

2016 EAF-NANSEN SURVEY NO. 1

**INTERCALIBRATION TRIALS BETWEEN R/V DR. FRIDTJOF NANSEN AND R/V
MIRABILIS**

Cruise report No 1/2016

11 - 30 January 2016



THE EAF-NANSEN PROJECT

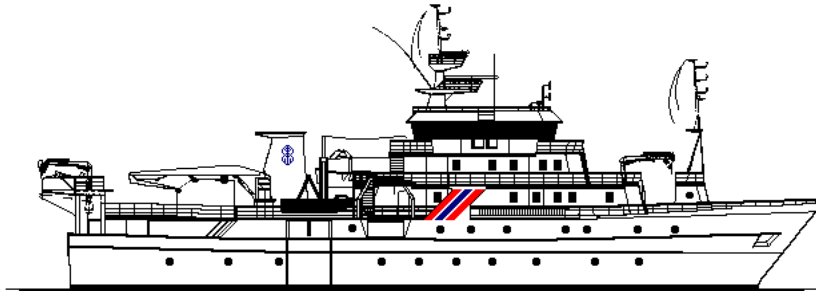
FAO started the implementation of the project "Strengthening the Knowledge Base for and Implementing an Ecosystem Approach to Marine Fisheries in Developing Countries (EAF-Nansen GCP/INT/003/NOR)" in December 2006 with funding from the Norwegian Agency for Development Cooperation (Norad). The EAF-Nansen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

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

LE PROJET EAF-NANSEN

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

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



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by

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1 Introduction

During the regional work in BENEFIT and BCLME standardisation of survey methods have been high on the agenda. Likewise time series on the distribution and abundance has been established on the national and regional level. For both these objectives intercalibration of survey vessels are necessary when several vessels take part in a regional survey or contributing to a time series at different times. In Namibia a monitoring scheme on demersal fish was established by Dr. Fridtjof Nansen in 1990 at the time of Namibian National Independence. A time series with Dr. Fridtjof Nansen was then collected in the period 1990-1999. In the early years up to three surveys per year was carried out, but after regional consultations in 1994 January-February was selected as the standard monitoring time period for an annual survey. South Africa had run time series on the demersal resources on its West coast since 1982 and the synchronisation was the first attempt towards a semi-synoptic coverage on the regional hake resources. As part of a plan to phase out the Dr. Fridtjof Nansen in national surveys and transfer responsibility for the time series to Namibian scientists and vessels, a commercial trawler with identical rigging as the Nansen and with Namibian scientists in charge were working in parallel with the Dr. Fridtjof Nansen during the standard 1998 survey and a unique set of 176 paired hauls were collected. This exercise was repeated in 1999 and then 189 successful hauls were collected. Analysis of the results showed that 95% of the catches gave an average difference in catch rates to be within $\pm 5\%$ in 2008 and $\pm 7\%$ in 2009 (Strømme and Lilende 2001). For all practical purposes the vessel were considered similar in catching power. From 2000 the Nansen was pulled out of the Namibian annual surveys and the timeseries was run by the commercial trawler Blue Sea. Two later intercalibrations with Dr. Fridtjof Nansen, in 2002 and 2009, with about 50 and 40 parallel hauls respectively, confirmed the stable and identical performance of the two vessels and though the number of hauls was not sufficient for statistical testing.

In 2013 Namibia got a new research vessel Mirabilis that had sufficient fishing power to take on the demersal trawl surveys and thus replace the Blue Sea. During 2014 several test and improvements were made on the winch systems and finally in January 2015 7 days of intercalibration between Dr. Fridtjof Nansen and Mirabilis was carried out. The short period only led to 25 successful pairs which was not sufficient for statistical testing (Lipinski 2015), but pointed to a systematic bias between the two ships where Nansen was catching systematically more than Mirabilis. It was suspected that the trawl geometry on Mirabilis was not optimal. It was concluded that a review of the trawl system was necessary and that a more thorough

intercalibration should be conducted in 2016 in order for Mirabilis to fully take over responsibility for the Namibian time-series. The present report is on the intercalibration trials in 2016 and is also including a deeper analysis of the the short 2015 survey.

Specific objectives of Dr. Fridtjof Nansen for this survey are:

1. To do underway synchronised parallel trawling with R/V Mirabilis at regular trawl stations carried out during the annual Namibian trawl survey 2016.
2. To record catch in number and weight for all species in the catches
3. To record length frequencies of target species: shallow water hake, deep water hake, monk and jacoever.

There would not be collected any other biological data, and no environment sampling will be carried out by Dr. Fridtjof Nansen. This was all conducted onboard R/V Mirabilis.

2 Materials and methods

2.1 Synchronisation of the trawls

Nansen and Maribilis took day-alternate leader and follower in the exercise. The leading vessel was setting out the trawl according to given positions from the set up of the standard trawl survey. The leading vessel would signal by VHF when it was launching the trawl and when it was recorded on bottom by the Scanmar system. The following vessel would position itself 1 cablelengths behind the leading vessel and 2 cablelength off the wake. When receiving the message that the leading trawl was out it would continue on its parallel course until perpendicular to the position where the leading vessel was when the “trawl out” message was sent and then launch its trawl, approximately a two minutes delay at three knots.

2.2 Trawl sampling procedures

The standard bottom trawl of Dr. Fridtjof Nansen, a Gisund Super shrimp cum fish trawl, was used in the survey on both vessels. A description of the trawl and gear is given in Annex 2. Dr. Fridtjof Nansen uses a 20 m strapping on the warps 105 m in front of the doors to keep the door and wingspread constant at 50 m and 21 m respectively, independent of trawl depth.

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 wing 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 comparisons of length frequency distributions on the targeted species densities are expressed as number of fish per nautical mile sorted by 5cm classes. A classlength is noted by its lower limit, i.e. the 50cm lengthclass from 50 to 54 cm.

2.3 *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. All samples of small hake was checked for the species identity by vertebrae count (usually 3-5 fish were examined).

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.

2.4 *Communication*

A special WI-FI link with wide angle directional antennas was set up between the vessels which facilitated daily PC to PC transfer of scientific data between the vessels. The system had a range of several kilometres and worked very well with the short distances between the vessels during the intercalibration, about 300-500m.

2.5 Comparison of catches, analysis

A calibration is a procedure where we compare the measurement of one instrument with an instrument which is defined as a standard. In our case the instruments are research vessels which are using bottom trawls for sampling fish populations at bottom, and one vessel is the standard to be compared to. Both vessels might have bias in their sampling but we are only interested in the difference in bias between the vessels. The underlying assumption for intercalibration exercises is that the vessels are sampling from the same population and that a trawl is a representative catch for this underlying population. With an ideal condition of an evenly scattered population we can assume that any difference in catches between vessels is due only to difference in sampling bias from the gear or/and from the vessel, termed gear effect and vessel effect respectively giving systematic bias with error term ϵ_B . However when the underlying population is not evenly scattered but more likely uneven or even patchy, a difference in catch is also ascribed a random factor, the random error term (ϵ_R).

The two vessels are not in a causal but a correlation relationship. The catch in one vessel is of course not causing the effect of the other, but are correlated as the samples are drawn from the same population. A usual way of exploring such data is in x/y correlation plots. In an 'ideal world' with an evenly scattered population and no gear and vessel effects between the two vessels all x/y plots would fall along the x=y line with an inclination equal to x/y = 1.0

Any vessel or gear effect (bias) between vessels would show up in an inclination different from 1.0. The bias inclination ϵ different from 1/1 line is then the deviation from 1.0 in the declination.

The relationship between the catches from the two vessels can then be expressed as:

$$y/x = 1.0 + \epsilon. \quad (1)$$

A positive ϵ indicates that the y catches are systematically higher than the x catches. When ϵ is negative the x catches are systematically higher. By rearranging the formula we can isolate the error term, and also predict the catches of y from x or vice versa when the error term is known:

$$\epsilon = y/x - 1.0 \quad (2)$$

$$y = x + \epsilon x$$

$$x = y / (1 + \epsilon)$$

When the underlying population is not uniformly distributed as in the real world this simple model no longer applies. An additional random element is introduced which gives difference in catches even if one samples from the same underlying population. To make it even more complicated this random error is related to the underlying density of the population, the higher the density level is the higher is the random error. It is assumed that this is related to the patchiness of the underlying population. The higher the density level is the more likely it is that the degree of patchiness increases, catch differences from sampling from the same location increases with the catch level. This leads to a not much wanted feature in statistics, heteroscedasticity, which means that the variance in sample is not independent of the level of the measured variable, in our case the catch rate or the sampled density. Presence of heteroscedasticity violates a main assumption for doing regression analysis. Hence in trawl intercalibration analysis we cannot apply simple regression analysis on catch data expressed as CPUE or densities, but must work around this problem.

Including the random error in the estimation of calibration error formula (2) then becomes

$$\epsilon_s + \epsilon_r(X) = y/x - 1$$

where ϵ_s is the systematic error (bias) and $\epsilon_r(X)$ is the random error which is a random function but governed by X , the population density, the density level at the location. (Note that the random error is not a function of x but of X). In a plot of total error ($\epsilon_s + \epsilon_r(X)$) as a function of $x/y - 1$ the data shall group around a mean which is estimate of the ϵ_s while the residuals express the spread of the random error, $\epsilon_r(X)$. A good thing with random errors is that they tend to cancel themselves out with high sample size and as this increases the accumulated $\epsilon_r(X)$ error term approaches zero. Usually one have to have a sample size of more than 100 to be able to isolate the random effect in trawl intercalibrations.

In exploratory analysis one trick can assist us in separation the vessel effect and the random error. If one sort the catches by increasing catches and plot them as cumulative plots a systematic vessel effect will show up in an increasingly different path for the of the catches in the individual vessel series. If there is no systematic bias the cumulative plots will overlap completely, but where the random effect is still not balanced as from the few very highest catches at the end of the cumulative plot.

As examples Figure 2.1a and b shows such a plot from the intercalibration trials in 1998 and in 2015 respectively. The 1998 case is from 187 hauls which shows an almost perfect overlap in the performance of the two intercalibrating vessels. The 2015 case is from the not so successful intercalibration between Nansen and Mirabilis with only 27 hauls One can see that vessel b, Mirabilis (triangles) is systematically lagging behind in the cumulative plot, which points to a grave systematic error in 2015.

In efforts to quantify the systematic vessel effect simple statistical analysis of catch ratios using means and standard error will not work as the ratios are not a linear function. Instead one can use the similarity index (SI) which is expressed as :

$$SI = \frac{c1 - c2}{c1 + c2}$$

where $c1$ and $c2$ are catch from vessel 1 (Nansen) and 2 (Welwitchia) respectively.

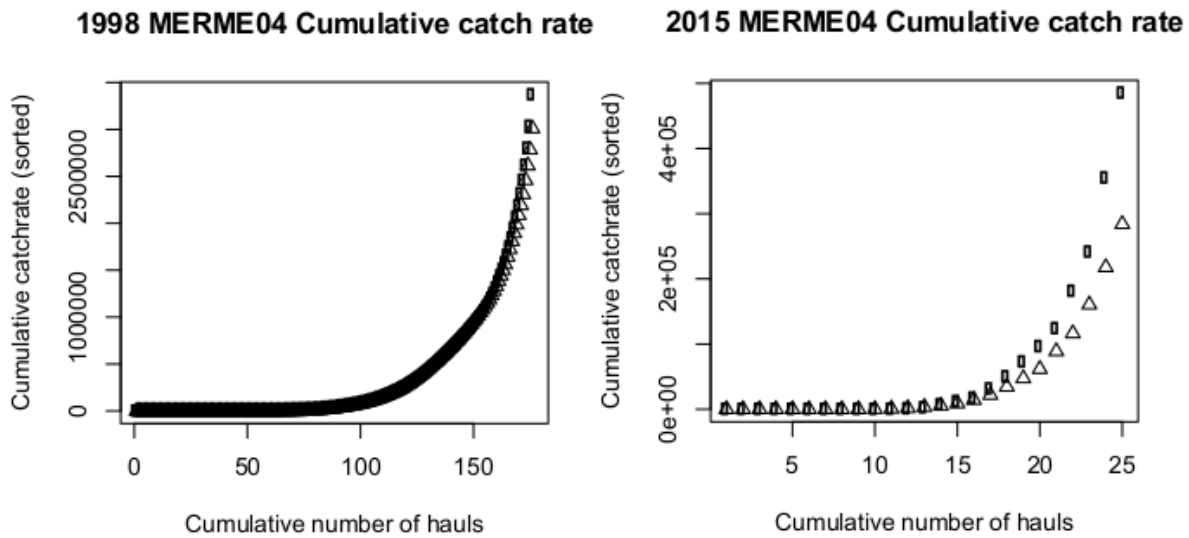


Figure 2.1. Cumulative catch rate sorted by catch size from intercalibration experiments in 1998 (left) and 2015 (right). *Merluccius capensis*. Fridtjof Nansen squares (1998 and 2015) , commercial trawler (triangles 1998) and Mirabilis (triangles 2015)

The SI is linear, symmetric around 0 and the residuals from random errors are transformed to a normal distribution around the mean SI (Strømme and Lilende 2000) neutralising the heteroscedasticity in the data. An example showing this feature is shown in Figure 2.2a and b with the SI distribution from intercalibration trials in 1998 and 2015 respectively. The 1998 case shows a fairly normal-distribution around the 0 balance point, indication similar vessel effects from the 2 vessels. In 2015 the SI values are distributed in a bi-modal fashion and skewed to the right of the 0.0 center. This points to a systematic factor in favour of vessel 1 (Nansen) while the bi-modal distribution form could be from an unstable system plip-plopping or simply due to not sufficient number of trials to model the underlying distribution which is expected to be normally distributed. We will use similar plots as in Figure 2.1 and 2.2 to analyse the features of the intercalibration trials in 2016.

