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Assessment of Sardinella and other Small Pelagics in West Africa

Progress Report 2003

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Summary

The year 2003 was the sixth year of the cooperation between RIVO and the Mauritanian fisheries research institute IMROP (Institut Mauritanien des Recherches Océanographiques et de Pêche). It was also the second year of the current contract between RIVO and the Dutch Ministry of Agriculture, Nature and Food Quality. The cooperation between the Dutch and Mauritanian institutes is aimed at the transfer of technology and experience in the field of pelagic stock assessment. By increasing Mauritania's capacity for pelagic stock assessment, prospects are improved for a sustainable management of pelagic resources in the area.

Work on acoustic surveys was continued in 2003. The investments in equipment, fishing gear and training in previous years are now starting to produce results. Three surveys were conducted with the Mauritanian research vessel "Al Awam", and acoustic estimates were produced for the pelagic stocks in the Mauritanian zone. The crew of the "Al Awam" is now well acquainted with pelagic trawling, and the identification of echo-traces is no longer a problem.

The scientific observer programme covered 13% of all fishing trips made by Dutch trawlers in Mauritania. The quality of the data shows a steady improvement, thanks to the growing experience of the observers and the close supervision of the programme by IMROP and RIVO staff.

Biological studies were aimed at determining the spawning season of sardinella, and also at age reading of this species. Despite two international workshops that were organised in 2003, considerable differences remained between the results of age-readers from different countries.

A new programme was initiated for stomach sampling of sardinella and its predators. The main objective of this study is to find out whether sardinella and other pelagic species eat each other's larvae and juveniles, and thereby affect each other's population size.

The project sponsored the third annual meeting of the FAO working group on small pelagics in West Africa. This meeting took place in March in Agadir (Morocco). The Mauritanian team at the meeting consisted of 3 IMROP and 2 RIVO scientists. Results of the assessments indicated that the stock of sardinella in West Africa shows a steady decline, whereas the stocks of sardine, mackerel and horse mackerel appeared to be stable. The meeting recommended a freeze on fishing effort as a precautionary approach.

1. Introduction

The project "Assessment of sardinella and other small pelagics in West Africa" was contracted by the Dutch Ministry of Agriculture, Nature and Food Quality (LNV) to the Netherlands Institute for Fisheries Research (RIVO) in January 2002. The project is a continuation of the cooperation between RIVO and the Mauritanian fisheries research institute IMROP (previously named CNROP) that started already in 1998. Results of the work in previous years have been reported by Corten (2000, 2002, 2003).

The interest of the Dutch government in stock assessment of small pelagics in West Africa stems from the activities of the Dutch fleet in the area. This fleet consists of 6-8 modern freezer trawlers that target species such as sardinella, sardine, horse mackerel and mackerel. These species are abundant in Mauritanian waters, but so far they are only lightly exploited by Mauritanian fishermen. The Mauritanian government has issued licenses to foreign ship owners to harvest the surplus potential. Catches by Dutch vessels are transhipped in Las Palmas or at sea off Nouadhibou, the main fishing port of Mauritania. The catches are used exclusively for human consumption, and the main markets are other West African countries where large populations depend on fish for their protein supply.

The joint project between RIVO and IMROP is aimed at strengthening Mauritania's capacity for pelagic research and stock assessment. The resulting management advice will assist the Mauritanian government in formulating a management policy for the pelagic resources. The emphasis of the project is on the transfer of technology that was developed by RIVO in its research on small pelagics in Western Europe, and that can be applied to similar species in West Africa. Since the pelagic stocks migrate back and forth between several West African countries, the project also deals with stock assessment at a regional level.

The project has a number of components, all of which are relevant to the management of small pelagics:

- acoustic evaluation of the abundance of pelagic fish
- biological studies to establish parameters such as age and time of reproduction
- an observer programme on board commercial trawlers for monitoring catches and discards
- a study of the effects of hydrographic variation on fish distribution and reproduction
- a study of migration patterns and stock identity
- a study of predation and natural mortality
- a contribution to the FAO working group for stock assessment of small pelagics in West Africa.

