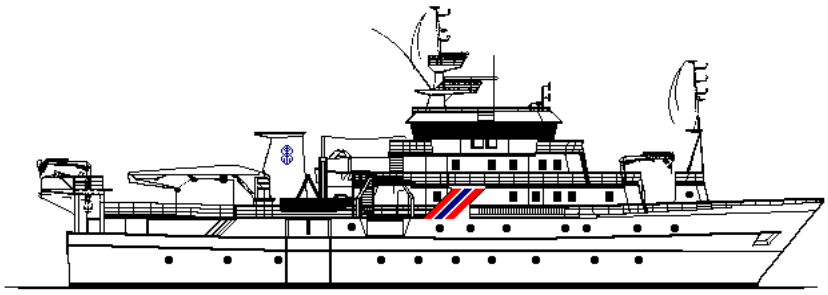

BENEFIT SURVEYS

Diel vertical migration in gobies

10 – 21 January 2006

Ministry of Fisheries & Marine Resources
Swakopmund
Namibia

Marine and Coastal Management
Cape Town
South Africa

Institute of Marine Research
Bergen
Norway

CRUISE REPORTS "DR. FRIDTJOF NANSEN"

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Diel vertical migration in gobies

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by

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Bergen, 2006

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CHAPTER 1. INTRODUCTION

1.1. BACKGROUND

An overall goal of BENEFIT is to improve the knowledge and understanding of the Benguela ecosystem's living marine resources, their environmental condition and the linkage between environmental processes and growth, distribution, fluctuations and abundance of the fish stocks, and also to provide data and information needed as input for management of both national and shared resources in the region.

The Benguela ecosystem is among the world's most productive upwelling areas. The primary production within this ecosystem supports a large abundance of plankton feeding fish species, which again support a wide variety of marine mammals, seabirds, and commercially important fish species. Several large-scale system changes have been reported in this system during the last 20-30 years. The pilchard, *Sardinops ocellatus,* resource, together with many other pelagic fish species, has decreased dramatically from several million thons in the 1970's to less than 200 000 tons at the end of the 1990's, at the same time as jellyfish (*Chrysaora hysoscella* and *Aequorea aequorea*), and gobies (*Sufflogobius bibarbatus*) have been suggested to have become more abundant. However, direct abundance estimates of jellyfish and gobies have been non-existing in the Benguela, and so has knowledge on their biology end ecology within the system. BENEFIT has therefore seen it as a priority to obtain more knowledge of these species and their role in the ecosystem.

Both jellyfish and gobies has a distribution roughly overlaying the hydrogen sulphide-producing mud belt in the Benguela upwelling ecosystem along Namibia's inner continental shelf, this area also happens to correspond with the nursery grounds of several commercially important fish species. The diatomaceous mud belt is known for its frequent emissions of hydrogen sulphide, not only toxic in itself but also rapidly and directly leading to anoxic or hypoxic conditions as the hydrogen sulphide reduces oxygen in the overlying water column. As a consequence water masses in these regions can be severely hypoxic. The animals living in these environments are likely to have adapted to these environments, but different groups may show different strategies to cope with such events, and the response to such stress may depend on the distribution of predation risk and feeding opportunities.

The general goal of the present BENEFIT cruise is to study the ecology of small pelagic fish

and gobies in relation to environmental variables and the predators present in the environment they are living in. The research group onboard investigated the ecology and behaviour of gobies with particular emphasis on diel vertical migration and behaviour under simulated upwelling events with hypoxia. This project is part of collaboration between Namibia, Norway and South Africa and jointly funded by the Norwegian and the South African Research Council and by BENEFIT.

Many marine organisms undertake diel vertical migrations which are associated with feeding and predator avoidance. These characteristics can be studied using a combination of trawling to catch the fish, plankton net sampling to catch the prey, and hydroacoustic measurements to monitor up and down migrations of organisms, all on 24 H stations (i.e. all sampling are done throughout the water columns on the same geographical position).

1.2. OBJECTIVES OF THE SURVEY

The survey had three objectives:

a) To study the diel vertical migration of gobies in relation to environmental variables such as oxygen concentration, temperature, light and their predators (hake and horse mackerel), competitors (mesopelagic fish, jellyfish) and prey (zooplankton) in two sub areas of the Namibian Benguela (inshore vs. offshore)
b) To study behavioural response to simulated anoxic conditions.
c) Investigate the feasibility of using routine acoustic abundance surveys to assess the biomass of gobies

1.3. PARTICIPATION

The participants consisted of scientific staff from:

the University of Bergen, Norway
Frank Midtøy, David Strand and Anne Christine Utne-Palm

NatMIRC, Namibia:
Jan Gei-Khaub, Bronwen Currie, Paloma Ellitsen and Martha Uumati

UWC, South Africa:
Kenneth Anthony, Bevan van Blomenstein and Riaan Cedas
BENEFIT, Namibia
Arved Staby

the University of Oslo, Norway:
Stein Kaartvedt, Thor Alksander Klevjar, Anders Røstad and Hege Finsås Vestheim

and Institute of Marine Research, Norway:
Jens Otto Krakstad (Cruise Leader), Tore Mørk and Jan Frode Wilhelmsen

1.4. NARRATIVE

The ship left Walvis Bay Monday the 10th at 19:00 local time (UTC+2) and sailed to Langstrand where the four keels mounted transducers (18, 38, 120 and 200 kHz) were calibrated together with the submersible TS transducer (38 kHz). The conditions were favourable for calibration and the successful calibration took approximately 24 hours. The ship left Langstrand Tuesday 11th at 19:00 and sailed southwards searching between 50 m and 200 m bottom depth for a suitable diel station.

The first pelagic trawl at 05:06 the 12th in position -23°09'S 13°47'E caught approximately 4 tons of jellyfish. The echo sounders showed a thick Sound Scattering Layer (SSL) identified to be jellies. This layer was widely distributed and present in all parts of the water column except near the bottom, were oxygen levels dropped below 0,3 ml/l O_2. The search for a suitable station without jellies continued in zigzag pattern along the coast towards Lüderitz, taking CTD's and identifying acoustic scatters with trawls, but no station fulfilled the requirements set and it was decided to return to one of the first trawl stations conducted during the survey (23°21' S 14°12'E) at 120 m depth. This position was also visited during the 2004 Goby survey. The vessel arrived on the 14th at 15:00. Wind and current had cleared away some of the jellyfish and although there was still a lot of jellyfish in the region a diel cycle session was set up. The vessel anchored at midnight the same day and recorded acoustic data for 24 h before a 48 h continues sampling programme commenced with bottom and pelagic trawls, plankton nets, video recordings, mud coring and CTD casts.

After completing this session another diel cycle session was conducted approximately 30 NM

further offshore in position 23°32’ S, 13°44’ E at 180 m water depth. The vessel arrived on the 18th at 20:30 and a 48 h continues sampling program was started immediately following the same strategy as during the first diel cycle. The vessel then anchored for a 24 h period and recorded stationary acoustic data in the same position from the 20th at 09:30.

After completing the last diel cycle the vessel steamed to Walvis Bay where the survey was completed at 21st January at 15:30.

All together 61 Pelagic trawls, 21 bottom trawls, 24 plankton nets, 41 hydrographical casts, five casts with camera recordings and 5 mud core stations were completed during the survey.

Difficulties with the trawl gear was experienced due to the large amount of jellyfish in the survey area. Several trawls had to be aborted because large amounts of jellyfish clogged the net and destroyed the trawl. All together four trawls were damaged (but mended onboard) during the survey due to overload of jelly.

CHAPTER 2. METHODS

2.1. DIEL STATIONS

Two diel cycle stations were conducted during the survey. Each diel stations consisted of a 24 h period where the vessel was anchored and acoustic data from the water column was recorded with the ships four keel mounted acoustic transducers (18 kHz, 38 kHz, 120 kHz and 200 kHz) and with the 38 kHz submergible TS transducer. During this period a video rig were also deployed to observe the bottom habitat and record goby behaviour, and a mud corer was deployed to take samples of the bottom environment.

Before or after this period a 48 h intense sampling regime was put in place to identify all acoustic targets in the water column and to collect environmental data and biological data of the gobies, their prey and predators. During this period regular cycles with bottom trawl haul, pelagic trawl using the multisampler, hydrobios multinet, for zooplankton sampling and a Seabird CTD-rig with oxygen and light sensors attached, to measure temperature, salinity, oxygen concentration and light levels trough the water column. Regular cycles were conducted throughout the two 24 h periods.

2.2. MULTIFREQUENCY ACOUSTIC SAMPLING AND ANALYSIS

Two Simrad EK 500 echo sounders connected to altogether four transducers with operating frequencies of 18 kHz, 38 kHz, 120 kHz (split beam) and 200 kHz (single beam) were used during the survey. All acoustic transducers were calibrated successfully at Langstrand prior to the survey. No major deviation from prior calibrations was observed, the calibration report with the technical specifications and operational settings used can be found in Annex II. The to minimise differences in sampling resolution, the pulse length and band width setting of the transducer were set to short/wide (18 kHz), medium/wide (38 kHz) and long/narrow respectively (120 kHz and 200 kHz). Acoustic raw data was logged to file using a logging program created by one of the cruise participants, T. Klevjar, and Windows based SonarData_Echolog v3.4. Analysis and post processing of logged data was done using Sonardata_Echoview software, v3.4 and Sonar 6 (Balk and Lindem 2006).

The composite echogram presented in this report were resampled from the raw data selecting single pings at equal time intervals using the virtual variable module in Sonar data Echo view. This operator in Echo view resample the input variable (ping) using a fixed time interval in the time/distance domain, and a specified upper depth, lower depth and number of data points in the depth domain. The raw variable was re-sampled every 90 sec with the resolution set to 5000 data points in the depth domain. The upper display depth was fixed at 0 m while the lower display depth were adjusted as needed.

2.3. MULTINET PLANKTON SAMPLER

Zooplankton was sampled with a Multinet plankton sampler from Hydrobios. The plankton sampler has an opening of 0.5 x 0.5 m and five nets with a mesh size of 405 μm. A flow meter was mounted at the opening of each net to measure the filtered volume. A Scanmar depth recorder with acoustic transmission to the vessel was mounted on top of the Multinet. The plankton sampler was retrieved at a speed of 0.5 -1.0 m/sec while the vessel maintained a speed of 2 - 2.5 knots. Five discrete plankton samples were collected during each deployment. After removing the cups from the Multinet the samples were transferred into plastic containers and preserved on 96% alcohol. The samples were sent to the University of Western Cape after the survey to be analysed by Honours, and Master students under the supervision of Dr. Mark Gibbons.

2.4. HYDROGRAPHIC SAMPLING

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 *ad hoc* as deemed necessary. The casts were stopped a few meters above the bottom, and at a maximum of 500 m depth.

An underwater low-light sensor attached to the CTD provided information of light extinction with depth.

Meteorological data logged from the Aanderaa meteorological station included wind direction and speed, air temperature, incident solar intensity and sea surface temperature (SST). All

data were averaged by unit distance sailed (1 NM).

The Thermosalinograph was out of order during the survey and no continues surface salinity data were recorded.

2.5. TRAWL SAMPLING

Bottom and Pelagic trawls with the Multisampler were used to verify acoustic recordings, study the horizontal and vertical distribution of gobies and to collect individuals for genetic studies and measurements of length, weight and sex.

Each diel station consisted of 24 h at anchor recording acoustic observations and a 48 h intensive sampling program with trawl and Multinet.

2.4.1 Bottom trawl

The standard Gisund super Bottom trawl used on all surveys with Dr. Fridtjof Nansen was used for this survey. The trawl has a typical wing distance of 18 m and 4.5-6 m net opening. The bottom trawl was hauled for 15-30 minutes using a speed of 3 knots/h. The trawls were hauled slowly to the surface (59 m/min) in order to try to keep gobies alive. Bottom trawling was usually conducted before the Multisampler trawl.

2.4.2 Pelagic trawl with Multisampler

The Åkrahamn pelagic trawl was used during the survey. The trawl has a typical opening of 18 m and a wing-to-wing distance of about 35 m. The trawl was connected with the multisampler. The multisampler is advantageous because it has three codends that can be opened and closed at any depth. It can therefore take three separate discrete samples in each hauls. Each net was typically open for 10 –15 min during trawling.

2.4.3 Preservation of trawl samples

Whenever gobies were caught the number and weight of the total catch of all species was recorded. A total of 100 randomly chosen gobies were measured for total length (mm) and weighed (g) and individuals larger than 40 mm were sexed. All individuals were measured if less than 100 individuals were caught in the haul. Samples were frozen for genetic and age and growth studies, and others were preserved on 96% alcohol for studies of the diet. The samples on alcohol and half of the frozen samples were shipped to the University of Western Cape for analysis of diet and age and growth. The other halves of the frozen fish were brought

to the University of Bergen for further genetic studies and to investigate whether otoliths can be used for ageing of the goby.

2.6. BEHAVIOURAL EXPERIMENTS

2.6.1. Animal handling:

Live gobies were removed carefully from the trawl samples and put into well-aerated seawater in a holding thank of 250 L. The ships seawater was oversaturated with nitrogen and could not be used directly on the fish, as this will cause problems with inflation of gas bladder and gas bubbles in eyes. This water was therefore aerated with pressure air before used in the holding thank and experimental aquariums. The holding thank was cooled by cooling coils (see below). Some of the fish had swim bladder problems (bursting full) when landed on deck. Thus, to release the gas the swim bladder of some of the experimental fish was punctured by a syringe.

2.6.2. Behavioural responses to decreasing oxygen concentration.

Experimental set-up

Four experimental closed aquaria with cooling elements were built and put together in a rack Figure 1. Each glass aquarium measured 60 x 30 x 30 cm and was sealed by a Plexiglas lid with 70% light penetration. The back and sides were painted black. Two cooling coils (ca 200 cm) were attached to the lid. To get fish in and out of the aquarium, the lid had a circular opening ca 20 cm diameter that could be closed. Air-stone was used through this opening when fish had aerated water. During the experiments the aquarium was sealed by placing a square Plexiglas lid (larger than the circular opening) on the top of the opening. Silicon grease around the edges of the lid prevented air seeping. An oxygen sensor (type: WTW Oxi 330i) was mounted trough the lid. The aquaria were also fitted with stopcock inlets and outlets for nitrogen gas and water sampling, respectively. A nitrogen gas bottle was secured next to the aquariums with a regulated flow to all four aquariums. Two long strings where fitted through the lid of the aquarium. These strings were possible to turn from the outside of the aquarium, and were used to poke the fish with to look at escape response at low oxygen levels.

Figure 1 Aquaria used for the response to decreasing oxygen concentration and recovery from hypoxia on gobies

Experimental procedures

Four fish of different size (large, medium, small medium and small) were housed in each aquarium filled with well-aerated seawater. The experimental fish had been starved for 24 hours before start of experiment. Air stone was removed and the aquaria sealed. The dissolved oxygen content was controlled by the oxygen sensor. Also water sample was taken from the aquarium during the experiments to measure oxygen contents using the Winkler method. Before starting lowering oxygen level the background (T0) number of gill beats per minute was recorded for the four individual fish. Afterwards the aquarium water was deoxygenated by bubbling nitrogen gas trough the water. Gill beats where recounted every 15 to 20 minutes during deoxygenating (increasing hypoxic stress by decreasing the oxygen concentration of the water). Maximum oxygen stress was kept for 2.5 to 4.5 hours, before the nitrogen gas was turned off, lid removed from the aquaria top and air stone put into the water again to oxygenate the water and observe the recovery of the fish. During recovery gill beats were counted and oxygen contents measured just like in the deoxygenating process.

In order to simulate upwelling events we added sulphide to one of the aquariums that where deoxygenated, and we looked at the response of the gobies.

Fish and water from three of the experimental replicates including the one testing the effect of H_2S were frozen down for later studies of possible anaerobe build-ups like lactate and alcohol.

2.6.3. Respirometry study

We wanted to find out how much oxygen the gobies are consuming when they are in waters with oxygen levels similar to what they experience in nature. Therefore, was a respirometric study conducted, where gobies experienced oxygen conditions from 3-5 ml DO /l done to

anoxic water.

Experimental set-up

One fish was placed in a glass bottle 1215 ml (606 ml) filed with seawater of known oxygen level. The bottle was placed in an aquarium (60 x 30 x 30 cm) where temperature were kept close to constant (13.5 °C $\pm$ 0.5) by two cooling coils (ca 200 cm) on each side of the bottle Figure 2. To establish the oxygen level in the bottle a water samples was sucked out of the bottle by a glass syringe. On its way to the syringe the water passed by an oxygen electrode (type Strathkelvin Instruments, Oxygen meter Model 781b, 1302 electrode). As water was sucked out of the bottle new water was pulled in to the bottle from another glass syringe filed with water of known oxygen level. The oxygen meter was connected to a printer, expressing the oxygen reading graphically. In this set-up the oxygen level in the experimental bottle was lowered only by the fish's one use of oxygen (respiration). So by knowing the oxygen level in the bottle at the start and the amount of oxygen in the water added along the way one can calculate respiration or amount of oxygen used.

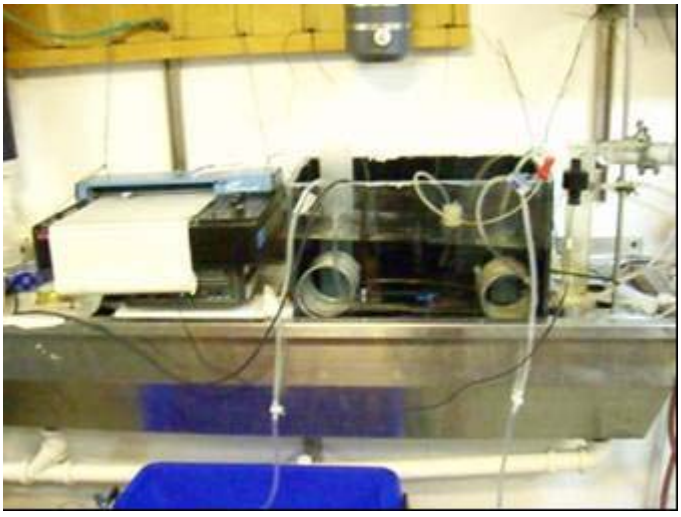

Figure 2 An overview picture of the experimental set-up in the respirometry study. Aquarium with cooling coils and bottle containing fish. The two glass syringes, used to sample (mounted on the oxygen sensor) and restore water in the bottle, and the printer showing the oxygen level of sampled water.

Experimental procedures

Three fish was used in these experiments. All three fishes had been starved and acclimatised to the water temperature for 24 hours before the experiment started. Fish 1 and 2 was placed in 1215 ml bottles and both had their swim bladder perforated 24 hours before the experiment took place. Fish 3 was placed in a 606 ml bottle and had a none-perforated swim bladder. Fish 1 started out in water with ca 5 ml DO /litre, while fish 2 and 3 started in ca 2 ml DO /litre. Oxygen level was controlled every one to four hours. Opercula beat or gill beat was counted about every hour. The experiment was terminated when the fish tipped-over. Fish 1 and 2 was in the bottle for 16.5 and 14.5 hours respectively, while fish 3 died after 5 hours in the bottle.

Recovery study was not done on fish 1 and 2 (fish 3 died). All 3 fishes including water from the experimental bottles were frozen down for later studies of possible anaerobe build-ups like lactate and alcohol.

2.6.4. Sulphide tolerance experiments

Gobies are often found over the sulphidic mud where hydrogen sulphide is not unusual in bottom water. Gobies were therefore exposed experimentally to sulphide.

Gobies collected from trawls were held on board in the same holding tanks used for the other experiments and handled in the same delicate manner. For the experiments the water temperature was not controlled: ambient surface water from the deck supply was used to fill 2 experimental aquaria 60cm x 40cm x 40cm, secured in a wooden frame on deck. The aquaria could be sealed with a small circular glass roof-window , and were fitted with stopcock inlets and outlets from the nitrogen gas bottle supply and for water sampling respectively. Water in the aquaria was deoxygenated as required by bubbling through nitrogen gas. The DO (dissolved oxygen) content was accurately determined at any stage of the experiment by tapping off a sample for Winkler analysis.

A stock solution of sodium sulphide dissolved in deoxygenated seawater was used to add sulphide as required to the tanks. The ambient sulphide concentration of sulphide in the tanks, as with oxygen, was sampled at intervals throughout each experiment. Sulphide analyses were carried out on board using the Kline method.

CHAPTER 3. RESULTS

In addition to the results reported here, frozen and fixed fish samples, and fixed plankton samples has been forwarded to the University of Western Cape for diet studies, and studies of zoo and phytoplankton in the water column. Fixed fish samples have been forwarded to the University of Bergen for genetic studies and hydro acoustic data to the University of Oslo for in depth studies of fish and plankton behavioural responses.

3.1. CROSS SHELF OBSERVATIONS

The region where the two experimental stations were carried out was characterised by warm surface water with a pronounced thermocline at 20 m depth overlying cooler water masses with bottom temperatures down to < 13°C. Salinity was typical for oceanic water masses off Namibia with salinity concentrations around 35.1 ‰. The surface layers were well oxygenated with o_2 concentrations > 6 ml/l. Bottom water masses were characterised by hypoxic and anoxic conditions with o_2 concentrations < 0.3 ml/l in the bottom 30 m, Figure 3.

