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Report

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Pelagic Project Mauritania 2005-2006

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Summary

The Pelagic Project Mauritania 2005-2006 was the continuation of two earlier, but similar, projects for the years 1998-2001 and 2002-2004. The project was carried out in cooperation between IMARES and IMROP and had as most important objectives to further the assessment of small pelagic species, mainly Sardinella, in Mauritanian waters, and the collection of by-catch data by the crews of Dutch freezer trawlers fishing in these waters. The project was commissioned by the Association of Dutch Pelagic Shipowners (RVZ).
As far as the assessment of small pelagics is concerned, the scientific observer programme was continued and towards the end of the project period the responsibility for this programme was handed over to IMROP scientists. In the course of the project two acoustic surveys were partly funded by the project, as well as a meeting of the FAO working group on the assessment of small pelagics in Northwest Africa.
During 2006, by-catch data were collected by four different vessels for 1072 hauls. In 343 hauls an excluder was used, a proto-type of which was developed during the preceding contract. By-catch rates observed in 2006 were rather low, especially when compared with records from scientific observers for the years 2001-2004. A positive effect of the excluder on the amount of by-catches could not be shown, possibly because part of the by-catches was released while the net was still in the water, and therefore not recorded. The efficiency of the excluder for small cetaceans remains as yet to be proven.

1. Introduction

In the course of the 1990ies, Dutch freezer trawlers started a fishery in Mauritanian waters. Right from the beginning, this fishery was accompanied by scientific research (Corten, 2000). The Pelagic Project 2005-2006 is the continuation of similar projects carried out in the years 1998-2001 and 2002-2004 (Corten 2002 & 2006)[1]. The subject of these projects has, in one way or another, been the assessment of the pelagic resources in Mauritania, with a focus on *Sardinella*. Other parts of earlier project studied the use of remote sensing (Zeeberg 2005) and possibilities to prevent the by-catch of large megafauna in the Dutch fishery for small pelagics. In this report attention will be given to different details of the assessment of small pelagics and observations on the efficiency of the proto-type of an excluder developed in the preceding project (de Haan & Zeeberg 2005). The project was carried out for the Association of Dutch Pelagic Shipowners (RVZ), and was partly funded by fuel-subsidy funds made available through the European Commission and "Directorate Fish" of the Dutch Ministry for Agriculture, Nature and Food Quality.

[1] Annex 3 provides an overview of all reports and papers resulting from the Pelagic Projects so far.

2. Assessment of small pelagics

2.1 Observer programme and logbook data

To collect reliable data for stock assessment in the Mauritanian region, a scientific observer programme was established in 1999. Initially, the programme just focused on the Dutch fleet and observers collected data on catch composition and discards on board of Dutch freezer trawlers. Logbook data are an essential addition to the data collected by the observers. Through IMARES, copies of the logbooks of the Dutch fleet were provided to IMROP. From 2005 onwards, also Russian and Baltic pelagic trawlers have been included in the sampling scheme of this programme (Table 2.1). With this extension, also a data analysis problem was introduced. Since neither IMROP nor IMARES had direct access to the logbooks of the Russian and Baltic vessels, an alternative way through the DSPCM (the Mauritanian fishery inspection service), was found to obtain these logbooks. Logbook information provided by the DSPCM, however, was often incomplete and therefore further attention is needed on how to improve the quality of these data (see Section 2.6).

Fleet	1999	2000	2001	2002	2003	2004	2005	2006	Total
Dutch	13	10	8	8	9	8	4	2	62
Irish								1	1
Russian							3	5	8
Total	13	10	8	8	9	8	7	8	**71**

Table 2.1: Number of observer missions per year per fleet

From Table 2.1 it can be seen that the sampling effort of the observer programme has shifted from the Dutch trawlers to Russian trawlers. In 2006 the number of observer missions on board of Russian vessels was even higher than the number of missions on board of Dutch vessels, while the total sampling effort of around 8 missions per year remained stable. This shift can be explained from the inclusion of other fleets in the programme. Also logistical problems and a hesitation of some of the Dutch skippers to take observers on board have played a role. The next step in the development of the programme is a better distribution of sampling effort over the different fleets throughout the year.
Table 2.2 gives an overview, for the period 1999-2005, of the days per ship that observers were on board (observer days), the days a ship was fishing in the Mauritanian zone (days fishing), and the ratio between these two figures (sampling intensity).

	Observer Days (1999-2005)	Days fishing (1999-2005)	Sampling intensity
SCH24	148	840	18%
SCH81	343	1991	17%
SCH72	168	986	17%
SCH302	254	1553	16%
KW171	121	1162	10%
KW174	98	1006	10%
SCH54	153	1892	8%
SCH118	120	1514	8%
ROS785	27	733	4%
SCH171	11	433	3%
SCH120	19	1356	1%
Other ships (10)	0	1160	none
Grand Total	1462	14626	10%

Table 2.2: Observer days, days at sea ship, sampling intensity for the period 1999-2005

It can be concluded that the sampling intensity was not evenly spread over the fleet. This was mainly due to logistical problems and to some extent because certain skippers preferred not too cooperate with the observer programme.

In 1999 the collection of by-catch data was added to the tasks of the observers. Due to organizational problems the systematic collection of by-catch data stopped after two years. The first data on the by-catch of Dutch freezer trawlers in Mauritanian waters can be found in Zeeberg *et al.* (2006). See also Chapter 3 of this report.

2.2 Acoustic surveys

In order to include fisheries independent data in the stock assessments, acoustic surveys were added to the Pelagic Project. These surveys started in 2001 and were carried out by the Mauritanian RV "Al Awam". In order to equip the "Al Awam" for acoustic surveys, investments were made in electronic instrumentation and fishing gear. Furthermore, IMROP scientists were trained abroad and on board the "Al Awam" in the use of acoustic instruments and the application of special software. As a result, IMROP is now fully capable to run acoustic surveys without external support. Inter-calibration experiments with the Norwegian RV "Dr. Fridtjof Nansen" have shown that the results produced by the "Al Awam" are comparable to those obtained by the Norwegian research vessel. The Pelagic Project partly financed the meetings of planning groups for the coordination of the acoustic surveys among Morocco, Mauritania and Senegal. A point of concern is that IMROP was, up till now, not capable of finding sufficient funds to continue these surveys twice a year. In Table 2.3 an overview is given of the Mauritanian acoustic surveys since 2001. A more detailed description on the situation at IMROP, as far as acoustic surveys are concerned, is provided in Ybema (2006).

Acoustic surveys	
2001	Testing
2002	Testing
2003	March/June/December
2004	April/November
2005	March/November
2006	March

Table 2.3: Overview of acoustic surveys in Mauritania

2.3 Assessment meetings

In 2000 the FAO, in co-operation with IMARES, established a regional working group on the assessment of small pelagic fish in North West Africa and its first meeting was in 2001. The Pelagic Project has co-funded these meetings so far. During the meetings data from the observer programme are analysed, and together with biomass estimates from the acoustic survey programme used in the assessments. The meetings are very well attended and bring together scientists from Mauritania, Morocco, Senegal, The Gambia, Spain, Russia, Norway and The Netherlands. The report on the 2006 meeting, including the management advice given for the different stocks for 2007, is given in Annex 2.

