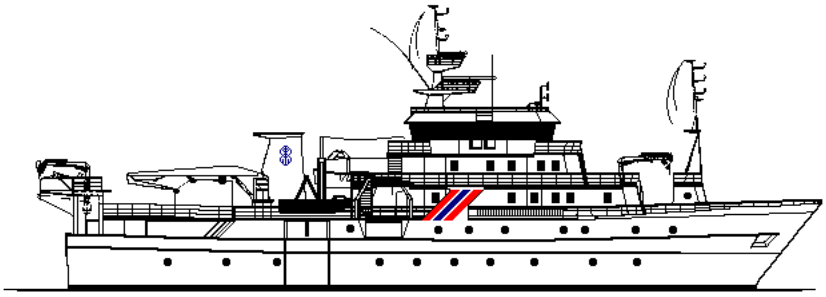
CRUISE REPORTS "DR. FRIDTJOF NANSEN"



BENEFIT SURVEYS

A SURVEY TO EXPLORE THE TRANSBOUNDARY DISTRIBUTION AND MIGRATORY PATTERN OF THE DEEP-WATER HAKE BETWEEN NAMIBIA AND SOUTH AFRICA. INTERCALIBRATIONS WITH R/V AFRICANA.

Preliminary Cruise report No 3/2004

5 February– 10 March 2004

by
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1. INTRODUCTION

1.1 General objective

The present survey is the third survey within the BENEFIT project XXXX "Coordinated trawl surveys" where the general objective is to seek standardisation in survey and analytical methods as regards the demersal stocks of the coasts off south-western Africa. This is to allow a more regional and transboundary scope as regards the research and management of the demersal stocks.

1.2 History of the project and specific objectives of the survey.

Earlier surveys have focused in intercalibration between research vessels (2002), comparison of survey designs in mini-studies (2002) and full-scale surveys (2003).

The transboundary scope is of special relevance as regards the deep-water hake *Merluccius paradoxus* which is assumed to be a shared stock between Namibia and South Africa. Earlier surveys both in Namibia and South Africa show aggregation of the species in the border area, and the shallow areas just south of the Orange River is known to hold considerable amounts of young fish in the length range 20-30 cm. This area is therefore considered to be a nursing area for the young deep-water hake but the extent and structure of the population is not well investigated. On the other hand Namibia is known to hold considerable biomass of adult deep-water hake, while the small amount of young fish in the country is not believed to be enough to sustain the adult population. The common view is therefore that adult hake migrates in from South Africa although the route and active migratory periods is not known.

Several barriers are active in the region. The upwelling cells, specially off Lüderitz and off Hondeklip Bay is assumed to influence the distribution and migration of the hake, specially the younger classes in the shallow waters. The adult fish mainly occupies the shelf area between 300 and 450 m bottom depth and this zone forms wide plateaus in Namibia and South Africa, but off Panther Head in Namibia this zone narrows to a small channel, a few km wide that could act as a bottleneck in the northward (and possibly southward) migration.

The main objective of this survey to map the distribution of the hake stocks in the transboundary area and link this up to topographic and environmental features/barriers in the region. One survey gives a frozen picture in time, but it is assumed that diffusion or migratory patterns can be depicted from separate analysis of size classes' spatial distribution.

Since 1997 Namibia and South Africa have harmonised their survey activities on the west coast and the annual surveys are since then been executed early in the year to facilitate complete stock analysis. However the two countries use different trawls and survey designs and it has been part of this BENEFIT project to analyse the consequences for the research this will imply and propose measures to mitigate them. One important activity has been to carry out intercalibrations between the research vessel to be able to produce standardised regional distribution maps and abundance estimates. The South African R/V "Africana" changed its trawl and gear in 2003 and in order to provide calibration between the old and the new gear to the time series can be linked, the Dr. Fridtjof Nansen has done major intercalibration exercises with Africana on two previous occasions, in October 2001 and January 2003. As the trawls on Africana now recently have changed, new exercises will be carried out in to portions in 2004, part one during the present survey and the second part in September. **The second objective** of this survey is therefore to carry out intercalibrations with the new trawl of Africana.

