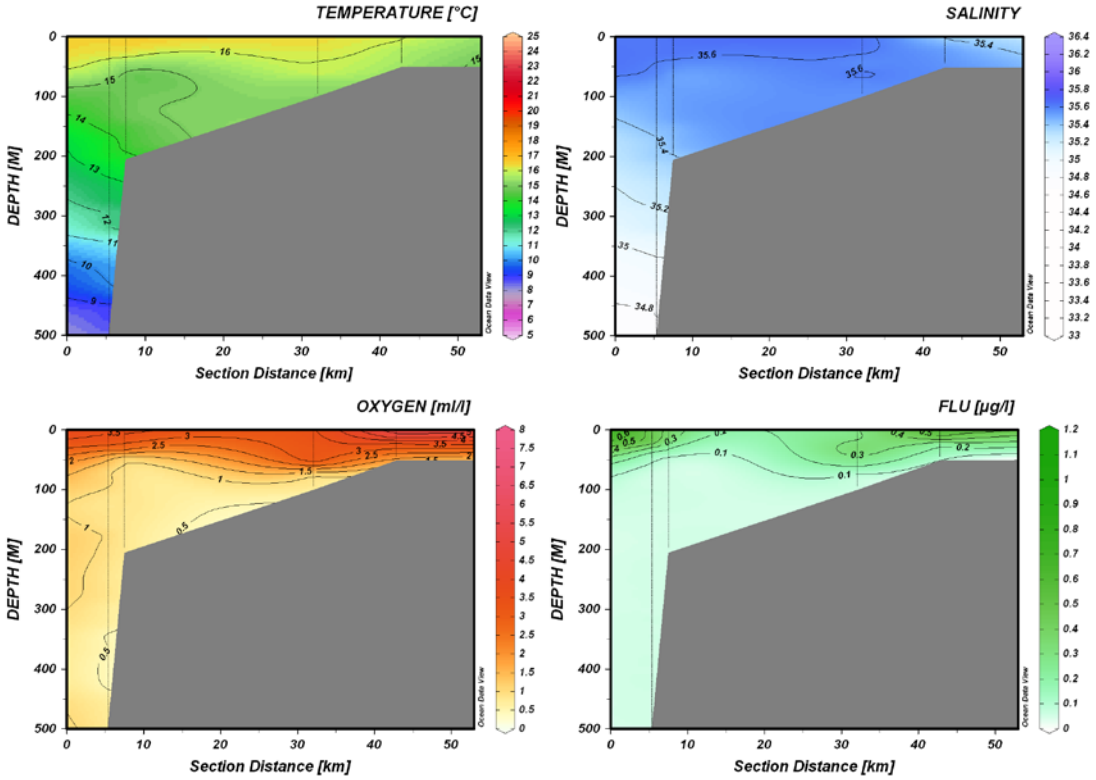


Figure 6 - Vertical sections of temperature, salinity and dissolved oxygen off Baía dos Tigres

Cunene River

The Cunene section showed signs of coastal upwelling characterized by the marked lifting of both isotherms and isohalines, as well as by turbulence observed in the water column. The surface temperature ranged from 17°C offshore to 16°C inshore, being this isotherm the dominant one the entire surface layer. The salinity and oxygen also showed the same distribution pattern as the temperature. The highest values were found offshore while the lowest values were inshore. Intense biological activity was recorded on the continental shelf with fluorescence values around 0.4µg/l. and 0.5µg/l.

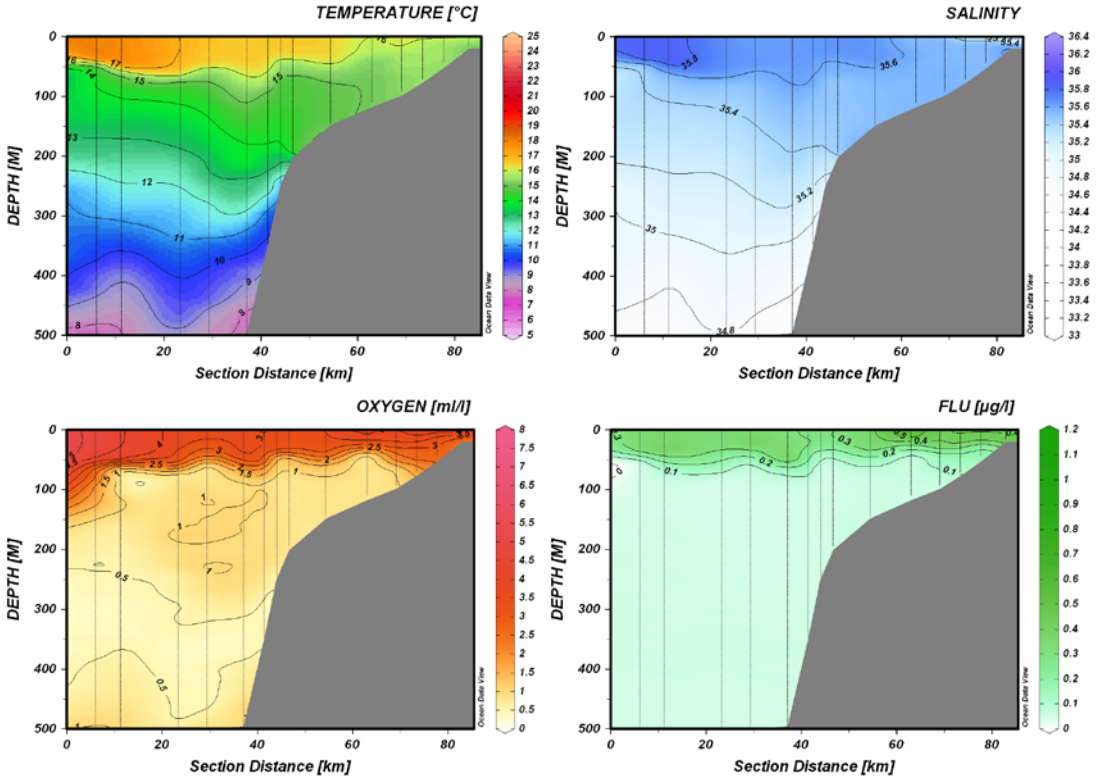


Figure 7 - Vertical sections of temperature, salinity and dissolved oxygen off Cunene River.

Cape Frio

The Cape Frio column water masses (Figure 8) showed a similar behaviour in terms of the vertical distributions of temperature, salinity and oxygen with signs of intensive upwelling characterized by the accentuated uplift of the isolines. Surface temperature ranged from <14°C inshore to 15°C offshore, while surface salinity levels varied between 35.3-35.5. Water masses shallower than 100 m were richer in oxygen content with values around 4-5 ml/l and the major biologically activities occurred in the vicinity of the extreme offshore and inshore stations. Another interesting feature observed was the sinking of the oceanographic salient isolines on the continental shelf.

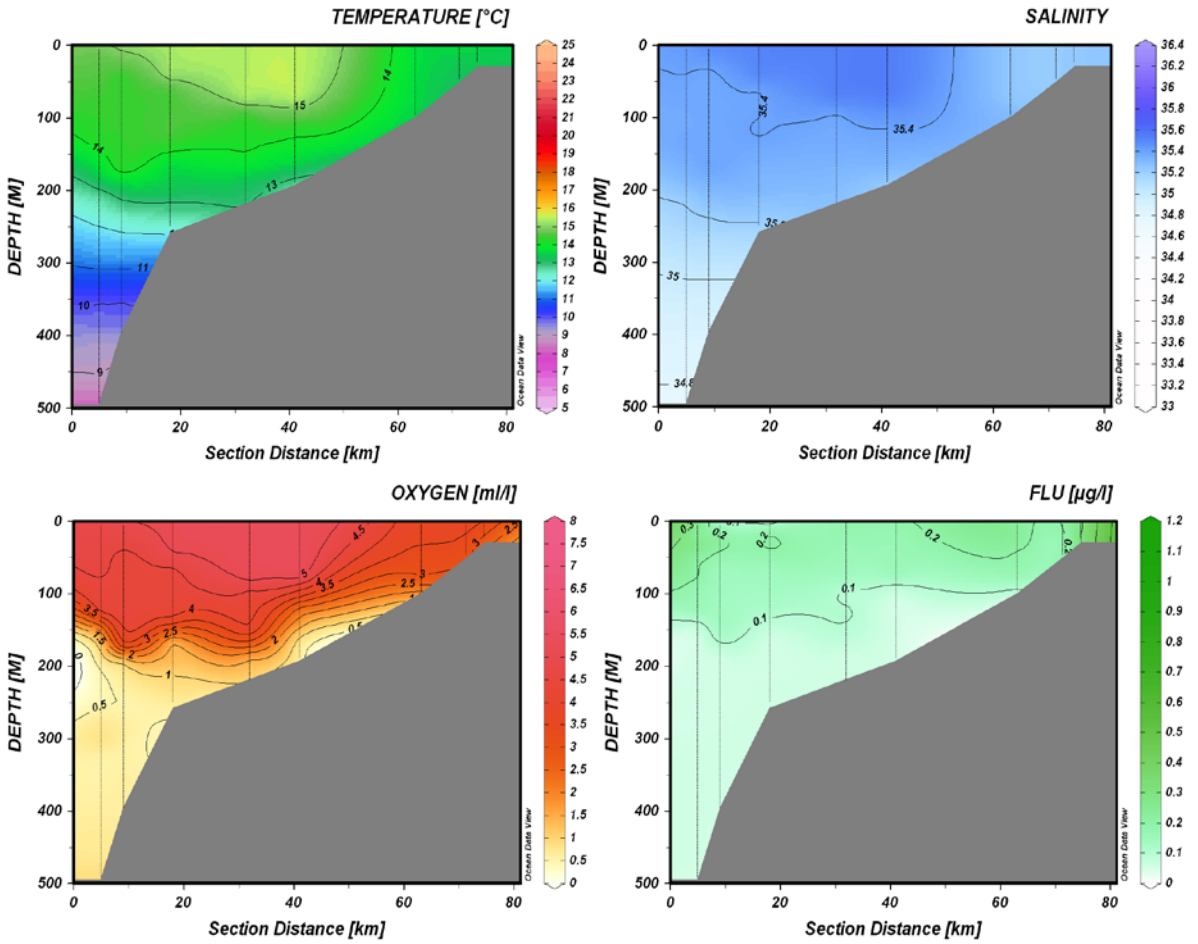


Figure 8 - Vertical sections of temperature, salinity, dissolved oxygen and fluorescence off Cape Frio.

Rocky point and Dune Point

The oceanographic conditions were similar both in Rocky Point (Figure 9) and Dune Point (Figure 10) sections, in which it was observed the occurrence of upwelling of subsurface waters revealed by uplift of isolines from 200m to the surface. The surface temperature ranged from 15 ºC to 13 ºC offshore to inshore. While the salinity at the surface ranged from 35.4 offshore to 35.2 inshore. The 0-200 m layer was richer in oxygen ranging 5.5 ml/l at surface and 1 ml/l in 200m depth. The greatest biological activities (0.2 – 0.3µg/l) were recorded in the stations of the ends of each section, *i.e*. in offshore and inshore, respectively.

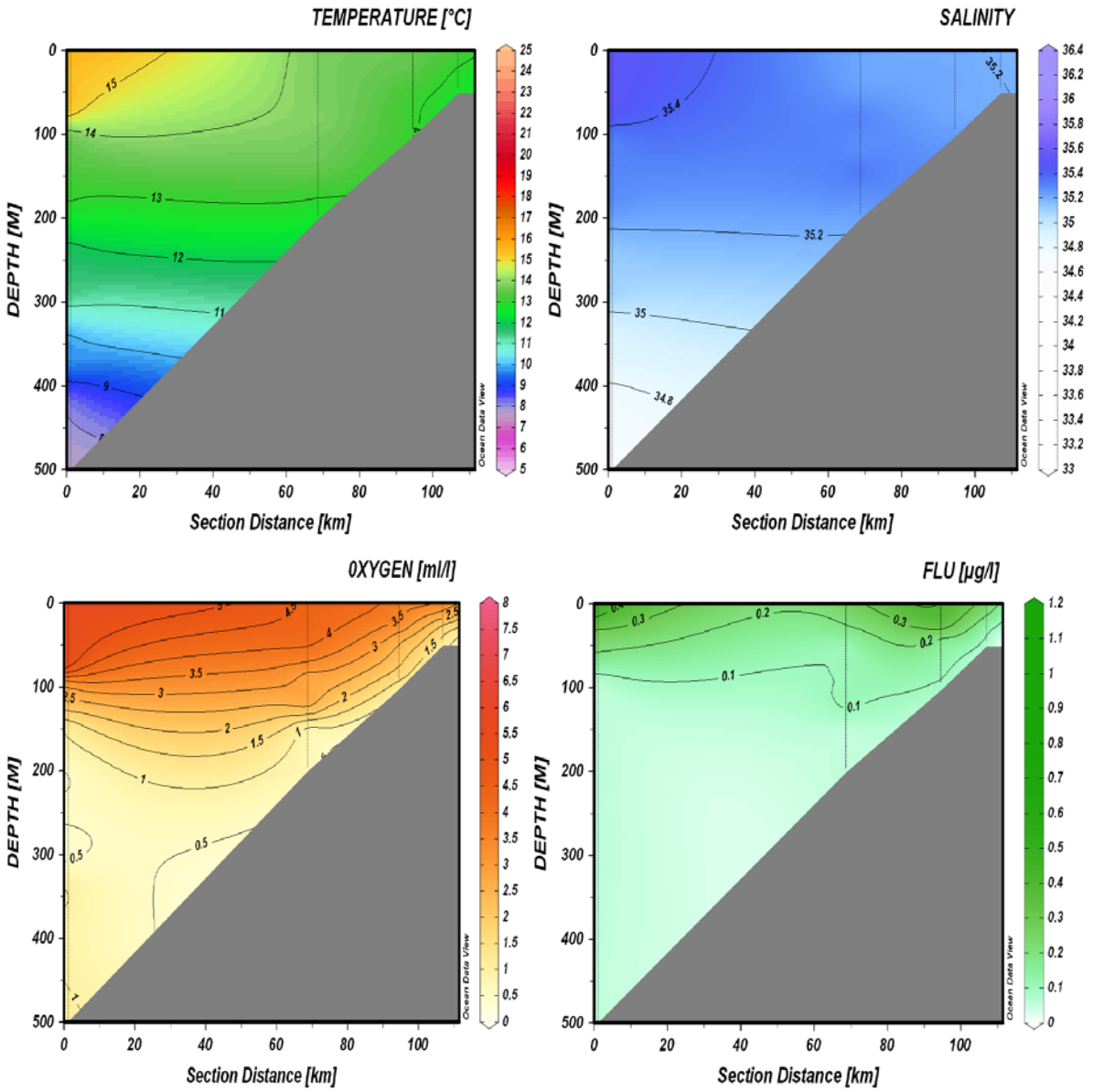


Figure 9 - Vertical sections of temperature, salinity, dissolved oxygen and fluorescence off Rocky Point