In 2006 IMARES organized, in cooperation with IMROP, a length frequency meeting in Nouakchott. This meeting, also funded by the Pelagic Project, was attended by scientists from the north-western region of Africa. The objective of the meeting was to do an exploratory analysis of the regional length frequency data to see whether cohort data could be included in the FAO assessment working group (besides or instead of the production model now being used). The results look promising, but at the time this evaluation was written the results of that meeting were not yet published.

2.4 Data base developments

In order to store all data for the assessment of small pelagics in a structured way, the Pelagic Project focused in 2005 on recuperating historical data, structurally archiving the data collection forms from the scientific observers and implementing a digital database for these data. Length frequency data on catch and discards together with biological data are stored in a database, containing data for the entire duration of the project. Historical data on by-catches of the Dutch pelagic fleet could not be completely retrieved and therefore these data are not completely reliable. For the acoustic surveys most of the existing data and documents were stored on a variety of different computers. All data and reports have now been put on a shared network drive that is accessible for all pelagic scientists at IMROP; unfortunately much information is still missing (see Table 2.4).

	Raw acoustic data	Analysed acoustic data (BI60/HAC)	NANSIS data	Hydrology data	Cruise report	Analysis documents
2001 October	X	-	?	-	X	X
2002 September	X	-	?	-	Preliminary	X
2002 November	-	-	?	-	X	X
2003 March	X	-	-	-	X	X
2003 June	X	-	-	-	X	X
2003 December	X	-	-	-	X	X
2004 April	X	-	-	X	X	X
2004 November	X	-	-	-	X	-
2005 March	X	-	-	-	X	X
2005 November	X	-	-	-	-	-
X = present		**- =missing**		**? = probably not available**		

Table 2.4: Status of acoustic data availability on the shared network drive of IMROP by November 2005.

2.5 Transfer of programme responsibilities to IMROP

The last six months of 2006 were dedicated to the transfer of the responsibilities of the scientific observer programme to IMROP. Although all responsibilities are now completely transferred to IMROP, the six month period proved not to be sufficient. Further assistance in consolidating of what was transferred is certainly advisable. The risk exists that the scientific observer programme quickly falls apart, due to a lack of 'sense of ownership' for this programme at IMROP. Most of the IMROP scientists still consider the observer programme as a programme for which IMARES is responsible. Another serious threat is the deficiency of short term funds to support this programme financially.

2.6 Recommendations for further cooperation between IMARES and IMROP

Over the past seven years, much effort has been put in establishing a scientific observer programme for the Dutch fleet in Mauritania. The last six months the focus was on handing over programme responsibilities to our Mauritanian colleagues. These six months were probably not sufficient, and the programme might easily collapse due to a lack of 'sense of ownership'. Further efforts to hand over responsibilities is advisable.

Data collected during the Pelagic Project have been used by the FAO assessment working group. Although the collected data proved to be of great importance in the stock assessment of small pelagic species in the region, the focus has mainly been on the Dutch fleet. Including other fleets in the programme would improve the basis of the assessments. Since the fishing strategy of all other fleets (most from the former Soviet Union) is different from that of the Dutch fleet, data collection and analysis methods from the current programme can not simply be copied without adaptation. In order to support the extra work load resulting from an extension to other fleets, IMROP is planning to increase its observer corps by next year. IMARES could assist IMROP in the implementation of new methods for sampling and data analysis and the training of the new observers.

In order to use data from scientific observers for stock assessment, an extrapolation to fleet level is necessary. For this purpose, logbook data from the Dutch fleet were used in the current programme. IMROP received copies of these logbooks from the Dutch Pelagic Shipowners Organisation through IMARES. It is evident that IMROP can not use this source for their logbooks indefinitely. Therefore, in the future IMROP will have to rely on the logbook database of the Mauritanian fishery inspection service DSPCM. Currently IMROP has great difficulties in processing the logbook data received from the DSPCM, as these data are received as 2500 separate dbf files. At this moment no standard exists on how to process these datasets in a structured way, and this consequently results in various, inconsistently, processed logbook datasets within IMROP. Given the need for logbook data for stock assessment, it is clear that the structuring of the DSPCM datasets needs to be addressed. IMARES could assist IMROP in automating and standardizing the processing of the separate dbf files into a single relational database.

Another point of concern is the quality of the data received from the DSPCM. A comparison of the logbook database of the DSCPM with the 'original' Dutch logbooks received from the Pelagic Shipowners Organisation, showed that the logbook database from the DSPCM is not complete. This is an issue which needs to be solved by the DSPCM, through IMROP. IMARES could assist in setting up mechanisms for data management at the DSPCM. It is important that this problem is solved as soon as possible since observer data alone, are of no use for stock assessment, if they can not be extrapolated to fleet level on the basis of reliable logbook data.

Thanks to the three Pelagic Projects, IMROP is now fully capable to run acoustic surveys without external support. However, there are still some issues in the acoustic surveys that IMROP could improve with the assistance of IMARES. At the moment the TS (target strength) used in the surveys, is that for herring. IMROP would very much like to perform calibration experiments in order to obtain the TS for the main pelagic species in the North West African region. Another point which needs attention is the capacity of IMROP as far as the operation and maintenance of SIMRAD software and hardware, which is being used for these surveys, is concerned.

3. The by-catch of large fish and cetaceans

As part of the preceding Pelagic Contract 2003-2004, a proto-type of an excluder was developed, in order to prevent – as far as possible – the by-catch of large fish and cetaceans when fishing for small pelagics (de Haan & Zeeberg 2005; Zeeberg *et al.* 2006). During the present project (2005-2006), the excluder was tested in order to study its effectiveness. In the contract it was agreed that trawler crews would collect observations themselves, which would then be analysed and presented in the final report of this study. In addition, some additional underwater observations were made during the present contract period.

3.1 Observations by the crew

According to the original set-up it was agreed that the observations would be made on board three freezer trawlers, fishing in Mauritanian waters during the months May to August. These three vessels would alternately fish with and without the excluder. All three vessels were to record the following data by haul: start and end time of haul, position, surface water temperature, and catch data. Information on by-catches of large fish and cetaceans would also be recorded, including details on species, their number and their size. If possible, pictures would be taken, to facilitate proper identification. Also, the position where these by-catches were found in the net was to be recorded.

In the course of 2006 data have been collected on board of four Dutch-owned freezer trawlers: SCH 24 “Afrika”, SCH 81 “Carolien”, SCH 118 “Johan Maria” and H171 “Cornelis Vrolijk”. By these four vessels, data were collected for a total of 1072 hauls (Table 3.1). These hauls were made during 16 trips, altogether consisting of 350 fishing days, in the period 26 April to 15 November 2006. Details on the number of hauls per vessel and per day, and the use of the excluder, are given in Annex 1 of this report.