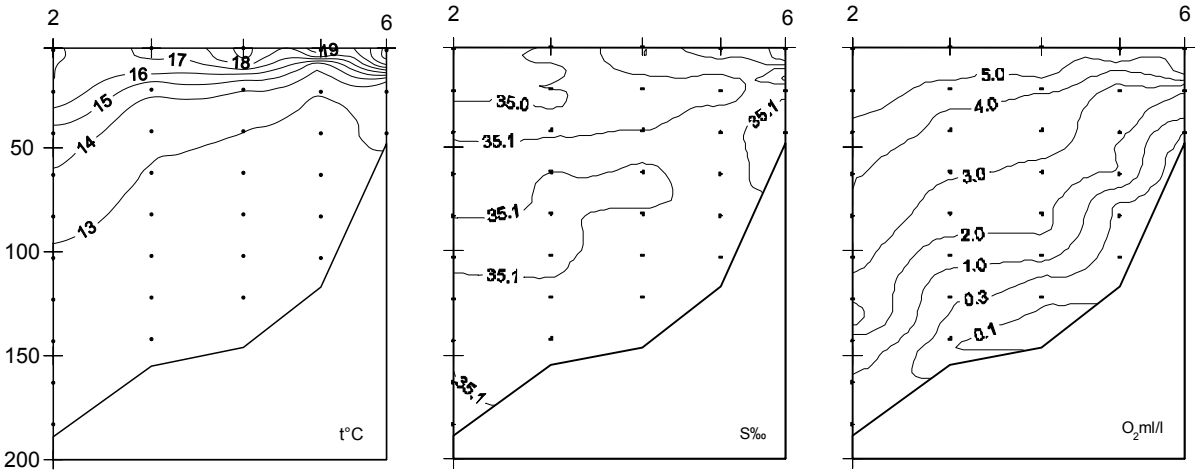

Figure 3 Cross shelf transect off Sandwich Harbour (23°21' S, 14°24' E) depicting the temperature, salinity and oxygen concentrations in the area were the two experimental stations were conducted

The composite picture depicting the acoustic backscattering illustrates the typical features in the water column, and indicates the extent of the diatomeous mud flat, Figure 4. The major mud flat extends from approximately 50 m depth inshore to 150 m depth offshore, seen as a tick red bottom layer on the echogram. Above this layer can be seen an almost white area corresponding with the hypoxic layer seen in Figure 3. This area is almost devoid of any

living organisms but a closer look (Diel experiment 1) shows that relatively large quantities of gobies are found in this hostile environment. The backscattering objects in the water column above is mainly jellyfish (*Chrysaora hysoscella* and *Aequorea aequorea*) mixed with zooplankton.

The two diel stations were conducted at 120 m depth on Figure 4 (Diel Station 1) and at 180 m depth at the shelf break 30 NM further southeast.

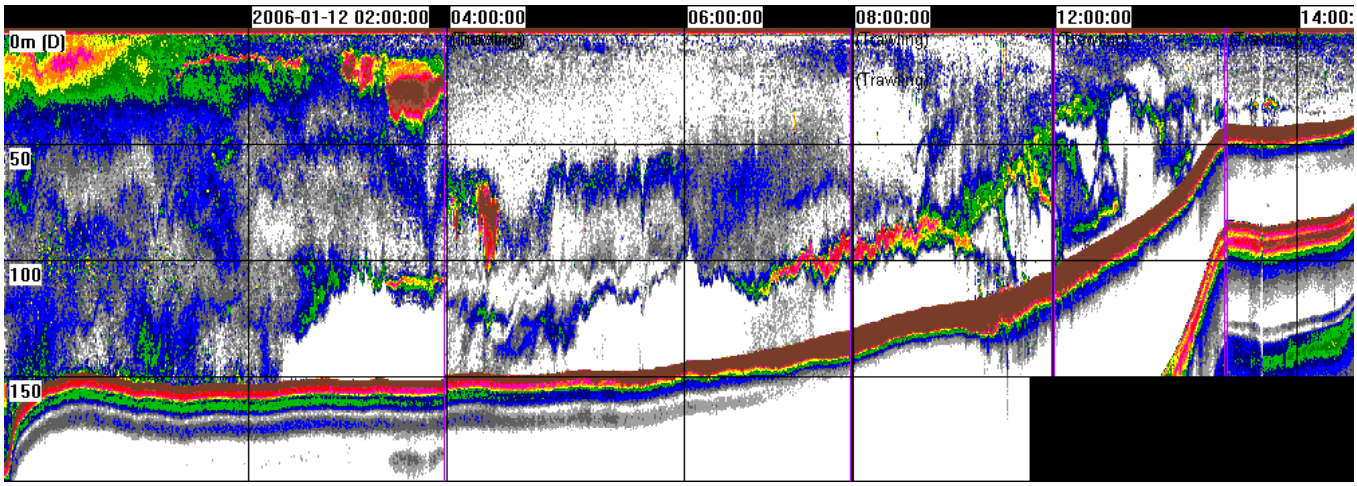

Figure 4 Composite picture of the hydroacoustic recordings (mean values) with the 38 kHz transducer (min. Colour Sv, – 80dB) depicting the major backscattering features in the water column

3.2. DIEL SYCLE 1

Diel sycle 1 was conducted at 120 m depth in position 23°21' S 14°12'E. This station was the same as was surveyed during the goby survey in 2004 (2004401, BEN 1) and good comparative scientific material was therefore available. The station is in the middle of the diatomeous mud belt seen in Figure 4. The vessel arrived back in this position on the 14/01 at 15:00. Wind and current had cleared away some of the jellyfish observed previously although there was still a lot of jellyfish in the region. The vessel anchored at midnight after a few initial investigations and recorded acoustic data for 24 h before a 48 h continues sampling program commenced with bottom and pelagic trawls, plankton nets mud core stations and CTD stations.

The area is generally described by anoxic /sulphuric bottom water masses and diatomaceous mud substrate. The sulphur reducing bacterium *Beggiatoa sp.*and *Thiomargarita namibiensis*

was present in core samples from the station. Typically also in this area is the high number of fish and mammal skeleton parts mixed in the sediments.

Morning twilight on the 16/1 started at 06:00 UTC and sunrise at 06:25. Sun transit was at 13:07 while sunset was at 19:48 and end of evening twilight was at 20:13.

3.2.1. Observations at anchor

Acoustic recordings

Layers of the jellyfish *Chrysaora hyoscella* and lower concentrations with *Aequorea aquorea* dominate the major part of water column. The bottom layer was dominated by juvenile hake (*Merluccius capensis*) and gobies (*Sufflogobius bibarbatus*), see length frequencies in Figure 9. The lower part of the water column with < 0.03 ml/l oxygen was mainly devoid of jellyfish, but hake and gobies were still present.

Four separate acoustic layers were defined during the experiment, Figure 6. The surface layer was dominated by *Chrysaora hyoscella.* The layer was so dense that it made any attempt to trawl the other layers difficult and at times impossible. There was little diurnal variation in this layer, but it was slightly more concentrated during the day than at night. Jellyfish also dominated the two other layers. These layers showed a gradual migration downwards during the first part of the day and upwards after midday. The layers became more dispersed and less defined during night.

Gobies and hake were visible in the lower part of the echogram. These showed diurnal migration towards the bottom at daybreak, and considerable activity in the first hour of the morning, Figure 5. The activity decreased later during the day. This was interpreted to be because the fish became inactive, saving energy in the low oxygen water. The activity increased in the hour of the afternoon before the fish, both gobies and hake, ascended from the bottom, Figure 5. Acoustic and trawl observations suggested that the hake lifted from the bottom slightly before the gobies in the afternoon and descended to the bottom after the gobies in the morning.

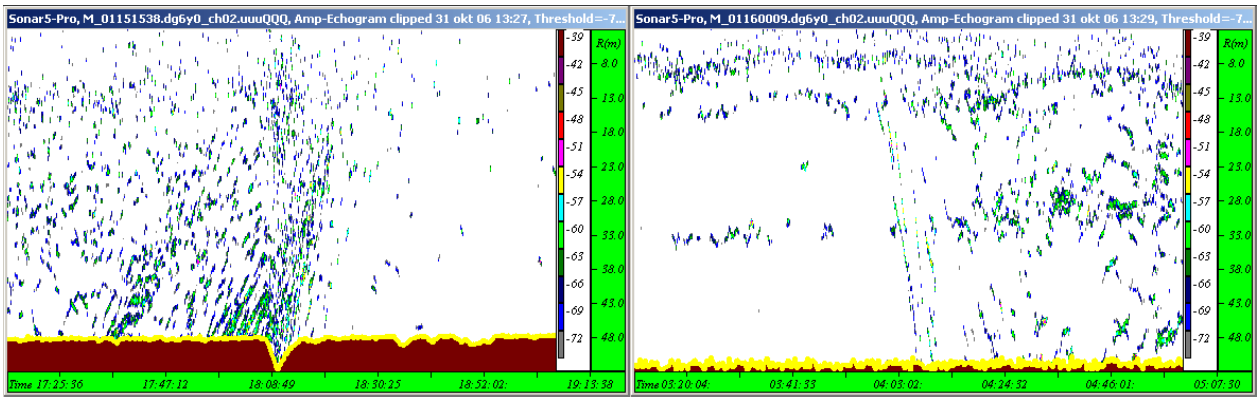

Figure 5 Echograms from submerged 38 kHz transducer showing ascent from and subsequent descent to the bottom waters of a mixed assemblage of gobies and hake (minimum Colour TS =-75 dB), recorded during diel cycle 1

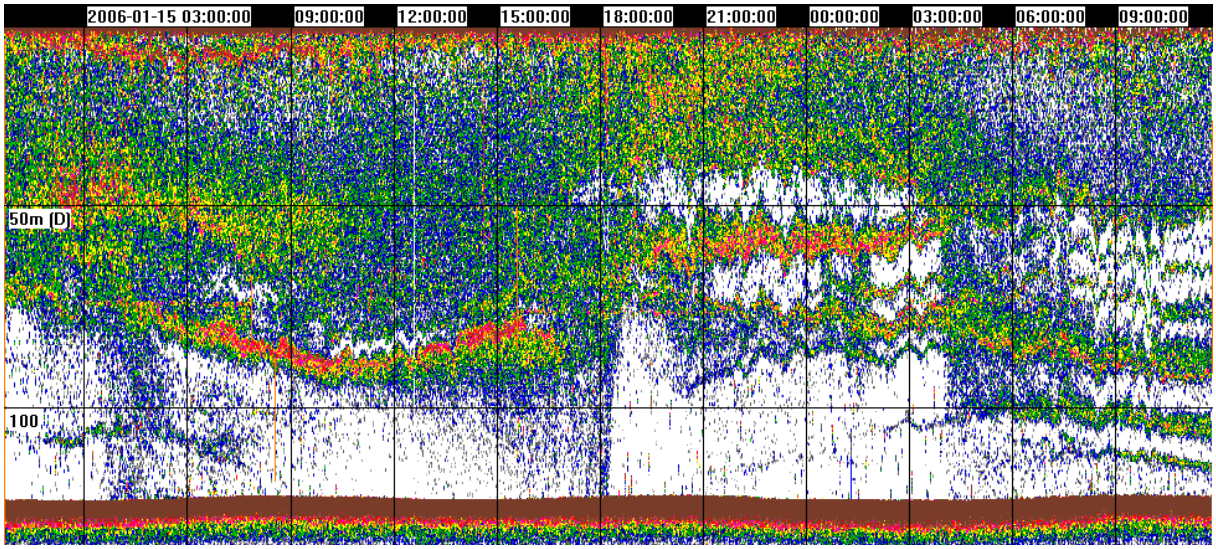

Figure 6 Composite echogram from the 120 kHz transducer (minimum Colour Sv =-90db) illustrating the diurnal changes in the scattering layers

Video observations

Three deployments with the video rig were made during the period at anchor. The most prominent features observed were the extensive layers of bioluminescent plankton and jellyfish, together with the observations of the diatomaceous mud flat with extensive white bacteria mats. The quality of observations on the bottom was however poor due to an inaccurate depth sensor, and no gobies could be identified with certainty on any of the recordings.

3.2.2. Catch distribution

All together 30 trawl stations (BT1668 –1697) were conducted during the first diel station.

When inspecting the results it is important to remember that the bottom trawl is 4 m high and catches only fish in this distance from the bottom, while the pelagic trawl is 15-18 m high and catches fish in this depth region (depth of headline is given in the Figureures). Neither gobies nor juvenile hake show any noticeable trawl avoidance and are expected to be caught representatively by the trawl. The dominating species in the catches were *Merluccius capensis*, *Sufflogobius bibarbatus*, *Chrysaora hyoscella* and *Aequorea aquorea*. No other species were important in the catches. See annex I for a total catch overview per stations. Figure 7 illustrates the depth of the relevant trawl catches during the first diel cycle with the relative proportion of hake (blue) and gobies (red), and the total catch rate in kg/h of the same two species. Bottom depth was 122 - 125 m in the area.

The trawl catches confirmed the acoustic observations and showed that there were no gobies present in the upper part of the water column at any time during the diel cycle (upper 95 m), while juvenile hake was caught in very shallow water (> 20 m) during the night, and also (40 m) in small amounts during the day. No pelagic trawls (of five) caught gobies off the bottom during the day, while all three bottom trawls conducted during the day caught gobies. The trawl catches also show that the gobies lifted from the bottom and became frequent just off the bottom at night wile a proportion of the fish continued to stay on the bottom and were caught by the bottom trawl. Both gobies and hakes stay together on the bottom for prolonged periods during the day. It may be that the life in anoxic water masses is so energy demanding that both hakes and gobies are resting, saving their energy reserves to food search in more oxygenated waters in the evening and night.

Every dusk and dawn three consecutive trawl s were performed just of the bottom to try to monitor the rise of the hake and gobies from the bottom. The events were difficult to time perfectly, but the results indicates that the hakes started lifting from the bottom approximately 30 min before the gobies in the evening and descended to the bottom 30 min after the gobies in the morning. This may indicate that the hakes had a higher “need“ to resupply fresh oxygen in higher more oxygenated water masses, or possibly as predators were rising earlier than the gobies to wait for them in more oxygenated water masses when they started ascending. The size difference between the two species normally considered as predator and prey, were however so small, Figure 9, that the gobies may not have been suitable prey for the hakes. Stomach investigations of the hake caught on this station will tell us.

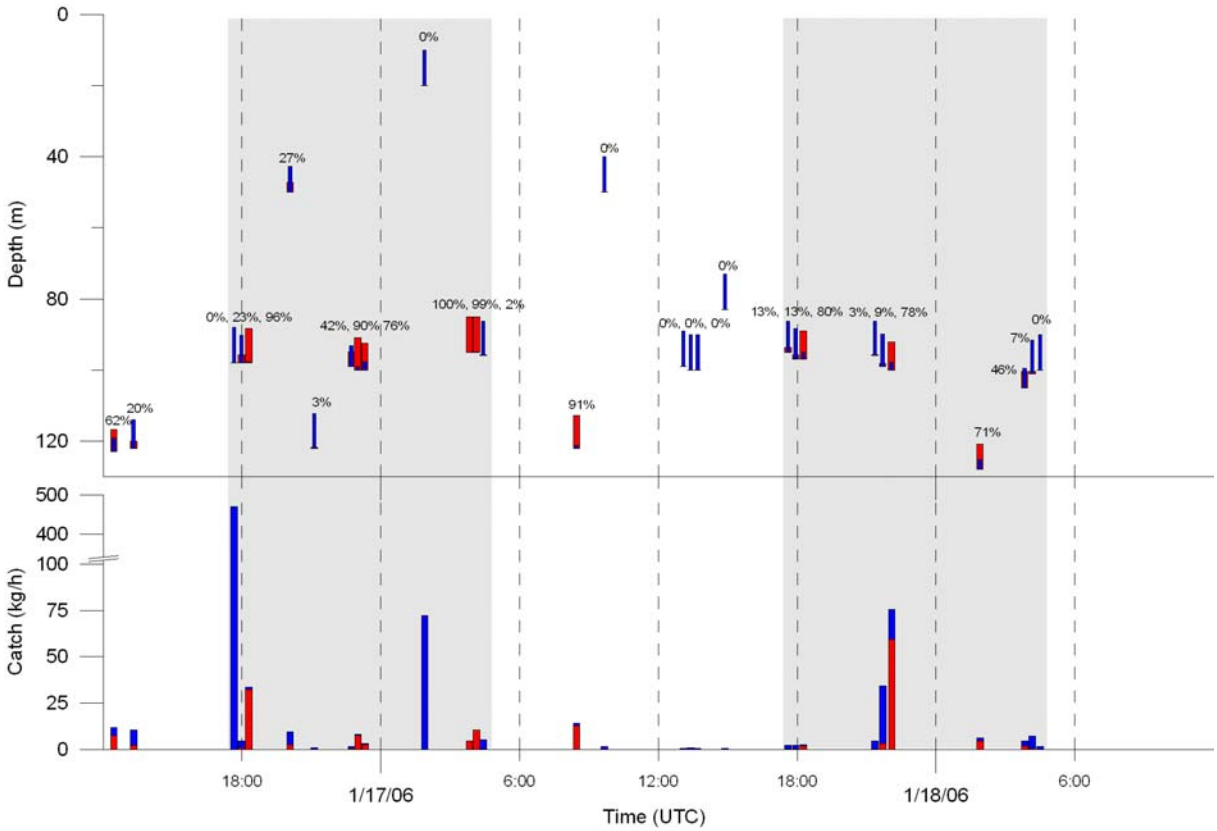

Figure 7 The depth of the individual trawl catches during the second diel cycle (time in hours on x-axis) with the relative proportion (upper diagram) of hake (blue) and gobies (red) and the total catch rate in kg/h of the same two species (lower diagram). Each bar represents one trawl haul. The data labels indicate the relative proportion of gobies in the catches (compared to hake), The grey area represents hours without daylight

By far the most abundant species in the water column was the jellyfish, *Chrysaora hyoscella* and *Aequorea aquorea*. Figure 8 show the relative proportion of the two species in the water masses and the total catch rates in kg/h for each of them. It is difficult to se a clear trend in the catches, but high catches of *Chrysaora hyoscella* were made high in the water column during the night, and the echograms indicates that this layer was also abundant with the same species during the day. Depths above 60 m were avoided when possible during the sampling because of the danger of breaking the net. Catches made around 100 m depth gave small catches of jellyfish throughout but with variable catch composition between the two species. The bottom trawl stations all gave moderate catches of both species with slightly variable proportions between the two. However, while the multisampler trawl can close each of the tree codends at a discrete depth the bottom trawl has no mechanism to close the codend, and may consequently be sampling moderately also while shooting and hiving.

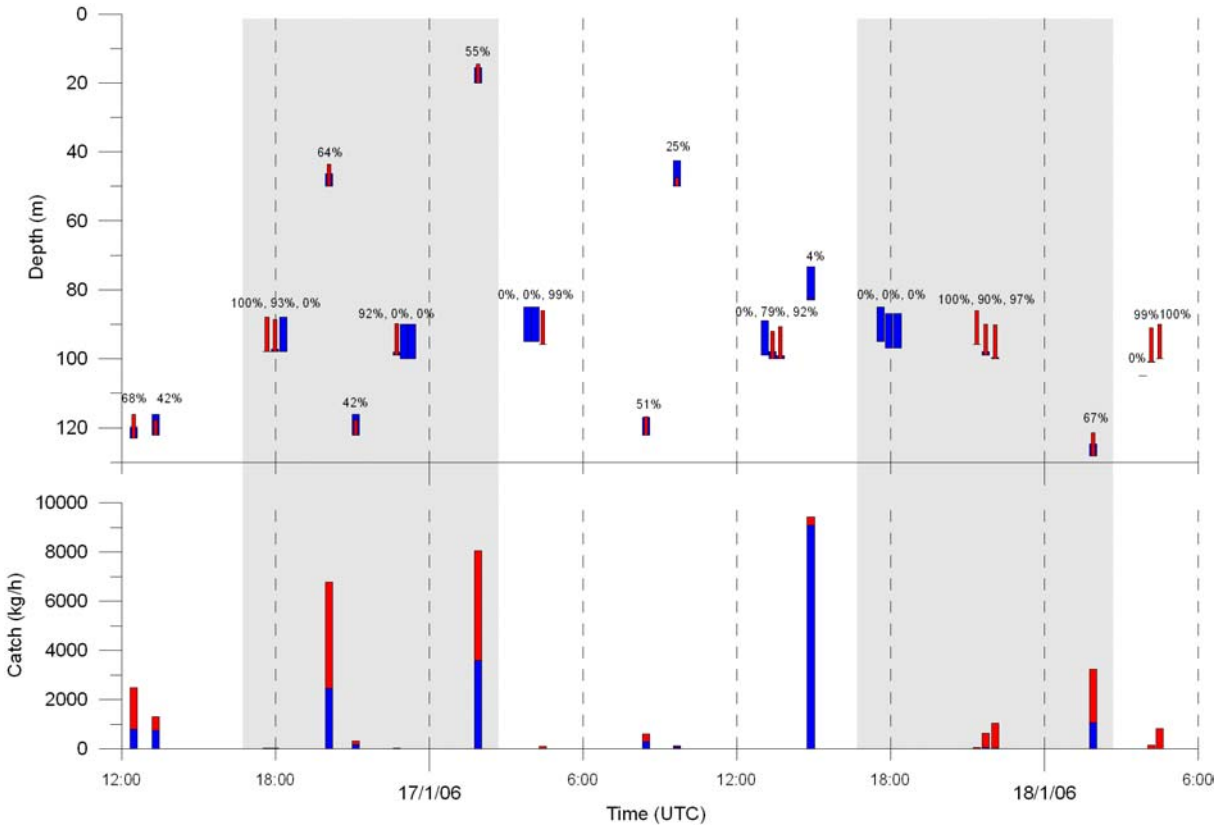

Figure 8 The depth of the individual trawl catches during the second diel cycle (time in hours on x-axis) with the relative proportion (upper diagram) of *Chrysaora hysoscella* (red) and *Aequorea aequorea* (blue) and the total catch rate in kg/h of the same two species (lower diagram). Each bar represents one trawl haul. The data labels indicate the relative proportion of *Chrysaora hysoscella* in the catches (compared to *Aequorea aequorea*), The grey area represents hours without daylight

Biological data were collected from the four main species caught in the trawl during the diel cycle. These were *Merluccius capensis*, *Sufflogobius bibarbatus*, *Chrysaora hyoscella* and *Aequorea aquorea.* The length frequency of all four species are presented below, Figure 9. The length frequencies for hake and gobies showed a unimodal distribution, with a modal peak around 13 cm for hake and at 6 cm for gobies. The disk diameter was measured for the two jellyfish species. The size distribution of *Aequorea aquorea* was unimodal with a modal disk diameter of 7 cm while *Chrysaora hyoscella* had a much wider distribution without clear modal peaks.

