

2012 BCC Survey No 2

Cruise Report No 6/2012

Distribution and behaviour of juvenile cape hake (*M. capensis*) off Namibia

08 October – 20 October 2012

11 januar 2013

Institute of Marine Research
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Bergen

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Institute of Marine Research

Norway



THE EAF-NANSEN PROJECT

FAO started the implementation of the project “Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries (EAF-Nansen GCP/INT/003/NOR)” in December 2006 with funding from the Norwegian Agency for Development Cooperation (Norad). The EAF-Nansen project is a follow-up to earlier projects/programmes in a partnership involving FAO, Norad and the Institute of Marine Research (IMR), Bergen, Norway on assessment and management of marine fishery resources in developing countries. The project works in partnership with governments and also GEF-supported Large Marine Ecosystem (LME) projects and other projects that have the potential to contribute to some components of the EAF-Nansen project.

The EAF-Nansen project offers an opportunity to coastal countries in sub-Saharan Africa, working in partnership with the project, to receive technical support from FAO for the development of national and regional frameworks for the implementation of Ecosystem Approach to Fisheries management and to acquire additional knowledge on their marine ecosystems for their use in planning and monitoring. The project contributes to building the capacity of national fisheries management administrations in ecological risk assessment methods to identify critical management issues and in the preparation, operationalization and tracking the progress of implementation of fisheries management plans consistent with the ecosystem approach to fisheries.

LE PROJET EAF-NANSEN

La FAO a initié la mise en oeuvre du projet "Renforcement de la base des connaissances pour mettre en œuvre une approche écosystémique des pêcheries marines dans les pays en développement (EAF-Nansen GCP/INT/003/NOR)" en décembre 2006. Le projet est financé par de l'Agence norvégienne de coopération pour le développement (Norad). Le projet EAF-Nansen fait suite aux précédents projets/ programmes dans le cadre du partenariat entre la FAO, Norad et l'Institut de recherche marine (IMR) de Bergen en Norvège, sur l'évaluation et l'aménagement des ressources halieutiques dans les pays en développement. Le projet est mis en oeuvre en partenariat avec les gouvernements et en collaboration avec les projets grands écosystèmes marins (GEM) soutenus par le Fonds pour l'Environnement Mondial (FEM) et d'autres projets régionaux qui ont le potentiel de contribuer à certains éléments du projet EAF-Nansen.

Le projet EAF-Nansen offre l'opportunité aux pays côtiers de l'Afrique subsaharienne partenaires de recevoir un appui technique de la FAO pour le développement de cadres nationaux et régionaux visant une approche écosystémique de l'aménagement des pêches et la possibilité d'acquérir des connaissances complémentaires sur leurs écosystèmes marins. Ces éléments seront utilisés pour la planification et le suivi des pêcheries et de leurs écosystèmes. Le projet contribue à renforcer les capacités des administrations nationales responsables de l'aménagement des pêches en introduisant des méthodes d'évaluation des risques écologiques pour identifier les questions d'aménagement d'importance majeure ainsi que la préparation, la mise en œuvre et le suivi de progrès de la mise en œuvre de plans d'aménagement des ressources marines conformes à l'approche écosystémique des pêches.



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08 October – 20 October 2012**

by

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CHAPTER 1 INTRODUCTION

1.1 Objectives

The main objective of this BCC survey was to locate juvenile cape hake (< 15cm) and study their horizontal and vertical distribution on the upper Namibian continental shelf (50 – 200m bottom depth) between Walvis Bay and Lüderitz. In the event that sufficient amounts of juvenile fish are found, the horizontal extent of such school will be determined and its vertical distribution behaviour studied during 24 hour stations.

The specific objectives of the survey were the following:

- To acoustically transect the area between 23-25⁰S, and identify acoustic targets by pelagic (multisampler) and bottom trawling.
- To collect biological information on target species: *M. capensis*, *S. bibarbatus*, *T.trachurus capensis*
- To determine the stomach content and collect otoliths from *M.capensis*.
- To collect depth stratified samples of zoo plankton in order to able to relate hake stomach contents to the zooplankton composition and density.
- To map the general meteorological, hydrographical and biological conditions in the survey area by means of continuous recordings of weather data, CTD-casts (Temperature, Salinity and Oxygen), ADCP measurements (Acoustic Doppler Current Profiler) and plankton sampling along acoustical and hydrographical transect lines.

The surveyed area was extended north to 21⁰S, after no significant amounts of juvenile hake could be located between 23-25⁰S. An additional secondary objective was formulated for the survey, in the event that no juvenile hake were found, i.e. to collect trawl and acoustic data such that the areal extent and an abundance estimate of jellyfish and gobies could be obtained.

1.2 Participation

The scientific staff consisted of:

From NatMIRC, Namibia:

08.10-20.10.2012: Sarah Paulus (Team leader), Anne-Marie Amunyela, Victoria Erasmus, Suama Akuumba, Vasana Tutjavi, Ernestus Kangombe, Claudia Kanduumombe, Malakia Shimhanda

From UWC, South Africa:

08.10-20.10.2012: Oliver Numwa

From Imr, Norway:

08.10-20.10.2012: Jan Frode Wilhelmsen, Ole Sverre Fossheim.

08.10-20.10.2012: Arved Staby (Cruise Leader), Oddgeir Alvheim.

1.3 Narrative

The vessel departed Walvis Bay on the 8th of October at 16:00 UTC and steamed south to 25^o lat S (50 m bottom depth), where she arrived on the 9th at 08:00 UTC. The vessel then commenced with acoustic transects parallel to the latitude in a northerly direction. Once the 23^o15 S line was completed, the survey did a southwards zig-zag coverage at 70 – 120 m depth between 23^o15 and 24^o00, since this was the depth range where most juvenile hake were caught on previous transects. At 24^o00 the vessel was stationary until dusk the following day, to observe changes in the vertical distribution of scatters. However, due to the high density of jellyfish, which made it difficult to discern different targets, and the malfunction of the multisampler, the experiment was aborted and the vessel steamed northwards to 23^o00 to continue transecting northwards to 21^o00. Bad weather due to very strong winds prohibited any further work on Friday 19th, and the vessel arrived in Walvis Bay on the 19th October in the evening.

The scientific echo sounders (18, 38, 120 kHz transducers) were NOT calibrated, as this was done in Baía dos Elefantes on September 18th 2012.

1.4 Survey effort

Figure 1 shows the cruise tracks with fishing, plankton (multinet) and hydrographical stations. Both the small pelagic (10 m vertical opening) and the mid-sized (15 m vertical opening) pelagic trawl equipped with the multisampler unit, and the demersal trawl (5 m vertical opening), were used during the survey. Table 1 summarizes the survey effort by latitude.

Table 1. Summary of survey effort by latitude, showing number of demersal (BT) and pelagic (PT) trawl hauls, CTD casts, multinet stations (2-5 zooplankton samples per station) and distance surveyed (log).(3 multisampler PT were invalid)

Area	BT	PT	Total trawls	CTD casts	Multinet stations	Log (NM)
21 ^o -22 ^o	4	4	8	17	16	4290-4521
22 ^o -23 ^o	3	7	10	19	15	3976-4289
23 ^o -24 ^o	2	9	11	21	18	3465-3802 3859-3972
24 ^o -25 ^o	9	5	14	23	18	3174-3464 3803-3858
Total	18	25	46	80	67	1347

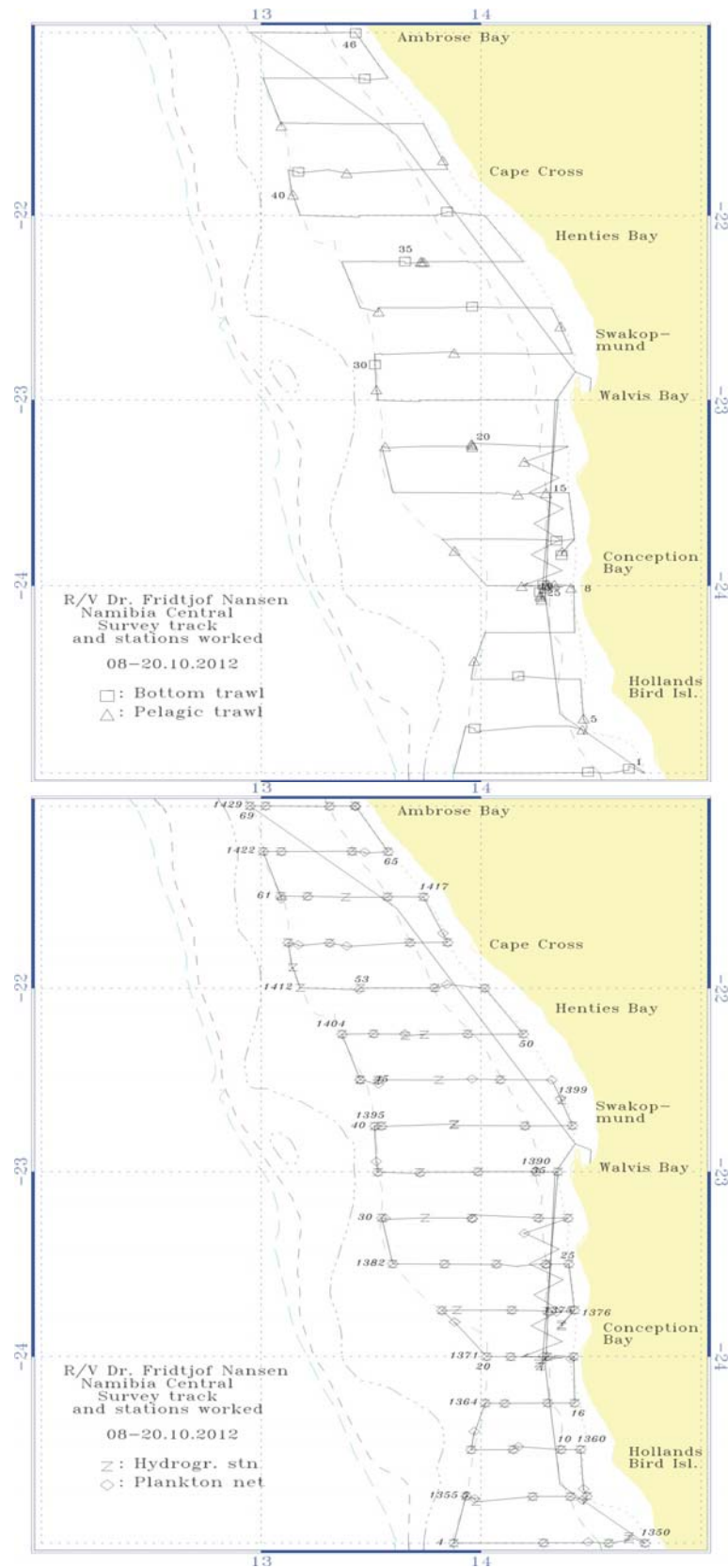


Figure 1. Course track showing a) fishing, and b) hydrographical and multinet stations, between 21-25° latitude. Depth contours are indicated for 20, 50, 100, 200 and 300 m depths.

CHAPTER 2 METHODS

2.1 Hydrographical sampling

CTD

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 made at 50, 100, 150 and 200 m bottom depth, and stopped a few meters above the bottom. **NOTE:** In the previous report the oxygen sensor was shown to be stable, and thus no calibration was conducted during this survey.

Attached to the CTD was also a Chelsea fluorometer of the type Mk III Aquatrack. It measures chlorophyll A in microgram per litre with an uncertainty of 3%. Factory slope and offset was 0.921 and -0.02.

Thermosalinograph

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

Current speed and direction measurements (ADCP)

The vessel-mounted Acoustic Doppler Current Profiler (VMADCP) from RD Instruments was not functioning during the survey.

Meteorological observations

Meteorological data logged from the Norwegian Meteorological Institute's (DNMI) meteorological station on board, included air temperature, humidity, air pressure, wind direction and speed, and sea surface temperature (SST). All data were averaged by unit distance sailed (1 NM).

2.2 Fish sampling

A brief description of the fishing gear is provided in Annex IV. All trawl catches were sampled for species composition by weights and numbers. Records of catch rates are given in Annex I. Total length (TL) was measured for the commercial pelagic and demersal species cape hake, monkfish, snoek, horse mackerel, and the non-commercial pelagic goby.

Biological samples were obtained for cape hake. Total length (TL) and body weight were determined to the nearest 1 cm and 1 g below, respectively. Sex and gonad development were determined by macroscopic examination, following the gonad stage classification used at NatMIRC. In addition otoliths of cape hake < 19 cm were collected.

Stomach content analysis of cape hake was done onboard by assessing the content macroscopically. Type and number of prey items were recorded, as well as their stage of digestion.

2.3 Plankton sampling

Zooplankton

Zooplankton was sampled using a HYDROBIOS Multinet (180 μm) by covering five depth intervals: 0-25, 25-50, 50-75, 75-100 and 100-200 m. Zooplankton was collected at the same locations as the CTD stations. Data from the flow meter was recorded electronically from the Multinet receiver unit. A SCANMAR depth sensor gave real-time information of the depth. The nets were opened and closed remotely from the bridge of the vessel. The samples were preserved in 4% formalin for later analysis at NatMIRC.

2.4 Acoustic sampling

Acoustic equipment

Acoustic data were recorded using a Simrad ER60 scientific echo sounder equipped with keel-mounted transducers at nominal operating frequencies of 18, 38 and 120 kHz. The 200 kHz transducer was not functioning during the survey. The survey was started without *a priori* calibration. All transceivers were calibrated during the previous pelagic and trans-boundary survey in Baía dos Elefantes (Angola) on the 18th September. The technical specifications and operational settings of the echo sounder used during the survey are given in Annex II.

Allocation of acoustic energy to species group

The acoustic data were scrutinized using the LSSS version 1.61. Scatters were displayed at 38 kHz. The mean 5 nautical miles (NM) area backscattering coefficient s_A (m^2/NM^2) was allocated to a predefined set of species groups (Table 3) on the basis of echogram features. Ground truthing and estimation of mean length and weight were accomplished by means of targeted pelagic and demersal trawling. Due to high densities of jelly fish and sometimes also gobies in the entire survey region it was difficult to differentiate different pelagic species (groups) and the allocation of backscatter to specific pelagic species was thus near impossible and resultantly imprecise.

Table 2. Allocation of acoustic densities to species groups.

Group	Taxon	Species
Horse mackerel	<i>Trachurus</i> sp.	<i>T. trachurus capensis</i>
Pelagic goby	Gobiidae	<i>S. bibarbatus</i>
Cape hake	<i>Merluccius</i> sp.	<i>M. capensis</i>
Mesopelagic species	Mesopelagic fish	<i>Lampanyctodes hectoris</i> <i>Maurollicus muelleri</i>
Plankton	Other plankton Jellyfish	

CHAPTER 3 OCEANOGRAPHIC CONDITIONS

3.1 Surface distribution

Wind, sea surface temperature (SST, 5m depth), sea surface salinity (SSS, 5m depth), sea surface oxygen (SSO, 5m depth) and sea surface fluorescence (SSF, 5m depth) are shown in Figure 2 and 3. Environmental conditions just above the sea floor are shown in Figure 4.