	Trips	Fishing days	Hauls without excluder	Hauls with excluder	Total hauls
SCH 24	5	112	267	74	341
SCH 81	4	91	199	120	319
SCH 188	4	87	179	72	251
H 171	3	60	84	77	161
Total	16	350	729	343	1072

Table 3.1. Overview of the vessels and hauls for which these vessels provided information on by-catches.

Figure 3.1 shows the number of hauls for which reports have been received for each month, split in hauls with and without excluder. The hauls are reasonably well spread over the season, with the majority of them made in the months of May, June, July and August.

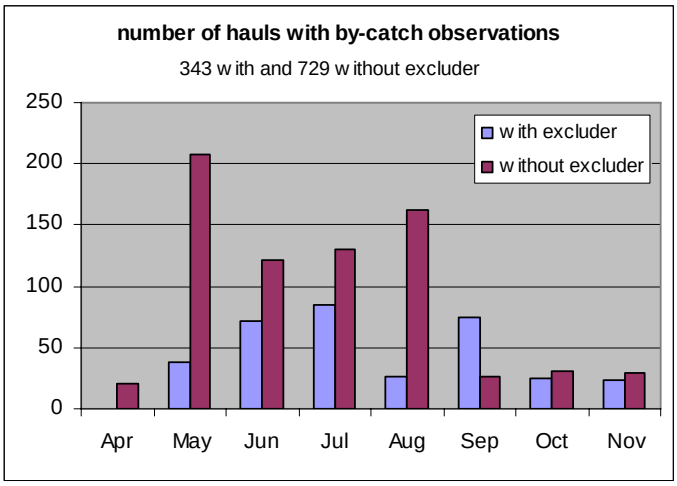

Figure 3.1. Number of hauls, with and without excluder, for which by-catch observations were provided.

For the observed hauls, Table 3.2 provides information on the observed by-catches of large megafauna: in how many hauls was a certain species or species-group observed, and how many specimens were reported to have been caught. Separate columns indicate whether these by-catches were made when an excluder was used and when not.

	Numbers				**Percentage**		**Average per 1000 hauls**	
	with excluder		without excluder		with	without	with	without
	hauls	specimens	hauls	specimens	hauls	hauls	specimens	specimens
devil ray ("manta")	0	0	11	14	0.00	1.51	0.0	19.2
hammerhead shark	10	42	20	36	2.92	2.74	122.4	49.4
other sharks	2	6	6	12	0.58	0.82	17.5	16.5
billfish	8	28	21	100	2.33	2.88	81.6	137.2
sunfish	19	36	28	66	5.54	3.84	105.0	90.5
turtle	2	2	3	3	0.58	0.41	5.8	4.1
dolphin	1	4	4	15	0.29	0.55	11.7	20.6
pilot whale	0	0	1	1	0.00	0.14	0.0	1.4
hauls observed	343		729					

Table 3.2. Overview of the by-catch observations: number of hauls, with and without excluder, in which certain large by-catch species were observed, and the total number of specimens reported. In addition the percentage of the hauls in which these by-catches occurred is indicated for each group (e.g. in 10 out of 343 (= 2.92%) observed hauls with excluder hammerhead sharks were caught), and the average by-catch in number per 1000 hauls.

None of the vessels provided photo material of the by-catches, so no further attempts for a more detailed identification could be made. Some comments on the reported "species" or species-groups can, however, be made. One of the species mentioned in the previous project (Zeeberg *et al.* 2006) was the "manta" ray. These fish were unfortunately wrongly identified and are not real manta (*Manta birostris*) but devil-ray (*Mobula mobular*). In the world of elasmobranch scientists and conservationists, the reports on the by-catch of "manta" in Zeeberg *et al.* (2006) raised some concern, since manta are considered an endangered species. *Manta birostris*, however, does not occur in the eastern Atlantic.

The category "Hammerhead shark" consists of at least 2 species. The "other sharks" category consists of several species such as blue shark, thresher sharks and mako's. "Billfish" is a general name for marlin, sailfish and swordfish. "Sunfish" is just one species (*Mola mola*) but turtle, dolphin and pilot whale may again consist of several species.

Details on how the reported by-catches were spread over the fishing season are provided in Figure 3.2 which gives, by month, the percentage of the hauls in which a certain by-catch was observed. From Table 3.2 and Figure 3.2 no clear difference can be seen about the amount of by-catches between hauls with and without the excluder. Devil rays, however, were only caught when no excluder was used.