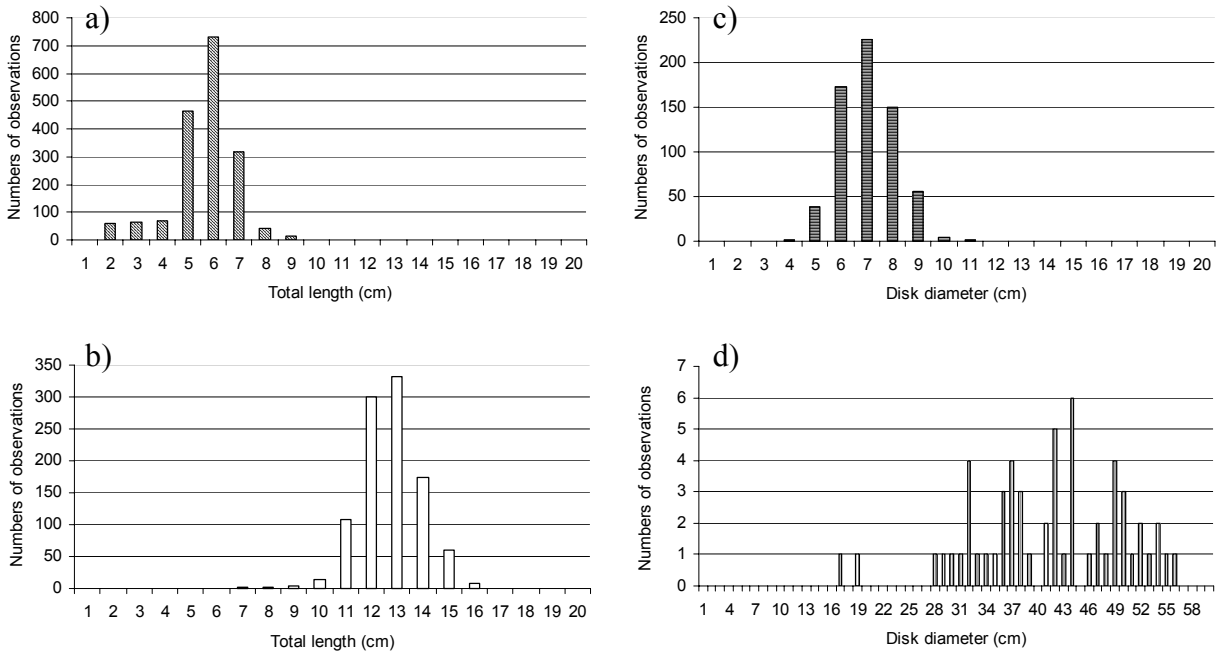

Figure 9 The length frequency of *Sufflogobius bibarbatus*, 1754 obs., a), *Merluccius capensis*, 1014 obs., b), *Aequorea aquorea*, 650 obs., c)and *Chrysaora hyoscella*, 57 obs., d). Note the different scale on the x and y axis

3.2.3. Environmental conditions

All together 8 CTD stations were conducted at this diel stations (HD21 – HD29). Figure 10 describes changes in temperature salinity and oxygen during the cycle period. The temperature profile show warm water masses in the upper 15 - 20 m and a strong thermo cline at this depth. Cooler water masses are observed below this. No changes in salinity are observed, while a strong decline in oxygen vs. depth can be seen. Note in particular the low oxygen water masses with concentrations < 0.3 ml/l below 80 m depth.

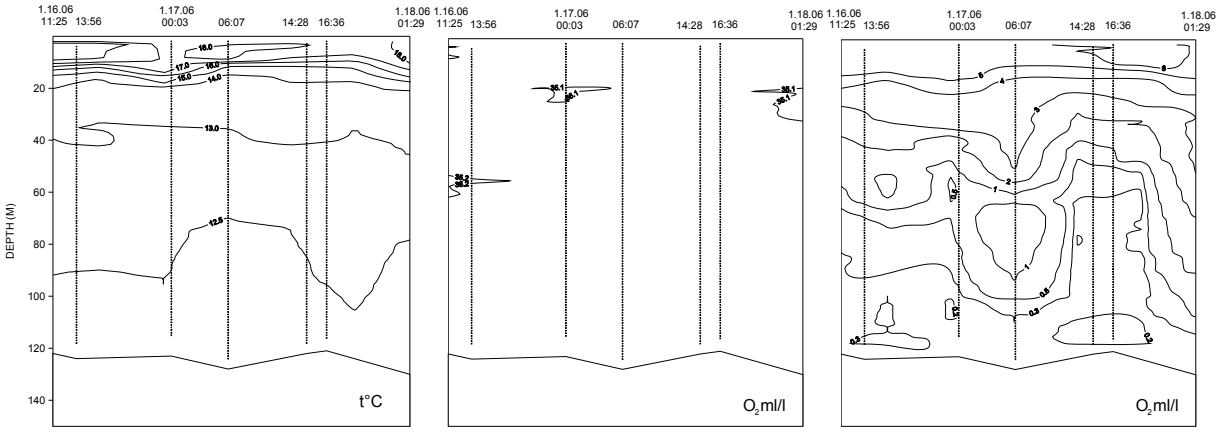

Figure 10 Composite pictures illustrating changes in temperature, salinity and oxygen during the period of diel cycle 1

Most light absorption and extinction happened in the upper 20-30 m, obviously with a stronger gradient at night. Bioluminescence was observed to have some effect below this at night Figure 11. Some deck light has been on during night deployment of the light sensor giving unrealistic high surface recordings.

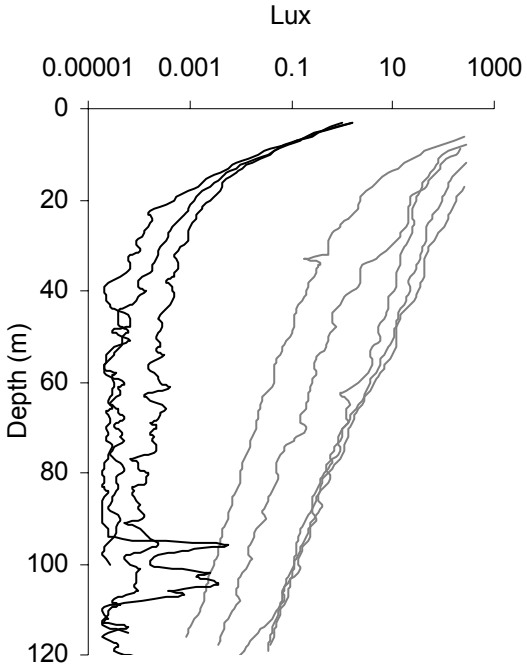

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Figure 11 Light absorption in the water column during Diel cycle 1 (Note log scale on x-axis)

3.3. DIEL SYCLE 2

After completing the first station another diel station was conducted approximately 30 NM further offshore in position 23°32' S 13°44' E. The depth was 180 m. The vessel arrived in the position on the 18th at 20:30 and a 48 h continues sampling program was started immediately. The vessel then anchored in the same position 20/01-2006 at 09:30. The sampling followed the same strategy as during the first diel cycle.

3.3.1. Observations at anchor

Acoustic observation

Chrysaora hyoscella was the most dominant species in the water column and was particularly abundant in the upper 50 m. Lower concentrations of *Aequorea aquorea* were more abundant in the middle layer while the bottom layer was dominated by juvenile hake (*Merluccius capensis*) and gobies (*Sufflogobius bibarbatus*). Low oxygen levels < 0.03 ml/l was present in the lower part of the water column, deeper than 150 m. This area was generally devoid of jellyfish, but hake and gobies were still present.

A clear diurnal change in distribution pattern was observed also on this station, Figure 12. A layer formed at night in water masses with oxygen level between 0.5 – 1.0 ml /l, and the bottom that was more or less devoid of life during the day show more activity at night, and particularly during dusk and dawn. The surface layer did not show large diurnal fluctuation, but there was a tendency towards more dispersed and less defined layers during the night.

Gobies and hake were visible in the lower part of the echogram. In the same way as during the first diel cycle these species showed diurnal migration towards the bottom at daybreak, and considerable activity in the first hour of the morning (Figure 19). The activity decreased later during the day. This was interpreted to be because the fish became inactive, saving energy in the low oxygen water. The activity increased in the hour of the afternoon before the fish (both gobies and hake) ascended from the bottom. The timing of the ascent and decent observed during the first diel station was also observed at this station, and trawl sampling confirmed the observations.

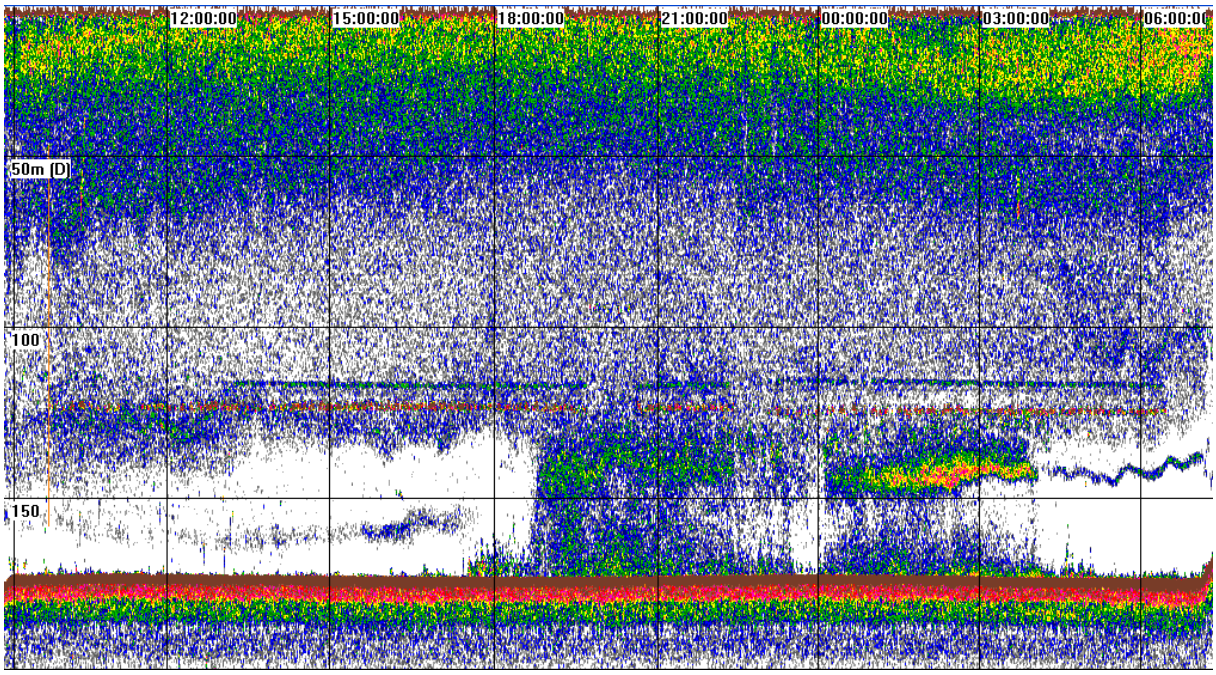


Figure 12 Composite echogram from the 120 kHz transducer illustrating the diurnal changes in scattering layers, Colour sv =-80 db

Figure 13 show a snapshot of the morning situation recorded with the 18 kHz transducer. The red layer around 125 m is the backscatter from the submersible 38 kHz transducer used for detailed behavioural studies. The most typical feature on the echogram was the jellyfish that were diving towards the bottom in the early morning to a depth around 140 m depth. Interestingly, this is the same depth as were the night layer was formed, and were many of the

gobies stayed in during the night. The layer is relatively abundant with gobies, diving towards the bottom at daybreak.

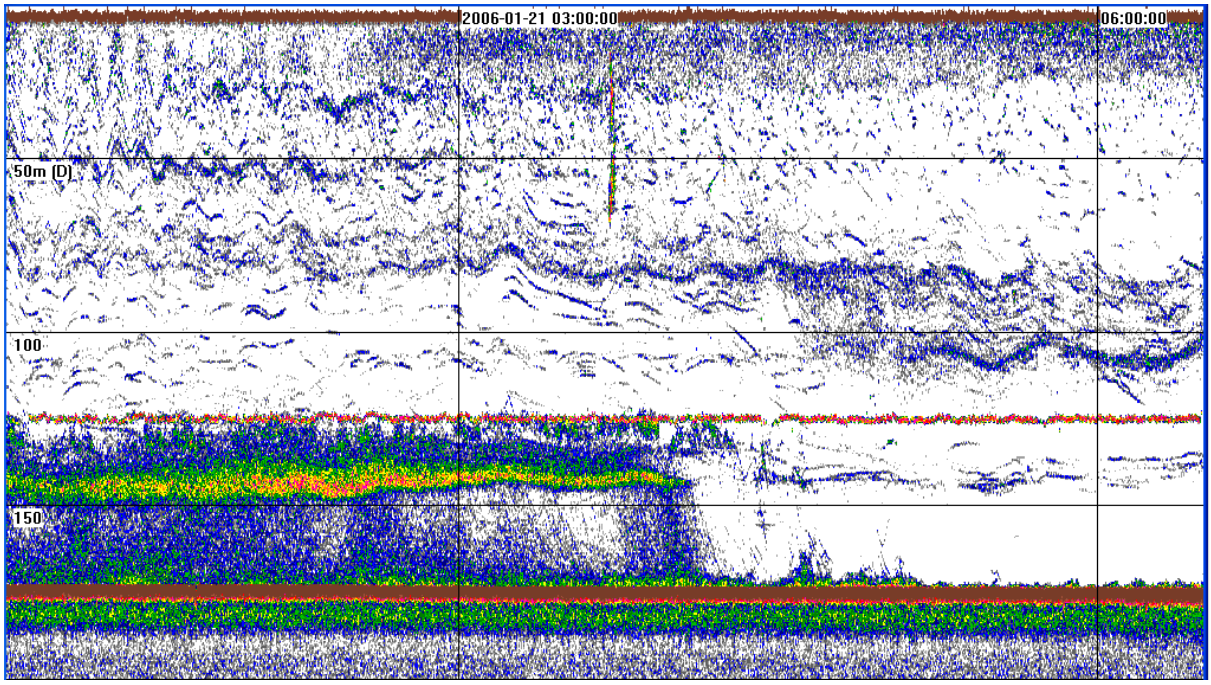


Figure 13 Jellyfish (*Chrysaora hyoscella*) in the middle part of the echogram, and fish in the lower part are both migrating downwards in the morning. Data recorded with the 18 kHz transducer. Min. Colour sv –75 db

Video observations

Two deployments with the video rig were made during the period at anchor, one at night and one during the day. The daytime recordings were interesting although sea swell affected the quality of the video recordings to some extent. The video rig was placed just above the bottom for a period of approximately 8 minutes, and approximately ±10 gobies were observed to be stationary under the camera during that period. They seemed not to be affected seriously by the camera light. Observations made show that the gobies were very inactive and stayed only cm's from the bottom or also on the bottom. The fish were grouped together, but well spaced apart and not typically schooling. In general all the specimens were directed in the same direction although slow swimming motion was observed, Figure 14. A predator (probably hake) was observed in the picture frame without having any observable effect on the gobies. The video recordings support the idea that the gobies use the day as a resting period and also illustrates why they are difficult to observe at daytime on the echo sounder. The gobies observed typically occupied the acoustic blind zone. They were also not densely aggregated, but rather well spaced, meaning that they as small objects become more difficult to identify as an acoustic object. The video recording made at night gave no good footage of gobies.

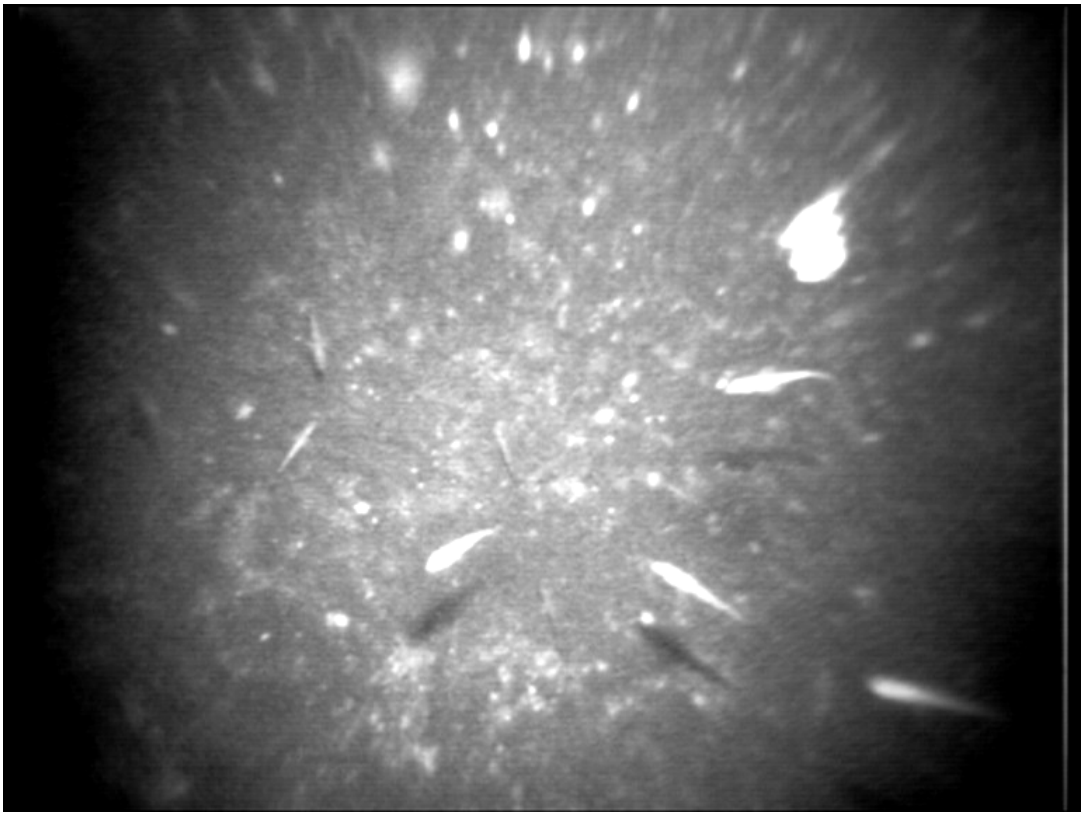


Figure 14 at least seven gobies can be identified near the bottom. Please note the shadow below some of the gobies. Scale in the focus of the picture is approximately 1:7. The bottom is even, with sandy / muddy substrate with white unidentified patches, oxygen level is < 0.3 ml/l

3.3.2. Catch distribution

All together 33 trawl stations (BT1699 –1732) were conducted during the second diel station. The dominating species in the catches were *Merluccius capensis*, *Sufflogobius bibarbatus* and *Chrysaora hyoscella*. *Aequorea aquorea* was also frequently caught but much less abundant than during the inshore diel station. No other species were important in the catches. See annex I for a total catch overview per stations. Figure 15 illustrates the depth of the relevant trawl catches during the second diel cycle with the relative proportion of hake (blue) and gobies (red) and the total catch rate in kg/h of the same two species. Bottom depth was 180 m in the area.

