No.

Department of Marine Fisheries (DPM)
Oceanographic Research Center in Dakar-Thiaroye (CRODT)
Republic of Senegal

THE STUDY ON FISHERIES RESSOURCES ASSESSMENT AND MANAGEMENT IN THE REPUBLIC OF SENEGAL

FINAL REPORT

OCTOBER 2006

JAPAN INTERNATIONAL COOPERATION AGENCY

OVERSEAS AGRO FISHERIES CONSULTANTS CO., LTD.

SNO
JR
06-003

PREFACE

In response to a request from the Government of the Republic of Senegal, the Government of Japan decided to conduct a development study on fisheries resources assessment and management and entrusted the study to the Japan International Cooperation Agency (JICA).

From July 2003 to June 2006, JICA sent to Senegal nine times, a study team led by Mr. Yasuo Ishimoto of Overseas Agro-Fisheries Consultants Co., Ltd.

The team held discussions with concerned officials from the Government of Senegal, and conducted a field survey at the study area. After the team returned to Japan, further studies were made, and as a result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of the friendly relationship between our two countries.

I wish to express my sincere appreciation to the concerned officials of the Government of the Republic of Senegal for their close cooperation extended to the team.

October 2006

Kazuhisa Matsuoka
Vice-President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Mr. Kazuhisa Matsuoka
Vice-President
Japan International Cooperation Agency

Dear Mr. Matsuoka

We are pleased to submit to you the Study Report on Fisheries Resource Assessment and Management in the Republic of Senegal.

This study report is a compilation of the study results conducted by the study team, with close relations with the Department of Marine Fisheries and Oceanographic Research Center in Dakar-Thiaroye, and concerned organizations during the three-year period from July 2003 to June 2006. It consists of resource assessment and resource management.

We would like to express our sincere appreciation for the great understanding and cooperation received from concerned officials from the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fishery as well as from your agency, during the study period. Additionally, as for the Government of the Republic of Senegal, we would like to note the respectful cooperation that we received from the Department of Marine Fisheries and Oceanographic Research Center in Dakar-Thiaroye, and other concerned officials of the Government. Moreover, we would like to express our gratitude to the personnel of the Japanese Embassy in Senegal for their valuable advice and support.

Finally, we hope that this report will contribute to your further promotion of the project.

Very truly yours,

Yasuo Ishimoto
Project Manager
Study team of fisheries resources assessment and management
in the Republic of Senegal
Overseas Agro-Fisheries Consultants Co., Ltd.

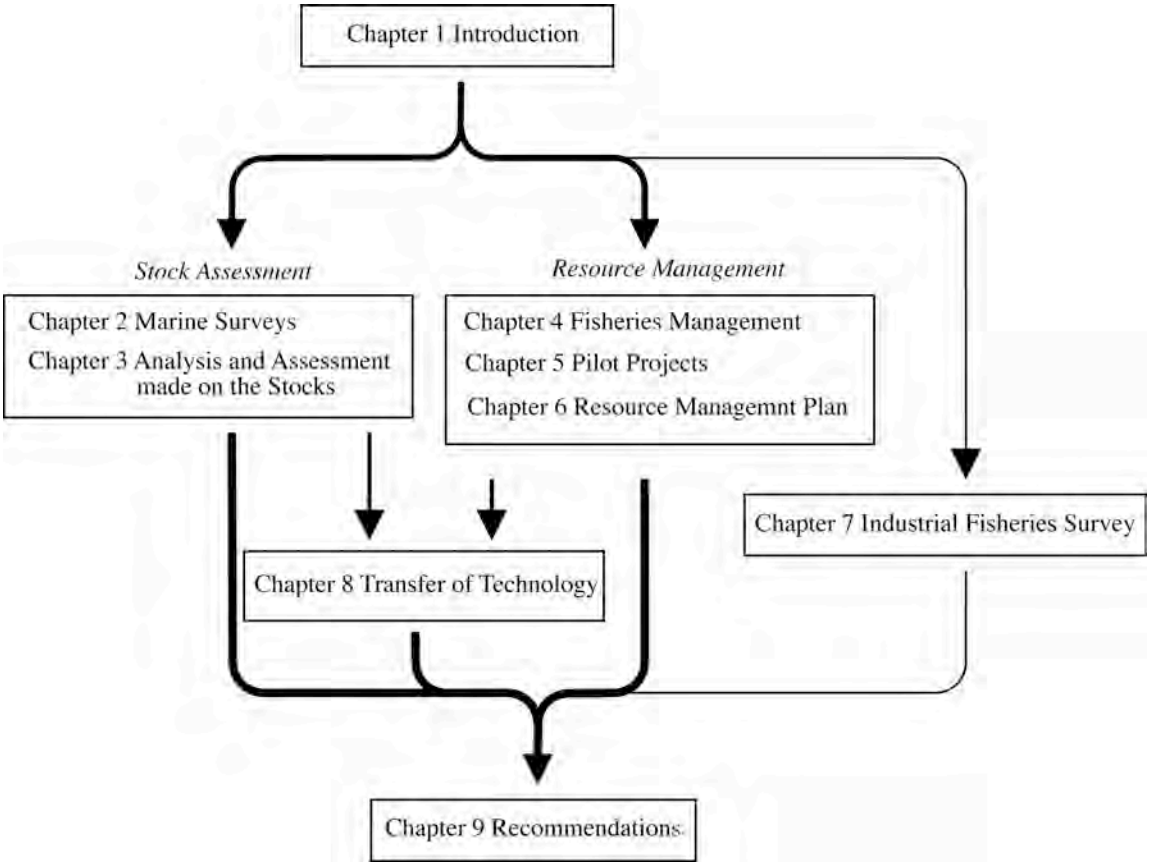
Composition of the report

The report consists of one (1) volume, nine (9) chapters.

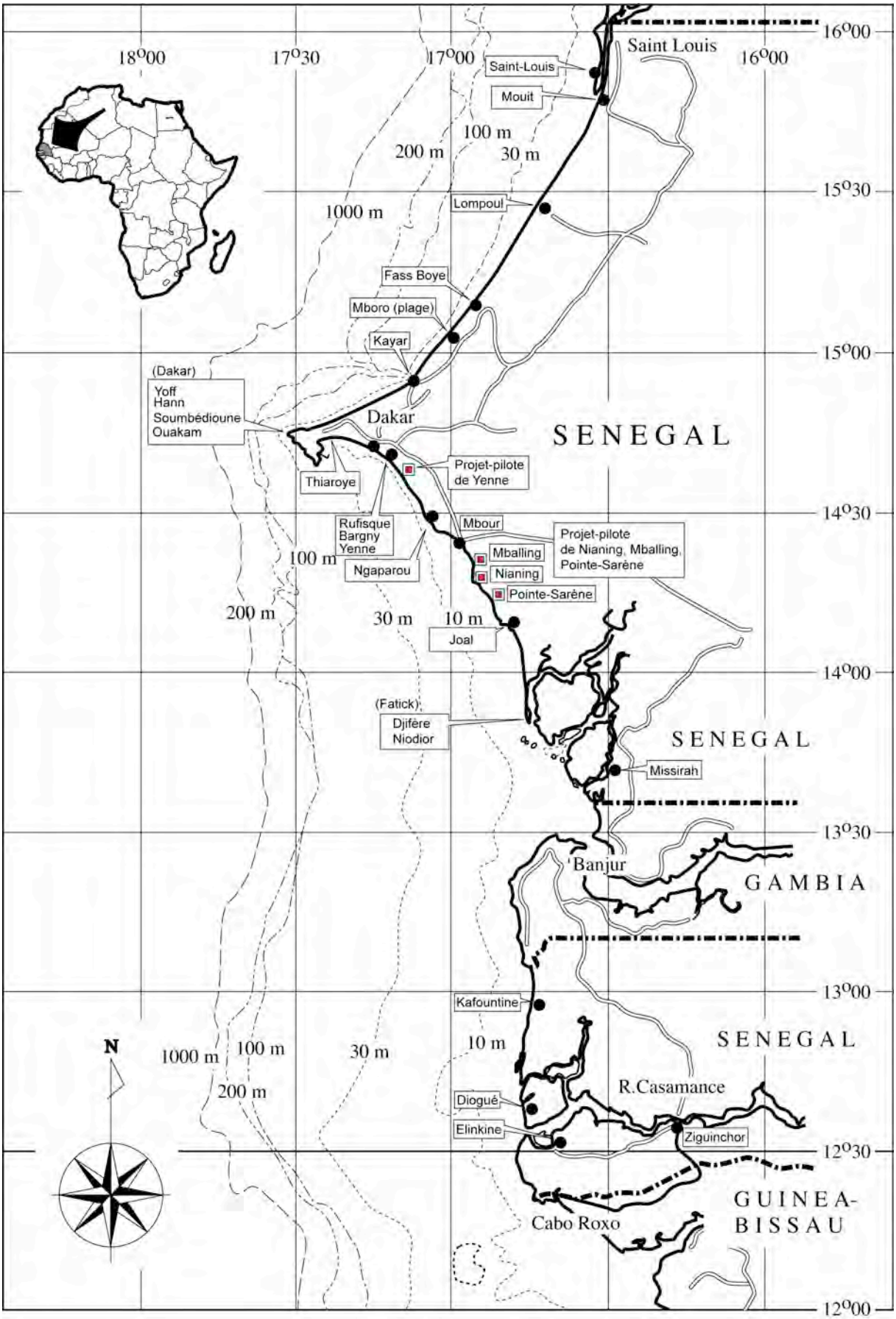
Starting from <Chapter 1 Introduction>, chapters concerning the surveys and activities related to two major components of this study such as “stock assessment” and “resource management” follow. “Stock assessment” consists of <Chapter 2 Marine Surveys> and <Chapter 3 Analysis and Assessment made on the stocks>. On the other hand, “resource management” consists of <Chapter 4 Fisheries Management> which is the study result on current situation, <Chapter 5 Pilot Project> which describes the activities of pilot projects planned based on the said study, and <Chapter 6 Resource Management Plan> which is planned comprehensively and based on the experience of pilot projects. Moreover, the content of technology transfer to Senegalese counter-parts during the work of two components is described in <Chapter 8 Transfer of Technology>.

“Resource Management” component concerns mostly artisanal fishery sub-sector. However, industrial fishery sub-sector also uses the same fishery resource. Therefore, it was decided to conduct survey on this sub-sector as well <Chapter 7 Industrial Fisheries Survey>.

And based on the contents from chapter 2 to 8, the recommendations to the Senegalese side were compiled in <Chapter 9>.



Composition of the report



Map of coastal fishing villages in Senegal

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AFD	: Agence Française de Développement
AMP	: Aire Marine Protégée
C/P	: Counter-Part
FCFA	: Franc de la Communauté Financière d'Afrique
CLPA	: Conseils Locaux de Pêche Artisanale
CNCPM	: Conseil National Consultative des Pêches Maritimes
CNPS	: Collectif National des Pêcheurs Artisans du Sénégal
CONIPAS	: Conseil National Interprofessionnel de la Pêche Artisanal au Sénégal
CRODT	: Centre de Recherches Océanographiques de Dakar Thiaroye
CSRP	: Commission Sous-Régionale des Pêches
CTD	: Conductivity-Temperature-Depth
DPM	: Direction des Pêches Maritimes
DPSP	: Direction de la Protection et de la Surveillance des Pêche
ENDA	: Environnement et développement du tiers monde
EU	: European Union
FAO	: Food and Agricultural Organization of the United Nation
FENAGIE-PECHE	: Fédération Nationale des GIE de Pêche du Sénégal
FENAMS	: Fédération Nationale des Mareyeurs du Sénégal
FENATRAMS	: Fédération Nationale des Transformatrices et Mareyeurs du Sénégal
GIE	: Groupement d'Intérêt Economique
GIRMaC	: Projet de Gestion Intégrée des Ressources Marines et Côtières
IC/R	: Inception report
ISRA	: Institut Sénégalais de Recherche Agronomique
IUCN	: The World Conservation Union
JICA	: Japan International Cooperation Agency
LDC	: Least Development Country
NGO	: Non-Governmental organization
NOVIB	: Oxfam Netherlands
OFCA	: Overseas Fisheries Consultants Association
OJT	: On the Job Training
PAMECAS	:
PAPA-SUD	: Programme d'Appui à la Pêche Artisanale
PHRD	: Japan Policy and Human Resources Development Fund
PMEDP	: Programme pour des moyens d'existence durables dans la pêche
SIAP	: Système d'Information et d'Analyse des Pêche
STD	: Salinity-Temperature-Depth
TA	: Technical Assistance
TAC	: Total Allowable Catch
UNAGIEMS	: Union Nationale des GIE Mareyeurs du Sénégal
WAAME	: West African Association for Marine Environment
WAMER	: Western Africa Marine Eco-Region
WWF	: World Wildlife Fund

GEOGRAPHICAL NAMES

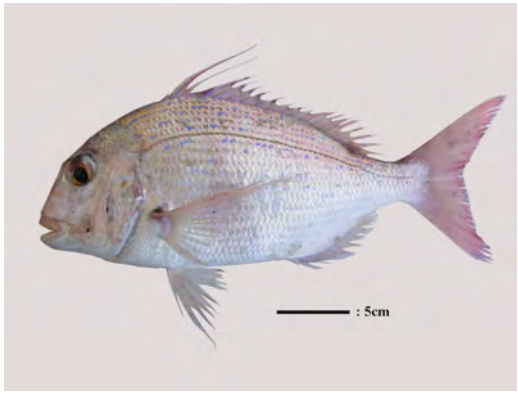
Bamboung
Bargny
Bel-air
Cap Vert
Casamance
Cotonou
Dakar
Dionouar
Fass Boye
Gorée
Grande Côte
Hann
Joal
Kelle
Kayar
Lébou
Lompour
Mballing
Mboro
Mbour
Miname
Nianghal
Ngor
Nianghal
Nianing
Niodior
Ngaparou
Petite Côte
Pointe-Sarène
Rufisque
Ouakam
Saint-Louis, St. Louis
Siné-Saloum, Saloum Delta
Sendou
Sindia
Soumbédioune
Toubab-Djalaou
Thiaroye
Thiès
Yoff
Yenne
Yenne Guedj
Yenne Kao
Yenne Todd
Yenne Nditakh
Ziguinchor

LIST OF FISH SPECIES

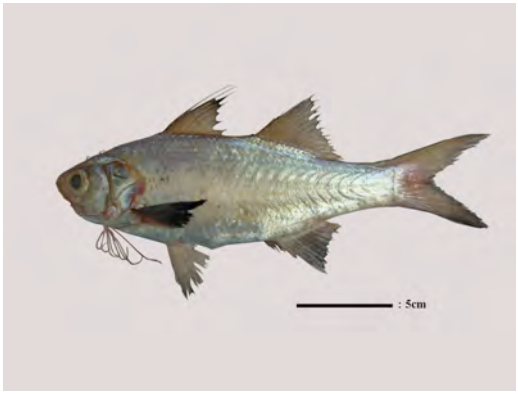
Fish Species			
Scientific name	French	Local name	FAO (French) name
(Fish species)			
Acanthurus monroviae	Docteur	Doktooru, Suru seen	Chirurgien chas-chas
Alectis alexandrinus	Cordonnier bossu	Yawal	Cordonnier bossu
Arius heudeloti	Machoiron	Kong, Ank, Dakak, Gardj	Mâchoiron banderille
Balistes punctatus	Baliste	Ndor	Baliste à taches blues
Brachydeuterus auritus	Pristipome dor bandes	Feyur	Lippu pelon
Brotula barbata	Brotula	Mori	Brotule barbée
Chelidonichthys gabonensis	Grondin du Gabon		Grondin du Gabon
Chloroscombrus chrysurus	Petite carangue	Lana-lana	Sapater
Cynoglossus senegalensis	Sole	Tpalé	Sole-langue sènegalaise
Decapterus punctatus			Cométe quiaquia
***Dasyatis* sp.**			
Dentex angolensis	Dentón angolés		Dentón angolés
Dentex canariensis	Denté à tache rouge	Bassé	Dent tache rouge
Depapterus rhonchus	Chinchard	Dyay, Diaï	Comète coussut
Diplodus bellotti	Sparaillon africain	Sunde	Sparaillon africain
Epinephelus aeneus	Thiof	Coof , Tiof, Thiof,Loger	Mérou blanc
Epinephelus alexandrinus	Mérou badèche	Doy	Mérou oriflamme
Epinephelus guaza	Mérou jaune	Kautieu	
Galeoides decadactylus	Faux-capitaine, Plexiglass	Tièkem, Cekéém, Sikket mbàw	Petit capitaine
Lagocephalus laevigatus	Faux perroquet	Boun foki, Regen	Compére lisse
Lutjanus agennes	Vivaneau, Carpe rouge ,	Yakh,Diabar , Jaabaar	Vivaneau africain rouge
Merluccius senegalensis	Merlus, Merlu du Sénégal		Merlu du Sénegal
Mustelus mustelus	Emissole lisse,Chien de mer		Émissole lisse
Mycteroperca rubra	Badeche, Mérou royal	Géjj	Badéche rouge ,
Pagellus bellottii	Pageot	Tiki	Pageot à tache rouge
Pomadasys incisus	Pristipome ordinaire	M'belle, Sompatt	Grondeur métis
Pomadasys jubelini			
Pseudotolithus senegalensis	Otolithe du Senegal	Fëtt, Tuunuun	Otolithe sénegalais
Pseudotolithus typus			Otolithe nanka
Pseudupeneus prayensis	Rouget (barbet)	Ngóór sikim	Rouget du Sénégal
Rhinobatos rhinobatos	Raie-guitare		Poisson-guitare commun
Sardinella aurita	Sardinelle ronde	Yabóy mërëg	Allache
Sardinella maderensis	Sardinelle plat	Yabóy tas	Grande allache
Scomber japonicus		Wo, Ouo	Maquereau
Scorpaena stephanica	Rascasse	Téyantan	Rascasse nageoires tachetées
Serranus scriba	Serran écriture	Saliou guetj	Serran écriture
Solea seneglensis	Sole du Sénégal	Palpalé (Papayo)	Sole du Sénegal
Sparus caeruleostictus	Pagre	Kibaro , Warangne	Pagre points bleus
Trachurus trecae			Chinchard cunéne
Zeus faber	Dorede,		Saint-Pierre
(Mollusc)			
Alloteuthis africana			
Octopus vulgaris	Poulpe		
Sepia officinalis	Seiche		
(Shellfish)			
***Cymbium* spp.**	Volute	Yeet	
***Anadara* spp.**	Coque	Pague	
***Haliotis* spp.**	Ormeau	Omeaux	
***Murex* spp.**	Touffa	Touffa	
(Crustacean)			
Parapenneus lougirosstris	Crevette profonde		
Penaeus notialis	Crevette blanche	Sipakh	

SPECIES TARGETED FOR STOCK ASSESSMENT

Epinephelus aeneus



Sparus caeruleostictus



Galeoides decadactylus

Arius heudelotii

Pseudotolithus senegalensis

Cynoglossus senegalensis

Pomadasys jubelini

SUMMARY

1. Background

The Republic of Senegal, with its abundant natural environment enhancing the productivity of the ocean, has some of the richest fishing grounds in Africa. In the 1960s and 1970s, around the time when African nations gained independence, the developed countries took notice of the abundant fisheries resources in this area and embarked on full-scale development. As a result, trawler fleets were dispatched to the region and obtained massive catches. After that, with the setting of 200 nautical mile exclusive economic zones, foreign fishing boats promoted resources development upon concluding fisheries agreements with the Senegalese government, and investment was vigorously carried out into establishing joint venture companies as well as fisheries companies based on local capital. The government vigorously supported this trend and, at the beginning of the 1980s, the largest fishing base in western Africa was developed at Dakar Port under assistance from the World Bank. In the area of coastal artisanal fisheries, the government lent full support to a program for installing outboard engines on wooden canoes. As a result, many people took up fishing for the first time and fisheries production dramatically increased from 120,000 tons in 1970 to 250,000 tons in 2000, thereby making Senegal the most productive fisheries nation in Africa. Currently, marine fisheries occupy a vital position in the national economy. The fisheries sector accounted for 2.3% of GDP in 2002 and, when related sub-sectors such as fisheries processing and distribution and so on are taken into account, production turnover amounted to US$ 550 million.

The volume of marine fisheries production in Senegal reached a peak of 466,000 tons in 1997, however, since then it has been in gradual decline. The depletion of stocks began at the beginning of the 1990s, and this trend has been underpinned by the fall in demersal fish catches and reduction in the body size of fish. Against such a background, the Senegalese government has strengthened fisheries regulations and has examined measures geared to providing an environment for the realization of sustainable fisheries. In 1998, the fisheries law was reinforced, implementation byelaws were established, and the surveillance was strengthened in order to prevent unlawful fishing. Meanwhile, concerning the artisanal fishery, which employs a lot of workers, fishermen were granted free access to resources and allowed to continue fishing largely untroubled; moreover, fishermen support measures such as fishing gear tariff exemptions and fuel oil tax exemptions were maintained. As a result, the number of fishermen as well as the number of fishing boats continued to increase. From around the middle of the 1990s, amid growing realization that regulations were also required with respect to artisanal fisheries, the government started survey and research regarding the stipulation of artisanal fishing rights and registration of fishing boats, etc.

2. Objectives and Contents of the Study

This Study was thus implemented in response to the request from the Government of Senegal at a time when the fishing industry of that country is about to undergo major change.

The Study has the following objectives:

① To assess major fisheries stocks within the exclusive economic zone of Senegal by utilizing data obtained from fisheries statistics, marine surveys and age determination, etc.;

② To compile an effective fisheries resource management plan that will contribute to the sustainable development of fisheries; and

③ To implement transfer of technology to the counterparts on the Senegal side.