1.3 Participation

The survey was run in two legs: leg 1: 5-13 February, leg 2: 15-10 March. The scientific staff during the cruise was:

From South Africa:
Marek Lipinski (BENEFIT project leader, team leader), Mandisile Mqoqi, Kwnele Booi, Clifford Hart, Johan de Goede (leg 1), Mark Hendricks (leg 1), Phoebe Mullins (leg1), Renée Osborne (leg 1), Donavan Charles (leg 1), Shaun Evans (leg 2), Bernard Pharo(leg 2),

From Norway:
Oddgeir Alvheim (cruise leader leg 1), Tore Strømme (cruise leader leg 2), Marek Ostrowski (leg 2), Tore Mørk and Ole Sverre Fossheim

1.4 Narrative

The vessel left Cape Town on the evening of 5 February and joined Africana for intercalibration in the slope area off St. Helena Bay. Intercalibration started on the morning of 6 February and was carried out in daylight hours for nine days until 13 February, one day shorter than planned as Africana had to go for dry-docking. The position of the 50 intercalibration tows completed are shown in Figure 1. The vessel called on Cape Town 13-15 February for change of scientific crew. Second leg started with departure from Cape Town on the afternoon of 15 February. Course track with stations sampled are shown in

Figure 2. The vessel steamed to south of Hondeklip Bay where trawl sampling started on the morning of 16 March. The shelf and slope was covered with trawl stations laid on transects perpendicular to the coast and 20nm apart. Close to Orange River the sampling was suspended and a call on Lüderitz was made on 28 February to obtain spare parts for current meters. A northern transect was completed on 29 February where after the vessel moved to the area off Panther Head to commence trawl sampling. A current meter was launched on 3 March at 320 m bottom depth to monitor the current in the assumed channel for the hake migrating northwards. This was added with some detailed trawl sampling in the channel and its vicinity. A two-day storm hindered the sampling work 4-5 March where after the sampling was completed northwards. Due to time constraints following the storm it was necessary to sacrifice some sampling in the shallow waters north of Orange River. Trawl sampling was completed on the evening of 8 February, when the vessel steamed to Walvis Bay with arrival evening of 9 February.

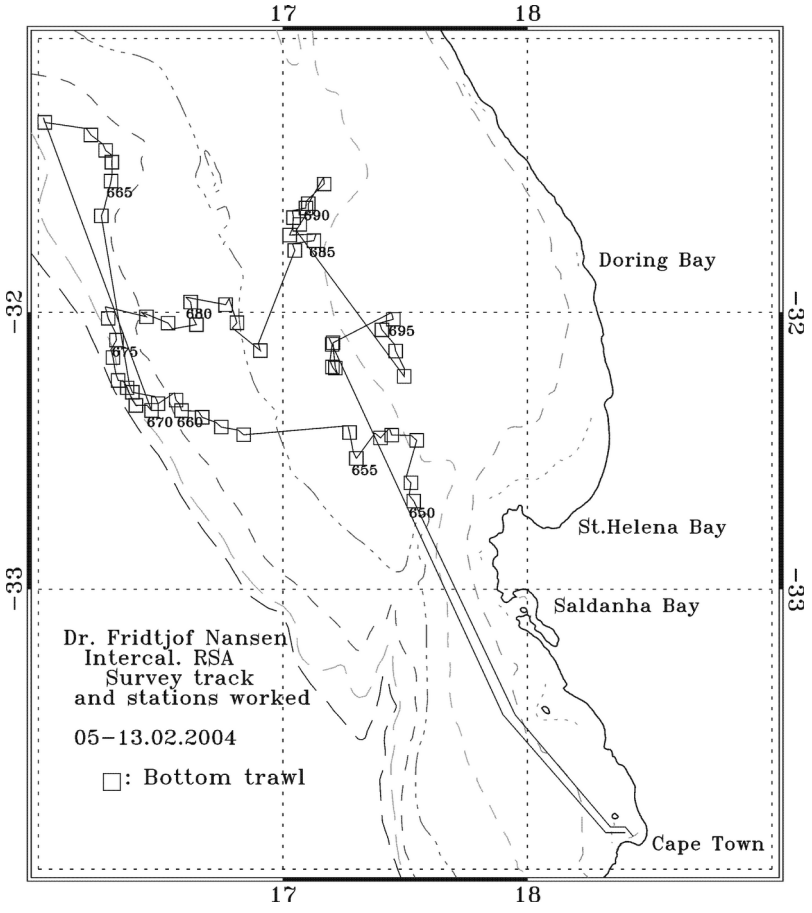


Figure 1 Course track and fishing stations. Depth contours 50, 100, 200, 300, 400, 500 and 600 m are indicated.