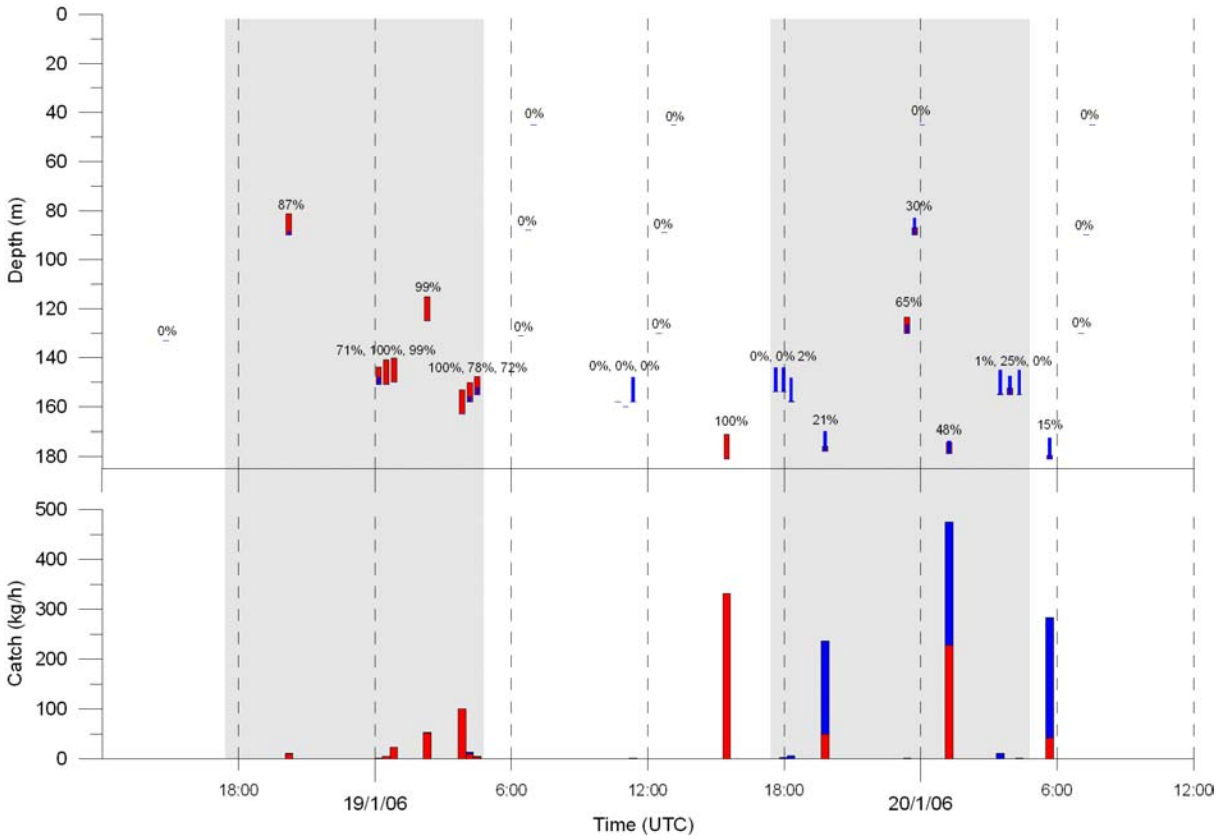


Figure 15 The depth of the individual trawl catches during the second diel cycle (time in hours on x-axis) with the relative proportion (upper diagram) of hake (blue) and gobies (red) and the total catch rate in kg/h of the same two species (lower diagram). Each bar represents one trawl haul. The data labels indicate the relative proportion of gobies in the catches (compared to hake), The grey area represents hours without daylight

Observations on the second diel station was similar to the first although catch rates were generally higher, and less hake was present, at least during the first 24 h of the sampling program. Gobies were only present on the bottom during the day while lifting off the bottom was observed at night with catches made at 90 m depth both nights. However, the major catches of gobies were made on the bottom both day and night indicating that only parts of the resource carried out diel vertical migration. More hake were present in the samples the second night, and the size were larger than during the first diel cycle, Figure 15. The gobies showed a tendency towards less migration up in the water column with increasing predator presence. Three consecutive multisampler trawls were conducted at dusk and dawn as during the first diel cycle. The results indicate the same thing, a tendency of gobies to leaving the bottom after the hake in the evening and returning before the hake in the morning. However the picture was less clear than during the first diel station, possibly because less gobies migrated up in the water column.

As during the first diel station, the most abundant species was the jellyfish. *Chrysaora hyoscella* dominated the catches while much smaller quantities of *Aequorea aquorea* was

found, Figure 16. Generally less jellyfish were caught at this station compared to the one more inshore.

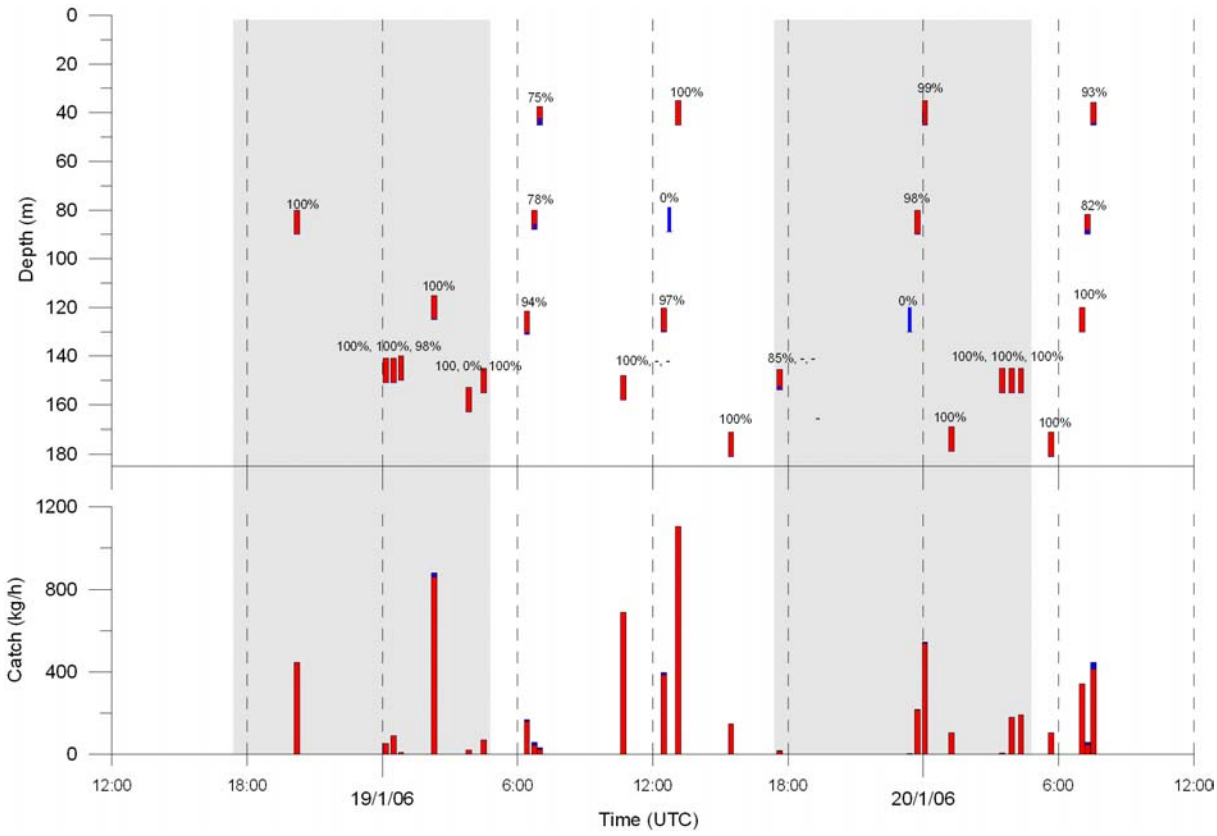


Figure 16 The depth of the individual trawl catches during the second diel cycle (time in hours on x-axis) with the relative proportion (upper diagram) of *Chrysaora hysoscella* (red) and *Aequorea aequorea* (blue). Each bar represents one trawl haul. The data labels indicate the relative proportion of *Chrysaora hysoscella* in the catches (compared to *Aequorea aequorea*), The grey area represents hours without daylight

The biological data collected from the station show the size distribution of two main fish species caught in the trawl during the second diel cycle, gobies and hake respectively, Figure 17. The length frequencies for gobies and hake showed wider distributional ranges than during diel cycle 1. The lengths show a modal peak at 6 cm for gobies, and indications of another peak at 11 cm. The hake caught during the second diel cycle was significantly bigger than during the first cycle, with a modal peak at 21-22 cm, with a size range from 10 to 30 cm.

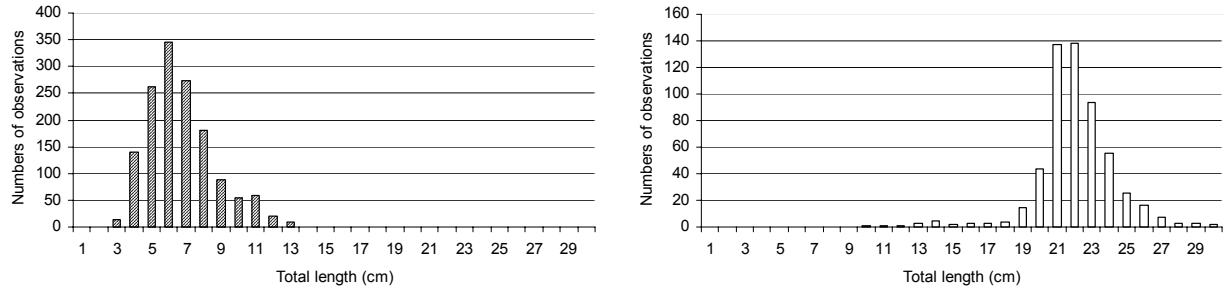


Figure 17 The length frequency of *Sufflogobius bibarbatus*, 1447 obs., a) and *Merluccius capensis* 562 obs., b). Note the different scales on the y axis

3.3.3. Environmental conditions

Figure 18 describes changes in temperature salinity and oxygen at the second diel station during the cycle period. The temperature profile show warm water masses in the upper layer but with a less pronounced thermocline than further inshore. Cooler water masses with temperatures around 13°C is observed from 80 m depth to the bottom. No, or minor, changes in salinity are observed, while a strong decline in oxygen vs. depth can be seen. Note in particular the low oxygen water masses with concentrations < 0.3 ml/l below 165 m depth.

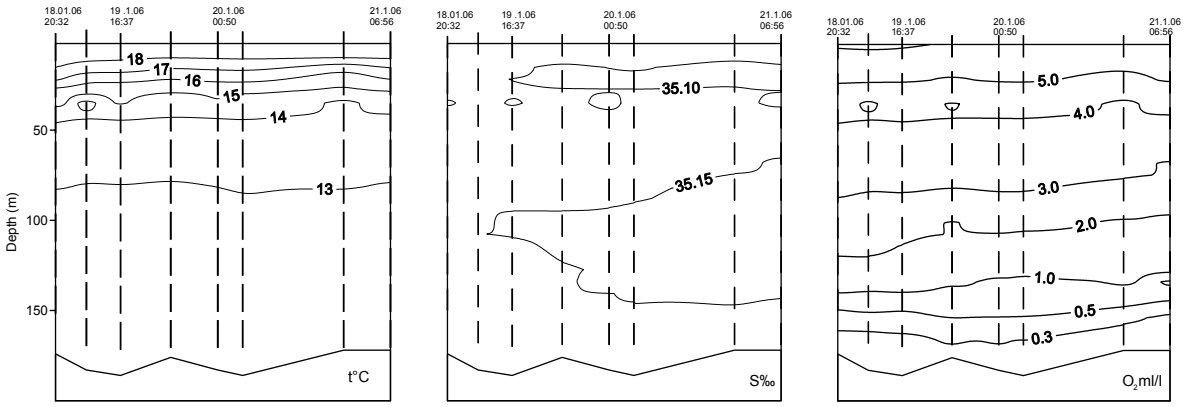


Figure 18 Temperature salinity and oxygen profiles illustrating changes in these parameters during the second diel cycle

3.4. SUBMERGED ACOUSTICS

At both diel stations detailed studies of individual fish swimming patterns and swimming

speed together with the interaction between the individuals of different species, mainly hake and gobies, were studied using the submersible 38 kHz transducer. No detailed analysis of vertical swimming speeds has yet been performed on the data obtained during the first diel cycle, so most of the behavioural results presented here are from the second station.

In the second diel cycle studied, it is apparent that the acoustically smaller organisms ascended first, Figure 19 and Figure 20, followed shortly after by a dense layer of larger organisms. Trawling at this site however failed to resolve timing differences between gobies and hake, the hake were also larger on this site compared to the first station. Based on the length distribution from the catches, the weaker targets could be gobies, though as mentioned above it may also include small hake, so further analysis is needed in order to reach safe conclusions. Regardless of identity, this situation contrasts with that on the first station, in that smaller organisms migrated first, and it is tempting to speculate whether the differences in sizes and timing with regards to the migration is influenced by the presence of larger hake in quantity.

More detailed analysis of swimming speeds in these two ascending pulses (not shown) suggested that whereas all the weaker targets swam more or less directly upwards, some of the larger targets also descended, though the layer as a whole clearly ascended. Distributions of vertical swimming speeds for both groups had peaks in the region 3 – 4 cm/s.

The ascent from the bottom resulted in the formation of a dense scattering layer approximately 30 meters above the bottom, and this layer was present until dawn occured the next morning, Figure 19 C. During the night there was a continuous exchange of animals between this scattering layer and the bottom, Figure 19 B (4). In the morning this layer broke down, as the organisms in it descended to the bottom, Figure 19 C.

Both the ascent phase and the descent phase could clearly be seen in the distributions of vertical speeds, Figure 21, as a shift towards respectively more negative or positive speeds (positive speeds implying downwards swimming in this instance). During the night however, the distribution of swimming speeds (measured in the region between the bottom and the layer) was relatively broader, as organisms continuously both descended from and ascended towards the scattering layer. Densities inside the scattering layer were too high to permit target tracking.

The results from the submerged acoustical equipment showed that this approach is viable for obtaining information on *in situ* behaviour, even in an open ocean situation. Despite high densities of scatterers and moderately deep waters, the system was (mostly) successful in

resolving single organisms in the zone close to the bottom, thereby providing detailed information on the swimming activities of the animals here.

For the acoustical method employed to work at its maximum capability, however, some problems remain to be solved:

First of all acoustical information alone is not necessary enough to clearly separate between the different components. In a situation where there are large differences in size between the prey (gobies) and the predator (hake), acoustical target strengths (TS) will usually be enough to tentatively identify members of the different guilds. However, size differences at the first station was relatively small, Figure 9, and a preliminary investigation of TS from the different pulses of migrating animals at this station suggested that TS may not be enough to properly separate hake from gobies.

Nevertheless, the echograms recorded at this station shows that the ascent phase of the diel vertical migration, Figure 5 consists of two distinct pulses leaving the bottom area, separated by approximately 30 minutes. This information was used for planning the sampling design, which clearly revealed species differences in the timing, as the trawl catches revealed that the first of these two consisted almost entirely of hake, whereas the latter was almost entirely gobies. The implications of these results are discussed elsewhere in this report.

Better acoustical results would also be obtained if the acoustical platform were more stable, at present we are limited to analysing only the vertical component of behaviour. A more stable platform, possibly bottom-mounted, would overcome this problem. This limitation may also at least partly be overcome by better post-processing tools, the number of targets present in the data are possibly high enough that statistical procedures may be used to eliminate the platform movement.

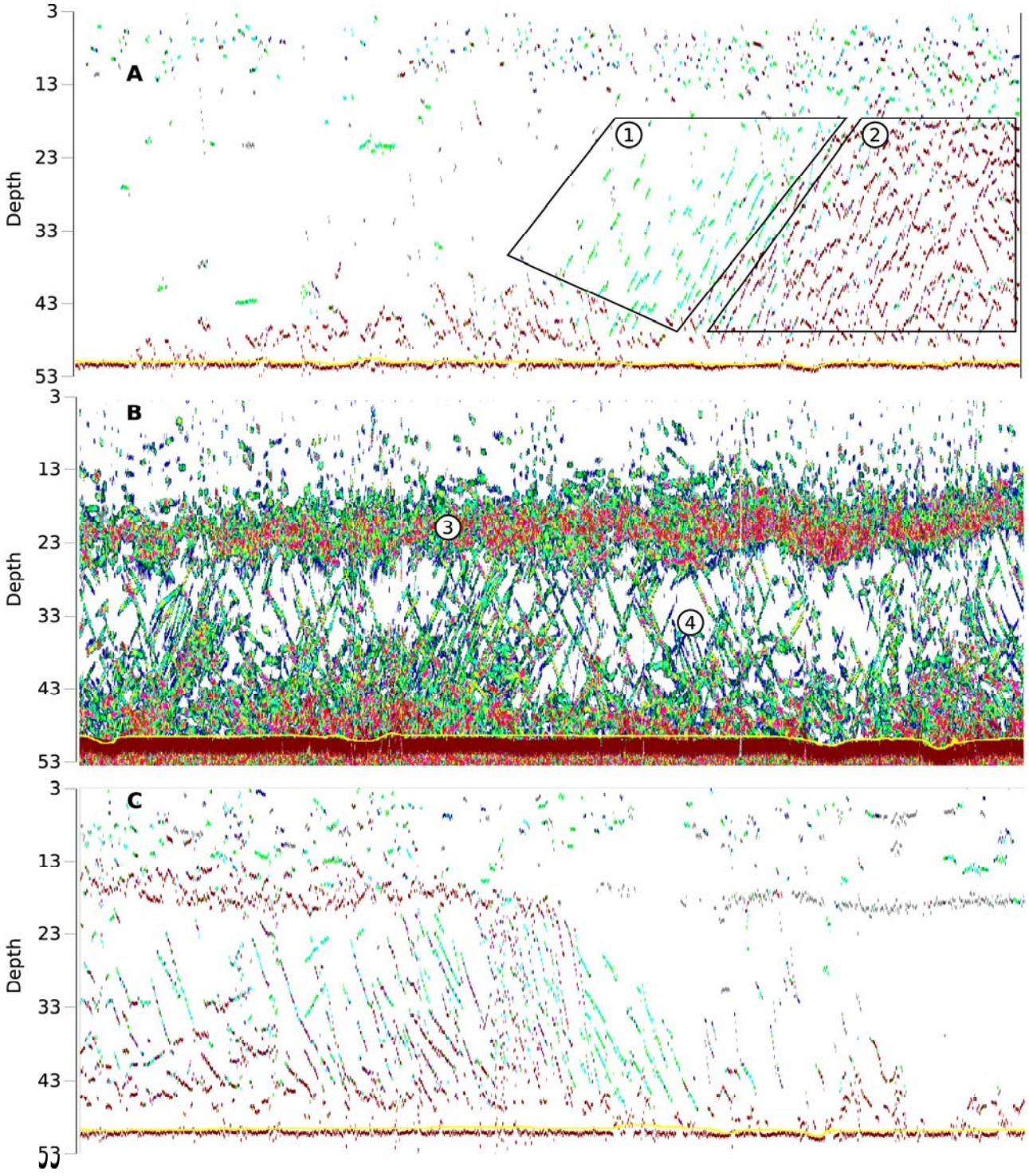


Figure 19 Echograms from submerged transducer, B is a □normal□ 40 log R echogram, while A & C shows detected single echoes, all echograms represent approx. 2 hours in time. A shows the period around the ascent from the bottom, B shows a period during night, whereas C shows the period around the descent to the bottom. Box 1 and 2 in Figure A outlines the different timings of weaker and stronger targets during the ascent, in Figure B the numbers highlight respectively the dense layer of scatterers and the exchange of organisms between this layer and the bottom layer

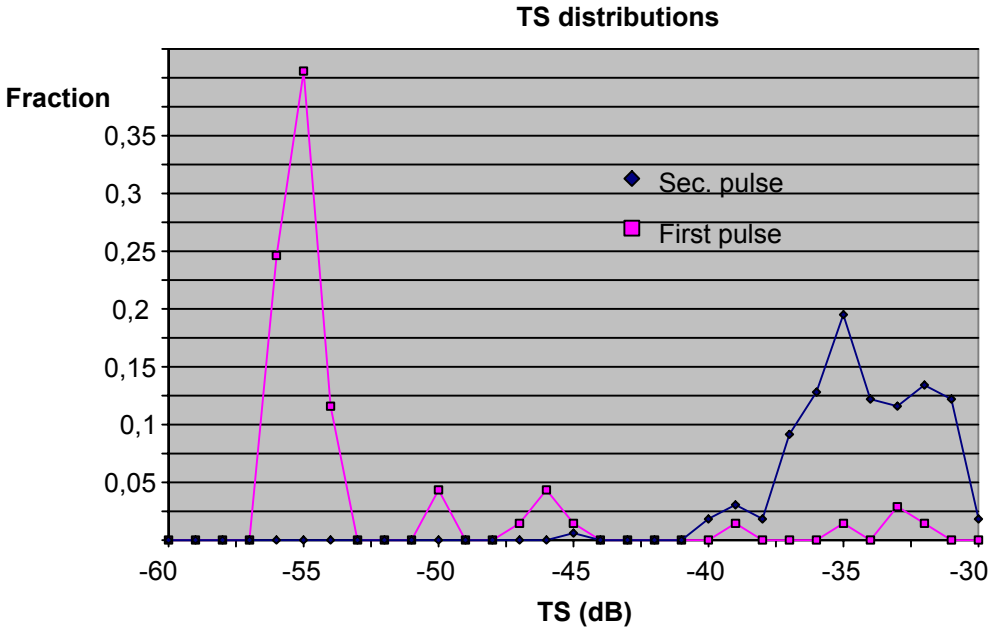


Figure 20 Distribution of track average target strengths in the ascending layer, as detected from the submerged 38 kHz transducer, separated as shown in Figure. 19 A.