Target area : The exclusive economic zone of Senegal (in reality to a depth of 200 m) and coastal fishing villages

Implementation period : June 2003 ~ July 2006

Implementation agency : Ministry of Maritime Economy and International Marine Transport (the former Ministry of Maritime Economy), Department of Marine Fisheries (DPM) and Dakar Thiaroye Marine Research Institute (CRODT)

Work contents :

① Stock assessment field (with CRODT as the C/P)

- Two marine surveys (30 days each) using the fisheries research vessel ITAF DEME
- Estimation of stock volumes in waters to a depth of 200 m based on the sweep area method
- Training on mid-water trawl technology
- Age determination based on otoliths and scales, and transfer of technology for that purpose
- Cohort analysis of seven target fish species and transfer of technology for that purpose
- Estimation of current stocks of two species of shellfish
- Transfer of technology concerning underwater surveys
- Proposals concerning the fisheries statistics system

② Resource management field (with DPM as the C/P)

- Survey of current conditions in fishing villages (directly implemented and consigned surveys)
- Implementation of pilot projects
- Establishment of the resource management plan

3. Marine Surveys

In the past, assessment of demersal fish stocks was based on stock volume estimated according to catch statistics gathered by the Senegal side, however, marine surveys were implemented and estimation of the stock volume was also implemented by the sweep area method (direct method) in order to bolster this approach. The marine surveys were conducted using the fisheries research vessel ITAF DEME (318 tons) and its bottom trawl gear. Surveys targeting coastal demersal fish species at depths of between 10~200 m were carried out two times per year, once in the warm season and once in the cool season.

During the warm season and cool season marine surveys, 26 members comprising 17 crewmembers, seven biological and marine observation survey personnel, and two Japanese surveyors constantly manned the vessel. Out of the direct operating costs of marine surveys, the Japanese side paid 75% of the fuel, fresh water and food costs.

Since the ichthyofauna changes according to the water depth, the survey depth was divided into three zones, i.e. 10~50 m, 50~100 m and 100~200 m, in consideration of the past surveying experience of CRODT. In consideration of the migration of demersal fish, the survey area was divided into three blocks, namely the Northern Block comprising the area north of the Kayar Trench and south of the border with Mauritania, the Central Block comprising the area north of the border with the north side of Gambia and south of the Kayar Trench, and the Southern Block comprising the area north of the border with Guinea-Bissau and south of the border with the south side of Gambia. The survey grids were set as 2 square miles in order to provide as much compatibility as possible with past marine survey data of CRODT.

Work onboard the vessel during the marine biological surveys comprised the following activities:

① Measurement and recording of all caught fish by species;

② Concerning the seven species subject to Beverton-Holt type analysis, measurement and recording of body length by species and by sex to know the body length composition at each station using the punch card method; and

③ Concerning the same seven species, extraction of individual fish equally distributed from small to large sizes, measurement of body length and wet weight, sampling of scales and otoliths, confirmation of sex, and observation and recording of the state of maturation of sexual glands according to each species.

Marine survey in the cool season was implemented at 82 stations from January 23 to February 25, 2004. Moreover, the marine survey in the warm season was implemented at 82 stations from July 29 to August 27 the same year.

In the ocean environmental survey, STD was used in order to measure water temperature and salinity at each survey point in the cool season and warm season surveys.

Demersal fish stocks were estimated using the sweep area method. Comparing the Northern Block, Central Block and Southern Block according to each depth belt, in the cool season, estimated stock volume decreased moving southwards in the 0-50m and 50-100m zones, however, in the 100-20m zone, estimated stocks conversely increased moving in the southern direction. In the warm season survey, the highest figures were recorded in the Central Block at all the depth zones.

Examination was also conducted on unexploited useful stock, however, nothing could be found pertaining to effective utilization now.

4. Stock Assessment and Analysis

In the analysis and assessment of stocks, “Cohort Analysis” was conducted on seven target fish species that were identified in discussions with CRODT. Cohort analysis entails estimating the number of fish of each species in each age group and analyzing changes in this over time in order to assess the state of stocks. Three types of data are required in this process, i.e. age and growth pattern, relationship between body-length and body-weight, and length-composition of commercial catch.

Sample fishes were measured for body length (total or fork length) and wet weight; then, their otoliths and a few scales were collected and the *radii of annuli* were read in order to estimate age. Also, individual fishes were opened up in order to observe their sex glands and determine sex, and the degree of maturation of sex glands was recorded.

The data on “Length-Weight Relationship” was cited mostly from the past study made by CRODT. Based on the length-weight relationship from composition of specimen length obtained here, the total weight of specimens was calculated, and length composition of each fish species was estimated based on the ratio with total catch volume.

The catch statistics according to fish species, age group and fishery type compiled by CRODT over 33 years (1971-2003) were employed. In estimating the age composition of caught fish, a single “work hypothesis” that was set by combining the above growth analysis results with the length composition of caught fish was used.

Main Assessment Points of the Seven Target Species

No.	Target Species	Sate of Stocks	Phase in;	Immediate Action needed for Remedy (Guide post for the action)
1	**Thiof** ***Epinephelus aeneus***	**Heavily exploited**	**Cautious phase**	**Reduction in fishing intensity. (Annual catch, less than 500 tons)**
2	**Pagre** ***Sparus caeruleostictus***	**Moderately exploited**	**Careful phase**	**No need for immediate actions. (Careful monitoring is essential.)**
3	**Thiekem** ***Galeoides decadactylus***	**Heavily exploited**	**Cautious phase**	**Reduction in fishing intensity. (Annual catch, 1,000-2,000 tons)**
4	**Otolithe** ***Pseudotolithus senegalensis***	**Most-Heavily exploited**	**Highly dangerous phase**	**Reduction in fishing intensity.** (Total ban of catching "Otolithe".)
5	**Machoiron** ***Arius heuderotti***	**Heavily exploited**	**Cautious phase**	**Reduction in fishing intensity. (Annual catch, less than 1,000 tons)**
6	**Sole** ***Cynoglossus senegalensis***	**Heavily exploited**	**Cautious phase**	**Reduction in fishing intensity. (Annual catch, less than 2,500 tons)**
7	**Sompatt** *Pomadasys jubelini*	**Moderately exploited**	**Careful phase**	**No need for immediate actions. (Careful monitoring is essential.)**

Moreover, the amount of biomass by year and age group was sought through applying the age-separate average weight to the initial stock numbers by year and age group obtained from the Cohort analysis. The rates in percent of the amount of biomass compared to the beginning were respectively; “Thiof” 35 %, “Pagre” 111 %, “Thiekem” 21 %, “Otolithe” 8 %, “Machoiron” 6 %, “Sole” 22 %, and “Sompatt” 993 %. All values showed a large decline from the beginning with the exceptions of “Pagre” and “Sompatt”. Biomass showed the greatest decline for “Otolithe” and “Machoiron”. Through the examination based on the biomass estimates made, the results obtained were identical to the results obtained according to “Initial Stock Numbers”.

Biomass was also estimated for two species of snails, (spiral shells, Gastropoda, “Cymbium” and “Murex” spp.). As a result, “Cymbium” was estimated as 28,000 tons and “Murex” as 8,000 tons.

5. Resource Management

Because open access is guaranteed to artisanal fishery fishing grounds, there is competition to get to fisheries resources first. The government considers that excessive fishing effort is the greatest obstacle to resource management in Senegal, and it is advancing preparations for the introduction of a concession system to counter this.

Fisheries statistics are essential for compiling prompt policies and they are also important as primary data for fisheries research. Until 1996, the DPM and CRODT collected and estimated artisanal fisheries statistics using their own respective data collection methods and techniques. From 1996 it was decided to unify methods in line with the CRODT approach, however, only recently has data

collection based on CRODT survey sheets become established at eight major landing areas excluding Saint-Louis. Since industrial catch sizes are based on self-declarations by fishing boats, it is difficult to eliminate doubts of under-reporting.

Major donors such as the World Bank, EU, FAO and European Union, and also NGOs conduct various activities in their respective fields of interest. In geographical terms, assistance is concentrated around Saloum Delta in the south. France has dispatched two advisors and is cooperating with examinations geared to the introduction of the CNCPM, regional fisheries councils and fisheries concessions.

In order to disseminate bottom-up resource management to other areas, the Study Team has so far exchanged cooperation agreements with the World Bank's GIRMaC (Integrated management of marine and coastal resources), OCEANIUM (NGO), which collaborates with the French development agency (AFD), and ENDA-GRAF, which supports women's activities in fishing villages; moreover, it regularly holds a meeting for fisheries donors under cooperation from JICA.

Socioeconomic Survey in Fishing Villages

For the sake of pilot project implementation, fishing village surveys were implemented in order to gauge current conditions regarding the state of fisheries and socioeconomic conditions in fishing villages as well as the awareness of fishermen towards resource management. The survey was implemented in 22 villages and the survey targets (informants) were limited to boat owners since they are directly involved in decision-making regarding resource management.

Fishermen are currently implementing various resource management measures, namely setting of closed seasons, closed zones, body length regulations, catch size restrictions and so on. However, even though resource management cannot be implemented by individuals and needs to be conducted based on collaboration of fishermen who share the same interests, fishermen's organizations for implementing resource management hardly exist at all. Regarding the question of what kind of organization should play the central role in implementing resource management in the future, 48% of informants said the DPM, indicating a strong sense of dependence on officialdom. Furthermore, in response to the question of what resources are required for deploying activities, the top answer given was the existence of trustworthy leaders, second was funding and third was equipment.

Preferential Measures for Artisanal Fisheries

The artisanal fisheries sector in Senegal expanded production through adopting tax benefits for fisheries fuel and producer goods and promoting modernization. However, against the current critical background surrounding coastal stocks, it will be difficult to promote coastal resource management measures so long as preferential measures for artisanal fisheries are upheld. As a

result of the survey, it was found that fuel tax benefits combined with preferential measures for fisheries equipment and supplies and the cost of benefits for the artisanal fisheries sector worked out as 4.44 billion Fcfa in 2003. It is estimated that almost 20% of the annual operating profits of fishing households are derived from artisanal fisheries preferential measures.

6. Pilot Project

In the pilot project, it was decided to focus on bottom-up resource management under the initiative of fishermen by referring to the experiences of Kayar and Japan. Having said that, since resource management also requires government involvement regarding the enhancement of scientific knowledge and preparation of fishing methods, the project objective was defined as "constructing a model of joint management under the initiative of fishermen."

If it is aimed to implement resource management via closed seasons and closed zones, etc., since immediate fisheries incomes will decrease, fishermen will not want to lend their support and the project will not be feasible. In order to overcome this problem, it is important to diversify sources of income for fishermen.

Nianing and Yenne were selected as the project sites because they offered the conditions required for resource management, i.e. fishermen were willing to take part in the project and there is good solidarity among existing fishermen's organizations, etc.

The features of the selected project sites can be described as follows: (1) there is high awareness of resource management; (2) solidarity of fishermen's organizations is strong; (3) there is a high ratio of local fishermen; (4) there is a high ratio of fixed stocks; (5) the fishing villages are compact in size; (6) fishing villages possessing similar conditions are located nearby; (7) there is no overlapping of projects by other donors; (8) access from government agencies is good; (9) market access is good; and (10) fisheries infrastructure is under-developed.

6-1 Project in Nianing, Pointe-Sarene and Mballing

In the first year, the project was implemented in Nianing. At this time, the fishermen decided to implement autonomous management measures such as the setting of closed seasons and release of shellfish fry in order to restore stocks. However, since implementing resource management alone would lead fishing households into bankruptcy, the fishermen also decided to augment household incomes through generating revenue from the joint shipping of octopus and cymbium. Meanwhile, since resource management cannot only be implemented by fishermen but also requires government involvement, it is important to build joint management between fishermen and the government.

Accordingly, the local government established an ordinance concerning autonomous management. Also, CRODT decided to provide biological information regarding important stocks to the fishermen.

In the second year, participation was expanded to neighboring Pointe-Sarene and Mballing that share the same resources and fishing grounds. The three villages jointly set closed seasons for octopus and cymbium and reduced the use of gillnets targeting demersal fish (mainly sole). Moreover, in collaboration with a local NGO, the villages made preparations for the setting of marine protection zones. Regarding resource management compensation measures, since the treatment of large amounts of waste shells is a problem in the three villages, they decided to carry out recycling. Specific measures comprised, (1) small-scale poultry farming making use of shells, (2) octopus spawning reefs (pots) making use of shells, and (3) development of building materials made from shells. In Pointe-Sarene and Mballing, fueling facilities were constructed.

The following outputs were realized:

1) Demonstration of autonomous management by fishermen
2) Clarification of the roles of the government and fishermen in resource management
3) Maintenance of the living standard of local residents
4) Revitalization of local economic activities
5) Registration of fishermen and fishing boats, and utilization of fisheries statistics in resource management

All resource management activities were planned in discussions with the fishermen.

In light of the project concept of constructing a model of bottom-up joint management, it was important that the government and fishermen respectively compiled and executed appropriate action plans. Both sides confirmed that, 1) the role of the government was to provide scientific information to fishermen and take the legal measures necessary for resource management, and 2) the role of the fishermen was to establish autonomous management rules pertaining to local fisheries stocks and to take an organized approach to resource management.

The project was a success in terms of realizing joint resource management under the initiative of fishermen. The issue in future will be to disseminate the joint management model that was constructed in the project.

The biggest factor in the success of the pilot project was the active participation of residents, but other factors were as follows:

1) Fishermen were made the focal point of the project and were given the responsibility and authority for resource management.

2) Rather than imposing the ideas of the government and donors, the experiential know-how and technology of fishermen were emphasized.
3) Economic unease over resource management was removed through implementing lifestyle improvement activities such as joint shipping, etc.
4) The local government supported resource management through establishing an ordinance, etc.
5) CRODT and the fishermen jointly conducted biological surveys that clarified the spawning periods, etc. of target species.
6) Equipment and materials necessary for efficiently and effectively implementing resource management activities and lifestyle improvement activities were supplied.
7) The Study Team visited the fishing villages on numerous occasions in order to discuss resource management and compensation with residents.
8) The DPM branch officials devotedly supported the fishermen in both technical and mental terms.
9) Employees of FENAGIE-PECHE played an important role as project participants, mainly in terms of the operation of fishermen's organizations.
10) The motivation of fishermen was raised through media coverage of the project.

6.2 Project in Yenne

In Yenne, the aim of the project was to build a model of joint management of fisheries stocks between the government and fishermen via the setting of artificial reefs. In other words, the project concept was that, based on a contractual relationship between fishermen and government, the government guarantees resource exploitation rights to fishermen, and the fishermen take responsibility for appropriately sustaining and managing resources. Two factors underpin this approach: first, the government does not possess the human resources to conduct resource management on the village level, and second, administrative authorities are starting to realize that top-down resource management unilaterally decided by the government does not work very well. In this concept, since it is difficult claim the ownership of stocks in Senegal, i.e. to say that the fisheries stocks of a certain place belong to the fishermen who live there, it was decided that there should be little problem in claiming ownership of stocks that attach to fishing grounds that have been created by fishermen. The project here aimed to demonstrate a certain style of management, in which fishermen build artificial reefs offshore of Yenne and manage the resources that gather there.

Yenne, situated approximately 40 km south of Dakar, is a fishing village composed of seven smaller communities. The types of fishery operations in each of the seven communities of Yenne are distinct and can be divided into bottom gillnet fishing, coastal longline fishing and offshore longline fishing.

It was anticipated that the pilot project would realize the following outputs with the goal of establishing artificial reef installation as a method of fisheries resource management:

1) The parties involved in managing fisheries stocks around artificial reefs were clarified.
2) Fish gathered around the artificial reefs and stocks were regenerated.
3) Rights and obligations concerning the exploitation of stocks around artificial reefs were given to the fishermen.
4) Survey capacity in related fields was increased.

The project started from the desire of the fishermen to, "Create and manage our own fishing grounds." The fishermen of Yenne are also involved in the Bargny artificial reef project and are interested in these types of reef. Accordingly, the Study Team proposed artificial reefs based on these types but smaller in size to make handling by the fishermen easier, and this idea was accepted. In specific terms, it was decided to manufacture and install artificial reefs composed of small blocks and gabions made by filling natural stones into wire netting. It was also decided to establish a resource management committee following installation of the artificial reef. This committee was to unify the fishermen, while determining the management rules and negotiating with administrative authorities.

Following manufacture of the fish reefs and installation of the octopus spawning reefs, the fish reefs were installed at the following locations:

(First year)

75 concrete blocks (with 75 cm sides) and approximately 400 gabions were installed at lat. 14° 37' N. and long. 17° 12' W.

(Second year)

Octopus reefs were installed in the following ocean areas:

① The sea area known as "Casao" off the coast of Yenne Todd in the north

Lat. 14° 38.12' N., Long. 17° 12.007' W.: 40 reefs

② Waters where artificial reefs were installed in the previous year: 20 reefs

③ The sea area known as "Devo" off the coast of Toubab-Dialaw in the south

Lat. 14° 36.062' N., Long. 17° 10.698' W.: 40 reefs

A resource management committee (Comité de gestion) was established in the village to implement and promote the pilot project as well as manage fisheries resources from now on. The management committee is responsible for determining the resource management rules and thoroughly informing them to the village fishermen.

Project Assessment

The social impacts of introducing coastal fishing ground management based on the artificial reef are, 1) the organization of fishermen, and 2) heightening of awareness of coastal fishing rights. Although the fisheries sector has traditionally been a difficult sector to foster solidarity, the experience of Yenne, in which fishermen from seven different communities jointly constructed and set an artificial reef and also implemented management activities, albeit loose management, based on the common interest of the artificial reef, indicates that there has been a certain degree of impact in terms of organizing the local fishermen. Moreover, the fact that fishermen have established and manage the artificial reef through investing their own labor and funds has generated greater awareness of fishing rights in coastal waters among the fishermen. An indicator of this impact is the execution of the code of conduct indicated by the resource management committee; however, it has to be said that this impact is currently not strong enough.

If these fishermen incorporate the artificial reef fishing ground into their annual operating plans, obtain a certain degree of profit from this, and then fulfill their beneficiary's burden by becoming the managers of the artificial reef, then the system for fishing ground management by coastal residents using the artificial reef as a tool becomes feasible.

The human resources and equipment and materials invested in establishment of the artificial reef have been hugely useful in forming the fish reef fishing grounds. Although detailed management techniques have not been realized like originally planned, loose fishing ground management was achieved through enforcement of the rule not to use net fishing gear around the fish reef. Because the artificial reef was too small, hardly any impact was confirmed in terms of biology and fishery resources. However, in both the advance case of Bargny and this case of Yenne, gathering of seven band grouper (*Epinephelus aeneus*, local name "thiof"), which is the most sought after fish in Senegal, was confirmed around the artificial reef, so there are many fishermen who want a similar type of fish reef established in waters off their own village.

6-3 Bargny (Sub Project)

In Bargny, ongoing follow-up was carried out on stock regeneration based on an artificial reef (the first one to be installed in Western Africa by OFCA) and fish reef resource management under the initiative of fishermen, and an attempt was made to construct a model of joint management between fishermen and administration.

Bargny is a fishing village situated 33 km from Dakar, and it is composed of the three communities of Bargny, Miname and Sendou. The artificial reef was installed in June 2002.

After the fish reef was installed, the DPM and CRODT carried out enlightenment activities and a management committee composed of representatives from five coastal villages (Rufisque, Bargny, Sendou, Miname and Yenne) was formed. The committee, acting on the advice of CRODT from the viewpoint of stock protection, designated all waters around the reef as a total closed area and made this into legislation as a Rufisque Prefecture ordinance. Artificial reef projects by OFCA in the past were simply intended to confirm the fish gathering effect and stock propagation effect of fish reefs. The Study Team decided to target Bargny as a sub project of the pilot project in order to verify the effectiveness of artificial reef installation as an effective tool of resource management with Yenne in mind.

In order for residents to conduct autonomous management, since it is essential for residents to raise management costs themselves, various methods of allowing residents to sustain the management activities were investigated after the support from external donors was stopped.

The code of conduct (Code de conduit), which is based on opening the artificial reef as a hand line fishing ground and levying a fishing charge from fishing boats that enter the area, was established. Specifically, the code stipulates that the ocean area be divided into the first zone, which is a closed area, and the second zone, which is the fishing area, and it prescribes details concerning fishing access. However, the code of conduct has so far failed to function and there are no users of the fishing license system.

The method whereby a fishing ground management committee manages the fishing grounds while raising operating costs is a form of so-called tight management. However, because this tight management hardly functions at all, it is proposed that this be changed to a system of loose management more suited to current conditions.

Underwater Survey

In the pilot project, an underwater survey was implemented in order to estimate the scientific impact of artificial reef installation. Since scientific surveying of Senegalese coastal areas is the jurisdiction of the CRODT, three personnel selected by CRODT were trained as underwater survey divers. At the same time, diving equipment and underwater photography equipment were procured in order to build a set to enable CRODT to continue underwater surveys even after the project was finished.

The underwater surveys confirmed that, apart from octopus pot reefs of Yenne, the fish gathering and propagation facilities such as artificial reefs and octopus pots installed off the coast of Senegal are highly effective. In particular, the artificial reefs installed off the coast of Yenne and Bargny displayed more immediate and sustained effects than those installed in Japanese waters.

In future, it is anticipated that effective resource management based on artificial reefs, etc. can be realized in Senegal too. In order to efficiently implement fishing ground management around fish reefs, it is essential to gauge the seasonal and annual changes in fish gathering conditions around such facilities. Therefore, in addition to compiling new plans for artificial reef installation, it is desirable that Senegalese experts continue to implement qualitative and quantitative surveys of gathering fish (like the surveys conducted here) from now on.