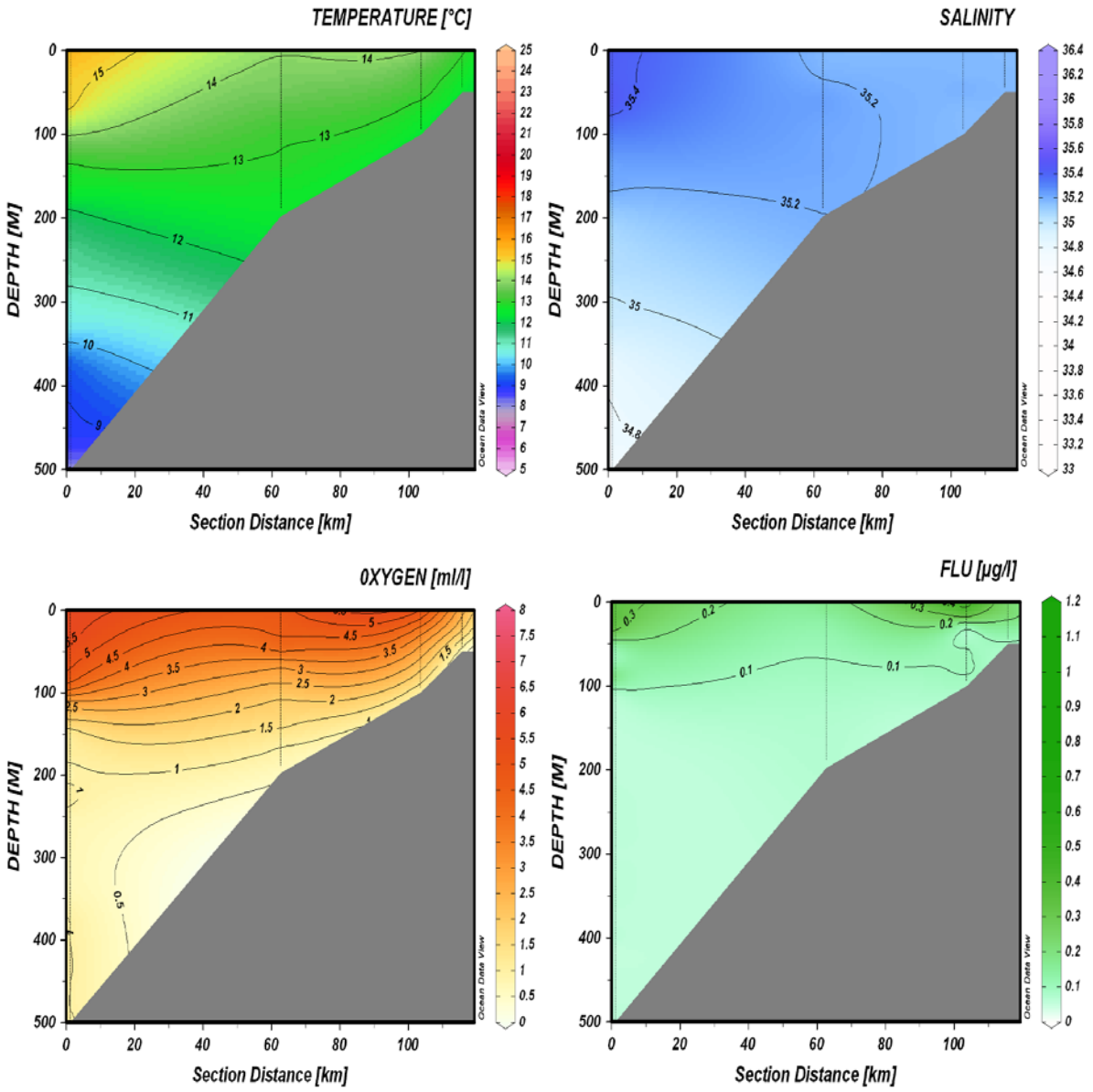


Figure 10 - Vertical sections of temperature, salinity, dissolved oxygen and fluorescence off Dune Point

CHAPTER 4. DISTRIBUTION, SIZE COMPOSITION AND BIOMASS ESTIMATES

4.1. Transboundary area

Trachurus capensis
The first encounter of *T. capensis* this year was further north of the transboundary area, at S 15°33'67 as compared with last year's position (S 16°12'23.4) and 2010 (S 16°18'10.1). The distribution of *T. capensis* was again discontinuous this year within the transboundary area as there was barely no encounter within the area between 17°24'19S and 17°40'53S. The discontinuity is hard to spot on the distribution figure (Figure 11) since this figure represent both the distribution of *T. capensis* and *T. trecae*. *T. capensis* was not found within Tiger Bay this year just like 2010, but there were aggregations just immediately before the bay and adjacent the bay further offshore up to 1 000 m isobaths (Figure 11).

There were no trawls on three consecutive transects within the area north of Cape Frio due to a storm. However, the identification of species within this area was done based on trawls immediately before and after this area. There have been overlaps between shoals found offshore and inshore, this can clearly be seen within areas around 16°49' S (south of Tiger Bay), North of Cape Frio (18°14' S) and immediately before Rocky Point. Overall, most of the fish were offshore compared to those found inshore. There was an unusual behaviour for the Namibian *T. capensis* whereby there was no vertical migration (diurnal) during the night to the upper water column. Therefore, many bottom trawls done during the night contained significant amounts of *T. capensis*. This is typical of *T. capensis* found in Angola and South Africa.

Three smaller, distinct aggregations were found within the transboundary area, one in the south, one in the central area and the other one in the north (16°27' S, to 16°40' S). The one in the south is specifically located north of Cape Frio (18°15' S) and was the biggest of the three while the central aggregation is north of Cunene's River mouth but somehow offshore. The last aggregation is from north of Tiger Bay, going around it and further offshore (16°27' S, to 16°40' S).

The estimated total biomass of *T. capensis* was at 290 700 tonnes this year, this a significant decrease, by 48%, compared to 2011 biomass (558 500 tonnes). Taken from the maturity proportions, 41% of this year's biomass was made up of adult fish (>17cm total length) as compared to 82% for previous year and 84% for 2010. This year the Namibian side of the transboundary area contributed 64% of the total biomass (187 300 tonnes), leaving the Angolan side with only 46% (103 400 tonnes). As for previous years (2008: 10 %; 2009: 11 %). Only approximately 13 % (by weight) of the total biomass of *T. t capensis* was found on the Angolan side of the transboundary area in 2010, contrasting the relative distribution found in Angola during the first transboundary survey in 2005, in which 64 % of the Cape horse mackerel biomass was found in Angolan waters.

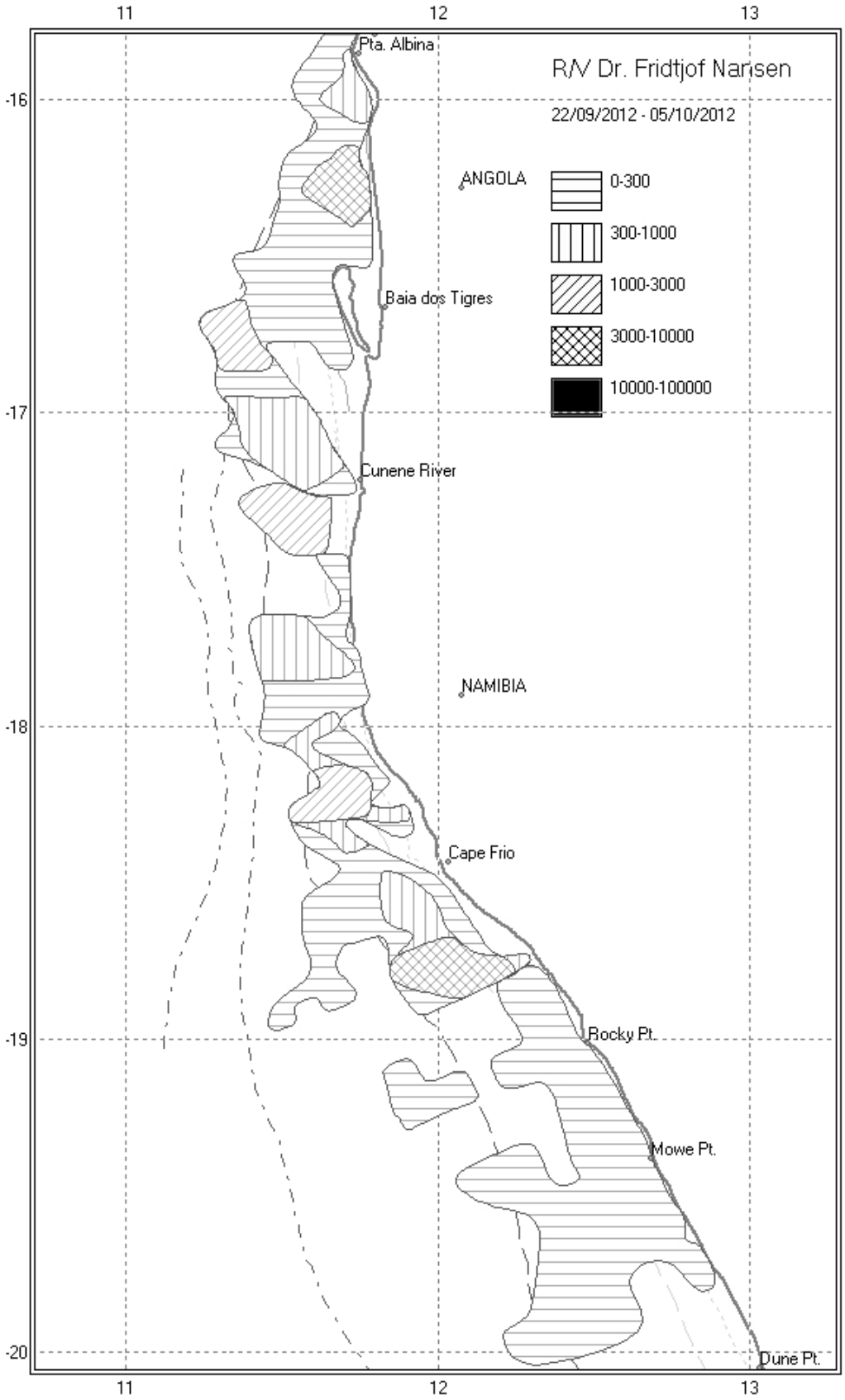


Figure 11 Distribution of the horse mackerel (*T. capensis and T. trecae*) in the Angola-Namibia transboundary area (15°50'-19°00' S) and south of transboundary area (19°00' S-20°15' S). Isobaths are indicated at 100, 200, 500, 1,000 and 2,000 m depths.

The size composition showed multimodal distribution with modal peaks at 10cm, 14cm, 17cm and 25cm length classes (Figure 12) (*N*= 14 834 mill. individuals).

A total of 4098 fish were sampled for length frequency analysis which yielded a mean total length of 16.4cm which corresponds to mean individual total weight of 46.8 g. Therefore there is an increase in mean total length compared to that of last year (15.3 cm). The length weight relationship showed a good fit (r^2=0.99) just like last year and resulted into 0.0069 and 3.0419 for *a* and *b* respectively (Figure 13).

Further, a sub sample of 880 fish was taken from 4098 fish sampled for biological analysis. Maturity analysis showed that, 419 fish were found immature while 461 fish were mature. The majority of the fish was found to be in stage 4 with males dominating that stage (Figure 14). Male fish dominated all other maturity stages except stages 5 and 6. See Annex IV for a description of the maturity stages

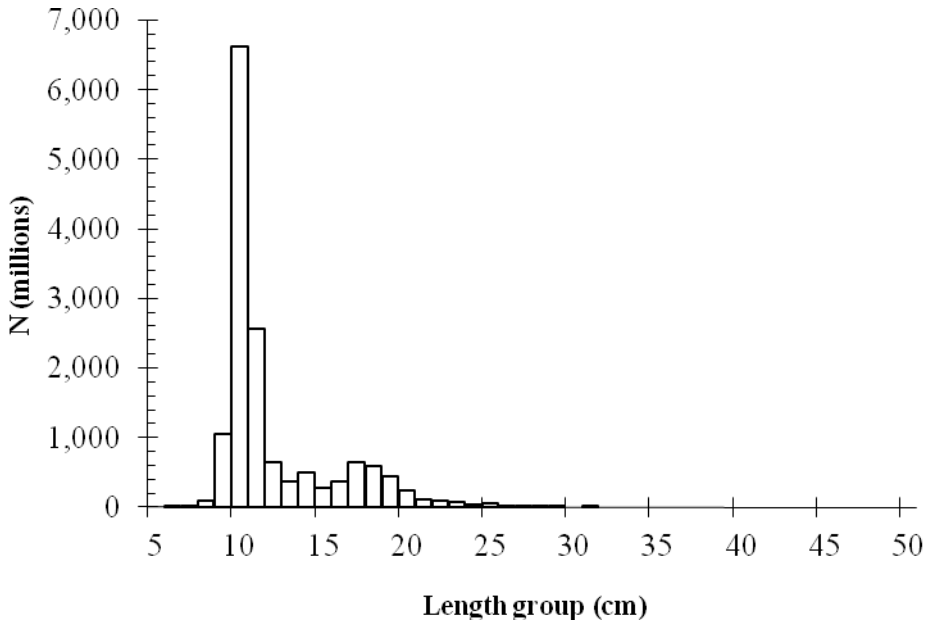


Figure 12 Estimated length distribution of *T. capensis* in the transboundary area (15°50'-19°00' S)

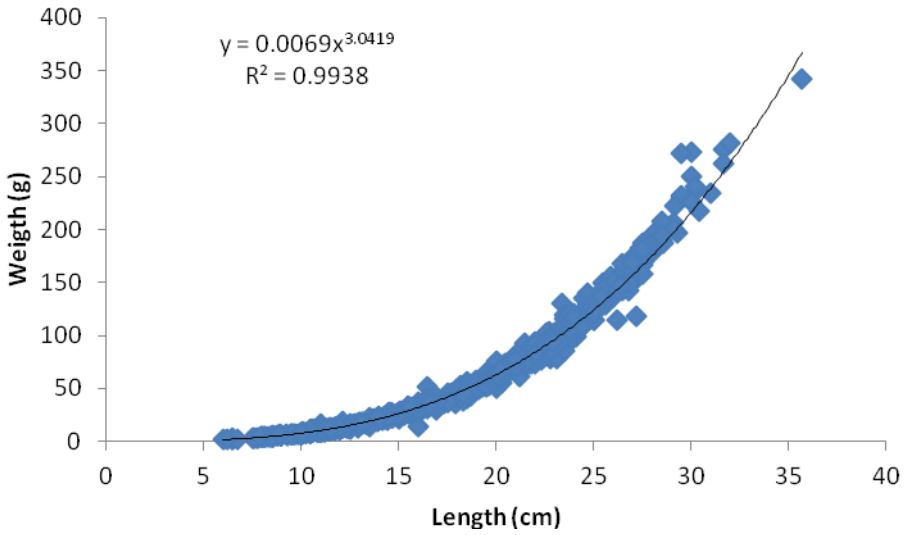


Figure 13 Length-weight relationship for *T. capensis* in the transboundary area (15°50'-19°00' S) (*n* = 880).

The overall sex ratio was in favour of the males (M:F) 1.34:1. Mature-before-pre-spawning and mature-pre-spawning stages were the predominant stages for males, while mature-before-pre-spawning and mature-in-spawning were the dominant stages in females (Figure 14). The smallest sexually mature male was 15.5cm TL weighing 26.3 g, the female was 12.2 cm TL with a weight of 14.4 g.

In mature males, total length ranged from 15.5 to 28.0 cm TL and weight ranged from 26.3 to 186.1 g. In mature females, total length ranged between 12.2 to 35.7 cm and weight ranged from 26.3 to 342.6 g.