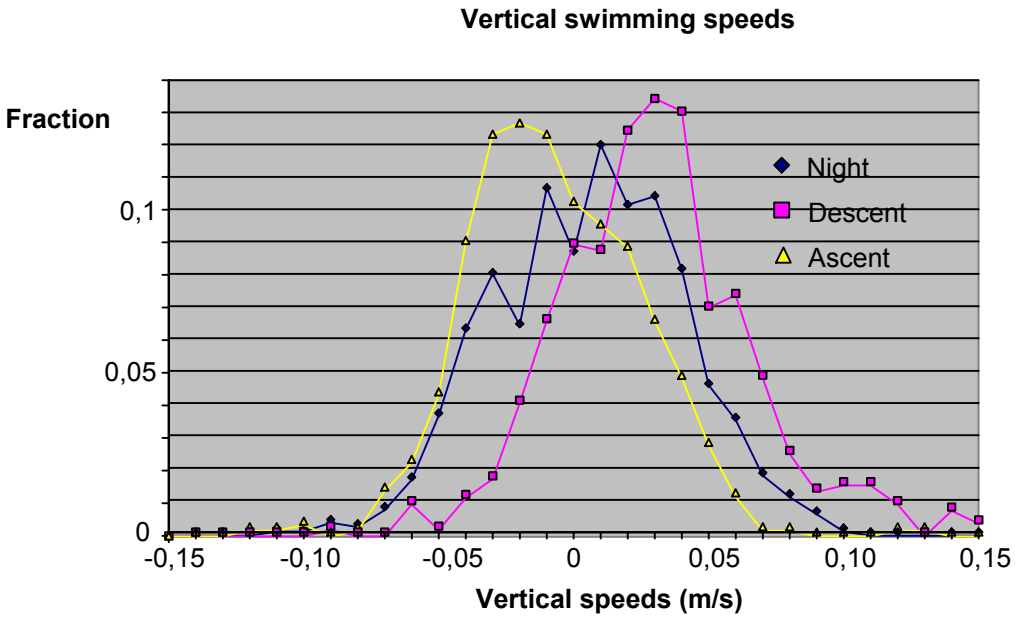


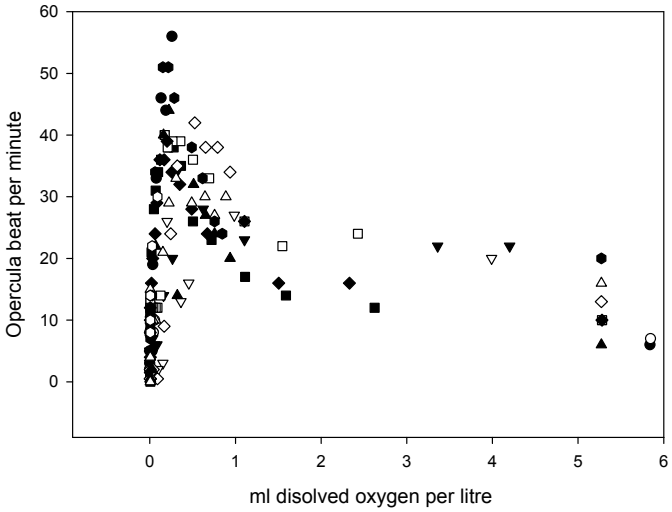
Figure 21 Distribution of vertical swimming speeds of tracked organisms, tracked in the same time periods as shown in Figure 19 A-C. Negative speeds are ascending organisms

3.5. RESPONSE TO HYPOXIC STRESS

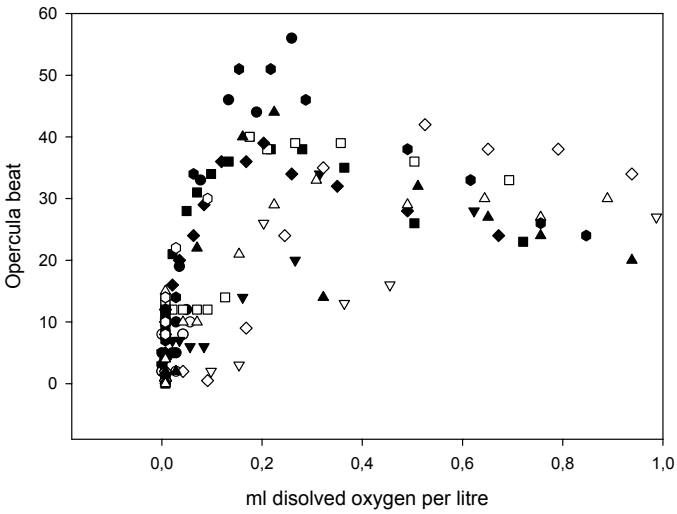
3.5.1. Behavioural responses to decreasing oxygen concentration

Adult gobies show a remarkably high tolerance to low concentrations of dissolved oxygen. Their response to decreasing oxygen was an intermediate increasing the gill ventilation volume and frequency at ca 0.2 ml DO/l (called critical oxygen level) followed by a sudden drop in gill beat frequency (< 0.2 ml DO/l) (see Figure 22 a and b). Critical oxygen level is the oxygen level at which the fish shifts from aerobe to anaerobe breathing. They tolerated 4.5 hours in levels of < 0.01 ml DO/l without showing signs of equilibrium loss. They recovered rapidly to normal breading and behaviour after been under oxygen stress for 5 to 9 hours (Figure 22 c).

a)



b)



c)

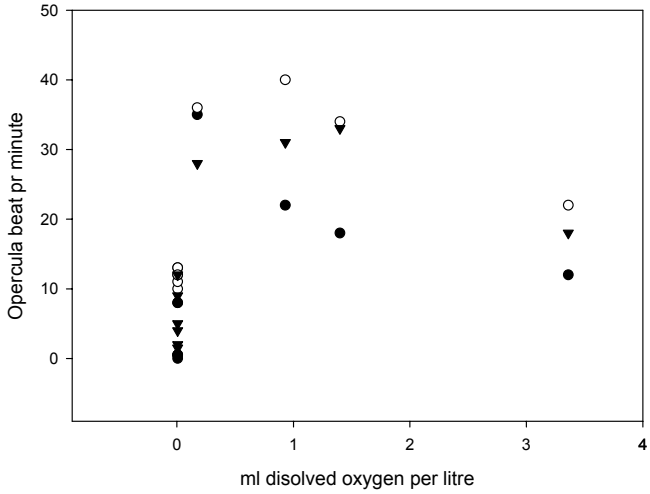


Figure 22 Opercula beat of twelve individual fish (each represented with a different symbol) during decreasing levels of dissolved oxygen. A) Shows all data obtained. B) Shows opercula beat from 1 ml DO/l and done to 0.01 ml DO/l, to clarify the peek of opercula beat or the. C) Shows opercula beat during recovery

When the gobies were "attacked" (poked by a stick) after been in < 0.01 ml DO/l for 4.5 hours, they responded immediately with an escape response, showing that their brain is turned on also after long time of anaerobe breading.

Adult and juvenile gobies were tolerant to presence of sulphide in anoxic (< 0.01 ml DO/l).

3.5.2. Respirometry study

The results from the respirometry study concerning individual oxygen use related to oxygen level are not yet analysed. The gobies did not cope with the same low oxygen levels in the respirometry set-up as they did in the behavioural aquarium studies (Behavioural responses to decreasing oxygen concentration). In the respirometry study the gobies lost equilibrium at much higher oxygen levels (0.6 to 0.8 ml DO/l). However, in these studies the gobies where in low oxygen water for 15 to 17 hours. This is longer than what will normally be the case in nature (from dusk to dawn ca 12 hours). Also the gobies seemed much stressed when placed in the bottle, they tried to swim up, and their opercula beat rate went up almost immediately after placed in the bottle. In this study the gobies reached maximum opercula beat (critical oxygen level) at much higher oxygen level (1.7 to 2.5 ml DO/l) than shown in the behavioural aquarium studies (0.2 ml DO/l).

The unexpected early increase in opercula beat and early loss of equilibrium (when related to oxygen level) could be due to a build-up of waste products (lactate and alcohol) in the bottle water (1215 to 606 ml). The goby that was tested in bottle of 606 ml water, died after 5 hours, and reached maximum opercula beat at a higher DO level (2.5 ml DO/l) than to the two fish tested in 1215 ml bottles (1,7 ml DO/l). In the behavioural studies performed in aquariums there was much more water per fish (wastes more diluted), and also there was some gas exchange trough the top/lid of the aquarium. Water samples from the bottle water (respirometry study) and aquarium water (behavioural study) is not yet analysed, neither is the fish from the two experimental set-ups.

3.5.3. Sulphide tolerance experiments

Fish were observed concurrently in the test (top) and control (bottom) tanks. During the experiment outlet tubes could be used to tap off samples for oxygen and sulphide analyses (Winkler and Cline methods respectively)

During the first tests the experimental fish were exposed to high concentrations of sulphide (up to 400umol l^{-1} - far greater than gobies living in the water column will experience in their natural environment) Apart from the immediate effect of intense sulphide exposure these high concentrations had an important secondary effect of reducing the oxygen concentration in the experimental tank to zero, as confirmed by Winkler analysis. Sulphide was added twice during the experiment so that these extreme conditions were maintained. The gobies survived both the high sulphide as well as the anoxia for 2 hours (50% survival) and one of the five experimental fish survived for 2 hours and 32 minutes.

In the second experiment gobies were again exposed to sulphide, but in lower concentrations in order to simulate high but realistic levels of sulphide that gobies could expect on the mud

bottom (between 0 and 40 umol l^{-1}). Ambient temperature was 19 deg C. The same procedure as described above was followed. Because the sulphide was added in small amounts the oxygen level in the experimental tank dropped gradually from 0.04 ml l^{-1} to zero over an extended period of 2 hours.

Experimental fish survived for > 6 hours (70% survival). Opercular beats were low at this stage (approx 12/minute) however on stimulus the fish swam wildly around the tank, which showed that their reactions were not impaired.

Three of the experimental goby were frozen for later analysis (in Norway) of metabolites, one was left in the sulphide/ anoxia for a further hour and the others were transferred to the control tank where they showed recovery (opercular beats rose to approx. 45 per minute).

Behavioural observations to sulphide exposure

When sulphide is introduced into the water gobies show no violent reaction and there is no apparent avoidance behaviour. Opercular counts slow in a similar way as occurs when hypoxic conditions intensify. Although gobies as a group are known to be tolerant to harsh environmental conditions, this goby species - an open ocean fish found abundantly off the Namibian coast – shows exceptional tolerance to sulphide, which may explain their success in the unique inshore environment off Namibia. Although these and past experiments confirm their remarkable tolerance to sulphide, it remains to be seen whether tolerance limits are determined by anoxia or by sulphide. Further work is planned to investigate the physiological tolerance to sulphide.

3.6. Benthic environment

The diatomaceous muds along the Namibian coast are a result of excessively high phytoplankton production that sinks unutilised onto the shallow, broad shelf. This plentiful supply of organic matter results in anaerobic conditions and rapid bacterial sulphate reduction in the surface sediments to produce high concentrations of hydrogen sulfide. Mats of large sulfur bacteria *Beggiatoa sp.*and *Thiomargarita namibiensis* flourish over large areas of these sediments. Fueled by the underlying sulfide, they efficiently restrict diffusion of this toxic substance into the overlying water by converting sulphide into elemental sulphur microgranules in their cytoplasm, this imparts the white color seen on the sediment surface. Mats of *Beggiatoa* create a narrow (1-2 cm) niche habitat on the mud surface, of severely hypoxic to anoxic, but sulphide-free substrate for a sparse, specialized small-sized fauna, including molluscs, polychaetes, cumaceans, brittle stars, nematodes, foraminiferans and a variety of protozoa.

Gobies have been recorded visually (ROV) resting on these mats; trawl catches confirm their presence in this hostile environment. Multicore samples (approx the upper 20 cm of sediment) were taken at three stations where gobies were found (eagle stations XXXXX) the cores showed the sediment to be extremely soft and soupy with highly sulphidic pore water. All sediment surfaces showed high counts of B*eggiotoa,* coexisting with plentiful *Thiomargarita*. At the shallower station (Station xx 47 m off Sandwich Harbor) small brittle stars and foraminifera were noted in the surface. The cores were sectioned and processed to provide biomass values of the bacteria and sulphide concentrations. The core sections as a spin-off will also provide information on dinoflagellate cysts to complement present HAB research being carried out at NatMIRC.

The mud lens lies east-west over the inner shelf, extending from approximately 50 to 150 m. water depth along its central portion. It is thickest (up to 20m thick) in its central portion at depths of 80 – 120 m. A narrow coastal strip of better oxygenated bottom water and firmer sediment hugs the coast south of Walvis Bay. From depths of > 160 meters westwards, the bottom water hypoxia is not so severe and the sediment becomes firmer.

Stations trawled at both eastern and western margins of the mud indicated a marked increase in faunal diversity, both in number of animals and in animal-size. In the shallower stations off Sandwich Harbour sedentary tubiculous polychaetes (unidentified) were collected from bottom trawls. In the deeper station (diel station) at 183 m benthic species from trawls included sea cucumbers, starfish, whelks, and sea pens. (The bottom was considered unsuitable for coring at this station).

Thus from a goby feeding perspective in the worked area:
Both close inshore < 50 m and offshore >150m benthic food is potentially available. Bottom hypoxia in these areas is present but not severe as sulphide is rarely present, so that energy expenditure associated with prey capture and digestion can be considered realistic.

Over the thick mud lens the bottom hypoxic water layer is severe and wider, and bottom sulphide may be present. Acoustically this layer can be seen to be void of most fauna, indicating unfavorable conditions. Abundant sulphur bacteria cover the surface mud, which provides habitat for limited benthic fauna. However whether the energy expenditure by gobies for feeding/digestion in this hypoxic and sometimes anoxic/sulphidic environment is worthwhile is questionable. The advantage of possibly being able to exploit the available benthic food resource whilst in refuge from predators is obvious.

Preliminary fresh goby gut inspection

To contribute towards investigations of feeding behaviour, preliminary inspection of goby guts – mainly stomachs – was made immediately the fish arrived on board. The focus was only on gobies found in the area overlying the thick sulphidic mud (approx 50m to 150m water depth). In both deeper and shallower areas it is known that there is more oxygen available and vastly increased faunal diversity at the bottom.

Questions:

1. Do the gobies feed (during the day) on the bottom, where oxygen concentrations are minimal? Arguments are that
    a. The oxygen levels are so low over the anoxic muds (where gobies settle during the day) that feeding will be at the cost of valuable energy expenditure to both seeking and digesting food at the bottom
    b. The extreme bottom conditions do not offer much in the way of food
    c. However the bacterial mats
        i. may themselves provide food
        ii. are known to create a niche for a variety of small invertebrates
2. Or do they feed mainly in the water column (during the night) where a more diverse and larger supply of diet items are available, and oxygen usage for digestion is not limiting.

On deck from trawls most gobies were "blown up" from decrease pressure change: most fish had guts pushed out to some extent. Therefore these observations give only an overview of the type of content that was found.

RESULTS

Throughout the size of gobies opened was between 8 and 12 cm Total Length. Gobies were taken from trawl samples and immediately inspected:

Random inspection of guts from gobies taken near CTD stn 20, (also coring stations)

Of 10 gobies opened :

5 empty guts.

3 stomachs contained diatomaceous mud. Of these 2 contained a filamentous net of *Beggiatoa.* (see photographs DSCF0041: *Beggiatoa* trichome; and DSCF0236: *Beggiatoa* trichomes and diatom frustules) One stomach contained a single tiny white bivalve (unidentified).

1 stomach contained a variety of crustacean remains: apparent were euphusiid and amphipod (s) – see picture DSCF0011.

1 contained copepod remains and diatomaceous mud

CTD station 24 (also coring stn): Night approx. 23h

Of 20 gobies opened:

16 empty guts

4 contained diatomaceous mud

CTD station 24; Morning approx 09h

Of 20 guts inspected

14 empty guts

5 with soft white lumps in intestine: no structure apparent ? flesh

1 with soft white lumps and eye (=?fish)

Date 17 Jan Trawl station Bottom gobies ascending

6 empty

5 with diatomaceous mud*

3 with scanty soft white lumps in intestines

6 with diatomaceous mud + white lumps

1 with live polychaetes (microscopic, unidentified)

* Under high magnification: at least 1 gut contained sulphur granule remains of sulphur bacteria: both the round form of *Thiomargarita* as well as the filamentous form of *Beggiotoa* were apparent. Also observed under high magnification were abundant and still live sedentary polychaetes (length approx 3mm), as well as remains of polychaetes (setae). These should be identified. It is possible that more microscopic animals will be found when stomachs are examined under high magnification.

Preliminary conclusions

Gobies living over the diatomaceous mud area consume limited diatomaceous mud. Whether this is whilst seeking specific prey in the mud, or feeding on the sulphur bacteria themselves, is not clear. Only 1 individual's stomach was found to contain a substantial amount of mud knitted together with *Beggiotoa* threads. Because the sulphur bacterial mats – particularly the thick Beggiatoa mats - create a microniche of sulpide-free substrate on which are found numerous micro- and meiofauna, it may be that whilst the gobies are on the bottom they non-selectively feed on the mat. It is unlikely that they depend solely on these bottom fauna for their dietary intake.

It appears that gobies feed indiscriminately and opportunistically, both in the water column and on the bottom.

More samples from mid-night trawls over this area need to be inspected to relate bottom-day to pelagic-night feeding.

Annex I Calibration report

Vessel:	"Dr. Fridtjof Nansen"		Date:	2006.01.11	
Echo sounder:	EK500-1		Locality:	Langstrand	
Transducer:	ES18-B	Sphere:	WC38	Bottom depth:	29 m
Sound vel: 1524 m/s (measured in situ)	r_{sphere}:17,7 m	$T_{sph-dep.}$:20,5 °C, $S_{sph-dep.}$:35,2 ‰		TS_{sphere}: -42,7 dB (correct for sound vel. or t, s)	

TX/RX no: 3	Frequency: 18 kHz	Date previous calibration: 5/8-2005

Settings in sound velocity menu during calibration:

Mean sound velocity between 0 m and sphere depth: 1524 m/s (settings to be optimised according the present conditions)

Setting parameters in transmitter/receiver menu:	Previous values:	Values appeared at this calibration	Values set after calibration
Transducer depth (m) during (has to be 0,0 m during calibration)	0,0	0,0	5,5
Absorption coefficient (dB/km)	3	3	3
Pulse duration (ms)	Short	Short	Short
Band width (kHz)	Wide	Wide	Wide
TX effect ref. transducer terminals (W)	2000	2000	2000
Equivalent beam angle (10 log ψ) (dB)	-17,2	-17,2	-17,2
S_V transducer sensitivity (dB)	23,87	23,90	23,90
TS transducer sensitivity (dB)	23,82	23,86	23,86
Angle sensitivity along ship	13,9	13,9	13,9
Angle sensitivity athwart ship	13,9	13,9	13,9
3 dB beam width along ship (deg)	10,9	10,9	10,9
3 dB beam width athwart ship (deg)	10,7	10,9	10,9
Along ship deviation from centre (deg)	0,04	-0,18	-0,18
Athwart ship deviation from centre (deg)	0,09	-0,05	-0,05

Measured values before any adjustments: (measured with sphere in acoustic axis)

Read TS_{sphere}: -42,7 dB	Read S_A: 394 m²/nmi²

Theoretical S_A in existing sphere depth (m²/nmi²)	388

$$S_A = \frac{\sigma}{r^2 \psi} 1852^2 \qquad \sigma = 4\pi 10^{0.1TS}$$

Read S_A after control/adjustment of S_V transducer sensitivity (m²/nmi²)	385

Remarks: *lowering keel:* *out* *in*

File name: 2006401.018

Weather conditions: ☐very good ☒good ☐bad (tick) Wind speed: 5,8 m/s

In cases where a variance of the transducer sensitivity is > 0,3 dB there has to be searched for possible causes. If no faults can be proven, a new calibration has to be made after relatively short time.