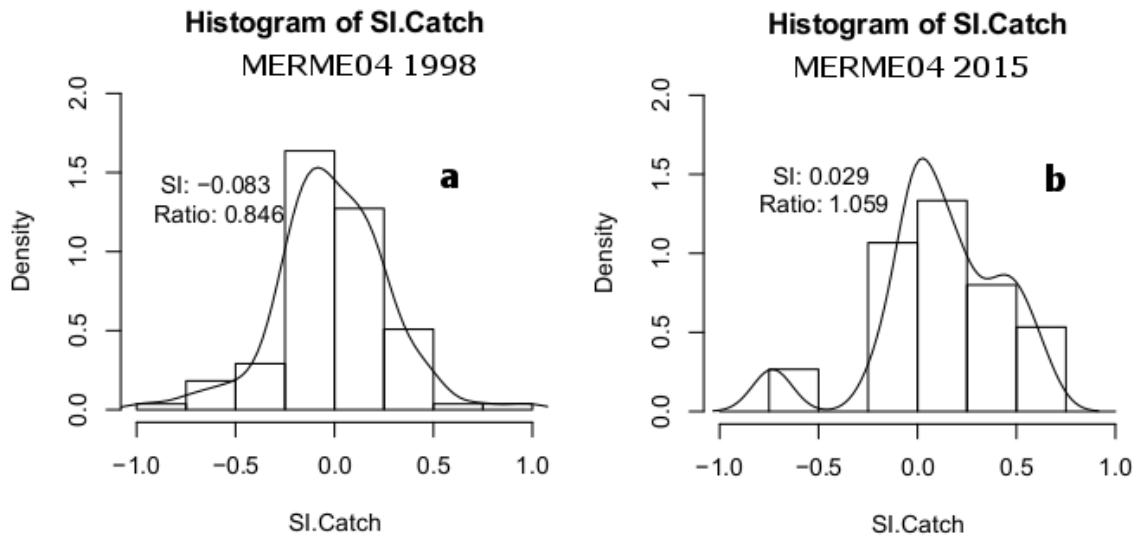


Figure 2.2. Density distribution of similarity index (SI) from pairs of catches of *Merluccius capensis* in 1998 (left) and 2015 (right)

3 Narrative

The scientific staff consisted of:

From NatMIRC, Namibia:

Suama Niinkoti (co-cruise-leader), Petrus A. Aitembu, Victoria N. Erasmus, Timoteus S.T. Kadhila, Tomas N Nalukaku

From IMR, Norway:

Tore Strømme (cruise leader), Oddgeir Alvheim (chief technician), Tor Magne Ensrud (technician), Tore Mørk (instrument chief), Inge Nymark (instrument operator)

In addition, Marek Lipinski (FAO consultant, South Africa) was responsible for leading the deck sampling work

The cruise tracks with fishing and hydrographical stations are shown in Figure 3.1.

The vessel departed Walvis Bay on 11 January together with R/V Mirabilis, heading south. To make optimum use of the daylight and the presence of the two vessels it was decided to do vessel transits preferably during night-time. The regular transects are thus not taken in their usual latitudinal sequence from south to the north, as seen in figure 3.1. Sampling started off Hottentot Point in morning of 13 January and continued southwards until 17 January when Dr. Fridtjof Nansen returned to Walvis Bay for crew change. In Walvis Bay it was discovered a leakage in the trunk of the sliding keel which caused a flooding in the gyro room, and a damaged gyro. The vessel had to spend four extra days in Walvis bay for repair of leakage and installation of a new gyro and departed Walvis Bay on 23 January to meet Mirabilis again off Easter point on the morning of 24 January. Mirabilis had in the meantime covered all of the southern Namibia in the regular trawl survey. From Easter Point the two vessels worked in tandem in a northern direction with about one transect per day, until on latitude with Walvis Bay. Both vessels arrived in Walvis Bay on the morning of 31 January, end of Nansen survey. Mirabilis went to sea again on 2 February for the second leg of the regular demersal survey. 57 successful parallel hauls were completed. This is about 24 stations short of the target due to the four days lost to the accident with the leakage. Dr. Fridtjof Nansen had only one shift of scientific crew which worked on deck from 8 AM to 8 PM in a 12 hour shift, where a maximum of 6 stations/day was feasible. The weather conditions was favourable during the whole survey and did not restrict the sampling work.

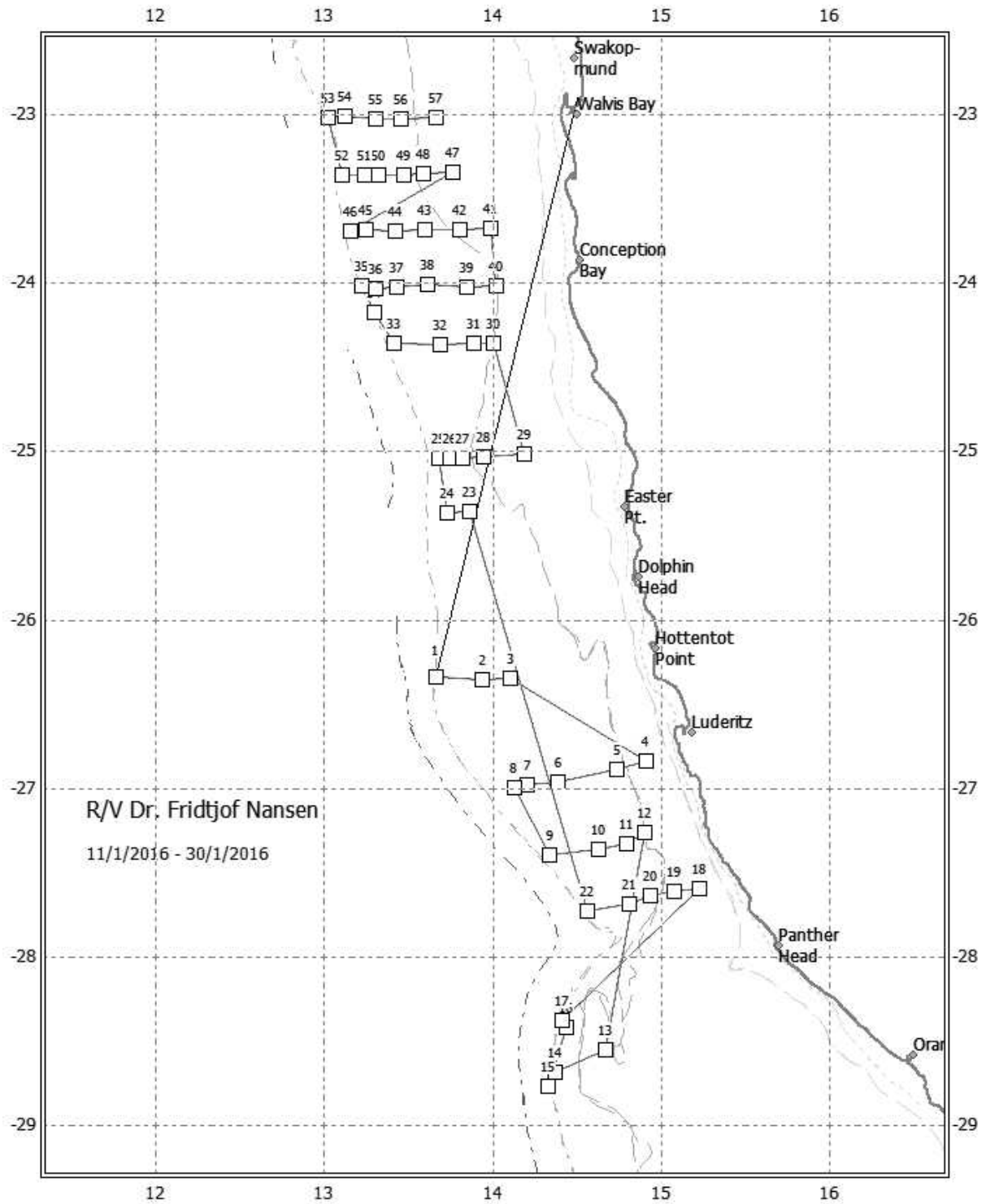


Figure 3.1 Course tracks with Nansen trawl stations during the survey.

4 Results

4.1 Catch comparisons

Annex 1 shows the complete record of the fishing stations of Dr. Fridtjof Nansen. Annex 2 shows a table with the main catch data tabulated together for the two vessels.

Figure 4.1a-c shows the sorted cumulative catch rate for *M. capensis*, *M. paradoxus* and (monk) respectively. The *capensis* show a remarkably similar curve for the two vessels while for the *paradoxus* the *Mirabilis* is lagging behind for the highest four catches but the last, bringing the total catch almost similar as well. We have no reason but to assume that this small deviation in the curve is from a random effect due to the small sample. In contrast the cumulative catch rates for the monk (Figure 4.1c) shows huge difference in cumulative shapes and in the total. The figure indicates that the monk catch rates on Nansen is on average 50% less than on *Mirabilis*. This is discussed further below.

Figure 4.2a-c shows the density distribution of the Similarity Index (SI) for the *capensis*, *paradoxus* and monk respectively. All three figures shows fairly normalised distributions. However given the low number of trials it is not possible to estimate a robust mean SI value that could be used a calibration factor. That the mean SI is fairly close to 0.0 is a valid assumption for the two hakes, but not for the monk which is biased into the negative, showing systematically higher catches for the *Mirabilis* as confirmed by the cumulative plot.

4.2 Length comparisons

Figure 4.3 a-c shows how the similarity index (SI) performs by the length of the species for *capensis*, *paradoxus* and monk respectively. For both the hakes the SI is fairly close to 0.0, but perhaps with a slight oversampling in favour of Nansen for the 20-40cm range and a shift towards slightly higher catches by *Welwitchia* for the 45-60cm range as regards the *capensis* hake. For the *paradoxus* no length dependency can be depicted, though the sample sizes in the higher size range are too low to conclude. In contrast the SI values by length for the monk shows a systematic bias toward negative values (*Welwitchia* with higher catches) for all length classes but where the sample size is extremely small.

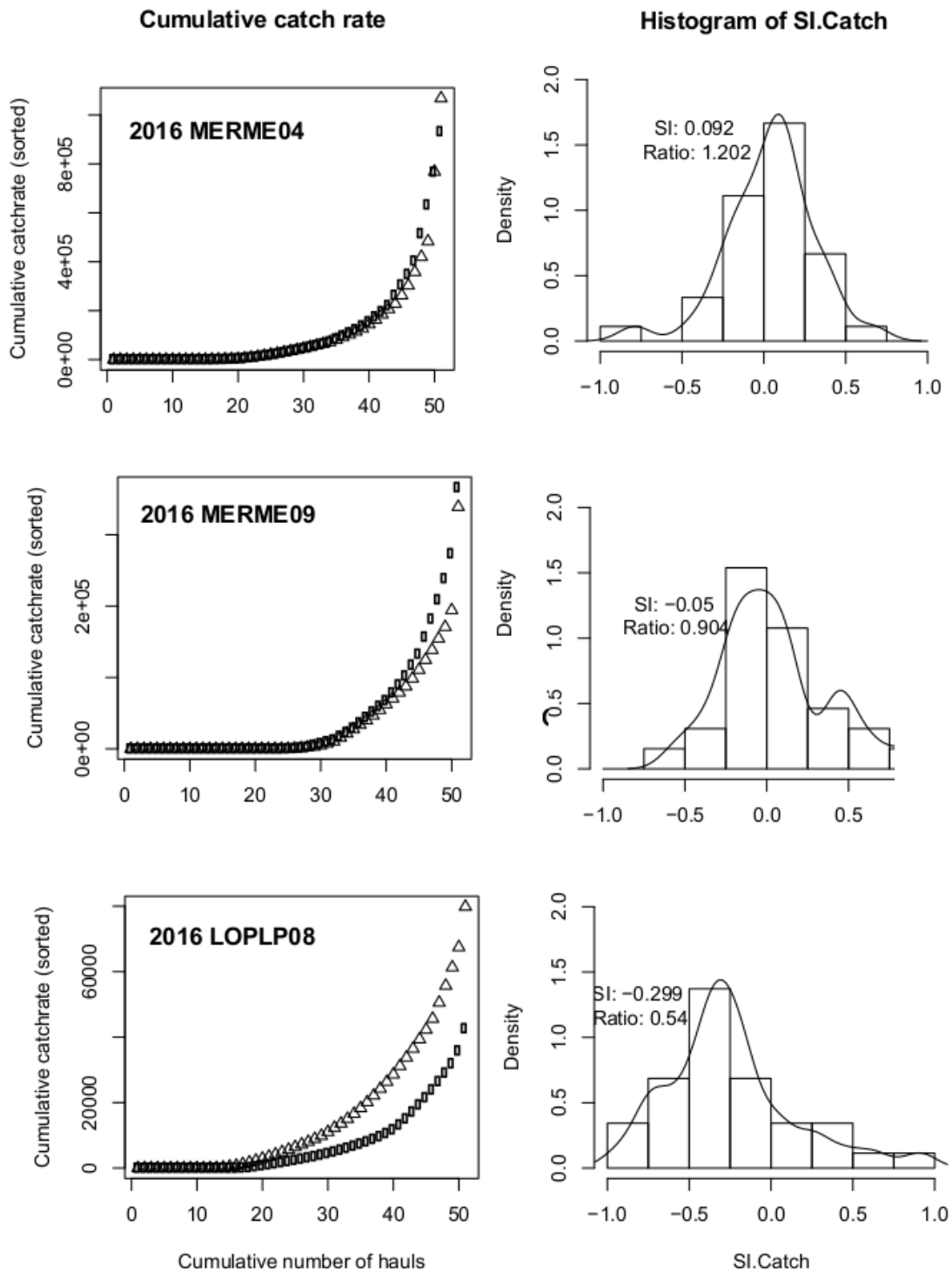


Figure 4.1. Left: Cumulative catch rates for two vessels overplot. Nansen (squares), Mirabilis(triangles). Right: Density distribution of similarity index (SI) from XX pair hauls. Three species: *Merluccius capensis* (top), *Merluccius paradoxus* (center), *Lophius xx*(bottom)