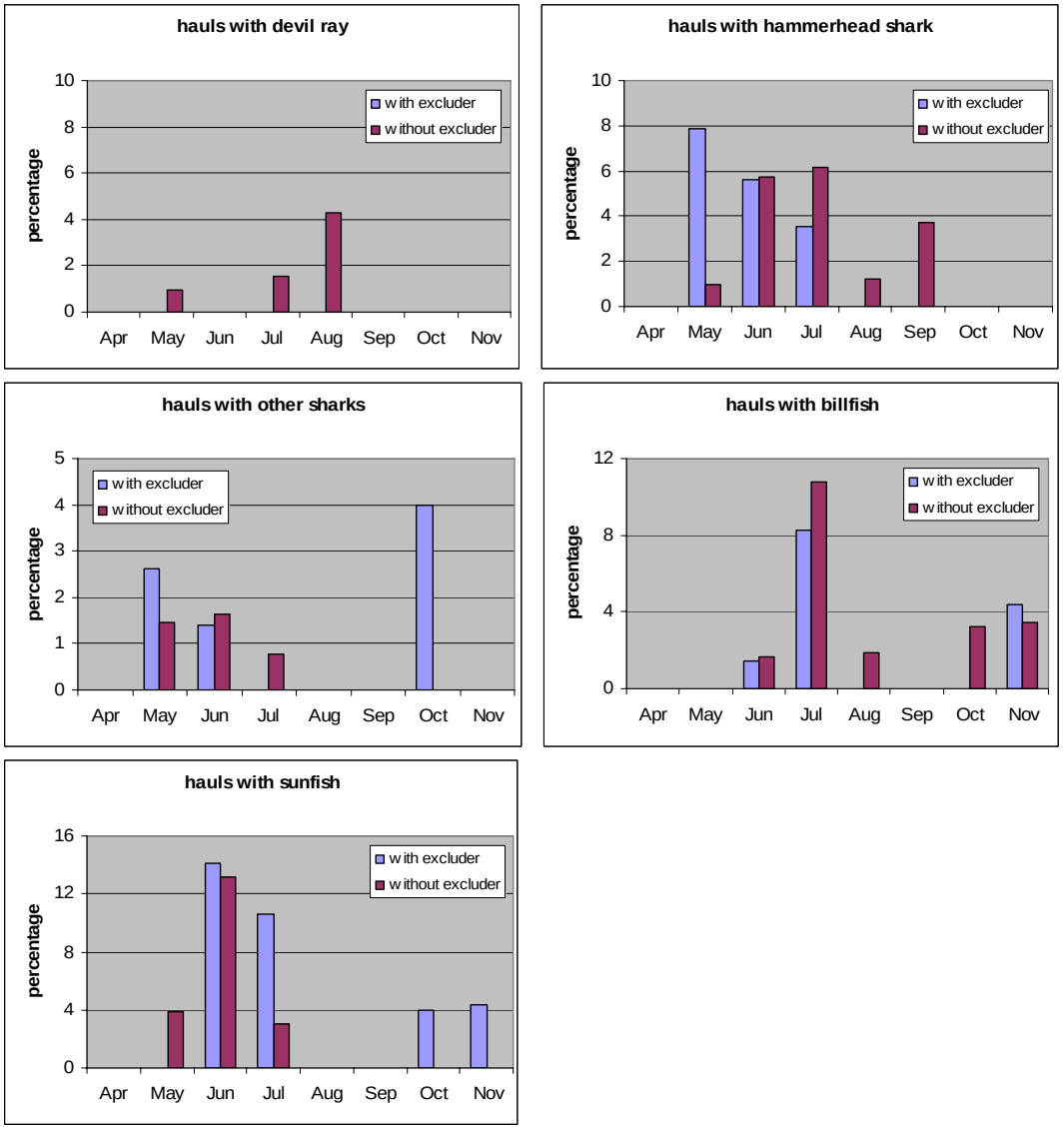

Figure 3.2. Percentage of hauls (with and without excluder) in which a certain by-catch was observed throughout 2006.

A comparison between by-catch rates based on observations in the period 2001-2004, as reported in Zeeberg *et al.* 2006, and observations during 2006 is made in Table 3.3. In Zeeberg *et al.* (2006) by-catch rates are partly based on observations by scientific observers from RIVO and IMROP, and based on reports from the crew. By-catch rates as noted by scientific observers were usually higher than the by-catch rates based on observations by the crew. By-catch rates reported by crew members for 2006 are again lower than the by-catch rates reported for the years 2001-2004, especially for the categories devil ray, hammerhead sharks and other sharks. The other by-catch rates (based on observations by the crew) are at a similar level for both periods.

	Previous study 2001 - 2004		This study
	observers	crew	crew
devil ray ("manta")	142.9	49.3	13.1
hammerhead shark	508.7	194.5	72.8
other sharks	179.4	92.0	16.8
billfish	155.1	58.6	119.4
sunfish	148.1	105.1	95.1
turtle	10.5	3.9	4.7
dolphin	139.4	14.5	17.7
pilot whale	15.7	0.0	0.9
number of hauls	574	761	1072

Table 3.3. Number of by-caught specimens per 1000 hauls based on observations by observers from RIVO and IMROP in the years 2001-2004, and on observations by crew members in the period 2002-2004 and during 2006. The number of observed hauls is also given.

The data provided by the crews also contained information on haul duration and on the total catch (including discards) of the target species. It has sometimes been suggested that by-catches especially occur when the catch-rates of the target species are low, resulting in a fairly long haul-duration. In Figure 3.3 the relation is shown between haul-duration and total catch of the target species. In this figure, hauls for which one or more by-catches were reported are indicated by open symbols. Table 3.4 summarises the data from Figure 3.3.

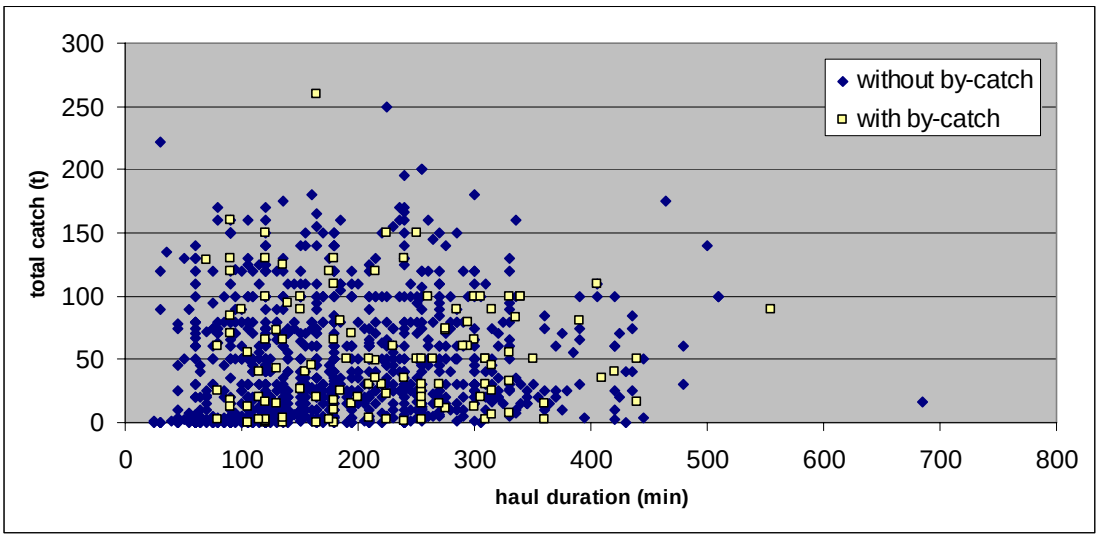

Figure 3.3. Relation between haul-duration (in minutes) and total catch of the target species (in t). Open symbols are for hauls for which one or more by-catches of any of the by-catch species was recorded.

haul duration (min)	nr of hauls	hauls with by-catch	%
0-60	56	0	0
61-120	255	28	11.0
121-180	268	24	9.0
181-240	190	21	11.1
241-300	172	23	13.4
301-360	75	20	26.7
361-420	25	4	16.0
421-480	15	2	13.3
481-540	3	0	0
541-600	1	1	100
601-660	0	0	
661-720	1	0	0
totaal	1061	123	

Table 3.4. Number of hauls (total, and with one or more by-catches) for different classes of haul-duration and percentage of hauls for which a by-catch was reported.

From both Figure 3.3 and Table 3.4 it can be seen that by-catches can occur throughout the range of haul-durations, except for hauls with a duration of less than one hour, which have probably targeted dense shoals. The percentage of hauls with one or more by-catches does not seem to increase with the increase of the haul-duration.

Finally, Table 3.5 shows that the use of the excluder did not significantly influence the catches of the target species. The average catch of hauls without excluder was 50.8 t, and for hauls with excluder this was 46.5 t.

	without excluder		with excluder	
	N hauls	average catch (t)	N hauls	average catch (t)
April	20	38.8	-	-
May	207	45.3	38	41.0
June	122	55.2	71	50.7
July	130	58.9	84	62.1
August	163	55.2	27	32.1
September	27	26.5	74	43.5
October	31	49.6	25	24.8
November	29	43.2	23	36.7
total	729	50.8	342	46.5

Table 3.5. Number of hauls per month, and the average total catch (including discards) of the target species for hauls without and with excluder.