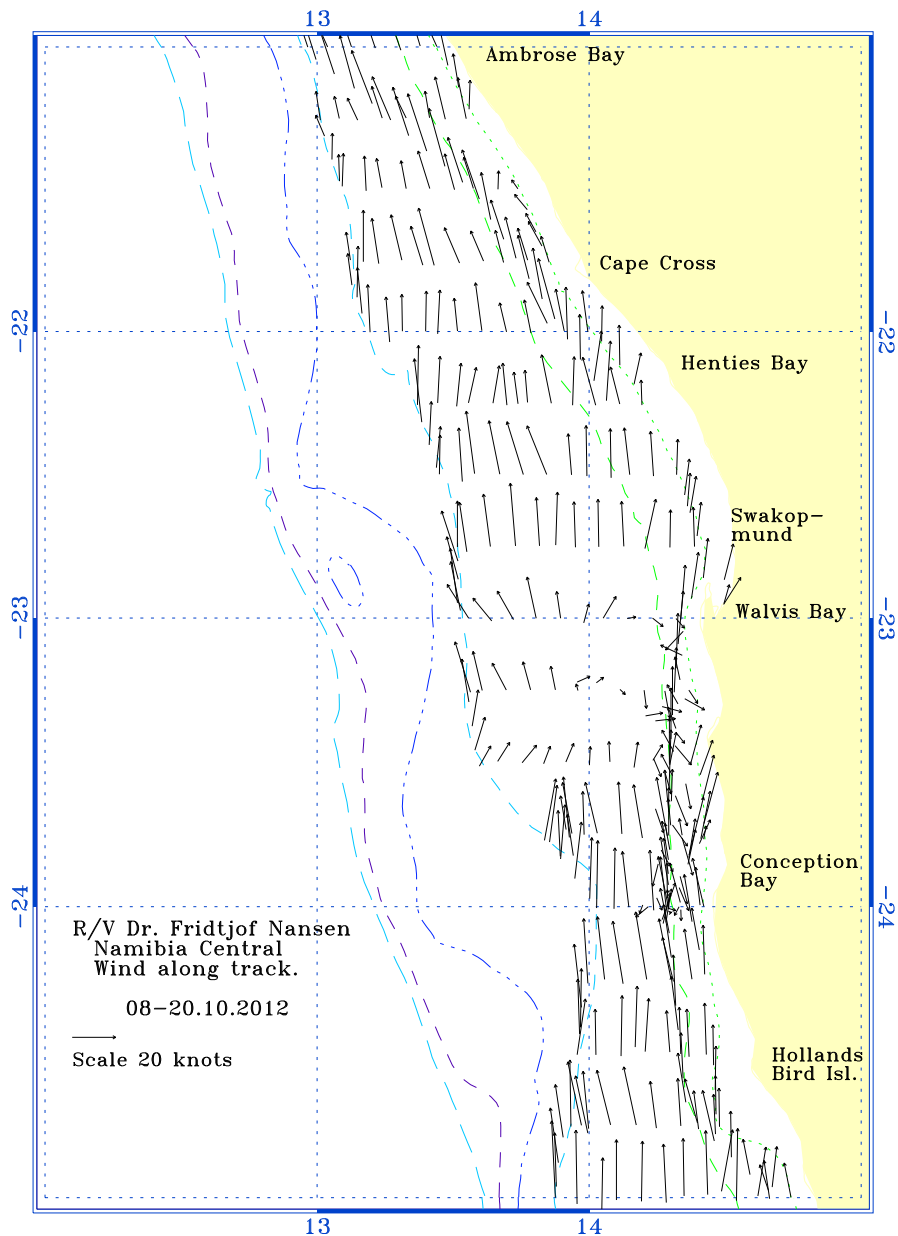


Figure 2: Distribution of wind velocities along the survey track for the southern region. Depth contours at 10, 20, 50, 100, 200 and 500 m.

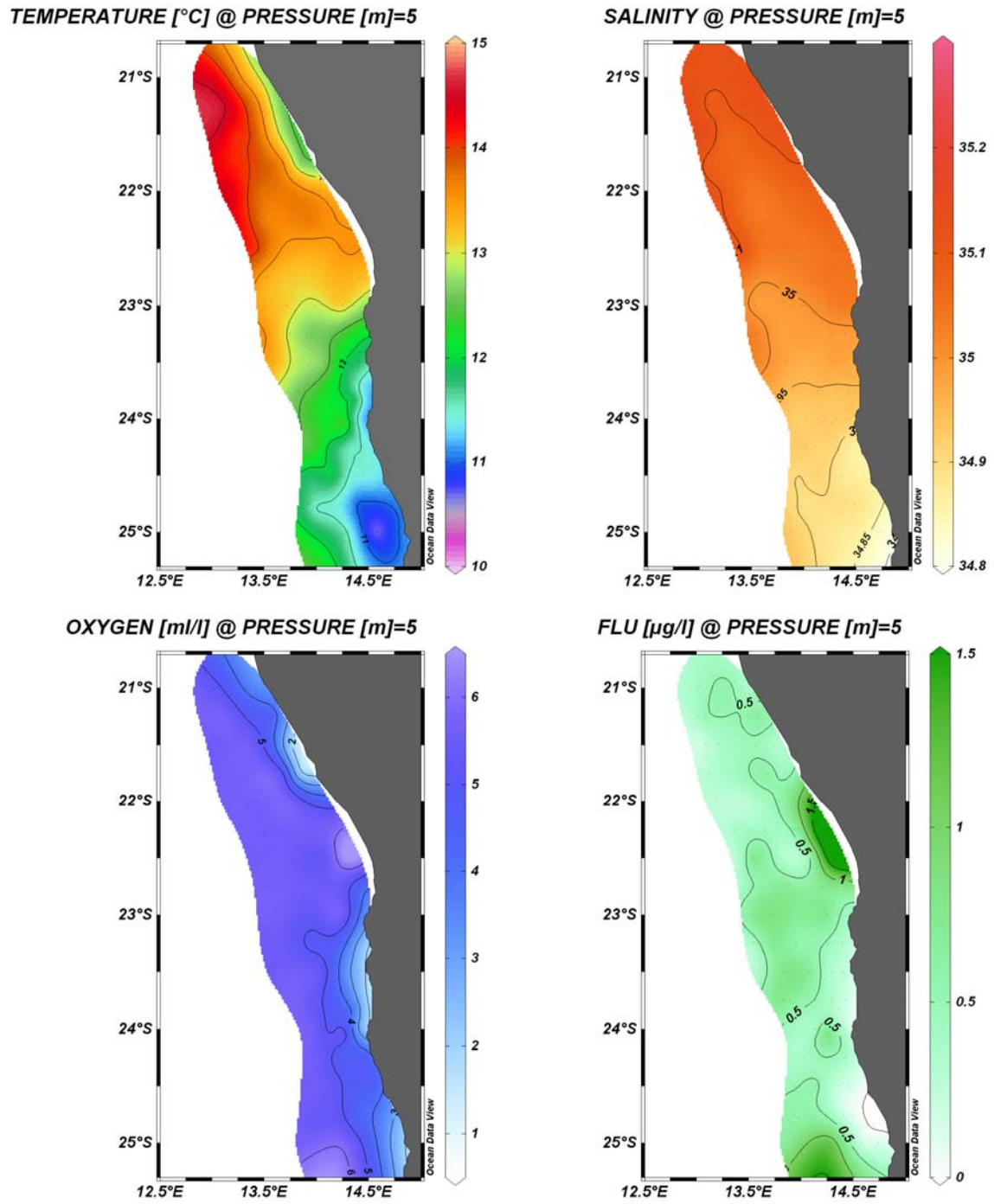


Figure 3: Contour (surface) plots of temperature, salinity, oxygen and fluorescence at 5m depth.

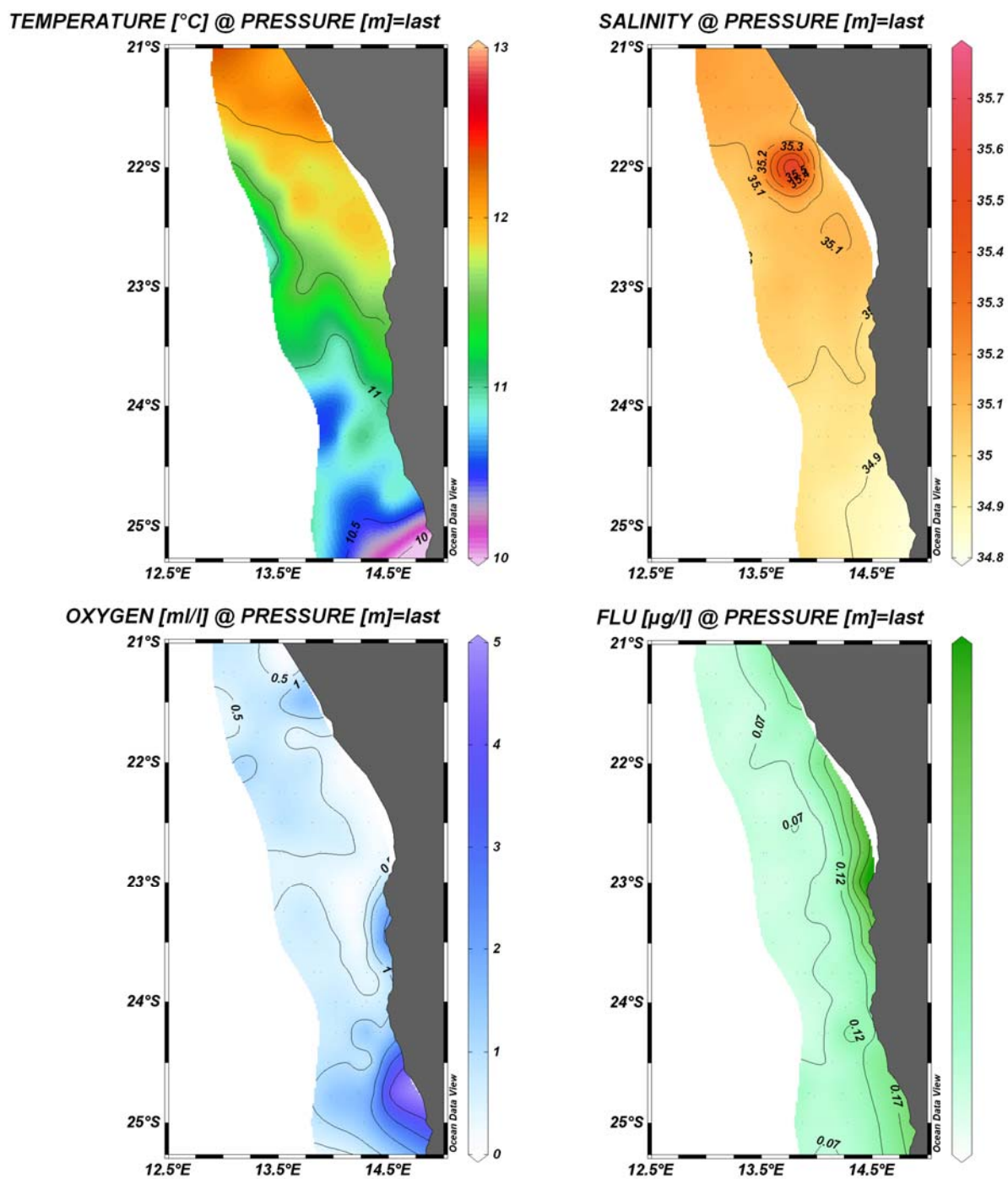


Figure 3: Contour (surface) plots of temperature, salinity, oxygen and fluorescence at deepest recorded depth.

3.2 Sections

Vertical gradients of temperature, salinity, oxygen and fluorescence are shown for each latitude between 21° and 25° S in Figures 4-8. Within this area temperature generally increased moving northwards. Lowest temperatures (app 10.5°C) were recorded inshore and on the upper shelf at 25° and 24° , indicative of upwelling taking place in this region. Highest recordings ($> 14^{\circ}\text{C}$) were made offshore at 22° , where temperature was generally above 12°C . Surface and bottom temperature and salinity readings at 21° - 22° indicate the advection of warm, high salinity water onto the shelf.

Dissolved oxygen at the surface (5 m) was generally above 4ml/l , and measured below 2 ml/l only inshore between 23° and 24° . The highest bottom oxygen readings corresponded with the upwelling region between 24° and 25° . Outside of this area, from 24° northwards, bottom oxygen was largely $< 1\text{ ml/l}$, with approximately half of the area measuring values of $< 0.5\text{ ml/l}$. The most hypoxic area ($< 0.5\text{ ml/l}$) was located inshore (50-100 m) between 22 - 24° , and stretched offshore to 200 m bottom depth at 23° .

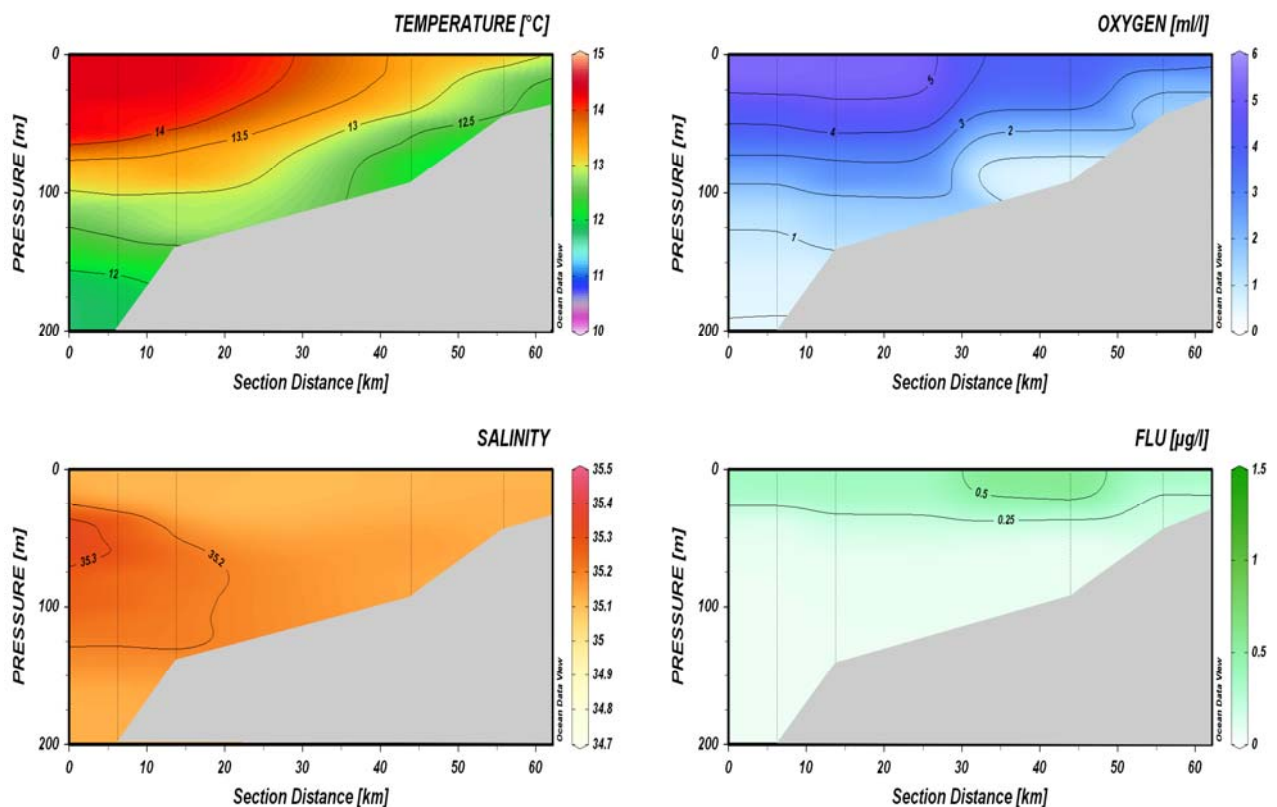


Figure 4: Vertical section of oceanographic conditions on transect 17, 21°S .