In addition to technical assistance in stock assessment and other research on small pelagics, the project also provides institutional support to IMROP. This applies, amongst other things, to the acquisition of computer hardware and software

The present report deals exclusively with the results of project 313-12300-01 "Assessment of sardinella and other small pelagics in West Africa". In addition to this project, RIVO has several other related projects in Mauritania. One of these (313-12300-02) deals with the application of satellite pictures and another (313-12300-03) concerns the prevention of by-catches of large species. Both projects are also financed by the Dutch Ministry of Agriculture, Nature and Food Quality. In June 2003, RIVO started a project on demersal fish stocks in Mauritania (project 313-12300-05). This project is financed by the Dutch Ministry of Foreign Affairs. Results of these other projects are published in separate reports.

This progress report presents an overview of all activities within project 313-12300-01. Detailed results of specific studies conducted within the framework of this project are presented in separate reports and working documents, a list of which is presented in section 10.

2. Project staff and facilities in 2003

2.1. RIVO project staff

No changes occurred in the composition of the RIVO staff in Mauritania in 2003. The project staff in Nouadhibou thus consisted of the following persons:

Ad Corten	project leader	RIVO	1 Jan - 31 Dec
Remment ter Hofstede	scientist	RIVO	1 Jan - 31 Dec
Irmien Mantingh	scientist	RIVO	1 Jan - 31 Dec

The RIVO staff worked on a rotation basis in Mauritania, with missions of 6 weeks in Nouadhibou alternating with periods of 6 weeks in Holland. The missions of the various team members partly overlapped, which resulted in a nearly continuous presence of RIVO scientists in Mauritania. At the end of the year, Remment ter Hofstede left the project to assume other duties at RIVO in Ymuiden.

Support in Holland was provided by JaapJan Zeeberg, who took care of administrative duties in periods when no other team members were present at RIVO.

2.2. Visitors to the project

A list of visitors to the project is presented in the table below.

Mor Sylla	technician	CRODT Senegal	23 Feb – 6 Mar
Martin Scholten	director	RIVO	6-10 Feb
Carolien Vrolijk	public relations	Vrolijk BV Ymuiden	6-10 Feb
Carla Bisseling	biologist	Ministerie LNV	14-16 Feb
Peter van der Heijden	biologist	IAC Wageningen	14-16 Feb
Kees Lankester	biologist	Scomber BV	14-16 Feb
Pierre Beillois	acoustic engineer	Ifremer France	7-15 March
Cees Bakker	electronic engineer	RIVO	7-15 March
Joseph Douard	fishing captain	Vrolijk BV Ymuiden	7-15 March
Dick de Haan	electronic engineer	RIVO	17-24 May
Fokko Vos	electronic engineer	Canview BV	19-22 November
Pavel Gasyukov	mathematician	Atlantniro	20 Nov – 20 Dec
Joseph Douard	gear expert	Vrolijk BV Ymuiden	14-20 December

RIVO-director Martin Scholten visited both the project in February. He also visited the Ministry of Fisheries in the capital Nouakchott, where he signed a convention between IMROP and RIVO in the presence of the Mauritanian minister of fisheries. Mr. Ahmedou Ould Ahmedou. The convention presents a framework of cooperation between the two institutes, which may also incorporate new projects (such as the demersal project).

In February the project also received a visit of a delegation from the Dutch Ministry of Agriculture, headed by Mrs. Carla Bisseling. The objective of this mission was to identify projects that could be financed from funds provided by the Dutch ministries of Agriculture and Foreign Affairs. These projects should protect marine bio-diversity in West Africa. A proposal was discussed for a project that would coordinate international management of small pelagics in West Africa. By promoting international management, the project would help to reduce fishing effort and thereby protect the ecosystem.