3.2 Underwater observations of the performance of a Large Animal Reduction Device (LARD)

In the contract for the current project it was agreed that during the experimental fishing with and without excluder, underwater observations would be made by the crews of some of the vessels. In the course of the project it became apparent that it would be very difficult for the crew to start underwater observations themselves, without a proper instruction by employees of IMARES, who since many years have worked with these underwater systems. Thanks to an extension of the contract some additional underwater observations could be made in Mauritania during a 2-week period, and meanwhile crew members could be instructed on the use of the underwater equipment. Due to personal circumstances only Mr. D. de Haan was able to perform the observations (de Haan, 2006).

In the period 12-25 July 2006 underwater video observations on two different prototypes of the Large Animal Reduction Device (LARD) were conducted on board the freezer trawler "Cornelis Vrolijk" H171 while fishing for Sardinella off the Mauritanian coast. As is usual on board Dutch freezer trawlers, also on "Cornelis Vrolijk" two pelagic trawls were being used, in order to minimize delays in case of trawl damage. One of the two trawls was rigged with a LARD. Underwater observations of the performance of the LARD were made at daytime during 7 out of a total of 39 hauls. During these seven cases only a single release of a small hammerhead shark was observed, while another one became entangled in the LARD interior. During the remaining 32 hauls the pelagic trawl equipped with a shark-grid was used.

The by-catch of non-targets in a trawl rigged with a shark blocking panel in the cod-end demonstrated that dolphins, hammerhead sharks and large rays are mainly caught during the night. The by-catch of dolphins illustrates the urgent need for research on the chances for escape of these animals through a LARD. Such research, however, can only be successful if the instruments could be modified to enable observations during night hauls.

Sardinella was observed swimming stationary inside the LARD over the complete observed fishing period and a large part of the fish was observed swimming forward outside the observed area and did not return during hauling. This observation indicates that part of the target fish escapes through larger meshes in the tapered net sections, which is also indicated by the gilled fish in 120 mm meshes.

At the start of the observation period only one LARD was available and the second device, originally intended for use on board freezer trawler "Willem van der Zwan" SCH 302, did not arrive until the end of the period and could, therefore, only be observed on board the "Cornelis Vrolijk" H171 on the last day of the research period. In spite of good intentions, our research was hampered by a number of flaws:

- the filter of the first LARD was repaired before the observation period and enlarged in width. This meant that a proper comparison with previous by-catch registrations could not be made;
- the design of the cod-end sections of the LARD's was not identical, since an arrangement behind the LARD to avoid fish from swimming forward (so-called "fish flaps" or valves) was only built in the second LARD;
- the mesh-size of the tunnel was different;
- both prototypes did not contain the desired and recommended weight on the junction of the filter grid and escape route. This affects the efficiency of filtering targets.

The underwater instrumentation performed well. A complete second instrumentation set was tested and left on board for continued trials by the crew. The use of the instrumentation and accessory instructions were demonstrated to the crew.

By-catch of commercial hauls without LARD					
Haul nr.	Sunfish	dolphin	hammerhead	Ray	Marlin
2				1	
3		10-20			
7		2-5	1		3
8		1-5	1		4
11		5-10			
13			3 (0.7 m)		
16	1				
18	1				
24					4
28					4
33				1	
34					2
36					3
Total	**2**	**18-40**	**5**	**2**	**18**

Table 3.6 Overview of by-catches of hauls without the LARD (but with a "shark" blocking panel). Haul numbers marked yellow refer to night hauls

During the same trip used to do the underwater observations of the LARD, also a number of hauls was made without using the LARD, but using a so-called "shark blocking panel" instead. Table 3.6 provides an overview of the by-catches from these hauls. Only few of these by-catches were observed during day-time. Most by-catches occurred at night. They consisted for a large part of dolphins (18 to 40 in total), probably common or striped dolphin, all caught west of the canyons. In most cases the by-catch was discarded into the sea, while the cod-end was still in the sea, but before the fish pumping started. This could be done from deck by pulling a rope that opens a "zipper gate" at the lower end of the shark panel. As the by-catch was not taken on deck, but discarded immediately in the sea, the by-catch observations in Table 3.6 can only be considered rough estimates. Only in one case (haul 3), a single male common dolphin of the remotely discarded dolphin catch was released on deck. When fishing west of Nouakchott marlins were regularly caught during both day and night. Only few sharks, hardly any sunfish, or devil rays (manta) were by-caught. In a single case a large devil ray was released alive.

3.3 Discussion and conclusions

During 2006, the crews of four freezer-trawlers collected data on 1072 hauls. In 124 hauls one or more by-catches of large fish, turtles or cetaceans were recorded. Comparison with data collected for the years 2001-2004 shows that the by-catch rates for 2006 were clearly lower for rays and sharks than for the earlier years (Table 3.3). But also, a difference seems to occur within the 2001-2004 data, where by-catch rates based on observations by scientific observers were usually higher than those based on crew-observations. This difference might partly be caused by the fact that for the period 2001-2004 most of the crew-observations are for the last part of the fishing season, when by-catches are presumed to be lower than in the summer-months (Zeeberg *et al.* 2006).

From the comparison of the number of cetaceans as reported by the crew in 2006, with the numbers estimated during an observation period of two weeks in July 2006 (see Section 3.2 and Table 3.6), it must be concluded that the observations by the crew are likely to be an underestimate of the total number of by-caught megafauna.

A good understanding of the working procedures on board is essential to understand the problem that has occurred. The following description is copied from ter Hofstede *et al.* (2004): *"As soon as the fishing skipper supposes that the amount of fish in the net is large enough for processing, most of the net is taken on board. Only the cod-end, the part where the target fish is gathered, stays in the water. The crew connects a fish-pump to the tip of the cod-end, and the catch can be pumped directly from the net into the storage-tanks on board the ship.*

Pelagic megafauna are retained by a specific part of the net, the so-called shark-grid, which consists of large meshes that allow the smaller fish to pass, but prevent the larger animals from entering the cod-end. As a result, the pelagic megafauna cannot block the fish-pump when the catch is taken on board the ship. Normally the captured large species are released while the net is still in the water."

The numbers as recorded during 2006 by the vessels themselves most likely only refer to the by-catches that have been on deck, while the scientific observers also estimated the numbers retained by the shark-grid, but released through the operation of the "zipper system", before the net was hauled on board. Or the observers usually asked the crew to take the whole catch on board. When large fish and cetaceans are released through the zipper-system, it is highly unlikely that they will survive, since most of the fish will have died from the high pressure in the net, whereas the cetaceans will already have suffocated. The zipper-system is only used when a shark-grid is being applied. If large megafauna retained by the shark-grid is not, or not always, included in the by-catch records this will possibly have caused a serious bias in the by-catch rates for hauls without excluder.

Devil-rays ("manta") were only caught when no excluder was used, but the number of observations is quite small (11 hauls, 14 specimens). Apart from devil rays, and in contrast with the conclusions of Zeeberg *et al.* (2006), no clear difference in by-catch rates of hauls with and without excluder can be seen. Although underwater observations showed the escape of target species (Section 3.2) the comparison of the catch of hauls with and without excluder did not reveal a clear effect of the excluder on the total catch of these target species (Table 3.5).