7. Resource Management Plan

In Senegal, since fisheries activities are unregulated and open access to fisheries stocks is guaranteed, there is intense competition to catch demersal fish species that fetch high market prices, and this is accelerating the destruction of stocks. Many fishermen are aware of the need for resource management, however, they need to give higher priority to their standard of living.

In the Study, attention was turned to the climate, society and economic conditions of Senegal and various resource management activities such as closed seasons, artificial reefs and regulation of fishing nets, etc. were implemented based on the fundamental premise of “bottom-up” management. Also, joint shipping, refueling equipment and poultry farming activities were implemented in order to compensate the negative impact of resource management on fishing household economy. In the project, the win-win approach to managing stocks and alleviating poverty proved successful and it was possible to almost fully realize the original objective of building a model of resource management based on fishermen’s initiative. There is increasing awareness in Senegal that bottom-up resource management is an effective approach in that country.

In Senegal, administrative authorities take the initiative in implementing resource management, however, there is a limit to administration-led resource management. Moreover, as an adverse effect of preferential measures for the promotion of artisanal fisheries, fishermen rely too heavily on the government and have lost their sense of autonomy. What Senegal needs is low-energy resource management that doesn’t require a great deal of cost and manpower. Accordingly, it is considered appropriate to introduce co-management, where the government and fishermen work together.

When planning and executing resource management, priority is given to the experiential know-how and technology of fishermen, however, government assistance is borrowed regarding scientific survey, setting of ordinances and others areas that cannot be handled by fishermen alone. Resource management is started in each fishing village; these activities are widened to local areas, and finally they are disseminated over the whole country. When doing this, policy for the expansion of bottom-up management is needed, and in order to restore fisheries stocks, the government must control industrial fisheries too.

It is effective to implement artisanal fisheries resource management with priority placed on the following activities:

- Protect spawning parent fish
- Protect small-size fish
- Reduce the size of catches.
- Sell fish at high prices
- Implement economic activities other than fishing.

Resource Management Plan

Based on the experiences of the pilot project, the direction and basic perspective of resource management as well as issues that should be treated with priority by Senegal are proposed. However, the experience of the pilot project is limited to only a very minor experience in a restricted area, and it would be dangerous to extend this to resource management plans targeting the whole country without conducting activities in areas of differing conditions first. However, it is thought that the thinking and direction of resource management proposed in this section equally applies to all districts in the country.

In order to make the resource management plan effective, it is important for fishermen to take the initiative in planning and implementation rather than the government and donors. (Fishermen do not accept top-down resource management that is implemented under the initiative of governments and donors). For this reason, rather than focusing on the actual contents of the plan, it commentates on important points in the planning process.

The important points to consider when conducting resource management are as follows:

- Fishermen play the central role in compiling resource management plans
- Government and donors must not determine the contents of projects.
- Compile budgets that can be used according to the discretion of fishermen
- Encourage fishermen to have autonomy
- Organization is a means, not the end.
- Securing of democratic operation and transparency of resource management committees
- Start from income generating activities
- Distribution improvement is effective for resource management
- Conduct scientific surveys with fishermen

Policy Recommendations regarding Resource Management

The major policy recommendations concerning resource management in Senegal are as follows.

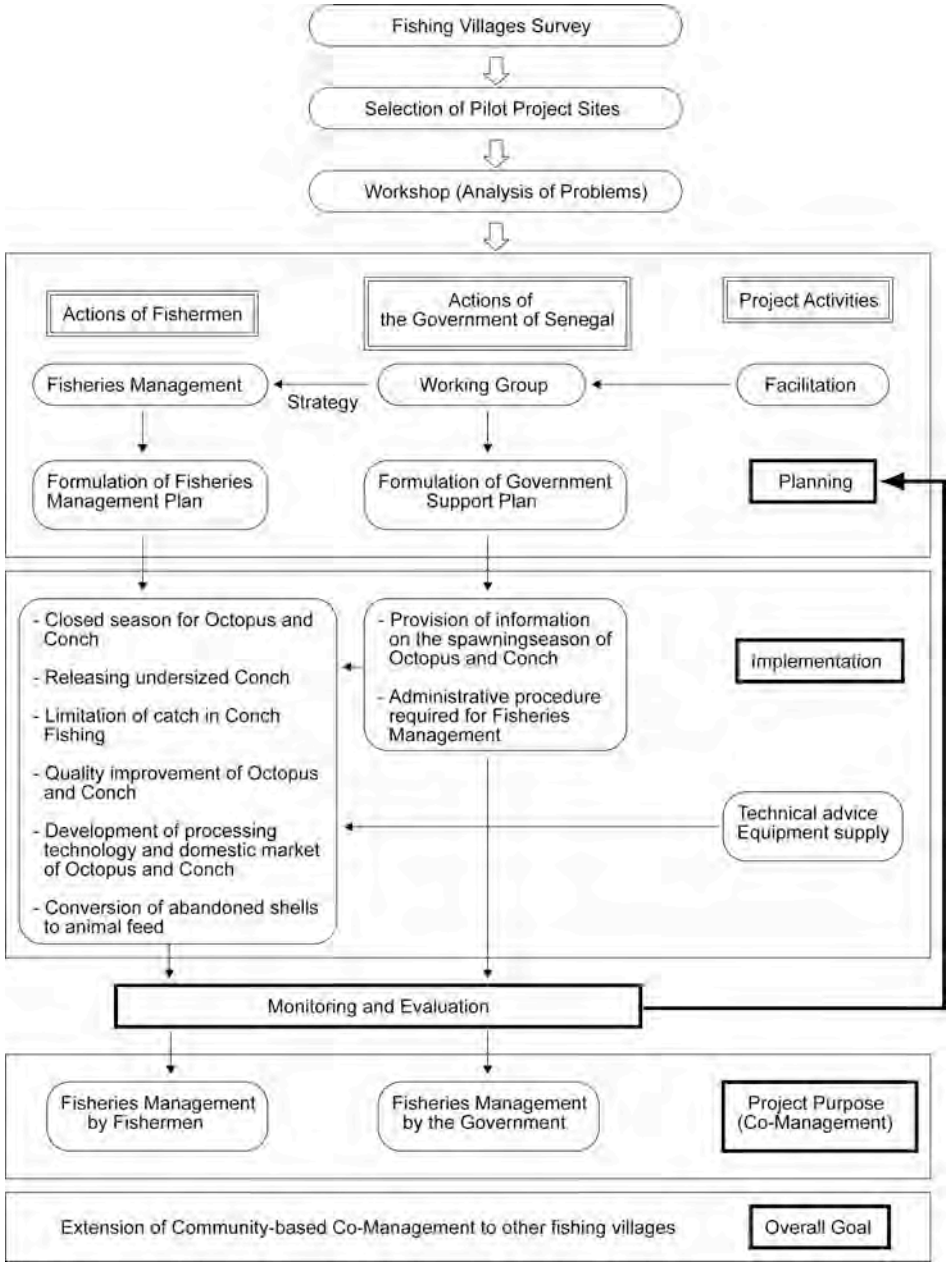
1) Review centralized resource management and promote decentralized, participatory resource management.

2) Construct resource management models for each type of fishing village.

3) Introduce systems to give preferential treatment to fishing villages and fishermen that take a positive stance towards resource management.

4) Bolster links between residents, corporations, administration and research in resource management.

5) Reflect the experiences of Asia, where fisheries conditions are similar to those in Senegal, in policy.



Activity flow of fisheries resource management project at artisanal fishing villages

8. Industrial Fisheries Survey

A written questionnaire survey and hearing survey were carried out with respect to fisheries companies. As a result, it was found that, for various reasons, and following a spate of corporate bankruptcies in 1997~1998, financial institutions are unwilling to lend money in general. For this reason, plant investment in companies is sluggish and many corporations hope that the Senegalese government will take measures such as guaranteeing loans from financial institutions.

Almost all fisheries corporations recognize that fisheries stocks in waters off Senegal are in decline.

Corporations are also aware of the need for fisheries regulations in order to protect stocks, however, they basically desire regulations by means of the following three methods, which have no direct impact on maintenance of their own business operations.

1) Regulation of fisheries activities by foreign fishing boats
2) Prohibiting the issue of new licenses in the industrial fishery
3) Introduction of an artisanal fishing boat registration system and regulation on the number of fishing boats

The vast majority of those asked basically desire the balanced coexistence of corporate fisheries with artisanal fisheries. If new closed seasons are to be set, in addition to implementing and announcing spawning seasons and specific surveys based on a scientific basis, it is desirable to compile fisheries regulations that do not put an excessive burden on fishermen.

There is the possibility of setting a total allowable catch (TAC) and prohibiting fishing once this limit is reached. However, since there is currently no consistency on fisheries statistics gathering methods, functions for rapidly processing catch sizes by species are undeveloped, and means of information communication for consolidating landing data are not in place, implementation of such an approach is unfeasible.

The fisheries stock assessment and management policies that are anticipated by fisheries corporations can be summarized as follows.

1) Implementation of appropriate stock assessment
2) Disclosure of the results of stock assessment
3) Prior explanation of fair resource management and methods for realizing it
4) Implementation of appropriate resource management and monitoring activities
5) Continuation of resource assessment activities and disclosure of results following the implementation of stock management

9. Transfer of Technology

Transfer of fish catching technology was implemented with concerning effective utilization of the net recorder, which is used to obtain necessary data regarding fishing gear, and the method of measuring warp angle in the lateral direction necessary for calculating the sweep area.

In the biological survey, technical guidance was carried out with the emphasis placed on test navigation and treatment of samples in the CRODT wet laboratory. Regarding the scale and otolith sampling onboard, the staff needed roughly 15~20 minutes per fish at the start, however, they were able to dramatically shorten work times upon carrying out repeated practice. The staffs are now able to remove otoliths from a fish in around one minute.

In the mid-water trawl training, the objective was to impart fish catching technology that would allow targeted pelagic fish to be caught. This was done by effectively conveying various kinds of information obtained from GPS, aerovane, fish finder, sonar, tide gauge and net recorder, etc. to the fish catching staff and processing it. In the training here, the stage of actually catching a targeted fish shoal was not reached because no ideal shoals appeared during the general training (the fishing season for pelagic fish was already finished) and some of the information from the instruments lacked reliability. However, the Senegalese crewmembers were able to understand the basic techniques.

Transfer of technology concerning age determination based on otoliths was implemented as on the job training for three CRODT counterparts (C/P) from the second field survey (October-November 2003) to the seventh field survey (October-November 2005). During these activities, guidance and transfer were carried out regarding the method of otolith sampling from fish specimens, otolith wrapping, otolith cutting using a cutter, preparation of flake samples, observation and analysis by microscope, and other technologies necessary for conducting age determination. Moreover, a manual of all the processes of otolith treatment was prepared in French in a joint effort with the C/P, and this was presented to CRODT. In future it is hoped that the transferred technology will be applied to other important species such as horse mackerel and so on. Furthermore, transfer of technology concerning age determination based on scales, transfer of technology concerning the method for analyzing growth history from the results of age determination based on otolith and scales, and analysis of initial stock numbers by age group were implemented; and theoretical and practical guidance based on computer operation was provided to bring the transfer of technology to an end.

Underwater survey is indispensable in order to gauge the current conditions and effects of artificial reefs. Three counterparts from CRODT learned about basic underwater photography using the underwater still camera and video camera that were supplied in the study, and methodology for estimating fish gathering volume using the belt transect method and the fixed point observation

method. However, it will be necessary for CRODT to build an internal support system that allows the diving team members to acquire further knowledge and gain further experience.

10. Recommendations

10.1 Recommendations concerning the Fisheries Research Setup

- Continue to implement coastal demersal stock surveys at least twice a year as performed in the Study.
- Regarding the technical side of offshore demersal stock surveys, constantly confirm the remaining warp rope length on the trawl winch, and effectively utilize ground rope for use on continental shelf slopes.
- Concerning pelagic resource surveys, establish sampling catch methods utilizing mid-water trawl as soon as possible, in order to transfer to survey using measurable scientific echo sounder.
- Reinforce organization through establishing an “Operation Control Section” (provisional name) to manage marine survey operations.
- Strengthen the budget for marine survey work.
- Prepare fishing ground maps.
- Secure representative body length composition of specimens. (Measure body length composition in 30 samples per measurement, performing this three times a month at three sites throughout the country).
- Gather more biological knowledge necessary for accurately gauging the state of stocks.
- Strengthen marine survey capacity.
- Recruit young researchers.
- Transfer research agencies under fisheries administration agencies.
- Collaborate with neighboring countries (especially Gambia).

10.2 Recommendations concerning Fisheries Administration

- Improve the quality of regional branch personnel
- Conduct reorganization corresponding to decentralization
- Respond to the ageing of personnel, recruit young staff and train them
- Secure necessary budget for resource management
- Implement resource management plans (co-gestion)
- Install artificial reefs.

CHAPTER 1

INTRODUCTION

CHAPTER 1
INTRODUCTION

1.1 Background of the Study

(1) Natural Environment

In the seawaters off the coast of the Republic of Senegal, which is located on the westernmost tip of the African Continent, the Canary Current from the north clashes with the Guinea Current from the south. Moreover, upwelling of deep water arises along the slope of the continental shelf. The surface temperature of the ocean never falls below 15 degrees throughout the year. The Senegal, Gambia and Casamance Rivers flow into the ocean from the continent, and these channels supply nutrient salts during the rainy season. Furthermore, sand containing abundant mineral salts is carried by winds from the Sahara Desert. Such favorable natural conditions enhance the productivity of the ocean and give rise to some of the most fertile fishing grounds in Africa. Strong winds blow and the seas become rough when the seasons change between the rainy season and dry season, however, ocean waters here are on the whole tranquil and people are able to benefit from the fruits of the ocean in safety.

(2) History of Fisheries

Fisheries has for a long time been monopolized by certain tribes: for example, the Guet-ndariens in Saint Louis, which originate from the basin of Senegal River, the Lebou on the outskirts of Dakar, and the Nyominka who live mainly around Saloum Delta. These tribes have traditionally followed the seasonal movements of fish groups and fished in waters stretching along 2,000 km of coast from Mauritania in the north to Sierra Leone in the south. Artisinal fishermen conduct fishing in canoes and small sailboats, and catches are supplied to inland residents as either smoked or dried products.

In the 1960s and 1970s, around the time when African nations gained independence, the developed countries took notice of the abundant fisheries resources in this area and embarked on full-scale development. As a result, trawler fleets were dispatched to the region and obtained massive catches. After that, with the setting of 200 nautical mile exclusive economic zones, foreign fishing boats promoted resources development upon concluding fisheries agreements with the Senegalese government, and investment was vigorously carried out into establishing joint venture companies as well as fisheries companies based on local capital. The government vigorously supported this trend and, at the beginning of the 1980s, the largest fishing base in western Africa was developed at Dakar Port under assistance from the World Bank. In the area of coastal artisanal fisheries, the government lent full support to a program for installing outboard

engines on wooden canoes. As a result, many people took up fishing for the first time and fisheries production dramatically increased from 120,000 tons in 1970 to 250,000 tons in 2000, thereby making Senegal the most productive fisheries nation in Africa. Fish came to make a major contribution to the national diet as a source of animal protein, and the per capita consumption of fish increased to 26 kg per year.

(3) Economic Contribution

For Senegal, which is not blessed with many natural resources, marine fisheries occupy a vital position in the national economy. The fisheries sector accounted for 2.3% of GDP in 2002 and, when related sub-sectors such as fisheries processing and distribution and so on are taken into account, production turnover amounted to US$ 550 million. Moreover, the fisheries sector directly and indirectly employs a working population of approximately 600,000, accounting for approximately 17% of the total working population. Exports of fisheries products from Senegal amounted to 130,000 tons worth approximately US$ 320 million in 2000, and the sector has continuously been the country's main source of foreign currency ever since.

(4) Relations with Japan

Being impressed by the abundant fisheries resources in Senegal, the stable political environment and the high quality of the labor force, Japanese fisheries companies invested in local joint ventures for 10 years or so from the 1970s. At the same time, overseas development assistance in the fisheries sector was vigorously carried out. Numerous facilities and equipment were constructed and supplied, and many fisheries experts were dispatched to Senegal in order to conduct transfer of technology. Furthermore, numerous Senegalese government employees, technicians and researchers in the fisheries sector visited Japan to undergo training. These different forms of assistance were initially directed towards promoting the development of fisheries resources, however, they were subsequently expanded to include improvement of fisheries products distribution and quality levels. Meanwhile, in the area of stock assessment, research vessels were provided, however, no actual surveys or research works were implemented. Concerning resource management too, the trainees who visited Japan learned about advanced resource management technologies, however, they were unable to reflect these in specific measures.

(5) Practice of Resource Management

The volume of marine fisheries production in Senegal reached a peak of 466,000 tons in 1997, however, since then it has been in gradual decline. The depletion of stocks began at the beginning of the 1990s, and this trend has been underpinned by the fall in demersal fish catches and reduction in the body size of fish. In the commercial fisheries sector, some companies have been

forced into suspending operations or even going out of business due to poor profitability. Furthermore, when the currency of Senegal (the Fcfa[1]) was devalued in 1994, it had a major economic impact on fisheries exports.

Against such a background, the Senegalese government has strengthened fisheries regulations and has examined measures geared to providing an environment for the realization of sustainable fisheries. In 1998, the fisheries law was reinforced, implementation byelaws were established, and the surveillance was strengthened in order to prevent unlawful fishing. These measures mainly targeted easily controllable Senegalese commercial fisheries and regulated the activities of large domestic fishing boats. Fishing access for foreign fishing boats was controlled under bilateral fishing agreements, etc. Meanwhile, concerning the artisanal fishery, which employs a lot of workers, fishermen were granted free access to resources and allowed to continue fishing largely untroubled; moreover, fishermen support measures such as fishing gear tariff exemptions and fuel oil tax exemptions were maintained. As a result, the number of fishermen as well as the number of fishing boats continued to increase.

From around the middle of the 1990s, amid growing realization that regulations were also required with respect to artisanal fisheries, the government started survey and research regarding the stipulation of artisanal fishing rights and registration of fishing boats, etc. Moreover, in line with moves toward decentralization, the government advanced study on the establishment of local fisheries councils (Conseils Locaux de Peche Artisanal: CLPA). It took a long time for people to support these measures that also included tough regulations, and they were not realized for many years, however, the government finally established a CLPA in Joal in 2005. Moreover, it announced that it would register canoes and issue fishing rights to artisanal fishermen, and it is currently implementing coordination geared to the realization of these measures.

This Study was thus implemented at a time when the fishing industry of Senegal is about to undergo major change.

1.2 Objectives of the Study

The Study has the following objectives:

① To assess major fisheries stocks within the exclusive economic zone of Senegal by utilizing data obtained from fisheries statistics, marine surveys and age determination, etc.;

[1] The Fcfa (CFA Franc) is the common currency adopted by eight countries of the former French West Africa (Senegal, Mali, Niger, Guinea-Bissau, Cote D'Ivoire, Burkina Faso, Togo and Benin). In January 1994, the fixed exchange rate linked to the French franc was revised from 1: 50 to 1: 100, thereby devaluing the currency by half. Now, since the French franc has been abandoned with the appearance of the Euro, the Fcfa is linked to the Euro at a fixed rate of 1 Euro = 655.957 Fcfa.

② To compile an effective fisheries resource management plan that will contribute to the sustainable development of fisheries; and

③ To implement transfer of technology to the counterparts on the Senegal side.

1.3 Contents of the Study

Target area : The exclusive economic zone of Senegal (in reality to a depth of 200 m) and coastal fishing villages

Implementation period : June 2003 ~ July 2006

Implementation agency : Ministry of Maritime Economy, Department of Marine Fisheries (DPM) and Dakar Thiaroye Marine Research Institute (CRODT)

Work contents : ① Stock assessment field (with CRODT as the C/P)

- Two marine surveys (30 days each) using the fisheries research vessel ITAF DEME
- Estimation of stock volumes in waters to a depth of 200 m based on the sweep area method
- Training on mid-water trawl technology
- Age determination based on otoliths and scales, and transfer of technology for that purpose
- Cohort analysis of seven target fish species and transfer of technology for that purpose
- Estimation of current stocks of two species of shellfish
- Transfer of technology concerning underwater surveys
- Proposals concerning the fisheries statistics system

② Resource management field (with DPM as the C/P)

- Survey of current conditions in fishing villages (directly implemented and consigned surveys)
- Implementation of pilot projects
- Establishment of the resource management plan

1.4 Implementation of the Study

1.4.1 First Field Survey (July ~ August 2003)

The first field survey began in July 2003. In this survey, the Draft Inception Report was presented to the Senegalese side, the Senegalese fisheries sector was reviewed, the background of the Study was grasped, and the implementation feasibility of the study plan compiled by the Japanese side was

examined. Also, efforts were made to convey the thinking of the Study Team to the Senegalese side. The major survey items were as follows.

(1) Review of the fisheries statistics collection system and preparation of the draft improvement plan

Fisheries statistics are currently collected by two agencies, i.e. CRODT and DPM. In addition to reviewing catch data collection methods, discussions were held concerning the plan to improve the catch statistics system including the following contents:

① Examination of the data collection and sharing methods of the two agencies,
② Examination of the data required in order to conduct resource management,
③ Proposal of measures to improve the data collection system,
④ Design of a collected data standardization and simplification system

(2) Review of current survey activities by fisheries research vessel

The Study Team investigated in detail past operations of research vessel in Senegal. The Team also surveyed the state of maintenance, equipment storage conditions and feasibility of use of fishing gear on the research vessel ITAF DEME. The Team also confirmed the technical level of crew and the operating system, and examined whether or not the vessel could implement the plan being considered by the Team. As a result, it was deemed that, apart from some minor problems regarding the handling of some items of equipment including the CTD and so on, the vessel was capable of implementing the trial voyage in the second field survey.