Vessel: "Dr. Fridtjof Nansen"		Date: 2006.01.11	
Echo sounder: EK500-1		Locality: Langstrand	
Transducer: ES38-B	Sphere: WC38	Bottom depth: 29 m	
Sound vel: 1524 m/s (measured in situ)	r_{sphere}:17,6 m	$T_{sph-dep.}$:20,5 °C, $S_{sph-dep.}$:35,2 ‰	TS_{sphere}: -42,4 dB (correct for sound vel. or t, s)

TX/RX no: 1	Frequency: 38 kHz	Date previous calibration: 5/8-2005

Settings in sound velocity menu during calibration:

Mean sound velocity between 0 m and sphere depth: 1524 m/s (settings to be optimised according the present conditions)

Setting parameters in transmitter/receiver menu:	Previous values:	Values appeared at this calibration	Values set after calibration
Transducer depth (m) during (has to be 0,0 m during calibration)	0,0	0,0	5,5
Absorption coefficient (dB/km)	10	10	10
Pulse duration (ms)	Medium	Medium	Medium
Band width (kHz)	Wide	Wide	Wide
TX effect ref. transducer terminals (W)	2000	2000	2000
Equivalent beam angle (10 log ψ) (dB)	-21,0	-21,0	-21,0
S_V transducer sensitivity (dB)	26,91	26,96	26,96
TS transducer sensitivity (dB)	27,05	27,07	27,07
Angle sensitivity along ship	21,9	21,9	21,9
Angle sensitivity athwart ship	21,9	21,9	21,9
3 dB beam width along ship (deg)	7,0	6,9	6,9
3 dB beam width athwart ship (deg)	6,9	6,8	6,8
Along ship deviation from centre (deg)	0,01	-0,07	-0,07
Athwart ship deviation from centre (deg)	0,02	0,08	0,08

Measured values before any adjustments: (measured with sphere in acoustic axis)

Read TS_{sphere}: 42,4 dB	Read S_A: 1024 m^2/nmi^2

Theoretical S_A in existing sphere depth (m^2/nmi^2)	1003

$$S_A = \frac{\sigma}{r^2 \psi} 1852^2 \qquad \sigma = 4\pi 10^{0.1TS}$$

Read S_A after control/adjustment of S_V transducer sensitivity (m^2/nmi^2)	1014

Remarks: *lowering keel:* *out* *in*

File name: 2006401.038

Weather conditions: ☐very good ☒good ☐bad (tick) Wind speed: 5,6 m/s

In cases where a variance of the transducer sensitivity is > 0,3 dB there has to be searched for possible causes. If no faults can be proven, a new calibration has to be made after relatively short time.

Vessel: "Dr. Fridtjof Nansen"		Date: 2006.01.11	
Echo sounder: EK500-1		Locality: Langstrand	
Transducer: ES120-7	Sphere: WC38	Bottom depth: 29 m	
Sound vel: 1524 m/s (measured in situ)	r_{sphere}:17,5 m	$T_{sph-dep.}$:20,5 °C, $S_{sph-dep.}$:35,2 ‰	TS_{sphere}: -39,6 dB (correct for sound vel. or t, s)

TX/RX no: 2	Frequency: 120 kHz	Date previous calibration: 5/8-2005

Settings in sound velocity menu during calibration:

Mean sound velocity between 0 m and sphere depth: 1524 m/s (settings to be optimised according the present conditions)

Setting parameters in transmitter/receiver menu:	Previous values:	Values appeared at this calibration	Values set after calibration
Transducer depth (m) during (has to be 0,0 m during calibration)	0,0	0,0	5,5
Absorption coefficient (dB/km)	38	38	38
Pulse duration (ms)	Long	Long	Long
Band width (kHz)	Narrow	Narrow	Narrow
TX effect ref. transducer terminals (W)	1000	1000	1000
Equivalent beam angle (10 log ψ) (dB)	-20,6	-20,6	-20,6
S_V transducer sensitivity (dB)	25,95	26,23	26,23
TS transducer sensitivity (dB)	26,00	26,38	26,38
Angle sensitivity along ship	21,0	21,0	21,0
Angle sensitivity athwart ship	21,0	21,0	21,0
3 dB beam width along ship (deg)	7,2	7,3	7,3
3 dB beam width athwart ship (deg)	7	7,2	7,2
Along ship deviation from centre (deg)	0,10	-0,18	-0,18
Athwart ship deviation from centre (deg)	-0,06	-0,07	-0,07

Measured values before any adjustments: (measured with sphere in acoustic axis)

Read TS_{sphere}: -39,6 dB	Read S_A: 2020 m^2/nmi^2

Theoretical S_A in existing sphere depth (m^2/nmi^2)	1772

$$S_A = \frac{\sigma}{r^2 \psi} 1852^2 \qquad \sigma = 4\pi 10^{0.1TS}$$

Read S_A after control/adjustment of S_V transducer sensitivity (m^2/nmi^2)	1802

Remarks: *lowering keel: out* *in*

File name: 2006401.120

Weather conditions: ☐very good ☒good ☐bad (tick) Wind speed: 5,6 m/s

In cases where a variance of the transducer sensitivity is > 0,3 dB there has to be searched for possible causes. If no faults can be proven, a new calibration has to be made after relatively short time.

Vessel: "Dr. Fridtjof Nansen"		Date: 08.08.2006	
Echo sounder: EK500-2		Locality: Baia dos Elefantes, Angola	
Transducer: 200-7F	Sphere: WC38	Bottom depth: 30 m	
Sound vel: 1517 m/s (measured in situ)	r_{sphere}:20.0 m	$T_{sph-dep.}$:17.772 °C, $S_{sph-dep.}$:35.741 ‰	TS_{sphere}: -38,9 dB (correct for sound vel. or t, s)

TX/RX no: 1	Frequency: 200 kHz	Date previous calibration: 11.01.2006

Settings in sound velocity menu during calibration:

Mean sound velocity between 0 m and sphere depth: 1524 m/s (settings to be optimised according the present conditions)

Setting parameters in transmitter/receiver menu:	Previous values:	Values appeared at this calibration	Values set after calibration
Transducer depth (m) during (has to be 0,0 m during calibration)	0,0	0,0	5,5
Absorption coefficient (dB/km)	53	53	53
Pulse duration (ms)	Long	Long	Long
Band width (kHz)	Narrow	Narrow	Narrow
TX effect ref. transducer terminals (W)	1000	1000	1000
Equivalent beam angle (10 log ψ) (dB)	-20,5	-20,5	-20,5
S_V transducer sensitivity (dB)	23.82	23.50	23.50
TS transducer sensitivity (dB)	24,80	23.50	23.50
Angle sensitivity along ship			
Angle sensitivity athwart ship			
3 dB beam width along ship (deg)			
3 dB beam width athwart ship (deg)			
Along ship deviation from centre (deg)			
Athwart ship deviation from centre (deg)			

Measured values before any adjustments: (measured with sphere in acoustic axis)

Read TS_{sphere}: -38.9 dB	Read S_A: 1960 m^2/nmi^2

Theoretical S_A in existing sphere depth (m^2/nmi^2)	1558

$$S_A = \frac{\sigma}{r^2 \psi} 1852^2 \qquad \sigma = 4\pi 10^{0.1TS}$$

Read S_A after control/adjustment of S_V transducer sensitivity (m^2/nmi^2)	1540

Remarks: *lowering keel: out* *in*

File name:

Weather conditions: ☒very good ☐good ☐bad (tick) Wind speed: 3.5 m/s

In cases where a variance of the transducer sensitivity is > 0,3 dB there has to be searched for possible causes. If no faults can be proven, a new calibration has to be made after relatively short time.

Vessel: "Dr. Fridtjof Nansen"		Date: 2006.01.11	
Echo sounder: EK500-2		Locality: Langstrand	
Transducer: ES38-D (T.S.)	Sphere: WC38	Bottom depth: 29 m	
Sound vel: 1524 m/s (measured in situ)	r_{sphere}:14,7 m	$T_{sph-dep.}$:20,5 °C, $S_{sph-dep.}$:35,2 ‰	TS_{sphere}: -42,4 dB (correct for sound vel. or t, s)

TX/RX no: 2	Frequency: 38 kHz	Date previous calibration: 14/10-98

Settings in sound velocity menu during calibration:

Mean sound velocity between 0 m and sphere depth: 1524 m/s (settings to be optimised according the present conditions)

Setting parameters in transmitter/receiver menu:	Previous values:	Values appeared at this calibration	Values set after calibration
Transducer depth (m) during (has to be 0,0 m during calibration)	0,0	0,0	0,0
Absorption coefficient (dB/km)	10	10	10
Pulse duration (ms)	Medium	Medium	Medium
Band width (kHz)	Wide	Wide	Wide
TX effect ref. transducer terminals (W)	2000	2000	2000
Equivalent beam angle (10 log ψ) (dB)	-21,0	-21,0	-21,0
S_V transducer sensitivity (dB)			24,72
TS transducer sensitivity (dB)	24,30	24,72	24,72
Angle sensitivity along ship	21,9	21,9	21,9
Angle sensitivity athwart ship	21,9	21,9	21,9
3 dB beam width along ship (deg)	6,7	6,5	6,5
3 dB beam width athwart ship (deg)	6,7	6,4	6,4
Along ship deviation from centre (deg)	-0,02	-0,13	-0,13
Athwart ship deviation from centre (deg)	0,12	-0,15	-0,15

Measured values before any adjustments: (measured with sphere in acoustic axis)

Read TS_{sphere}: dB	Read S_A: m^2/nmi^2

Theoretical S_A in existing sphere depth (m^2/nmi^2)	

$$S_A = \frac{\sigma}{r^2 \psi} 1852^2 \qquad \sigma = 4\pi 10^{0.1TS}$$

Read S_A after control/adjustment of S_V transducer sensitivity (m^2/nmi^2)	

Remarks: *lowering keel: out* *in*

Only lobe calibration was performed. Vessel and transducer movements made it very difficult to measure Sv transducer sensitivity, and to integrate the sphere.

File name:

Weather conditions: ☐very good ☒good ☐bad (tick) Wind speed: 3,9 m/s

In cases where a variance of the transducer sensitivity is > 0,3 dB there has to be searched for possible causes. If no faults can be proven, a new calibration has to be made after relatively short time.

Calibration carried out by: Jan Frode Wilhelmsen, Tore Mørk

Institute of Marine Research, Bergen

Annex II Records of Fishing stations

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1651
DATE:12/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2310
start stop duration Long E 1349
TIME :03:06:20 03:37:26 31 (min) Purpose code: 1
LOG :4155.29 4157.59 2.28 Area code : 2
FDEPTH: 20 20 GearCond.code:
BDEPTH: 157 156 Validity code: 4
Towing dir: 298ø Wire out: 110 m Speed: 40 kn*10

Sorted: Kg Total catch: 4000.00 CATCH/HOUR: 7741.94

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	7741.94		100.00	
Total	7741.94		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1652
DATE:12/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2318
start stop duration Long E 1404
TIME :08:42:20 08:56:54 15 (min) Purpose code: 1
LOG :4186.11 4186.85 0.74 Area code : 2
FDEPTH: 120 120 GearCond.code: 9
BDEPTH: 139 141 Validity code: 9
Towing dir: 298ø Wire out: 330 m Speed: 30 kn*10

Sorted: Kg Total catch: 3007.00 CATCH/HOUR: 12028.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	11200.00		93.12	
Aequorea aequorea	800.00		6.65	
Thyrsites atun	22.48	8	0.19	193
Chelidonichthys queketti	5.72	24	0.05	194
CARTR01	4.32	4	0.04	195
Total	12032.52		100.05	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1653
DATE:12/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2317
start stop duration Long E 1403
TIME :09:01:37 09:17:53 16 (min) Purpose code: 1
LOG :4187.09 4187.88 0.78 Area code : 2
FDEPTH: 103 103 GearCond.code: 9
BDEPTH: 142 144 Validity code: 9
Towing dir: 298ø Wire out: 315 m Speed: 29 kn*10

Sorted: Kg Total catch: CATCH/HOUR:

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
N O C A T C H	0.00			
Total				

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1654
DATE:12/ 1/06 GEAR TYPE: BT No: POSITION:Lat S 2323
start stop duration Long E 1414
TIME :12:02:28 12:04:57 2 (min) Purpose code: 1
LOG :4204.47 4204.52 0.09 Area code : 2
FDEPTH: 117 117 GearCond.code:
BDEPTH: 117 117 Validity code:
Towing dir: 286ø Wire out: 385 m Speed: 30 kn*10

Sorted: Kg Total catch: 88.16 CATCH/HOUR: 2644.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	2100.00		79.40	
Aequorea aequorea	450.00		17.01	
Merluccius capensis, juveniles	84.30	5040	3.19	196
Sufflogobius bibarbatus	9.60	3450	0.36	197
Trachurus capensis, juvenile	0.30	60	0.01	198
Total	2644.20		99.97	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1655
DATE:12/ 1/06 GEAR TYPE: BT No: POSITION:Lat S 2328
start stop duration Long E 1424
TIME :13:57:41 14:07:35 10 (min) Purpose code: 1
LOG :4217.54 4218.01 0.47 Area code : 2
FDEPTH: 47 46 GearCond.code:
BDEPTH: 47 46 Validity code:
Towing dir: 360ø Wire out: 160 m Speed: 30 kn*10

Sorted: Kg Total catch: 208.20 CATCH/HOUR: 1249.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	720.00		57.64	
Chrysaora hysoscella	540.00		43.23	
Merluccius capensis, juveniles	0.72	48	0.06	200
Sufflogobius bibarbatus	0.24	288	0.02	199
Trachurus capensis, juvenile	0.06	6		201
Total	1261.02		100.95	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1656
DATE:12/ 1/06 GEAR TYPE: BT No:15 POSITION:Lat S 2337
start stop duration Long E 1416
TIME :16:03:35 16:21:51 18 (min) Purpose code: 1
LOG :4232.39 4233.33 0.94 Area code : 2
FDEPTH: 110 109 GearCond.code:
BDEPTH: 110 109 Validity code:
Towing dir: 360ø Wire out: 345 m Speed: 30 kn*10

Sorted: 35 Kg Total catch: 543.30 CATCH/HOUR: 1811.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	1571.67		86.78	
Aequorea aequorea	140.67		7.77	
Sufflogobius bibarbatus	66.93	18407	3.70	202
Merluccius capensis, juveniles	28.67	2080	1.58	203
Etrumeus whiteheadi	3.07	53	0.17	204
Total	1811.01		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1657
DATE:12/ 1/06 GEAR TYPE: BT No:15 POSITION:Lat S 2337
start stop duration Long E 1417
TIME :18:56:53 19:04:31 8 (min) Purpose code: 1
LOG :4236.25 4236.48 0.21 Area code : 2
FDEPTH: 106 108 GearCond.code:
BDEPTH: 106 108 Validity code: 4
Towing dir: 215ø Wire out: 320 m Speed: 29 kn*10

Sorted: Kg Total catch: 5000.00 CATCH/HOUR: 37500.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	37500.00		100.00	
Total	37500.00		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1658
DATE:12/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2340
start stop duration Long E 1412
TIME :20:40:17 20:50:11 10 (min) Purpose code: 1
LOG :4243.29 4243.81 0.51 Area code : 2
FDEPTH: 78 78 GearCond.code:
BDEPTH: 137 140 Validity code:
Towing dir: 217ø Wire out: 200 m Speed: 34 kn*10

Sorted: Kg Total catch: 2500.00 CATCH/HOUR: 15000.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	14400.00		96.00	
Aequorea aequorea	600.00	12000	4.00	
Sufflogobius bibarbatus	0.30	102		205
Total	15000.30		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1659
DATE:12/ 1/06 GEAR TYPE: BT No:15 POSITION:Lat S 2353
start stop duration Long E 1402
TIME :23:23:03 23:53:16 30 (min) Purpose code: 1
LOG :4262.66 4264.29 1.63 Area code : 2
FDEPTH: 195 189 GearCond.code:
BDEPTH: 195 189 Validity code:
Towing dir: 40ø Wire out: 606 m Speed: 30 kn*10

Sorted: 45 Kg Total catch: 344.15 CATCH/HOUR: 688.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Trachurus capensis	234.60	2156	34.08	208
Merluccius capensis	183.08	2390	26.60	209
Chrysaora hysoscella	164.68		23.93	
Sardinella aurita	102.42	1000	14.88	207
Sufflogobius bibarbatus	3.52	1460	0.51	206
Total	688.30		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1660
DATE:13/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2401
start stop duration Long E 1413
TIME :02:18:27 02:21:51 3 (min) Purpose code: 1
LOG :4282.03 4282.24 0.18 Area code : 2
FDEPTH: 40 39 GearCond.code: 9
BDEPTH: 123 122 Validity code: 9
Towing dir: 123ø Wire out: 140 m Speed: 40 kn*10

Sorted: Kg Total catch: 360.72 CATCH/HOUR: 7214.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	4800.00		66.53	
Chrysaora hysoscella	2400.00		33.27	
Merluccius capensis, juveniles	5.40	120	0.07	210
C E P H A L O P O D A	2.80	120	0.04	
Total	7208.20		99.91	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1661
DATE:13/ 1/06 GEAR TYPE: BT No:15 POSITION:Lat S 2552
start stop duration Long E 1453
TIME :16:53:09 16:54:26 1 (min) Purpose code: 1
LOG :4409.57 4409.63 0.09 Area code : 2
FDEPTH: 34 34 GearCond.code: 9
BDEPTH: 34 34 Validity code: 9
Towing dir: 184ø Wire out: 150 m Speed: 32 kn*10

Sorted: Kg Total catch: 1000.00 CATCH/HOUR: 60000.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	57000.00		95.00	
Aequorea aequorea	3000.00		5.00	
Total	60000.00		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1662
DATE:13/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2554
start stop duration Long E 1423
TIME :20:36:40 20:45:55 9 (min) Purpose code: 1
LOG :4439.29 4439.87 0.57 Area code : 2
FDEPTH: 35 35 GearCond.code: 9
BDEPTH: 207 205 Validity code: 9
Towing dir: 184ø Wire out: 150 m Speed: 32 kn*10

Sorted: Kg Total catch: 4000.00 CATCH/HOUR: 26666.67

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	26000.00		97.50	
Aequorea aequorea	666.67		2.50	
Total	26666.67		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1663
DATE:14/ 1/06 GEAR TYPE: BT No:15 POSITION:Lat S 2451
start stop duration Long E 1352
TIME :04:48:35 05:09:30 21 (min) Purpose code: 1
LOG :4511.73 4512.83 1.09 Area code : 2
FDEPTH: 228 228 GearCond.code:
BDEPTH: 228 228 Validity code:
Towing dir: 12ø Wire out: 640 m Speed: 32 kn*10

Sorted: 28 Kg Total catch: 582.50 CATCH/HOUR: 1664.29

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	960.00		57.68	
Merluccius capensis	687.14	7509	41.29	212
Pterothrissus belloci	8.49	51	0.51	
Sufflogobius bibarbatus	7.86	926	0.47	211
Austroglossus microlepis	1.74	9	0.10	
Lepidopus caudatus	0.26	26	0.02	
S H R I M P S	0.17	9	0.01	
Total	1665.66		100.08	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1664
DATE:14/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2413
start stop duration Long E 1359
TIME :09:15:07 09:48:07 33 (min) Purpose code: 1
LOG :4549.93 4551.83 1.89 Area code : 2
FDEPTH: 75 150 GearCond.code:
BDEPTH: 218 218 Validity code:
Towing dir: 10ø Wire out: 380 m Speed: 32 kn*10

Sorted: Kg Total catch: 101.40 CATCH/HOUR: 184.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora sp.	135.71		73.61	
Thyrsites atun	35.35	11	19.17	215
Aequorea aequorea	8.00		4.34	
Maurolicus muelleri	4.64	9358	2.52	213
MYCTOPHIDAE	0.58	585	0.31	214
Lepidopus caudatus	0.05	20	0.03	216
Total	184.33		99.98	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1665
DATE:14/ 1/06 GEAR TYPE: BT No:15 POSITION:Lat S 2354
start stop duration Long E 1404
TIME :12:13:30 12:43:17 30 (min) Purpose code: 1
LOG :4570.37 4571.87 1.50 Area code : 2
FDEPTH: 183 180 GearCond.code:
BDEPTH: 183 180 Validity code:
Towing dir: 10ø Wire out: 565 m Speed: 30 kn*10

Sorted: 44 Kg Total catch: 370.80 CATCH/HOUR: 741.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	670.00	9136	90.35	218
J E L L Y F I S H	54.40		7.34	
Sufflogobius bibarbatus	17.20	9446	2.32	217
Total	741.60		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1666
DATE:14/ 1/06 GEAR TYPE: BT No:15 POSITION:Lat S 2338
start stop duration Long E 1407
TIME :15:10:45 15:31:56 21 (min) Purpose code: 1
LOG :4586.60 4587.62 1.01 Area code : 2
FDEPTH: 150 149 GearCond.code: 8
BDEPTH: 150 149 Validity code: 4
Towing dir: 10ø Wire out: 465 m Speed: 30 kn*10