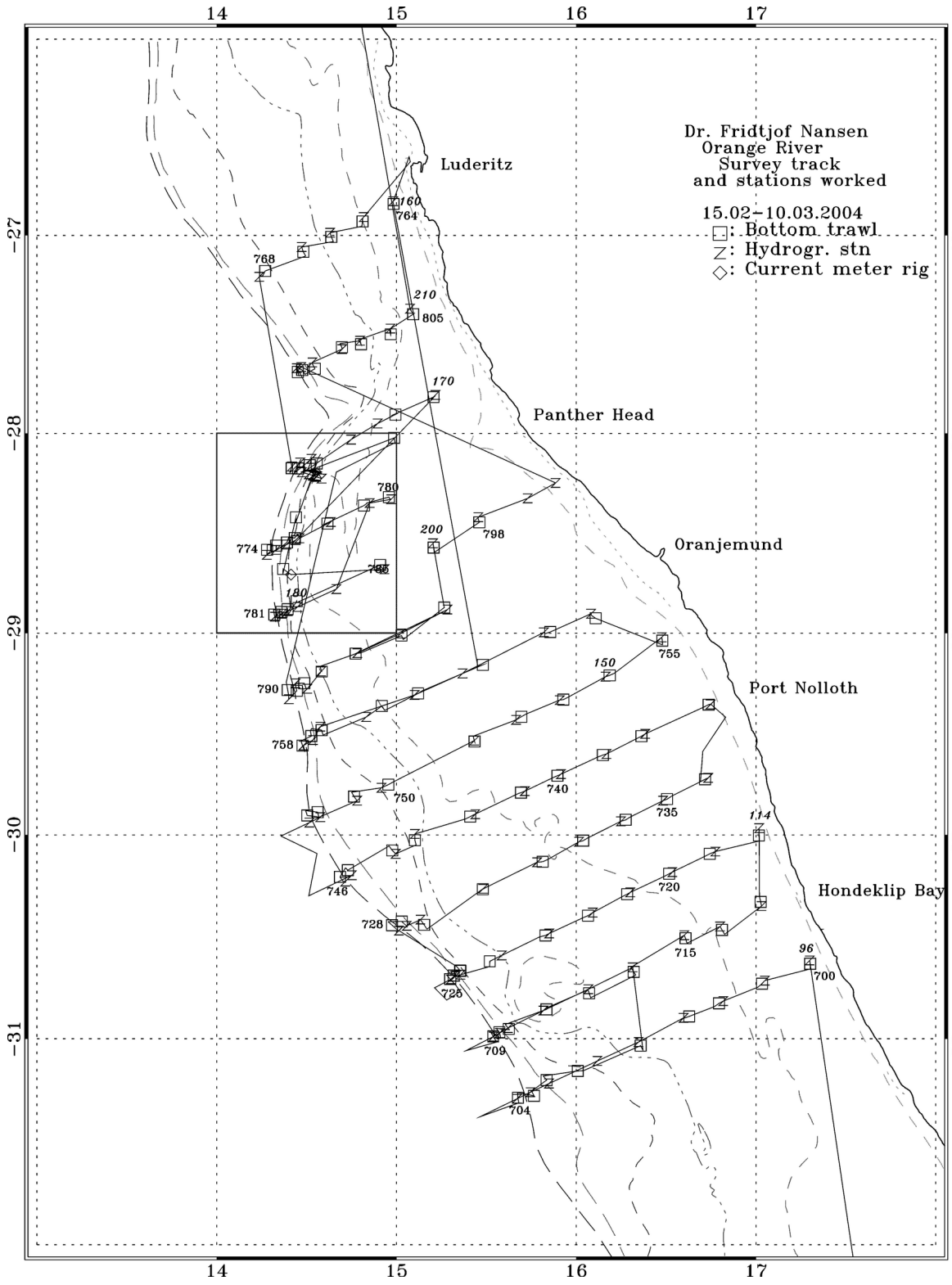


Figure 2 Course track, fishing and hydrographic stations. Depth contours as in Fig. 1.