2.3. IMROP staff

The following IMROP scientists worked either full-time or part-time on the pelagic project:

Ebaye Ould Mohamed Mahmoudh	Project coordinator for IMROP
Ahmedou Ould Mohamed Ould Moustapha	Scientist / acoustics
Wagué Abdoulaye	Scientist /biology
Ely Sidi Ould Beibou	Scientist / information technology
Abdelahhi Ould Samba	Scientist / biology
Beyah Ould Moïssa	Senior technician / data management
Mohamed Ahmed Ould Taleb	Electronic engineer
Amadi Sow	Librarian

The project coordinator, Ebaye Ould Sidina, was absent during part of the year because of his study for a Master's degree in fisheries biology at the University of Marseille, France. He returned in October, after successfully completing his studies in France

RIVO (co)financed the following foreign journeys by IMROP staff in 2002:

Wagué Abdoulaye	Brest, France	10-13 June	Training in age determination
Ebaye Ould Mohamed Mahmoudh, Ahmedou Ould Moustapha, Mahfoudh Ould Taleb Sidi, Abdoulaye Wagué	Banjul, Gambia	March	FAO working Group on small pelagics in West Africa
Sall Mamadou Diallo	Nantes, France	27 May-25 June	Acoustic training on board R/V "Thalassa"
Mohamed Ahmed Ould Taleb	Nouakchott	16-27 June	Acoustic training on board R/V "Dr Fridtjof Nansen"
Ebaye Ould Mohamed Mahmoudh	Marseilles	Jan-October	Study for master's degree
Amadi Sow	Accra, Ghana	June	IAMSLIC conference
Amadi Sow	Port Elisabeth, South Africa	October	Conférence sur les réseaux d'échange d'information en Afrique
Beyah Ould Meïssa	Praia, Cap Verde	October	FISAT training
Abdelahhi Ould Samba	Tenerife	6-13 Dec	Otolith workshop
Mika Diop	Tenerife	6-13 Dec	Otolith workshop

2.4. Project facilities

The project office at the IMROP compound, opened in 2002, proved to be a great success. It quickly became the centre of the RIVO activities at IMROP, and a place where IMROP scientists met their RIVO colleagues. Later in the year, the office was also used for the RIVO demersal project.

The radio link with directional beam antennas between the IMROP institute in Cansado and the town of Nouadhibou broke down on two occasions during the year. This radio link is used for the Internet connection of the institute. In March the link broke down because of problems with the access points. RIVO expert Dick de Haan flew to Nouadhibou to repair the access points. He taught the IMROP technical staff how to maintain the equipment, and he prepared a protocol for testing the radio link. With the help of this protocol, it was easy to establish whether communication problems were due to the radio link or to problems with the Internet in town.

In October the radio link broke down for a second time. This time one of the antennas was struck by lightning during a thunderstorm. A representative of "Camview electronics", the supplier of the equipment, flew to Nouadhibou to replace the faulty antenna and access point. He left a stock of spare parts in Nouadhibou for future repairs by IMROP technicians.

In order to improve radio communications with the Mauritanian research vessel "Al Awam", a short-wave radio transmitter/receiver was purchased. This radio set was installed in the project office. It allowed project staff ashore to contact the vessel at any time, without having to depend on the existing IMROP radio. In the past, the contact via the IMROP radio proved to be unreliable.

3. Acoustic surveys

3.1. Surveys conducted in 2003

Three acoustic surveys were conducted with RV "Al Awam" in 2003. Details of each survey are presented below.

10 – 25 March 2003

This survey covered the entire Mauritanian shelf. RIVO-scientists and consultants on board included Cees Bakker (electronic engineer), Pierre Beillois (acoustic expert), Joseph Douard (fishing skipper), Remment ter Hofstede (biologist) and Ad Corten (project manager). The whole survey area was successfully covered, and the biomass of the various species estimated. *Sardinella* turned out to be very scarce in the whole zone. Sardines, on the other hand, were very abundant, even in the southern part of the area. The abundance and southern extension of the sardine stock was probably related to the low water temperature, and possibly also to the recent increase of the stock in Moroccan waters. The vessel worked satisfactorily, and several hauls were made with the pelagic trawl. The main problem in fishing was that the net could not be used in very shallow water; the areas where most fish schools were encountered. As in previous surveys, the captain was reluctant to keep the ship in the open sea at night, and he preferred to anchor the ship in coastal waters.