According to the estimates of mean length at sexual maturity, males attain sexual maturity at a slightly smaller size than females (mean male length = 21.5 cm TL, mean female length = 22.5 cm TL). Mean total length at 50% maturity (for both sexes, including the juvenile group) was estimated at around 22 cm TL (Figure 15)

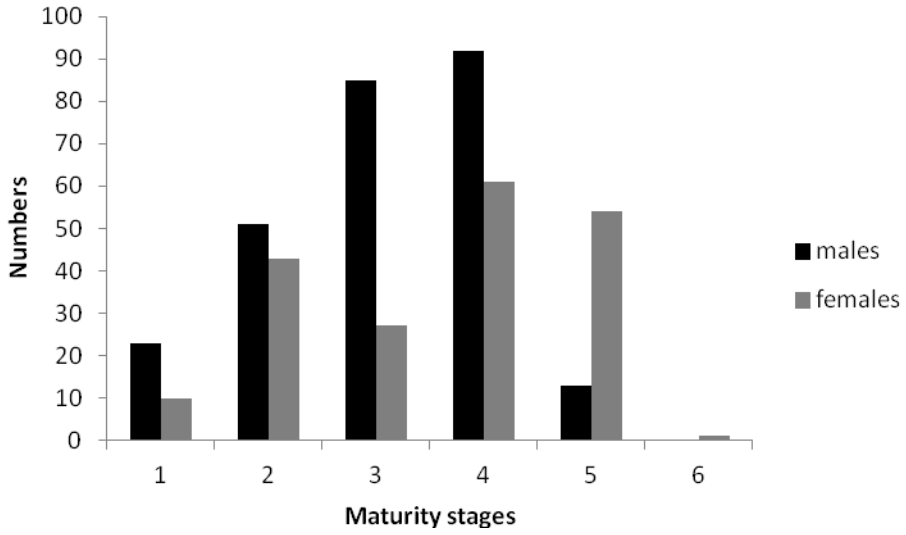


Figure 14 Number of specimens by maturity stages for *T. capensis* in the transboundary area (males *n* = 264 and females *n* = 196).

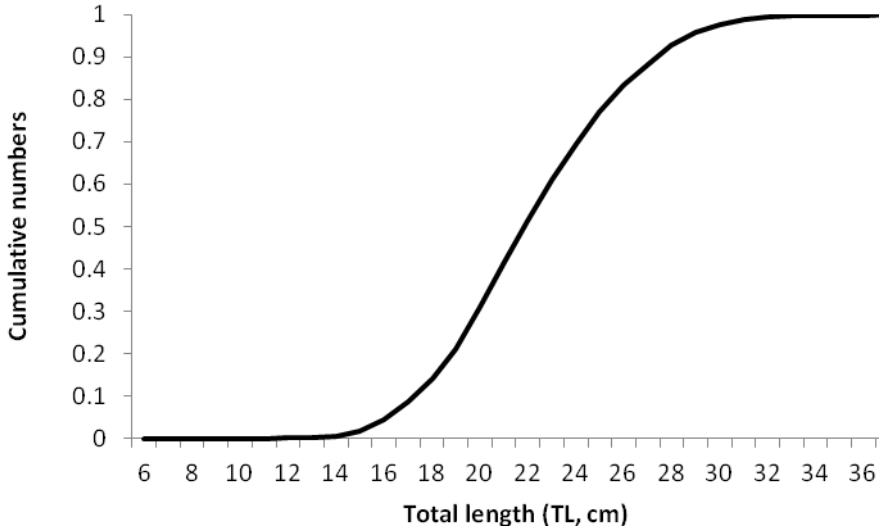


Figure 15 Cumulative numbers for *T. capensis* in the transboundary area.

Trachurus trecae

T. trecae's distribution was continuous from the Angolan side of the transboundary area and up to 17°11'11.4S. Its distribution went as far as 19°01'39.4 S. It is however worth noting that rare encounters of *T. trecae* were observed further south of the transboundary area. *T. trecae* was mostly encountered in low densities (S_A< 1000) except for the one area of high density (1001<s_A<3000 m^2/NM^2) at 18°50'S.

The total biomass of *T. trecae* was estimated in 59 800 tonnes which is 66% higher compared to last year (39 500 tonnes). About 49% of the biomass was adult fish (>17 cm total length) while the rest, 51%, were juveniles. A large part of the biomass was found at the Angolan side of the transboundary area (59 600 tonnes). The distribution pattern was strikingly similar to the one found last year, with the main distribution starting in Ponta Albina (15°55' S) and extending southwards towards the Angolan-Namibian border to 17°00'-17°15' S.

The size composition from the acoustic estimate showed a bi-modal distribution with modal peaks at 10 cm and 17 cm total lengths (Figure 16). The mean total fish length, 16.5 cm TL, was estimated from a sample of 1094 fish, sampled for length frequency analysis.

This year a total of 265 fish were biologically analysed with 130 fish immature and 135 mature. The majority of the fish were found in stages 3 and 4 with female dominations at both stages (Figure 18). Females dominated most of the maturity stages, except stages 1 and 2 which were dominated by males. See Annex IV for a description of the maturity stages. The overall sex ratio was in favour of the females (M:F) 0.73:1. Maturing-virgin-and-recovering-spent and mature-before-pre-spawning stages were the predominant for males, while mature-before-pre-spawning and mature-pre-spawning were the dominant stages in females (Figure 18).

A total of 1279 fish with an overall size distribution ranging from 10-17 cm total length were sampled for length-weight and biological analyses, yielding a mean total sample length of 16.5 cm, corresponding to a mean individual total weight of 50.0 g. The length weight

relationship for *T. trecae* showed a very good fit (r^2=0.9892), where *a* and *b* were estimated at 0.0089 and 2.9843, respectively (Figure 17).

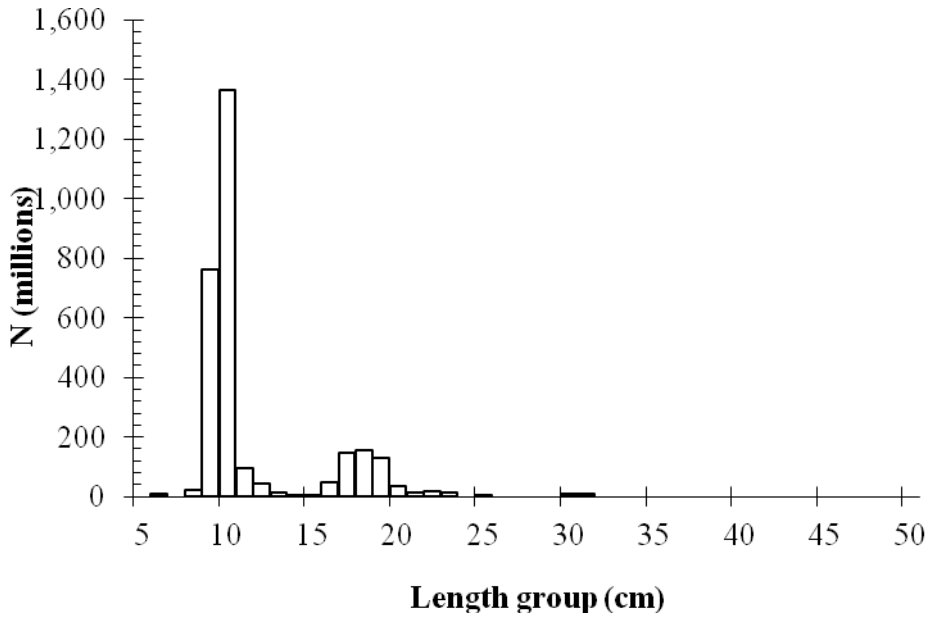


Figure 16 Estimated length distribution of *T. trecae* in the transboundary area (15°50'-19°00' S)

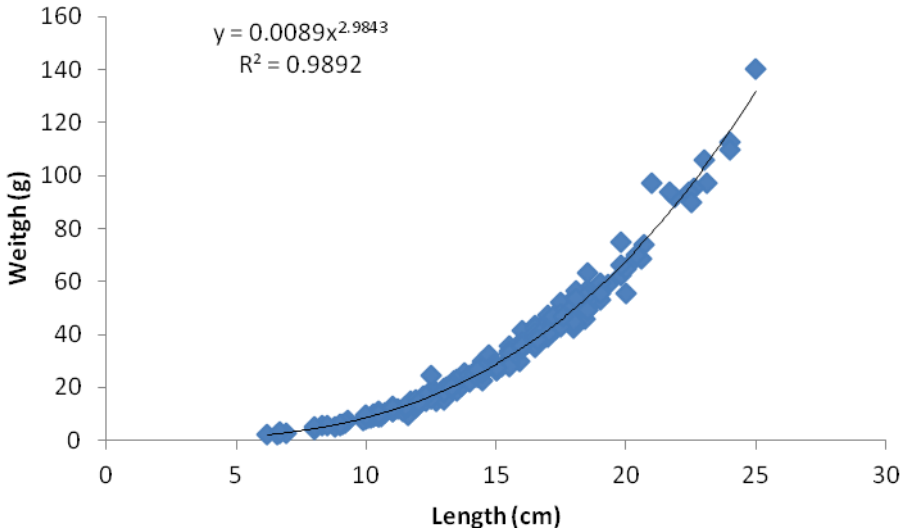


Figure 17 Length-weight relationship for *T. trecae* in the transboundary area (15°50'-19°00' S) (*n*=935).

The distribution of mature *T. trecae* indicated that the dominant maturity stage was among the 18 cm to 27 cm fish cohort for both males and females.

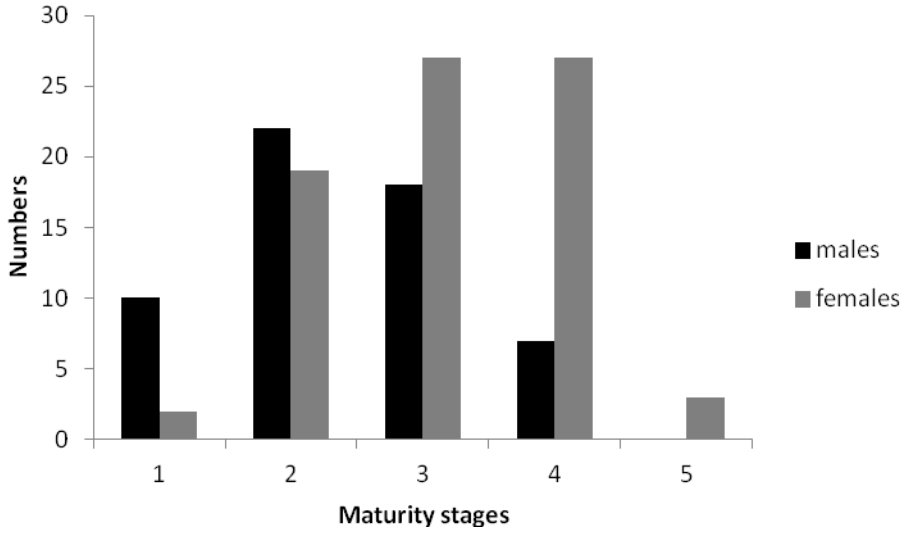


Figure 18 Number of specimens by maturity stages for *T. trecae* in the transboundary area (males *n* = 57 and females *n* = 78).

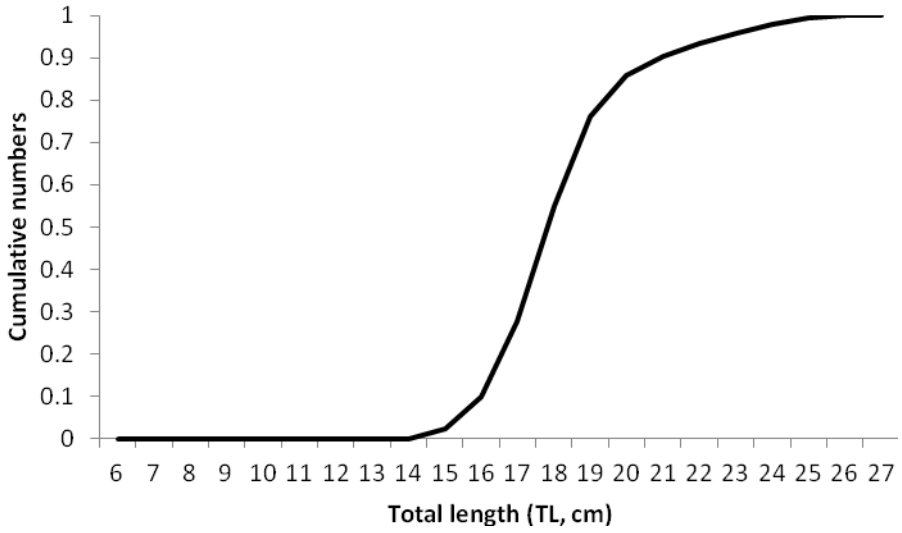


Figure 19 Cumulative numbers for T. trecae in the transboundary area.

Sardinops sagax

The distribution of *Sardinops sagax* is shown in Figure 22 below. An dense aggregation was found inshore (<200m) within the area north of Tiger Bay (16°15'-16°29' S) while a continuous aggregation was also found in Angolan waters just west Tiger Bay, whereby it extend until the mouth of Cunene River (17°15' S). The only two aggregations found in Namibian waters were north and south of Cape Frio (18°20' S). The total biomass of *S. sagax* was estimated at 87 100 tonnes which is far less compared to the biomass of 2011 (132 300 tonnes). This represents a whopping of a 35 % decrease. It also represents a 78% dramatic decline as compared to 2010 (399 000 tonnes). However, these figures do not necessarily represent the state of the sardine stock.

Caution should be taken when interpreting this dramatic change as a decline in stock size since first, the estimates are relative indices and not absolute estimates of abundance and so the population estimate should not be interpreted in absolute terms. Second, this was not a

dedicated sardine survey, where the acoustic and net sampling was limited, thus warranting some uncertainty associated to this estimate (ref. Chapter 1 Introduction and the stated survey objectives). Third, the estimates of the sardine do not cover the entire distribution of the sardine stock, which is known to migrate between Angolan and Namibian waters, and changes from one year to another may be caused by migration rather than population changes. Finally, the estimates of the relative indices of the proportion of the stock distributed within the transboundary area are, as for all acoustic estimates, prone to survey errors such as statistical sampling errors (caused by distribution in relatively small, high-density patches typical for sardine), vessel avoidance and the availability to acoustic sampling (upper blind zone errors) at the time of the survey (Anon. 2003, 2004).

The total length of *S. sagax* ranged from 8 to15 cm TL with muiltimodes at 11cm, 14cm and 16cm (Figure 20). The mean estimated total fish length from a total of 525 sampled fish was 13 cm TL (n = 12 771 mill. individuals). A sub sample of 101 was taken for length-weight and biological analyses. The length-weight relationship for *S. sagax* showed r^2=0.91, where a and b were estimated at 0.0223 and 2.5227, respectively (Figure 21).