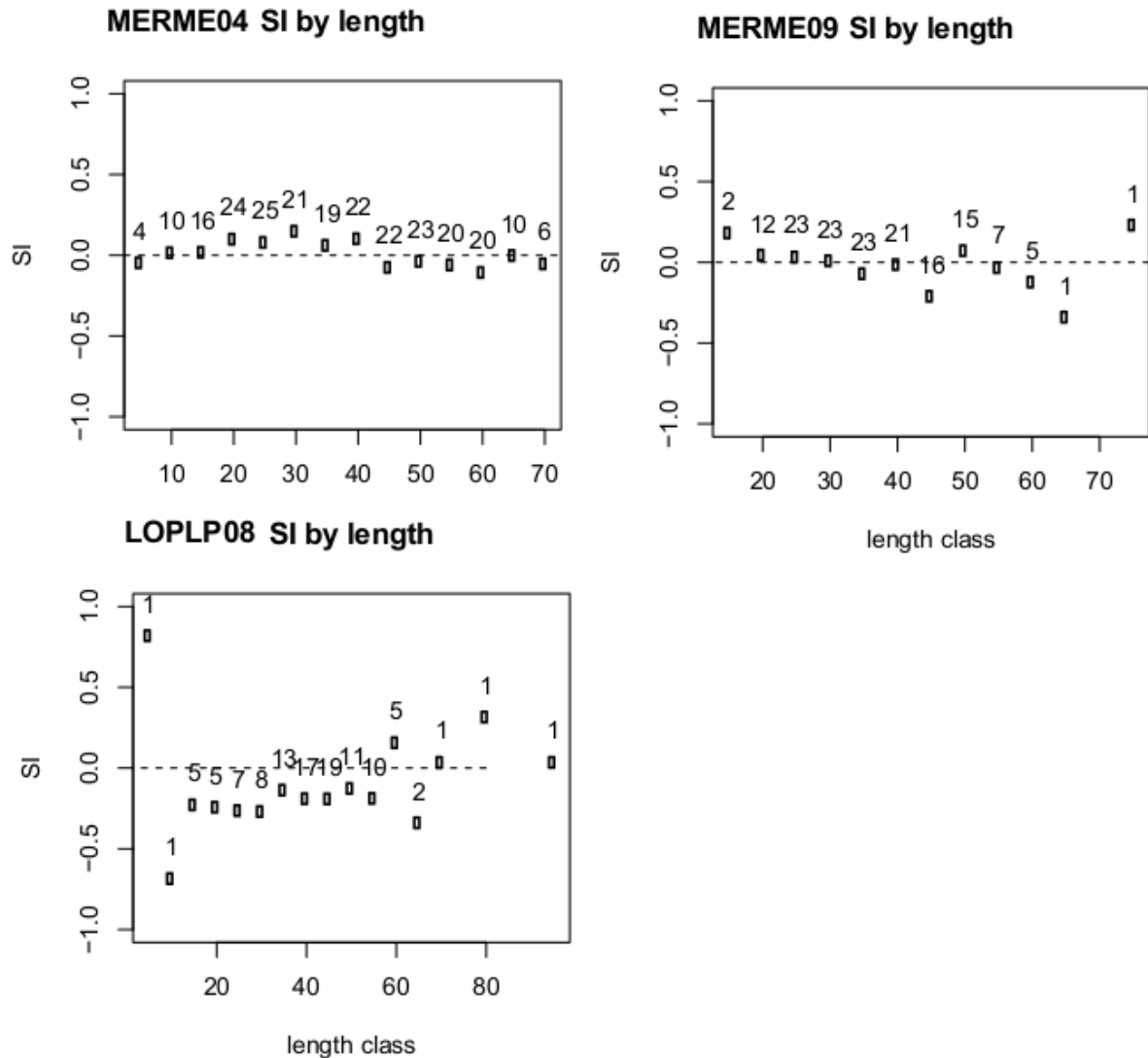


Figure 4.2 Mean similarity index (SI) by 5-cm length classes for three species in intercalibration trials in 2016. MERME04=Merluccius capensis, MERME09=Merluccius paradoxus, LOPLP08: Lophius volmerinus.

4.3 Comparisons with intercalibration trials in 2015.

The first intercalibration between Nansen and Mirabilis was carried out in January 2015. It was only possible to dedicate 7 days for this work which led to 25 successful intercalibration pairs. The data has been analysed with same methods as for the 2016 trials and the figures are included in this report as annex 4. They show that Nansen is consistently catching at higher

rates than Mirabilis also for all length classes of both hakes. However for the monk both vessels perform the same. The reason for these results are that the trawl setup of Mirabilis was not optimal in 2015, with insymmetry as a result. This gives the strange result that both vessels perform bad for the monk in 2015, but for different reasons. Nansen performs 'bad because of light bottom contact, while Mirabilis performs bad because of unsymmetry in the trawl geometry.

5 Discussion and conclusions.

The 57 successful pair trials in 2016 is 24 pairs short of the target due to technical errors with Dr. Fridtjof Nansen. Hence the conclusions are not as statistically robust as it would be from a complete set of data. The general conclusion is that Dr. Fridtjof Nansen and Mirabilis performs the same for both hakes in 2016. This is in line with previous experiments with Blue Sea that also confirmed that the vessel effect is negligible for the hakes when trawls and procedures are identical. Thus the catch rates from Mirabilis from 2016 onwards can be used in the time series without correction. In 2015 the Mirabilis had an unsymmetric rigging of the trawl system and the catches would thus be less than in an optimal rigging. Serious caution should therefore be applied in using these data in the time series of the hakes and should likely be avoided. From the limited intercalibration hauls in 2015 the size range 20-50cm seems seriously underrepresented in Mirabilis catches, indicating a loss in the order of 50%.

The Mirabilis is consistently catching more monk than Dr. Fridtjof Nansen in 2016. This is a pattern confirmed in earlier calibrations in 1998, 1999, 2002 and 2009 with Blue Sea and other commercial vessels. The reason Nansen catch less monk is because it has a slightly lighter bottom contact due to a 60cm strap mounted on the top bridles since 1990. This strap is not included in the drawing of the bridles which has been used by the trawl manufacturer for NATMIRC. The strap has been introduced to avoid the trawl digging into soft bottom by giving the trawl bag a slight lift vector. This has severe effect on the catchability of monk, but not for the hakes that does not stick that close to bottom, the results show. The bottom trawls rigging used in the Namibian national surveys are therefore not completely identical to the rigging used by the Dr. Fridtjof Nansen as earlier assumed. This has a severe effect on the Nansen's catchability on bottom dwelling species such as monk and sole, but minor or negligible effect on the hakes. The advantage of the strap is that one has a lower probability in digging into the mud in soft bottoms thus having a higher rate of successful hauls in these areas.

6 References

- Stenevik, E.K., Lipinski, M. and Zaera, D. 2009. Transboundary survey between Namibia and South Africa with focus on the juvenile stage of deep water hake. Survey No. 2 2009. 28 pp. Mimeo.
- Strømme, T., and Lilende T 2001 Precision in systematic trawl surveys as assessed from replicate sampling by parallel trawling off Namibia. S Afr J Mar Sci 23:385-396

Annex 1 Records of fishing station

start stop duration Lon E 14° 20. 22
 TIME : 06:16:03 06:46:46 30.7 (min)
 LOG : 9679.35 9680.95 1.6
 FDEPTH: 443 437
 BDEPTH: 443 437
 Towing dir: 0° Wire out : 950 m
 Sorted : 167 Total catch: 166.93

Towing dir: 0° Wire out : 480 m Speed : 3.2 kn
 Sorted : 248 Total catch: 2912.13 Catch/hour: 5691.46

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Merluccius capensis	5370.49	45000	94.36
Ascidacea	88.14	0	1.25
Chelidoniichthys capensis	62.21	139	1.09
Callorhynchus capensis	46.91	47	0.82
Sufflogobius bi barbatus	43.62	7073	0.77
Trachurus capensis	40.38	186	0.71
Austrogllossus microlepis	17.18	115	0.30
Austrogllossus microlepis	6.76	14	0.12
Exodromia sp.	5.57	324	0.16
G A S T R O P O D S	4.07	487	0.07
Pterygosquilla armata capensis	2.89	301	0.05
Lampanyctodes hectoris	1.86	672	0.03
Myxine capensis	1.39	23	0.02
Total	5691.46	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 13
 DATE : 16/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 28° 33.08
 start stop duration Lon E 14° 40.21
 TIME : 05:10:57 05:41:20 30.4 (min)
 LOG : 9815.75 9817.45 1.7
 FDEPTH: 170 172
 BDEPTH: 170 172
 Towing dir: 0° Wire out : 420 m Speed : 3.3 kn
 Sorted : 215 Total catch: 281.10 Catch/hour: 554.99

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Trachurus capensis	108.98	936	19.64
Merluccius capensis	86.67	63	15.62
Chelidoniichthys capensis	80.55	154	14.51
Chelidoniichthys queketti	65.55	397	11.81
Sea urchin	42.65	683	7.68
Etrumeus whiteheadi	26.85	308	4.84
Zeus capensis	20.57	18	3.71
Loligo reynaudi	20.14	57	3.63
Thyrustes atun	17.18	22	3.09
PORIFERA (Sponges)	14.61	0	2.63
Congopodus spinifer	12.75	71	2.30
Raja straeleni	7.31	2	1.32
Callorhynchus capensis	6.91	4	1.25
Lepidopus caudatus	6.91	4	1.25
Emmelichthys nitidus	5.21	602	0.94
Polypriion americanus	4.74	2	0.85
Squalus megalops	4.74	10	0.85
Holohalaelurus regani	3.55	14	0.63
Cynoglossus zanzibarensis	3.47	39	0.63
Squalus acanthias	2.76	2	0.50
CYPRAEIDAE (Bulia)	1.82	16	0.33
Scomber colias	1.78	4	0.32
Scyliorhinus capensis	1.58	16	0.28
Todaropsis eblanae	1.50	51	0.27
Starfish - fleshy	1.46	12	0.26
Anemones, white	1.18	4	0.21
Merluccius capensis	1.18	4	0.21
Sepia australis	0.83	47	0.15
Starfish white 5 arms	0.33	20	0.06
Loligo reynaudi	0.30	2	0.05
Gonorynchus gonorynchus	0.28	2	0.05
Giant bullia gastropod	0.26	4	0.05
Sepia hieronis	0.20	4	0.04
Ophiuroidea	0.15	71	0.03
Arnglossus capensis	0.04	4	0.01
Total	554.99	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 14
 DATE : 16/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 28° 41.08
 start stop duration Lon E 14° 22.00
 TIME : 08:20:01 08:50:00 30.0 (min)
 LOG : 9839.31 9840.87 1.6
 FDEPTH: 458 463
 BDEPTH: 458 463
 Towing dir: 0° Wire out : 1000 m Speed : 3.1 kn
 Sorted : 273 Total catch: 272.72 Catch/hour: 545.80