1-6 June

This survey had been originally designed to test a new, smaller pelagic trawl. However, due to logistic problems, this trawl had not yet arrived in Nouadhibou by June. Therefore, the objective of the survey was changed into making a limited acoustic survey of the shelf off Cap Blanc. This was an exercise both in fishing and in conducting an acoustic survey. The survey was successfully completed under the leadership of IMROP colleague Ahmedou Ould Moustapha. Despite rough weather during the whole period, six trawl sets were made. Due to the heavy swell, the ship lost its big anchor when the captain tried to anchor in rough weather. Few sardinellas were encountered, despite the fact that Dutch trawlers were taking good catches during this week. Apparently, the sardinellas were concentrated in a small area outside the survey area of the "Al Awam". During this trip, the RIVO scientists on board contacted their colleagues ashore through the new radio at the RIVO office.

14-27 December

A complete survey was conducted of the Mauritanian shelf, and biomass estimates were made for the various pelagic species. During the first leg of the survey, few pelagic schools were registered. However, during the last few days of the survey, dense schools of sardinella were encountered in the inshore waters off Cap Blanc. The vessel stayed in this area for two days to make a comparison between day and night surveys. It appeared that the vessel registered higher acoustic densities during night than during daytime. Also the length range of the fish in the catches was larger during night than during day. The lower acoustic densities and smaller length range of the fish in the catches during daytime may be due to avoidance of the vessel by the fish during daytime.

The French consultant Joseph Douard and the project manager Ad Corten were on board during the first part of the survey. The work on board went rather smooth, and it appeared that the IMROP colleagues were capable of running the survey without external help. The vessel worked around the clock during most of the survey, which put a heavy strain on both scientists and crew. In view of the limited number of scientists and crew on board, it may be better to restrict working to 16 hours per day during future surveys.

The new pelagic trawl was extensively tested during the survey, and it appeared to work well. Because of its small vertical opening, this net can be used in shallow depths down to 15 meters.

3.2. Acquisition of fishing gear

The Dutch company Maritiem BV supplied a second pelagic trawl for the “Al Awam”. This net was delivered on board the ship when it was in Las Palmas for dry-docking. The second net was slightly smaller than the existing trawl, and it was designed specifically for work in shallow areas. The net was tested extensively during the survey in December. An advantage of this net is that most panels are interchangeable with those of the other pelagic trawl. This means that the vessel has to carry only one set of spare parts on board.

3.3. Acoustic instrumentation

Cees Bakker, the electronic engineer from RIVO, took part in the survey of “Al Awam” in March, and he also visited the vessel in October when it was in Las Palmas for maintenance. During his visits to the vessel, Cees installed a number of new instruments and made modifications to the existing equipment. In addition, he assisted in repairs of the gyrocompass and other instruments on board. Modifications to the acoustic instruments included:

- Replacement of the existing display unit CF-140 by a Flat-screen Display of 17 inch. This required a modification of the EK 500 scientific sounder from RGB to VGA. The old CF-140 was kept on board as spare.
- An Hp deskjet 970 Cxi was installed for the EK500. The old printer had to be replaced because ink cartridges were no longer available.
- The EK500 sounder was equipped with the new software version 5.33. This was necessary because of the installation of a new printer. A new chapter “EK500 Software modifications” was added to the existing manual
- An uninterrupted power supply (UPS) of 1.5 kilowatt was installed. This was necessary to prevent the EK 500 sounder and its computer from stalling in case of a temporary power cut. The UPS can take over power supply during 5 minutes; sufficient to switch off the instruments and to save the data. During the March survey the UPS took over power supply on two occasions. This demonstrated the need for this equipment. The improved power supply was probably one of the reasons for the correct functioning of the “Movies” software during this trip.
- The arrangement of the instruments in the acoustic laboratory was improved. However, the existence of some large instruments that are no longer in use (Epson printer and weather fax) prevents an optimal arrangement of the instruments. Plans were made for a more thorough re-arrangement, to be conducted during dry-docking in Las Palmas.
- Plans were made for the construction of a new set of steel fishing rods and line counters that are needed for calibration exercises. The existing Japanese equipment does not function properly, which greatly complicates the calibration of the transducers. An attempt to calibrate the sounders during the survey in March had to be cancelled for this reason.
- Two standard copper spheres for the calibration of the 38 kHz transducer were bought from SIMRAD in Norway.
- The cable of the headline transducer was damaged during the survey in March. The vessel did not have the right equipment on board for repairing the cable. However, with some improvising, the cable could be provisionally repaired. Recommendations were made for the acquisition of the necessary material and the training of the ship’s engineers.
- A set of tools was purchased to be used for maintenance of acoustic and electronic instruments on board. This toolkit proved to be invaluable for the engineers of the “Al Awam” during the subsequent voyages of the vessel.