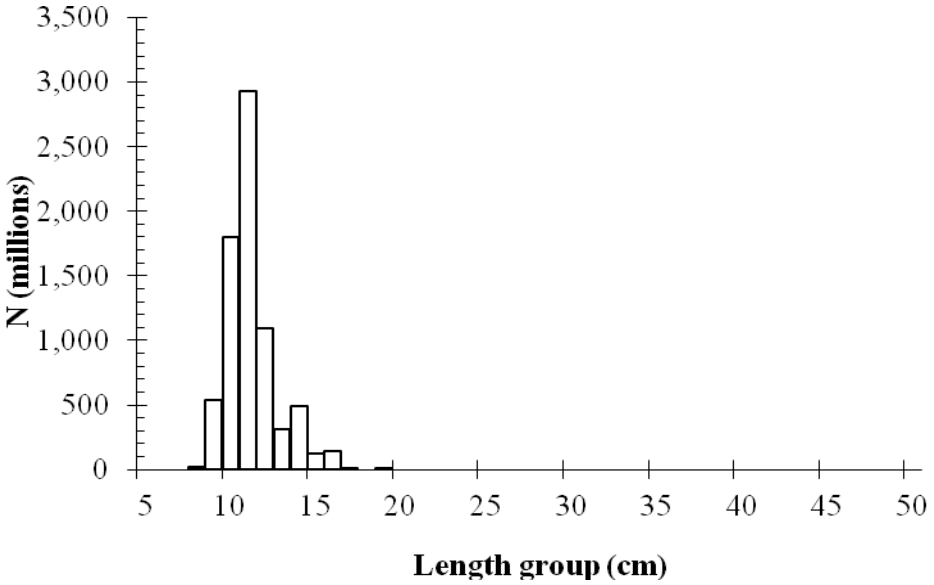


Figure 20 Overall length frequency of *S. sagax* in the transboundary area (15°50'-19°00' S) (n= 12 771 mill. ind)

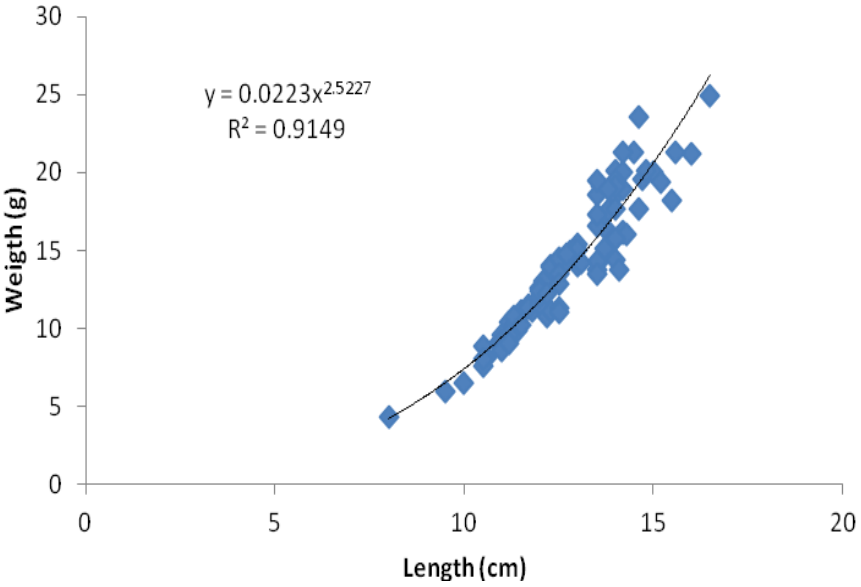


Figure 21 Length-weight relationship for *S. sagax* in the transboundary area (15°50'-19°00' S).

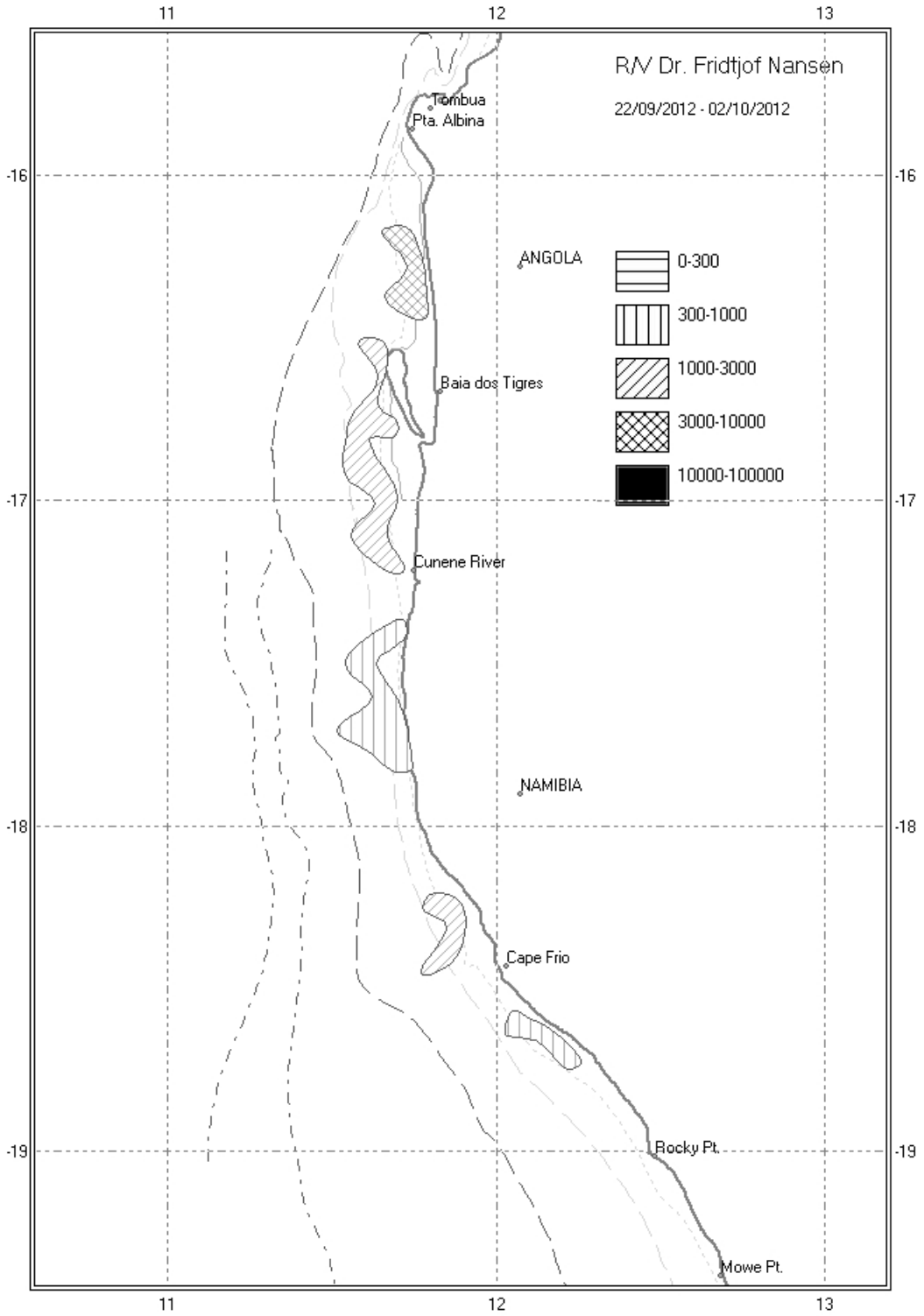


Figure 22 Distribution of *Sardinops sagax* in the Angola-Namibian transboundary area (15°50'-19°00' S). Isobaths are indicated at 50, 100, 200 and 500 m depths.

Pelagic 1 *(Etrumeus whiteheadii and Engraulis capensis)*

E. whiteheadii and *E. capensis* were as usual mostly found in mixed shoals and were thus recorded jointly as Pelagic Species 1 (other clupeids, Table 2). The distribution of *E. whiteheadii* and *E. capensis* is given in Figure 23 below. These species were found throughout the transboundary area, ranging from Pta. Albina (16°00 S) in Angola, to north of Rock Point in Namibia.

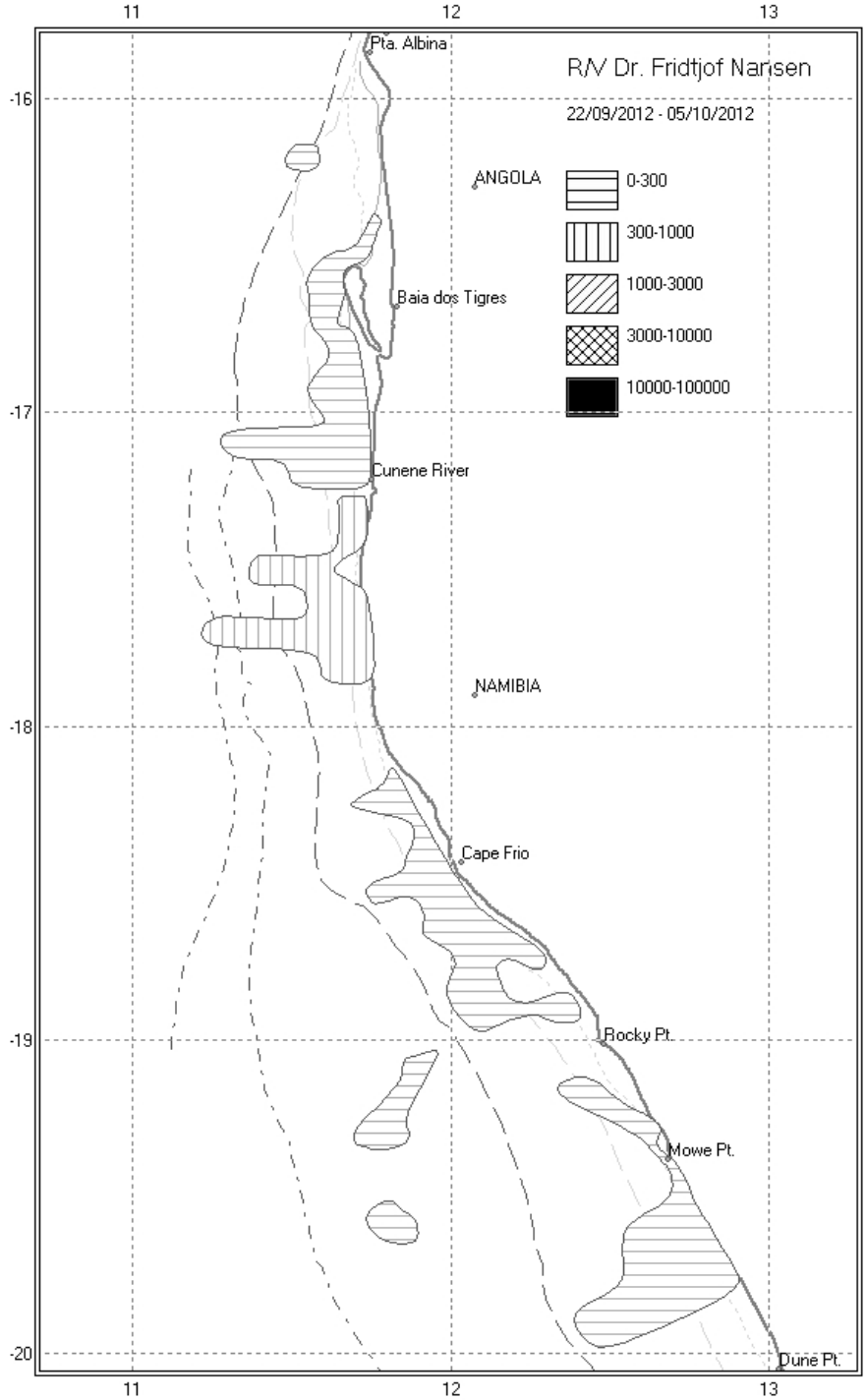


Figure 23 Distribution of *E. whiteheadii* and *E. capensis* (Pelagic Species 1) in the Angola-Namibia transboundary area (15°50'-19°00' S) and south of transboundary area (19°00'S-20°15'S). Isobaths are indicated at 50, 100, 200, 500, 1,000 and 2,000 m depths

E. whiteheadii *E. capensis*

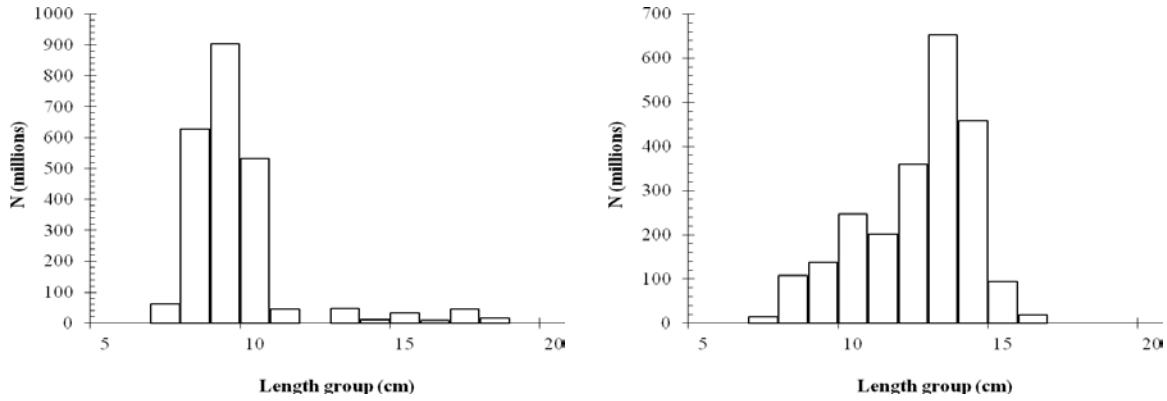


Figure 24 Overall length frequencies of *E. whiteheadii* and *E. capensis* in the transboundary area (15°50'-19°00' S).

Table 3. Catch rates (kg/h) of the main groups of pelagic Transboundary Angola-Namibia(15°50'-19°00' S).

Station	Gear depth	*E encrasicolus*	*E whiteheadi*	*S.aurita*	*Sardinops*	*T. capensis*	*T. trecae*	Other	Total
72	104	0	168.8	1.1	0	9.1	178.7	815.8	1173.5
73	5	0	10.1	2977.3	2.4	181.7	29.4	979.6	4180.6
74	5	0	0.3	46.8	0	52.4	29.1	0	128.6
75	49	0	22.4	0	6.9	9674.8	1064.8	396.9	11165.9
76	106	0	61.2	3.5	0	1975.9	8	64.7	2113.3
77	80	67	29.3	0	0	138.5	6	897	1137.8
78	84.5	0	32	0	0	7376.3	5.6	1073.8	8487.7
79	116	0	0	0	0	4215.4	135.8	1285.4	5636.6
80	48	31.3	95.1	0	404.9	23.4	7.8	349.3	911.8
81	129.5	0	0	0	0	6893.9	562.8	1709.8	9166.5
82	26.5	74.6	1044.4	0	718	0	257	211.9	2305.8
83	0	0	0	0	0	0	0	79.4	79.4
84	106	0	0	0	0	3291.8	196.6	815.4	4303.7
85	22.5	1.2	0	0	8447.5	0	0	124.3	8573
86	150	0	0	0	0	3816.5	0	596.3	4412.8
87	82.5	129.1	5	5717.9	27.8	651.7	7	139.1	6677.5
88	140.5	0	0	0	0	499.7	0	2166.7	2666.4
89	55	170	303.8	1.8	25.3	1.5	0.4	46	548.9
90	35.5	0.8	0	0	1.7	0.1	151.8	355.5	510
91	130	0	0	0.7	0	448.2	0	19.1	468
92	110	16.8	4.9	0.3	0.3	335.3	0	0.6	358.2
93	120	0	58.5	0	2.7	1834.6	0	582.3	2478.2
94	190.5	0	0	0	0	9928.9	0	1223.9	11152.8
95	62.5	17	0	0	0.7	1249.9	1.6	1066.1	2335.3
96	22	4.1	33.1	0	0.7	1.4	0	614	653.2
97	221.5	0	0	0	0	1350.6	0	3174.3	4525
98	167.5	0	0	0	0	2306.9	0	808.5	3115.4
99	25	45.9	9.1	0.4	4.6	34	0	1809.4	1903.5
100	175	0	0	0	0	0	0	71.3	71.3
101	62.5	2.3	1.5	0	1	678.5	0	4150.3	4833.6
102	231	0	0	0	0	590.9	0	185.2	776.2
103	298	0	0	0	0	2139.1	0	1548.3	3687.4
104	0	0	0	0	0	0	0	18.1	18.1
105	35	0	0	0	0	0	0	129	129
106	190	0	0	0	0	8	0	21.7	29.7
107	305.5	0	0	0	0	292.3	0	938.8	1231.2
108	25	0	0	0	0	0	0	7428.8	7428.8
109	22.5	0	0	0	0	1250	0	3413.9	4663.9
110	36.5	0	0	0	0.8	133.9	137.1	3751	4022.9

4.2. Northern Namibia (19-22° S)

Horse mackerel (Trachurus capensis):

No *T. trecae* was encountered south of the transboundary area this year, just like in 2010. During the 2009 transboundary survey, about 5 300 tonnes found in this region. The distribution of *T. capensis* is shown in Figure 11 above.