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
Merluccius paradoxus	237.36	426	43.49
Rajilla barnardi	79.65	66	14.59
Coelorhynchus simorhynchus	68.05	851	12.47
Gerypteris capensis	65.16	36	11.94
Lophius vomerinus	20.61	4	3.78
Helicolenus dactylopterus	11.33	24	2.08
Octopus magnificus	11.01	2	2.02
Todarodes angolensis, female	6.60	10	1.21
Raja straeleni	6.40	4	1.17
Hydrolagus sp.	5.40	6	0.99
Selachophidi um guentheri	3.80	36	0.70
Gymnoscopelus sp.	3.50	438	0.64
Lucigadus ori	3.20	68	0.59
Nezumia micronychodon	3.20	92	0.59
Phosichthys argentatus	2.80	112	0.51
Bassanago albescens	2.52	14	0.46
Ruvettus pretiosus	2.20	2	0.40
Ebuniana costaecanarie	2.00	12	0.37
Anemones, white	1.86	12	0.34
Starfish - fleshy	1.50	6	0.28
Starfish (large)	1.20	2	0.22
Funchalia woodwardi	1.18	78	0.22
Tripterophycis gilchristi	0.90	36	0.17
Holohalaelurus regani	0.80	2	0.15
Parapagurus pilosimanus	0.80	58	0.15
Etmopterus brachyurus	0.40	18	0.07
Beryx splendens	0.40	2	0.07
Todarodes angolensis, male	0.26	2	0.05
PORIFERA (Sponges)	0.20	0	0.04
Todarodes angolensis, juvenile	0.17	4	0.03
G A S T R O P O D S	0.14	26	0.03
Epi gonus sp.	0.12	8	0.02
Coelorhynchus simorhynchus	0.11	24	0.02
Rossea enigmatica	0.10	4	0.02
Lycoteuthis lorigera	0.10	10	0.02
Starfish (pentagon)	0.09	2	0.02
Galeus polli	0.09	2	0.02
Lestrolepis intermedia	0.08	10	0.01
PORIFERA (Sponges)	0.07	0	0.01
Notacanthus sexspinis	0.07	4	0.01
Neosopelus macrolepidotus	0.06	2	0.01
Scopelus meadi	0.06	2	0.01
Shark eggs	0.03	4	0.01
Sea pens	0.03	2	0.01
Howella sherborni	0.03	4	0.01
Rochinia sp.	0.02	4	0.00
Starfish - many arms	0.02	2	0.00
Stoloteuthis leucoptera	0.02	2	0.00
Total	545.74	99.99	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 11
 DATE : 15/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 27° 19.58
 start stop duration Lon E 14° 47.57
 TIME : 11:38:02 12:09:14 31.2 (min)
 LOG : 9714.47 9716.07 1.6
 FDEPTH: 288 287
 BDEPTH: 288 287
 Towing dir: 0° Wire out : 630 m Speed : 3.1 kn
 Sorted : 295 Total catch: 303.34

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
PORIFERA (Sponges)	323.08	0	55.38
Merluccius capensis	61.92	352	10.62
Gerypteris capensis	48.46	56	8.31
Chrysaora hyosocella	38.46	0	6.59
Lophius vomerinus	30.00	19	5.14
Pterygosquilla armata capensis	25.46	1787	4.36
Raja straeleni	17.54	8	1.98
Merluccius paradoxus	9.62	83	1.65
Helicolenus dactylopterus	6.15	88	1.05
Sufflogobius barbatus	5.44	1813	0.93
Callorhynchus capensis	4.23	4	0.73
Galeus polli	3.79	54	0.65
Aequorea forskalea	2.88	6	0.49
Ascidacea	2.60	0	0.45
Todarodes angolensis, female	2.31	4	0.40
Coelorhynchus simorhynchus	1.71	29	0.29
Starfish white 5 arms	1.38	462	0.24
G A S T R O P O D S	1.29	96	0.22
Trachurus capensis	0.96	6	0.16
Lepidopus caudatus	0.38	4	0.07
Sepia hieronis	0.36	12	0.06
Starfish - many arms	0.31	31	0.05
Todarodes angolensis	0.30	2	0.05
Todaropsis eblanae, male	0.22	2	0.04
Lampanyctodes hectoris	0.20	121	0.03
Bathynectes piperitus	0.17	12	0.03
Exodromia sp.	0.13	9	0.02
Total	583.36	100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 12
 DATE : 15/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 27° 15.63
 start stop duration Lon E 14° 54.36
 TIME : 13:36:31 14:07:13 30.7 (min)
 LOG : 9725.39 9727.05 1.7
 FDEPTH: 198 202
 BDEPTH: 198 202

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 15
 DATE : 16/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 28° 45.88

Towing dir: 0° Wire out: 450 m Speed: 2.9 kn
Sorted: 443 Total catch: 1351.14 Catch/hour: 2693.31

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius capensis	1804.58	0	67.00	131
Chrysosara hysoscella	598.01	0	22.20	
Aequorea forskalea	142.58	3704	5.29	
Giant bullia gastropod	119.60	5201	4.44	
Nudi branches	8.97	2563	0.33	
Sufflogobius barbatus	7.38	1967	0.27	
Thyrises atun	6.78	2	0.25	
Pterygosquilla armata capensis	2.95	197	0.11	
Ascidacea	2.46	319	0.09	
Total	2693.31		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 31
DATE: 26/01/16 GEAR TYPE: BT No: 26 POSITION: Lat S 24° 21.46 Lon E 13° 53.02
TIME: 06:54:52 07:21:57 27.1 (min) Purpose: 3
LOG: 653.15 654.51 1.4 Region: 5000
FDEPTH: 281 280 Gear cond.: 0
BDEPTH: 281 280 Validity: 0
Towing dir: 0° Wire out: 660 m Speed: 3.0 kn
Sorted: 207 Total catch: 1067.42 Catch/hour: 2365.03

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius capensis	1154.58	12603	48.82	134
Coelorinchus simorhynchus	650.07	11306	27.49	
Merluccius capensis	147.12	208	6.22	133
PORIFERA (Sponges)	79.76	0	3.37	
CYPRAEIDAE (Bulia)	74.18	6450	3.14	
Lophius vomerinus	72.45	93	3.06	132
Pterygosquilla armata capensis	57.63	2883	2.44	
Ascidacea	46.26	3855	1.96	
Trachurus capensis	38.49	179	1.63	
Sufflogobius barbatus	19.94	6647	0.84	
Macropodus australis	5.58	140	0.24	
Starfish white 5 arms	5.18	3456	0.22	
Todarodes ahlanae	4.79	120	0.20	
Austrogladius micropus	2.59	20	0.11	
Merluccius capensis	2.39	299	0.10	135
Chlorophthalmus agassizi	1.20	279	0.05	
Exodromia sp.	1.00	80	0.04	
Krill	0.70	4188	0.03	
Nudi branches	0.64	359	0.03	
Hexanchus griseus	0.40	20	0.02	
Lampanyctodes hectoris	0.06	40	0.00	
Total	2365.01		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 32
DATE: 26/01/16 GEAR TYPE: BT No: 26 POSITION: Lat S 24° 21.71 Lon E 13° 41.36
TIME: 08:52:35 09:21:26 28.9 (min) Purpose: 3
LOG: 666.84 668.24 1.4 Region: 5000
FDEPTH: 333 331 Gear cond.: 0
BDEPTH: 333 331 Validity: 0
Towing dir: 0° Wire out: 780 m Speed: 2.9 kn
Sorted: 206 Total catch: 1029.97 Catch/hour: 2142.06

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	857.89	4164	40.05	140
Heart urchin	418.65	0	19.54	
Helicolenus dactylopterus	194.45	2745	9.08	152
Coelorinchus simorhynchus	177.07	3340	8.27	
Merluccius capensis	151.20	114	7.06	137
Nezumia micronychodon	100.66	2516	4.70	
Lophius vomerinus	73.00	42	3.41	138
Galeus polli	42.32	435	1.98	
Selachophis dium guentheri	26.08	1133	1.22	
Genypterus capensis	24.12	12	1.13	139
Trachurus capensis	15.79	46	0.74	
PORIFERA (Sponges)	14.64	0	0.68	
Bathynectes piperitus	14.41	824	0.67	
CYPRAEIDAE (Bulia)	12.81	549	0.60	
Todarodes angolensis, female	5.82	6	0.27	
Epi gonus sp.	5.49	34	0.26	
G A S T R O P O D S	1.60	92	0.07	
Shrimps, small, non comm.	1.60	480	0.07	
Lepidopus caudatus	1.41	4	0.07	
Pterygosquilla armata capensis	1.14	69	0.05	
Todarodes angolensis, male	1.14	2	0.05	
Ebi nania costaeanae	0.69	46	0.03	
Symbolophorus boops	0.07	23	0.00	
Total	2142.06		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 33
DATE: 26/01/16 GEAR TYPE: BT No: 26 POSITION: Lat S 24° 21.30 Lon E 13° 24.87
TIME: 11:17:33 11:50:19 32.8 (min) Purpose: 3
LOG: 683.77 685.39 1.6 Region: 5000
FDEPTH: 390 386 Gear cond.: 0
BDEPTH: 390 386 Validity: 0
Towing dir: 0° Wire out: 880 m Speed: 3.0 kn
Sorted: 304 Total catch: 344.79 Catch/hour: 631.28

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	292.95	1329	46.41	146
Coelorinchus simorhynchus	111.69	1619	17.69	
Genypterus capensis	56.03	31	8.88	144
Merluccius paradoxus	46.32	53	7.34	143
Nezumia micronychodon	20.14	575	3.19	
Merluccius capensis	19.59	11	3.10	142
Rajella barnardi	14.65	13	2.32	
Epi gonus denticulatus	10.25	320	1.62	
Lophius vomerinus	9.89	5	1.57	145
Helicolenus dactylopterus	7.40	35	1.17	141
Dipturus dotrei	7.32	2	1.16	
Chaceon maritae	6.04	13	0.96	
Beryx splendens	5.13	31	0.81	
Hexanchus griseus	4.76	2	0.75	
Todarodes angolensis	4.61	9	0.73	
G A S T R O P O D S	3.15	7	0.50	
Krill	3.11	0	0.49	
Todarodes angolensis, female	3.00	4	0.48	
Rajella leopardus	2.89	2	0.46	
Selachophis dium guentheri	1.25	22	0.20	
Muni da sp.	0.44	220	0.07	
CYPRAEIDAE (Bulia)	0.29	7	0.05	
Symbolophorus boops	0.13	22	0.02	
Phosichthys argenteus	0.07	7	0.01	
Notacanthus sexspinis	0.07	4	0.01	
Shrimps, small, non comm.	0.07	11	0.01	
Ebi nania costaeanae	0.02	4	0.00	
Sea cucumber	0.01	4	0.00	
Nudi branches	0.01	4	0.00	
Total	631.28		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 34
DATE: 26/01/16 GEAR TYPE: BT No: 26 POSITION: Lat S 24° 10.33 Lon E 13° 17.73
TIME: 13:24:57 13:55:05 30.1 (min) Purpose: 3
LOG: 639.24 638.80 1.6 Region: 5000
FDEPTH: 478 468 Gear cond.: 0
BDEPTH: 478 468 Validity: 0
Towing dir: 0° Wire out: 1030 m Speed: 3.1 kn
Sorted: 359 Total catch: 767.09 Catch/hour: 1527.56

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachyrincus scabrurus	658.35	0	43.10	
Merluccius paradoxus	314.84	1231	20.61	150
Nezumia micronychodon	109.72	2011	7.18	
Merluccius paradoxus	79.65	102	5.21	149
Lophius vomerinus	68.50	18	4.48	148
Galeus polli	47.93	564	3.14	
Hoplostethus mediterraneus	41.24	2011	2.70	
Selachophis dium guentheri	39.47	472	2.58	
Shrimps, small, non comm.	21.94	10972	1.44	
Li thodes ferox	15.13	36	0.99	
Helicolenus dactylopterus	14.46	62	0.95	151
Genypterus capensis	13.34	4	0.87	147
Rajella barnardi	12.94	14	0.85	
Etmopterus sculpinus	12.61	25	0.83	
Todarodes angolensis, female	9.96	14	0.65	
Notacanthus sexspinis	8.32	189	0.54	
Centrophorus squamosus	7.17	2	0.47	
Todarodes angolensis, male	5.58	12	0.37	
CYPRAEIDAE (Bulia)	5.55	480	0.36	
Ancistrocheilus lesueurii	4.78	2	0.31	
Chaceon maritae	4.58	6	0.30	
Gonostoma elongatum	4.29	452	0.27	
Epi gonus denticulatus	4.16	163	0.27	
Rajella leopardus	3.58	4	0.23	
Ebi nania costaeanae	3.28	50	0.21	
Funchalia woodwardi	3.03	655	0.20	
Centrolophus niger	2.99	2	0.20	
Schedophilus huttoni	2.59	2	0.17	
Anemones, white	2.27	13	0.15	
Muni da sp.	1.64	1639	0.11	
G A S T R O P O D S	1.01	102	0.07	
Phosichthys argenteus	0.50	50	0.03	
Hermit, mixed	0.38	38	0.02	
Di lophos taenia	0.31	13	0.02	
Ascidans	0.31	13	0.02	
Bathypolypus valdiviae	0.30	13	0.02	
Symbolophorus boops	0.29	13	0.02	
Chauliodus sloani	0.29	13	0.02	
Octopoteuthis sicula	0.25	16	0.02	
Total	1527.56		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 35
DATE: 27/01/16 GEAR TYPE: BT No: 26 POSITION: Lat S 24° 0.96 Lon E 13° 13.44
TIME: 05:08:14 05:38:26 30.2 (min) Purpose: 3
LOG: 725.95 727.50 1.6 Region: 5000
FDEPTH: 465 465 Gear cond.: 0
BDEPTH: 465 465 Validity: 0
Towing dir: 0° Wire out: 990 m Speed: 3.1 kn
Sorted: 94 Total catch: 170.18 Catch/hour: 338.10