Sorted: 4 Kg Total catch: 4.36 CATCH/HOUR: 12.46

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis	11.77	126	94.46	219
Sufflogobius bibarbatus	0.69	183	5.54	220
Total	12.46		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1668
DATE:16/ 1/06 GEAR TYPE: BT No:16 POSITION:Lat S 2321
start stop duration Long E 1411
TIME :12:28:56 12:35:30 7 (min) Purpose code: 1
LOG :4644.97 4645.28 0.30 Area code : 2
FDEPTH: 123 122 GearCond.code:
BDEPTH: 123 122 Validity code:
Towing dir: 360ø Wire out: 367 m Speed: 30 kn*10

Sorted: Kg Total catch: 291.62 CATCH/HOUR: 2499.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	1681.54	403	67.27	225
Aequorea aequorea	806.14	11854	32.25	224
Sufflogobius bibarbatus	7.37	2786	0.29	222
Merluccius capensis, juveniles	4.54	240	0.18	223
Total	2499.59		99.99	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1669
DATE:16/ 1/06 GEAR TYPE: BT No:16 POSITION:Lat S 2320
start stop duration Long E 1411
TIME :13:19:19 13:27:36 8 (min) Purpose code: 1
LOG :4646.87 4647.24 0.37 Area code : 2
FDEPTH: 122 122 GearCond.code:
BDEPTH: 122 122 Validity code:
Towing dir: 190ø Wire out: 376 m Speed: 30 kn*10

Sorted: Kg Total catch: 177.16 CATCH/HOUR: 1328.70

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	765.00		57.58	
Chrysaora hysoscella	553.20		41.63	
Merluccius capensis, juveniles	8.33	480	0.63	228
Sufflogobius bibarbatus	2.10	698	0.16	226
Trachurus capensis	0.08	15	0.01	227
Total	1328.71		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1670
DATE:16/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2323
start stop duration Long E 1413
TIME :17:40:57 17:56:27 16 (min) Purpose code: 1
LOG :4660.65 4661.52 0.87 Area code : 2
FDEPTH: 98 98 GearCond.code:
BDEPTH: 119 117 Validity code:
Towing dir: 142ø Wire out: 265 m Speed: 32 kn*10

Sorted: Kg Total catch: 133.00 CATCH/HOUR: 498.75

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	471.38	33821	94.51	233
Chrysaora hysoscella	27.38	11	5.49	
Total	498.76		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1671
DATE:16/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2324
start stop duration Long E 1414
TIME :17:59:34 18:14:27 15 (min) Purpose code: 1
LOG :4661.70 4662.54 0.83 Area code : 2
FDEPTH: 98 98 GearCond.code:
BDEPTH: 116 114 Validity code:
Towing dir: 142ø Wire out: 265 m Speed: 32 kn*10

Sorted: 6 Kg Total catch: 6.37 CATCH/HOUR: 25.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	19.32	4	75.82	
Merluccius capensis, juveniles	3.56	252	13.97	231
Aequorea aequorea	1.52	24	5.97	
Sufflogobius bibarbatus	1.04	384	4.08	232
S H R I M P S	0.04	4	0.16	
Total	25.48		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1672
DATE:16/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2325
start stop duration Long E 1415
TIME :18:18:29 18:33:27 15 (min) Purpose code: 1
LOG :4662.77 4663.65 0.86 Area code : 2
FDEPTH: 98 98 GearCond.code:
BDEPTH: 113 110 Validity code:
Towing dir: 142ø Wire out: 265 m Speed: 32 kn*10

Sorted: 9 Kg Total catch: 8.54 CATCH/HOUR: 34.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	32.32	9020	94.61	230
Merluccius capensis, juveniles	1.20	68	3.51	229
Aequorea aequorea	0.64	12	1.87	
Total	34.16		99.99	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1673
DATE:16/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2324
start stop duration Long E 1414
TIME :20:05:59 20:10:09 4 (min) Purpose code: 1
LOG :4667.20 4667.44 0.25 Area code : 2
FDEPTH: 50 50 GearCond.code:
BDEPTH: 116 117 Validity code:
Towing dir: 319ø Wire out: 170 m Speed: 34 kn*10

Sorted: Kg Total catch: 451.62 CATCH/HOUR: 6774.30

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	4305.00	630	63.55	
Aequorea aequorea	2460.00	25350	36.31	236
Merluccius capensis, juveniles	6.75	465	0.10	235
Sufflogobius bibarbatus	2.55	1260	0.04	234
Total	6774.30		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1674
DATE:16/ 1/06 GEAR TYPE: BT No:16 POSITION:Lat S 2323
start stop duration Long E 1412
TIME :21:08:41 21:27:18 19 (min) Purpose code: 1
LOG :4669.75 4670.72 0.97 Area code : 2
FDEPTH: 121 122 GearCond.code:
BDEPTH: 121 122 Validity code:
Towing dir: 320ø Wire out: 380 m Speed: 30 kn*10

Sorted: Kg Total catch: 103.63 CATCH/HOUR: 327.25

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	189.47	1535	57.90	241
Chrysaora hysoscella	136.93	57	41.84	240
Merluccius capensis, juveniles	0.95	57	0.29	239
Sufflogobius bibarbatus	0.03	13	0.01	238
Trachurus capensis	0.03	3	0.01	237
Total	327.41		100.05	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1675
DATE:16/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2321
start stop duration Long E 1411
TIME :22:44:06 22:58:36 15 (min) Purpose code: 1
LOG :4673.37 4674.15 0.77 Area code : 2
FDEPTH: 98 100 GearCond.code:
BDEPTH: 123 123 Validity code:
Towing dir: 320ø Wire out: 250 m Speed: 35 kn*10

Sorted: Kg Total catch: 7.74 CATCH/HOUR: 30.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	26.96		87.08	
Aequorea aequorea	2.48		8.01	
Merluccius capensis, juveniles	0.84	60	2.71	244
Sufflogobius bibarbatus	0.60	188	1.94	243
C E P H A L O P O D A	0.08	4	0.26	
Total	30.96		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1676
DATE:16/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2322
start stop duration Long E 1411
TIME :23:01:07 23:15:42 15 (min) Purpose code: 1
LOG :4674.29 4675.09 0.80 Area code : 2
FDEPTH: 100 100 GearCond.code:
BDEPTH: 123 123 Validity code:
Towing dir: 320ø Wire out: 250 m Speed: 34 kn*10

Sorted: Kg Total catch: 2.23 CATCH/HOUR: 8.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	7.52	2972	84.30	245
Merluccius capensis, juveniles	0.80	48	8.97	246
Aequorea aequorea	0.60	8	6.73	
Total	8.92		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1677
DATE:16/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2323
start stop duration Long E 1412
TIME :23:19:06 23:33:42 15 (min) Purpose code: 1
LOG :4675.28 4676.08 0.79 Area code : 2
FDEPTH: 100 100 GearCond.code:
BDEPTH: 123 123 Validity code:
Towing dir: 160ø Wire out: 250 m Speed: 34 kn*10

Sorted: Kg Total catch: 1.00 CATCH/HOUR: 4.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	2.52	792	63.00	247
Merluccius capensis, juveniles	0.80	48	20.00	248
Aequorea aequorea	0.64	12	16.00	
Total	3.96		99.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1678
DATE:17/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2322
start stop duration Long E 1411
TIME :01:54:06 01:58:20 4 (min) Purpose code: 1
LOG :4679.15 4679.37 0.21 Area code : 2
FDEPTH: 40 0 GearCond.code:
BDEPTH: 124 124 Validity code:
Towing dir: 340ø Wire out: 110 m Speed: 35 kn*10

Sorted: Kg Total catch: 548.30 CATCH/HOUR: 8224.50

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	4473.00		54.39	
Aequorea aequorea	3592.50	48285	43.68	250
J E L L Y F I S H	82.50	60	1.00	
Merluccius capensis, juveniles	72.15	4590	0.88	249
C E P H A L O P O D A	3.75	135	0.05	
Total	8223.90		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1679
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2321
start stop duration Long E 1411
TIME :03:50:33 04:05:03 15 (min) Purpose code: 1
LOG :4683.18 4684.00 0.81 Area code : 2
FDEPTH: 95 95 GearCond.code:
BDEPTH: 124 124 Validity code:
Towing dir: 160ø Wire out: 258 m Speed:340 kn*10

Sorted: Kg Total catch: 2.02 CATCH/HOUR: 8.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	4.36	1500	53.96	251
Aequorea aequorea	3.68	16	45.54	252
S H R I M P S	0.04	4	0.50	
Total	8.08		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1680
DATE:17/ 1/06 GEAR TYPE: OT No: 2 POSITION:Lat S 2322
start stop duration Long E 1411
TIME :04:08:38 04:23:46 15 (min) Purpose code: 1
LOG :4684.19 4685.05 0.86 Area code : 2
FDEPTH: 95 95 GearCond.code:
BDEPTH: 124 125 Validity code:
Towing dir: 160ø Wire out: 260 m Speed: 34 kn*10

Sorted: Kg Total catch: 2.77 CATCH/HOUR: 11.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	10.32	3612	93.14	253
Aequorea aequorea	0.60	16	5.42	
Merluccius capensis, juveniles	0.12	8	1.08	
S H R I M P S	0.04	4	0.36	
Total	11.08		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1681
DATE:17/ 1/06 GEAR TYPE: OT No: 2 POSITION:Lat S 2323
start stop duration Long E 1412
TIME :04:26:44 04:41:45 15 (min) Purpose code: 1
LOG :4685.22 4686.06 0.84 Area code : 2
FDEPTH: 95 97 GearCond.code:
BDEPTH: 124 124 Validity code:
Towing dir: 160ø Wire out: 270 m Speed: 35 kn*10

Sorted: Kg Total catch: 29.17 CATCH/HOUR: 116.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	110.64		94.82	
Merluccius capensis, juveniles	5.12	324	4.39	254
Aequorea aequorea	0.80	16	0.69	
Sufflogobius bibarbatus	0.12	36	0.10	255
Total	116.68		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1682
DATE:17/ 1/06 GEAR TYPE: BT No:16 POSITION:Lat S 2323
start stop duration Long E 1412
TIME :08:28:19 08:42:58 15 (min) Purpose code: 1
LOG :4692.25 4692.96 0.69 Area code : 2
FDEPTH: 122 121 GearCond.code:
BDEPTH: 122 121 Validity code:
Towing dir: 7ø Wire out: 370 m Speed: 32 kn*10

Sorted: Kg Total catch: 158.70 CATCH/HOUR: 634.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	317.60		50.03	
Aequorea aequorea	303.20	4508	47.76	257
Sufflogobius bibarbatus	12.80	4040	2.02	256
Merluccius capensis, juveniles	1.20	80	0.19	258
Total	634.80		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1683
DATE:17/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2323
start stop duration Long E 1412
TIME :09:40:57 09:56:10 15 (min) Purpose code: 1
LOG :4694.94 4695.84 0.89 Area code : 2
FDEPTH: 75 25 GearCond.code:
BDEPTH: 121 121 Validity code:
Towing dir: 150ø Wire out: 150 m Speed: 33 kn*10

Sorted: Kg Total catch: 31.61 CATCH/HOUR: 126.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	93.36		73.84	261
Chrysaora hysoscella	31.68	20	25.06	260
Merluccius capensis, juveniles	1.40	104	1.11	259
C E P H A L O P O D A	0.00	8		
Total	126.44		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1684
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2323
start stop duration Long E 1413
TIME :13:05:11 13:20:10 15 (min) Purpose code: 1
LOG :4699.45 4700.24 0.79 Area code : 2
FDEPTH: 98 100 GearCond.code:
BDEPTH: 121 122 Validity code:
Towing dir: 330ø Wire out: 250 m Speed: 35 kn*10

Sorted: Kg Total catch: 1.34 CATCH/HOUR: 5.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	4.88		91.04	
Merluccius capensis, juveniles	0.48	36	8.96	262
Total	5.36		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1685
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2322
start stop duration Long E 1412
TIME :13:24:02 13:38:39 15 (min) Purpose code: 1
LOG :4700.45 4701.22 0.77 Area code : 2
FDEPTH: 100 100 GearCond.code:
BDEPTH: 122 123 Validity code:
Towing dir: 330ø Wire out: 250 m Speed: 34 kn*10

Sorted: Kg Total catch: 3.89 CATCH/HOUR: 15.56

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	11.60	8	74.55	
Aequorea aequorea	3.04		19.54	
Merluccius capensis, juveniles	0.76	52	4.88	263
Total	15.40		98.97	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1686
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2321
start stop duration Long E 1412
TIME :13:42:29 13:57:29 15 (min) Purpose code: 1
LOG :4701.43 4702.23 0.80 Area code : 2
FDEPTH: 100 100 GearCond.code:
BDEPTH: 122 122 Validity code:
Towing dir: 330ø Wire out: 250 m Speed: 34 kn*10

Sorted: Kg Total catch: 2.67 CATCH/HOUR: 10.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	9.36	4	87.64	
Aequorea aequorea	0.80		7.49	
Merluccius capensis, juveniles	0.52	32	4.87	264
Total	10.68		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1687
DATE:17/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2321
start stop duration Long E 1412
TIME :14:53:25 15:07:02 14 (min) Purpose code: 1
LOG :4704.57 4705.38 0.80 Area code : 2
FDEPTH: 100 65 GearCond.code:
BDEPTH: 122 122 Validity code:
Towing dir: 330ø Wire out: 250 m Speed: 35 kn*10

Sorted: Kg Total catch: 2200.00 CATCH/HOUR: 9428.57

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	9081.43	108647	96.32	266
Chrysaora hysoscella	346.11	69	3.67	267
Merluccius capensis, juveniles	0.56	39	0.01	265
Total	9428.10		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1688
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2323
start stop duration Long E 1413
TIME :17:36:37 17:51:38 15 (min) Purpose code: 1
LOG :4710.86 4711.69 0.82 Area code : 2
FDEPTH: 95 95 GearCond.code:
BDEPTH: 121 121 Validity code:
Towing dir: 335ø Wire out: 270 m Speed: 33 kn*10

Sorted: Kg Total catch: 1.49 CATCH/HOUR: 5.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	3.88	60	65.10	268
Merluccius capensis, juveniles	1.80	120	30.20	269
Sufflogobius bibarbatus	0.28	84	4.70	
Total	5.96		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1689
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2322
start stop duration Long E 1412
TIME :17:56:33 18:11:30 15 (min) Purpose code: 1
LOG :4711.97 4712.80 0.83 Area code : 2
FDEPTH: 95 99 GearCond.code:
BDEPTH: 121 121 Validity code:
Towing dir: 335ø Wire out: 270 m Speed: 33 kn*10

Sorted: Kg Total catch: 0.72 CATCH/HOUR: 2.88

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	1.96	116	68.06	273
Aequorea aequorea	0.56	16	19.44	
Sufflogobius bibarbatus	0.28	384	9.72	272
S H R I M P S	0.08	72	2.78	271
Total	2.88		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1690
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2321
start stop duration Long E 1412
TIME :18:16:31 18:31:32 15 (min) Purpose code: 1
LOG :4713.08 4713.91 0.82 Area code : 2
FDEPTH: 96 97 GearCond.code:
BDEPTH: 122 121 Validity code:
Towing dir: 335ø Wire out: 270 m Speed: 33 kn*10

Sorted: Kg Total catch: 0.86 CATCH/HOUR: 3.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	1.92	280	55.81	270
Aequorea aequorea	1.04	12	30.23	
Merluccius capensis, juveniles	0.48	24	13.95	274
Total	3.44		99.99	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1691
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2320
start stop duration Long E 1411
TIME :21:22:51 21:37:58 15 (min) Purpose code: 1
LOG :4717.57 4718.42 0.84 Area code : 2
FDEPTH: 95 97 GearCond.code:
BDEPTH: 121 123 Validity code:
Towing dir: 243ø Wire out: 270 m Speed: 34 kn*10

Sorted: Kg Total catch: 16.96 CATCH/HOUR: 67.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	63.36		93.40	
Merluccius capensis, juveniles	4.36	340	6.43	276
Sufflogobius bibarbatus	0.12	44	0.18	275
Total	67.84		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1692
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2320
start stop duration Long E 1410
TIME :21:42:38 21:57:41 15 (min) Purpose code: 1
LOG :4718.68 4719.49 0.80 Area code : 2
FDEPTH: 98 100 GearCond.code:
BDEPTH: 124 126 Validity code:
Towing dir: 243ø Wire out: 280 m Speed: 34 kn*10

Sorted: Kg Total catch: 168.44 CATCH/HOUR: 673.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	576.96		85.63	
Aequorea aequorea	62.60		9.29	
Merluccius capensis, juveniles	31.12	2124	4.62	278
Sufflogobius bibarbatus	3.08	1040	0.46	277
Total	673.76		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1693
DATE:17/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2321
start stop duration Long E 1409
TIME :22:05:16 22:19:49 15 (min) Purpose code: 1
LOG :4719.89 4720.62 0.73 Area code : 2
FDEPTH: 100 100 GearCond.code:
BDEPTH: 127 129 Validity code:
Towing dir: 243ø Wire out: 250 m Speed: 35 kn*10

Sorted: Kg Total catch: 277.90 CATCH/HOUR: 1111.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	1004.60		90.37	
Sufflogobius bibarbatus	59.32	18600	5.34	279
Aequorea aequorea	31.24		2.81	
Merluccius capensis, juveniles	16.32	1092	1.47	280
Total	1111.48		99.99	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1694
DATE:18/ 1/06 GEAR TYPE: BT No:16 POSITION:Lat S 2320
start stop duration Long E 1408
TIME :01:54:58 01:59:33 5 (min) Purpose code: 1
LOG :4725.90 4726.11 0.20 Area code : 2
FDEPTH: 128 127 GearCond.code:
BDEPTH: 128 127 Validity code:
Towing dir: 60ø Wire out: 390 m Speed: 30 kn*10

Sorted: Kg Total catch: 271.40 CATCH/HOUR: 3256.80

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	2160.00		66.32	
Aequorea aequorea	1080.00		33.16	
Sardinops ocellatus	5.88	60	0.18	285
REGALECIDAE	4.56	12	0.14	286
Sufflogobius bibarbatus	4.44	1656	0.14	281
Merluccius capensis, juveniles	1.80	108	0.06	282
Engraulis capensis	0.12	12		284
Trachurus capensis	0.12	12		283
Total	3256.92		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1695
DATE:18/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2320
start stop duration Long E 1409
TIME :03:50:45 04:05:42 15 (min) Purpose code: 1
LOG :4729.74 4730.53 0.79 Area code : 2
FDEPTH: 105 105 GearCond.code:
BDEPTH: 126 124 Validity code:
Towing dir: 60ø Wire out: 270 m Speed: 32 kn*10

Sorted: Kg Total catch: 1.12 CATCH/HOUR: 4.48

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	2.44	144	54.46	290
Sufflogobius bibarbatus	2.04	524	45.54	289
Total	4.48		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1696
DATE:18/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2320
start stop duration Long E 1410
TIME :04:10:23 04:25:22 15 (min) Purpose code: 1
LOG :4730.78 4731.56 0.77 Area code : 2
FDEPTH: 102 100 GearCond.code:
BDEPTH: 124 122 Validity code:
Towing dir: 60ø Wire out: 270 m Speed: 32 kn*10

Sorted: Kg Total catch: 43.52 CATCH/HOUR: 174.08

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	166.16	1168	95.45	292
Merluccius capensis, juveniles	6.52	396	3.75	291
Aequorea aequorea	0.88		0.51	
Sufflogobius bibarbatus	0.48	136	0.28	287
S H R I M P S	0.04	16	0.02	288
Total	174.08		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1697
DATE:18/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2320
start stop duration Long E 1412
TIME :04:30:16 04:45:16 15 (min) Purpose code: 1
LOG :4731.82 4732.61 0.78 Area code : 2
FDEPTH: 100 100 GearCond.code:
BDEPTH: 122 120 Validity code:
Towing dir: 60ø Wire out: 270 m Speed: 32 kn*10

Sorted: Kg Total catch: 205.36 CATCH/HOUR: 821.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	820.00		99.82	294
Merluccius capensis, juveniles	1.52	88	0.19	293
Total	821.52		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1698
DATE:18/ 1/06 GEAR TYPE: BT No:16 POSITION:Lat S 2258
start stop duration Long E 1419
TIME :08:50:16 08:59:43 9 (min) Purpose code: 1
LOG :4759.45 4759.88 0.42 Area code : 2
FDEPTH: 78 75 GearCond.code:
BDEPTH: 78 75 Validity code:
Towing dir: 4ø Wire out: 220 m Speed: 30 kn*10

Sorted: Kg Total catch: 225.54 CATCH/HOUR: 1503.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	1230.00		81.80	
Aequorea aequorea	273.33		18.18	
Sufflogobius bibarbatus	0.13	27	0.01	296
Trachurus capensis	0.13	47	0.01	295
Total	1503.59		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1699
DATE:18/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2304
start stop duration Long E 1334
TIME :14:48:27 14:51:08 3 (min) Purpose code: 1
LOG :4805.24 4805.37 0.12 Area code : 2
FDEPTH: 145 120 GearCond.code:
BDEPTH: 163 163 Validity code:
Towing dir: 350ø Wire out: 366 m Speed: 35 kn*10