(3) Review of past fisheries stock assessment

The Study Team reviewed the assessment of fisheries stock that was previously conducted by the Senegalese side. It was found that fairly huge amounts of data are amassed in CRODT according to each fish species. Moreover, thanks to cooperation from SIAP (the Fisheries Information Analysis Project), it was found that stock assessments were being implemented on a number of species using different methods from those planned in the Study.

(4) Discussion and decision of the fish species targeted for stock assessment (including sampling plans at landing sites)

The Study Team discussed and implemented survey and research on 17 species with the CRODT. Concerning the age determination of fish, it was decided not to limit age characteristics to otoliths but to also examine scales, spines and body length composition. In order to complement sampling in the marine survey, it was decided to also implement sampling on land.

(5) Preparation of the marine survey implementation concept and fisheries research vessel operating plan (6 months)

The implementation concept for the marine surveys was compiled upon considering techniques (number of survey points, timing, items) in marine surveys previously conducted by the Senegalese side, the state of the research vessel, fishing gear and materials, and the survey period and budget. In particular, the Study Team paid attention to the following points:

① Number of survey points and method of dividing sea blocks and stratification
② Catch efficiency of fishing gear (hearings on commercial trawlers, etc.)
③ Annual survey budget (including research vessel maintenance costs) and staff assignment of the CRODT

(6) Arrangement and analysis of existing information in the fisheries sector

The following items of existing information were collected, arranged and analyzed as useful data for conducting resource management:

① Fishing methods and marketing system in the artisanal fishery
② Fisheries organizations, fishermen's practices and fisheries rules
③ Achievements and lessons pertaining to autonomous resource management by fishermen (case studies in Saloum Delta, Kayar and Bargny)
④ State of progress of legislation concerning artisanal fisheries management in the DPM

The Study Team also held discussions and promised cooperation regarding collaboration and activity blocks with the Southern Artisanal Fisheries Support Programme (PAPA-SUD) sponsored by the EU and AFD.

(7) Survey on organization and structure related to resource management

The Study Team investigated the resource management organization (legislation and monitoring organization) of the government as well as setups of the central government, regional governments, instructors, donors and NGOs, etc. for supporting management by fishermen. As a result, it was confirmed that activities by private agencies such as FENAGIE-PECHE and so forth have increased in recent years.

(8) Socio-economic fact-finding survey of fishing villages

In consultation with CRODT and DPM, the Study Team selected approximately 30 villages as targets for the socio-economic fact-finding survey to be implemented in the second field survey.

It was decided to consign implementation of the survey to a local NGO, and the necessary information was gathered on potential consignees and the conditions of consignment, etc.

(9) Preparation of the Inception Report (IC/R)

The IC/R was compiled upon taking into account the results of the discussions with the Senegalese government implementing agencies and findings of the preparatory work in Japan and first field survey.

(10) Preparation of the technology transfer plan

Regarding the contents of transfer of technology to the counterparts in the Study, the technology transfer plan was prepared and presented upon holding discussions with the Senegalese government.

(11) Preparation of the field survey report (1)

The Field Survey Report (1) was prepared by compiling the findings of the first field survey.

1.4.2 First Work in Japan

(1) Explanation to and discussions with the Work Supervisory Committee (September 3, 2003)

The contents of the Inception Report (draft) were explained to and discussed with the Work Supervisory Committee, and consensus was reached.

(2) Preparation of the implementation plan for the Second Field Survey

The implementation plan for the Second Field Survey was prepared in consideration of the findings of the First Field Survey. In particular, the work plan and specifications including concrete survey sheets for the fishing village socio-economic survey were prepared. Moreover, in order to procure and deliver the fishing gear and materials required for the marine survey, examination was conducted into specifications, suppliers and conditions of procurement, etc.

1.4.3 Second Field Survey (October ~ December 2003)

(1) Explanation and discussion of the Inception Report

Upon explaining and discussing the contents of the IC/R with the implementing agencies on the Senegalese side, consensus was arrived at concerning the implementation concept of the survey, and the minutes of meetings were signed between the Study Team and the DPM and CRODT (October 27, 2003).

(2) Staging of a workshop at the start of the survey (November 3, 2003)

A workshop was held at CRODT at the beginning of the survey in order to thoroughly inform local fisheries officials of the concept, etc. of the survey. The workshop was attended by approximately 50 participants comprising government officials from the ministry of fisheries and ministry of agriculture, artisanal fishermen's representatives from FENAFIE-PECHE and so on, industrial fisheries representatives, officials of donor nations and international agencies such as France and the EU, and members of NGOs engaged in resource management.

(3) Guidance in how to prepare age determination samples (otoliths, scales, spines, etc.)

Concerning the five fish species (otolithe, machoiron, sole, sompatt, brotula) targeted for age determination by otolith reading, trial specimens were prepared in sampling on land. Moreover, work was started on preparing a manual on age character analysis.

(4) Guidance in data collection methods at major landing sites

Based on the data collection improvement plan that was prepared in the first field survey, a manual on data collection and utilization techniques was prepared and leader training was implemented with respect to the counterparts and existing data collectors.

(5) Trial navigation of the research vessel

Trial navigation was implemented from November 5~7. As a result, the following points were discovered:

① Malfunctioning of the gyrocompass
② Inappropriate display of the Doppler log
③ Inadequacy of radio equipment on the land side

As for the other engines and equipment, it was confirmed that they could withstand the survey navigation.

(6) Local hearings

The Study Team conducted further detailed hearing surveys with fishermen's organization GIE representatives and village representatives. Regarding villages that have a high awareness of resource management and villages that have already started concrete resource management activities, the Team investigated the basic thinking of the people concerned and the specific contents of activities. When conducting the local hearings, the Team gathered 10 or so local fishermen and held group discussions.

(7) Implementation of the fishing village socio-economic survey (22 target villages)

The objective of the survey was to clarify the socio-economic environment of fishing boat owners, who are directly involved in decision-making regarding resource management. 25 samples were collected from each targeted village, giving a total of 550 samples from the 22 targeted villages. The actual survey work was consigned to the local NGO SENAGROSOL. The questionnaire approach was adopted and the survey targeted fishing boat owners. The survey was implemented from the beginning of November to the beginning of December.

(8) Survey for biomass assessment of shellfish

In those villages that currently gather shellfish, hearing surveys were carried out within the socio-economic survey of fishermen who catch four target species of shellfish.

(9) Survey of business management conditions in industrial fisheries

A questionnaire survey targeting corporate trawlers and sardine purse seiners that are in competition with the artisanal fishermen was implemented. Corporate owners were directly interviewed to hear the problems they face and to gauge business conditions regarding operating costs, returns and number of employees, etc. Also, the Study Team surveyed the framework for the allocation of policy and economic incentives, for example, whether or not there are preferential measures for corporations and the contents of export promotion schemes, etc.

(10) Preparation of the pilot project concept

In order to clarify the concept of the pilot projects, the Study Team held a meeting to exchange opinions with the counterparts and discuss feasibility of the pilot projects.

(11) Establishment of an office and work environment

The Study Team set up an office inside the DPM. Moreover, it established an office and workshop in the CRODT, where it installed otolith cutters and implemented test work. Moreover, the Team prepared an environment to implement fish autopsies and otolith sampling, etc. in the wet laboratory of CRODT.

1.4.4 Third Field Survey (January ~ February 2004)

(1) Preparation of the research vessel navigation plan (6 months)

Based on the survey concept that was prepared in the First Field Survey, the Study Team and counterparts prepared the research vessel navigation plan for the upcoming six months including the term of the Third Field Survey. Within this it was decided to implement the cool season

marine survey for one month from the end of January to the end of February and the warm season marine survey for the same amount of time in June.

(2) Preparation of the research vessel

The research vessel was prepared for the marine survey work. In specific terms, the problem with the gyrocompass that was revealed in the Second Field Survey was repaired, the area around the Doppler log sensor was cleaned, and a new trawl net was set.

(3) Guidance on implementation of Marine Survey I (Cool Season)

The marine survey was implemented from January 23 to February 25 upon dividing the target sea area into the Northern Block, Central Block and Southern Block.

1) Catch survey and sampling guidance

The survey points (80 points) were determined using the stratified random extraction method, and the catch survey was implemented. Biological surveys were implemented with respect to the fish species targeted for stock assessment and other species caught by the trawl method, and also water temperature and salinity, etc. were surveyed. Furthermore, the Study Team provided guidance to the CRODT counterparts regarding methods of sampling, treatment and measurement.

2) Technical guidance in the fishing gear and fishing method fields (OJT)

A. reparation and setting of inner net at cod-end

Fishing gear for the marine survey was prepared in advance, however, the Study Team provided guidance regarding the preparation and setting of the inner net at cod-end of the bottom trawl fishing gear.

B. Net repair technology using drawings

Utilizing opportunities offered by net tears during the marine survey, the Study Team provided guidance on reading net drawings and repairing and maintaining nets according to the said drawings. The Team provided guidance on basic drawing reading by using fishing gear composite drawings and trawl net assembly drawings, etc. according to the technical level of the counterparts.

C. Fishing gear operation

The Study Team prepared vessel speed/water depth/warp length tables and sleeve interval calculation equations, etc. and provided basic explanations on fishing gear operation including how to decipher net recorder images, etc.

D. Preparation of fishing ground maps

Based on depth and position information for logged waters, the Team corrected the depth information on seabed terrain maps that were prepared under technical cooperation from France, and it started work on compiling fishing ground maps.

(4) Establishment of the implementation plan for pilot projects and decision of project sites

Based on the targets and strategy of resource management, the Study Team prepared the implementation plan for the pilot projects upon the discussions with local governments. In selecting project sites, screening criteria for satisfying separate conditions were prepared and sites offering the easiest implementation conditions when viewed objectively were selected.

① Appropriate natural conditions (water source, land, surrounding environment)
② Good social acceptance (participation and cooperation of citizens can be obtained)
③ Proximity to areas of activity by the Fisheries Department and NGOs.
④ No problems in terms of access and civil order
⑤ Potential for dissemination of project achievements to the surrounding area

(5) Building of an implementation setup for pilot projects

In implementing each pilot project, workshops were held for the counterparts who were responsible for disseminating and instructing activities to residents.

(6) Staging of workshops targeting fishermen's organizations

The Study Team held workshops targeting fishermen's organizations affected by the pilot projects.

February 16, 17	Workshop in Nianing
February 18, 19	Workshop in Yenne

(7) Preparation of Progress Report (1)

The findings of the marine surveys and socio-economic surveys and the state of preparation for the pilot projects were compiled into the Progress Report (1).

1.4.5 Fourth Field Survey (June ~ October 2004)

(1) Guidance on implementation of Marine Survey II (Warm Season)

The marine survey was implemented from July 30 to August 26 upon dividing the target sea area into the Northern Block, Central Block and Southern Block.

As in the cool season survey, survey points were determined by the stratified random extraction method, and the catch survey was implemented. The same surveys that were conducted in the cool season were implemented with respect to the fish species targeted for stock assessment and other species caught by the trawl method. Furthermore, the Study Team provided further guidance to the CRODT counterparts regarding the method of sampling, treatment and measurement. Concerning the survey stations, because the coastal artisanal fishermen were more active than in the cool season and nets were lying around all over the place, there were a number of stations where it was difficult to conduct trawl. In such cases, there was no other choice than to alter the survey points to alternative blocks prepared in advance. (Survey was conducted at 82 points).

(2) Technical guidance on mid-water trawl

Practical training on mid-water trawl for pelagic fish was implemented on the research vessel ITAF DEME from 6th to 22nd of September 2004.

(3) Preparation of the progress report

Findings of the marine surveys thus far were compiled into Progress Report (2) and submitted.

(4) Assessment of age composition and body length composition in target species

The age composition of target fish gathered in the marine and land surveys was analyzed. In conducting the analysis, the results of assessment based on otoliths and scales were utilized.

(5) Stock analysis of target fish species

Stock analysis of the target species was started based on the data obtained in the surveys as well as past statistical materials of CRODT. Moreover, work was started on preparation of the FORTRAN Program Manual on fish growth analysis, issue of this to CRODT, transfer of technology regarding age determination and growth analysis based on otoliths and scales, and stock assessment based on COHORT analysis.

(6) Implementation of the pilot projects

1) Activities in Nianing

The following activities were implemented: setting of the closed season for *cymbium spp*, setting and observance of the octopus closed season, quality improvement of catches, and the socioeconomic impact survey, etc.

2) Activities in Yenne

The following activities were implemented: manufacture and installation of artificial fish reefs, socioeconomic survey, etc.

3) Activities in Bargny

The following activities were implemented: discussion of methods for managing and utilizing artificial reef between fishermen, DPM and the Study Team.

(7) Public Relations

1) Press tour and orientation cruise

In order to have as many people as possible understand the contents of the Study, representatives from government agencies, aid agencies and medias were invited to the project sites (Nianing and Yenne) to hear project explanations and observe the project activities on September 23. Moreover, on October 7, project officials and members of the press were invited onboard the research vessel ITAF DEME to witness ocean navigation, trial fishing and biological survey activities and thus get a feel for the current state of fisheries stock. As a result, all the local newspapers in Senegal carried articles introducing the Study activities, and there was even a report on TV.

2) Newsletter

In order to have as many people as possible understand the contents of the Study, a newsletter, “Frontline,” explaining the state of progress of the survey was issued in French and Japanese.

1.4.6 Second Work in Japan (November ~ December 2004)

An Interim Report, containing the results of surveys and analysis conducted since the start of the project, the contents of transfer of technology and a progress report on the project, etc., was prepared.

1.4.7 Fifth Field Survey (January ~ February 2005)

(1) Staging of the Interim Seminar

This seminar, aimed at widely informing related persons of the activities and achievements realized thus far from the start of the project, was held over two days on February 9 and 10 in the conference room of the Hotel Novotel in Dakar. There were approximately 80 participants from the DPM, the Ministry of Maritime Economy, CRODT, the villages earmarked for the pilot projects, and fisheries-related groups, etc.

(2) Discussions regarding the Interim Report

Representatives of the DPM and CRODT and the Study Team held discussions on the Interim Report prepared by the Study Team. The comments heard in these talks will be reflected in the Final Report.

(3) Follow-up of pilot projects

Follow-up was conducted on the activities that started in June 2004. The activities in each project were as follows.

1) Nianing

Discussions were held concerning support for activities in the *cymbium spp*. closed season, whether or not to include the two neighboring villages of Pointe-Sarene and Mballing from the next year, and the contents of activities.

2) Yenne

Discussions were held with a view to conducting biological survey based on underwater survey and establishing the artificial reef management setup.

(4) Preparation of the field survey report (2)

The Field Survey Report (2) giving the interim report of the pilot projects was prepared.

1.4.8 Sixth Field Survey (June ~ August 2005)

(1) Follow-up of pilot projects

1) Nianing, Pointe-Sarene and Mballing

- Discussions were held with residents concerning the restriction in number of gill nets and continuing the octopus closed season. Regarding compensation measures, gasoline

stations were constructed and the equipment and facilities required to conduct joint shipping of catches were supplied and built in the two new villages. As for Nianing, where catches were introduced to processing plants, an attempt was made to diversify incomes through introducing chicken breeding.

- Reef for octopus spawning was made from earthenware pots and installed in the fishing grounds, and it was confirmed that parent octopuses were spawning inside the pots with a high probability.

2) Yenne

- The biomass was surveyed by means of underwater observation. Also, guidance on the survey method was provided to the CRODT diving team.
- Hybrid reefs comprising pots and concrete blocks were made and installed with the aim of encouraging spawning of octopuses.

(2) Collaboration with donors and NGOs

Collaboration was strengthened with the donors and NGOs that share the same objectives and target areas regarding the pilot projects in Nianing, Pointe-Sarene and Mballing. The specific activities and organizations were as follows:

- Joint management of resources by residents and administration: GIRMaC (Project for integrated management of marine and coastal resources)
- Setting of beach seine restrictions and closed area (AMP): OCEANIUM (a local environmental NGO)
- Enlightenment activities for fishermen: FENAGIE-PECHE (Federation of fishermen's and fish processing women's associations)
- Life support for fish processing women: ENDA (social development NGO)

(3) Newsletter

The second edition of the newsletter "Frontline" introducing the project activities was issued.

1.4.9 Seventh Field Survey (October ~ December 2005)

(1) Transfer of technology of stock assessment techniques

Guidance was provided to the CRODT researchers on numerical analysis techniques for Cohort analysis.

(2) Follow-up of pilot projects

The following activities were continued and the final assessment of projects was implemented.

1) Nianing, Pointe-Sarene and Mballing

Activities were continued regarding the survey of reef for octopus spawning, provision of life support and monitoring of the octopus closed season, etc.

2) Yenne

The biomass was surveyed by means of underwater observation. Also, guidance on the survey method was provided to the CRODT diving team.

3) Implementation of a press tour

Following on from the previous year, a press tour was arranged in order to provide information to the donors and NGOs.

1.4.10 Eighth Field Survey (January ~ February 2006)

(1) The draft edition of the resource management plan was discussed with the DPM, and the contents were adjusted for the final edition.

(2) The Study Team directly explained the project activities and resource management measures to the Minister of Maritime Economy.

1.4.11 Nineth Field Survey (May ~ June 2006)

(1) The final seminar was held over 2 days, May 31st and June 1st of 2006 at Hotel Novotel, Dakar. There were approximately 90 participants from the DPM, the Ministry of Maritime Economy, CRODT, the villages earmarked for the pilot projects, and fisheries-related groups, etc.

(2) Representatives of the DPM and CRODT and the Study Team held discussions on the draft version of final report prepared and presented in advance by the Study Team. The comments heard in these talks will be reflected in the Final Report.

CHAPTER 2

MARINE SURVEYS

CHAPTER 2
MARINE SURVEYS

2.1 History of Marine Surveying in Senegal

Surveys to assess stocks of pelagic and demersal fish in Senegal were started from the end of the 1960s under the initiative of the CRODT with cooperation from ORSTOM (the present IRD) using the research vessel LAURENT AMARO. The survey activities were passed on to the research vessel LOUIS SAUGER in 1986, since when surveys have largely been implemented on demersal fish stocks. From 2001, the research vessel ITAF DEME took over the survey activities and has also conducted joint surveying with the Norwegian R/V Dr. Fridtjof Nansen.

2.2 Marine Survey Techniques in the Project

In the past, assessment of demersal fish stocks was based on stock volume estimated according to catch statistics gathered by the Senegal side, however, marine surveys were implemented and estimation of the stock volume was also implemented by the sweep area method (direct method) in order to bolster this approach. The marine surveys were conducted using the fisheries research vessel ITAF DEME and its bottom trawl gear. Surveys targeting coastal demersal fish species at depths of between 10~200 m were carried out two times per year, once in the warm season and once in the cool season.

Since demersal fish stock data obtained by the LOUIS SAUGER in the past couldn't be used to compare catch efficiency with the bottom trawl gear of the ITAF DEME, this old data couldn't be used as comparative data for estimating the demersal fish stock. Moreover, since the sweep area couldn't be confirmed in past demersal fish stock surveys implemented by the ITAF DEME, there was little point in comparing this data with the project data. Accordingly, it was decided to compile the demersal fish stock survey plan for 2004 onwards based on the demersal fish stock assessment technique adopted in the project.

2.2.1 Research vessel Specifications

CRODT operates and manages the fisheries research vessel ITAF DEME. The vessel's specifications are as follows:

Total length:	37.40 m
Total width:	8.10 m
Molded depth:	3.50 m

Figure 2-1 Research Vessel ITAF DEME

Total tonnage:	318 tons	Main engine output:	809 kw
Model type:	Stern trawl	Built:	September 2000

2.2.2 Specifications of Bottom Trawl Gear

In order to abbreviate the procedure of comparing catch efficiency, the Japanese side procured two new sets of the same type of bottom trawl gear as owned by the ITAF DEME. Inner net with a mesh size of 25 mm was attached to two cod ends, and this gear was used to catch all small fish aged between 1~2 years without omission. These fish were then surveyed for body length composition. Fishing gear specifications were as follows:

Gear total length (excluding cod):	31.8 m	Cod end inner net mesh:	25 mm
Ground rope length:	33.9 m		

2.2.3 Composition of Survey Activity Personnel

During the warm season and cool season marine surveys, 26 members comprising 17 crewmembers, seven biological and marine observation survey personnel, and two Japanese surveyors constantly manned the vessel. Table 2-1 shows the list of survey personnel.

2.2.4 Operation Cost

Out of the direct operating costs of marine surveys, the Japanese side and Senegalese side paid 75% and 25% of the fuel, fresh water and food costs respectively.

2.2.5 Setting of the Survey Stations

Since the ichthyofauna changes according to the water depth, the survey depth was divided into three zones, i.e. 10~50 m, 50~100 m and 100~200 m, in consideration of the past surveying experience of CRODT.

In consideration of the migration of demersal fish, the survey area was divided into three blocks, namely the Northern Block comprising the area north of the Kayar Trench and south of the border with Mauritania, the Central Block comprising the area north of the border with the north side of Gambia and south of the Kayar Trench, and the Southern Block comprising the area north of the border with Guinea-Bissau and south of the border with the south side of Gambia.

The survey grids were set as 2 square miles in order to provide as much compatibility as possible with past marine survey data of CRODT (see Figures 2-2-1 and 2-2-2).

More than 80 survey stations were randomly selected according to the water depth and survey grid in consideration of the water depth belts and areas of each grid in the warm season survey and cool season survey respectively. Backup stations were also set just in case there may be some stations where the bottom could not be trawled due to seabed conditions, etc. (see Table 2-2).