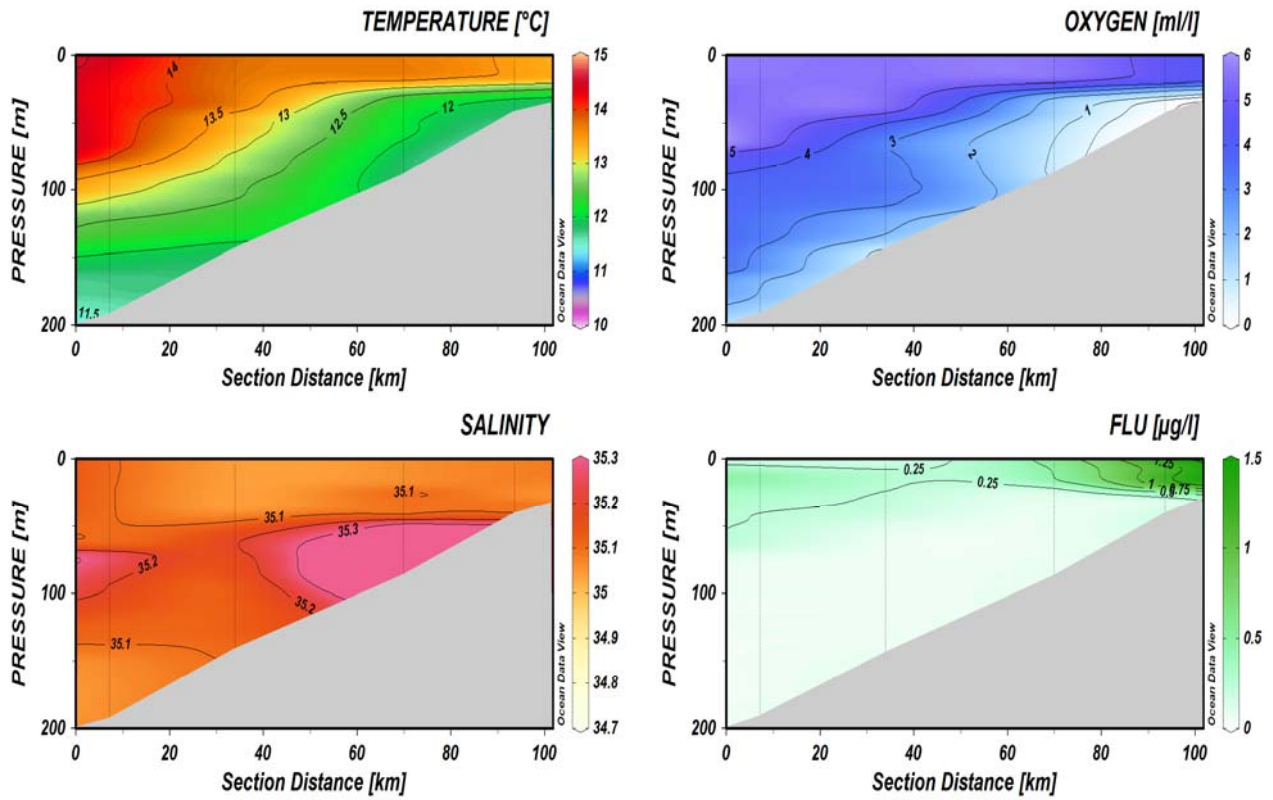


Figure 5: Vertical section of oceanographic conditions on transect 13, 22⁰S.

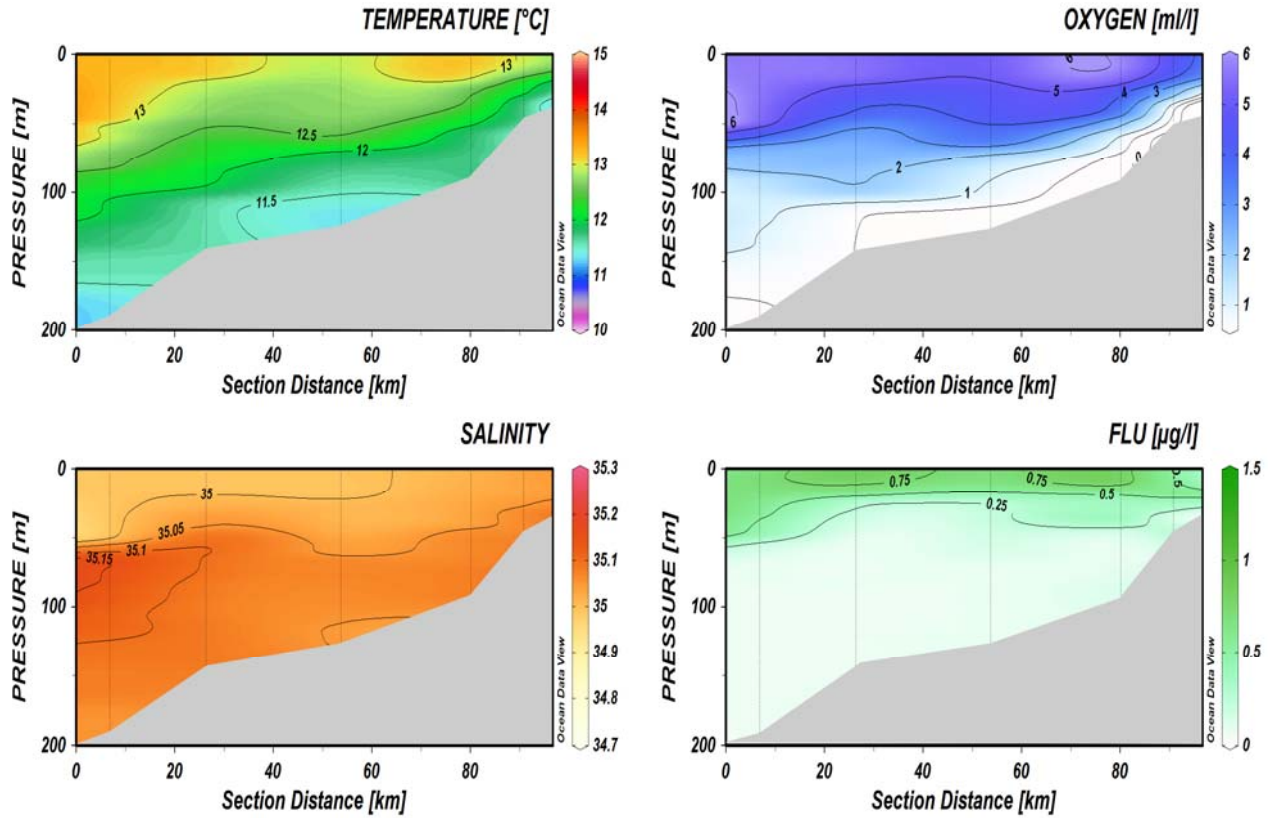


Figure 6: Vertical section of oceanographic conditions on transect 9, 23⁰S.

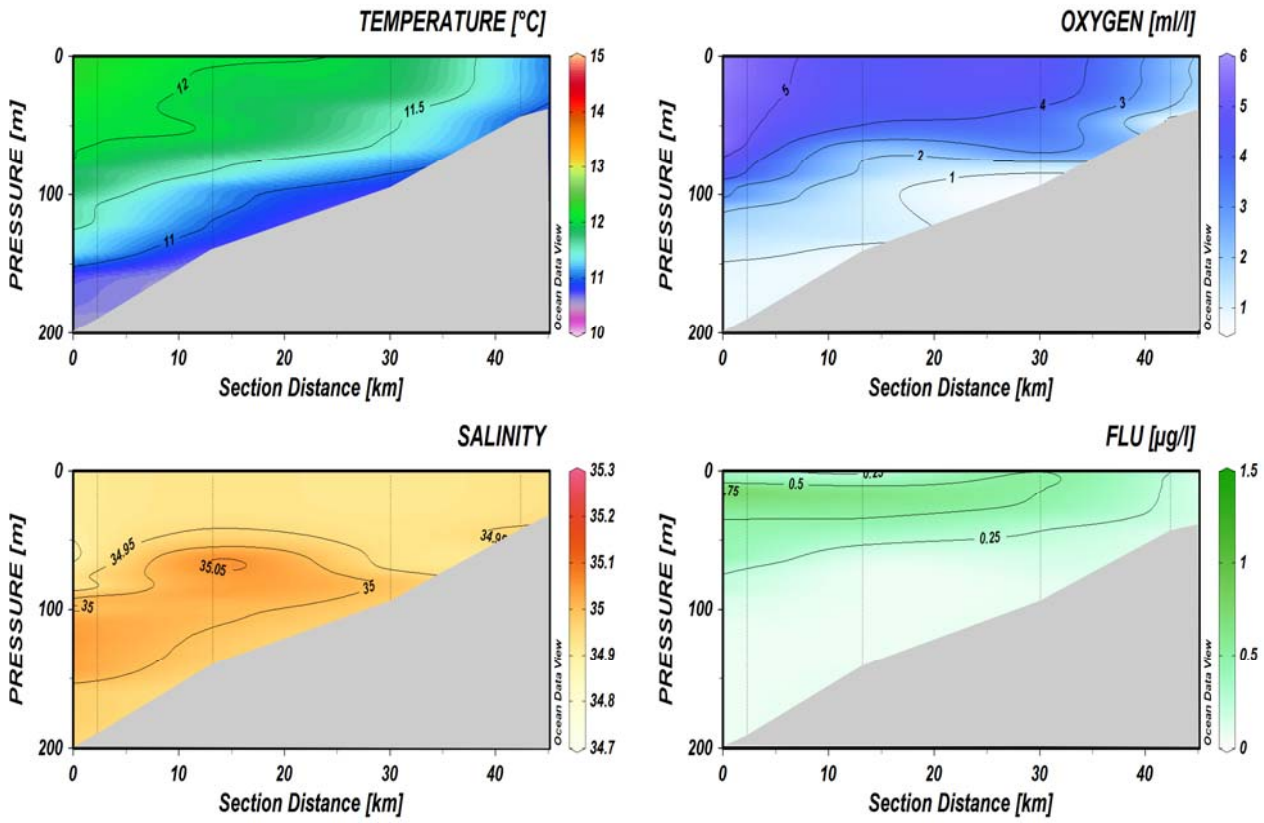


Figure 7: Vertical section of oceanographic conditions on transect 5, 24⁰S.

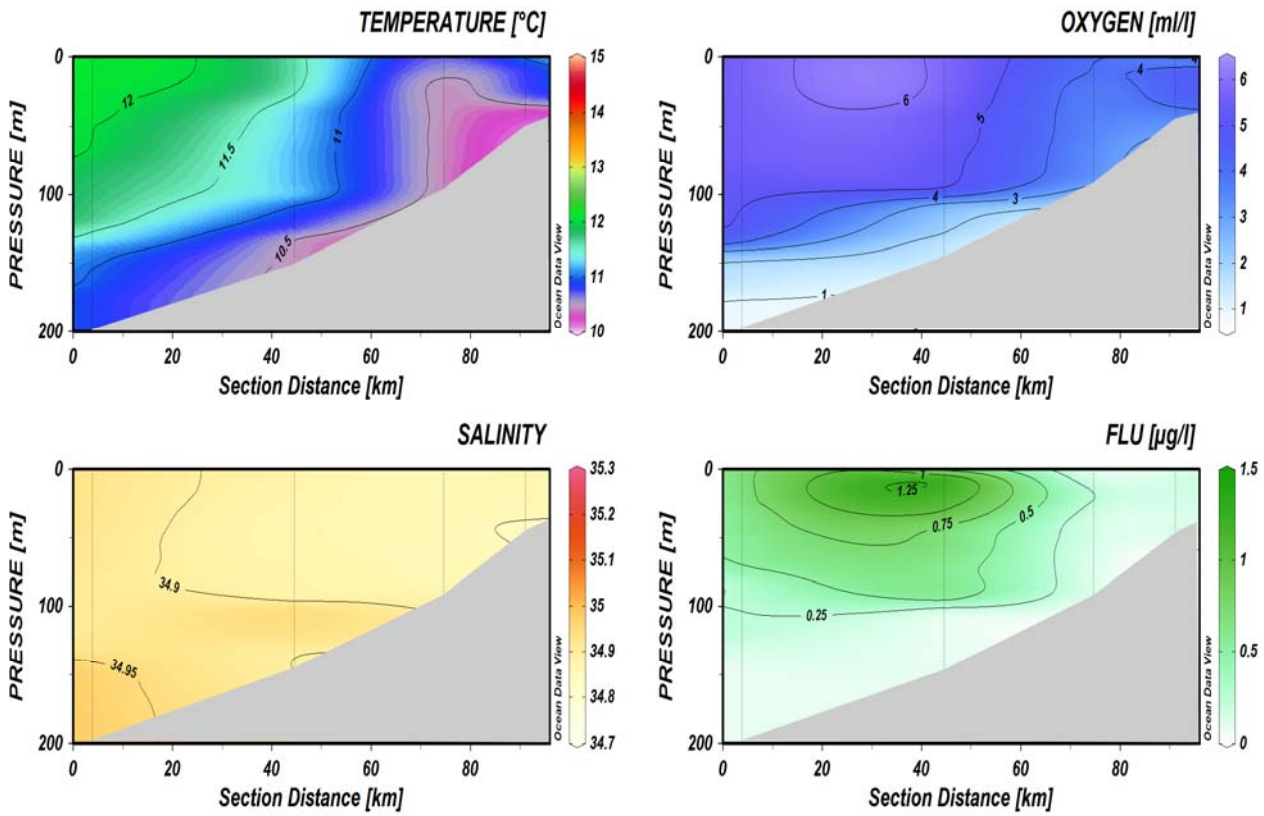


Figure 8: Vertical section of oceanographic conditions on transect 1, 25⁰S.

CHAPTER 4 DISTRIBUTION, AND SIZE COMPOSITION

4.1 Catch composition

Catch rates (kg/hr) and percentages of the total catch for the most frequently caught species (totalling more than 98% of the total catch) – jellyfish, hake (*M. capensis*), goby (*S.*

bibarbatus) and horse mackerel (*T. capensis*) – are grouped by depth ranges (50-100, 100-150, and 150-200 m) and presented in Tables 3-5.