The efficiency of the excluder, tested by four freezer-trawlers in 2006, for dolphins, is as yet not known and the figures do not express a clear positive effect of this device. It is, therefore, recommend that further work on the design and efficiency of the excluder for large fish, turtles and small cetaceans is carried out.

Later tests with a new instrumentation set on board of the German research vessel, "Walther Herwig III", have shown that underwater observations during night hauls are feasible. The total observation time could even be extended to seven hours.

For a proper analysis of the quantity and composition of by-catches, and thus of the efficiency of the excluder, it is essential that the whole catch is taken on board. The use of a zipper-construction to release by-catches while the net is still partly in the water, as is the current practice of the fleet, should not be allowed when information on by-catches is being collected. This conclusion was already drawn by ter Hofstede *et al.* in 2004, but has mistakenly not been specifically included in the instructions provided to the crews before the 2006 fishing season.

Although there may be exceptional circumstances, depending on catch and by-catch load in relation to the risk of damaging the gear, that this procedure is in practice impossible, conclusions on the effectiveness of excluders can only be drawn reliably when observations are made on all by-catches. In cases that it is impossible to take the total by-catch on board, it should at least be noted as detailed as possible what the composition is of the by-catch that is released through the operation of the zipper system.

As stated by ter Hofstede *et al.* (2004) the sampling of large by-catches can only been done in close cooperation with the crew, because they must perform other, and thus more work than in general. Observers should be able to motivate the crew to do this additional work. It is, therefore, essential that observers have good communication skills and are well-trained in order to be able to fulfil their difficult task.

4. Literature

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ANNEX 1

Number of hauls, by vessel and by day, with and without excluder, as recorded in 2006.

		Johanna Maria		Afrika		Cornelis Vrolijk		Carolien	
		SCH118		**SCH24**		**H171**		**SCH81**	
week nr	date	without	with excl	without	with excl	without	with excl	without	with excl
17	26 Apr							5	
17	27 Apr							3	
17	28 Apr							3	
17	29 Apr							5	
17	30 Apr							4	
18	1 May							6	
18	2 May							6	
18	3 May							2	
18	4 May							3	
18	5 May							4	
18	6 May							2	
18	7 May			1				4	
19	8 May			2				6	
19	9 May			2				5	
19	10 May			3				2	
19	11 May			3				4	
19	12 May			3				5	
19	13 May			4				4	
19	14 May			4				6	
20	15 May			1		2		5	
20	16 May			4		3		6	
20	17 May			3		3		2	
20	18 May			3			3		3
20	19 May			1		2		3	
20	20 May			3			2		3
20	21 May			1		2		2	
21	22 May	3		6			3		6
21	23 May	3					3	2	
21	24 May	4		3		3	1		4
21	25 May	2		4			5	6	
21	26 May	4		5		2			
21	27 May	5		4			2		
21	28 May	3		3		2			
22	29 May	1		1			2		
22	30 May	3		3		3			
22	31 May	2		3			1		
22	1 Jun	3		2		1			
22	2 Jun	4		4			3		
22	3 Jun	4		2		1			
22	4 Jun	4		4			1		
23	5 Jun	1		5		5			4
23	6 Jun	1					4		1
23	7 Jun	4				2			4
23	8 Jun	3					3		3
23	9 Jun	3				1			5
23	10 Jun	4							1
23	11 Jun	3							
24	12 Jun	2							
24	13 Jun								
24	14 Jun								
24	15 Jun								
24	16 Jun			2					
24	17 Jun			4					
24	18 Jun			2					
25	19 Jun			3			2		
25	20 Jun			3		1			
25	21 Jun			3		3			
25	22 Jun			3			4		
25	23 Jun			4		3			
25	24 Jun		2	2			2		
25	25 Jun		3	1		3			
26	26 Jun		4	3			2		
26	27 Jun		5	2		2			
26	28 Jun		5	5			3		
26	29 Jun		4	2		4			
26	30 Jun		3	4			3		
26	1 Jul		3	4		3			
26	2 Jul		3	3			2		
27	3 Jul		3	3		3			
27	4 Jul		2	4			1		
27	5 Jul		2						
27	6 Jul		4						
27	7 Jul		2						
27	8 Jul		3						
27	9 Jul		3						
28	10 Jul		2						
28	11 Jul		3						
28	12 Jul		3						
28	13 Jul		1			1			
28	14 Jul			2		2			
28	15 Jul			3		3	1		
28	16 Jul			4		2	2		
29	17 Jul			4		3	1		
29	18 Jul			2		2			
29	19 Jul			5		5			
29	20 Jul			4		3			
29	21 Jul			3		3			
29	22 Jul		3	3		4			
29	23 Jul		2	2		2	1		
30	24 Jul		3	3			4		
30	25 Jul		3	3			2		
30	26 Jul	2	1	1			5		
30	27 Jul	2		4			4		2
30	28 Jul	4		3			2	5	
30	29 Jul	4		3			2		5
30	30 Jul	3		2			1	2	
31	31 Jul	3		4					4
31	1 Aug	3		3				3	
31	2 Aug	3		1					4
31	3 Aug	3						3	
31	4 Aug	3							4
31	5 Aug	3						5	
31	6 Aug	2							3

week nr	date	Johanna Maria SCH118 without	Johanna Maria SCH118 with excl	Afrika SCH24 without	Afrika SCH24 with excl	Cornelis Vrolijk H171 without	Cornelis Vrolijk H171 with excl	Carolien SCH81 without	Carolien SCH81 with excl
32	7 Aug	3						4	
32	8 Aug	3							3
32	9 Aug	2						3	
32	10 Aug	2							4
32	11 Aug			4				3	
32	12 Aug			4					4
32	13 Aug			3				3	
33	14 Aug			4					4
33	15 Aug			4				3	
33	16 Aug			3					1
33	17 Aug			4					
33	18 Aug			4					
33	19 Aug	3		3					
33	20 Aug	4		3					
34	21 Aug	4		3					
34	22 Aug	3		3					
34	23 Aug	2		3					
34	24 Aug	3		2					
34	25 Aug	4		3					
34	26 Aug	3		5					
34	27 Aug	2		3					
35	28 Aug	4		4					
35	29 Aug	3		2					
35	30 Aug	3							
35	31 Aug	3							
35	1 Sep	2							
35	2 Sep	4							
35	3 Sep	3							
36	4 Sep	2							
36	5 Sep	2							
36	6 Sep	3			5				
36	7 Sep	3			3				
36	8 Sep	2			2				
36	9 Sep	2			1				
36	10 Sep	1			1				
37	11 Sep	2			2				
37	12 Sep	1			3				
37	13 Sep				3				
37	14 Sep				3				
37	15 Sep				2				
37	16 Sep				4				
37	17 Sep				3				
38	18 Sep				4				
38	19 Sep				3				
38	20 Sep				3				
38	21 Sep				1				
38	22 Sep				4				
38	23 Sep				3				
38	24 Sep				3				
39	25 Sep				4				
39	26 Sep				4				
39	27 Sep				4				
39	28 Sep				3				
39	29 Sep				4				
39	30 Sep				2				
39	1 Oct								
40	2 Oct								
40	3 Oct								
40	4 Oct								
40	5 Oct								
40	6 Oct								
40	7 Oct								
40	8 Oct								
41	9 Oct								
41	10 Oct								
41	11 Oct								
41	12 Oct								
41	13 Oct								2
41	14 Oct							3	
41	15 Oct								2
42	16 Oct							3	
42	17 Oct								3
42	18 Oct							3	
42	19 Oct								2
42	20 Oct							5	
42	21 Oct								3
42	22 Oct							4	
43	23 Oct								3
43	24 Oct							4	
43	25 Oct								4
43	26 Oct							2	
43	27 Oct								2
43	28 Oct							3	
43	29 Oct								2
44	30 Oct							4	
44	31 Oct								2
44	1 Nov							3	
44	2 Nov								2
44	3 Nov							4	
44	4 Nov								4
44	5 Nov							3	
45	6 Nov								3
45	7 Nov							3	
45	8 Nov								4
45	9 Nov							5	
45	10 Nov								3
45	11 Nov							5	
45	12 Nov								3
46	13 Nov							4	
46	14 Nov								4
46	15 Nov							2	
N hauls		179	72	267	74	84	77	199	120