2.2.6 Backup System for Survey Cruise

As a safeguard against unforeseen accidents during the survey cruise, and in order to confirm the state of progress of the surveys, the Japanese side installed an SSB radio at CRODT, thereby enabling CRODT Headquarters to stay in contact with the research vessel (see Figure 2-3). Furthermore, the Japanese side prepared an emergency contact list for nighttime use, etc., thereby establishing the backup system on land.

2.2.7 Preparation for the Marine Surveys

(1) Research vessel, fishing gear and marine observation instruments

In preparation for the cool season marine surveys, the Japanese side supplied spare parts for the fuel pump and conducted an overhaul of the research vessel's engine.

Prior to the cool season marine surveys, test cruise was carried out for three days in November 2003 in order to check the operating state of navigation instruments and adjust the fishing gear, etc. As a result, a defect was found in the gyrocompass and the Japanese side paid for its repair.

The CRODT side cleaned the ship's bottom as well as the receiving and transmitting parts of instruments attached to the bottom. The crewmembers connected and adjusted the two sets of bottom trawl gear and made spare hand nets, etc., however, because the fishing gear drawings possessed by the Senegal side used the Japanese cut line method of display[1], the drawings were redrafted according to the Senegalese method of cut line display so that they could be used for implementing fishing gear repairs (see Figure 2-4 Fishing Gear Drawings).

[1] Triangular nets are made by cutting the mesh. In Japan, the ratio of vertical cuts to horizontal cuts is displayed, however, in Senegal, the number of node cuts (2-leg cuts) and leg cuts (1-leg cuts) are displayed.

(2) Biological research instruments

The Japanese side newly provided weighing scales, body length measuring boards, fish boxes, scale sampling bags and otolith sampling bags, introduced body length punch cards, and simplified the body length measurement and recording work in order to reduce the incidence of body length reading and entering mistakes.

(3) Marine biological survey

Work onboard the vessel during the marine biological surveys comprised the following activities:

① Measurement and recording of all caught fish by species;

② Concerning the seven species subject to Beverton-Holt type analysis, measurement and recording of body length by species and by sex to know the body length composition at each station using the punch card method; and

③ Concerning the same seven species, extraction of individual fish equally distributed from small to large sizes, measurement of body length and wet weight, sampling of scales and otoliths, confirmation of sex, and observation and recording of the state of maturation of sexual glands according to each species.

2.3 Cool Season and Warm Season Marine Surveys

2.3.1 Outline of Marine Survey in the Cool Season

Marine survey in the cool season was implemented at 82 stations from January 23 to February 25, 2004 (see Figures 2-5-1 and 2-5-2). Surveying was conducted from sunrise to sunset. At nighttime, the research vessel was anchored close to the coast to ensure the safety of personnel onboard.

In order to prevent fishing gear accidents as much as possible, the nature of sea bottom, etc. at each station was surveyed by echo sounder and possible trawl courses were selected before casting the nets. In cases where trawl was deemed to be impossible, the survey point was switched to the backup stations.

In the marine surveys, bottom trawl net was dragged for 30 minutes over a grid of 2 square-miles at each survey station and the fish caught in the net during this time were surveyed. Next, the target fish species were sorted; the number and wet weight of fish by species were measured; the body length and body weight of target fish were measured; sex and maturation were visually observed; and otoliths and scales were sampled. Moreover, during the biological surveys, the ship was temporarily stopped and

STD was used in order to measure the water temperature and salinity (see Table 2-3). Temperature of water at the net depth in bottom trawl is essential data for stock assessment.

Because the STD marine observation device owned by CRODT can only output measurements by printout, there is a risk of mistakes being made when reading or transcribing measurements. However, since the CTD that was provided with this research vessel would enable measurements to be directly incorporated and processed on computer and thereby allow graph analysis to be performed (the software was supplied already installed on portable personal computer), the Japanese Study Team strongly requested that the CTD be used. However, since the CRODT had no experience of using the CTD and it would have been necessary to consign the manufacturer to do its calibration, it was decided not to use it.

2.3.2 Marine Biological Survey in the Cool Season

Figure 2-6 shows total catches at each station in the surveyed area. The total catch in the Northern Block (22 points, total sweep area 1.15 km^2) was 6,769 kg, that in the Central Block (28 points, total sweep area 1.37 km^2) was 6,599 kg, and that in the Southern Block (32 points, total sweep area 1.68 km2) was 5,934 kg (see Figure 2-7).

The average catch ± standard error was 307.66 ± 48.14 kg in the Northern Block (average sweep area 0.052 km^2), 235.68 kg ± 81.46 kg in the Central Block (average sweep area 0.049 km^2), and 185.45 ± 29.62 kg in the Southern Block (average sweep area 0.052 km^2). Accordingly, the average catch ± standard error was found to be highest in the Northern Block and lowest in the Southern Block (see Figure 2-8).

The main species and quantities of fish caught in each sea area are as follows.

Table 2-4 Main Species and Quantities of Fish Caught in the Cool Season Marine Survey

Sea Area	Main Species of Caught Fish		
	Name of Species	Catch Size (kg)	Figure No.
Northern Block	Brachydeuterus auritus	1,841	2-9,a
	Trachurus trecae	1,225	2-9,b
	Dentex angolensis	346	2-9,c
Central Block	Acanthurus monroviae	735	2-9,d
	Alectis alexandrinus	712	2-9,e
	Alloteuthis Africana	386	2-9,f
Southern Block	Acanthurus monroviae	1,167	
	Alectis alexandrinus	1,119	
	Alloteuthis Africana	449	

The following table shows the total quantities of fish caught in each block during the cool season survey.

Table 2-5 Total Catches of Target Species by Block in the Cool Season Survey

Fish Name Figure No.	Sea Area	Catch (kg)	Remarks	Fish Name Figure No.	Sea Area	Catch (kg)	Remarks
Arius heudeloti (2-9, g)	Northern	3.9		Sparus caeruleostictus (2-10, e)	Northern	2.1	Specifically common in the Central Block
	Central	0			Central	129.4	
	Southern	0			Southern	46.9	
Cynoglossus senegalensis (2-9, h)	Northern	1.4	Generally scarce	Cymbium spp. (2-10, f)	Northern	72.8	
	Central	3.0			Central	3.5	
	Southern	5.0			Southern	52.9	
Epinephelus aeneus (2-10,a)	Northern	0.4	Specifically common in the Southern Block	Murex spp. (2-10, g)	Northern	0.6	
	Central	5.5			Central	67.0	
	Southern	37.1			Southern	0	
Galeoides decadactylus (2-10, b)	Northern	42.4	The largest catches of all targeted species	Octopus vulgaris (2-10, h)	Northern	43.1	
	Central	90.6			Central	87.4	
	Southern	78.8			Southern	94.9	
Pomadasys incisus (2-10, c)	Northern	0	Specifically common in the Southern Block	Penaeus notialis (2-11, a)	Northern	28.3	
	Central	17.5			Central	2.7	
	Southern	243.6			Southern	2.9	
Pseudotolithus senegalensis (2-10, d)	Northern	116.6	Specifically common in the Northern Block				
	Central	2.2					
	Southern	9.9					

2.3.3 Outline of Marine Survey in the Warm Season

The marine survey in the warm season was implemented at 82 stations from July 29 to August 27, 2004 (see Figures 2-19-1 and 2-19-2). In the warm season survey, it was scheduled to survey the same blocks and points as in the cool season survey, however, because artisinal fishermen were more active and set more fixed gill nets close to the coast during the warm season, there were some areas where trawl wasn't possible. In such cases, the survey work was switched to predetermined survey points in alternative grid.

Compared to the cool season survey navigation, air temperatures were higher and it was necessary to pay more attention to the health management of onboard personnel during the warm season survey. Accordingly, it was decided to survey around four stations per day to ensure that the crewmembers got enough rest. The fact that the seabed sediment, etc. around the survey blocks was thoroughly investigated during the cool season survey meant that the data obtained at this time could be utilized here, thereby allowing similar exploration time to be shortened and the daily number of survey stations to be reduced.

2.3.4 Marine Biological Survey in the Warm Season

Figure 2-20 shows total catches at each station in the surveyed area. The total catch in the Northern Block (22 points, total sweep area 1.05 km^2) was 2,817 kg, that in the Central Block (28 points, total sweep area 1.26 km^2) was 6,588 kg, and that in the Southern Block (32 points, total sweep area 1.46 km^2) was 2,663 kg (see Figure 2-7).

The average catch ± standard error was 128.02 ± 14.14 kg in the Northern Block (average sweep area 0.046 km^2), 235.28 kg ± 78.50 kg in the Central Block (average sweep area 0.045 km^2), and 83.21 ± 19.75 kg in the Southern Block (average sweep area 0.046 km^2). Accordingly, the average catch ± standard error was found to be highest in the Central Block and lowest in the Southern Block (see Figure 2-8).

The main species and quantities of fish caught in each sea area are as follows.

Table 2-7 Main Species Caught and Size of Catches in the Warm Season Marine Survey

Sea Area	Main Species of Caught Fish		
	Name of Species		Name of Species
Northern Block	Trachurus trecae Brachydeuterus auritus Chelidonichthys gabonensis	690 316 101	2-11,b
Central Block	Trachurus trecae Scomber japonicus Pagellus bellottii	2,067 490 486	2-11,c 2-11,d
Southern Block	Brachydeuterus auritus Chloroscombrus chrysurus Pomadasys incisus	438 301 150	2-11,e

In the Northern Block, as in the cool season survey, Brachydeuterus auritus and Trachurus trecae were caught in large quantities; however, in the Central Block and Southern Block, catches of Acanthurus monroviae and Alectis alexandrinus were lower than in the cool season. In the Central Block, Trachurus trecae was the most common catch, whereas in the Southern Block, Brachydeuterus auritus was the most common.

The main species and quantities of fish caught in each sea area are as follows.

Table 2-8 Total Catches of Target Species by Block in the Warm Season Survey

Fish Name Figure No.	Sea Area	Catch (kg)	Remarks	Fish Name Figure No.	Sea Area	Catch (kg)	Remarks
Arius heudeloti (2-9, g)	Northern	0.2		Sparus caeruleostictus (2-10, e)	Northern	0.3	Specifically common in the Central Block
	Central	0			Central	26.7	
	Southern	12.4			Southern	32.9	
Cynoglossus senegalensis (2-9, h)	Northern	0	Generally scarce	Cymbium spp. (2-10, f)	Northern	11.3	
	Central	0.8			Central	95.3	
	Southern	7.1			Southern	95.2	
Epinephelus aeneus (2-10,a)	Northern	3.0		Murex spp. (2-10, g)	Northern	0	
	Central	6.5			Central	21.6	
	Southern	8.6			Southern	0	
Galeoides decadactylus (2-10, b)	Northern	19.0	Compared to the cold season, more than 2 times greater in the Southern Block	Octopus vulgaris (2-10, h)	Northern	52.7	
	Central	3.8			Central	70.8	
	Southern	177.3			Southern	23.4	
Pomadasys incisus (2-10, c)	Northern	0.5	Common in the Central Block and Southern Block	Penaeus notialis (2-11, a)	Northern	3.6	
	Central	184.4			Central	0.6	
	Southern	150.0			Southern	1.5	
Pseudotolithus senegalensis (2-10, d)	Northern	0	Contrasting results to the cool season survey				
	Central	0.7					
	Southern	0.2					

2.3.5 Ocean Environmental Survey

Figures 2-28~2-31 show the results of measuring water temperature and salinity on the seabed at each survey point in the cool season and warm season marine surveys.

The following table shows the bottom layer water temperature (Figure 2-28) in the areas measured during the cool season survey.

Table 2-9 Bottom Layer Water Temperature by Block and Water Depth in the Cool Season Survey

Sea Area	Water Depth Belt		
	0-50m	50-100m	100-200m
Northern	15-16˚C	14-15˚C	13-15˚C
Central	16-20˚C	15-18˚C	14-16˚C
Southern	17-23˚C	15-17˚C	15-17˚C

In all the survey areas, water temperature gradually declined as the depth increased. Moreover, water temperature at each depth increased moving from north to south.

The following table shows the bottom layer water temperature (Figure 2-29) in the areas measured during the warm season survey.

Table 2-10 Bottom Layer Water Temperature by Block and Water Depth in the Warm Season Survey

Sea Area	Water Depth Belt		
	0-50m	50-100m	100-200m
Northern	18-23˚C	14-17˚C	13-16˚C
Central	20-30˚C	15-21˚C	14-15˚C
Southern	18-29˚C	16-21˚C	15-16˚C

As in the cool season survey, water temperature gradually declined as the depth increased. Moreover, water temperature at each depth increased moving from north to south.

The following table shows the bottom layer salinity (Figure 2-30) in the areas measured during the cool season survey.

Table 2-11 Bottom Layer Salinity by Block and Water Depth in the Cool Season Survey

Sea Area	Water Depth Belt		
	0-50m	50-100m	100-200m
Northern	35.5-36.0‰	35.0-36.0‰	33.0-36.0‰
Central	35.5-36.0‰	35.0-36.0‰	35.0-36.0‰
Southern	34.5-36.0‰	35.5-36.0‰	35.5-36.0‰

A sudden drop in salinity was recorded at the N-20 point at depth of 100-200m in the North Bock. The reason for this is unclear, but it is thought the measuring equipment temporarily malfunctioned.

The following table shows the bottom layer salinity (Figure 2-31) in the areas measured during the warm season survey.

Table 2-12 Bottom Layer Salinity by Block and Water Depth in the Warm Season Survey

Sea Area	Water Depth Belt		
	0-50m	50-100m	100-200m
Northern	35.0-36.0‰	35.0-36.0‰	35.0-36.0‰
Central	35.5-36.5‰	35.0-36.0‰	35.0-36.0‰
Southern	34.5-36.0‰	35.5-36.0‰	35.0-36.0‰

In both the cool season and the warm season surveys, in the Northern and Central Blocks, slighter higher salinity was recorded in coastal waters at depth of 0-50m than in offshore waters. As for the

Southern Block, salinity was lower in the coastal shallows, but increased going out to sea. It is surmised that these differences in salinity between different depths arise according to volumes of inflowing water from nearby land.

2.4 Estimation of Demersal Fish Stock according to the Sweep Area Method

The seabed area swept by bottom trawl gear is calculated by multiplying the distance moved by fishing gear by the distance between wing tips of the fishing gear (see Figures 2-32 and 2-33). The distance moved by fishing gear is obtained by GPS on the position of starting point and finishing point of trawl operation and calculating the distance between the two. Meanwhile, the distance between wing tips is calculated from the angle of spread of the warp rope in the horizontal direction.

The stock volume (biomass) at the respective depths range of 10~50m, 50~100m and 100~200m in each surveyed block was estimated by the sweep area method (catch/catch efficiency x surveyed sea area/sweep area in each block) (see Table 2-13). Incidentally, for the catch efficiency envisaging escape of fish from the net, 0.5 was adopted since this has been commonly used in other surveys.

Data concerning catch size and estimated demersal fish stock volume, etc. are shown at the end of the chapter, while estimated stock volumes (mean value ± standard error) per square kilometer at each depth of 0-50m, 50-100m and 100-200m are shown in Figure 2-34.

In the Northern Block during the cool season survey, the stock volume at 0-50m was large at an estimated 22,800±5,257 kg/km2, whereas that at 50-100m and 100-200m was less than half of this at 7,939±1,473kg/km^2 and 8,974±2,790kg/km^2 respectively. In the Central Block, the stock volume was similar in the 0-50m and 100-200m depth zones at 12,857±2,008kg/km^2 and 13,665±5,256kg/km^2 respectively, however, it was only around half of this in the 50-100m depth zone at 6,585±1,399kg/km^2. In the Southern Block, stock volume was highest in the 100-200m depth zone at an estimated 17,743±10,133kg/km^2, but it was only around half of this in the 50-100m and 100-200m depth zones at 7,235±1,190kg/km^2 and 5,491±1,449kg/km^2 respectively.

In the Northern Block during the warm season survey, estimated stock at 0-50m was 7,221±1,425kg/km^2, roughly half that estimated in the cool season survey. Estimated stock volumes in the 50-100m and 100-200m depth zones were also less than in the cool season at 5,533±864kg/km^2 and 4,146±1,049kg/km^2 respectively. In the Central Block, stock in the 100-200m depth zone was large at 16,058±12,121kg/km^2, however, this was due to the fact that the fish catch of 2,176kg at C-001 was unusually higher than at the other survey points (roughly 200kg). If the catch from C-001 is excluded, the stock volume works out as 4,020kg/km2, which in fact is lower than at 0-50m (9152±3,359kg/km^2) and 50-100m (8,452±2,554kg/km^2). In the Southern Block, whereas the stock volume

at 50-100m and 100-200m was low at 2,931±1,158kg/km^2 and 2,760±547kg/km^2, it more than doubled in the 0-50m depth zone at 4,974±1,626kg/km^2.

Comparing estimated stock by water depth zone in the Northern, Central and Southern Blocks, it tended to decrease at 0-50m and 50-100m heading southwards in the cool season, whereas at 100-200m it increased heading southwards. In the warm season survey, estimated stock at all water depths was highest in the Central Block.

Concerning the reasons for the said variations in estimated stock volume at each depth and block, it will be necessary to examine the relationships between stock disparities for each fish species and changes in water temperature in future. In any case, by continuing this type of stock estimation every year from now on, it should be possible to gauge variations in stock in the coastal waters off Senegal.

2.5 Unexploited Useful Stock

One species of fish that was caught in relatively large quantities during the cool season and warm season marine surveys but is hardly used for eating at all is the Brachydeuterus auritus (see Figure 2-9, a). The following examination was conducted regarding the feasibility of making effective use of this fish in Senegal.

(1) Utilization as bait

It is thought that this species is only caught in the bottom trawl nets of corporate trawlers, however, since the idea that “fisheries refers to the capture of fish for eating purposes” is extremely strong in Senegal, it will be very difficult to change this perception without adopting some kind of coercive policy. Industrial fishing boats would need to sell these fish as boat-frozen products to bait plants on land, however, it would be difficult to secure a sale price that would cover the cost of freezing onboard.

(2) Utilization as food

Senegal has hardly any food processing sector like in Asia, where fish can be utilized as preserved food in a variety of forms. Accordingly, all fisheries products are consumed either as fresh fish or as smoked fish. Moreover, since the fish caught bv industrial fishing boats are basically exported, they hardly ever reach general households. Sometimes products that are not in demand in the export market and are not of sufficient quality for export find their way onto the domestic market, however, consumers are conservative in their tastes. Therefore, it is difficult to imagine that this species will be immediately accepted as a fresh fish for eating by general consumers in the country.

In recent years Senegal has developed technologies for preserving fruits that cannot be consumed at once, whereas processing in the fisheries sector is limited to canning and smoking fish and shellfish as soup stock. Concerning the big eye grant, which is caught in relatively large quantities, a processing method that creates a flavor suited to Senegalese tastes and entails low cost equipment investment would need to be developed. For the time being, it is deemed appropriate to work on this as an experimental project.

Since Europe mainly imports high-grade fresh fish, there is little chance of exporting this species as a fresh or even frozen product. As for exporting to other African nations, due to the lack of data on fresh fish and processing consumption as well as the need for refrigeration facilities and infrastructure, this would also be difficult at the present time.

In consideration of the above, nothing can be said regarding the effective use of currently unexploited resources. It is hoped that the Senegalese side continues to conduct independent investigations and examinations into the issue in future.