Composition: 50-100 m depth

The two jellyfish species (*Chrysaora sp.*, *A. forskalea*) dominated trawl catches regardless of trawl type, i.e. fishing depth, and were caught in 100% and 83% of all pelagic and bottom tows respectively. Their average contribution to the total catch rate was approximately 93% (6626 kg/hr), followed by the pelagic goby (4%; 280 kg/hr) and small cape hake (2%; 123 kg/hr). Gobies and hake were respectively caught in 100% and 83% of all bottom tows, but were absent in all pelagic tows. Horse mackerel was caught in small quantities in only one pelagic and two bottom trawls (Table 3).

Table 3: Catch rates (kg/hr) of the main species in bottom and pelagic trawls at 50 – 100 m. Contribution of each species to the total catch is shown in parentheses. N.B. jellyfish catches often had to be estimated, since it was not possible to get the entire catch onboard.

Station	Gear type	Gear depth	Jellyfish	<i>M. capensis</i>	<i>Suflogobius bibarbatus</i>	<i>T. capensis</i>	Total
1	BT	74	0 (0)	1534 (46.1)	49 (1.5)	0	3324.7
4	PT	42.5	73 (91.5)	0	0	0	79.6
5	PT	25	55 (87.9)	0	0	0	62
8	PT	16.5	1606 (99.8)	0	1	0	1609.2
9	PT	59.5	18090 (100)	0	0	0	18089.6
12	BT	89	7581 (81.2)	38 (0.4)	1715 (18.4)	0	9334.7
13	BT	80.5	30000 (96.9)	0	960 (3.1)	0	30960
14	PT	20	8746 (100)	0	0	0	8746.4
32	PT	10	3181 (99.9)	0	0	1	3184.5
39	BT	90	8287 (95.7)	11 (0.1)	359 (4.1)	0	8658.9
43	PT	9.5	963 (99.8)	0	0	0	966.1
45	BT	94	1694 (89.5)	15.5 (0.8)	176.4 (9.3)	5.3 (0.3)	1891
46	BT	52	5858 (97)	5.2 (0.1)	138.5 (2.3)	38.6 (0.6)	6041
Mean			6625.7	123.4	280.4	0.5	7149.9

Composition: 100-150 m depth

Jellyfish were caught in all 16 trawls in this depth range. Hake and gobies were respectively present in 100% and 86% of all bottom trawls (n=7), and in 22% and 33% of all pelagic tows (n=9). The average contribution to the total catch rate of cape hake in bottom tows increased to 6.6%, with an average catch rate of 1227 kg/hr. The catch rate of gobies increased to an average 481 kg/hr (3%), and while the catch rate of jellyfish increased to 16778 kg/hr, their contribution to the total catch decreased slightly to 90%. The largest hake catches were at 105-120 m bottom depth, while large quantities of gobies were caught in a pelagic trawl at approximately 35 m depth. Horse mackerel were with the exception of one bottom trawl absent in trawl catches.

Table 4: Catch rates of the main species in bottom and pelagic trawls at 100 – 150 m. Contribution of each species to the total catch is shown in parentheses. N.B. jellyfish catches often had to be estimated, since it was not possible to get the entire catch onboard.

Station	Gear type	Gear depth	Suflogobius				Total
			Jellyfish	M. capensis	bibarbatus	T. capensis	
2	BT	111	61 (5)	756 (61.3)	83 (6.7)	0	1233.7
6	BT	146.5	1253 (24.6)	1245 (24.4)	77 (1.5)	0	5098.2
10	BT	108	21637 (59.1)	13374 (36.6)	1570 (4.3)	0	36580.1
15	PT	71	5378 (99.5)	0	29 (0.5)	0	5407
16	PT	35	2417 (68.7)	0	1102 (31.3)	0	3518.4
22	PT	80	5173 (99.9)	5 (0.1)	0	0	5177.8
23	BT	106.5	10443 (86.1)	45 (0.4)	1640 (13.6)	0	12127.9
24	PT	75	48261 (99.9)	0	3 (0.1)	0	48300
25	BT	115.5	7958 (71.3)	2660 (23.8)	542 (4.9)	0	11159.3
31	PT	21.5	54147 (100)	0	0	0	54150.6
33	BT	119	47182 (93.8)	9	2645 (5.3)	0	50326.9
35	BT	130	3168 (80.1)	319 (8.1)	0	466 (11.8)	3954.5
36	PT	60	6700 (100)	0	0	0	6699.9
37	PT	40	2059 (100)	0	0	0	2059.2
38	PT	22.5	1823 (100)	0	0	0	1822.9
42	PT	106.5	2399 (99.9)	3 (0.1)	0	0	2401.4
Average			16778	1227	481	29	18667

Composition: 150-200 m depth

With the exception of horse mackerel, the catch rates of jellyfish, hake and especially gobies decreased. But similar to catches from the shallower depth ranges, jellyfish dominated trawl catches and were present in all bottom and pelagic trawls. Their average contribution to the total catch decreased to 83% (3783kg/hr), that of hake was 8% (368 kg/hr), and horse

mackerel increased to 7% (316 kg/hr). Gobies were virtually absent in catches, contributing 0,4-0,6% to the total catch. Both hake and mackerel were exclusively caught in bottom trawls.

Table 5: Catch rates of the main species in bottom and pelagic trawls at 150 – 200 m. Contribution of each species to the total catch is shown in parentheses. N.B. jellyfish catches often had to be estimated, since it was not possible to get the entire catch onboard

Station	Gear type	Gear depth	Jellyfish	M. capensis	Suflogobius bibarbatus	T. capensis	Total
3	BT	163.5	790 (16.9)	2516 (53.7)	27 (0.6)	1185 (25.3)	4682.6
17	BT	181	2308 (83.2)	371 (13.4)	0	44 (1.6)	2774.5
18	PT	102	4072 (100)	0	0	0	4072.3
19	PT	59.5	987 (100)	0	0	0	987
20	PT	29	122 (100)	0	0	0	122.3
34	PT	123.5	6135 (99.2)	0	0	0	6185
40	PT	164	8911 (98.3)	0	0	0	9068.3
41	BT	181.5	2000 (48.9)	428 (10.5)	16 (0.4)	1619 (39.5)	4092.9
44	PT	109	8721 (100)	0	0	0	8720.9
Mean			3783	368	5	316	4523

4.2 Distribution of cape hake

Catch rates of cape hake by latitude are shown in Figure 9. Catch rates were highest south of 24°, and were, with the exception of one bottom trawl (660 kg/hr), below 500 kg/hr north of 24°, with a high percentage (60%) of tows with small hake catches. There seemed to be no visible correlation between fishing depth and catch rate of hake, as high catch rates of hakes were made at all depths between 50 and 200m depth (Figure 10).

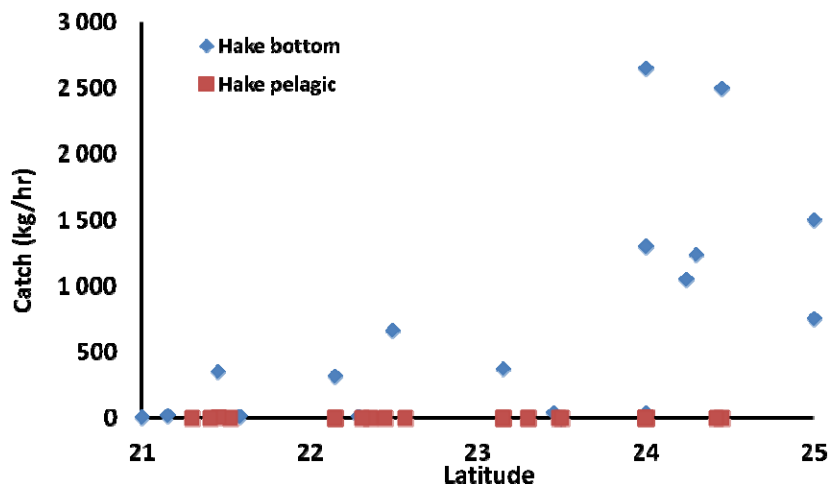


Figure 9: Catch rates of hake in bottom and pelagic tows by latitude.

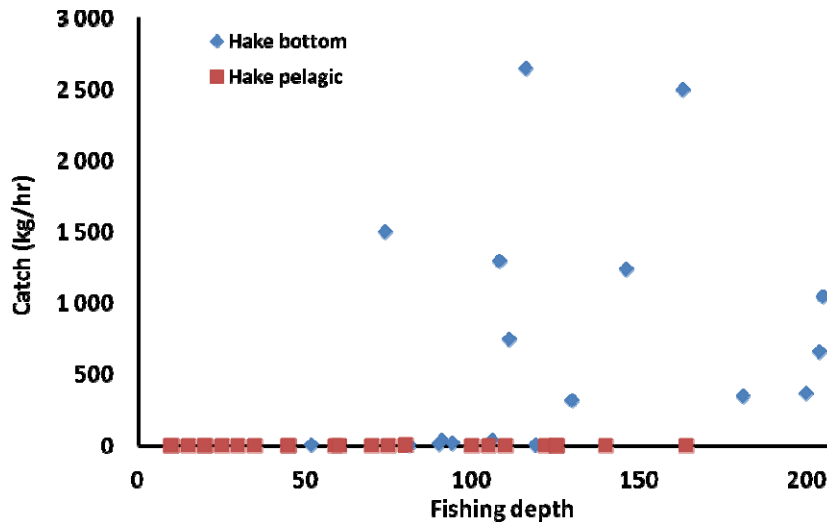


Figure 10: Catch rates of hake in bottom and pelagic tows by bottom depth.

Hake was caught at bottom oxygen concentrations ranging from approximately 0.5 to 3.4 ml/l (Figure 11). Both high and low catch rates were recorded at low oxygen levels (0.5–1.0 ml/l), with no indication that catch rates increased with increasing oxygen concentrations.

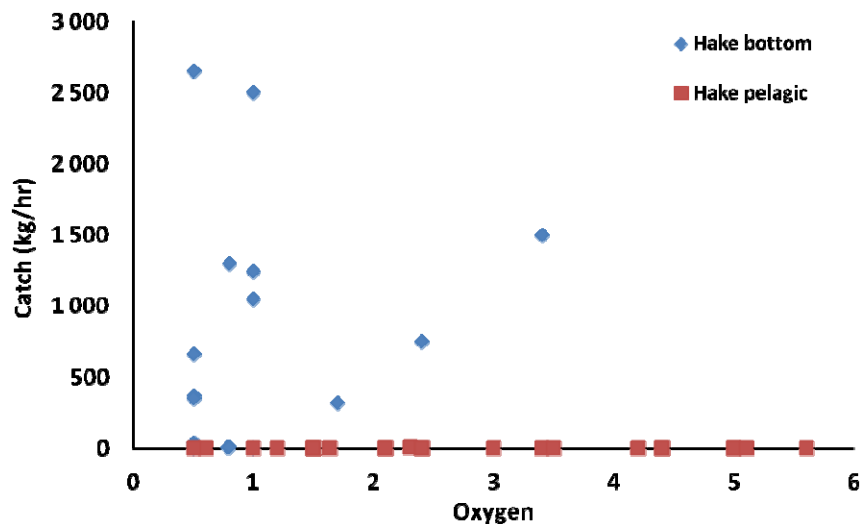


Figure 11: Catch rates of hake in bottom and pelagic tows vs bottom oxygen concentrations.

4.3 Acoustic echograms

Acoustic echograms were interpreted based on the catch composition of both pelagic and demersal trawls, as well as the depth, structure (occurrence) of scattering layers and acoustic

targets. Examples of acoustic transects are shown in Figures 12-17.

Acoustic backscattering inshore of 150 m was primarily produced by both species of jellyfish, gobies and various macro plankton. The contribution of juvenile hake to the backscatter was limited to south of 24⁰ (Figure 9), and were mostly visible on the bottom (10 m channel) at depths of 80-120 m.

Echograms show that in general extensive layers, up to 40-100 m thick and composed of both jellyfish species, pelagic gobies and plankton, occurred inshore of 150 m. The vertical extent (width) and density of these layers varied with daytime, location, and seemingly also oxygen concentration. Offshore beyond 150 m, scattering layers in the upper 100 m became weaker and less dense. Occasionally mesopelagic fish (*M. muelleri*) composed scattering layers visible at 100-150 m, and small aggregations (schools) of horse mackerel could be detected both on and off the bottom at 150-200 m. On selected transects (23 and 23.5⁰), the scattering layer did not extend all the way to the bottom, but seemingly 'stopped' (20-50 m off the bottom) when oxygen concentrations were 0.5 ml/l and continued to decrease towards the bottom, resulting in a void with no acoustic targets below (Figure 13). These 'voids' were on the same transects interrupted by gobies apparently descending from the pelagic to the bottom in large quantities (Figure 13). This behaviour of gobies returning to the bottom was also observed on several of the later transects further north, and occurred at approximately the same depths of 75-80 m and 120-130 m (Figure 12 to 15).

Dense acoustic marks of small hake close to the bottom were visible on transects south of 24⁰, at 80 – 110 m depth. However, it was generally difficult to discern hake acoustically, due to 1) the often high density of the jellyfish/goby layer, especially at night time when a proportion of fish usually lift off the bottom, 2) inability to obtain sufficient samples from acoustic targets with bottom trawls as a result of very short tow duration. North of 24⁰ hake appeared mostly as scattered marks close to the bottom. We were not able to detect any significant amounts of pelagic hake during this survey.

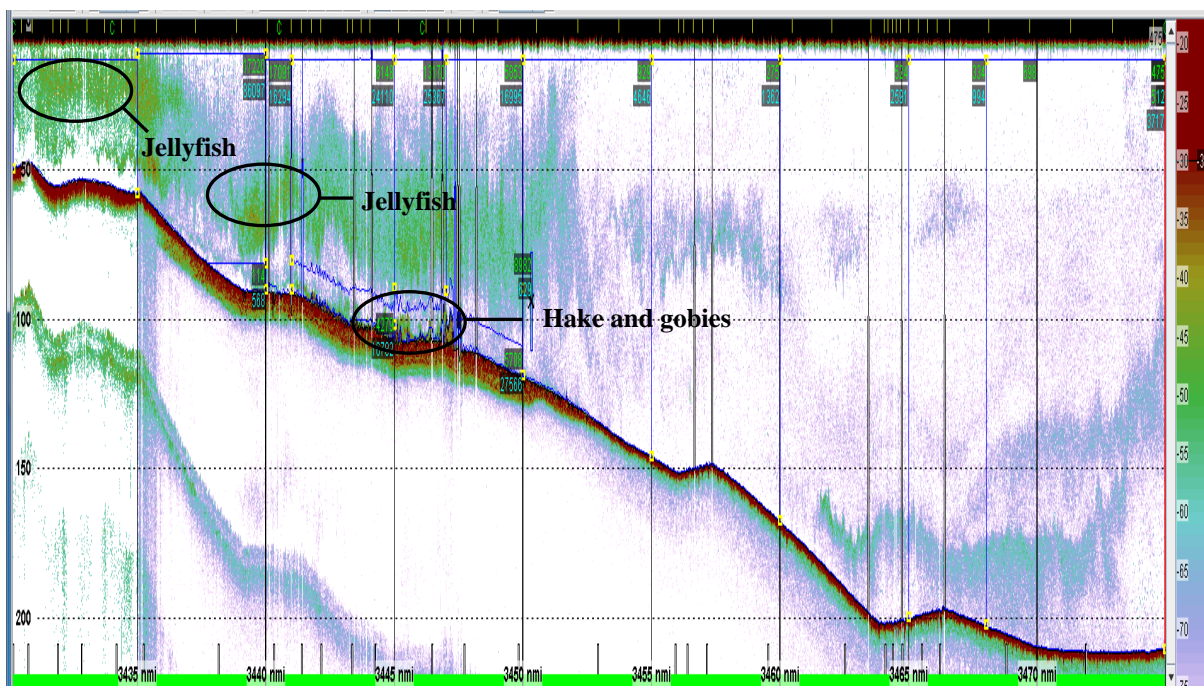


Figure 12: Acoustic echogram from transect 5 (24°S). Acoustic targets were identified with pelagic trawls 8 and 9 (jellyfish) and bottom trawl 10 (hake and gobies).