3.4. Training

IMROP technician Mr. Sall Mamadou Diallo took part in an acoustic survey of the French research vessel "Thalassa" in the Bay of Biscay from 29 May – 24 June. During this cruise he participated in the sampling of the catch. He also gathered experience in the use of the French computer programmes. These programmes are also used in Mauritania. This was the third year in which an IMROP colleague participated in the survey of "Thalassa". The cooperation between IMROP and the French organisation IFREMER (sponsored by the project) has turned out to be very efficient. French scientists have been very cooperative, and the IMROP colleagues easily get around on board the French vessels because they speak the language.

The electronic engineer on the project, Mohamed Ahmed Ould Taleb, made two trips on board the Norwegian research vessel "Dr. Fridtjof Nansen", one in June and one in November. He also worked together with RIVO expert Cees Bakker during the visits of Cees to Nouadhibou and Las Palmas. Cees Bakker taught him the main aspects of the maintenance of the EK-500 echo sounder.

The Mauritanian project coordinator, Ebuye Ould Mohamed Mahmoudh, successfully completed his study at the University of Marseille by obtaining a Master's Degree in fisheries acoustics.

4. Observer programme

4.1. General

The observer programme on board Dutch trawlers was continued in 2003. In the framework of this programme, teams consisting of two Mauritanian observers join Dutch trawlers in order to collect information on catches and discards. The observers are employees of IMROP (technicians or scientists) that participate in the programme on a rotating basis. The observers join the vessels in Nouadhibou or in Las Palmas. The RIVO project takes care of flight tickets, per diem, and material for the work on board. In addition, it makes the arrangements with ship owners and captains. IMROP provides the observers with visa and their normal salary plus a sea allowance. While at sea, the observers record the species composition of catches and discards. They record the length composition of each species (both the preserved fraction and the discarded fraction), and a number of biological parameters including weight, maturity stage, fat content and stomach fullness. Data collected by the observers are used to estimate total annual landings and discards of the EU fleet (excluding the Irish vessels "Veronica" and "Atlantic Dawn"). These data are subsequently used for stock assessment by the FAO working group on small pelagics in West Africa.

4.2. Coverage in 2003

Of the 68 fishing trips made by Dutch trawlers in 2003, nine were sampled by IMROP observers. This represents a coverage of 13%, which is about equal to that of the previous two years. Only three trips were sampled during the first half of the year, which was below the target. This low sampling was due primarily to the scarcity of ships in Mauritania during the first half of the year. Thanks to a close supervision of the work of the observers, the quality of their data improved in 2003. This applied both to the observations on pelagic species and to the data collected on large by-catch species (see below).

The observer data base now contains an impressive amount of data for the period 1999-2003. These data are ready to be used for further studies on the biology and ecology of the various species.

4.3. Estimates of catches and discards

Data collected by the observers were used to estimate total catches, landings and discards of the EU-fleet in Mauritania (except for the Irish vessels). The results of these extrapolations are presented in Hofstede (in preparation).

Of the total catch of target species of 163,000 tons, 91.6% was landed and 8.4% was discarded. The percentage discards was comparable to that in previous years. The landings consisted mainly of sardinella, sardine and mackerel. The contribution of sardinella to the total catch was still high (56%), but it was lower than in the first years of the fishery (1996-2000). The decline of sardinella has been compensated by an increase of sardine and mackerel, which has resulted in a stabilisation of the total catch at the level of the previous years.