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	76.29	268	22.56	155
Hoplostethus cadonati	43.07	1566	12.74	
Li thodes ferox	31.79	0	9.40	
Nezumia micronychodon	26.86	779	7.94	
Rajella barnardi	26.23	30	7.76	
Selachophis dium guentheri	22.01	262	6.51	
Galeus polli	18.99	310	5.62	
Di aphus sp.	12.48	1313	3.69	
Coelorinchus simorhynchus	12.08	103	3.57	
Lophius vomerinus	11.13	10	3.29	154
Schedophilus huttoni	7.95	4	2.35	
Epi gonus telescopus	7.39	284	2.19	
Helicolenus dactylopterus	6.36	93	1.88	153
Sergia sp.	6.36	2825	1.88	
Artibeus sp.	4.61	769	3.99	
Myxine capensis	4.53	79	1.34	
G A S T R O P O D S	3.58	318	1.06	
B I V A L V E S	3.18	501	0.94	
Todarodes angolensis, male	2.58	8	0.76	
Ebi nania costaeanae	2.51	26	0.74	
Todarodes angolensis, female	2.38	4	0.70	
Notacanthus sexspinis	2.15	56	0.63	
Chaceon maritae	1.39	4	0.41	
Muni da sp.	0.64	485	0.19	
Starfish white 5 arms	0.22	16	0.07	
Trachyrincus scabrurus	0.21	16	0.06	
Bathypolypus valdiviae	0.21	16	0.06	
Stereomastis sp.	0.18	72	0.05	
MYCTOPHIDAE	0.12	32	0.04	
P O L Y C H A E T A	0.10	24	0.03	
Symbolophorus boops	0.10	16	0.03	
Di aphus sp.	0.09	24	0.03	0
HISTIOTEUTHIDAE	0.09	8	0.03	
Chauliodus sloani	0.08	16	0.02	
Hermit, mixed	0.07	8	0.02	
AXIIDAE	0.05	8	0.01	
Shark eggs	0.04	8	0.01	
MYCTOPHIDAE	0.02	8	0.01	0
Total	338.10		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 36
DATE: 27/01/16 GEAR TYPE: BT No: 26 POSITION: Lat S 24° 1.75 Lon E 13° 18.32
TIME: 07:07:07 07:37:35 30.6 (min) Purpose: 3
LOG: 737.38 738.86 1.5 Region: 5000
FDEPTH: 341 344 Gear cond.: 0
BDEPTH: 341 344 Validity: 0
Towing dir: 0° Wire out: 810 m Speed: 2.9 kn
Sorted: 187 Total catch: 335.62 Catch/hour: 658.72

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Helicolenus dactylopterus	210.89	0	32.02	160
Coelorinchus simorhynchus	149.75	2909	22.73	
Merluccius capensis	90.48	0	13.74	156
Merluccius paradoxus	74.58	0	11.32	159
Todarodes angolensis, female	18.25	29	2.77	
Todarodes angolensis, male	18.06	53	2.74	
Lophius vomerinus	15.90	0	2.41	157
Galeus polli	15.53	173	2.36	
Genypterus capensis	13.94	0	2.12	158
Selachophis dium guentheri	9.82	220	1.49	
Hexanchus griseus	6.08	2	0.92	
Schedophilus huttoni	6.08	2	0.92	
Bathynectes piperitus	5.70	228	0.87	
Shrimps, small, non comm.	5.50	1466	0.83	
Rajella barnardi	4.71	4	0.72	
Epi gonus denticulatus	4.60	234	0.70	
Brama brama	2.16	2	0.33	
Anemones, white	1.65	14	0.25	
CYPRAEIDAE (Bulia)	1.24	55	0.19	
Nezumia micronychodon	0.96	77	0.15	
Chlorophthalmus agassizi	0.89	27	0.14	
Lampanyctodes hectoris	0.62	77	0.09	
PORIFERA (Sponges)	0.55	0	0.08	
Total				

Lithodes ferox	0.34	7	0.05
Ebiwania costaeacanarie	0.21	7	0.03
Hopllostethus cadonati	0.14	7	0.02
Mini da sp.	0.08	96	0.01
Total	658.72		100.00

Sorted : 532 Total catch: 686.40 Catch/hour: 1373.72

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 37
DATE : 27/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 24° 1.37 Lon E 13° 25.61
start stop duration Purpose : 3
TIME : 09:07:08 09:37:13 30.1 (min) Region : 5000
LOG : 749.87 751.15 1.5 Gear cond. : 0
FDEPTH: 295 294 Validity : 0
BDEPTH: 295 294
Towing dir: 0° Wire out : 680 m Speed : 3.0 kn
Sorted : 206 Total catch: 1276.87 Catch/hour: 2546.11

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Heart urchin	1022.93	0	40.18
PORIFERA (Sponges)	551.84	0	21.67
Helicolenus dactylopterus	376.87	9480	14.80
Merluccius capensis	197.21	373	7.75
Chlorophthalmus agassizi	145.36	4690	5.71
Galeus polli	82.10	1081	3.22
Lophius vomerinus	44.07	48	1.73
Trachurus capensis	42.87	104	1.68
Coelornichus simorhynchus	41.72	1077	1.64
Todarodes angolensis, female	20.34	34	0.80
Bathymectes peritius	6.73	359	0.26
CYPRAEIDAE (Bulia)	4.49	315	0.18
Todarodes angolensis, male	4.39	10	0.17
Brama brama	1.99	2	0.08
Starfish white 5 arms	1.79	495	0.07
Sepia hieronis	1.39	45	0.05
Total	2546.11		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 38
DATE : 27/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 24° 0.39 Lon E 13° 36.52
start stop duration Purpose : 3
TIME : 11:17:48 11:49:02 31.2 (min) Region : 5000
LOG : 764.09 765.60 1.5 Gear cond. : 0
FDEPTH: 276 273 Validity : 0
BDEPTH: 276 273
Towing dir: 0° Wire out : 650 m Speed : 2.9 kn
Sorted : 0 Total catch: 589.10 Catch/hour: 1131.43

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Helicolenus dactylopterus	221.25	8059	19.56
PORIFERA (Sponges)	201.28	0	17.79
Coelornichus simorhynchus	152.11	4112	13.44
Trachurus capensis	120.15	338	10.62
Heart urchin	118.31	0	10.46
Merluccius capensis	97.76	125	8.64
Merluccius capensis	78.94	701	6.98
Chlorophthalmus agassizi	59.00	3278	5.21
Merluccius capensis	21.51	338	1.90
Chrysaora hyosocella	17.21	0	1.52
Lophius vomerinus	13.64	15	1.21
Macropus australis	9.53	280	0.84
Pterygosquilla armata capensis	4.92	200	0.43
Todarodes angolensis, female	4.07	6	0.36
CYPRAEIDAE (Bulia)	3.84	292	0.34
Galeus polli	2.46	31	0.22
Todarodes angolensis, male	1.84	4	0.16
Starfish white 5 arms	1.38	691	0.12
Sufflogobius barbatus	0.77	77	0.07
Sepia hieronis	0.60	46	0.05
Todaropsis eblanae	0.52	15	0.05
Lampanyctodes hectoris	0.34	92	0.03
Total	1131.43		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 39
DATE : 27/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 24° 1.49 Lon E 13° 50.96
start stop duration Purpose : 3
TIME : 14:04:57 14:36:01 31.1 (min) Region : 5000
LOG : 783.21 784.81 1.6 Gear cond. : 0
FDEPTH: 247 243 Validity : 0
BDEPTH: 247 243
Towing dir: 0° Wire out : 590 m Speed : 3.1 kn
Sorted : 122 Total catch: 627.23 Catch/hour: 1211.26

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Merluccius capensis	594.11	7018	49.05
PORIFERA (Sponges)	125.72	0	10.38
Coelornichus simorhynchus	102.20	2377	8.44
Macropus australis	78.27	2337	6.46
Ascidacea	67.52	5871	5.57
Chrysaora hyosocella	57.93	0	4.78
Sufflogobius barbatus	52.72	5857	4.35
Merluccius capensis	33.02	42	2.73
Lophius vomerinus	21.82	21	1.80
BIVALLVE S	16.63	4158	1.37
CYPRAEIDAE (Bulia)	15.00	1249	1.24
JELLYFISH	9.73	20	0.80
Todarodes angolensis, female	8.11	14	0.67
Merluccius capensis	5.07	608	0.42
Trachurus capensis	4.75	23	0.39
Austroglossus microlepis	3.01	6	0.25
Todarodes angolensis, male	2.70	6	0.22
Lophius vomerinus	2.03	81	0.17
Chelidonicichthys capensis	1.93	4	0.16
Starfish white 5 arms	1.82	730	0.15
Pterothrissus belloci	1.62	20	0.13
Chlorophthalmus agassizi	1.32	467	0.11
Todaropsis eblanae	1.22	20	0.10
Pterygosquilla armata capensis	1.01	41	0.08
Galeus polli	1.01	20	0.08
Lampanyctodes hectoris	0.28	102	0.02
Exodromia da sp.	0.28	20	0.02
Helicolenus dactylopterus	0.18	20	0.02
Anemones, white	0.12	20	0.01
Helicolenus dactylopterus	0.10	122	0.01
Total	1211.26		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 40
DATE : 27/01/16 GEAR TYPE: BT NO: 26 POSITION: Lat S 24° 1.07 Lon E 14° 1.41
start stop duration Purpose : 3
TIME : 16:03:41 16:23:47 20.1 (min) Region : 5000
LOG : 796.58 797.33 0.8 Gear cond. : 0
FDEPTH: 203 202 Validity : 5
BDEPTH: 203 202
Towing dir: 0° Wire out : 510 m Speed : 2.2 kn
Sorted : 0 Total catch: 0.00 Catch/hour: 0.00

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
N O C A T C H	0.00	0	0.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 41
DATE : 28/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23° 40.59 Lon E 13° 59.13
start stop duration Purpose : 3
TIME : 05:00:19 05:30:18 30.0 (min) Region : 5000
LOG : 821.30 822.86 1.6 Gear cond. : 0
FDEPTH: 174 172 Validity : 0
BDEPTH: 174 172
Towing dir: 0° Wire out : 440 m Speed : 3.1 kn

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Chrysaora hyosocella	600.40	0	43.71
Merluccius capensis	389.06	6522	28.32
BIVALLVE S	360.24	0	26.22
Acqueria forskalea	20.01	0	1.46
Starfish white 5 arms	1.76	544	0.13
CYPRAEIDAE (Bulia)	0.96	96	0.07
Sufflogobius barbatus	0.88	472	0.06
Ascidans	0.24	16	0.02
Nudi branches	0.08	16	0.01
Anemones, white	0.08	48	0.01
Total	1373.72		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 42
DATE : 28/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23° 41.06 Lon E 13° 48.11
start stop duration Purpose : 3
TIME : 06:52:33 07:12:40 20.1 (min) Region : 5000
LOG : 833.62 834.71 1.1 Gear cond. : 0
FDEPTH: 192 191 Validity : 0
BDEPTH: 192 191
Towing dir: 0° Wire out : 480 m Speed : 3.3 kn
Sorted : 315 Total catch: 1936.62 Catch/hour: 5775.21

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Trachurus capensis	3834.99	19980	66.40
Merluccius capensis	1404.57	14076	24.32
Merluccius capensis	369.78	432	6.40
Coelornichus simorhynchus	45.33	984	0.78
Sufflogobius barbatus	31.61	3573	0.55
Pterothrissus belloci	18.49	149	0.32
Lophius vomerinus	17.48	15	0.30
JELLYFISH	10.74	30	0.19
Macropus australis	9.24	328	0.16
Chelidonicichthys capensis	8.65	15	0.15
CYPRAEIDAE (Bulia)	6.56	716	0.11
Starfish white 5 arms	5.07	1581	0.09
Todarodes angolensis, female	4.00	9	0.07
Lophius vomerinus	2.68	30	0.05
Merluccius capensis	2.39	268	0.04
Ascidans	1.19	89	0.02
Lepidopus caudatus	0.95	3	0.02
Todarodes angolensis, male	0.80	3	0.01
Pterygosquilla armata capensis	0.60	30	0.01
Chlorophthalmus agassizi	0.30	30	0.01
Total	5775.21		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 43
DATE : 28/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23° 40.98 Lon E 13° 35.73
start stop duration Purpose : 3
TIME : 09:33:11 10:03:15 30.1 (min) Region : 5000
LOG : 848.21 849.78 1.6 Gear cond. : 0
FDEPTH: 228 227 Validity : 0
BDEPTH: 228 227
Towing dir: 0° Wire out : 555 m Speed : 3.1 kn
Sorted : 413 Total catch: 428.98 Catch/hour: 856.25