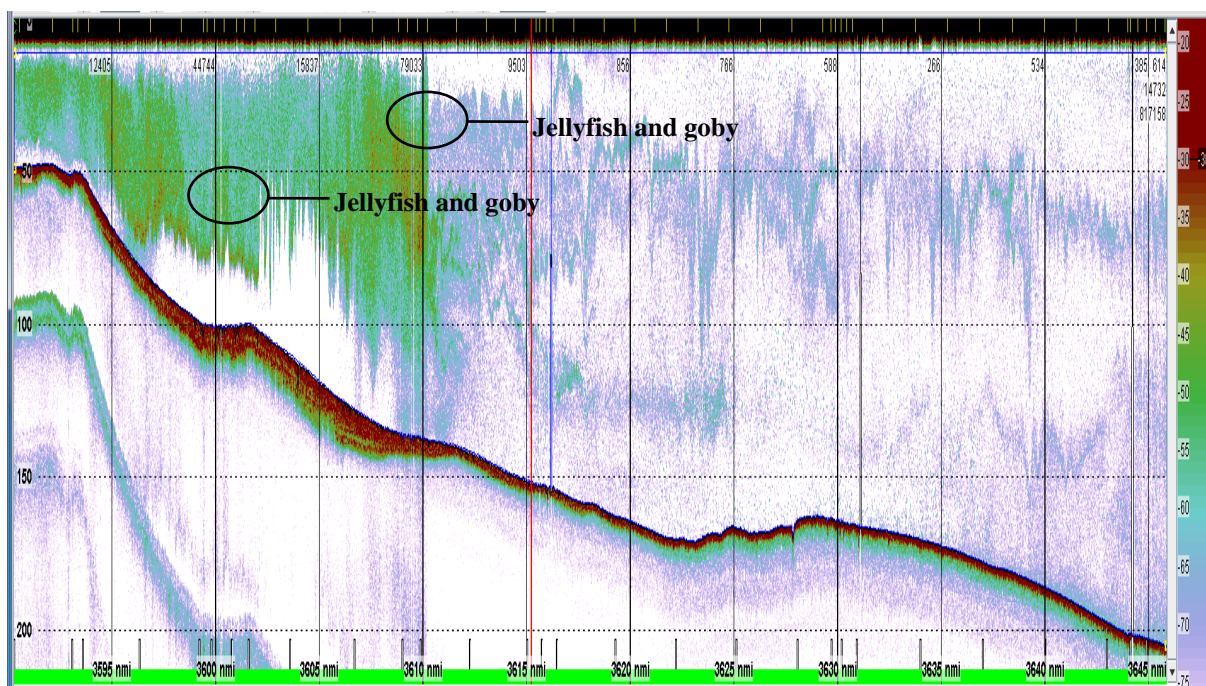


Figure 13: Acoustic echogram from transect 7 ($23^{\circ}30'\text{S}$). Acoustic targets were identified with pelagic trawls 15 and 16.

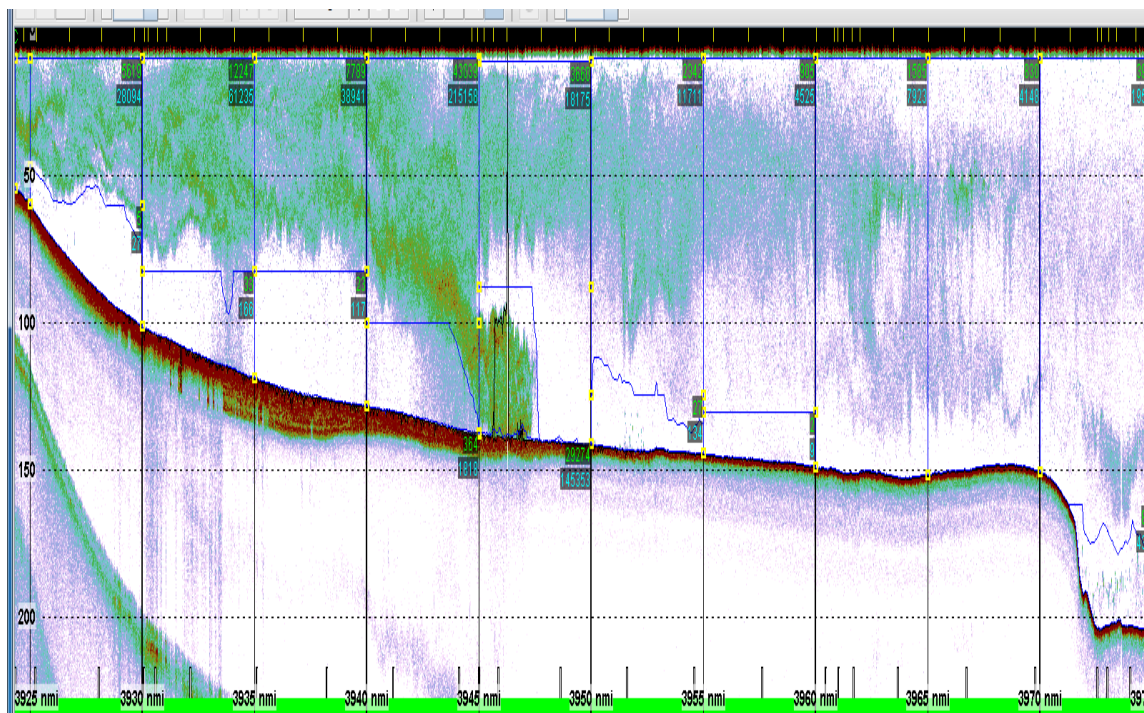


Figure 14: Acoustic echogram from transect 9 (23⁰⁰S).

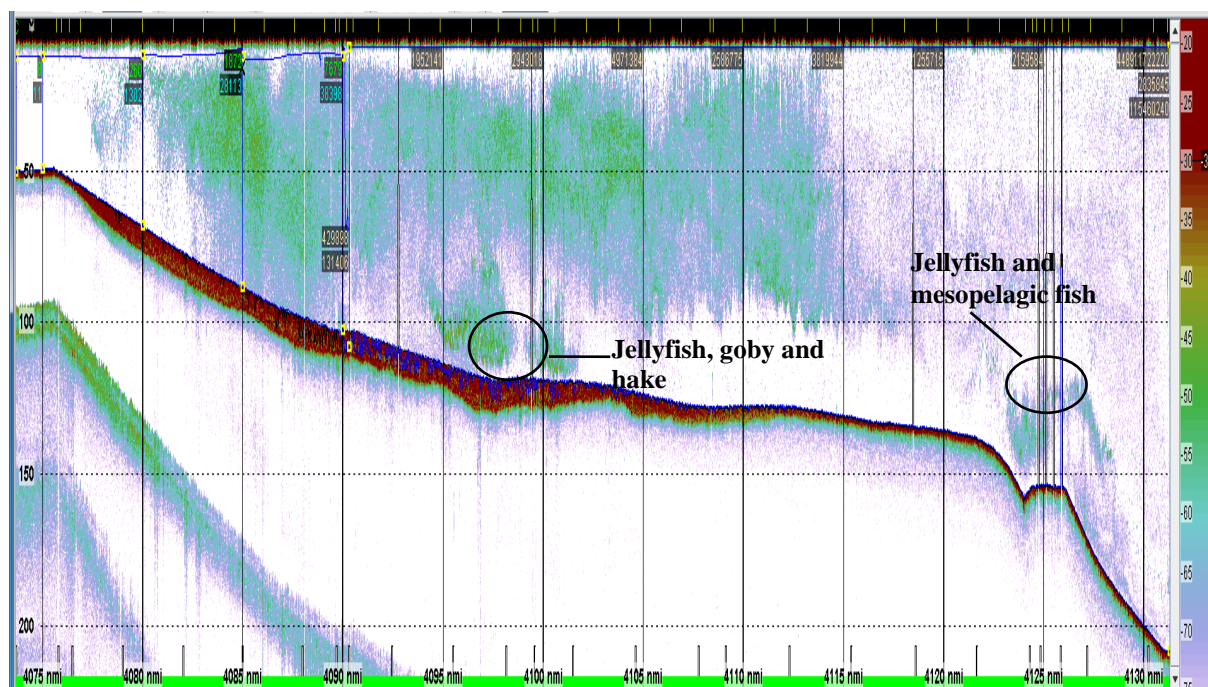


Figure 15: Acoustic echogram from transect 11 (22³⁰S). Acoustic targets were identified with pelagic trawl 33 (jelly fish, goby and hake) and pelagic trawl 34 (jellyfish and mesopelagic fish).

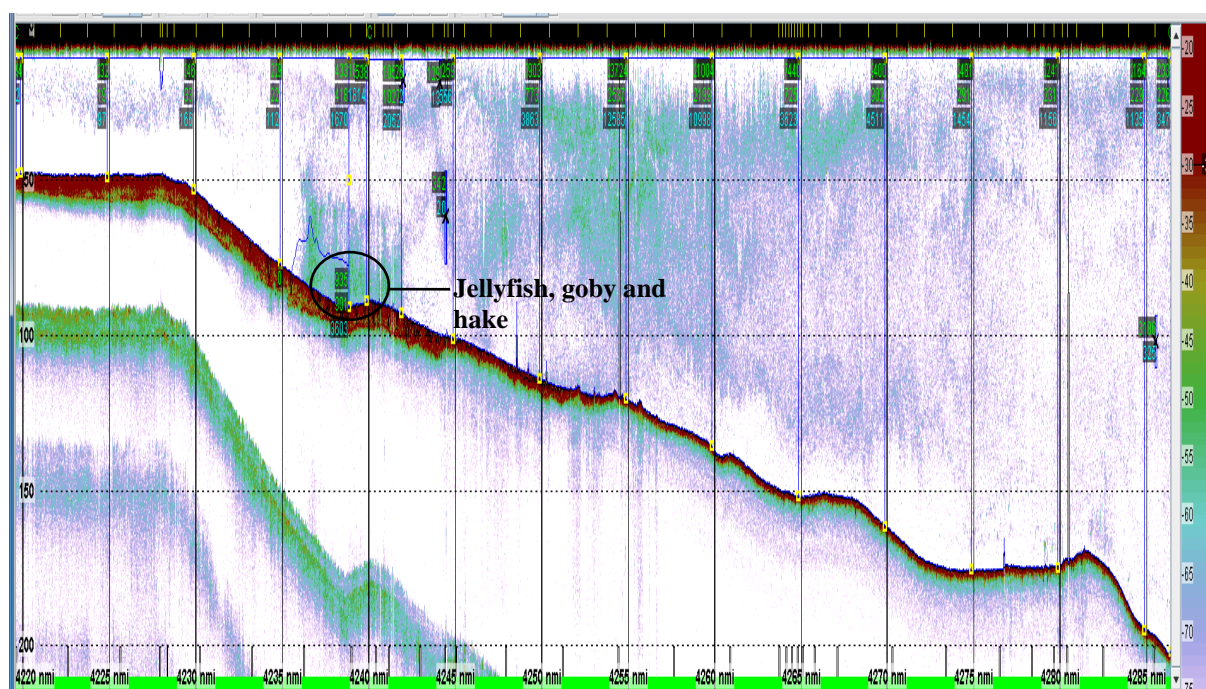


Figure 16: Acoustic echogram from transect 13 (22⁰00S).

4.4 Biology

Length frequency:hake

Length data for cape hake was binned into three depth ranges (50-100, 100-150, >150 m), and the resulting length frequency distributions are shown in Figure 17. The modes for the 50-100 m and 100-150 m distributions were the same (22 cm), and the width of the distributions similar. Larger amounts of bigger fish were caught at depths greater than 150 m. Assuming that cape hake mature at 19 cm (Sarah Paulus pers. com), juvenile fish (< 19 cm) amounted to only 6% of all fish caught. The large majority of these were caught inshore of 120 m depth. The remaining 94% of the hake caught were thus 1+ fish (one year and older), indicating that these were spawned in 2011 or earlier. It also suggests that fish at this age and length have already changed their habitat from pelagic to demersal. Average length of cape hake within depth ranges did not seem to vary a lot by latitude (Figure 18). Regardless of latitude larger fish (> 30 cm) were caught deeper than 150 m, while smaller fish (< 25 cm) were caught inside of 150 m.

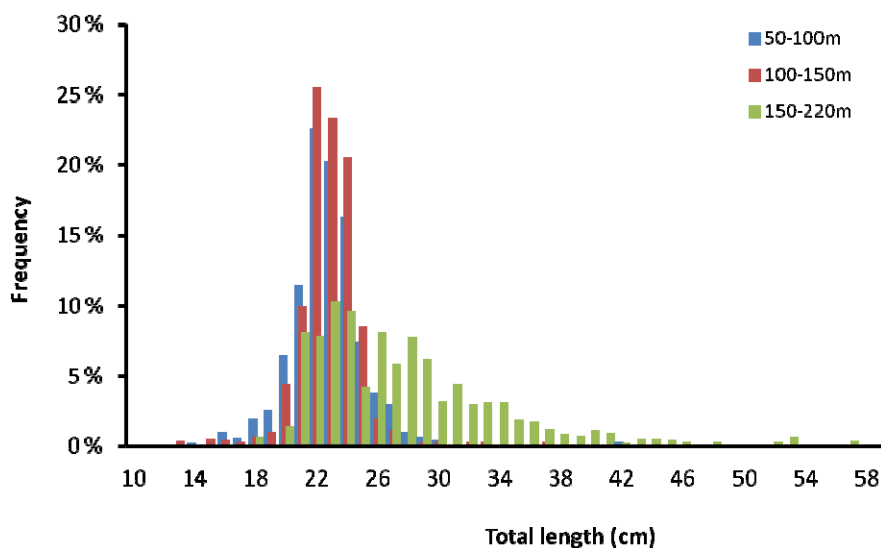


Figure 17: Length frequency distribution of cape hake by depth range. Fish > 60 cm were few and are not shown in the histogram.