4.4. Accidental by-catches of large species

An analysis was made of large species taken as by-catch in the period 1999-2002 (Ter Hofstede et al. in preparation). Large species are arbitrarily defined as those species attaining a length of more than 1 meter. They include sharks, rays, dolphins, tunas, turtles swordfish and ocean sunfish. These species are taken by accident, and they are not retained on board (except for the tunas). Catches of these species are monitored for ecological reasons. Some of the species involved have a low reproductive rate because they have few natural enemies. By-catches of these species in the commercial fisheries may have a relatively large impact on the existing populations. The monitoring programme is aimed at assessing the magnitude of the problem, also at collecting information that may be used for designing methods to reduce these by-catches.

The data were divided into two categories: the "old" and "new" data sets. The "old" data set refers to material collected by IMROP observers in the years 1999-2002. In this period the emphasis of the observer programme was on commercial species. The observers, therefore, paid little attention to large animals that occurred in the catch, but that were discarded directly from the main deck. For their normal work, the observers stay on the factory deck where they can not observe the species that are discarded directly from the net.

The "new" data series refers to trips made from early 2003 onwards when observers were given explicit instructions to pay more attention to the by-catches of large species. In addition, this series includes observations made by RIVO scientists on board commercial vessels. These trips were made either in the framework of the sardinella project (stomach sampling), or as part of the RIVO projects on remote sampling and the prevention of by-catches.

The old data set could only be used to make qualitative statements on the distribution of the by-catches in time and in area. The "new" data set was used also to make preliminary quantitative estimates of the by-catches of large species in the EU-fleet.

5. Biological studies

5.1. General

Most of the biological work was still aimed at *Sardinella aurita*, the main target species of the Dutch fleet in Mauritania. As in the two previous years, much research was directed at the spawning cycle of sardinella. In addition, the study of age reading on this species was intensified.

A study was started into the food-web relations of the pelagic ecosystem. This study should provide answers to the questions “what eats sardinella” and “who eats sardinella”. The research involves the analysis of stomach contents, both of sardinella and its predators.

5.2. Maturity cycle of sardinella

As in the previous two years, samples of sardinella were collected in order to follow the maturity cycle and to identify spawning periods. Samples were collected from Dutch trawlers fishing in the offshore areas, and from local fishermen exploiting the inshore population. The local fishery was sampled both near the capital Nouakchott and in Nouadhibou. In Nouakchott, the samples were collected by Diakhaté, an employee of IMROP. In Nouadhibou, samples were obtained from Spanish purse seiners that were fishing sardinella for a local canning factory.

In order to compare the macroscopic appearance of the gonads with the microscopic structure, a number of histological slides were prepared from ovaries in different stages of maturity. The preparation of these slides was subcontracted to the CECAF laboratory in Lowestoft.

Results of the study on the maturity cycle of sardinella for the period 1999-2002 were presented in a report by Irmen Mantingh (Mantingh, 2003). These results showed that spawning of sardinella is variable, both in time and area. The main spawning appears to occur in the northern part of the Mauritanian zone. In most years, peak spawning seemed to occur between August and October. Exceptions were the years 1999 and 2001 when high numbers of ripe fish were found in January / February. As could be expected, the weight of the gonads (expressed as gonado-somatic index) was positively correlated with the maturity stage for stages 1-5. No clear relationship between maturity stage and fat content or stomach fullness was found.

5.3. Age and growth of sardinella

The age reading of sardinella was a key issue this year of the FAO working group on small pelagics in West Africa. Two international workshops were organised; one in Dakar in February, and one in Tenerife in December. Both workshops were preceded by an exchange of otoliths between scientists in the various West African states.

RIVO colleague Irmen Mantingh participated in both workshops. In addition, the project paid for the participation of several Mauritanian counterparts (Wagué Abdoulaye in February and November, Ahmed Diagne, Mika Diop, Wagué Abdoulaye and Abdelahhi Ould Samba in December). The project also provided four microscopes for the workshop in Dakar; two newly bought and two existing ones from RIVO. The microscopes were donated to the Senegalese institute CRODT after the workshop.