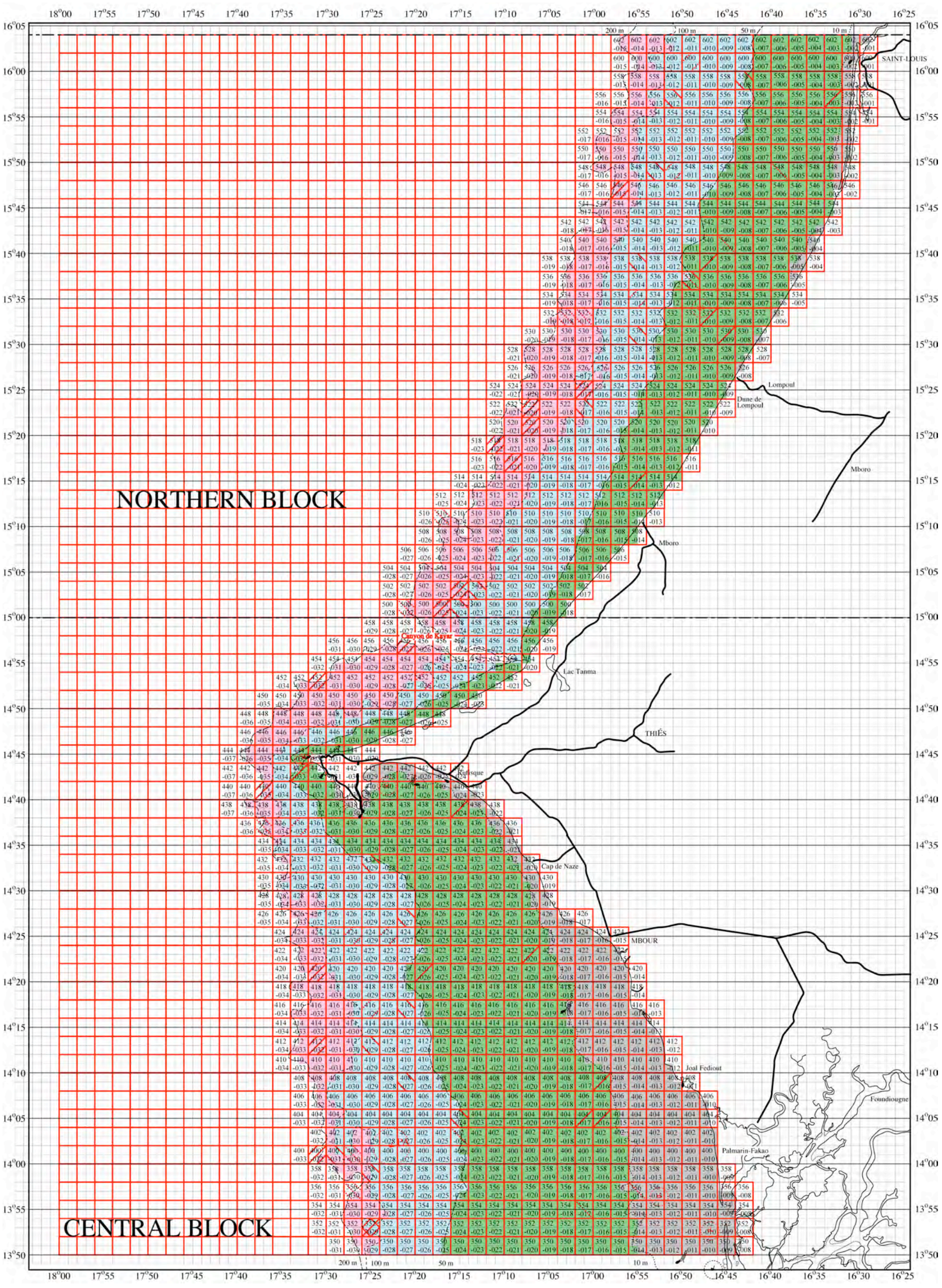


Figure 2-2-1 Marine Survey Blocks (Northern Block and Part of the Central Block)

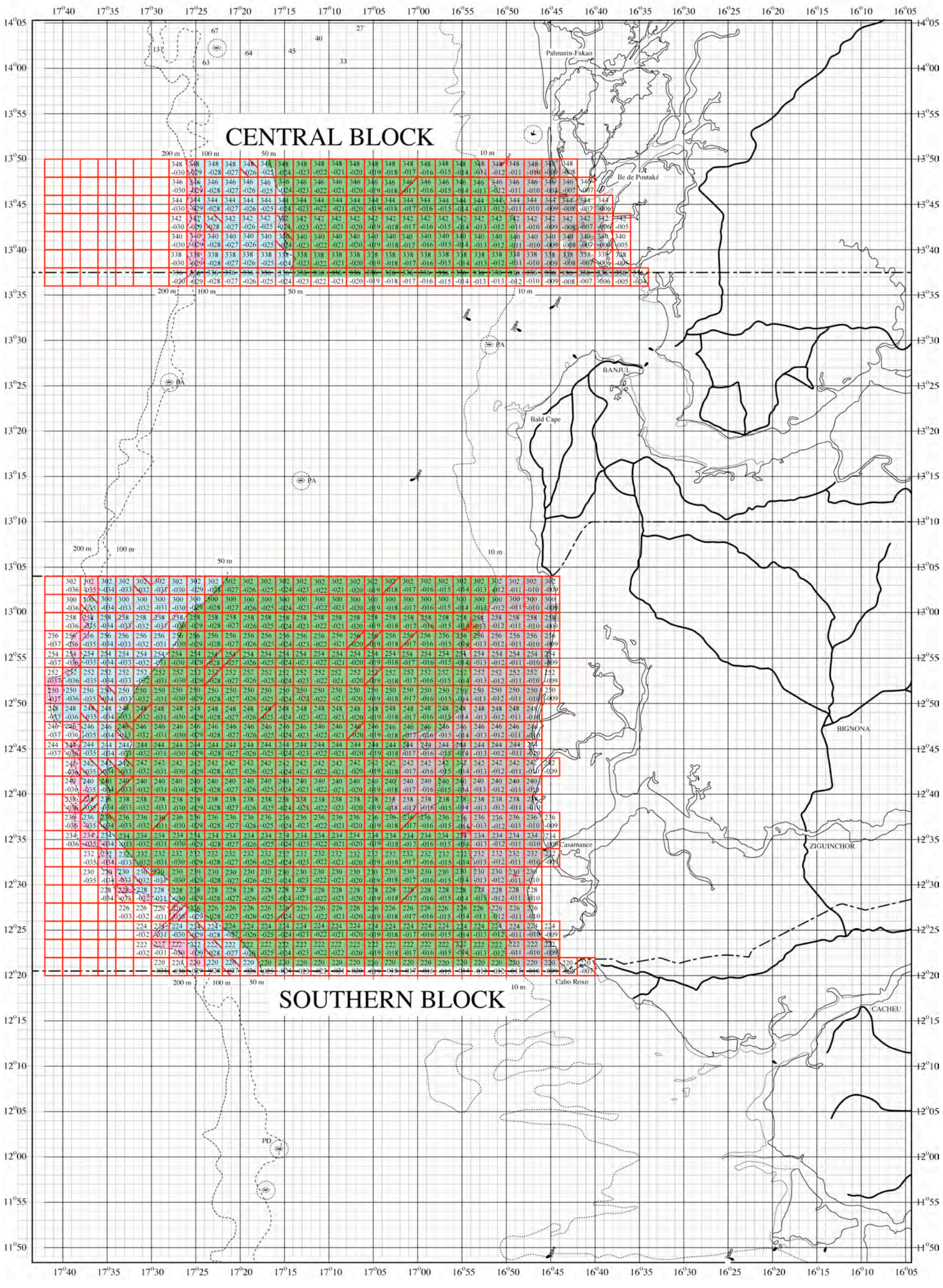
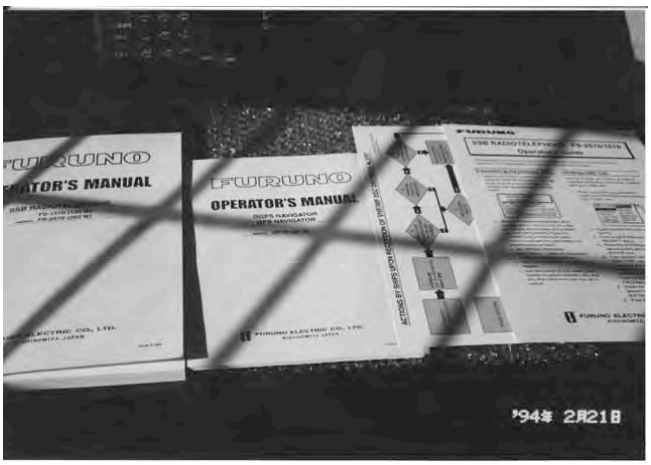


Figure 2-2-2 Marine Survey Blocks (Southern Block and Part of the Central Block)

RADIO BLU (SSB) INSTALLE AU CRODT

Radio BLU (SSB)

Antenne de la Radio



Manuels de la Radio BLU

Figure 2-3 SSB Radio Photographs

Chalut de fond

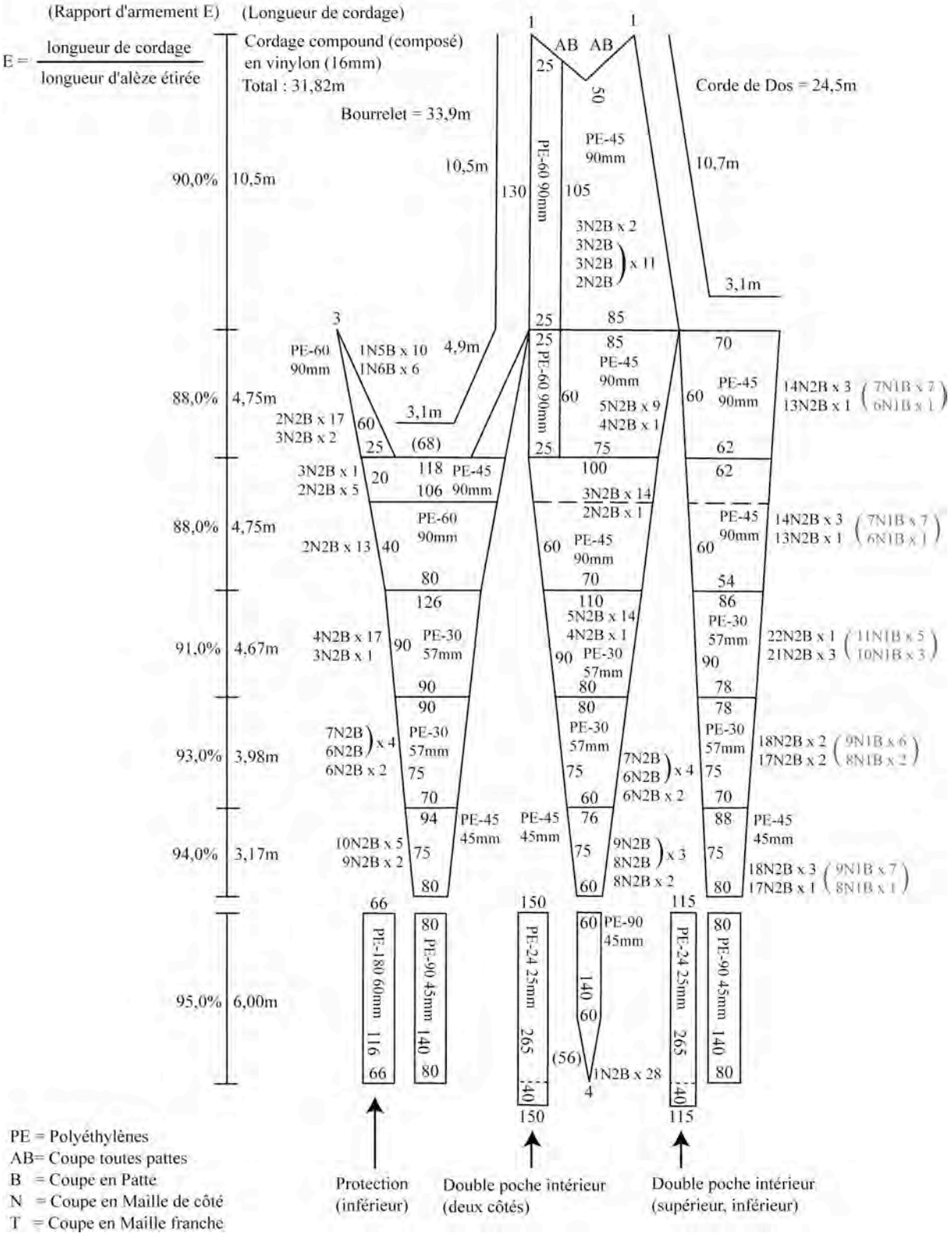
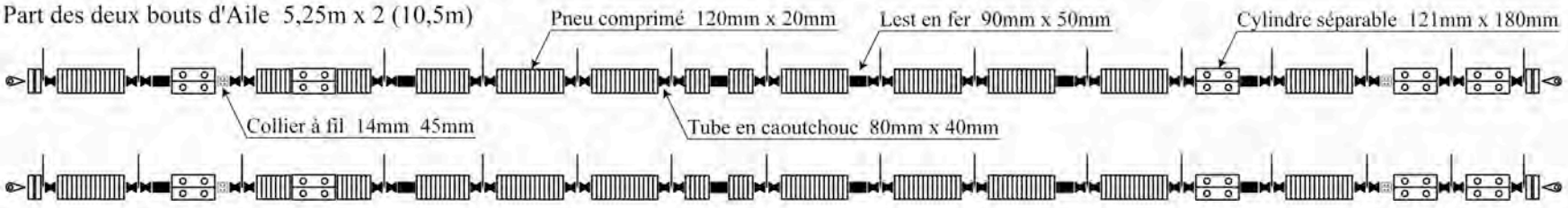


Figure 2-4 Fishing Gear Drawings (1)

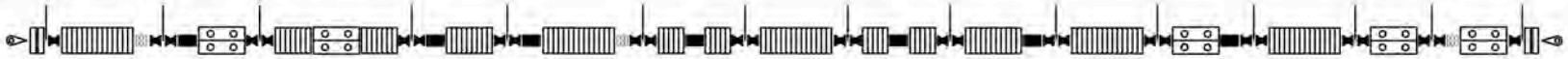
Bourrelet et Corde de Dos pour Chalut de fond

Construction de Bourrelet type A (pour fond plat)

Part des deux bouts d'Aile 5,25m x 2 (10,5m)



Part au millieu d'Aile 4,9m

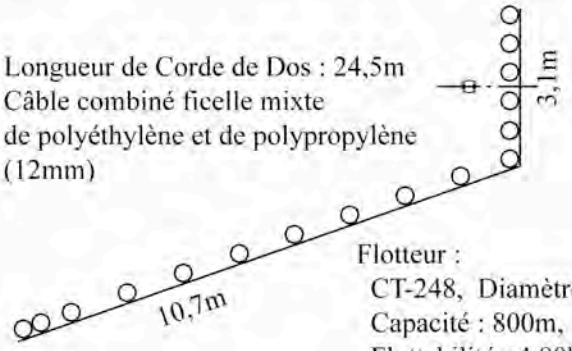


Part centrale 3,1m

Fil de fer 14mm, Corde croisee 18mm Matériaux Description	Part des deux bouts d'Aile 10,5m (x 2)	Part au millieu d'Aile 4,9m (x 2)	Part centrale 3,1m	Total 33.9m
Cylindre séparable 121mm x 180mm	10 pcs. x 2	5pcs. x 2	4pcs.	34pcs.
Pneu comprimé 120mm x 20mm	302pcs. x 2	128pcs. x 2	64pcs.	924pcs.
Tube en caoutchouc 80mm x 40mm	60pcs. x 2	28pcs. x 2	16pcs.	192pcs.
Collier à fil 14mm 45mm	4pcs. x 2	3pcs. x 2	4pcs.	18pcs.
Chaîne à suspension N-9	32pcs. x 2	15pcs. x 2	10pcs.	104pcs.
Lest en fer 90mm x 50mm	12pcs. x 2	7pcs. x 2	5pcs.	43pcs.
Poids en l'air / Poids en la mer	117,1kg x 2 / 50,1kg x 2	57,2kg x 2 / 26,4kg x 2	38,1kg / 19,2kg	386,7kg / 172,2kg

Construction de Corde de Dos type A (pour fond plat)

Longueur de Corde de Dos : 24,5m
Câble combiné ficelle mixte
de polyéthylène et de polypropylène
(12mm)



Flotteur :
CT-248, Diamètre : 240mm
Capacité : 800m, Quantité : 26pcs.
Flottabilité : 4,80kg/pc, total : 124,8kg
Poids en l'air : 2,10kg/pc, total : 48,3kg

Figure 2-4 Fishing Gear Drawings (2)

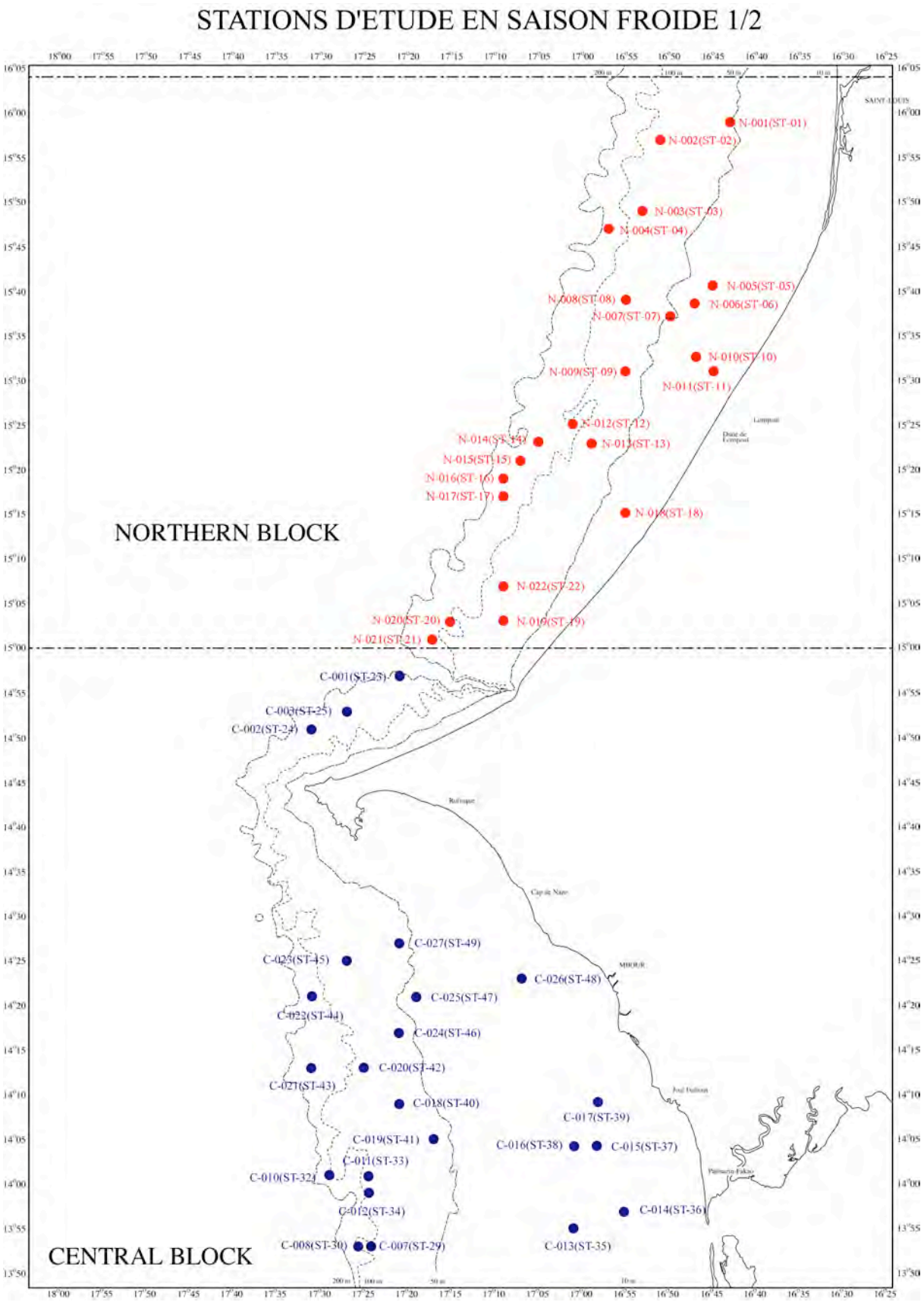


Figure 2-5-1 Cool Season Survey Stations (Northern Block and Part of the Central Block)

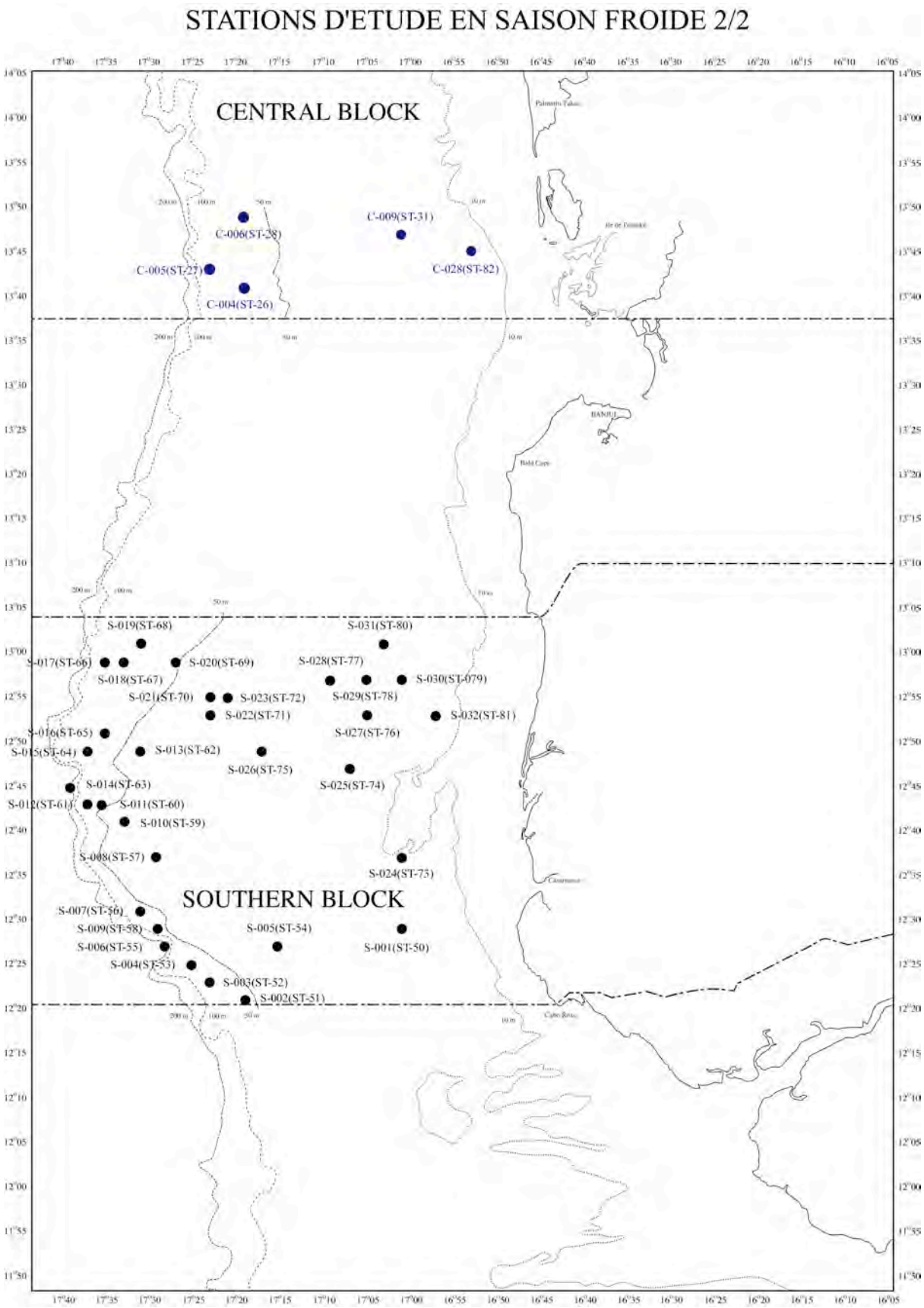


Figure 2-5-2 Cool Season Survey Stations (Southern Block and Part of the Central Block)