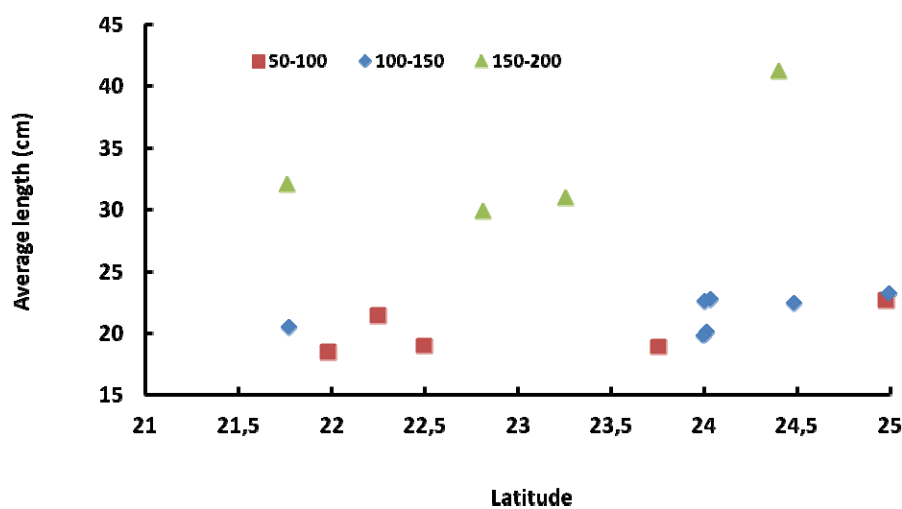


Figure 18: Average cape hake length in trawl catches from three depth ranges and by latitude.

4.5 Stomach content analysis

A total of 298 hake stomachs were analysed for the presence of gobies and micronekton species. Of these 102 stomachs contained digested or fresh gobies ($n = 162$). Besides gobies hake stomachs also contained myctophids and euphausiids, the latter occasionally found in large numbers. The presence (frequency of occurrence) of gobies in hake stomachs varied between stations (Figure 19).

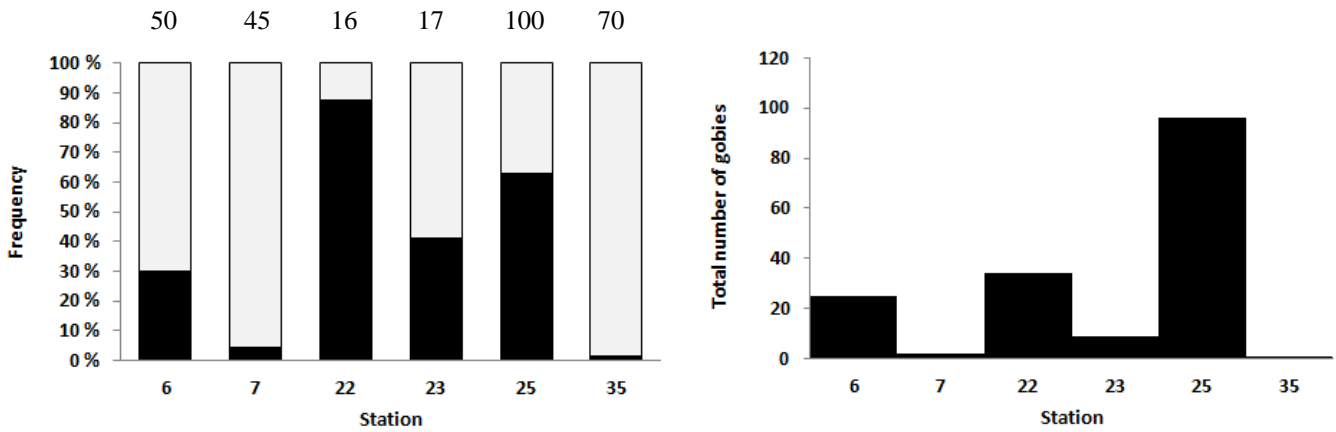


Figure 19: The frequency of occurrence of gobies in hake stomachs (black bars) (left panel), and total number of gobies identified in hake stomachs on each station (right panel). The number of fish analysed per station is indicated at the top of the left panel.

Highest frequencies of occurrence of gobies were observed in hake caught at 100 – 130 m depth (stations 22, 23 and 25 Figure 19), which generally also corresponded with the presence of large numbers of gobies in trawl catches. Most gobies were consumed by 22-23 cm long fish (Figure 20), while the frequency of gobies in stomachs was high (> 30 %) in fish 21 – 26 cm long fish. The highest number of gobies (n = 5) was found in a 25 cm fish. The length range of gobies preyed on was 5-7 cm, with a mode at 6 cm.

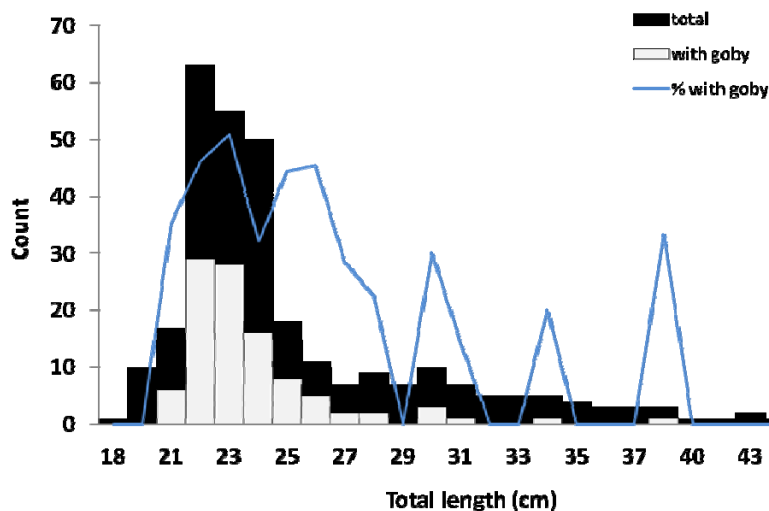


Figure 20: Length distribution of hake sampled (total), showing the number of hake with gobies recorded in each length class, and the corresponding frequency of occurrence.

CHAPTER 5 SUMMARY OF SURVEY RESULTS

5.1 Juvenile hake distribution

The objective of locating and mapping high densities of juvenile hake was not achieved on this survey. There may be several reasons for this (not in order of importance): 1) juvenile hake occurred outside the surveyed area during the survey period, 2) the timing of the survey was not optimal, i.e. hake do not spawn in autumn/winter, such that an 0-group cohort could have been observed, 3) the high densities of jellyfish and gobies made it difficult to positively identify high densities of small hake acoustically, in essence 'hiding' the presence of juvenile hake, 4) the transect spacing of 15nm was too large, with a high likelihood of missing smaller aggregations of juvenile hake, 5) acoustic targets were wrongly identified and consequently a decision not to trawl was made.

The largest hake catches were made south of 24⁰ where inshore bottom oxygen concentrations tended to be higher than further north (Figure 3). The size of hake caught throughout the survey was generally above 19 cm, suggesting that most of these fish were spawned during 2011, or earlier. Catches contained few hake below 19 cm in length, and no observations of pelagic hake schools (aggregations) were made. The only pelagic schools identified were observed on inter-transect lines north of 22⁰45'S and consisted most probably of juvenile horse mackerel and other pelagic species (stations 32 and 43).

The current knowledge on the pelagic lifecycle of juvenile hake is limited, if not poor, with limited information available from 0-group hake surveys conducted in the mid 90's with the *RV Dr Fridtjof Nansen*. It is possible that additional acoustic records of pelagic hake were collected during the period the *RV DR Fridtjof Nansen* was conducting surveys in the northern Benguela. Such records would be of great help in planning and conducting future surveys to locate and detect pelagic hake schools.

It is clear from this survey that both jellyfish species and the pelagic goby are an integral part of the shelf ecology in the northern Benguela. Acoustic and catch records show that the high densities (abundance) of these species are not a local phenomena, but that these species occur along the entire upper shelf inshore of 150 m, from 21⁰-25⁰S. The vertical and horizontal extent of jellyfish may effect the occurrence of other species and their vertical and horizontal distribution, as well as the entire shelf ecology.

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Schlitzer R (2011) Ocean Data View, <http://odv.avi.de>

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ANNEX I: Fishing stations

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 1
 DATE :10/09/12 GEAR TYPE: BT NO: 25 POSITION:Lat S 24°58.70
 start stop duration Region : 5000
 TIME :10:52:13 11:00:43 8.5 (min) Purpose : 1
 LOG : 3185.01 3185.43 0.4 Lon E 14°40.30
 FDEPTH: 74 74 Gear cond.: 0
 BDEPTH: 74 74 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 2.9 km
 Sorted : 54 Total catch: 471.01 Catch/hour: 3324.78

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chelidonichthys capensis	1023.11	1984	30.77	
Merluccius capensis	822.00	8704	24.72	1
Merluccius capensis	711.88	8104	21.41	2
Dead shells	656.40	0	19.74	
Sufflogobius bibarbatatus	48.64	6424	1.46	5
Thyrsites atun	43.84	106	1.32	4
Austroglossus microlepis	18.85	219	0.57	3
Total	3324.71		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 2
 DATE :10/09/12 GEAR TYPE: BT NO: 25 POSITION:Lat S 24°59.66
 start stop duration Region : 5000
 TIME :01:29:39 01:36:26 6.8 (min) Purpose : 1
 LOG : 3200.00 3200.29 0.3 Lon E 14°29.18
 FDEPTH: 111 111 Gear cond.: 0
 BDEPTH: 111 111 Validity : 0
 Towing dir: 0° Wire out : 250 m Speed : 2.6 km
 Sorted : 16 Total catch: 139.41 Catch/hour: 1233.72

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius capensis	433.27	4438	35.12	6
Merluccius capensis	322.74	3385	26.16	7
Lampanyctodes hectoris	157.26	54239	12.75	
Sufflogobius bibarbatatus	82.74	7522	6.71	10
Chelidonichthys capensis	76.02	1133	6.16	
Aequorea forskalea	60.97	381	4.94	
Dead shells	57.96	0	4.70	
Thyrsites atun	32.83	9	2.66	9
Austroglossus microlepis	9.91	115	0.80	8
Total	1233.72		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 3
 DATE :10/10/12 GEAR TYPE: NO: 25 POSITION:Lat S 24°45.76
 start stop duration Region : 5000
 TIME :01:31:50 01:49:04 17.2 (min) Purpose : 1
 LOG : 3271.03 3271.80 0.8 Lon E 13°58.25
 FDEPTH: 163 164 Gear cond.: 0
 BDEPTH: 163 164 Validity : 0
 Towing dir: 0° Wire out : 370 m Speed : 2.7 km
 Sorted : 64 Total catch: 1344.70 Catch/hour: 4682.65

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius capensis	1426.00	16381	30.45	13
Trachurus capensis	1184.68	7971	25.30	11
Merluccius capensis	1089.61	11701	23.27	12
Chrysaora sp.	731.28	0	15.62	
Dead shells	131.63	0	2.81	
Aequorea forskalea	58.50	731	1.25	
Sufflogobius bibarbatatus	27.06	2706	0.58	14
Lepidopus caudatus	11.70	246	0.25	
Macropodus australis	6.58	219	0.14	
Lophius vomerinus	4.63	7	0.10	15
Coelrorhinus coelrorhinc. polli	4.39	219	0.09	
Pterothrissus belloci	4.39	73	0.09	
Lampanyctodes hectoris	1.46	439	0.03	
Squilla aculeata calmani	0.73	73	0.02	
Total	4682.65		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 4
 DATE :10/10/12 GEAR TYPE: NO: 1 POSITION:Lat S 24°46.14
 start stop duration Region : 5000
 TIME :07:35:48 08:05:42 29.9 (min) Purpose : 1
 LOG : 3303.26 3304.82 1.6 Lon E 14°27.64
 FDEPTH: 55 30 Gear cond.: 0
 BDEPTH: 87 90 Validity : 0
 Towing dir: 0° Wire out : 110 m Speed : 3.1 km
 Sorted : 40 Total catch: 39.67 Catch/hour: 79.61

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Aequorea forskalea	53.84	0	67.63	
Chrysaora sp.	18.96	0	23.82	
Todaropsis eblanae	6.76	1230	8.50	
CENTROLOPHIDAE	0.02	2	0.03	
Miscellaneous fishes	0.02	2	0.03	
Total	79.61		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 5
 DATE :10/10/12 GEAR TYPE: NO: 1 POSITION:Lat S 24°42.61
 start stop duration Region : 5000
 TIME :09:39:47 09:47:27 7.7 (min) Purpose : 1
 LOG : 3313.03 3313.44 0.4 Lon E 14°27.97
 FDEPTH: 25 25 Gear cond.: 0
 BDEPTH: 49 51 Validity : 0
 Towing dir: 0° Wire out : 85 m Speed : 3.2 km
 Sorted : 8 Total catch: 7.93 Catch/hour: 62.03

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Aequorea forskalea	53.90	0	86.89	
Todaropsis eblanae	7.12	1424	11.48	0
Chrysaora sp.	0.63	0	1.01	
Sufflogobius bibarbatatus	0.23	110	0.38	16
Lepidopus caudatus	0.16	55	0.25	
Total	62.03		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 6

DATE :10/10/12 GEAR TYPE: BT NO: 25 POSITION:Lat S 24°29.01
 start stop duration Region : 5000
 TIME :03:08:44 03:18:45 10.0 (min) Purpose : 1
 LOG : 3349.03 3349.51 0.5 Lon E 14°10.15
 FDEPTH: 146 147 Gear cond.: 0
 BDEPTH: 146 147 Validity : 0
 Towing dir: 0° Wire out : 340 m Speed : 2.9 km
 Sorted : 0 Total catch: 851.40 Catch/hour: 5098.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Miscellaneous fishes	2327.07	0	45.64	
Chrysaora sp.	1215.03	0	23.83	
Merluccius capensis	727.54	12533	14.27	17
Merluccius capensis	517.37	0	10.15	
Dead shells	160.06	0	3.14	
Sufflogobius bibarbatatus	76.83	29263	1.51	20
Aequorea forskalea	38.02	0	0.75	
Symblophorus boops	26.71	10671	0.52	
Austroglossus microlepis	9.58	36	0.19	19
Total	5098.20		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 7
 DATE :10/10/12 GEAR TYPE: PT NO: 7 POSITION:Lat S 24°24.15
 start stop duration Region : 5000
 TIME :07:53:58 08:14:12 20.2 (min) Purpose : 1
 LOG : 3373.27 3374.28 1.0 Lon E 13°58.17
 FDEPTH: 205 205 Gear cond.: 0
 BDEPTH: 214 214 Validity : 0
 Towing dir: 0° Wire out : 480 m Speed : 3.0 km
 Sorted : 78 Total catch: 546.23 Catch/hour: 1620.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius capensis	565.51	4182	34.91	23
Chrysaora sp.	543.53	0	33.55	
Merluccius capensis	437.85	0	27.03	0
Merluccius capensis	31.65	21	1.95	
Coelrorhinus coelrorhinc. polli	22.78	664	1.41	
Merluccius capensis	14.41	21	0.89	22
Lophius vomerinus	2.58	3	0.16	25
Austroglossus microlepis	1.16	3	0.07	26
Bathynectes piperitus	0.59	21	0.04	
Total	1620.06		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 8
 DATE :10/11/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 24°0.69
 start stop duration Region : 5000
 TIME :06:15:16 06:26:08 10.9 (min) Purpose : 1
 LOG : 3434.05 3434.73 0.7 Lon E 14°24.55
 FDEPTH: 15 18 Gear cond.: 0
 BDEPTH: 56 58 Validity : 0
 Towing dir: 0° Wire out : 75 m Speed : 3.8 km
 Sorted : 42 Total catch: 291.53 Catch/hour: 1609.18