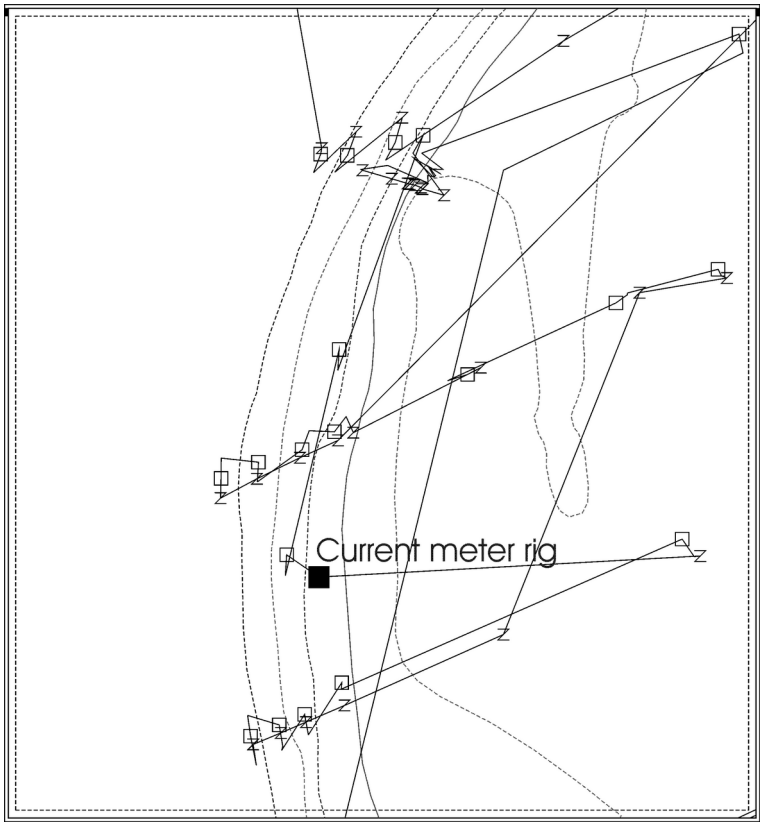


Figure 3 Course track and stations near the current meter rig.

2. MATERIAL AND METHODS

2.1 Physical measurements

(Marek, some general stuff here)

2.1.1 Bathymetry

2.1.2 Wind data

2.1.3 Current data ?

2.1.4 Hydrography

2.2 Acoustic measurements

Acoustic equipment

The acoustic recordings were conducted using Simrad EK 500 echosounder coupled to a keel-mounted transducer of 38 kHz. Acoustic raw-data was logged on the Sun-Unix based Bergen Echo Integrator (BEI) version 2000. The technical specifications and operational settings of the echosounders used during the survey are given in Annex IV together with the results from the last calibration of the system. The acoustic data were scrutinized using the post-processing module of the BEI software.

Classification

Scatterers were displayed at 38 kHz, standardized to 5 NM echograms with 1,000 pings (horizontal) by 500 bins (vertical). The mean 5 NM area backscattering coefficients s_A (m^2/NM^2) was allocated to a predefined set of species or species groups on the basis established echogram features. When concentrations of juvenile pelagic hake were encountered the s_A-values were stored with a 1 nm resolution.

Acoustic groups used were: a) Juvenile pelagic hake < 17 cm, b) older hake, usually demersal, c) horse mackerel, d) Pelagic group1 (pilchard, anchovies, red eye), e) Pelagic group 2 (pelagic fish not of Pelagic 1), f) demersal fish, not hake, g) mesopelagic fish, h) plankton. The classification was based on the characteristics of the echo traces, experience accumulated from previous similar surveys in Namibia since 1990 and in South Africa since 2000, supported when possible with results from nearby bottom trawl stations. Time constraints did not permit pelagic trawling on targets.