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Trachurus capensis	359.28	950	41.96
Merluccius capensis	283.43	291	33.06
Merluccius capensis	108.78	908	12.70
Chrysaora hyosocella	29.94	0	3.50
Sufflogobius barbatus	22.16	1846	2.59
Coelornichus simorhynchus	13.41	327	1.01
Chelidonicichthys capensis	8.62	14	0.17
Thyrssites atun	7.47	2	0.87
Todarodes angolensis, female	7.27	12	0.85
Macropus australis	6.95	198	0.81
Todarodes angolensis, male	4.19	8	0.49
PORIFERA (Sponges)	2.57	0	0.30
Chlorophthalmus agassizi	1.38	198	0.16
Lophius vomerinus	1.51	12	0.06
Synagrops microlepis	0.36	30	0.04
Todaropsis eblanae	0.24	6	0.03
CYPRAEIDAE (Bulia)	0.06	6	0.01
Merluccius capensis	0.03	12	0.00
Total	856.25		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 44
DATE : 28/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23° 41.31 Lon E 13° 25.40
start stop duration Purpose : 3
TIME : 11:26:35 11:54:44 28.1 (min) Region : 5000
LOG : 860.50 861.90 1.4 Gear cond. : 0
FDEPTH: 269 269 Validity : 0
BDEPTH: 269 269
Towing dir: 0° Wire out : 650 m Speed : 3.0 kn
Sorted : 263 Total catch: 816.93 Catch/hour: 1741.23

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Trachurus capensis	744.17	2447	42.74
Merluccius capensis	354.93	2784	20.38
Helicolenus dactylopterus	157.85	5478	9.07
Merluccius capensis	153.32	151	8.86
Chlorophthalmus agassizi	114.71	3888	6.59
Galeus polli	92.16	1660	5.29
Centrolophus niger	31.55	4	1.81
Coelornichus simorhynchus	23.33	953	1.34
Brama brama	17.68	15	1.02
Todarodes angolensis, female	14.75	23	0.85
PORIFERA (Sponges)	14.71	0	0.84
Thyrssites atun	7.33	2	0.42
Macropus australis	4.51	147	0.26
Todarodes angolensis, male	4.18	9	0.24
Trachipterus trachipterus	2.05	20	0.12
Chelidonicichthys capensis	1.28	2	0.07
Pterygosquilla armata capensis	0.88	38	0.05
Lampanyctodes hectoris	0.69	234	0.04
Merluccius capensis	0.10	30	0.01
Starfish white 5 arms	0.05	38	0.00
Total	1741.23		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 45
DATE : 28/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23° 41.13 Lon E 13° 15.05
start stop duration Purpose : 3
TIME : 13:17:50 13:49:13 31.4 (min) Region : 5000
LOG : 873.02 874.55 1.5 Gear cond. : 0
FDEPTH: 333 335 Validity : 0
BDEPTH: 333 335
Towing dir: 0° Wire out : 770 m Speed : 2.9 kn
Sorted : 294 Total catch: 348.48 Catch/hour: 666.32

SPECIES	CATCH/HOUR	% OF TOT. C	SAMP
weight numbers			
Merluccius capensis	352.01	350	52.83
Helicolenus dactylopterus	115.49	1681	17.33
Merluccius capensis	73.61	250	11.95
Chlorophthalmus agassizi	48.57	1350	7.29
Coelornichus simorhynchus	24.09	438	3.62
Todarodes angolensis, female	12.31	17	1.85
Galeus polli	10.59	111	1.59
Genypterus capensis	7.27	8	1.09
Schedophilus huttoni	6.50	2	0.98
Krill	3.82	0	0.57
Nezumia micronychodon	3.52	88	0.53
Todarodes angolensis, male	3.37	8	0.51
Lophius vomerinus	3.10	4	0.46
Symbolophorus boops	1.72	222	0.26
SHRIMP S	0.19	65	0.03
Merluccius capensis	0.10	0	0.01
Epigonus denticulatus	0.04	4	0.01
Solenocera africana	0.03	0	0.00
Total	666.32		100.00

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 46
 DATE : 28/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°41.66
 start stop duration Lon E 13°9.53
 TIME : 15:08:04 15:38:13 30.1 (min)
 LOG : 882.53 884.03 1.5
 FDEPTH: 426 432
 BDEPTH: 426 432
 Towing dir: 0° Wire out : 970 m
 Sorted : 224 Total catch: 318.19
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.0 kn
 Catch/hour: 633.21

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	220.10	792	34.76	202
Helicolenus dactylopterus	107.96	903	17.05	203
Hoplostethus cadenati	60.20	2314	9.51	
Lophius vomerinus	55.32	10	8.74	201
Coelorinchus simorhynchus	40.30	545	6.36	
Selachophidium guentheri	37.31	557	5.89	
Small shrimps	23.08	0	3.65	
Nezumia micronychodon	20.75	830	3.28	
Todarodes angolensis, male	13.89	30	2.19	
Genypterus capensis	11.94	4	1.89	200
Todarodes angolensis, female	10.95	16	1.73	
Galeus polli	9.25	105	1.46	
Schedophilus huttoni	5.73	2	0.91	
Epigonus denticulatus	3.53	96	0.56	
Aristeus variabilis	3.28	0	0.52	
Notacanthus sexspinus	3.08	139	0.49	
Lithodes ferox	1.83	2	0.29	
Etmopterus sp.	1.35	2	0.21	
Ebinania costaecanariae	1.14	25	0.18	
Rajella barnardi	0.68	2	0.11	
Diplodus taeniam	0.50	0	0.08	
Phosichthys argenteus	0.35	36	0.05	
CYPRAEIDAE (Bulia)	0.25	15	0.04	
Chlorophthalmus agassizi	0.16	5	0.03	
Symbolophorus boops	0.13	25	0.02	
Gonostoma sp.	0.04	5	0.01	
Lampadena sp.	0.04	5	0.01	
Gymnoscopelus sp.	0.03	5	0.01	
MCTOPHIDAE	0.01	5	0.00	
Total	633.21		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 47
 DATE : 29/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°20.66
 start stop duration Lon E 13°45.97
 TIME : 04:59:54 05:21:26 21.5 (min)
 LOG : 932.35 933.55 1.2
 FDEPTH: 165 165
 BDEPTH: 165 165
 Towing dir: 0° Wire out : 410 m
 Sorted : 262 Total catch: 646.33
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.4 kn
 Catch/hour: 1801.18

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	726.03	6482	40.31	
Merluccius capensis	534.16	7845	29.66	206
Chrysaora hyosocella	334.42	0	18.57	
Pterothrissus belloti	75.09	521	4.17	
Sufflogobius barbatus	38.73	4556	2.15	
Chelidoniichthys capensis	35.39	148	1.96	
Merluccius capensis	25.36	45	1.41	
BIVALVES	11.84	0	0.66	205
CYPRAEIDAE (Bulia)	5.80	0	0.32	
Merluccius capensis	3.44	284	0.19	207
Austroglanidium micropolis	3.29	14	0.18	204
Ascidians	3.08	557	0.17	
Galeus polli	1.90	12	0.11	
Todarodes angolensis, male	1.06	3	0.06	
Todarodes angolensis, female	0.84	3	0.05	
Macropodus australis	0.32	12	0.02	
Sea cucumber	0.26	72	0.01	
Lepidopus caudatus	0.08	12	0.00	
Lophius vomerinus	0.07	12	0.00	209
Munda sp.	0.03	24	0.00	
Total	1801.19		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 48
 DATE : 29/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°20.84
 start stop duration Lon E 13°35.13
 TIME : 09:11:46 09:41:52 30.1 (min)
 LOG : 947.65 949.22 1.6
 FDEPTH: 184 181
 BDEPTH: 184 181
 Towing dir: 0° Wire out : 445 m
 Sorted : 269 Total catch: 724.47
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.1 kn
 Catch/hour: 1444.12

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	814.88	5470	56.43	
Merluccius capensis	315.75	4268	21.86	213
Merluccius capensis	108.64	163	7.52	210
Chrysaora hyosocella	99.67	0	6.90	
Coelorinchus simorhynchus	32.29	751	2.24	
Sufflogobius barbatus	24.32	3040	1.68	
Lophius vomerinus	12.44	24	0.86	211
Macropodus australis	12.36	407	0.86	
Chelidoniichthys capensis	8.73	14	0.60	
Aequorea forskalea	3.99	80	0.28	
Lophius vomerinus	2.39	32	0.17	216
Austroglanidium micropolis	1.91	2	0.13	215
Merluccius capensis	1.20	128	0.08	212
Todarodes angolensis, male	1.16	2	0.08	
Chlorophthalmus agassizi	1.12	335	0.08	
Starfish white 5 arms	0.88	247	0.06	
Pterothrissus belloti	0.64	40	0.04	
Todarops eblanae	0.56	24	0.04	
Lepidopus caudatus	0.56	2	0.04	
CYPRAEIDAE (Bulia)	0.48	40	0.03	
Galeus polli	0.16	16	0.01	
Helicolenus dactylopterus	0.02	16	0.00	214
Total	1444.12		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 49
 DATE : 29/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°21.26
 start stop duration Lon E 13°28.09
 TIME : 10:50:23 11:21:24 31.0 (min)
 LOG : 958.11 959.67 1.6
 FDEPTH: 238 241
 BDEPTH: 238 241
 Towing dir: 0° Wire out : 570 m
 Sorted : 297 Total catch: 1437.82
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.0 kn
 Catch/hour: 2781.08

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	1653.94	9110	59.47	
Merluccius capensis	344.57	4785	12.39	219
Helicolenus dactylopterus	318.43	6228	11.45	220
Chlorophthalmus agassizi	242.39	11275	8.72	
Merluccius capensis	104.06	132	3.74	217
Coelorinchus simorhynchus	30.30	605	1.09	
Lophius vomerinus	17.99	12	0.65	218
JELLYFISH	17.82	0	0.64	
PORIFERA (Sponges)	14.02	0	0.50	
Chrysaora hyosocella	13.54	0	0.49	
Todarodes angolensis, female	8.20	14	0.29	
Sufflogobius barbatus	8.20	1261	0.26	
Todarodes angolensis, male	2.48	4	0.09	
Macropodus australis	2.38	60	0.09	
Galeus polli	1.31	24	0.05	
Pterygosquilla armata capensis	0.39	24	0.01	
Todarops eblanae	0.32	12	0.01	
Lepidopus caudatus	0.27	2	0.01	
Merluccius capensis	0.23	0	0.01	
Synagrops micropolis	0.18	12	0.01	
GASTROPODS	0.07	12	0.00	
Total	2781.08		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 50
 DATE : 29/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°21.63
 start stop duration Lon E 13°19.41
 TIME : 12:53:40 13:23:55 30.3 (min)
 LOG : 970.58 972.10 1.5
 FDEPTH: 334 333
 BDEPTH: 334 333
 Towing dir: 0° Wire out : 780 m
 Sorted : 154 Total catch: 198.24
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.0 kn
 Catch/hour: 393.20

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius capensis	177.92	220	45.25	221
Helicolenus dactylopterus	84.30	1293	21.44	225
Merluccius paradoxus	31.74	117	8.07	222
Lophius vomerinus	24.79	12	6.31	223
Coelorinchus simorhynchus	24.79	446	6.31	
Chlorophthalmus agassizi	16.71	419	4.25	
Galeus polli	11.31	188	2.88	
Todarodes angolensis, female	9.00	14	2.29	
Nezumia micronychodon	6.30	1144	1.60	
Solenocera africana	2.88	480	0.73	
Genypterus capensis	2.30	2	0.59	224
Todarodes angolensis, male	0.44	2	0.11	
Lampanyctodes hectoreus	0.35	105	0.09	
Macropodus australis	0.20	5	0.05	
Lepidopus caudatus	0.15	0	0.04	
Epigonus denticulatus	0.04	5	0.01	
Total	393.20		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 51
 DATE : 29/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°21.63
 start stop duration Lon E 13°14.08
 TIME : 14:47:58 15:18:09 30.2 (min)
 LOG : 980.09 982.54 1.6
 FDEPTH: 380 381
 BDEPTH: 380 381
 Towing dir: 0° Wire out : 890 m
 Sorted : 174 Total catch: 254.96
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.1 kn
 Catch/hour: 506.88