The distribution of *T. capensis* was continuous from Rocky Point (19°00'S) to the last transect at Dune Point (20°15'S) with a primarily inshore distribution throughout the area, although there was an offshore component immediately south of Rocky Point (19°20'S). The total biomass of *T. capensis* in northern Namibia (19-20°15' S) was estimated at 31 800 tonnes. There is no comparison between the biomass for this year and those for previous years because this survey did not cover the same area that was covered those years.

The estimated size distribution of *T. capensis* (8-25 cm total length) was tri-modal with modal peaks at 12 cm, 18 cm and 23 cm total length (Figure 25).

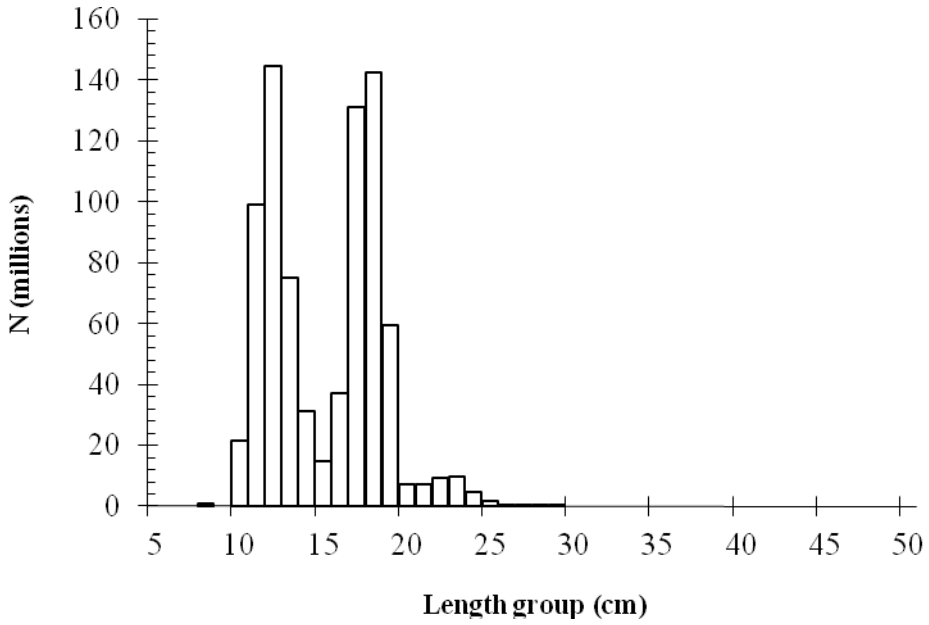


Figure 25 Overall length frequency of *T. capensis* in Northern Namibia (19-20°15S)

Pelagic 1 *(Etrumeus whiteheadii and Engraulis capensis)*

The distribution of Pelagic 1 (*Etrumeus whiteheadii* and *Engraulis capensis*) is shown in Figure 23 above. The total biomass of *E. whiteheadii* was 5 400 tonnes while for *E. capensis* it was 5 100 tonnes which makes up a total of 10 500 tonnes. This is an 87% decrease in the combined biomass compared to last year estimated 81 100 tonnes. There were not enough data to plot length frequencies.

CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

The results from this year's survey show the transboundary nature of the fish resources under study. The results still portray a more positive picture in terms of biomass for *T. capensis* and *T. trecae* although the same cannot be said about *S. sagax.* But caution should be taken when interpreting the data, as changes from year to year may well reflect migration in and out of the transboundary area rather than increases/decreases in the biomass levels. It should also be noted that the estimates are relative indices, not absolute estimates of abundance, and that all estimates, in particular for the densely and patchily aggregated sardine, are prone to acoustical survey errors (Anon. 2003, 2004).

As for previous years, the results also show that the *T. capensis* population is in comparatively much better condition than the *T. trecae* in terms of estimated biomass within the transboundary areas. It was also noted that *T. capensis* was not undergoing a vertical migration during the night. It should, however, be emphasized that the time series of the transboundary region cannot be interpreted as timeseries of the stock units, as many of the populations have distribution areas that go far beyond the transboundary area and are characterized by migrations in and out of the transboundary area due to environmental factors and, in particular, the positioning of the Angola-Benguela Front (ABF). Fluctuations in the abundance estimates within the transboundary area do thus not necessarily reflect fluctuations in the stock units.

Sardinella aurita has so far not been considered a transboundary species, but was in 2010 for the first time in the transboundary time series encountered in sizeable aggregations within the transboundary area (in Angola).

The main findings from the survey can be summarized as:

1) The biomass estimate of Cape horse mackerel was lower (290 700) than last year's (516 000 tonnes) but higher than in previous years (2008: 205 000 tonnes and 2009: 202 300 tonnes).

2) Approximately 46 % (by weight) of the Cape horse mackerel in the transboundary area was found in Angolan waters, which is far different to what has been found in recent years (2008: 10 %; 2009: 11 %; 2011: 13 %), but it still contrast the comparatively higher proportion found in Angola during the first transboundary survey in 2005 (64 %).

3) The variation in abundance of Cape horse mackerel in the transboundary area and the relative distribution of the biomass in Angolan and Namibian waters between years, show that the aggregation dynamics is highly dynamic within the transboundary area at this time of the year, and that both the total biomass and the relative distribution in the countries may fluctuate considerably over time, largely reflecting the impacts of a changing positioning of the Angola-Benguela Front (ABF).

4) An unusual behaviour for the Namibian *T. capensis* was observed during this survey whereby there was no vertical migration (diurnal) during the night to the upper part of the water column. Therefore, many bottom trawls done during the night contained

significant amounts of *T. capensis*. This is more typical of *T. trecae* in Angolan waters and *T. capensis* in South African waters and probably caused by more oxygenated water masses during the period of this survey, or possibly a lack of diurnal migration by the horse mackerel prey.

5) The estimate of Cunene horse mackerel was 59 800 tonnes which is relatively similar to those found in previous years (2005: 44 000 tonnes, 2009: 50 700 tonnes and 2011: 45 500 tonnes).

6) The distribution pattern of Cunene horse mackerel was strikingly similar to that of last year (2011) and 2009, with the majority of the biomass (66 %) found in Angolan waters, compared to 75 % in 2011, 78 % in 2009, 80 % in 2008 and 100 % in 2005.

7) Given yearly fluctuations due to oceanographic conditions (the position of the ABF), it seems that the main bulk of the Cunene horse mackerel biomass within the transboundary region is presently found predominantly in Angolan waters (>99 %), while the bulk of the Cape horse mackerel biomass (>64 %) is found in Namibian waters.

8) The biomass of Sardine (*Sardinops sagax*, "pilchard") decreased (87 100 tonnes) compared to 2011 (132 000) and (399 000 tonnes) in 2010 but it is higher compared to previous years (2005: 0; 2008: 0; 2009: 35 700 tonnes). It should however be noted that these estimates are relative indices, not absolute estimates of abundance and so the population estimate should not be interpreted in absolute terms. Similarly, this was not a dedicated sardine survey and both acoustic and net sampling was limited, thus warranting some uncertainty associated to this estimate, as discussed above.

9) In 2012, the sardine biomass was not found in a single, fairly homogenous aggregation like 2010 but there were aggregations in Namibian water as well. Nevertheless, the biggest aggregation was located in Angolan waters. As for Cape horse mackerel, both the aggregation pattern and the relative distribution between Angolan and Namibian zones within the transboundary area appear to fluctuate dramatically with environmental conditions between years. However, the more inshore-bound and short-lived life-history of the sardine compared to the carangid horse mackerels, combined with the fact that the sardine is still in a recovery phase from heavy fishing over the past decades, may add further to the dynamic picture for sardine compared to horse mackerel, rendering a yet more volatile and less predictable scenario in terms of abundance and distribution pattern for sardine compared to horse mackerel within the transboundary area.

10) This year, no *Sardinella aurita* was found in the transboundary area unlike in 2011 when 57 500 tonnes were found in the Angolan transboundary area.

11) The other clupeid species (round herring and anchovy) were found in extended, homogenous aggregation just like last year (2011), contrasting with the situation in 2009 where scattered, high-density aggregations were found.

5.1. Recommendations

The main recommendations are:

1) The time series should be continue, at the same time of the year, in order to monitor changes within the transboundary area over time and to establish whether the observed patterns are persistent over time.

2) Additional surveys should be conducted also in the warm season, as the distribution patterns of all the targeted species are likely to be quite different in the alternate season. Horse mackerel distributions over the transboundary area generally follow the position of the Angola-Benguela front (ABF), *i.e.* both species have a more southern distribution in the warm season, leading expectations of more Cunene horse mackerel in Namibian waters and less Cape horse mackerel in Angolan waters during summer.

3) Angola and Namibia should, through the BCC, put in place mechanisms for continuing the monitoring of the transboundary area and expand on the established collaboration in the management of the transboundary pelagic fish resources there; all populations studied are to some extent transboundary, and most are in low abundance.

4) Collaborative monitoring should focus on joint training and harmonization of survey techniques, irrespective of the future of the transboundary surveys.

5) The quality and use of transboundary surveys will improve if participants are trained in biological sampling, mostly on maturity and stomach fullness staging. Such information is subjective and requires consistency. That combined with retention of participants could help in data precision.

CHAPTER 6. REFERENCES

ANONYMOUS 2003 — BENEFIT Report on Survey Errors workshop, Cape Town, South-Africa 4–7 December 2000. BENEFIT Secretariat, Swakopmund, Namibia. 45 pp.

ANONYMOUS 2004 — BENEFIT Report on Survey Errors workshop, Cape Town, South-Africa 14-15 November 2003. BENEFIT Secretariat, Swakopmund, Namibia. 31 pp.

FOOTE, K. G. 1987 — Fish target strengths for use in echo integrator surveys. *J. Acoust. Soc. Am.* **82**(3): 981-987.

FOOTE, K. G., AGLEN, A. and O. NAKKEN 1986 — Measurements of fish target strength with a split-beam echosounder. *J. Acoust. Soc. Am.* **80**(2): 612-621.

HOLDEN, M.J. and D.F.S. RAITT (Eds) 1974 — Manual of fisheries science. Part 2-Methods of resource investigation and their application. FAO Fish. Tech. Pap. **115**(1). 214p.

KORNELIUSSEN, R.J., ONA, E., ELIASSEN, I.K., HEGGELUND, Y., PATEL, R., GODØ, O.R., GIERTSEN, C., PATEL, D., NORNES, E.H., BEKKVIK, T., KNUDSEN, H.P. and LIEN, G. 2006. The Large Scale Survey System-LSSS, a new post-processing system for multi-frequency echo sounder data. ICES WGFAST Report 2006

MISUND, O. A. and A. AGLEN 1992 — Swimming behaviour of fish schools in the North Sea during acoustic surveying and pelagic trawl sampling. *ICES J. Mar. Sci.* **49**: 3

CRUISE REPORT NO 2/2009. 2009. SURVEYS OF THE FISH RESOURCES OF ANGOLA, Survey of the pelagic resources, 23 May – 4 July 2009. Draft report. *Unpublished*

Annex I Records of fishing stations

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 72
DATE :22/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 15°33.67
start stop duration Lon E 11°55.26
TIME :12:05:19 12:28:30 23.2 (min) Purpose : 1
LOG : 733.90 735.11 1.2 Region : 4050
FDEPTH: 102 106 Gear cond.: 0
BDEPTH: 102 106 Validity : 0
Towing dir: 0° Wire out : 260 m Speed : 3.1 kn
Sorted : 151 Total catch: 453.36 Catch/hour: 1173.49

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	378.48	3269	32.25	292
Trachurus trecae	178.68	1421	15.23	289
Etrumeus whiteheadi	168.82	2865	14.39	
Pagellus bellottii	107.70	769	9.18	
Squatina oculata	73.85	16	6.29	
Umbrina canariensis	68.02	349	5.80	
Dentex barnardi	43.64	225	3.72	
Chelidonichthys capensis	38.75	388	3.30	
Zeus faber	33.93	70	2.89	
Atractoscion aequidens	27.80	31	2.37	
Dentex angolensis	13.90	194	1.18	291
Spondyliosoma cantharus	12.27	39	1.05	
Trachurus capensis	9.09	318	0.77	288
Trigla lyra	4.89	31	0.42	
Scomber japonicus	4.19	31	0.36	290
Lagocephalus guntheri	4.12	16	0.35	
Dentex gibbosus	2.56	23	0.22	
Loligo vulgaris	1.71	8	0.15	
Sardinella aurita	1.09	8	0.09	
Total	1173.49		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 73
DATE :22/09/2012 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°42.88
start stop duration Lon E 11°48.27
TIME :18:11:29 18:16:28 5.0 (min) Purpose : 1
LOG : 782.53 782.87 0.3 Region : 4050
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 40 48 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 4.1 kn
Sorted : 68 Total catch: 346.99 Catch/hour: 4180.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	2977.35	68771	71.22	293
J E L L Y F I S H	909.76	253	21.76	
Trachurus capensis	181.69	7711	4.35	294
Scomber japonicus	69.40	482	1.66	296
Trachurus trecae	29.40	771	0.70	295
Etrumeus whiteheadi	10.12	193	0.24	
Sardinops ocellatus	2.41	48	0.06	
Brama brama	0.48	48	0.01	
Total	4180.60		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 74
DATE :22/09/2012 GEAR TYPE: PT NO: 4 POSITION:Lat S 15°54.47
start stop duration Lon E 11°42.38
TIME :22:14:42 22:39:35 24.9 (min) Purpose : 1
LOG : 808.12 809.71 1.6 Region : 4050
FDEPTH: 5 5 Gear cond.: 0
BDEPTH: 60 89 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.8 kn
Sorted : 27 Total catch: 53.34 Catch/hour: 128.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	52.38	3839	40.72	298
Sardinella aurita	46.78	1167	36.37	299
Trachurus trecae	29.08	2334	22.61	297
Etrumeus whiteheadi	0.34	19	0.26	
Saurida brasiliensis	0.05	5	0.04	
Total	128.63		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 75
DATE :23/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°12.42
start stop duration Lon E 11°43.53
TIME :07:27:57 07:38:23 10.4 (min) Purpose : 1
LOG : 879.66 880.23 0.6 Region : 4050
FDEPTH: 49 49 Gear cond.: 0
BDEPTH: 49 49 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.3 kn
Sorted : 65 Total catch: 1941.00 Catch/hour: 11165.87