The results from the Dakar workshop in February were promising. The sardinella otoliths appeared to show clear rings, and it was assumed that each ring represented one year's growth. It was recommended that participants continued to sample sardinella throughout the year to study the formation of marginal growth zones.

The results of this exercise were discussed at the Tenerife workshop in December. Here it appeared that there were still considerable differences between the various otoliths readers. The only readers with consistent results were the Russian ones that had a long experience with West-African fish. Apparently, the reading of sardinella otoliths requires a considerable amount of experience that cannot be gained in one year.

The Senegalese expert on otoliths reading Mor Sylla visited IMROP from 23 February – 6 March to discuss otoliths sampling with his colleagues from IMROP and RIVO.

IMROP colleague Abdoulaye Wagué went to France in June for a training course in the use of the computer programme TNPC (traitement numérique des pièces calcifiées). This programme is used to describe various features of the otoliths in a quantitative way. It is of value in comparing otoliths from different areas or seasons.

5.4. Food relations

Since no expertise in food studies existed within the project, neither among the RIVO staff nor among the IMROP counterparts, it was decided to seek help of a consultant. Fortunately, a Russian ecologist working at IMROP, Dr. Alexei Gutchin, was prepared to assist with this study. Dr. Gutchin has worked in Mauritania for many years, and he is an expert on fish taxonomy and on food investigations. The project hired him as consultant for a 6-month period. Dr. Gutchin took care of the analysis of stomachs, whereas RIVO scientist Remment ter Hofstede organised the collection of material and designed the system of data storage and analysis.

Stomach contents were collected during 5 voyages, both on board the RV "Al Awam" and on board Dutch trawlers. The fieldwork was done by Dr. Gutchin, and also by the RIVO staff (Remment ter Hofstede, Irmen Mantingh and Ad Corten). By the end of the year, Dr. Gutchin had analysed most of the samples, and a start was made with the data analysis.

An interesting observation on feeding of sardinella was made in September along the cliffs near the institute. Adult flat sardinellas (*Sardinella maderensis*) were observed to prey on juveniles of their own species with a length around 20 mm. This showed that (a) sardinella is not a pure plankton feeder but also an opportunistic feeder on small fish, and (b) that high adult stock sizes may have a negative effect on recruitment through cannibalism.

5.5. Genetic studies on stock identity of sardinella

Genetic work was given low priority in 2003 because of the lack of manpower for this subject. Towards the end of the year, plans were made in collaboration with professor Jeanine Olsen from the Rijks Universiteit Groningen (RUG) for a joint study on this subject in early 2004. A proposal for this project was approved by the RIVO management.

6. Working groups

6.1. FAO Working Group on small pelagics in West Africa

This working group has been created in order to coordinate biological research on small pelagics in West Africa, conduct joint evaluations, and provide management advice to the governments of the different countries in the region. The working group has met annually since 2001. The RIVO project contributes 25% to the costs of these meetings.

The 2003 meeting was held in Agadir (Morocco) from 31 March to 10 April. The meeting was attended by scientists from Morocco, Mauritania, Senegal, The Gambia, Spain, Russia, Norway, FAO and The Netherlands. The Norwegian participant chaired the meeting. Two RIVO scientists (Corten and Ter Hofstede) participated in the meeting, together with three colleagues from IMROP. Compared to previous years, the discussions were very lively, indicating a growing experience and self-confidence among the participants.

The results of the assessment showed a decline of sardinella, and a stable stock situation for mackerel, horse mackerel and sardine. The group recommended a precautionary approach, and a limitation of fishing effort for the various species at the average level for the last five years. Further results of the assessments are presented in the report of the meeting (FAO, in preparation).

The Dutch participants urged that the report of the meeting should be released as quickly as possible after the meeting. In the previous two years, the reports had been issued almost a year after the meeting, which greatly reduced its practical value. In order to accelerate the preparation of the report, RIVO colleague Remment ter Hofstede offered to visit FAO headquarters in Rome for one week in May to assist in the final editing of the report.