The results from the acoustic system are considered as a pilot study with the main aim of delineating the limits of distribution of juvenile pelagic hake and some information on relative densities. The figures will not be converted to biomass, as the target strength is uncertain and as the classification scheme and methods are too course for such a purpose. Adult hake were very rarely observed in the acoustic channel during daytime, while it showed up frequently above bottom at nighttime.

2.3 Trawl survey and intercalibration with R/V Africana

The main information as regards fish distribution and abundance was obtained from the swept area survey. The same procedures were followed when handling the catch in the trawl survey and in the intercalibration experiment.

2.3.1 Survey design

The survey had a systematic design with transects perpendicular to the coast and across the main depth gradient. Transect distance was 20 nm. Hakes are known to form depth dependent aggregations, moving deeper as the fish grows in size. At uniform depth or slightly sloping shelf the trawl stations were semi-randomly laid out with between 10 and 15 nm between the stations. At the slope, usually beyond the 300 m depth contour, one station was put in each 100 m zone, irrespective of the geographical distance. This was done to pick up the main density gradient on the slope, which in most cases were evident and are used for mapping the resources. On each transects the slope was sampled at fixed 100 m intervals, i.e. 340, 440, 540 and 640, while the start-depth was varied between the transects.

2.3.2 Trawl sampling procedures

The standard bottom trawl of Dr. Fridtjof Nansen, a Gisund Super shrimp cum fish trawl, was used in the survey and for the intercalibration. A description of the trawl and gear is given in Annex XXX.

A standard haul was 30 minutes at 3 knots, sometimes reduced to 20 minutes in areas of expected high densities. The exact time for start and stop of the trawl operation was determined by SCANMAR sensors. The output from the SCANMAR system was also recorded on files to facilitate later analysis of bottom contact and door-spread if necessary.

For conversion of catch rates (kg/hour) to fish densities (t/nm²), the effective fishing area was considered as the product of the wing spread and the haul length, or distance over the bottom, based on GPS readings. In the survey a nominal distance of 18.5m was applied to facilitate analysis with previous surveys. The area swept for each haul was thus 18.5m times the distance trawled, converted to nm². The catchability coefficient (q), i.e. the fraction of the fish encountered by the trawl that was actually caught, was conservatively assumed equal to 1, to allow comparison with previous results. In the intercalibration the distance between the wings of the trawl was calculated to 21 m, based on SCANMAR readings and trawl geometry. In the new Africana trawl the wing spread was calculated to between 29 and 31 m based on reading of door spread. Dr. Fridtjof Nansen use a 20m strap on the warps 105 m in front of the doors to keep the door and wingspread constant at 50 m and 21 m respective, independent of trawl depth.

2.3.3 Handling the catch

In most cases, the whole trawl catch was sorted and all species were recorded with their weight and numbers. For especially big catches the abundant species were sub-sampled while the other fish were sorted out. Length measurements (total length) were taken for target species. The length of each fish was recorded to the nearest 1 cm below. The mantle length of squid was measured to the nearest 1 cm below.

An electronic measuring board was used for length measurement, main sample weights were recorded by Scanvaegt electronic balances and a Marel weight was used for single fish and small species measurements.

Annex XXX shows the complete record of the fishing stations. Pooled length frequency distributions, normalised to catch per nm^2, of selected species by area are shown in Annex II.

2.3.4 Target species

For the intercalibration the target species were:

Shallow water hake *Merluccius capensis*, deep water hake *M. paradoxus*, kingklip *Genypterus capensis*, monk *Lophius vomerinus* and jacopever *Helicolenus dactylopterus*. For the survey the target species were again the two hake species and jacopever.

2.3.5 Special procedures of the intercalibration experiment

Africana and Dr. Fridtjof Nansen were using their normal trawling speed during the experiment, 3 and 3.5 knots respectively. Nansen was usually starting the operation slightly ahead of the Africana, which would catch up with Nansen towards the end of the hauls. The vessel alternated sides to avoid systematic depth or wake effects.