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	9674.78	497252	86.65	300
Trachurus trecae	1064.81	101477	9.54	301
Trigla lyra	188.11	690	1.68	
Illex coindetii	125.98	6040	1.13	
Engraulis capensis	24.16	1208	0.22	
Etrumeus whiteheadi	22.44	1035	0.20	
Dicologoglossa cuneata	22.44	690	0.20	
Starfish	18.98	5523	0.17	
Chrysaora hysoscella	10.35	690	0.09	
Sardinops ocellatus	6.90	345	0.06	
Boops boops	3.45	345	0.03	
Dentex macrophthalmus	1.73	690	0.02	
GOBIIDAE	1.73	345	0.02	
Total	11165.87		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 76
DATE :23/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°16.27
start stop duration Lon E 11°31.02
TIME :10:40:37 11:17:19 36.7 (min) Purpose : 1
LOG : 905.14 906.87 1.7 Region : 4050
FDEPTH: 104 108 Gear cond.: 0
BDEPTH: 104 108 Validity : 0
Towing dir: 0° Wire out : 265 m Speed : 2.8 kn
Sorted : 66 Total catch: 1292.61 Catch/hour: 2113.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1975.93	76740	93.50	302
Etrumeus whiteheadi	61.21	1020	2.90	
Zeus faber	44.32	96	2.10	
Dentex macrophthalmus	12.11	191	0.57	
Trachurus trecae	7.96	64	0.38	
Mustelus mustelus	5.98	3	0.28	
Sardinella aurita	3.50	96	0.17	
Scomber japonicus	1.60	33	0.08	
Starfish	0.64	160	0.03	
Total	2113.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 77
DATE :23/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°23.05
start stop duration Lon E 11°38.36
TIME :15:13:06 15:26:13 13.1 (min) Purpose : 1
LOG : 934.41 935.09 0.7 Region : 4050
FDEPTH: 80 80 Gear cond.: 0
BDEPTH: 80 80 Validity : 0
Towing dir: 0° Wire out : 210 m Speed : 3.1 kn
Sorted : 60 Total catch: 248.79 Catch/hour: 1137.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	722.93	40134	63.54	305
Trachurus capensis	138.48	11030	12.17	304
Loligo vulgaris	70.98	1829	6.24	
Engraulis encrasicolus	66.95	3512	5.88	306
Etrumeus whiteheadi	29.27	915	2.57	
Sepia orbignyana	24.05	27	2.11	
Merluccius paradoxus	21.40	293	1.88	
Chelidonichthys capensis	20.49	1866	1.80	
Pterothrissus belloci	13.72	128	1.21	
Myliobatis aquila	11.34	18	1.00	
Mustelus mustelus	8.46	9	0.74	
Trachurus trecae	6.04	220	0.53	303
Zeus faber	3.11	55	0.27	
Citharus linguatula	0.55	110	0.05	
Total	1137.76		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 78
DATE :23/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°27.06
start stop duration Lon E 11°37.02
TIME :18:01:11 18:06:35 5.4 (min) Purpose : 1
LOG : 956.42 956.70 0.3 Region : 4050
FDEPTH: 85 84 Gear cond.: 0
BDEPTH: 85 84 Validity : 0
Towing dir: 0° Wire out : 200 m Speed : 3.2 kn
Sorted : 61 Total catch: 763.88 Catch/hour: 8487.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	7376.33	501933	86.91	307
Dentex macrophthalmus	591.67	16811	6.97	308
Chrysaora hysoscella	318.11	144	3.75	
Trigla lyra	59.78	422	0.70	
Loligo vulgaris	38.89	422	0.46	
Etrumeus whiteheadi	32.00	556	0.38	
Atractoscion aequidens	32.00	144	0.38	
Scomber japonicus	16.67	278	0.20	
Sepia orbignyana	9.78	278	0.12	
Trachurus trecae	5.56	144	0.07	
Dicologoglossa cuneata	4.11	144	0.05	
GOBIIDAE	2.78	833	0.03	
Total	8487.67		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 79
DATE :23/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°32.08
start stop duration Lon E 11°24.91
TIME :21:06:44 21:15:28 8.7 (min) Purpose : 1
LOG : 980.89 981.33 0.4 Region : 4050
FDEPTH: 116 116 Gear cond.: 0
BDEPTH: 116 116 Validity : 0
Towing dir: 0° Wire out : 280 m Speed : 3.0 kn
Sorted : 63 Total catch: 820.12 Catch/hour: 5636.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	4215.40	33618	74.79	309
Dentex macrophthalmus	620.96	10275	11.02	310
Trigla lyra	226.05	2144	4.01	
Pterothrissus belloci	151.89	1966	2.69	
Trachurus trecae	135.81	2680	2.41	311
Sepia orbignyana	75.05	89	1.33	
Atractoscion aequidens	62.54	179	1.11	
Paraconger notialis	38.42	1876	0.68	
Squalus megalops	32.71	48	0.58	
Loligo vulgaris	30.38	89	0.54	
Lagocephalus guntheri	24.12	89	0.43	
GOBIIDAE	8.93	804	0.16	
Dicologoglossa cuneata	7.15	715	0.13	
Scorpaena normani	7.15	89	0.13	
Total	5636.56		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 80
DATE :23/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°32.23
start stop duration Lon E 11°39.63
TIME :23:29:27 23:35:52 6.4 (min) Purpose : 1
LOG : 999.36 999.67 0.3 Region : 4050
FDEPTH: 48 48 Gear cond.: 0
BDEPTH: 48 48 Validity : 0
Towing dir: 0° Wire out : 100 m Speed : 2.9 kn
Sorted : 39 Total catch: 97.56 Catch/hour: 911.78

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	404.86	35327	44.40	312
J E L L Y F I S H	327.57	8533	35.93	
Etrumeus whiteheadi	95.14	12150	10.43	
Engraulis encrasicolus	31.31	4766	3.43	313
Trachurus capensis	23.36	140	2.56	
Trachurus trecae	7.76	140	0.85	
Ophidion sp.	7.76	47	0.85	
Loligo vulgaris	7.48	47	0.82	
Trichiurus lepturus	6.54	28	0.72	
Total	911.78		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 81
DATE :24/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°43.53
start stop duration Lon E 11°21.90
TIME :08:13:27 08:22:19 8.9 (min) Purpose : 1
LOG : 1058.96 1059.47 0.5 Region : 4050
FDEPTH: 129 130 Gear cond.: 0
BDEPTH: 129 130 Validity : 0
Towing dir: 0° Wire out : 320 m Speed : 3.4 kn
Sorted : 92 Total catch: 1355.12 Catch/hour: 9166.54

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	6893.91	54981	75.21	314
Dentex macrophthalmus	1375.20	18095	15.00	323
Trachurus trecae	562.80	8949	6.14	315
Merluccius paradoxus	145.16	399	1.58	
Raja miraletus	70.62	101	0.77	
Zeus faber	57.63	101	0.63	
Trigla lyra	32.81	298	0.36	
Lagocephalus guntheri	25.84	101	0.28	
Squalus megalops	2.50	7	0.03	
Total	9166.47		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 82
DATE :24/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°37.00
start stop duration Lon E 11°39.83
TIME :11:25:04 11:28:44 3.7 (min) Purpose : 1
LOG : 1086.43 1086.70 0.3 Region : 4050
FDEPTH: 26 27 Gear cond.: 0
BDEPTH: 26 27 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 4.3 kn
Sorted : 35 Total catch: 141.04 Catch/hour: 2305.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	1044.36	162768	45.29	
Sardinops ocellatus	718.04	66376	31.14	318
Trachurus trecae	257.00	10136	11.15	316
Chrysaora hysoscella	169.37	5493	7.35	
Engraulis encrasicolus	74.55	11640	3.23	317
POMATOMIDAE	23.54	392	1.02	
Trichiurus lepturus	12.43	1373	0.54	
Dicologoglossa cuneata	4.58	196	0.20	
Boops boops	1.31	131	0.06	
CENTROLOPHIDAE	0.65	65	0.03	
Total	2305.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 83
DATE :24/09/2012 GEAR TYPE: PT NO: 4 POSITION:Lat S 16°49.63
start stop duration Lon E 11°32.73
TIME :19:35:02 20:00:25 25.4 (min) Purpose : 1
LOG : 1162.01 1163.62 1.6 Region : 4050
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 103 106 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.8 kn
Sorted : 0 Total catch: 33.57 Catch/hour: 79.39

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	76.27	26	96.07	
SALPS	3.12	104	3.93	
Total	79.39		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 84
DATE :25/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°53.18
start stop duration Lon E 11°31.89
TIME :01:48:27 01:58:42 10.3 (min) Purpose : 1
LOG : 1210.82 1211.37 0.6 Region : 4050
FDEPTH: 106 106 Gear cond.: 0
BDEPTH: 106 106 Validity : 0
Towing dir: 0° Wire out : 260 m Speed : 3.2 kn
Sorted : 61 Total catch: 735.22 Catch/hour: 4303.73

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3291.80	215415	76.49	320
Dentex macrophthalmus	395.82	8687	9.20	321
Pterothrissus belloci	234.26	340	5.44	
Trachurus trecae	196.57	4818	4.57	319
Merluccius paradoxus	107.06	808	2.49	
Loligo vulgaris	51.86	539	1.21	
Chelidonichthys capensis	16.16	135	0.38	
Squilla mantis	4.74	135	0.11	
Dicologoglossa cuneata	3.40	70	0.08	
Maja squinado	2.05	70	0.05	
Total	4303.73		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 85
DATE :25/09/2012 GEAR TYPE: PT NO: 7 POSITION:Lat S 16°54.15
start stop duration Lon E 11°40.08
TIME :03:40:57 03:45:47 4.8 (min) Purpose : 1
LOG : 1221.27 1221.58 0.3 Region : 4050
FDEPTH: 25 20 Gear cond.: 0
BDEPTH: 41 40 Validity : 0
Towing dir: 0° Wire out : 80 m Speed : 3.9 kn
Sorted : 72 Total catch: 690.13 Catch/hour: 8573.04

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinops ocellatus	8447.45	518311	98.54	322
Chrysaora hysoscella	124.35	4373	1.45	
Engraulis encrasicolus	1.24	236	0.01	
Total	8573.04		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 86
DATE :25/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 16°59.18
start stop duration Lon E 11°20.61
TIME :07:25:39 07:45:16 19.6 (min) Purpose : 1
LOG : 1255.26 1256.36 1.1 Region : 4050
FDEPTH: 149 151 Gear cond.: 0
BDEPTH: 149 151 Validity : 0
Towing dir: 0° Wire out : 370 m Speed : 3.4 kn
Sorted : 96 Total catch: 1441.95 Catch/hour: 4409.63

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	3816.51	46835	86.55	324
Dentex macrophthalmus	363.76	4083	8.25	325
Merluccius paradoxus	92.66	321	2.10	
Pterothrissus belloci	86.70	1147	1.97	
Zeus faber	24.31	46	0.55	
Trigla lyra	21.56	183	0.49	
Squalus megalops	3.15	12	0.07	
Trichiurus lepturus	2.75	46	0.06	
Illex coindetii	0.92	46	0.02	
Dicologoglossa cuneata	0.46	46	0.01	
Total	4412.78		100.07	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 87
DATE :25/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°5.84
start stop duration Lon E 11°37.41
TIME :11:59:32 12:02:33 3.0 (min) Purpose : 1
LOG : 1293.67 1293.83 0.2 Region : 4050
FDEPTH: 82 83 Gear cond.: 0
BDEPTH: 82 83 Validity : 0
Towing dir: 0° Wire out : 205 m Speed : 3.2 kn
Sorted : 67 Total catch: 336.10 Catch/hour: 6677.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sardinella aurita	5717.88	153974	85.63	326
Trachurus capensis	651.66	62980	9.76	327
Engraulis encrasicolus	129.14	9338	1.93	328
Chelidonichthys capensis	82.45	497	1.23	
Sardinops ocellatus	27.81	1093	0.42	329
Merluccius paradoxus	23.84	695	0.36	
Illex coindetii	21.85	993	0.33	
Trachurus trecae	6.95	199	0.10	
Trichiurus lepturus	5.96	298	0.09	
Etrumeus whiteheadi	4.97	397	0.07	
Umbrina canariensis	2.98	99	0.04	
Pterothrissus belloci	0.99	99	0.01	
Synagrops microlepis	0.99	99	0.01	
Total	6677.48		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 88
DATE :26/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°16.84
start stop duration Lon E 11°31.35
TIME :09:12:46 09:37:09 24.4 (min) Purpose : 1
LOG : 1404.40 1405.67 1.3 Region : 5010
FDEPTH: 140 141 Gear cond.: 0
BDEPTH: 140 141 Validity : 0
Towing dir: 0° Wire out : 350 m Speed : 3.1 kn
Sorted : 88 Total catch: 1083.45 Catch/hour: 2666.41

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	1755.41	30389	65.83	331
Trachurus capensis	499.69	17247	18.74	330
Merluccius paradoxus	248.66	1211	9.33	
Squalus megalops	67.83	310	2.54	
Pterothrissus belloci	25.69	295	0.96	
Trigla lyra	14.77	59	0.55	
Sepia orbignyana	9.45	30	0.35	
Loligo vulgaris	7.09	59	0.27	
Zeus faber	7.09	30	0.27	
Illex coindetii	6.50	89	0.24	
Sufflogobius bibarbatus	5.91	738	0.22	0
Mustelus mustelus	5.05	2	0.19	
Trichiurus lepturus	3.54	59	0.13	
G A S T R O P O D S	2.07	1211	0.08	
Saurida brasiliensis	2.07	827	0.08	
Synagrops microlepis	1.48	532	0.06	
Scorpaena normani	1.48	59	0.06	
Sufflogobius bibarbatus	1.18	30	0.04	
Dicologoglossa cuneata	0.89	59	0.03	
Brotula barbata	0.59	30	0.02	
Total	2666.41		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 89
DATE :26/09/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°24.19
start stop duration Lon E 11°40.23
TIME :12:30:20 12:39:04 8.7 (min) Purpose : 1
LOG : 1428.39 1428.87 0.5 Region : 5010
FDEPTH: 50 60 Gear cond.: 0
BDEPTH: 81 76 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 3.3 kn
Sorted : 40 Total catch: 79.86 Catch/hour: 548.87

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Etrumeus whiteheadi	303.78	56564	55.35	333
Engraulis encrasicolus	170.03	15340	30.98	332
J E L L Y F I S H	46.05	14	8.39	
Sardinops ocellatus	25.29	1663	4.61	334
Sardinella aurita	1.79	55	0.33	
Trachurus capensis	1.51	302	0.28	336
Trachurus trecae	0.41	96	0.08	335
Total	548.87		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 90
DATE :26/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 17°32.40
start stop duration Lon E 11°42.89
TIME :21:24:17 21:45:54 21.6 (min) Purpose : 1
LOG : 1502.91 1504.00 1.1 Region : 5010
FDEPTH: 35 36 Gear cond.: 0
BDEPTH: 35 36 Validity : 0
Towing dir: 0° Wire out : 130 m Speed : 3.0 kn
Sorted : 73 Total catch: 183.77 Catch/hour: 510.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	276.91	10768	54.30	
Trachurus trecae	151.80	4421	29.77	338
Arius heudelotii	45.46	272	8.91	
Trigla lyra	8.96	14	1.76	
Dicologoglossa cuneata	7.85	125	1.54	
Rhinobatos albomaculatus	6.47	14	1.27	
Peristedion cataphractum	4.16	8	0.82	
Scyliorhinus capensis	2.66	11	0.52	
Trichiurus lepturus	1.75	105	0.34	
Sardinops ocellatus	1.75	56	0.34	337
Engraulis encrasicolus	0.78	78	0.15	339
G A S T R O P O D S	0.36	36	0.07	
Pythonichthys microphthalmus	0.36	8	0.07	
Spondyliosoma cantharus	0.22	22	0.04	
Pterothrissus belloci	0.22	36	0.04	
S H R I M P S	0.14	78	0.03	
Trachurus capensis	0.14	8	0.03	
Total	510.00		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 91
DATE :27/09/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°41.53
start stop duration Lon E 11°27.03
TIME :08:25:39 08:59:46 34.1 (min) Purpose : 1
LOG : 1576.30 1578.03 1.7 Region : 5010
FDEPTH: 110 150 Gear cond.: 0
BDEPTH: 197 198 Validity : 0
Towing dir: 0° Wire out : 300 m Speed : 3.1 kn
Sorted : 32 Total catch: 266.20 Catch/hour: 467.98

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	448.22	9338	95.78	345
Brama brama	11.32	2	2.42	
J E L L Y F I S H	7.74	127	1.65	
Sardinella aurita	0.70	14	0.15	
Total	467.98		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 92
DATE :27/09/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 17°42.89
start stop duration Lon E 11°34.80
TIME :10:28:54 10:47:30 18.6 (min) Purpose : 1
LOG : 1586.26 1587.15 0.9 Region : 5010
FDEPTH: 100 120 Gear cond.: 0
BDEPTH: 145 144 Validity : 0
Towing dir: 0° Wire out : 270 m Speed : 2.9 kn
Sorted : 56 Total catch: 111.04 Catch/hour: 358.19