Sorted: Kg Total catch: 1000.00 CATCH/HOUR: 20000.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Aequorea aequorea	12300.00		61.50	
Chrysaora hysoscella	7700.00		38.50	
Total	20000.00		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1700
DATE:18/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2332
start stop duration Long E 1345
TIME :20:13:37 21:04:06 29 (min) Purpose code: 1
LOG :4847.31 4848.92 1.60 Area code : 2
FDEPTH: 156 23 GearCond.code:
BDEPTH: 176 179 Validity code:
Towing dir: 170ø Wire out: 380 m Speed: 35 kn*10

Sorted: Kg Total catch: 222.17 CATCH/HOUR: 459.66

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	446.69		97.18	
Sufflogobius bibarbatus	10.22	2261	2.22	297
Merluccius capensis, juveniles	1.53	27	0.33	298
C E P H A L O P O D A	0.91	27	0.20	
Maurolicus muelleri	0.06	91	0.01	299
Lepidopus caudatus	0.02	14		
Total	459.43		99.94	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1701
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2332
start stop duration Long E 1345
TIME :00:10:40 00:25:30 15 (min) Purpose code: 1
LOG :4854.03 4854.75 0.72 Area code : 2
FDEPTH: 150 152 GearCond.code:
BDEPTH: 177 178 Validity code:
Towing dir: 180ø Wire out: 360 m Speed: 30 kn*10

Sorted: Kg Total catch: 13.85 CATCH/HOUR: 55.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	53.36		96.32	
Sufflogobius bibarbatus	1.36	472	2.45	300
Merluccius capensis, juveniles	0.56	12	1.01	301
C E P H A L O P O D A	0.12	8	0.22	
Total	55.40		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1702
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2332
start stop duration Long E 1345
TIME :00:30:23 00:45:15 15 (min) Purpose code: 1
LOG :4854.99 4855.73 0.73 Area code : 2
FDEPTH: 152 150 GearCond.code:
BDEPTH: 179 180 Validity code:
Towing dir: 180ø Wire out: 360 m Speed: 30 kn*10

Sorted: Kg Total catch: 24.42 CATCH/HOUR: 97.68

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	92.00		94.19	
Sufflogobius bibarbatus	5.68	992	5.81	302
Total	97.68		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1703
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1345
TIME :00:50:25 01:05:12 15 (min) Purpose code: 1
LOG :4855.98 4856.70 0.72 Area code : 2
FDEPTH: 150 150 GearCond.code:
BDEPTH: 181 183 Validity code:
Towing dir: 180ø Wire out: 360 m Speed: 30 kn*10

Sorted: Kg Total catch: 8.53 CATCH/HOUR: 34.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	23.28	4928	68.23	303
Chrysaora hysoscella	10.64	8	31.18	
Merluccius capensis, juveniles	0.20	4	0.59	304
Total	34.12		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1704
DATE:19/ 1/06 GEAR TYPE: PT No: 1 POSITION:Lat S 2333
start stop duration Long E 1345
TIME :02:18:42 02:29:50 11 (min) Purpose code: 1
LOG :4860.46 4861.13 0.67 Area code : 2
FDEPTH: 160 90 GearCond.code:
BDEPTH: 181 179 Validity code:
Towing dir: 360ø Wire out: 350 m Speed: 40 kn*10

Sorted: Kg Total catch: 171.20 CATCH/HOUR: 933.82

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	860.45		92.14	
Sufflogobius bibarbatus	52.80	13369	5.65	305
Aequorea aequorea	19.36		2.07	
Maurolicus muelleri	0.49		0.05	
C E P H A L O P O D A	0.44		0.05	
Merluccius capensis, juveniles	0.38	5	0.04	306
Total	933.92		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1705
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1345
TIME :03:50:42 04:05:28 15 (min) Purpose code: 1
LOG :4865.43 4866.21 0.78 Area code : 2
FDEPTH: 165 160 GearCond.code:
BDEPTH: 180 178 Validity code:
Towing dir: 360ø Wire out: 400 m Speed: 35 kn*10

Sorted: Kg Total catch: 30.30 CATCH/HOUR: 121.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	100.24	15472	82.71	307
Chrysaora hysoscella	20.48		16.90	
Merluccius capensis, juveniles	0.48	12	0.40	308
Total	121.20		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1706
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2332
start stop duration Long E 1345
TIME :04:10:43 04:25:47 15 (min) Purpose code: 1
LOG :4866.49 4867.30 0.81 Area code : 2
FDEPTH: 160 155 GearCond.code:
BDEPTH: 177 176 Validity code:
Towing dir: 360ø Wire out: 400 m Speed: 32 kn*10

Sorted: Kg Total catch: 3.43 CATCH/HOUR: 13.72

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	10.56	2424	76.97	309
Merluccius capensis, juveniles	3.00	48	21.87	310
C E P H A L O P O D A	0.16	4	1.17	
Total	13.72		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1707
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2331
start stop duration Long E 1345
TIME :04:30:40 04:45:42 15 (min) Purpose code: 1
LOG :4867.56 4868.37 0.81 Area code : 2
FDEPTH: 155 155 GearCond.code:
BDEPTH: 176 174 Validity code:
Towing dir: 360ø Wire out: 400 m Speed: 34 kn*10

Sorted: Kg Total catch: 19.71 CATCH/HOUR: 78.84

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	72.04		91.37	
Sufflogobius bibarbatus	4.20	648	5.33	311
Merluccius capensis, juveniles	1.60	24	2.03	312
C E P H A L O P O D A	0.96	36	1.22	
Lepidopus caudatus	0.04	4	0.05	
Total	78.84		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1708
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2331
start stop duration Long E 1344
TIME :06:25:37 06:42:23 17 (min) Purpose code: 1
LOG :4871.79 4872.71 0.92 Area code : 2
FDEPTH: 156 105 GearCond.code:
BDEPTH: 177 180 Validity code:
Towing dir: 360ø Wire out:4872 m Speed:230 kn*10

Sorted: Kg Total catch: 51.39 CATCH/HOUR: 181.38

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	159.11		87.72	
Todaropsis eblanae	12.35	427	6.81	313
Aequorea aequorea	9.92	74	5.47	
Total	181.38		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1709
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1344
TIME :06:45:30 06:58:28 13 (min) Purpose code: 1
LOG :4872.86 4873.59 0.73 Area code : 2
FDEPTH: 105 70 GearCond.code:
BDEPTH: 180 181 Validity code:
Towing dir: 360ø Wire out: 250 m Speed: 32 kn*10

Sorted: Kg Total catch: 12.87 CATCH/HOUR: 59.40

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	45.42		76.46	
Aequorea aequorea	12.55	203	21.13	
Todaropsis eblanae	1.43	51	2.41	
Total	59.40		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1710
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1344
TIME :06:59:15 07:14:09 15 (min) Purpose code: 1
LOG :4873.64 4874.55 0.91 Area code : 2
FDEPTH: 70 19 GearCond.code:
BDEPTH: 182 184 Validity code:
Towing dir: 360ø Wire out: 60 m Speed: 38 kn*10

Sorted: Kg Total catch: 8.84 CATCH/HOUR: 35.36

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	25.64		72.51	
Aequorea aequorea	8.48	76	23.98	
Todaropsis eblanae	1.24	44	3.51	314
Total	35.36		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1711
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2335
start stop duration Long E 1345
TIME :10:41:13 10:56:36 15 (min) Purpose code: 1
LOG :4878.10 4878.83 0.72 Area code : 2
FDEPTH: 155 160 GearCond.code:
BDEPTH: 183 181 Validity code:
Towing dir: 360ø Wire out: 380 m Speed: 30 kn*10

Sorted: Kg Total catch: 175.94 CATCH/HOUR: 703.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	688.80		97.87	
Todaropsis eblanae	14.92		2.12	
Maurolicus muelleri	0.04		0.01	
Total	703.76		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1712
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2334
start stop duration Long E 1345
TIME :11:01:57 11:16:52 15 (min) Purpose code: 1
LOG :4879.10 4879.81 0.71 Area code : 2
FDEPTH: 160 160 GearCond.code:
BDEPTH: 180 179 Validity code:
Towing dir: 360ø Wire out: 380 m Speed: 30 kn*10

Sorted: Kg Total catch: 0.05 CATCH/HOUR: 0.20

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
C E P H A L O P O D A	0.16		80.00	
S H R I M P S	0.04	96	20.00	315
Maurolicus muelleri	0.00			
Total	0.20		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1713
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1345
TIME :11:21:23 11:36:34 15 (min) Purpose code: 1
LOG :4880.03 4880.78 0.75 Area code : 2
FDEPTH: 160 155 GearCond.code:
BDEPTH: 178 177 Validity code:
Towing dir: 360ø Wire out: 380 m Speed: 30 kn*10

Sorted: Kg Total catch: 3.78 CATCH/HOUR: 15.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Thyrsites atun	14.00	4	92.59	316
Merluccius capensis, juveniles	1.04	16	6.88	317
C E P H A L O P O D A	0.16		1.06	
Total	15.20		100.53	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1714
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2332
start stop duration Long E 1345
TIME :12:29:08 12:44:12 15 (min) Purpose code: 1
LOG :4882.59 4883.47 0.87 Area code : 2
FDEPTH: 150 110 GearCond.code:
BDEPTH: 176 179 Validity code:
Towing dir: 180ø Wire out: 380 m Speed: 35 kn*10

Sorted: Kg Total catch: 99.90 CATCH/HOUR: 399.60

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	386.00		96.60	
Aequorea aequorea	12.40		3.10	
C E P H A L O P O D A	0.96	36	0.24	
Total	399.36		99.94	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1715
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1345
TIME :12:44:56 13:02:54 18 (min) Purpose code: 1
LOG :4883.51 4884.38 0.86 Area code : 2
FDEPTH: 108 70 GearCond.code:
BDEPTH: 179 181 Validity code:
Towing dir: 180ø Wire out: 210 m Speed: 35 kn*10

Sorted: Kg Total catch: 6.80 CATCH/HOUR: 22.67

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Maurolicus muelleri	19.97	51203	88.09	318
Aequorea aequorea	2.40		10.59	
Total	22.37		98.68	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1716
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2334
start stop duration Long E 1345
TIME :13:08:30 13:27:37 19 (min) Purpose code: 1
LOG :4884.60 4885.60 1.00 Area code : 2
FDEPTH: 70 20 GearCond.code:
BDEPTH: 182 185 Validity code:
Towing dir: 180ø Wire out: 80 m Speed: 35 kn*10

Sorted: Kg Total catch: 350.00 CATCH/HOUR: 1105.26

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	1105.26		100.00	
Total	1105.26		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1717
DATE:19/ 1/06 GEAR TYPE: BT No:14 POSITION:Lat S 2334
start stop duration Long E 1345
TIME :15:28:24 15:58:10 30 (min) Purpose code: 1
LOG :4888.00 4889.56 1.56 Area code : 2
FDEPTH: 182 179 GearCond.code:
BDEPTH: 182 179 Validity code:
Towing dir: 360ø Wire out: 545 m Speed: 30 kn*10

Sorted: Kg Total catch: 251.59 CATCH/HOUR: 503.18

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Sufflogobius bibarbatus	331.36	65014	65.85	320
Chrysaora hysoscella	148.62		29.54	
MERME01	22.60	302	4.49	319
S H R I M P S	0.60	22	0.12	
Total	503.18		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1718
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1346
TIME :17:37:33 17:53:03 16 (min) Purpose code: 1
LOG :4892.13 4892.97 0.82 Area code : 2
FDEPTH: 154 154 GearCond.code:
BDEPTH: 179 180 Validity code:
Towing dir: 185ø Wire out:4893 m Speed:230 kn*10

Sorted: Kg Total catch: 4.80 CATCH/HOUR: 18.00

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	15.08	4	83.78	
Aequorea aequorea	2.74		15.22	
Merluccius capensis, juveniles	0.19	4	1.06	
Total	18.01		100.06	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1719
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2334
start stop duration Long E 1346
TIME :17:58:37 18:13:41 15 (min) Purpose code: 1
LOG :4893.26 4894.08 0.81 Area code : 2
FDEPTH: 154 154 GearCond.code:
BDEPTH: 181 183 Validity code:
Towing dir: 180ø Wire out: 405 m Speed: 32 kn*10

Sorted: Kg Total catch: 0.74 CATCH/HOUR: 2.96

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	2.96	40	100.00	
Total	2.96		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1720
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2335
start stop duration Long E 1346
TIME :18:18:40 18:33:43 15 (min) Purpose code: 1
LOG :4894.35 4895.16 0.79 Area code : 2
FDEPTH: 154 162 GearCond.code:
BDEPTH: 183 185 Validity code:
Towing dir: 180ø Wire out: 405 m Speed: 32 kn*10

Sorted: Kg Total catch: 1.69 CATCH/HOUR: 6.76

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	6.72	96	99.41	321
Sufflogobius bibarbatus	0.12		1.78	
Total	6.84		101.19	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1721
DATE:19/ 1/06 GEAR TYPE: BT No:14 POSITION:Lat S 2335
start stop duration Long E 1346
TIME :19:48:31 20:18:14 30 (min) Purpose code: 1
LOG :4897.52 4899.17 1.63 Area code : 2
FDEPTH: 180 176 GearCond.code:
BDEPTH: 180 176 Validity code:
Towing dir: 360ø Wire out: 530 m Speed: 32 kn*10

Sorted: Kg Total catch: 118.26 CATCH/HOUR: 236.52

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	185.80	2694	78.56	323
Sufflogobius bibarbatus	50.32	6554	21.28	322
Maurolicus muelleri	0.26		0.11	
S H R I M P S	0.10	6	0.04	
Lepidopus caudatus	0.02	4	0.01	
Lophius vomerinus	0.02	2	0.01	
Total	236.52		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1722
DATE:19/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2332
start stop duration Long E 1346
TIME :23:24:36 23:39:44 15 (min) Purpose code: 1
LOG :4904.01 4904.88 0.87 Area code : 2
FDEPTH: 150 110 GearCond.code:
BDEPTH: 174 176 Validity code:
Towing dir: 180ø Wire out: 380 m Speed: 35 kn*10

Sorted: Kg Total catch: 55.57 CATCH/HOUR: 222.28

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	216.16		97.25	
Aequorea aequorea	4.48		2.02	
Sufflogobius bibarbatus	0.80	424	0.36	325
Merluccius capensis, juveniles	0.44	4	0.20	324
Maurolicus muelleri	0.04	8	0.02	
Todaropsis eblanae	0.04	12	0.02	
Total	221.96		99.87	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1723
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1346
TIME :23:44:19 00:00:34 16 (min) Purpose code: 1
LOG :4905.02 4905.91 0.89 Area code : 2
FDEPTH: 110 70 GearCond.code:
BDEPTH: 176 179 Validity code:
Towing dir: 180ø Wire out: 200 m Speed: 35 kn*10

Sorted: Kg Total catch: 58.59 CATCH/HOUR: 219.71

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	214.05		97.42	
Aequorea aequorea	4.20		1.91	
Todaropsis eblanae	0.30	15	0.14	
Merluccius capensis, juveniles	0.19	4	0.09	329
Sufflogobius bibarbatus	0.08	38	0.04	327
Lepidopus caudatus	0.04	15	0.02	328
Maurolicus muelleri	0.04	53	0.02	326
Total	218.90		99.64	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1724
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2334
start stop duration Long E 1345
TIME :00:04:52 00:23:02 18 (min) Purpose code: 1
LOG :4906.09 4907.05 0.96 Area code : 2
FDEPTH: 70 20 GearCond.code:
BDEPTH: 179 181 Validity code:
Towing dir: 180ø Wire out: 80 m Speed: 35 kn*10

Sorted: Kg Total catch: 163.94 CATCH/HOUR: 546.47

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	538.77		98.59	
Aequorea aequorea	4.23		0.77	
Schedophilus huttoni	3.30	7	0.60	330
Todaropsis eblanae	0.20		0.04	
Total	546.50		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1725
DATE:20/ 1/06 GEAR TYPE: BT No:14 POSITION:Lat S 2334
start stop duration Long E 1345
TIME :01:15:37 01:45:23 30 (min) Purpose code: 1
LOG :4908.84 4910.40 1.55 Area code : 2
FDEPTH: 180 177 GearCond.code:
BDEPTH: 180 177 Validity code:
Towing dir: 360ø Wire out: 545 m Speed: 30 kn*10

Sorted: Kg Total catch: 293.57 CATCH/HOUR: 587.14

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	247.20	2424	42.10	331
Sufflogobius bibarbatus	228.20	46082	38.87	332
Chrysaora hysoscella	104.00		17.71	
S H R I M P S	7.74		1.32	
Total	587.14		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1726
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2332
start stop duration Long E 1345
TIME :03:30:48 03:45:34 15 (min) Purpose code: 1
LOG :4913.30 4914.03 0.72 Area code : 2
FDEPTH: 155 155 GearCond.code:
BDEPTH: 177 179 Validity code:
Towing dir: 180ø Wire out: 370 m Speed: 35 kn*10

Sorted: Kg Total catch: 4.78 CATCH/HOUR: 19.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	11.72	172	61.30	334
Chrysaora hysoscella	7.28		38.08	
Sufflogobius bibarbatus	0.12	120	0.63	333
Total	19.12		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1727
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1345
TIME :03:55:25 04:10:14 15 (min) Purpose code: 1
LOG :4914.51 4915.24 0.73 Area code : 2
FDEPTH: 155 155 GearCond.code:
BDEPTH: 180 181 Validity code:
Towing dir: 180ø Wire out: 386 m Speed: 32 kn*10

Sorted: Kg Total catch: 45.73 CATCH/HOUR: 182.92

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	181.44		99.19	
Merluccius capensis, juveniles	0.12	4	0.07	335
Sufflogobius bibarbatus	0.04	8	0.02	336
Total	181.60		99.28	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1728
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2334
start stop duration Long E 1345
TIME :04:20:12 04:35:13 15 (min) Purpose code: 1
LOG :4915.73 4916.46 0.72 Area code : 2
FDEPTH: 155 155 GearCond.code:
BDEPTH: 182 184 Validity code:
Towing dir: 180ø Wire out: 380 m Speed: 31 kn*10

Sorted: Kg Total catch: 48.36 CATCH/HOUR: 193.44

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	192.00		99.26	
Merluccius capensis, juveniles	1.08	16	0.56	337
Todaropsis eblanae	0.36	12	0.19	
Total	193.44		100.01	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1729
DATE:20/ 1/06 GEAR TYPE: BT No:14 POSITION:Lat S 2334
start stop duration Long E 1344
TIME :05:40:16 06:08:54 29 (min) Purpose code: 1
LOG :4918.62 4920.23 1.61 Area code : 2
FDEPTH: 183 179 GearCond.code:
BDEPTH: 183 179 Validity code:
Towing dir: 10ø Wire out: 550 m Speed: 34 kn*10

Sorted: Kg Total catch: 187.70 CATCH/HOUR: 388.34

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Merluccius capensis, juveniles	240.52	3600	61.94	338
Chrysaora hysoscella	105.02		27.04	
Sufflogobius bibarbatus	42.81	8756	11.02	339
Total	388.35		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1730
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2332
start stop duration Long E 1345
TIME :07:02:08 07:17:12 15 (min) Purpose code: 1
LOG :4923.22 4924.04 0.81 Area code : 2
FDEPTH: 150 110 GearCond.code:
BDEPTH: 178 179 Validity code:
Towing dir: 175ø Wire out: 340 m Speed: 30 kn*10

Sorted: Kg Total catch: 86.83 CATCH/HOUR: 347.32

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	340.80		98.12	
Todaropsis eblanae	4.84	156	1.39	340
Chelidonichthys capensis	1.68	4	0.48	
Total	347.32		99.99	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1731
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2333
start stop duration Long E 1345
TIME :07:17:48 07:32:53 15 (min) Purpose code: 1
LOG :4924.07 4924.89 0.82 Area code : 2
FDEPTH: 110 70 GearCond.code:
BDEPTH: 179 181 Validity code:
Towing dir: 175ø Wire out: 200 m Speed: 31 kn*10

Sorted: Kg Total catch: 14.79 CATCH/HOUR: 59.16

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	48.24		81.54	
Aequorea aequorea	10.68	156	18.05	
Todaropsis eblanae	0.24	36	0.41	
Total	59.16		100.00	

R/V "DR. FRIDTJOF NANSEN" PROJECT:BE PROJECT STATION:1732
DATE:20/ 1/06 GEAR TYPE: PT No: 2 POSITION:Lat S 2334
start stop duration Long E 1345
TIME :07:33:29 07:48:26 15 (min) Purpose code: 1
LOG :4924.92 4925.77 0.84 Area code : 2
FDEPTH: 70 20 GearCond.code:
BDEPTH: 181 183 Validity code:
Towing dir: 175ø Wire out: 60 m Speed: 35 kn*10

Sorted: Kg Total catch: 111.78 CATCH/HOUR: 447.12

SPECIES	CATCH/HOUR weight	numbers	% OF TOT. C	SAMP
Chrysaora hysoscella	414.00		92.59	
Aequorea aequorea	33.12		7.41	
Total	447.12		100.00	