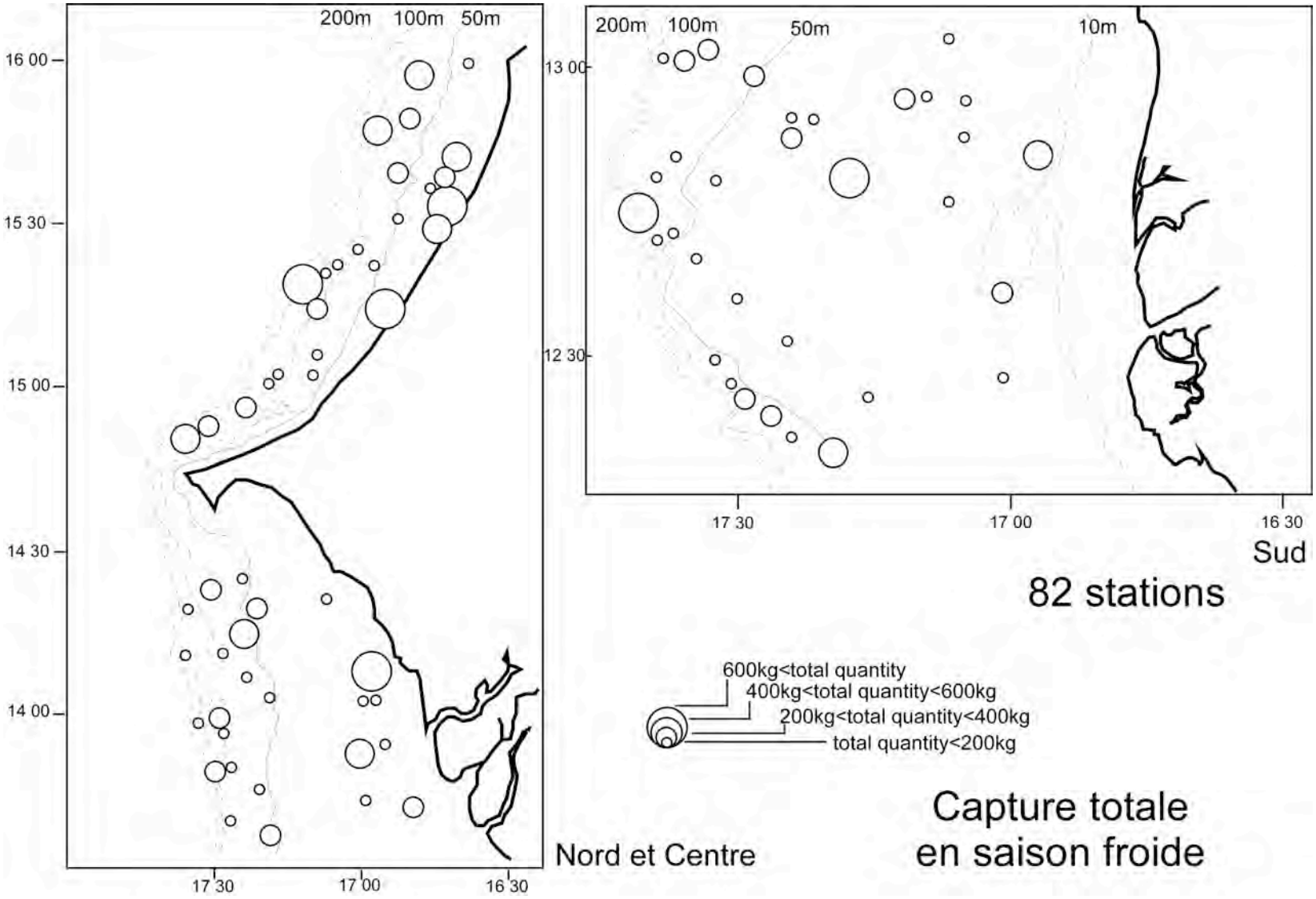


Figure 2-6 Total Catches at Each Station in the Cool Season Survey

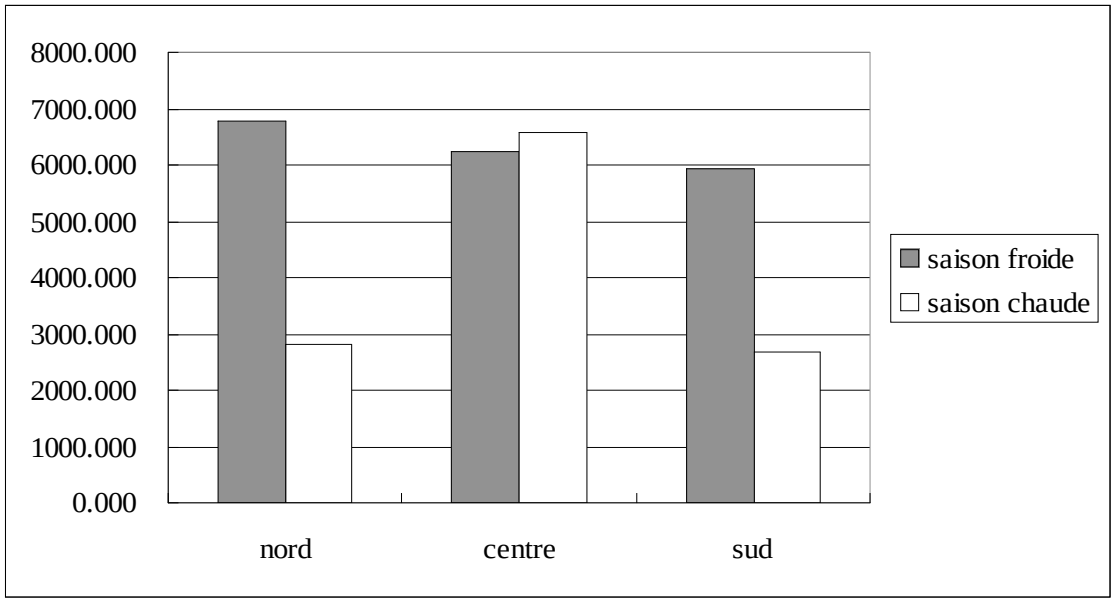


Figure 2-7 Total Catches in each Block in the Cool Season and Warm Season Surveys (unit: kg)

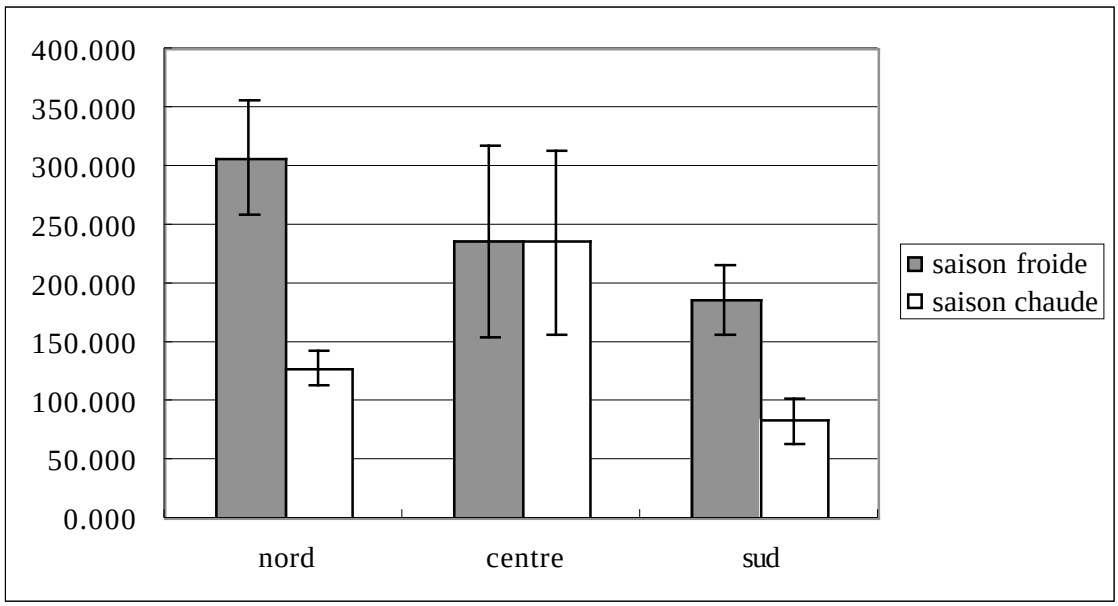


Figure 2-8 Average Catch ± Standard Error in Each Block in the Cool Season and Warm Season Surveys (unit: kg)

Figure 2-9, a Big eye grant, *Brachydeuterus auritus*

Figure 2-9, b Jack mackerel, *Trachurus trecae*

Figure 2-9, c Yellow sea bream, *Dentex angolensis*

Figure 2-9, d Surgeonfish, Acanthurus monroviae

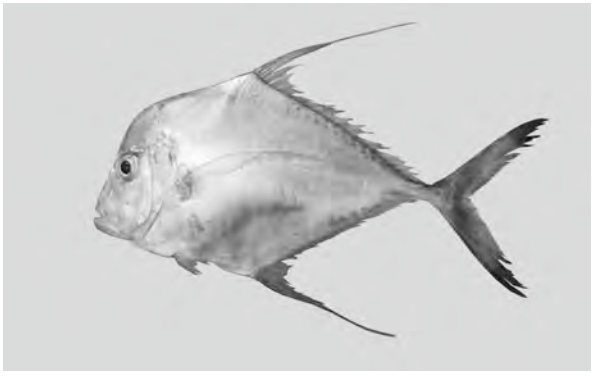


Figure 2-9, e Threadfish, *Alectis alexandrinus*

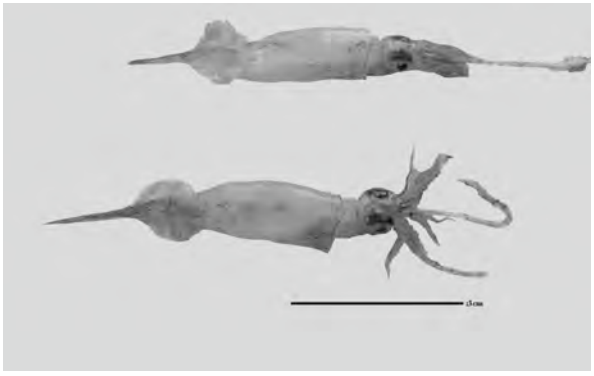


Figure 2-9, f Squid, *Alloteuthis africana*

Figure 2-9, g Machoiron, *Arius heudelotii*

Figure 2-9, h Sole, *Cynoclossus senegalensis*

Figure 2-9 Major Caught Fish Species 1

Figure 2-10, a Seven band grouper, *Epinephelus aeneus*

Figure 2-10, b Thiekem, *Galeoides decadactylus*

Figure 2-10, c Pigfish, *Pomadasys jubelini*

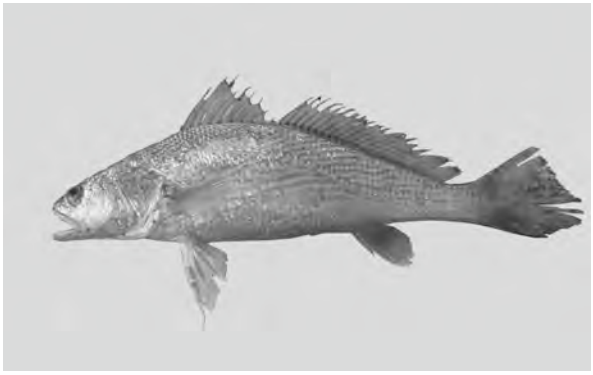


Figure 2-10, d Otolithe, *Pseudotolithus senegalensis*

Figure 2-10, e Pagre, *Sparus caeruleostictus*

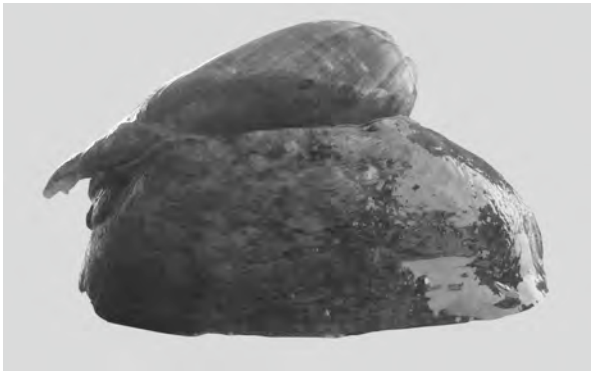


Figure 2-10, f Cymbium, *Cymbium* spp.

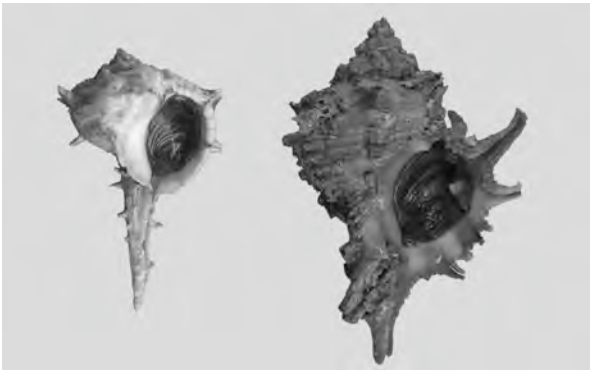


Figure 2-10, g Murex, *Murex* spp.