Biomass estimates based on swept-area method

In the bottom trawl survey, stock biomasses was estimated by the swept-area method with catch per haul as the index of abundance (see Strømme 1992). The general formula to estimate biomass B, using this method is:

$$B = \frac{A}{a} . \frac{\overline{X}}{q} \qquad (6)$$

A is the total area surveyed, **a** is the swept area of the net per haul, $\overline{X}$ is the average catch per haul (the index of abundance) and **q** is the proportion of fish in the path of the net that are actually caught. The density of the resource is estimated as biomass per unit area. In a stratified survey of k non-overlapping strata, if the mean catch per haul in stratum *i* and its variance are denoted by $\overline{X}_i$ and s_i^2 respectively, then an unbiased estimate of the population mean $\overline{X}$ is the stratified mean $\overline{X}_{st}$ -, which is given by:

$$\overline{X}_{st} = \frac{1}{N} \sum_{i=1}^{k} N_i \overline{X}_i = \sum_{i=1}^{k} W_i \overline{X}_i \qquad (7)$$

where Wi= $\frac{Ni}{N} = \frac{A_i}{A}$ is the relative size of the ith stratum (A_i is the area of the ith stratum and A is the total area surveyed). The variance of the stratified mean is given by

$$\text{var}(\overline{X}_{st}) = \sum_{i=1}^{k} w_i^2 \, \text{var}\, \overline{X}_i = \sum_{i=1}^{k} w_i^2 \frac{s_i^2}{n_i} \qquad (8)$$

where n_i is number of hauls in the ith stratum and n is the total number of hauls in the survey.

2.3.3 Biological samples

Biological samples were collected for the two hake species in special areas. The following information were collected: Sex, maturity stage, gonad weight and stomach content. The maturity scale used was the one adopted at Marine and Coastal Management:

3. RESULTS

3.1 Physical measurements

3.1.1 Bathymetry

3.1.2 Weather

3.1.3 Currents

3.1.4 Hydrography

3.2 Fish Biology

3.2.1 Distribution of pelagic hake from the acoustic system

3.2.2 Fish distribution, target demersal species

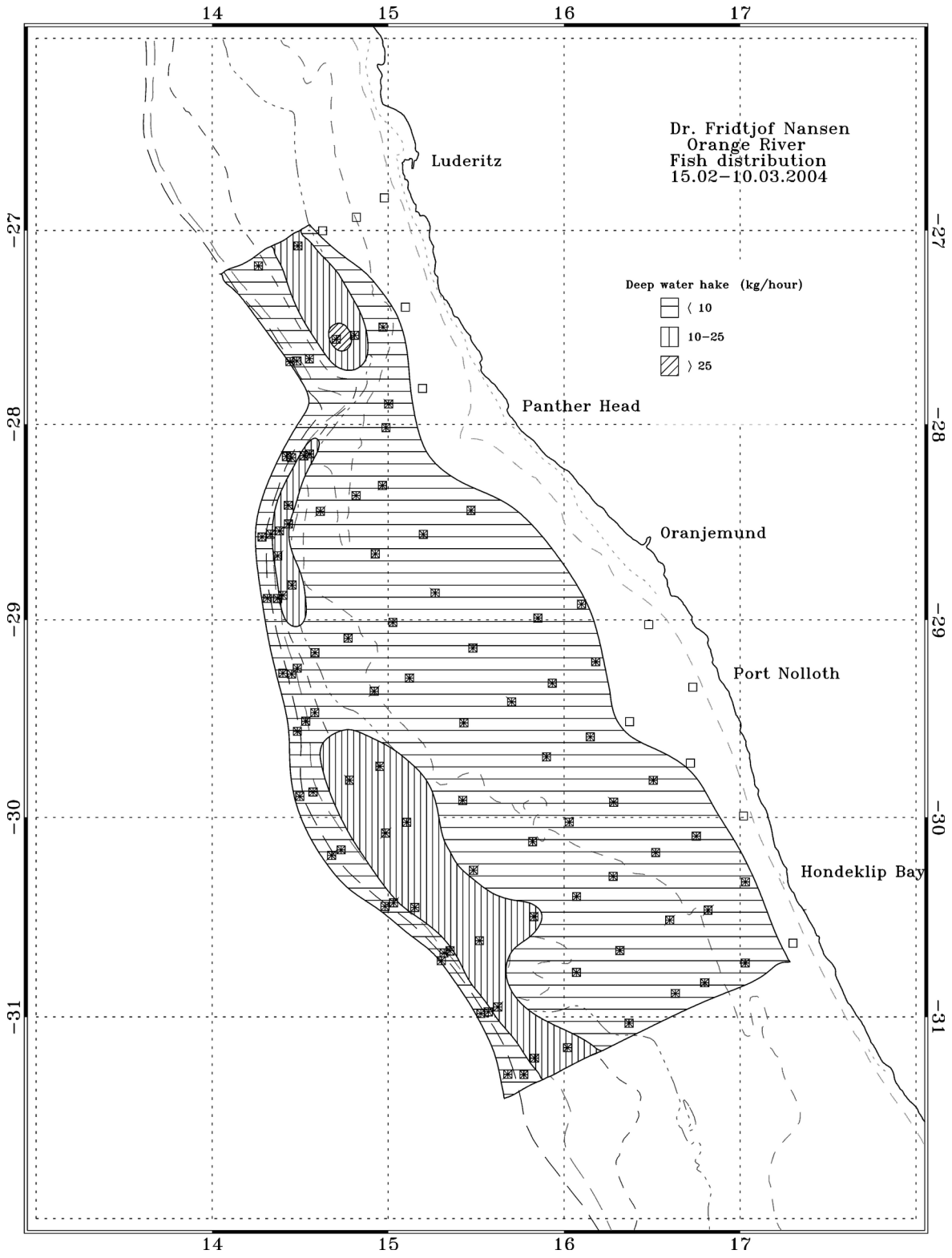


Figure 5 Distribution of deep-water hake. Empty squares indicate stations where no deep-water hake was caught.