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	215.71	1072	42.56	229
Helicolenus dactylopterus	101.79	787	20.08	230
Coelorinchus simorhynchus	34.83	509	6.87	
Merluccius paradoxus	29.02	6	5.84	228
Todarodes angolensis, female	23.30	42	8.07	
Galeus polli	19.09	207	3.77	
Selachophidium guentheri	16.78	326	3.31	
Notacanthus sexspinus	16.38	547	3.23	
Epigonus denticulatus	10.89	60439	2.15	
Lophius vomerinus	9.34	4	1.84	226
Nezumia micronychodon	7.48	252	1.47	
Todarodes angolensis, male	6.68	22	1.32	
Merluccius capensis	6.64	14	1.31	227
Heart urchin	5.25	151	1.04	
Hoplostethus cadenati	1.19	16	0.24	
Shrimps, small, non comm	1.19	298	0.24	
Bathynectes piperitus	0.56	8	0.11	
Phosichthys argenteus	0.12	8	0.02	
Gymnoscopelus sp.	0.04	8	0.01	
Total	506.88		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 52
 DATE : 29/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°21.36
 start stop duration Lon E 13°6.35
 TIME : 16:45:57 17:16:00 30.1 (min)
 LOG : 993.10 994.67 1.6
 FDEPTH: 448 452
 BDEPTH: 448 452
 Towing dir: 0° Wire out : 1030 m
 Sorted : 175 Total catch: 326.55
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.1 kn
 Catch/hour: 652.02

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	472.81	1286	72.51	233
Helicolenus dactylopterus	37.70	0	5.78	234
Selachophidium guentheri	35.94	495	5.51	
Nezumia micronychodon	15.69	361	2.41	
Todarodes angolensis, male	14.38	34	2.20	
Todarodes angolensis, female	12.38	24	1.96	
Shrimps, small, non comm	9.78	0	1.50	
Ancistrocheirus lesueurii	8.95	4	1.37	
Epigonus telescopus**	6.19	52	0.95	
Aristeus variabilis	5.15	1030	0.79	
Hoplostethus cadenati	4.71	204	0.72	
Schedophilus huttoni	4.39	2	0.67	
Genypterus capensis	4.31	2	0.66	231
Galeus polli	3.19	40	0.49	
Coelorinchus simorhynchus	2.88	56	0.44	
Lophius vomerinus	2.76	2	0.42	232
MCTOPHIDAE	2.64	0	0.40	
Etmopterus gracilispinis	1.48	4	0.40	
Phosichthys argenteus	1.40	136	0.21	
Etmopterus pusillus	1.20	4	0.18	0
Lithodes ferox	1.00	2	0.15	
Notacanthus sexspinus	0.80	24	0.12	
CARIDEA	0.48	0	0.07	
Trachyrincus scabrus	0.40	4	0.06	
Chauliodes sloani	0.40	0	0.06	
Bathynectes piperitus	0.32	8	0.05	
Ebinania costaecanariae	0.28	12	0.04	
Lampanyctodes hectoreus	0.24	64	0.04	
Epigonus denticulatus	0.12	8	0.02	
Munda sp.	0.06	68	0.04	
Stereomastix sp.	0.01	8	0.00	
Total	652.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 53
 DATE : 30/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°1.05
 start stop duration Lon E 13°1.46
 TIME : 05:11:06 05:42:20 31.2 (min)
 LOG : 1029.93 1031.57 1.6
 FDEPTH: 473 481
 BDEPTH: 473 481
 Towing dir: 0° Wire out : 1070 m
 Sorted : 206 Total catch: 232.18
 Purpose : 3
 Region : 5000
 Gear cond.: 0
 Validity : 0
 Speed : 3.1 kn
 Catch/hour: 446.07

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	242.07	582	54.27	235
Helicolenus dactylopterus	29.78	190	6.68	236
Selachophidium guentheri	23.82	280	5.34	
Nezumia micronychodon	22.44	71	5.03	
Ancistrocheirus lesueurii	21.35	12	4.78	
Sergia sp.	17.29	9101	3.88	
Hoplostethus cadenati	16.29	551	3.65	
Rajella barnardi	16.14	19	3.62	
Todarodes angolensis, female	12.03	17	2.70	
Lophius vomerinus	11.53	2	2.58	237
Controlophus niager	5.73	2	1.28	
Todarodes angolensis, male	5.00	10	1.12	
MYCTOPHIDAE	4.00	532	0.90	
Trachyrincus scabrus	3.00	35	0.67	
Aristeus variidens	2.96	269	0.66	
Deania profundorum	2.38	2	0.53	
Galus polli	2.27	19	0.51	
Etmopterus gracilispinis	1.65	4	0.37	
Histioteuthis reversa	1.50	12	0.34	
Phosichthys argenteus	1.08	100	0.24	
Lampanyctodes hectoris	0.92	263	0.21	
Lithodes ferax	0.77	2	0.17	
Chauliodus sloani	0.50	111	0.11	
Notacanthus sexspinis	0.46	15	0.10	
Bassanago albescens	0.38	8	0.09	
Epi gonus denticulatus	0.27	12	0.06	
Bathyrhynchus vicinus	0.27	4	0.06	
Gonostoma sp.	0.15	19	0.03	
Stereomastis sp.	0.06	15	0.01	
Nemichthys scolopaceus	0.02	4	0.00	
Lophius vomerinus	0.01	4	0.00	
Lestrolepis intermedia	0.00	4	0.00	
Total	446.08		100.00	

Lophius vomerinus	0.10	5	0.02	253
Helicolenus dactylopterus	0.07	75	0.02	254
Merluccius capensis	0.06	10	0.01	252
Total	494.02		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 57
 DATE : 30/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°0.84
 start stop duration Lon E 13°39.58
 TIME : 14:11:28 14:41:40 30.2 (min) Purpose : 3
 LOG : 1087.24 1088.76 1.5 Region : 5000
 FDEPTH: 152 152 Gear cond.: 0
 BDEPTH: 152 152 Validity : 0
 Towing dir: 0° Wire out : 360 m Speed : 3.0 kn
 Sorted : 257 Total catch: 564.55 Catch/hour: 1121.62

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Trachurus capensis	535.83	4784	47.77	
Merluccius capensis	194.90	2903	17.38	259
Chrysaora hyoscella	158.94	0	14.17	
Chelidonicichthys capensis	92.98	258	8.29	
Sufflogobius barbatus	61.39	5847	5.47	
Merluccius capensis	29.21	48	2.60	257
Aequorea forskalea	14.90	0	1.33	
Lophius vomerinus	11.42	20	1.02	256
Macropodus australis	5.42	179	0.48	
Pterothrissus belloci	3.64	42	0.32	
GASTROPODS	2.74	274	0.24	
Todaropsis eblanae	2.32	77	0.21	
Starfish white 5 arms	2.03	375	0.18	
Todarodes angolensis, female	1.75	2	0.16	
Todarodes angolensis, male	1.03	4	0.09	
Austroglossus microlepis	0.87	4	0.08	258
Lepidopus caudatus	0.87	4	0.08	
Sponges - yellow	0.66	0	0.06	
Merluccius capensis	0.48	72	0.04	260
Galus polli	0.24	24	0.02	
Total	1121.62		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 54
 DATE : 30/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°0.74
 start stop duration Lon E 13°7.47
 TIME : 07:27:29 07:57:31 30.0 (min) Purpose : 3
 LOG : 1042.74 1044.37 1.6 Region : 5000
 FDEPTH: 330 332 Gear cond.: 0
 BDEPTH: 330 332 Validity : 0
 Towing dir: 0° Wire out : 780 m Speed : 3.2 kn
 Sorted : 237 Total catch: 579.24 Catch/hour: 1157.32

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius paradoxus	501.20	0	43.31	240
Helicolenus dactylopterus	372.28	0	32.17	241
Merluccius capensis	166.83	0	14.42	238
Epi gonus denticulatus	29.99	1333	2.59	
Gerypterus capensis	26.77	0	2.31	239
Coelorinchus simorhynchus	14.34	246	1.24	
Galus polli	10.07	94	0.87	
Todarodes angolensis, female	5.63	8	0.49	
Todarodes angolensis, male	5.59	14	0.48	
Selachophidium guentheri	5.07	72	0.44	
PORIFERA (Sponges)	3.84	0	0.33	
Rajella barnardi	3.68	4	0.32	
Nezumia micronychodon	3.11	182	0.27	
Lepidopus caudatus	2.80	2	0.24	
Chlorophthalmus agassizi	1.88	130	0.16	
Pandalus sp.	1.23	348	0.11	
Lampanyctodes hectoris	0.94	282	0.08	
Beryx splendens	0.90	8	0.08	
Malacocephalus occidentalis	0.87	7	0.08	
GASTROPODS	0.15	14	0.01	
Helicolenus dactylopterus	0.09	29	0.01	242
Ebuniana costaeanae	0.04	7	0.00	
Nemichthys scolopaceus	0.03	14	0.00	0
Total	1157.33		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 55
 DATE : 30/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°1.69
 start stop duration Lon E 13°18.39
 TIME : 09:47:48 10:18:21 30.6 (min) Purpose : 3
 LOG : 1058.86 1060.44 1.6 Region : 5000
 FDEPTH: 363 363 Gear cond.: 0
 BDEPTH: 363 363 Validity : 0
 Towing dir: 0° Wire out : 860 m Speed : 3.1 kn
 Sorted : 113 Total catch: 185.74 Catch/hour: 364.80

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Helicolenus dactylopterus	80.52	619	22.07	247
Heart urchin	50.28	1436	13.78	
Galus polli	46.35	719	12.71	
Merluccius capensis	35.16	31	9.64	244
Merluccius paradoxus	26.71	145	7.32	243
Coelorinchus simorhynchus	24.43	357	6.70	
Nezumia micronychodon	22.78	507	6.25	
Lophius vomerinus	20.82	18	5.71	245
Notacanthus sexspinis	16.65	640	4.57	
Selachophidium guentheri	10.53	259	2.89	
Epi gonus denticulatus	6.36	344	1.74	
Pandalus sp.	5.81	1163	1.59	
Todarodes angolensis, male	3.81	8	1.04	
Todarodes angolensis, female	3.77	8	1.03	
Gerypterus capensis	2.44	2	0.67	246
Aequorea forskalea	2.28	55	0.62	
Ebuniana costaeanae	1.57	86	0.43	
PORIFERA (Sponges)	1.57	0	0.43	
Neoharriotta pinnata	1.49	2	0.41	
Solenocera africana	0.71	86	0.19	
Hoplostethus cadenati	0.47	8	0.13	
CYPRIDAE (Bulla)	0.24	8	0.06	
Chlorophthalmus agassizi	0.05	16	0.01	
Total	364.80		100.00	

R/V Dr. Fridtjof Nansen SURVEY: 2016401 STATION: 56
 DATE : 30/01/16 GEAR TYPE: BT NO: 27 POSITION: Lat S 23°1.34
 start stop duration Lon E 13°27.23
 TIME : 11:53:30 12:23:46 30.3 (min) Purpose : 3
 LOG : 1071.54 1073.10 1.6 Region : 5000
 FDEPTH: 281 280 Gear cond.: 0
 BDEPTH: 281 280 Validity : 0
 Towing dir: 0° Wire out : 670 m Speed : 3.1 kn
 Sorted : 157 Total catch: 249.23 Catch/hour: 494.02

SPECIES	CATCH/HOUR		% OF TOT. C	SAMP
	weight	numbers		
Merluccius capensis	157.78	220	31.94	249
Helicolenus dactylopterus	76.81	1312	15.55	255
Chlorophthalmus agassizi	65.41	10902	13.24	
Trachurus capensis	53.52	188	10.83	
Merluccius capensis	28.25	509	5.72	250
Coelorinchus simorhynchus	21.61	470	4.37	
Chrysaora hyoscella	17.34	0	3.51	
PORIFERA (Sponges)	15.86	0	3.21	
Lophius vomerinus	14.27	10	2.89	248
Todarodes angolensis, female	9.51	14	1.93	
Todarodes angolensis, male	9.32	22	1.89	
Galus polli	8.92	186	1.81	
Aequorea forskalea	4.96	0	1.00	
Pterygosquilla armata capensis	2.87	155	0.58	
Solenocera africana	2.13	501	0.43	
Lampanyctodes hectoris	1.14	325	0.23	
Lepidopus caudatus	0.94	10	0.19	
Macropodus australis	0.94	30	0.19	
GASTROPODS	0.84	10	0.17	
Krill	0.50	0	0.10	
Sufflogobius barbatus	0.30	89	0.06	
Todaropsis eblanae	0.30	5	0.06	
Starfish white 5 arms	0.15	83	0.03	
Giant bullia gastropod	0.12	5	0.03	

Annex 2 Instruments and fishing gear

The Simrad EK-500, 38 kHz scientific echosounder was used for abundance estimation during the survey, in addition data from the 18 kHz, 120 kHz and 200 kHz transducers were logged for possible future multi frequency target estimation. The LSSS was logging the echogram raw data from the sounder and used to scrutinize the acoustic records, and to allocate integrator data to fish species. All raw data were stored to tape, and a backup of the database of scrutinized data, stored. The details of the settings of the echosounders were as follows:

DRIFTSSKJEMA 1 - ekkolodd

DFN sept.-07

ER60			
Serienr: 18 kHz: 593 38 kHz: 489 GPT 120 kHz: 587 200 kHz: 492		Programversjon: 2.2.1	Driftsansvarlig: Tore Mørk
Fartøy: Dr. Fridtjof Nansen		Toktnr: 2012401	Tidsrom: 24.01 - 28.02.2012
Formål for anvendelse: Innsamling av ekkolodd rådata på tokt i Sør-Afrika og Namibia			
Tolkestasjon tilknyttet: LSSS ver. 1.5			
Ping Interval: 0,0 / 2,0 / 5,0 sek		Transmit Power: Normal	Noise Margin: 0 dB

Setup:	Transceiver 1	Transceiver 2	Transceiver 3	Transceiver 4
Frequency:	18 kHz	38 kHz	120 kHz	200 kHz
Transducer:	ES18-11	ES38B	ES120-7	ES200-7

Transceiver menu:

Mode	Active	Active	Active	Active
Transducer Type	ES18	ES38	ES120	ES200
Transd. Sequence	Off	Off	Off	Off
Transd Depth	5,5/7,5 m	5,5/7,5 m	5,5/7,5 m	5,5/7,5 m
Absorption Coeff.	2,2 dB/km	8,5 dB/km	45,1 dB/km	68,9 dB/km
Pulse Length	1,024 ms	1,024 ms	1,024 ms	1,024 ms
Bandwidth	1,57 kHz	2,43 kHz	3,03 kHz	3,09 kHz
Max. Power	2000 W	2000 W	250 W	120 W
2-way Beam Angle	-17,0 dB	-20,6 dB	-20,8 dB	-20,7 dB
Gain	22,53 dB	25,47 dB	25,30 dB	24,19 dB
SA correction	-0,73 dB	-0,71 dB	-0,39 dB	-0,26 dB
Angle Sens. Along	13,9	21,9	21,0	23,00
Angle Sens. Athw.	13,9	21,9	21,0	23,00
3 dB Beamw. Along	11,46 °	7,37 °	7,06 °	6,61 °
3 dB Beamw. Athw.	11,29 °	7,41 °	7,07 °	6,60 °
Alongship Offset	0,10 °	0,10 °	-0,12 °	0,09 °
Athw. ship Offset	0,04 °	0,05 °	0,06 °	0,33 °

TS Detection menu

Min. Value	-50 dB	-50 dB	-50 dB	-50 dB
Min. Echo Length	80 %	80 %	80 %	80 %
Max. Echo Length	180 %	180 %	180 %	180 %
Max. Gain Comp.	6,0 dB	6,0 dB	6,0 dB	6,0 dB
Max. Phase Dev.	8,0	8,0	8,0	8,0

Bottom detection menu

Minimum level -40 dB

Calibration

A calibration of the acoustic instruments was conducted in Baía dos Elefantes, Angola on 7 August 2011.

Fishing gear

The vessel has two different sized "Åkrahamn" pelagic trawls and one "Gisund super" bottom trawl. For all trawls, the Tyborøn, 7.8m² (1670 kg) trawl doors were used.

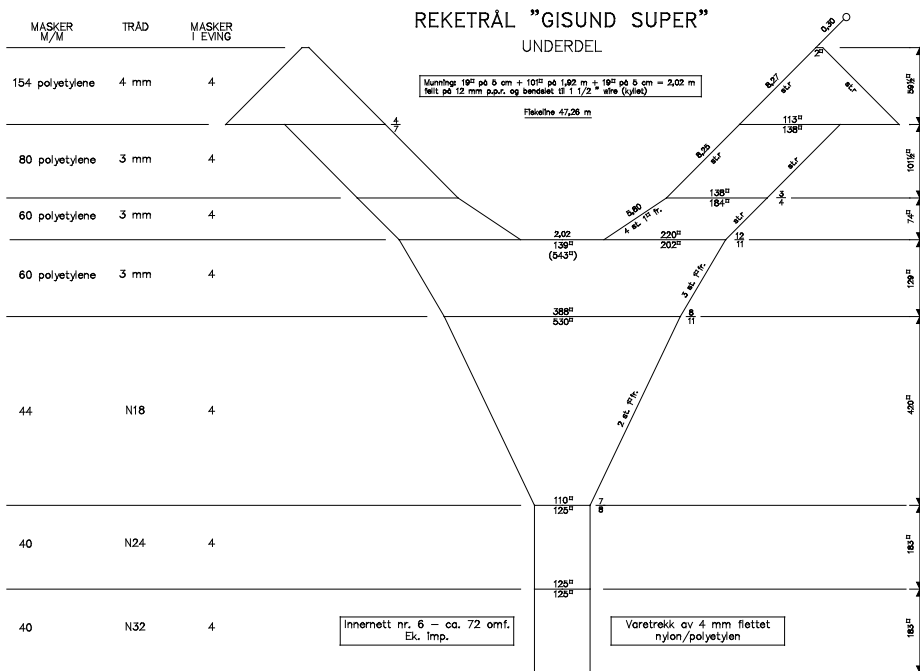
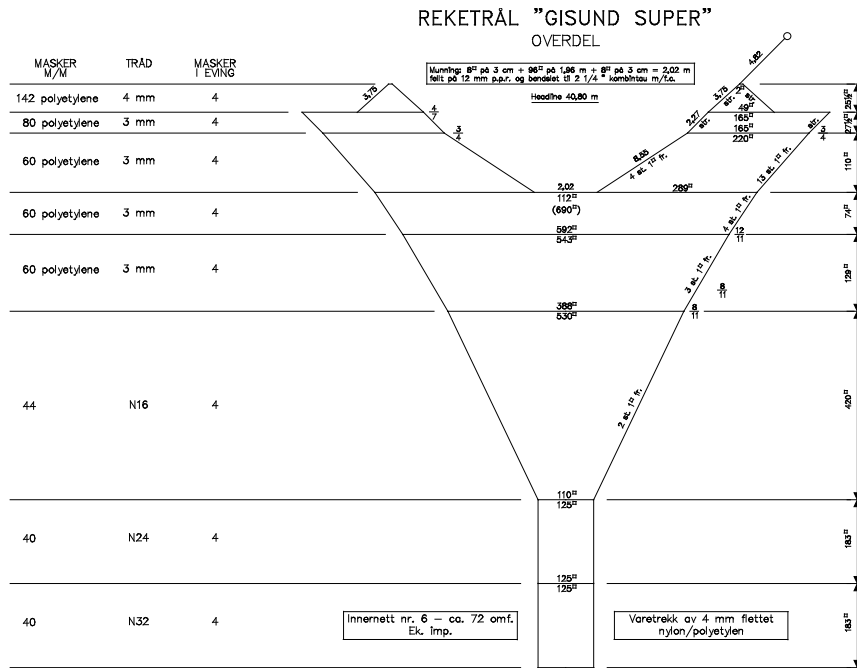


Figure 1 Design of the trawl used.

6,85 M
16 MM CHAIN
SHORT LINKED

SIDE GEAR
6,55 M

SIDE GEAR
6,55 M

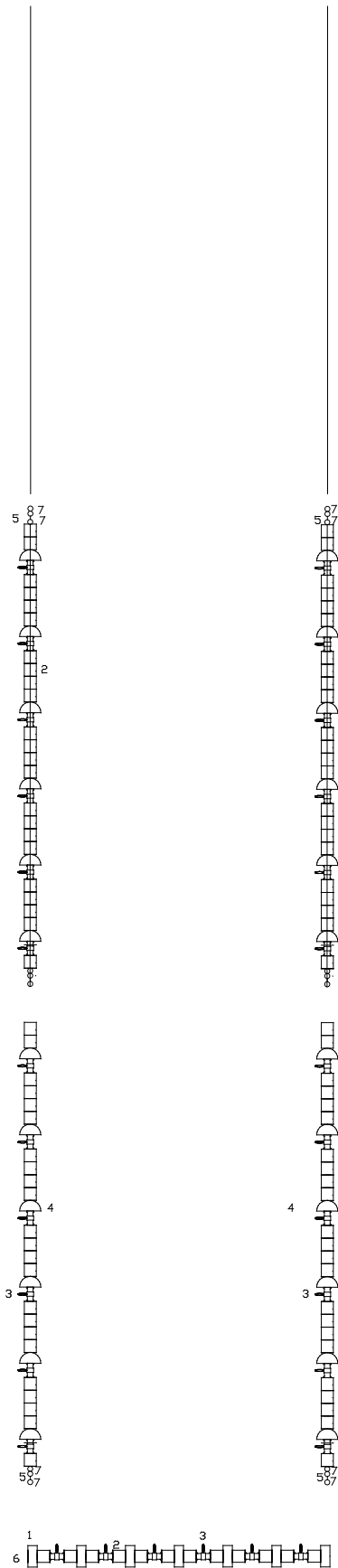


Figure 2 Schematic drawing of the ground gear used in the experiment.

Annex 4: Table of catches from the intercalibration trials in 2016
Insert pdf file: Catchsummary.pdf here:
NB Landscape format

Annex 5: Results from intercalibration trials in 2015

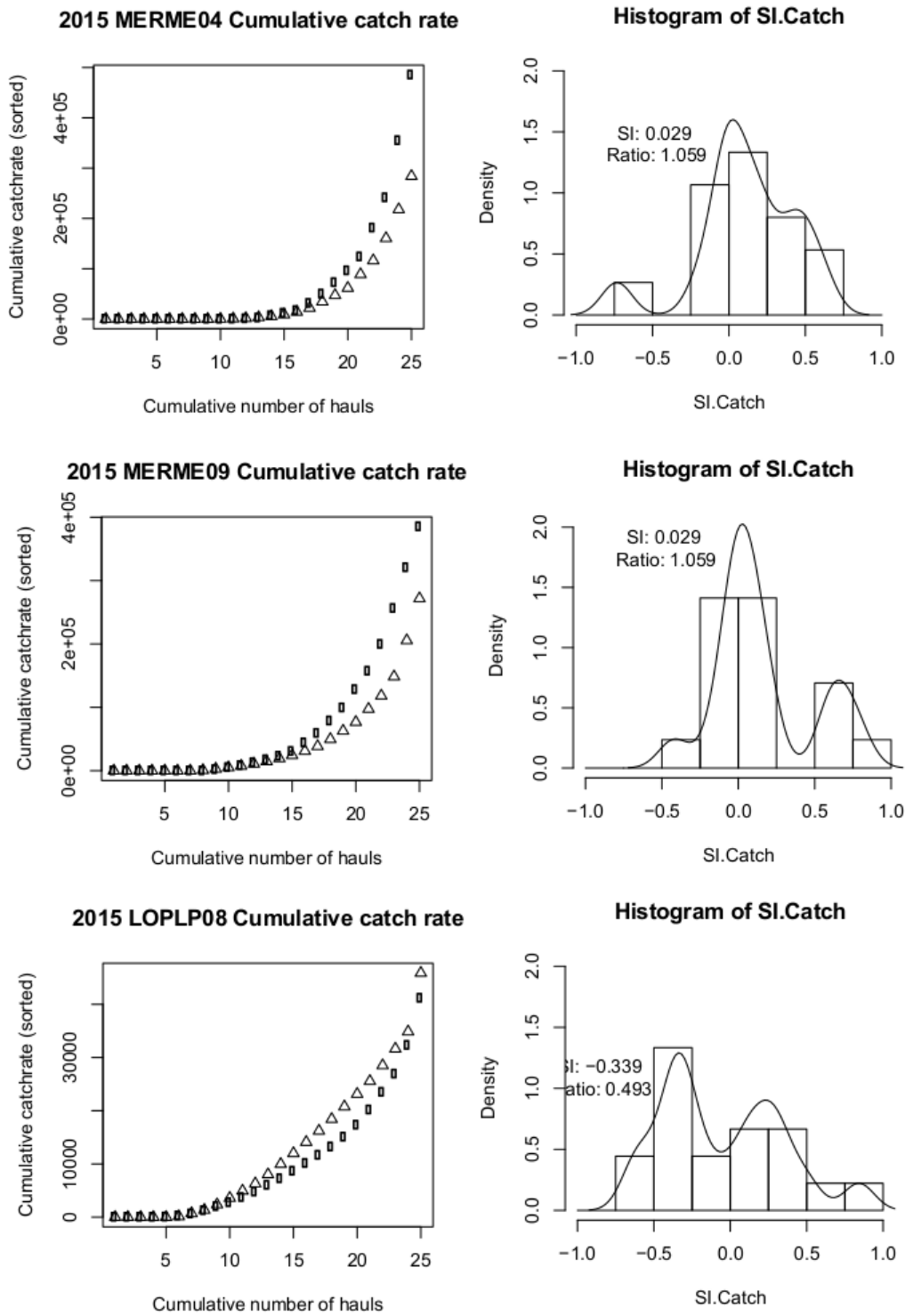


Figure Annex5. Left: Cumulative catch rates for two vessels overplot in 2015: Nansen (squares), Mirabilis(triangles). Right: Density distribution of similarity index (SI) from 27 pair hauls. Three species: Merluccius capensis (top), Merluccius paradoxus (center), Lophius volmerinus(bottom)