ANNEX 2

Meeting of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa, Banjul, The Gambia, 2-11 May 2006.

P.J. Tjoe-awie

Introduction

This year the sixth meeting of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa was held in Banjul, The Gambia, from 2-11 May 2006. The meeting was organized by FAO/FIRM in cooperation with the Fisheries Department of the Gambia with funding from Project GCP/INT/730/NOR: "International Cooperation with the NANSEN Programme: Fisheries Management and Marine Environment" and the Institute for Marine Resources and Ecosystem Studies (IMARES). The overall objective of the Working Group was to assess the status of the small pelagic resources in Northwest Africa and recommend on fisheries management and exploitation options aimed at ensuring optimal and sustainable use of small pelagic fish resources for the benefit of coastal countries.

The Terms of Reference of the Working Group were as follows:

1. Presentation of new data on catch, effort, sampling intensity and biological data by country. Updating existing data base.
2. Presentation of working papers on research activities. Review of research activities carried out during 2005/2006 as recommended by the Small Pelagics Working Group in 2005.
3. Presentation of reports on acoustic surveys; Nansen acoustic surveys Oct/Nov/Dec 2005, surveys by R/V AtlanNIRO/Atlantida and from the RVs of the different countries.
4. Presentation of the report of the Planning Group for the coordination of acoustic surveys and the results of the Workshop to analyse parallel survey results
5. Report on progress made on age reading of sardine and sardinella
6. Analyses of catch, effort and biological data for the period 1990-2005, if possible also for the period before 1990.
7. Updating stock assessments for anchovy, bonga, sardine, sardinellas, horse mackerels and mackerels
8. Advice on short term management for each resource/stock.
9. Coordination of Small Pelagics research project

List of participants

• Pedro Barros	FAO
• Eduardo Balguerias (until 5 May)	Spain
• Ana Maria Caramelo	FAO
• Hamid Chfiri	Morocco
• Ad Corten	the Netherlands
• Andrew Cook (2 and 3 May)	FAO-CCLME
• Hicham Gourich	Morocco
• Ebaye Mahmoud	Mauritania
• Asberr Mendy	the Gambia
• Azedinne Ramzi	Morocco
• Birane Samb	Senegal
• Abdoulaye Sarre (until 4 May)	Senegal
• Ibrahima Sow	Senegal

• Mahfoudh Ould Taleb	Mauritania
• Merete Tandstad	FAO
• Nikolay Timoshenko	Russia
• Pablo Tjoe-awie	the Netherlands
• Reidarn Toresen (chairman)	Norway

Selection of reference points for the 2006WG

In formulating the results of the assessment, the 2005 Working Group noted that it lacked a set of uniform reference points and management objectives for all stocks in the area. The group therefore decided that appropriate reference points should be addressed at the 2006 Working Group meeting. After a short discussion on the standardization of the use of reference points in the assessment of small pelagics, it was decided to establish a sub working group which will produce a working document on how to deal with RPs in the assessment of small pelagics in this working group. The sub working group consisted of the following persons:

- Ad Corten (Chair)
- Eduardo Balguerias
- Birane Samb
- Azedinne Ramzi
- Ebaye Mahmoud
- Asberr Mendy

This sub working group defined its findings as follows:

Given that the current assessment procedures are based on the application of a dynamic version of the Schaefer logistic production model, the Reference Points (RPs) to adopt should be those that can be calculated from those models. Since it was not possible, during this meeting, to explore adequately the properties of alternative RPs the Working Group decided to use RPs already investigated by other authors. The Working Group therefore decided to adopt B_{MSY} and F_{MSY} as the Limit Reference Points (LRP), and $F_{0.1}$ and $B_{0.1}$ as the Target Reference Points (TRP)

The estimation of the absolute (current or reference) values of fishing mortality and/or biomass is often very difficult, due to uncertainties in the data used, or in the parameters used in the modeling process. It is thus often not possible to define accurate absolute values of the RPs, nor the absolute current status of the stocks. In many cases, however, it is possible to estimate quantities that are proportional to these values, even if the proportionality constant is not known. In these cases, it will be possible to evaluate the current status of the stocks relative to the defined RPs.

Given the uncertainties associated with estimating absolute values of B and/or F, it was proposed that the WG keeps presenting the results of its assessment as current levels relative to the TRPs ($F_{0.1}$ and $B_{0.1}$). Additionally, the estimated current catch relative to the catch that would keep the stock at the current biomass level should also be presented.

If the stock biomass is assessed below a level of 30% of B_{MSY}, the WG decided to express a special warning of the stock status.

Canary Current Large Marine Ecosystem Project (CCLME)

This year the WG received a request from the Coordinator of the Canary Current Large Marine Ecosystem (CCLME), Andrew Cook, to ponder over issues that are trans-boundary in nature with regard to the small pelagic fish. The CCLME project is hosted at the Permanent Secretariat of the Sub-Regional Fisheries Commission (SRFC) and will be implemented in the member countries of the CCLME region namely; Cape Verde, Guinea-Bissau, Mauritania, Morocco, Senegal and The Gambia. The WG was therefore an important forum to discuss matters that

concern these shared stocks in the sub-region as it has invaluable knowledge of the small pelagic fish in the sub-region.

The Working Group was asked to discuss issues of concern which affect one or more countries which share these pelagic fish to contribute to the Trans-boundary Diagnostic Analysis (TDA) process and to propose demonstration projects that will address those concerns for possible funding. Funding will be in the form of co-funding at a rate of 2:1 (other funding source:CCLME funding).
The WG proposed the following projects which they deemed appropriate to enhance the assessment and sustainable management of the small pelagic fish.

Factors influencing abundance, migration and geographical distribution of small pelagic fish.