3.2.3 Fish distribution, size classes of hake

4. PRELIMINARY CONCLUDING REMARKS

Appendices

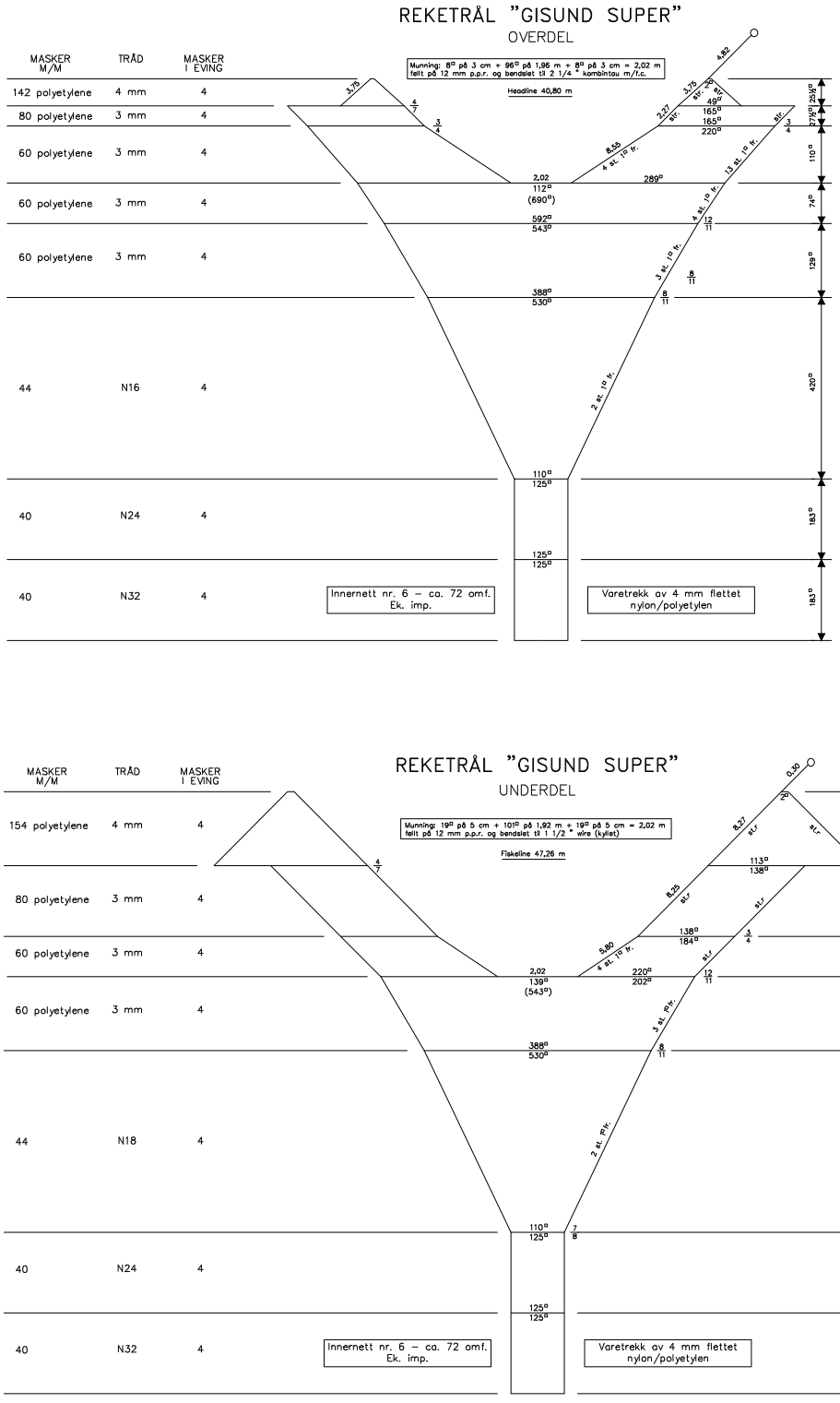
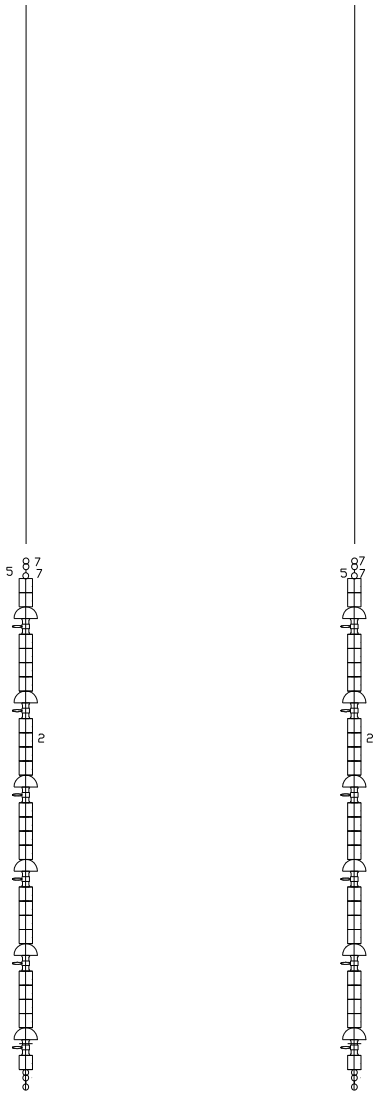


Figure 2a. Design of the trawl used.

6,85 M
16 MM CHAIN
SHORT LINKED



SIDE GEAR
6,55 M

SIDE GEAR
6,55 M

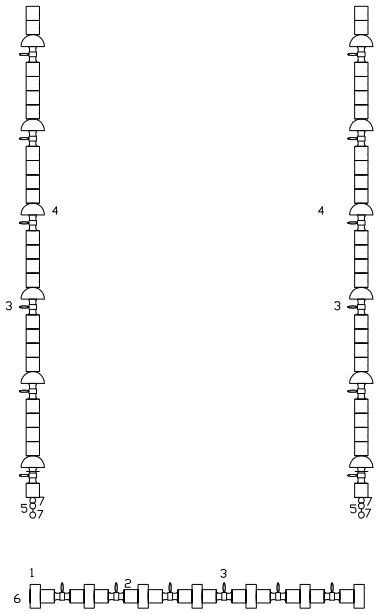


Fig. 2b. Schematic drawing of the ground gear used in the experiments