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	1605.81	0	99.79	
Chelidonichthys capensis	1.82	6	0.11	
Sufflogobius bibarbatatus	0.77	77	0.05	27
Todaropsis eblanae	0.77	39	0.05	
Total	1609.18		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 9
 DATE :10/11/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 23°59.57
 start stop duration Region : 5000
 TIME :07:20:43 07:37:28 16.8 (min) Purpose : 1
 LOG : 3440.53 3441.31 0.8 Lon E 14°20.01
 FDEPTH: 59 60 Gear cond.: 0
 BDEPTH: 91 92 Validity : 0
 Towing dir: 0° Wire out : 170 m Speed : 2.8 km
 Sorted : 40 Total catch: 5050.00 Catch/hour: 18089.55

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Aequorea forskalea	10397.01	0	57.48	
Chrysaora sp.	7692.54	0	42.52	
Total	18089.55		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 10
 DATE :10/11/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 23°59.84
 start stop duration Region : 5000
 TIME :09:07:50 09:14:56 7.1 (min) Purpose : 1
 LOG : 3446.61 3446.92 0.3 Lon E 14°17.04
 FDEPTH: 108 108 Gear cond.: 0
 BDEPTH: 108 108 Validity : 0
 Towing dir: 0° Wire out : 250 m Speed : 2.7 km
 Sorted : 30 Total catch: 4328.64 Catch/hour: 36580.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	20419.61	0	55.82	
Merluccius capensis	9053.75	104654	24.75	30
Merluccius capensis	4222.65	55977	11.54	29
Sufflogobius bibarbatatus	1569.80	642524	4.29	
Aequorea forskalea	1216.90	0	3.33	
Merluccius capensis	97.35	10952	0.27	28
Total	36580.06		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 11
 DATE :10/11/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 23°48.79
 start stop duration Region : 5000
 TIME :03:49:02 04:09:33 20.5 (min) Purpose : 1
 LOG : 3483.68 3484.69 1.0 Lon E 13°52.77
 FDEPTH: 45 50 Gear cond.: 0
 BDEPTH: 202 203 Validity : 0
 Towing dir: 0° Wire out : 150 m Speed : 3.0 km
 Sorted : 41 Total catch: 655.36 Catch/hour: 1916.26

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	1744.09	0	91.02	
Aequorea forskalea	172.16	0	8.98	
Total	1916.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 12
 DATE :10/12/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 23°45.50
 start stop duration Lon E 14°20.60
 TIME :06:28:18 06:31:59 3.7 (min) Purpose : 3
 LOG : 3545.43 3545.60 0.2 Region : 5000
 FDEPTH: 91 87 Gear cond.: 0
 BDEPTH: 91 87 Validity : 0
 Towing dir: 0° Wire out : 200 m Speed : 2.9 kn
 Sorted : 36 Total catch: 575.64 Catch/hour: 9334.70

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	6792.65	0	72.77	
Sufflogobius bibarbatu	1715.03	714551	18.37	34
Aegoreia forskalea	788.76	0	8.45	
Merluccius capensis	24.65	405	0.26	31
Merluccius capensis	8.92	130	0.10	32
Merluccius capensis	4.70	146	0.05	33
Total	9334.70		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 13
 DATE :10/12/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 23°50.15
 start stop duration Lon E 14°21.98
 TIME :01:00:37 01:02:37 2.0 (min) Purpose : 1
 LOG : 3566.05 3566.25 0.2 Region : 5000
 FDEPTH: 81 80 Gear cond.: 0
 BDEPTH: 81 80 Validity : 0
 Towing dir: 0° Wire out : 180 m Speed : 323.1 kn
 Sorted : 2 Total catch: 1003.20 Catch/hour: 30096.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	27000.00	0	89.71	
Aegoreia forskalea	3000.00	0	9.97	
Sufflogobius bibarbatu	960.00	214680	3.19	35
Total	30960.00		102.87	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 14
 DATE :10/12/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 23°48.90
 start stop duration Lon E 14°22.09
 TIME :01:58:01 02:01:27 3.4 (min) Purpose : 1
 LOG : 3569.61 3570.38 0.8 Region : 5000
 FDEPTH: 20 20 Gear cond.: 0
 BDEPTH: 80 81 Validity : 0
 Towing dir: 0° Wire out : 90 m Speed : 13.4 kn
 Sorted : 0 Total catch: 500.00 Catch/hour: 8746.37

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora hysoscella	8396.50	0	96.00	
Aegoreia forskalea	349.85	0	4.00	
Sufflogobius bibarbatu	0.02	35	0.00	
Total	8746.37		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 15
 DATE :10/12/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 23°30.19
 start stop duration Lon E 14°17.70
 TIME :06:28:00 06:35:35 6.6 (min) Purpose : 1
 LOG : 3600.94 3601.28 0.3 Region : 5000
 FDEPTH: 67 75 Gear cond.: 0
 BDEPTH: 101 101 Validity : 0
 Towing dir: 0° Wire out : 200 m Speed : 3.1 kn
 Sorted : 37 Total catch: 592.96 Catch/hour: 5406.93

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	2963.16	0	54.80	
Aegoreia forskalea	2414.59	0	44.66	
Sufflogobius bibarbatu	29.18	20426	0.54	36
Total	5406.93		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 16
 DATE :10/12/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 23°30.67
 start stop duration Lon E 14°10.04
 TIME :07:54:45 07:57:13 2.5 (min) Purpose : 1
 LOG : 3609.47 3609.63 0.2 Region : 5000
 FDEPTH: 30 40 Gear cond.: 0
 BDEPTH: 138 137 Validity : 0
 Towing dir: 0° Wire out : 100 m Speed : 3.9 kn
 Sorted : 36 Total catch: 144.84 Catch/hour: 3518.38

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	1839.35	0	52.28	
Sufflogobius bibarbatu	1101.86	0	31.32	37
Aegoreia forskalea	577.17	0	16.40	
Total	3518.38		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 17
 DATE :10/13/12 GEAR TYPE: PT NO: 7 POSITION:Lat S 23°15.11
 start stop duration Lon E 13°33.84
 TIME :05:01:01 05:08:27 7.4 (min) Purpose : 1
 LOG : 3666.57 3666.96 0.4 Region : 5000
 FDEPTH: 180 182 Gear cond.: 0
 BDEPTH: 187 188 Validity : 0
 Towing dir: 0° Wire out : 430 m Speed : 3.1 kn
 Sorted : 37 Total catch: 343.58 Catch/hour: 2774.54

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	2241.08	0	80.77	
Merluccius capensis	201.16	670	7.25	40
Merluccius capensis	170.07	1058	6.13	38
Aegoreia forskalea	66.54	0	2.40	
Coelestinus coelestinus	51.04	711	1.84	
Trachurus capensis	43.93	331	1.58	39
Lepidopus caudatus	0.73	8	0.03	
Total	2774.54		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 18
 DATE :10/13/12 GEAR TYPE: PT NO: 2 POSITION:Lat S 23°15.29
 start stop duration Lon E 13°57.62
 TIME :09:32:41 09:35:47 3.1 (min) Purpose : 1
 LOG : 3693.15 3693.34 0.2 Region : 5000
 FDEPTH: 102 102 Gear cond.: 0

BDEPTH: 151 152 Validity : 0
 Towing dir: 0° Wire out : 270 m Speed : 3.7 kn
 Sorted : 7 Total catch: 210.40 Catch/hour: 4072.26

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Aegoreia forskalea	2305.16	40084	56.61	
Chrysaora sp.	1767.10	426	43.39	
Total	4072.26		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 19
 DATE :10/13/12 GEAR TYPE: PT NO: 2 POSITION:Lat S 23°14.66
 start stop duration Lon E 13°57.50
 TIME :09:44:05 09:46:40 2.6 (min) Purpose : 1
 LOG : 3693.78 3693.95 0.2 Region : 5000
 FDEPTH: 60 59 Gear cond.: 0
 BDEPTH: 152 153 Validity : 0
 Towing dir: 0° Wire out : 155 m Speed : 3.8 kn
 Sorted : 4 Total catch: 42.44 Catch/hour: 986.98

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Aegoreia forskalea	790.70	10674	80.11	
Chrysaora sp.	196.28	0	19.89	
Total	986.98		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 20
 DATE :10/13/12 GEAR TYPE: PT NO: 2 POSITION:Lat S 23°14.13
 start stop duration Lon E 13°57.42
 TIME :09:53:20 09:55:24 2.1 (min) Purpose : 1
 LOG : 3694.31 3694.45 0.1 Region : 5000
 FDEPTH: 30 28 Gear cond.: 0
 BDEPTH: 152 152 Validity : 0
 Towing dir: 0° Wire out : 70 m Speed : 4.1 kn
 Sorted : 0 Total catch: 4.22 Catch/hour: 122.32

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	122.32	29	100.00	
Total	122.32		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 21
 DATE :10/13/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 23°20.04
 start stop duration Lon E 14°11.83
 TIME :04:14:07 04:18:31 4.4 (min) Purpose : 1
 LOG : 3736.14 3736.43 0.3 Region : 5000
 FDEPTH: 77 70 Gear cond.: 0
 BDEPTH: 122 122 Validity : 0
 Towing dir: 0° Wire out : 200 m Speed : 4.0 kn
 Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Total				

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 22
 DATE :10/14/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 24°0.14
 start stop duration Lon E 14°11.10
 TIME :01:07:50 01:25:14 17.4 (min) Purpose : 1
 LOG : 3814.24 3816.32 2.1 Region : 5000
 FDEPTH: 80 80 Gear cond.: 0
 BDEPTH: 137 128 Validity : 0
 Towing dir: 0° Wire out : 210 m Speed : 7.2 kn
 Sorted : 2 Total catch: 1501.56 Catch/hour: 5177.79

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Aegoreia forskalea	4482.76	0	86.58	
Chrysaora sp.	689.66	0	13.32	
Merluccius capensis	5.38	45	0.10	41
Total	5177.79		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 23
 DATE :10/14/12 GEAR TYPE: PT NO: 25 POSITION:Lat S 24°0.92
 start stop duration Lon E 14°17.42
 TIME :06:41:26 06:44:23 3.0 (min) Purpose : 1
 LOG : 3838.96 3839.12 0.2 Region : 5000
 FDEPTH: 106 107 Gear cond.: 0
 BDEPTH: 106 107 Validity : 0
 Towing dir: 0° Wire out : 250 m Speed : 3.2 kn
 Sorted : 37 Total catch: 596.29 Catch/hour: 12127.93

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	8656.27	0	71.37	
Aegoreia forskalea	1786.58	0	14.73	
Sufflogobius bibarbatu	1640.14	692502	13.52	42
Merluccius capensis	22.78	203	0.19	44
Merluccius capensis	18.71	183	0.15	45
Merluccius capensis	3.46	122	0.03	43
Total	12127.93		100.00	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 24
 DATE :10/14/12 GEAR TYPE: PT NO: 2 POSITION:Lat S 23°59.99
 start stop duration Lon E 14°17.59
 TIME :02:54:42 02:57:00 2.3 (min) Purpose : 1
 LOG : 3845.63 3848.27 2.6 Region : 5000
 FDEPTH: 106 111 Gear cond.: 0
 BDEPTH: 106 111 Validity : 0
 Towing dir: 0° Wire out : 190 m Speed : 68.7 kn
 Sorted : 38 Total catch: 1861.50 Catch/hour: 48560.87

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Chrysaora sp.	46956.52	0	96.70	
Aegoreia forskalea	1304.35	0	2.69	
Sufflogobius bibarbatu	39.13	14348	0.08	46
Total	48300.00		99.46	

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 25
 DATE :10/14/12 GEAR TYPE: BT NO: 25 POSITION:Lat S 24°2.11
 start stop duration Lon E 14°16.07
 TIME :04:18:19 04:24:12 5.9 (min) Purpose : 1
 LOG : 3853.70 3854.00 0.3 Region : 5000