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	335.29	31606	93.61	340
Engraulis encrasicolus	16.77	903	4.68	342
Etrumeus whiteheadi	4.90	148	1.37	341
Merluccius capensis	0.65	6	0.18	
Sardinops ocellatus	0.32	13	0.09	
Sardinella aurita	0.26	6	0.07	
Total	358.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 93
DATE :29/09/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°11.61
start stop duration Lon E 11°37.53
TIME :07:23:27 07:46:22 22.9 (min) Purpose : 1
LOG : 1773.20 1774.27 1.1 Region : 5010
FDEPTH: 110 130 Gear cond.: 0
BDEPTH: 157 152 Validity : 0
Towing dir: 0° Wire out : 310 m Speed : 2.8 kn
Sorted : 73 Total catch: 946.66 Catch/hour: 2478.17

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1834.63	136704	74.03	343
Thyrsites atun	270.89	102	10.93	
Aequorea forskalea	246.73	5445	9.96	
Chrysaora hysoscella	63.98	204	2.58	
Etrumeus whiteheadi	58.53	2995	2.36	
Sardinops ocellatus	2.72	136	0.11	344
Illex coindetii	0.68	34	0.03	
Total	2478.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 94
DATE :29/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°14.65
start stop duration Lon E 11°35.26
TIME :14:11:36 14:20:43 9.1 (min) Purpose : 1
LOG : 1820.22 1820.64 0.4 Region : 5010
FDEPTH: 191 190 Gear cond.: 0
BDEPTH: 191 190 Validity : 0
Towing dir: 0° Wire out : 430 m Speed : 2.8 kn
Sorted : 91 Total catch: 1695.23 Catch/hour: 11152.83

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	9928.95	218914	89.03	349
Helicolenus dactylopterus	271.71	7586	2.44	
Chlorophthalmus atlanticus	266.78	9546	2.39	
Merluccius paradoxus	204.08	1711	1.83	
Chrysaora hysoscella	101.58	4651	0.91	
Synagrops microlepis	100.33	9546	0.90	
Dentex macrophthalmus	99.14	1099	0.89	346
Pterothrissus belloci	79.54	1224	0.71	
Merluccius polli	50.20	980	0.45	
Squalus megalops	13.16	33	0.12	
Malacocephalus occidentalis	8.55	125	0.08	
MYCTOPHIDAE	8.55	1592	0.08	
Mustelus palumbes	8.03	7	0.07	
Macropipus rugosus	6.12	243	0.05	
Coelorinchus coelorhincus	6.12	125	0.05	
Total	11152.83		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 95
DATE :29/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°18.48
start stop duration Lon E 11°51.31
TIME :17:51:10 18:07:42 16.5 (min) Purpose : 1
LOG : 1848.68 1849.62 0.9 Region : 5010
FDEPTH: 63 62 Gear cond.: 0
BDEPTH: 63 62 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 3.4 kn
Sorted : 71 Total catch: 643.37 Catch/hour: 2335.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	1249.87	85655	53.52	347
Aequorea forskalea	735.35	4443	31.49	
Trigla lyra	151.25	327	6.48	
J E L L Y F I S H	83.63	98	3.58	
Arius heudelotii	55.86	327	2.39	
Callorhinchus capensis	34.30	33	1.47	
Engraulis encrasicolus	16.99	1078	0.73	348
Scyliorhinus capensis	5.08	29	0.22	
Trachurus trecae	1.63	33	0.07	
Crabs - hairy	0.65	33	0.03	
Sardinops ocellatus	0.65	33	0.03	
Total	2335.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 96
DATE :30/09/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°28.21
start stop duration Lon E 11°55.89
TIME :04:15:05 04:23:58 8.9 (min) Purpose : 1
LOG : 1939.28 1939.75 0.5 Region : 5010
FDEPTH: 20 24 Gear cond.: 0
BDEPTH: 71 73 Validity : 0
Towing dir: 0° Wire out : 90 m Speed : 3.1 kn
Sorted : 39 Total catch: 96.68 Catch/hour: 653.21

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	614.02	13973	94.00	
Etrumeus whiteheadi	33.11	6439	5.07	350
Engraulis encrasicolus	4.05	439	0.62	351
Trachurus capensis	1.35	257	0.21	352
Sardinops ocellatus	0.68	54	0.10	353
Total	653.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 97
DATE :30/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°33.90
start stop duration Lon E 11°36.38
TIME :07:41:28 07:51:18 9.8 (min) Purpose : 1
LOG : 1961.22 1963.74 0.5 Region : 5010
FDEPTH: 222 221 Gear cond.: 0
BDEPTH: 222 221 Validity : 0
Towing dir: 0° Wire out : 550 m Speed : 3.2 kn
Sorted : 89 Total catch: 741.34 Catch/hour: 4524.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Dentex macrophthalmus	1435.24	12128	31.72	354
Trachurus capensis	1350.64	18037	29.85	355
Merluccius paradoxus	473.16	2075	10.46	356
Callorhinchus capensis	414.93	153	9.17	
Chrysaora hysoscella	248.24	3241	5.49	
Synagrops microlepis	146.43	10083	3.24	
Helicolenus dactylopterus	124.58	2179	2.75	
J E L L Y F I S H	77.46	49	1.71	
Pterothrissus belloci	74.47	0	1.65	
Raja leopardus	54.69	49	1.21	
Lophius vaillanti	42.05	49	0.93	
Aequorea forskalea	39.00	1166	0.86	
Chlorophthalmus atlanticus	24.29	153	0.54	
Trigla lyra	11.17	49	0.25	
Sufflogobius bibarbatus	8.61	1013	0.19	
Total	4524.96		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 98
DATE :30/09/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°36.85
start stop duration Lon E 11°49.73
TIME :14:25:50 14:45:15 19.4 (min) Purpose : 1
LOG : 2015.67 2016.76 1.1 Region : 5010
FDEPTH: 168 167 Gear cond.: 0
BDEPTH: 168 167 Validity : 0
Towing dir: 0° Wire out : 420 m Speed : 3.4 kn
Sorted : 91 Total catch: 1008.36 Catch/hour: 3115.43

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2306.94	48158	74.05	357
Merluccius paradoxus	429.24	2243	13.78	
Dentex macrophthalmus	166.53	1835	5.35	358
Pterothrissus belloci	78.51	2175	2.52	
Sufflogobius bibarbatus	59.47	12167	1.91	
Synagrops microlepis	44.18	8938	1.42	
Thyrsites atun	9.82	3	0.32	
Myliobatis sp.	8.37	3	0.27	
Lophius vomerinus	5.44	34	0.17	
Dicologoglossa cuneata	4.76	102	0.15	
Squalus megalops	1.48	3	0.05	
Squilla aculeata calmani	0.68	204	0.02	
Total	3115.43		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 99
DATE :30/09/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°37.04
start stop duration Lon E 12°3.89
TIME :18:02:09 18:27:57 25.8 (min) Purpose : 1
LOG : 2043.39 2045.03 1.6 Region : 5010
FDEPTH: 20 30 Gear cond.: 0
BDEPTH: 47 75 Validity : 0
Towing dir: 0° Wire out : 120 m Speed : 3.8 kn
Sorted : 136 Total catch: 818.49 Catch/hour: 1903.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	1796.93	11400	94.40	
Engraulis encrasicolus	45.91	2735	2.41	361
Trachurus capensis	34.05	4926	1.79	359
Thyrsites atun	10.67	5	0.56	
Etrumeus whiteheadi	9.07	1549	0.48	362
Sardinops ocellatus	4.60	126	0.24	360
Merluccius paradoxus	1.81	14	0.10	
Sardinella aurita	0.42	2	0.02	
Total	1903.47		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 100
DATE :01/10/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 18°51.95
start stop duration Lon E 11°40.15
TIME :03:15:37 03:56:43 41.1 (min) Purpose : 1
LOG : 2121.48 2123.75 2.3 Region : 5010
FDEPTH: 150 200 Gear cond.: 0
BDEPTH: 285 282 Validity : 0
Towing dir: 0° Wire out : 560 m Speed : 3.3 kn
Sorted : 0 Total catch: 48.80 Catch/hour: 71.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	71.28	1653	100.00	
Total	71.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 101
DATE :01/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°45.14
start stop duration Lon E 12°11.54
TIME :09:16:44 09:35:31 18.8 (min) Purpose : 1
LOG : 2167.53 2168.59 1.1 Region : 5010
FDEPTH: 61 64 Gear cond.: 0
BDEPTH: 61 64 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 3.4 kn
Sorted : 77 Total catch: 1513.73 Catch/hour: 4833.62

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	3569.98	2507	73.86	
Trachurus capensis	678.46	47620	14.04	363
Trigla lyra	217.20	549	4.49	
Argyrosomus hololepidotus	178.72	51	3.70	
Callorhinchus capensis	124.53	86	2.58	
Thyrsites atun	38.80	16	0.80	
Aequorea forskalea	6.96	316	0.14	
Arius heudelotii	6.32	16	0.13	
Merluccius paradoxus	5.49	67	0.11	
Engraulis encrasicolus	2.33	150	0.05	364
Illex coindetii	2.33	51	0.05	
Etrumeus whiteheadi	1.50	115	0.03	365
Sardinops ocellatus	0.99	51	0.02	366
Total	4833.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 102
DATE :01/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°54.08
start stop duration Lon E 11°53.54
TIME :12:24:26 12:30:23 6.0 (min) Purpose : 1
LOG : 2192.04 2192.37 0.3 Region : 5010
FDEPTH: 231 231 Gear cond.: 0
BDEPTH: 231 231 Validity : 0
Towing dir: 0° Wire out : 570 m Speed : 3.3 kn
Sorted : 0 Total catch: 76.97 Catch/hour: 776.17

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	590.92	7845	76.13	367
Merluccius paradoxus	81.98	252	10.56	
Chrysaora hysoscella	40.64	756	5.24	
Pterothrissus belloci	26.12	232	3.36	
Dentex macrophthalmus	9.98	61	1.29	368
Aequorea forskalea	9.98	333	1.29	
Raja miraletus	9.48	10	1.22	
Chlorophthalmus atlanticus	4.03	232	0.52	
Sufflogobius bibarbatus	2.62	1008	0.34	
Synagrops microlepis	0.40	40	0.05	
Total	776.17		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 103
DATE :01/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 18°55.76
start stop duration Lon E 11°40.86
TIME :14:33:20 14:55:16 21.9 (min) Purpose : 1
LOG : 2208.67 2209.74 1.1 Region : 5010
FDEPTH: 296 300 Gear cond.: 0
BDEPTH: 296 300 Validity : 0
Towing dir: 0° Wire out : 670 m Speed : 2.9 kn
Sorted : 150 Total catch: 1347.75 Catch/hour: 3687.41

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	2139.07	18443	58.01	369
Merluccius paradoxus	550.83	1354	14.94	
Dentex macrophthalmus	518.58	2167	14.06	370
Pterothrissus belloci	233.68	1379	6.34	
Lophius vomerinus	85.44	74	2.32	
Helicolenus dactylopterus	43.34	2118	1.18	
Chlorophthalmus atlanticus	26.84	1231	0.73	
Chrysaora hysoscella	23.64	468	0.64	
Coelorinchus coelorhincus	20.19	689	0.55	
Synagrops microlepis	18.71	1404	0.51	
Galeus polli	17.24	345	0.47	
Macropipus rugosus	6.16	419	0.17	
Sufflogobius bibarbatus	2.71	172	0.07	
Austroglossus microlepis	0.98	49	0.03	
Fishing gears	0.00	1650	0.00	
Total	3687.41		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 104
DATE :01/10/2012 GEAR TYPE: PT NO: 4 POSITION:Lat S 19°2.22
start stop duration Lon E 11°43.87
TIME :20:04:17 20:25:37 21.3 (min) Purpose : 1
LOG : 2253.81 2255.04 1.2 Region : 5010
FDEPTH: 0 0 Gear cond.: 0
BDEPTH: 313 308 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.5 kn
Sorted : 0 Total catch: 6.43 Catch/hour: 18.09

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	7.26	464	40.12	
Euphausiacea	4.64	1179	25.66	
Aequorea forskalea	3.52	76	19.44	
MYCTOPHIDAE	1.74	450	9.64	
Lestrolepis intermedia	0.93	6	5.13	
Total	18.09		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 105
DATE :01/10/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°2.15
start stop duration Lon E 11°46.03
TIME :20:51:30 21:13:01 21.5 (min) Purpose : 1
LOG : 2256.12 2257.41 1.3 Region : 5010
FDEPTH: 30 40 Gear cond.: 0
BDEPTH: 301 293 Validity : 0
Towing dir: 0° Wire out : 150 m Speed : 3.6 kn
Sorted : 0 Total catch: 46.27 Catch/hour: 129.01

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	109.54	68465	84.91	
Chrysaora hysoscella	11.65	223	9.03	
Aequorea forskalea	7.81	215	6.05	
Total	129.01		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 106
DATE :01/10/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°0.56
start stop duration Lon E 11°50.43
TIME :22:02:34 22:32:29 29.9 (min) Purpose : 1
LOG : 2262.13 2263.48 1.4 Region : 5010
FDEPTH: 130 250 Gear cond.: 0
BDEPTH: 272 276 Validity : 0
Towing dir: 0° Wire out : 400 m Speed : 2.7 kn
Sorted : 0 Total catch: 14.80 Catch/hour: 29.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
MYCTOPHIDAE	11.99	5142	40.41	
Trachurus capensis	7.96	88	26.82	371
Chrysaora hysoscella	5.17	152	17.43	
Merluccius paradoxus	2.75	24	9.26	
Aequorea forskalea	1.00	44	3.38	
Synagrops microlepis	0.68	50	2.30	
Solenocera africana	0.12	36	0.41	
Total	29.68		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 107
DATE :02/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°8.69
start stop duration Lon E 11°48.34
TIME :07:50:21 08:20:37 30.3 (min) Purpose : 1
LOG : 2344.28 2345.78 1.5 Region : 5010
FDEPTH: 305 306 Gear cond.: 0
BDEPTH: 305 306 Validity : 0
Towing dir: 0° Wire out : 680 m Speed : 3.0 kn
Sorted : 141 Total catch: 621.12 Catch/hour: 1231.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius paradoxus	703.31	2224	57.13	
Trachurus capensis	292.35	2416	23.75	372
Sponges - yellow	64.36	785	5.23	
Chlorophthalmus atlanticus	55.02	2111	4.47	
Helicolenus dactylopterus	27.83	924	2.26	
Dentex macrophthalmus	17.70	69	1.44	373
Nezumia micronychodon	13.44	444	1.09	
MYCTOPHIDAE	11.16	2842	0.91	
Illex coindetii	11.08	26	0.90	
Scomber japonicus	6.62	8	0.54	
Galeus polli	5.65	52	0.46	
Synagrops microlepis	4.80	357	0.39	
SOLENOCERIDAE	4.00	1431	0.33	
Solenocera africana	2.87	603	0.23	
Aequorea forskalea	2.70	131	0.22	
Pterothrissus belloci	2.00	8	0.16	
Chrysaora hysoscella	1.82	52	0.15	
Macropipus rugosus	1.82	123	0.15	
Austroglossus microlepis	0.79	61	0.06	
Bathynectes piperitus	0.69	26	0.06	
Bassanago albescens	0.61	8	0.05	
Sufflogobius bibarbatus	0.52	26	0.04	
Fishing gears	0.00	137	0.00	
Total	1231.16		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 108
DATE :02/10/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°7.91
start stop duration Lon E 12°6.35
TIME :18:12:42 18:36:56 24.2 (min) Purpose : 1
LOG : 2417.80 2419.34 1.5 Region : 5010
FDEPTH: 20 30 Gear cond.: 0
BDEPTH: 193 176 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.8 kn
Sorted : 0 Total catch: 3000.00 Catch/hour: 7428.81

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea forskalea	7428.81	0	100.00	
Total	7428.81		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 109
DATE :02/10/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°3.34
start stop duration Lon E 12°19.08
TIME :20:22:34 20:32:39 10.1 (min) Purpose : 1
LOG : 2432.94 2432.66 0.6 Region : 5010
FDEPTH: 20 25 Gear cond.: 0
BDEPTH: 107 109 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 3.7 kn
Sorted : 71 Total catch: 783.54 Catch/hour: 4663.93