- Study environmental influence (upwelling, shift in thermal front, time series of environmental indices)
- Recruitment surveys (acoustic, trawling)
- Stock identity (genetics, morphology, parasitology)
- Migration (tagging, acoustic survey, trawling)

Re-enforcement capacities for the sustainable management of shared stocks.

- Improve biological and ecological data collection systems
- Improve monitoring, control and surveillance mechanisms
- Study mechanisms for putting in place catch quota system in the sub-region
- Develop common database for the shared stocks (fisheries statistics)
- Organize meetings between scientists and fisheries managers

Third meeting of the planning group for the coordination of acoustic surveys off northwest Africa.

The 2005 planning group for the coordination of acoustic surveys was held in Dakar, Senegal, from 27-29 October 2005. The meeting was organized by FAO/FIRM in cooperation with the CORDT Senegal with funding from Project GCP/INT/730/NOR: "International Cooperation with the NANSEN Programme: Fisheries Management and Marine Environment". The overall objective of the planning group is to discuss acoustic difficulties met by countries of the region, organize parallel surveys of each country's research vessel with the Norwegian R/V Dr. Fridtjof Nansen and act as a forum for discussion on issues important to acoustic surveys such as standardization of methods, acoustic research and training (trawl sampling, scrutinizing, data storage, target strength (TS) measurements etc).

The following problems were identified during this planning group:

- Trawling on small pelagic fish by the Senegalese still poses problems, proposed is to replace the trawl.
- Propeller noise of the Moroccan vessel interferes with their acoustic measurements, proposed is to revise the propeller when the vessel will be in dry dock
- To be able to better analyze regional acoustic data, central storage of data is proposed. Data storage will be facilitated by one of the member countries within existing structures.
- Further training (Simrad) of technicians was also identified as a need to further improve the quality of the regional acoustic programme.

In 2005 the R/V Dr. Fridtjof Nansen held its last echo-survey in the sub-region. The inter-calibration results of the different national vessels against this last mission looked very promising. For the upcoming national surveys in October 2006, the planning group placed a request for assistance at the Nansen programme. Support is wanted of Fridtjof Nansen cruise leaders onboard of the national vessels during these echo-surveys. This request will be taken into consideration by the Nansen programme.

Another point of concern of the planning group was the scrutinizing of the echo-survey data. Now all countries in the sub-region scrutinize their data independently from each other. Worries exist that using scrutinizing methods independently from each other might introduce an extra bias into the comparison of sub-regional echo-survey results. In order to minimize differences in scrutinizing methods, it is desirable to inter-calibrate the scrutinizing methods used among each other. The planning group decided to look further into this matter.

The 2005 Working Group recommended that an exchange of *Sardina pilchardus* and *Sardinella aurita* otholiths should be initiated after the 2005 Working Group. It was agreed upon that 50 otholiths covering all months is sufficient for age reading. An otholith exchange was carried out in January-May 2006 with the following objectives:

- to estimate precision from the age-reading of each individual age reader
- to improve the quality of sardine age-readings
- to stimulate regional collaboration

Sardina pilchardus
The *Sardina pilchardus* otholiths submitted by Morocco were rejected because of bad otholith quality. Generally there was a trend of overestimation below age 1 and underestimation above age 1. Compared to the previous year, there is an improvement in age reading results, and age reading results for *Sardina pilchardus* look promising.

Sardinella aurita
Russia submitted only 14 *Sardinella aurita* otholiths, which was not sufficient. The age reading results for *Sardinella aurita* were not known during this meeting, because the otholiths were still circulating among the different readers.

Regional stock assessment

This year, the Working Group made decisions on the use of reference points for management of the pelagic stocks in the region. The Group also made predictions on the development of the status of the stocks and on future effort and catch levels. In absence of reliable length and /or age composition data, the Working Group used production models for all stocks. In the table below, management advice for the stocks is given in relation to the reference points (B_{01} and $F_{0.1}$) and on the basis of the predictions.

The Working group decided this year to adopt a quality control diagram (internal use only) to be able to track the consistency of the assessments from year to year.

Announcements

The next Working group will be held in Morocco. In the course of this year all members of the Working group will be further notified on the exact date and location.

This year Reidarn Toresen announced his resignation as chairman from the Working Group. He will still attend the next year meeting. The chairman for the next meeting in Morocco will be Birane Samb. It was decided to circulate the chairmanship among the group members with a periodicity of 3 years

Stock	Last Year catch (1000 t) (5 year average)	$B/B_{0.1}$	$F/F_{0.1}$	Assessment	Management recommendations
Sardina pilchardus Zone A+B	550 (650)	128%	63%	Stock is not fully exploited	Do not increase catches above average level of last 5 years (600 000 tonnes)
Sardina pilchardus Zone C	190 (115)	177%	6%	Stock is underexploited	The total catch level may be progressively increased up to 1 000 000 tonnes during a 5 year period.
Sardinella aurita and *S.maderensis* whole sub-region	470 (460)	77%	212%	*S. aurita* stock is probably overexploited; no reliable results for *S. maderensis*	Decrease effort in total sardinella fishery by 50% corresponding to a total catch of sardinellas of not more than 220 000 tonnes (2007).
Trachurus trachurus whole sub-region	120 (90)	108%	151%	*T. trachurus* stock probably fully exploited	Because of mixed fishery with the other horse mackerel stock, decrease effort by 20%, corresponding to a total catch of horse mackerel of 260 000 tonnes in 2007.

Stock	Last Year catch (1000 t) (5 year average)	$B/B_{0.1}$	$F/F_{0.1}$	Assessment	Management recommendations
Trachurus trecae whole sub-region	220 (180)	159%	73%	Stock of *Trachurus trecae* not fully exploited	Because of mixed fishery with the other horse mackerel stock, decrease effort by 20%, corresponding to a total catch of horse mackerel 260 000 tonnes in 2007.
Scomber japonicus whole sub-region	185 (180)	140%	51%	Stock not fully exploited	Because of mixed fishery with the other stocks, the catch should not exceed 200 000 tonnes (2007)
Engraulis encrasicolus whole sub-region	84 (143)	NA	NA	NA, acoustic estimates showed an increase in biomass in recent years	As a precautionary measure, catch level should not exceed the average over the three last years (135 000 tonnes)
Ethmalosa fimbriata whole sub-region	NA	NA	NA	NA, but catch rates are stable	As a precautionary measure, catch level should not exceed the average over the five last years (42 000 tonnes)

ANNEX 3

Reports and publications concerning pelagic fisheries in Mauritania

2000

Corten, A. 2000. Biological research on pelagic fish stocks in West Africa. Final report, August 2000. Pelagic Freezer Trawler Association, IJmuiden, The Netherlands.

2002

Benjamins, S. 2002. Catch composition of the EU pelagic fleet in Mauritania in 1999. RIVO Report C042/02.

Benjamins, S. 2002. Incidental catches of pelagic megafauna by pelagic trawlers from the European Union in Mauritanian waters during 1999-2000. RIVO Report C036/02.

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