FDEPTH: 116 115		Gear cond.: 0		Total		54150.57		100.00	
BDEPTH: 116 115		Validity: 0							
Towing dir: 0°		Wire out: 260 m		Speed: 3.1 kn					
Sorted: 128		Total catch: 1091.75		Catch/hour: 11159.28					
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Chrysaora sp.		5861.09	0	52.52					
Aequorea forskalea		2096.52	0	18.79					
Merluccius capensis		1606.51	17080	14.40	48				
Merluccius capensis		1053.02	12256	9.44	47				
Sufflogobius bibarbatatus		542.15	246399	4.86	49				
Total		11159.28		100.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 26									
DATE :10/14/12		GEAR TYPE: PT NO: 2		POSITION: Lat S 24°3.10		Lon E 14°16.17			
TIME :05:52:35 05:54:42		duration: 2.1 (min)		Purpose: 1		Region: 5000			
LOG : 3856.50 3856.63		0.1		Gear cond.: 7		Validity: 9			
FDEPTH: 95 93				Speed: 3.7 kn		Catch/hour: 0.00			
BDEPTH: 114 114									
Towing dir: 0°		Wire out: 230 m							
Sorted: 0		Total catch: 0.00							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
N O C A T C H		0.00	0	0.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 27									
DATE :10/14/12		GEAR TYPE: PT NO: 2		POSITION: Lat S 24°3.66		Lon E 14°16.30			
TIME :06:02:43 06:07:33		duration: 4.8 (min)		Purpose: 1		Region: 5000			
LOG : 3857.08 3857.36		0.3		Gear cond.: 7		Validity: 9			
FDEPTH: 69 69				Speed: 3.5 kn		Catch/hour: 0.00			
BDEPTH: 113 114									
Towing dir: 0°		Wire out: 175 m							
Sorted: 0		Total catch: 0.00							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
N O C A T C H		0.00	0	0.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 28									
DATE :10/14/12		GEAR TYPE: PT NO: 2		POSITION: Lat S 24°4.55		Lon E 14°16.50			
TIME :06:19:07 06:20:16		duration: 1.1 (min)		Purpose: 1		Region: 5000			
LOG : 3857.98 3858.05		0.1		Gear cond.: 7		Validity: 9			
FDEPTH: 30 30				Speed: 3.7 kn		Catch/hour: 0.00			
BDEPTH: 114 114									
Towing dir: 0°		Wire out: 70 m							
Sorted: 0		Total catch: 0.00							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
N O C A T C H		0.00	0	0.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 29									
DATE :10/15/12		GEAR TYPE: PT NO: 1		POSITION: Lat S 22°56.69		Lon E 13°31.43			
TIME :10:03:01 10:11:18		duration: 8.3 (min)		Purpose: 1		Region: 5000			
LOG : 3979.34 3979.75		0.4		Gear cond.: 0		Validity: 0			
FDEPTH: 140 140				Speed: 3.0 kn		Catch/hour: 28992.75			
BDEPTH: 210 209									
Towing dir: 0°		Wire out: 362 m							
Sorted: 0		Total catch: 4001.00							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Aequorea forskalea		21739.13	0	74.98					
Chrysaora sp.		7246.38	0	24.99					
Maurolicus muelleri		7.25	0	0.02					
Total		28992.75		100.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 30									
DATE :10/15/12		GEAR TYPE: PT NO: 25		POSITION: Lat S 22°48.54		Lon E 13°31.07			
TIME :12:10:23 12:14:38		duration: 4.3 (min)		Purpose: 1		Region: 5000			
LOG : 3991.57 3991.77		0.2		Gear cond.: 0		Validity: 0			
FDEPTH: 205 204				Speed: 2.9 kn		Catch/hour: 15956.05			
BDEPTH: 205 204									
Towing dir: 0°		Wire out: 460 m							
Sorted: 1130		Total catch: 1130.22							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Chrysaora sp.		13411.76	0	84.05					
Trachurus capensis		1085.65	8442	6.80	50				
Aequorea forskalea		705.88	0	4.42					
Merluccius capensis		420.71	1906	2.64	53				
Merluccius capensis		238.87	1285	1.50	54				
Coelorinchus coelorrhinc. polli		51.53	904	0.32					
Pterothrissus bellocci		26.96	169	0.17					
Symbolophorus boops		6.21	3106	0.04					
Lophius vomerinus		5.08	28	0.03	51				
Sufflogobius bibarbatatus		2.96	0	0.02	52				
Chlorophthalmus agassizi		0.28	42	0.00					
Macropodus australis		0.14	14	0.00					
Total		15956.05		100.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 31									
DATE :10/15/12		GEAR TYPE: PT NO: 1		POSITION: Lat S 22°44.77		Lon E 13°52.63			
TIME :06:08:06 06:11:17		duration: 3.2 (min)		Purpose: 1		Region: 5000			
LOG : 4021.11 4021.27		0.2		Gear cond.: 0		Validity: 0			
FDEPTH: 20 23				Speed: 3.1 kn		Catch/hour: 54150.57			
BDEPTH: 134 134									
Towing dir: 0°		Wire out: 75 m							
Sorted: 38		Total catch: 2869.98							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Chrysaora sp.		31848.30	0	58.81					
Aequorea forskalea		22298.87	302566	41.18					
Thyriscites atun		3.40	113	0.01	55				
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 32									
DATE :10/16/12		GEAR TYPE: PT NO: 1		POSITION: Lat S 22°36.12		Lon E 14°21.64			
TIME :12:28:46 12:38:12		duration: 9.4 (min)		Purpose: 1		Region: 5000			
LOG : 4067.63 4068.09		0.5		Gear cond.: 0		Validity: 0			
FDEPTH: 10 10				Speed: 2.9 kn		Catch/hour: 3184.45			
BDEPTH: 54 54									
Towing dir: 0°		Wire out: 60 m							
Sorted: 0		Total catch: 500.49							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Chrysaora sp.		3117.71	0	97.90					
Aequorea forskalea		63.63	0	2.00					
Trachurus capensis		1.40	172	0.04	56				
Chelidonichthys capensis		1.34	19	0.04					
Engraulis capensis		0.32	25	0.01	57				
Etrumeus whiteheadi		0.06	6	0.00					
Total		3184.45		100.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 33									
DATE :10/16/12		GEAR TYPE: PT NO: 25		POSITION: Lat S 22°29.71		Lon E 13°57.57			
TIME :05:20:01 05:21:29		duration: 1.5 (min)		Purpose: 1		Region: 5000			
LOG : 4099.44 4099.52		0.1		Gear cond.: 0		Validity: 0			
FDEPTH: 119 0				Speed: 3.1 kn		Catch/hour: 50326.94			
BDEPTH: 119 0									
Towing dir: 0°		Wire out: 276 m							
Sorted: 34		Total catch: 1233.01							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Chrysaora sp.		32179.59	0	63.94					
Aequorea forskalea		15002.45	29388	29.81					
Sufflogobius bibarbatatus		2644.90	793469	5.26	58				
WASTED		470.20	0	0.93					
Chelidonichthys capensis		20.41	122	0.04					
Merluccius capensis		7.76	122	0.02	59				
Merluccius capensis		0.82	41	0.00	60				
Bathynectes piperitus		0.82	41	0.00					
Total		50326.94		100.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 34									
DATE :10/16/12		GEAR TYPE: PT NO: 1		POSITION: Lat S 22°31.32		Lon E 13°32.05			
TIME :09:07:59 09:10:52		duration: 2.9 (min)		Purpose: 1		Region: 5000			
LOG : 4125.82 4125.96		0.1		Gear cond.: 0		Validity: 0			
FDEPTH: 122 125				Speed: 2.9 kn		Catch/hour: 6185.00			
BDEPTH: 155 156									
Towing dir: 0°		Wire out: 320 m							
Sorted: 37		Total catch: 296.88							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Chrysaora sp.		4876.67	0	78.85					
Aequorea forskalea		1258.33	19833	20.34					
Maurolicus muelleri		50.00	25000	0.81					
Total		6185.00		100.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 35									
DATE :10/16/12		GEAR TYPE: PT NO: 25		POSITION: Lat S 22°15.02		Lon E 13°39.25			
TIME :04:35:36 04:40:33		duration: 5.0 (min)		Purpose: 1		Region: 5000			
LOG : 4170.85 4171.09		0.2		Gear cond.: 0		Validity: 0			
FDEPTH: 130 0				Speed: 2.8 kn		Catch/hour: 3954.55			
BDEPTH: 130 60									
Towing dir: 0°		Wire out: 320 m							
Sorted: 33		Total catch: 326.25							
SPECIES		CATCH/HOUR		% OF TOT. C		SAMP			
		weight numbers							
Chrysaora sp.		2742.30	0	69.35					
Trachurus capensis		465.45	5188	11.77	63				
Aequorea forskalea		425.70	6400	10.76					
Merluccius capensis		188.36	2109	4.76	61				
Merluccius capensis		128.24	1467	3.24	62				
Merluccius capensis		2.42	61	0.06	64				
Chelidonichthys capensis		1.70	12	0.04					
Bathynectes piperitus		0.36	12	0.01					
Total		3954.55		100.00					
R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 36									
DATE :10/16/12		GEAR TYPE: PT NO: 2		POSITION: Lat S 22°15.20		Lon E 13°44.49			
TIME :06:09:21 06:11:30		duration: 2.2 (min)		Purpose: 1		Region: 5000			
LOG : 4178.85 4178.98		0.1		Gear cond.: 0		Validity: 0			
FDEPTH: 125 126				Speed: 3.6 kn		Catch/hour: 6699.91			
BDEPTH: 125 126									
Towing dir: 0°		Wire out: 160 m							
Sorted: 35		Total catch: 240.08							

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 38
 DATE :10/16/12 GEAR TYPE: PT NO: 2 POSITION:Lat S 22°15.14
 start stop duration Lon E 13°43.49
 TIME :06:25:08 06:27:20 2.2 (min) Purpose : 1
 LOG : 4179.78 4179.93 0.2 Region : 5000
 FDEPTH: 23 22 Gear cond.: 0
 BDEPTH: 126 127 Validity : 0
 Towing dir: 126° Wire out : 60 m Speed : 4.1 kn
 Sorted : 33 Total catch: 66.84 Catch/hour: 1822.91

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Aegorea forskalea	1278.55	16473	70.14
Chrysaora sp.	544.36	327	29.86
Total	1822.91		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 39
 DATE :10/17/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 21°58.74
 start stop duration Lon E 13°50.69
 TIME :05:26:01 05:31:20 5.3 (min) Purpose : 1
 LOG : 4240.60 4240.85 0.2 Region : 5000
 FDEPTH: 90 90 Gear cond.: 0
 BDEPTH: 90 90 Validity : 0
 Towing dir: 0° Wire out : 220 m Speed : 2.7 kn
 Sorted : 38 Total catch: 767.76 Catch/hour: 8658.95

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Chrysaora sp.	7942.11	5414	91.72
Sufflogobius bibarbatatus	358.65	115714	4.14
Aegorea forskalea	345.11	5188	3.99
Merluccius capensis	10.94	237	0.13
Austroglossus microlepis	1.24	11	0.01
Bathynectes piperitus	0.90	11	0.01
Total	8658.95		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 40
 DATE :10/17/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 21°53.21
 start stop duration Lon E 13°8.70
 TIME :02:56:18 03:06:24 10.1 (min) Purpose : 1
 LOG : 4295.48 4296.01 0.5 Region : 5000
 FDEPTH: 164 164 Gear cond.: 0
 BDEPTH: 194 199 Validity : 0
 Towing dir: 0° Wire out : 450 m Speed : 3.1 kn
 Sorted : 24 Total catch: 1526.50 Catch/hour: 9068.32

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Chrysaora sp.	8910.89	0	98.26
Thysites atun	156.83	65	1.73
Maurollicus muelleri	0.59	0	0.01
Total	9068.32		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 41
 DATE :10/17/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 21°45.75
 start stop duration Lon E 13°10.17
 TIME :05:40:50 05:48:02 7.2 (min) Purpose : 1
 LOG : 4310.51 4310.89 0.4 Region : 5000
 FDEPTH: 181 182 Gear cond.: 0
 BDEPTH: 181 182 Validity : 0
 Towing dir: 0° Wire out : 460 m Speed : 3.2 kn
 Sorted : 137 Total catch: 491.15 Catch/hour: 4092.87

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Chrysaora sp.	1838.42	2217	44.92
Trachurus capensis	1618.50	13742	39.54
Merluccius capensis	183.50	1725	4.48
Merluccius capensis	164.25	1200	4.01
Aegorea forskalea	161.58	3358	3.95
Merluccius capensis	75.50	117	1.84
Sufflogobius bibarbatatus	16.08	3508	0.39
Pterothrissus belloci	11.42	117	0.28
Coelorrhinus coelorrhinc. polli	11.08	175	0.27
Merluccius capensis	5.00	17	0.12
Lophius vomerinus	3.75	17	0.09
Bathynectes piperitus	2.04	58	0.05
Squilla acuelata calmani	1.75	33	0.04
Total	4092.88		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 42
 DATE :10/17/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 21°46.15
 start stop duration Lon E 13°23.37
 TIME :08:39:23 08:42:19 2.9 (min) Purpose : 1
 LOG : 4326.66 4326.80 0.2 Region : 5000
 FDEPTH: 105 108 Gear cond.: 0
 BDEPTH: 144 145 Validity : 0
 Towing dir: 0° Wire out : 270 m Speed : 3.0 kn

Sorted : 391 Total catch: 117.27 Catch/hour: 2401.43

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Chrysaora sp.	1213.31	1167	50.52
Aegorea forskalea	1185.67	18123	49.37
Merluccius capensis	2.46	41	0.10
Total	2401.43		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 43
 DATE :10/18/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 21°41.97
 start stop duration Lon E 13°49.58
 TIME :01:35:37 01:48:04 12.5 (min) Purpose : 1
 LOG : 4359.98 4360.59 0.6 Region : 5000
 FDEPTH: 10 9 Gear cond.: 0
 BDEPTH: 53 53 Validity : 0
 Towing dir: 0° Wire out : 60 m Speed : 2.9 kn
 Sorted : 0 Total catch: 200.47 Catch/hour: 966.12

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Chrysaora sp.	963.86	0	99.77
Chelidonichthys capensis	1.54	19	0.16
Trachurus capensis	0.34	34	0.03
Etrumeus teres	0.19	19	0.02
Todaropsis eblanae	0.19	5	0.02
Total	966.12		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 44
 DATE :10/18/12 GEAR TYPE: PT NO: 1 POSITION:Lat S 21°30.66
 start stop duration Lon E 13°5.52
 TIME :10:04:20 10:14:39 10.3 (min) Purpose : 1
 LOG : 4417.80 4418.35 0.6 Region : 5000
 FDEPTH: 110 108 Gear cond.: 0
 BDEPTH: 200 197 Validity : 0
 Towing dir: 0° Wire out : 304 m Speed : 3.2 kn
 Sorted : 0 Total catch: 1500.00 Catch/hour: 8720.93

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Aegorea forskalea	4651.16	0	53.33
Chrysaora sp.	4069.77	0	46.67
Total	8720.93		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 45
 DATE :10/18/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 21°15.19
 start stop duration Lon E 13°28.27
 TIME :05:22:31 05:30:49 8.3 (min) Purpose : 1
 LOG : 4464.93 4465.37 0.4 Region : 5000
 FDEPTH: 94 93 Gear cond.: 0
 BDEPTH: 94 93 Validity : 0
 Towing dir: 0° Wire out : 230 m Speed : 3.1 kn
 Sorted : 37 Total catch: 261.92 Catch/hour: 1891.12

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Chrysaora sp.	1389.89	2729	73.50
Aegorea forskalea	303.75	3993	16.06
Sufflogobius bibarbatatus	176.39	44744	9.33
Merluccius capensis	10.90	101	0.58
Trachurus capensis	5.34	51	0.28
Merluccius capensis	4.77	29	0.25
Merluccius capensis	0.07	7	0.00
Total	1891.12		100.00

R/V Dr. Fridtjof Nansen SURVEY:2012406 STATION: 46
 DATE :10/18/12 GEAR TYPE: BT NO: 1 POSITION:Lat S 21°0.24
 start stop duration Lon E 13°25.78
 TIME :08:47:55 08:54:00 6.1 (min) Purpose : 1
 LOG : 4491.88 4492.20 0.3 Region : 5000
 FDEPTH: 52 52 Gear cond.: 0
 BDEPTH: 52 52 Validity : 0
 Towing dir: 0° Wire out : 140 m Speed : 3.2 kn
 Sorted : 72 Total catch: 612.21 Catch/hour: 6041.55

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
	weight	numbers	
Chrysaora sp.	5837.37	13007	96.62
Sufflogobius bibarbatatus	138.45	39326	2.29
Trachurus capensis	38.59	1263	0.64
Aegorea forskalea	21.02	336	0.35
Merluccius capensis	2.66	39	0.04
Merluccius capensis	1.88	39	0.03
Austroglossus microlepis	0.89	10	0.01
Merluccius capensis	0.69	10	0.01
Total	6041.55		100.00

ANNEX II: Instruments and fishing gear

5.2 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 m², 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	7.31° along ship 7.34° athwardship
Alongship offset	0.10°

Athwardship offset 0.04°

Bottom detection menu Minimum level -43 dB