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea forskalea	3312.44	58339	71.02	
Trachurus capensis	1250.00	63708	26.80	374
Chrysaora hysoscella	101.49	2292	2.18	
Total	4663.93		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 110
DATE :02/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°1.39
start stop duration Lon E 12°27.85
TIME :21:57:20 22:18:17 21.0 (min) Purpose : 1
LOG : 2443.20 2444.34 1.1 Region : 5010
FDEPTH: 38 35 Gear cond.: 0
BDEPTH: 38 35 Validity : 0
Towing dir: 0° Wire out : 140 m Speed : 3.3 kn
Sorted : 99 Total catch: 1404.65 Catch/hour: 4022.86

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Callorhinchus capensis	1325.56	1203	32.95	
Chrysaora hysoscella	1103.03	13232	27.42	
Fishing gears	755.00	43343	18.77	
Dicologoglossa cuneata	240.97	7578	5.99	
Trachurus trecae	137.13	5092	3.41	375
Trachurus capensis	133.92	7698	3.33	376
Rochinia sp.	120.29	16880	2.99	
Arius latiscutatus	106.65	842	2.65	
Argyrosomus hololepidotus	56.71	9	1.41	
Sponges - yellow	10.42	200	0.26	
Narke capensis	8.02	40	0.20	
Scyliorhinus capensis	6.04	29	0.15	
BATRACHOIDIDAE	4.41	40	0.11	
Starfish small	3.61	962	0.09	
Squalus megalops	3.49	9	0.09	
Merluccius paradoxus	2.41	80	0.06	
G A S T R O P O D S	1.60	521	0.04	
Helicolenus dactylopterus	0.80	40	0.02	
CORYSITIDAE	0.80	80	0.02	
Trichiurus lepturus	0.80	40	0.02	
Sardinops ocellatus	0.80	40	0.02	
Pterothrissus belloci	0.40	40	0.01	
Total	4022.86		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 111
DATE :03/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°27.43
start stop duration Lon E 12°14.55
TIME :12:06:17 12:16:28 10.2 (min) Purpose : 1
LOG : 2544.96 2545.50 0.5 Region : 5010
FDEPTH: 193 194 Gear cond.: 0
BDEPTH: 193 194 Validity : 0
Towing dir: 0° Wire out : 500 m Speed : 3.2 kn
Sorted : 130 Total catch: 782.77 Catch/hour: 4609.05

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea forskalea	2800.86	73413	60.77	
Trachurus capensis	691.03	6571	14.99	377
Merluccius capensis	525.34	3568	11.40	
Chrysaora hysoscella	426.42	2826	9.25	
Dentex macrophthalmus	48.75	247	1.06	378
Pterothrissus belloci	38.16	318	0.83	
Rochinia sp.	25.08	353	0.54	
MYCTOPHIDAE	16.60	6642	0.36	
Callorhinchus capensis	13.48	6	0.29	
Ornithoteuthis antillarum	8.83	35	0.19	
Sufflogobius bibarbatus	8.48	2084	0.18	
Chlorophthalmus atlanticus	2.12	106	0.05	
G A S T R O P O D S	1.77	636	0.04	
Synagrops microlepis	1.06	35	0.02	
Starfish small	1.06	212	0.02	
Total	4609.05		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 112
DATE :03/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°19.60
start stop duration Lon E 12°34.50
TIME :15:09:38 15:34:02 24.4 (min) Purpose : 1
LOG : 2569.27 2570.55 1.3 Region : 5010
FDEPTH: 75 75 Gear cond.: 0
BDEPTH: 75 75 Validity : 0
Towing dir: 0° Wire out : 200 m Speed : 3.2 kn
Sorted : 118 Total catch: 861.84 Catch/hour: 2119.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea forskalea	943.80	66	44.53	
Trachurus capensis	365.09	8882	17.23	379
Callorhinchus capensis	200.19	172	9.45	
Rhinobatos annulatus	172.82	52	8.15	
Merluccius paradoxus	96.05	981	4.53	
Chelidonichthys gabonensis	82.97	207	3.91	
Argyrosomus inodorus	73.77	25	3.48	
Starfish small	39.76	26698	1.88	
Sufflogobius bibarbatus	36.66	19382	1.73	
Chrysaora hysoscella	36.66	69	1.73	
Dicologoglossa cuneata	16.52	413	0.78	
Austroglossus pectoralis	14.63	34	0.69	
DASYATIDAE	14.29	2	0.67	
Galeichthys feliceps	13.77	69	0.65	
Myliobatis aquila	7.13	2	0.34	
Pterothrissus belloci	4.30	379	0.20	
Engraulis encrasicolus	0.52	34	0.02	
Rochinia sp.	0.34	69	0.02	
Total	2119.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 113
DATE :03/10/2012 GEAR TYPE: PT NO: 1 POSITION:Lat S 19°30.91
start stop duration Lon E 12°30.02
TIME :19:04:34 19:19:35 15.0 (min) Purpose : 1
LOG : 2600.72 2601.76 1.0 Region : 5010
FDEPTH: 17 20 Gear cond.: 0
BDEPTH: 124 128 Validity : 0
Towing dir: 0° Wire out : 110 m Speed : 4.1 kn
Sorted : 70 Total catch: 351.50 Catch/hour: 1403.19

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea forskalea	780.04	15269	55.59	
Trachurus capensis	500.20	9860	35.65	380
Chrysaora hysoscella	87.82	838	6.26	
J E L L Y F I S H	35.13	20	2.50	
Total	1403.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 114
DATE :03/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°36.56
start stop duration Lon E 12°13.65
TIME :21:26:09 21:56:03 29.9 (min) Purpose : 1
LOG : 2618.33 2619.83 1.5 Region : 5010
FDEPTH: 219 218 Gear cond.: 0
BDEPTH: 219 218 Validity : 0
Towing dir: 0° Wire out : 530 m Speed : 3.0 kn
Sorted : 58 Total catch: 400.31 Catch/hour: 803.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius paradoxus	209.48	652	26.08	
Trachurus capensis	208.31	1800	25.93	381
Pterothrissus belloci	94.43	771	11.76	
Aequorea forskalea	87.53	2217	10.90	
Dentex macrophthalmus	47.62	223	5.93	382
Starfish small	46.58	2466	5.80	
Chrysaora hysoscella	46.58	1461	5.80	
G A S T R O P O D S	26.23	7409	3.26	
Chlorophthalmus atlanticus	12.26	730	1.53	
Ornithoteuthis antillarum	8.87	66	1.10	
Coelorinchus simorhynchus	7.71	157	0.96	
Austroglossus pectoralis	4.43	14	0.55	
Sufflogobius bibarbatus	3.27	1017	0.41	
Total	803.30		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 115
DATE :04/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°47.69
start stop duration Lon E 12°19.26
TIME :04:08:58 04:39:32 30.6 (min) Purpose : 1
LOG : 2675.50 2677.09 1.6 Region : 5010
FDEPTH: 194 196 Gear cond.: 0
BDEPTH: 194 196 Validity : 0
Towing dir: 0° Wire out : 490 m Speed : 3.1 kn
Sorted : 67 Total catch: 469.63 Catch/hour: 921.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea forskalea	328.36	8449	35.62	
Merluccius capensis	136.15	247	14.77	
Merluccius paradoxus	136.15	1017	14.77	
Trachurus capensis	122.41	1223	13.28	383
Chrysaora hysoscella	62.92	467	6.83	
Pterothrissus belloci	43.96	440	4.77	
Dentex macrophthalmus	39.71	206	4.31	384
Lophius vomerinus	16.35	14	1.77	
J E L L Y F I S H	13.05	14	1.42	
Illex coindetii	7.42	55	0.80	
Synagrops microlepis	6.18	921	0.67	
Austroglossus pectoralis	5.50	14	0.60	
Sufflogobius bibarbatus	1.92	742	0.21	
Coelorinchus simorhynchus	0.96	41	0.10	
Chlorophthalmus atlanticus	0.69	151	0.07	
Total	921.75		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012405 STATION: 116
DATE :04/10/2012 GEAR TYPE: BT NO: 25 POSITION:Lat S 19°34.24
start stop duration Lon E 12°44.58
TIME :08:13:46 08:15:59 2.2 (min) Purpose : 1
LOG : 2707.70 2707.82 0.1 Region : 5010
FDEPTH: 59 58 Gear cond.: 0
BDEPTH: 59 58 Validity : 0
Towing dir: 0° Wire out : 180 m Speed : 3.1 kn
Sorted : 32 Total catch: 3557.54 Catch/hour: 97023.82

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	87837.27	5848036	90.53	385
Argyrosomus inodorus	2591.45	873	2.67	
Chrysaora hysoscella	2334.55	40855	2.41	
Fishing gears	2217.82	195518	2.29	
Etrumeus whiteheadi	1400.73	37936	1.44	
Sardinops ocellatus	437.73	26264	0.45	
Aequorea forskalea	204.27	8755	0.21	
Total	97023.82		100.00	

Annex II Catch rates

Station	Gear depth	*E encrasicolus*	*E whiteheadi*	*S.aurita*	*Sardinops*	*T. capensis*	*T. trecae*	Other	Total
72	104	0	168.8	1.1	0	9.1	178.7	815.8	1173.5
73	5	0	10.1	2977.3	2.4	181.7	29.4	979.6	4180.6
74	5	0	0.3	46.8	0	52.4	29.1	0	128.6
75	49	0	22.4	0	6.9	9674.8	1064.8	396.9	11165.9
76	106	0	61.2	3.5	0	1975.9	8	64.7	2113.3
77	80	67	29.3	0	0	138.5	6	897	1137.8
78	84.5	0	32	0	0	7376.3	5.6	1073.8	8487.7
79	116	0	0	0	0	4215.4	135.8	1285.4	5636.6
80	48	31.3	95.1	0	404.9	23.4	7.8	349.3	911.8
81	129.5	0	0	0	0	6893.9	562.8	1709.8	9166.5
82	26.5	74.6	1044.4	0	718	0	257	211.9	2305.8
83	0	0	0	0	0	0	0	79.4	79.4
84	106	0	0	0	0	3291.8	196.6	815.4	4303.7
85	22.5	1.2	0	0	8447.5	0	0	124.3	8573
86	150	0	0	0	0	3816.5	0	596.3	4412.8
87	82.5	129.1	5	5717.9	27.8	651.7	7	139.1	6677.5
88	140.5	0	0	0	0	499.7	0	2166.7	2666.4
89	55	170	303.8	1.8	25.3	1.5	0.4	46	548.9
90	35.5	0.8	0	0	1.7	0.1	151.8	355.5	510
91	130	0	0	0.7	0	448.2	0	19.1	468
92	110	16.8	4.9	0.3	0.3	335.3	0	0.6	358.2
93	120	0	58.5	0	2.7	1834.6	0	582.3	2478.2
94	190.5	0	0	0	0	9928.9	0	1223.9	11152.8
95	62.5	17	0	0	0.7	1249.9	1.6	1066.1	2335.3
96	22	4.1	33.1	0	0.7	1.4	0	614	653.2
97	221.5	0	0	0	0	1350.6	0	3174.3	4525
98	167.5	0	0	0	0	2306.9	0	808.5	3115.4
99	25	45.9	9.1	0.4	4.6	34	0	1809.4	1903.5
100	175	0	0	0	0	0	0	71.3	71.3
101	62.5	2.3	1.5	0	1	678.5	0	4150.3	4833.6
102	231	0	0	0	0	590.9	0	185.2	776.2
103	298	0	0	0	0	2139.1	0	1548.3	3687.4
104	0	0	0	0	0	0	0	18.1	18.1
105	35	0	0	0	0	0	0	129	129
106	190	0	0	0	0	8	0	21.7	29.7
107	305.5	0	0	0	0	292.3	0	938.8	1231.2
108	25	0	0	0	0	0	0	7428.8	7428.8
109	22.5	0	0	0	0	1250	0	3413.9	4663.9
110	36.5	0	0	0	0.8	133.9	137.1	3751	4022.9

Annex III Instruments and fishing gear

Fishing gear

The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super bottom trawl". During the present survey only the bottom trawl was used.

The bottom trawl has a headline of 31 m, footrope 47 m and 20 mm mesh size in the codend with an inner net of 10 mm mesh size. The trawl height was about 4.5 m and distance between wings during towing about 21 m. The sweeps are 40 m long. The trawl is equipped with a 12" rubber bobbins gear. Since 19.02.08 new and heavier "Thyborøn" combi trawl doors (7.41 m^2, 1720 kg) have been in used. During the present survey the door distance was kept nearly constant at about 50 m at all depths by the use of a 9 m strap between the wires at 120 m distance from the doors (normally applied at depths greater than 80 m). At depths greater than 300 m the trawl was equipped with a tickler chain, which improves the catchability of bottom living and borrowing species, particularly shrimps.

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 the trawl was equipped with a trawl eye that provides information about the trawl opening. A catch sensor on the cod-end indicated the size of the catch.

Acoustic instruments

The Simrad ER-60/18, 38, 120 and 200 kHz scientific sounder was run during the survey only for observation of fish and bottom conditions. No scrutinizing of the recordings was done. Last standard sphere calibrations was carried out the 08.03.2012 in Baía dos Elefantes using Cu-64, Cu-60, WC-38.1 add WC-38.1 spheres for 18, 38, 120 and 200 kHz, respectively. The details of the settings for the 38 kHz echo sounder were as follows:

Transceiver-2 menu (38 kHz)

Transducer depth	5.50 m / 8.0 m (when the keel was out)
Absorbtion coeff.	9.6 dB/km
Pulse duration	medium (1,024ms)
Bandwidth	2.43 kHz
Max power	2000 Watt
2-way beam angle	-20,6dB
gain	25,24 dB
SA correction	-0.46 dB
Angle sensitivity	21.9
3 dB beamwidth	7.31º along ship
	7.34º athwardship
Alongship offset	0.10º
Athwardship offset	0.04º

Bottom detection menu Minimum level -43 dB

Annex IV Gonad Maturity stages

Stage	Maturity status	Description
I	Immature	Ovary and testis lengths about 1/rd of body cavity length. Ovaries pinkish, translucent; testis whitish. Ova not visible to the naked eye. ***Ovary and testis quite narrow and have a tubular shape.***
II	Maturing virgin and recovering spent	Ovary and testis about ½ length of body cavity length. Ovary pinkish, translucent; testis whitish, more or less symmetrical. Ova not visible to the naked eye. ***Ovary more opaque; small specks make gonad appear more granular. Testes develop lobules, hence loosing the tubular shape. Some recovering spent ovaries have conspicuous blood vessels.***
III	Ripening	Ovary and testis about 2/3rds length of body cavity length. Ovary pinkish-yellow colour with granular appearance, testis whitish to creamy. No transparent ova visible. ***Milt can be seen inside testes when cut. Ovaries granular due to the presence of opaque oocytes. First time spawners have very swollen gonads. Ovaries that have spawned once lose consistency, but maintain the external appearance typical for this stage.***
IV	Ripe	Ovary and testis from 2/3rds to full length of body cavity. Ovary orange-pink in colour with conspicuous superficial blood vessels. Large transparent, ripe ova visible. Testis whitish to creamy, soft. ***Ovaries jelly-like due to the presence of translucent oocytes. Gonads extrude oocytes or milt when gently pressed.***
V	Spent	Ovary and testis shrunken to about ½ length of body cavity. Walls loose. Ovary may contain remnants of disintegrating opaque and ripe ova, darkened or translucent. Testis bloodshot and slack. ***Testes may have sperm remaining in the seminal duct. Pinkish areas appear in the periphery of the testes. Ovaries bloodshot and slack.***