6.2. Joint EU-Mauritanian scientific working group

A joint EU-Mauritanian scientific working group was established in October 2002 to assess the state of small pelagics and cephalopods in Mauritanian waters. The Group should report to the EU-Mauritanian Mixed Committee on fisheries. This Mixed Committee is an administrative body, responsible for revising the existing fisheries agreement between Mauritania and the EU. The RIVO project manager Ad Corten was invited to become a member of this scientific working group.

The first regular meeting of the group was held in Nouadhibou from 9 – 12 May 2003. The assessment of the small pelagics presented no problems. The group endorsed the conclusions of the FAO working group meeting in Agadir (see above). More problems were encountered with the cephalopods. Here a major difference of opinion arose between the Spanish member and the rest of the group. This conflict could not be resolved, and consequently the working group was unable to produce a unanimous report before the end of the year.

7. Institutional support to IMROP

The maintenance and repair of the directional beam antennas between IMROP and the town of Nouadhibou was already mentioned in section 2. This radio-link provides IMROP with access to the Internet, and the proper functioning of the link is therefore of vital importance for IMROP.

The project supported the participation of IMROP's librarian Mr. Amadi Sow to the international conference of librarians of fisheries institutes (IAMSLIC) in Accra, Ghana. Furthermore, the project co-financed the participation of Mr. Sow in a meeting in Port Elisabeth (South Africa). This meeting was dedicated to the improvement of information networks among fisheries institutes in Africa.

8. Public relations

The project manager gave a presentation at the World Pelagics Congress held in Cape Town, South Africa, from 27-28 October 2003. The title of the presentation was "West Africa: the first steps towards international management of small pelagics". In his presentation, Corten stressed the need for international research and management in West Africa, in order to avoid overexploitation.

As in previous years, the activities of the project were described in a number of articles for the Dutch fisheries magazine "Visserijnieuws". A contribution was also written for the bulletin of the Pelagic Freezertrawlers Association (PFA).

9. Reports and working documents published by project staff in 2003

Corten, A. 2003. Assessment of sardinella and other small pelagics in West Africa; Progress Report 2002. RIVO report C009/03.

Mantingh, I.T., 2003. The reproductive cycle of *Sardinella aurita* in the Eastern Atlantic Ocean off Northwest Africa, Progress Report 2002. RIVO report C079/03.

Ould Mohamed el Moustapha, A. 2003. Rapport de Campagne N/O "Al Awam" Prospection acoustique des ressources pélagiques côtières de la zone du Cap Blanc (ZEE mauritanienne) 01-06 juin 2003. IMROP internal report.

Ter Hofstede, R. 2003a. Incidental catches of pelagic megafauna by the EU pelagic fleet in the Mauritanian Exclusive Economic Zone during the year 2001. Results extracted from the Scientific Observer Program. RIVO Report C007/03. 18 pp.

Ter Hofstede, R. 2003b. Handleiding voor het werk van de wetenschappelijke waarnemers aan boord van schepen van de PFA. Nederlandse versie. RIVO Report C003/03. 25 pp.

Ter Hofstede, R. 2003c. Directive pour le travail des observateurs scientifiques a bord des chalutiers du PFA. Edition français. RIVO Report C004/03. 25 pp.

Ter Hofstede, R., In preparation. Catch composition of the Dutch pelagic fleet in the Mauritanian Exclusive Economic Zone during the year 2003. Results of the Scientific Observer Program.

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Zeeberg, J.J., Mantingh, I.T. and Ter Hofstede, R., 2003. The remote sensing research missions of 2002; application of satellite imagery and analysis of the fluctuation of the sardinella stock in the Mauritanian EEZ since 1996. RIVO report 03.005.

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FAO, 2002. Report of the FAO Working Group on the assessment of small pelagic fish off northwest Africa. Banjul, Republic of the Gambia, 5-12 April 2002. FAO Fisheries Report No.686.

FAO, 2003. Report of the FAO Working Group on the assessment of small pelagic fish off northwest Africa. Agadir, Morocco, 31 March – 10 April 2003. In preparation.