Figure 2-10, h Octopus, Octopus vulgaris

Figure 2-10 Major Caught Fish Species 2

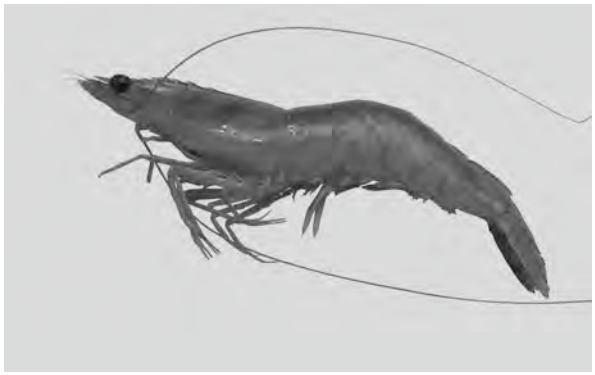


Figure 2-11, a Scampi, *Penaeus notialis*

Figure 2-11, b Kanagashira, *Chelidonichthys gabonensis*

Figure 2-11, c Common mackerel, *Scomber japonicus*

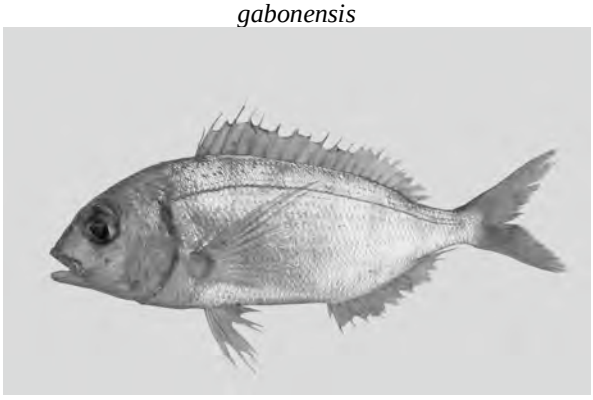


Figure 2-11, d Sea bream, *Pagellus bellottii*

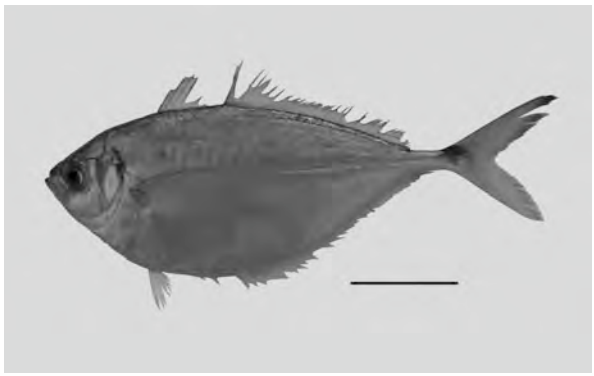


Figure 2-11, e Atlantic bumper, *Chloroscombrus chrysurus*

Figure 2-11 Major Caught Fish Species 3

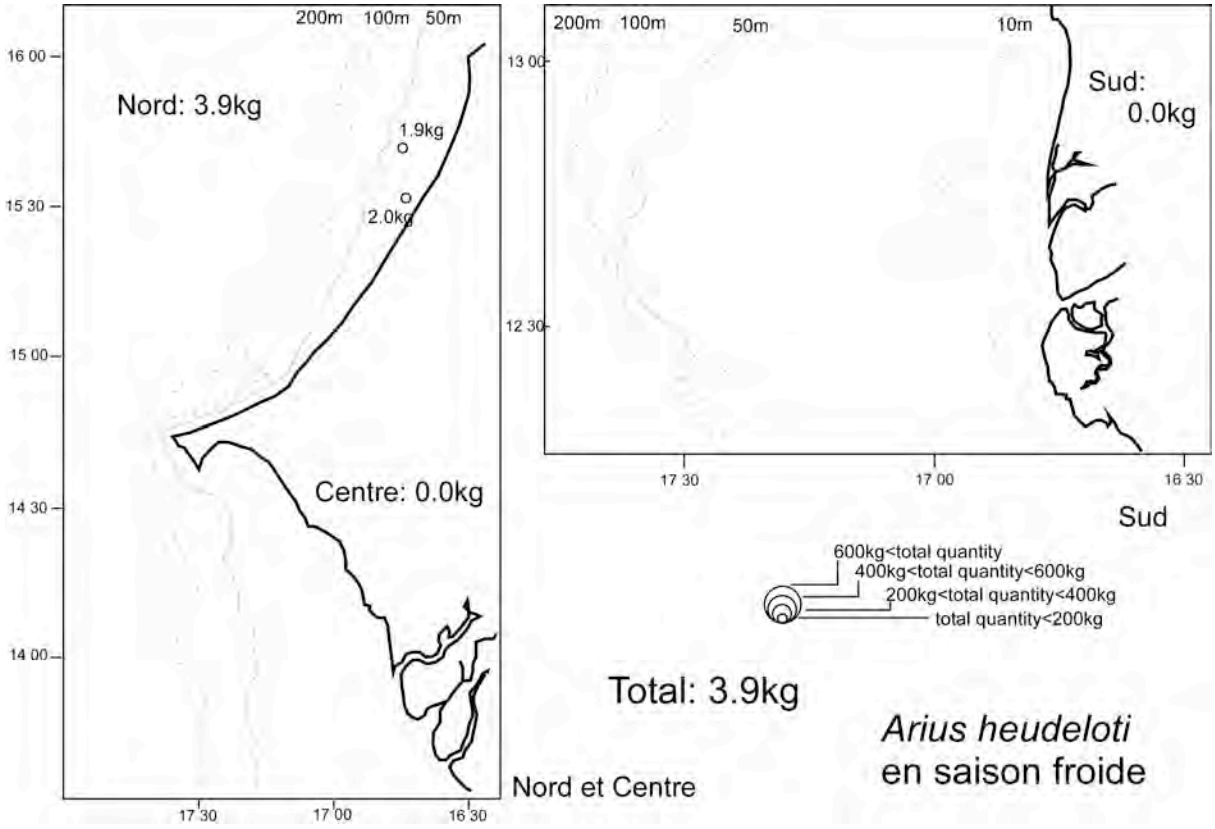


Figure2-12 Distribution of Machoiron Catches in the Cool Season Survey

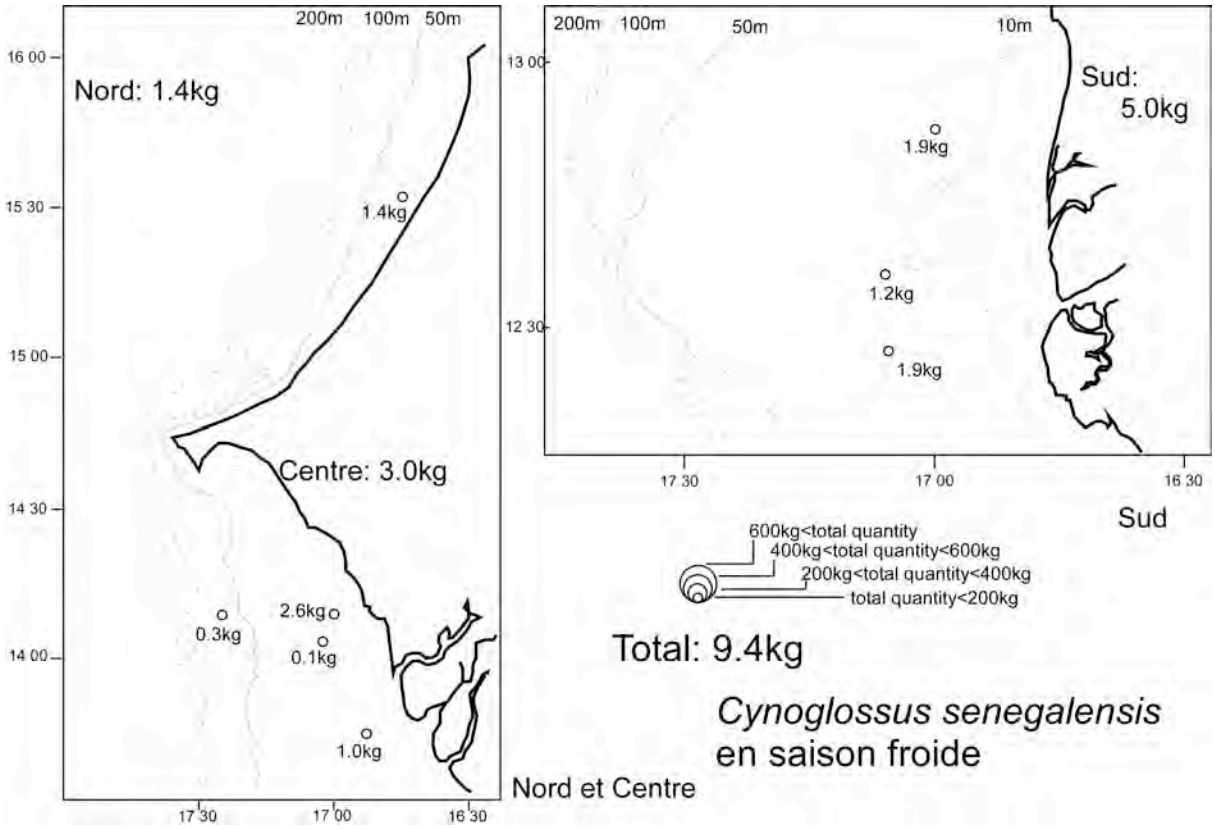


Figure 2-13 Distribution of Sole Catches in the Cool Season Survey

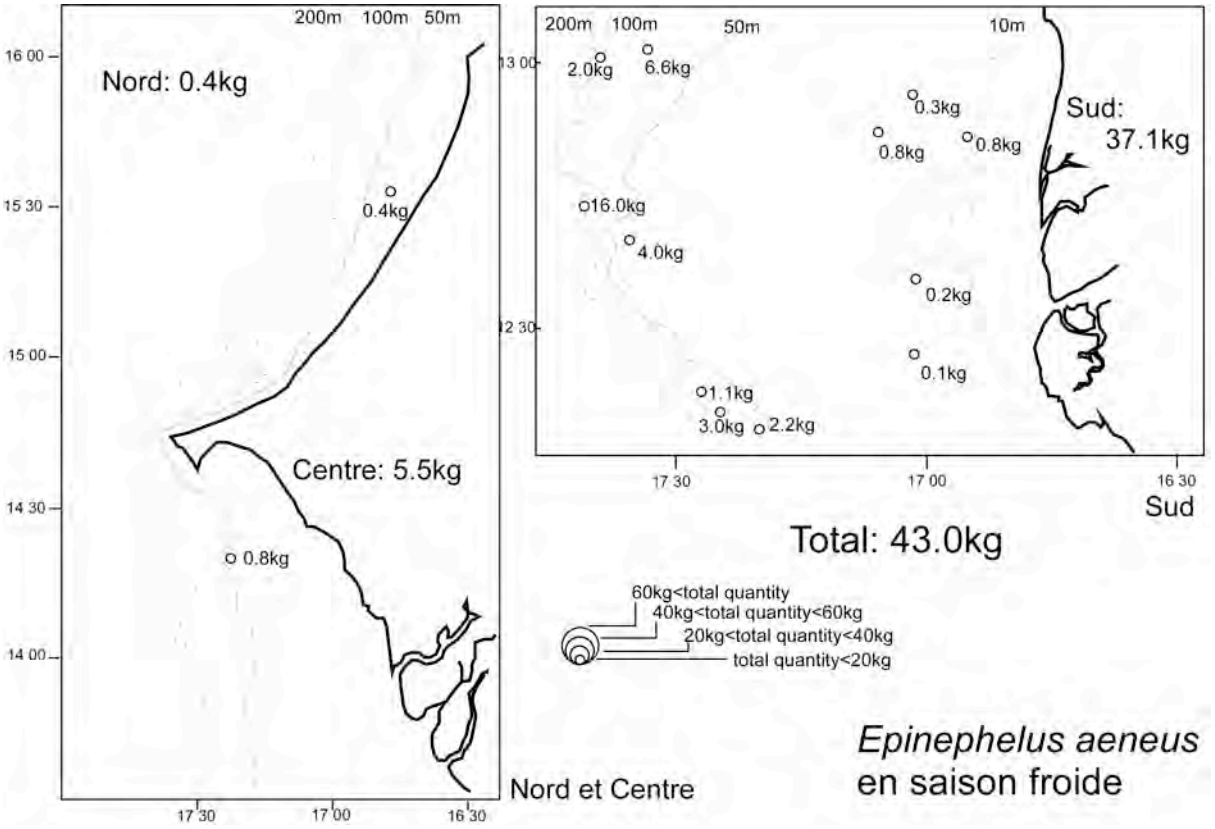


Figure 2-14 Distribution of Thiof Catches in the Cool Season Survey

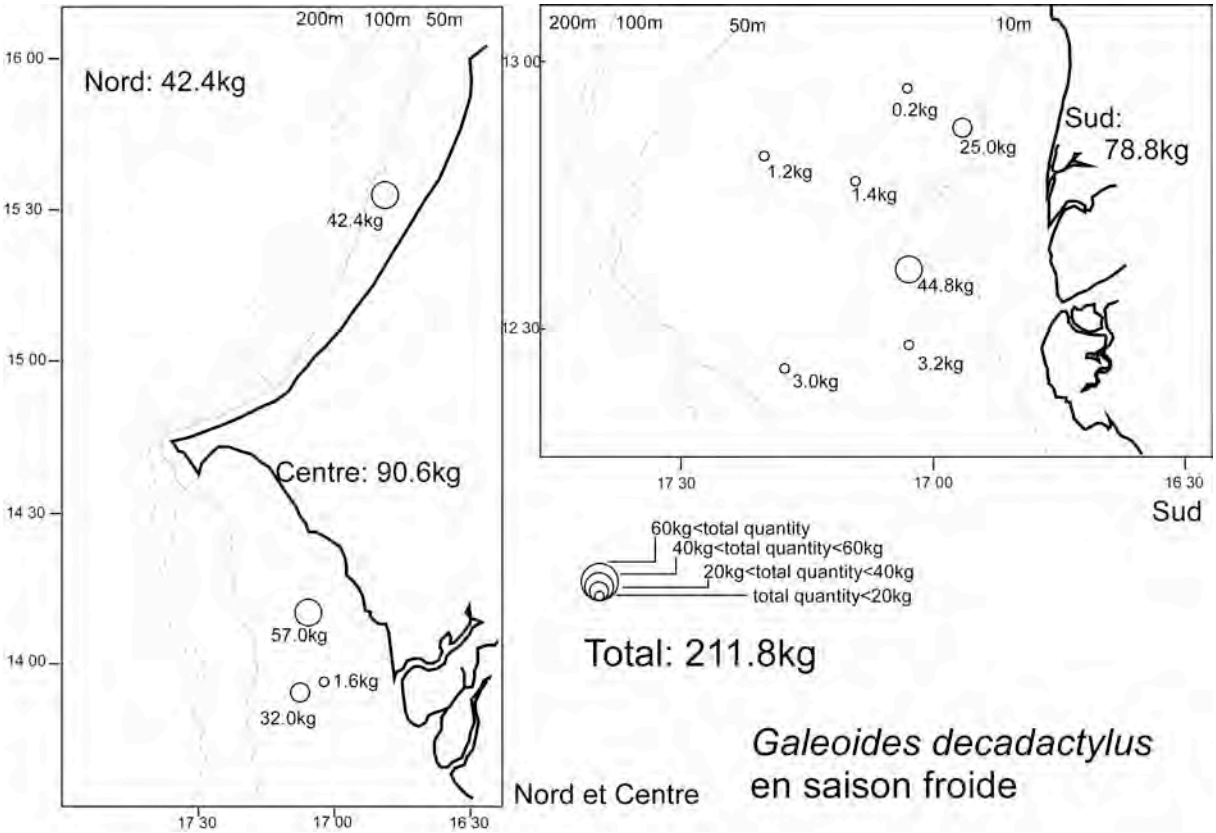


Figure 2-15 Distribution of Thiekem Catches in the Cool Season Survey

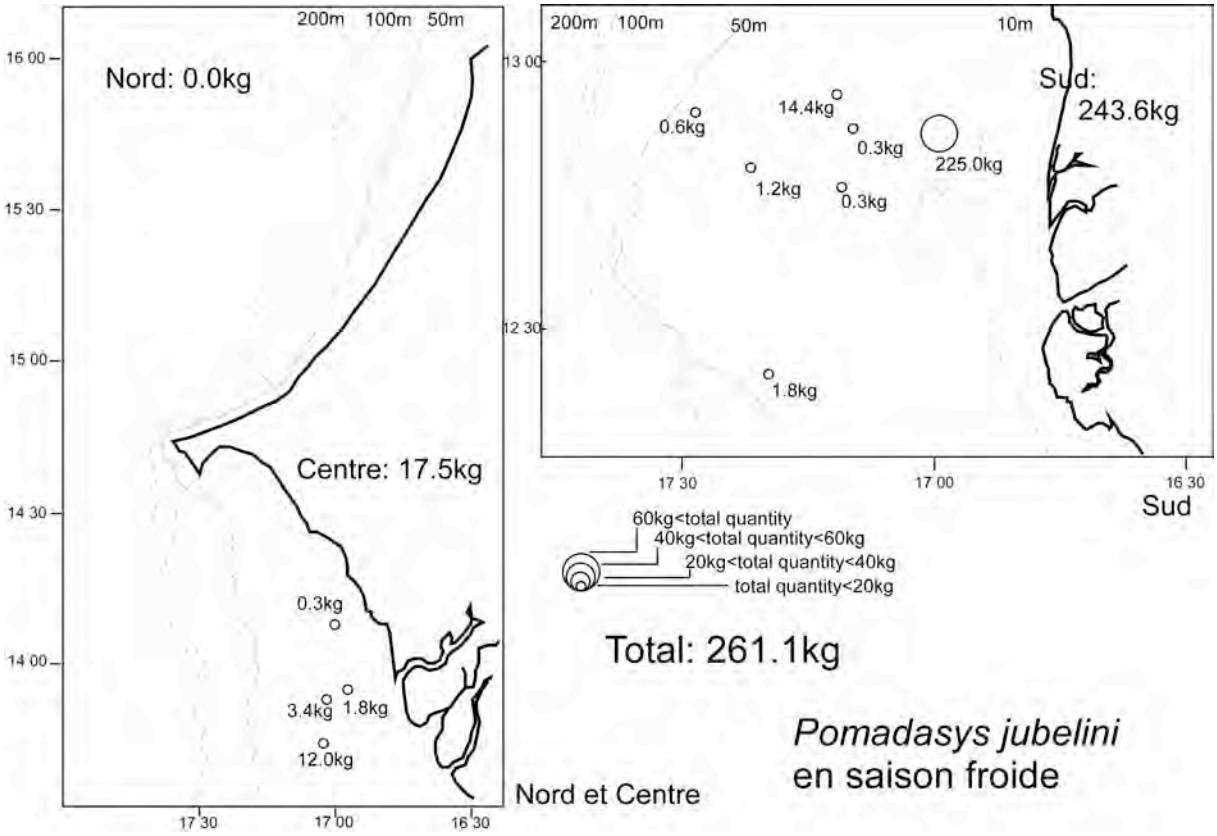


Figure 2-16 Distribution of Sompatt Catches in the Cool Season Survey

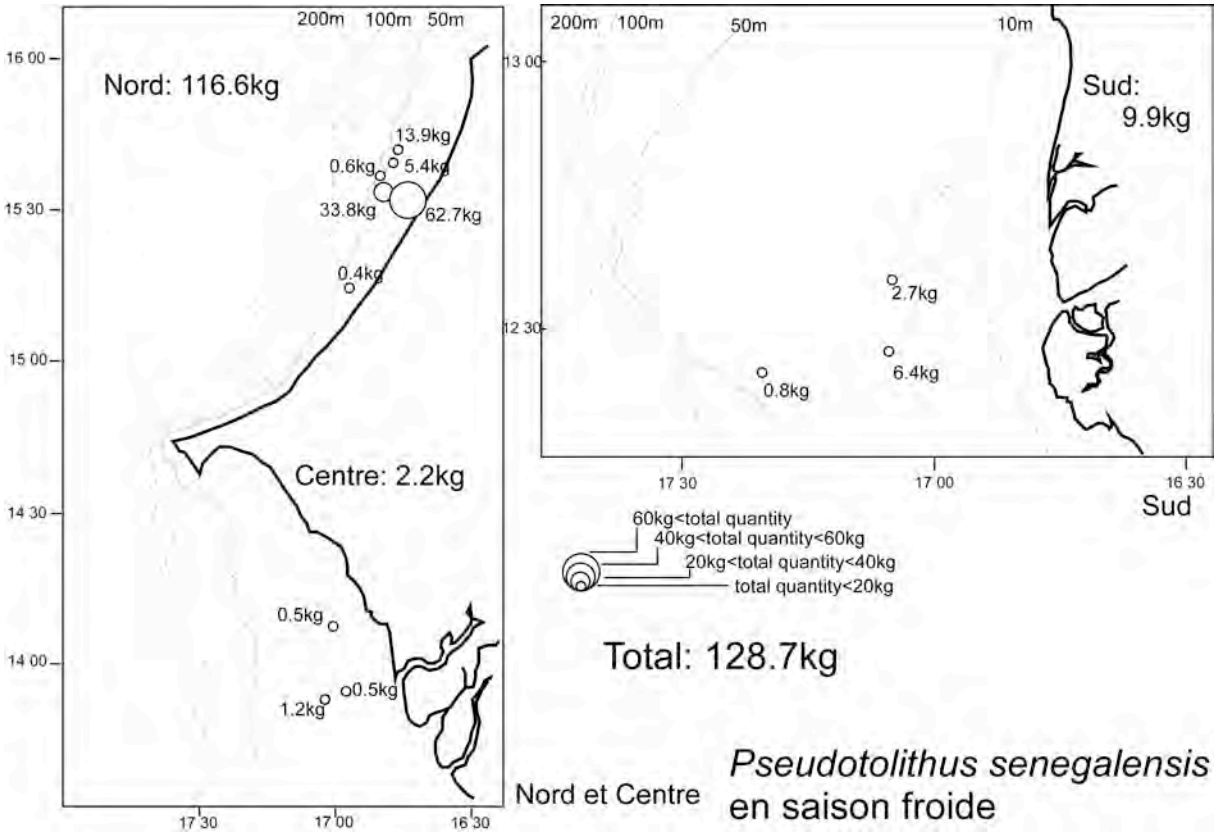


Figure 2-17 Distribution of Otolith Catches in the Cool Season Survey

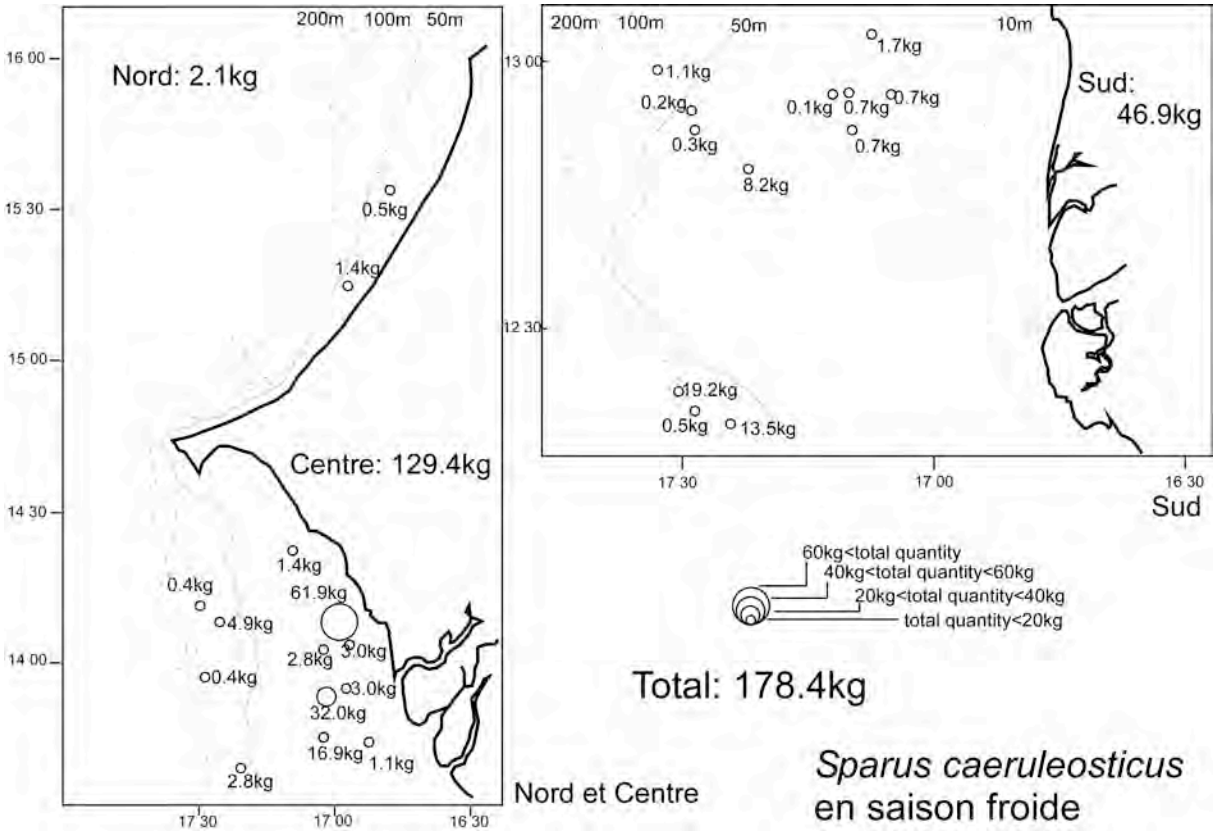


Figure 2-18 Distribution of Pagre Catches in the Cool Season Survey

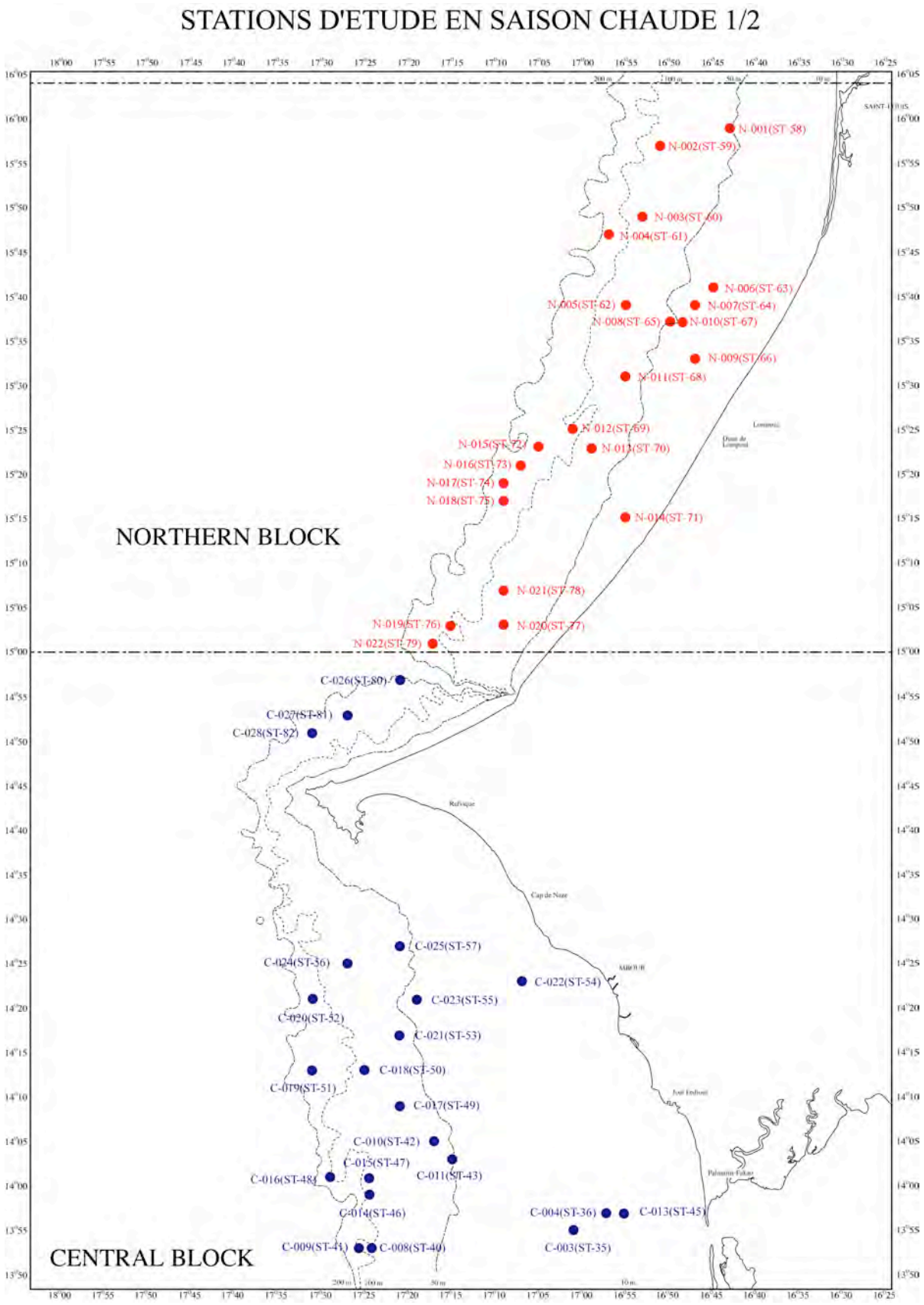


Figure 2-19-1 Warm Season Survey Stations (Northern Block and Part of the Central Block)

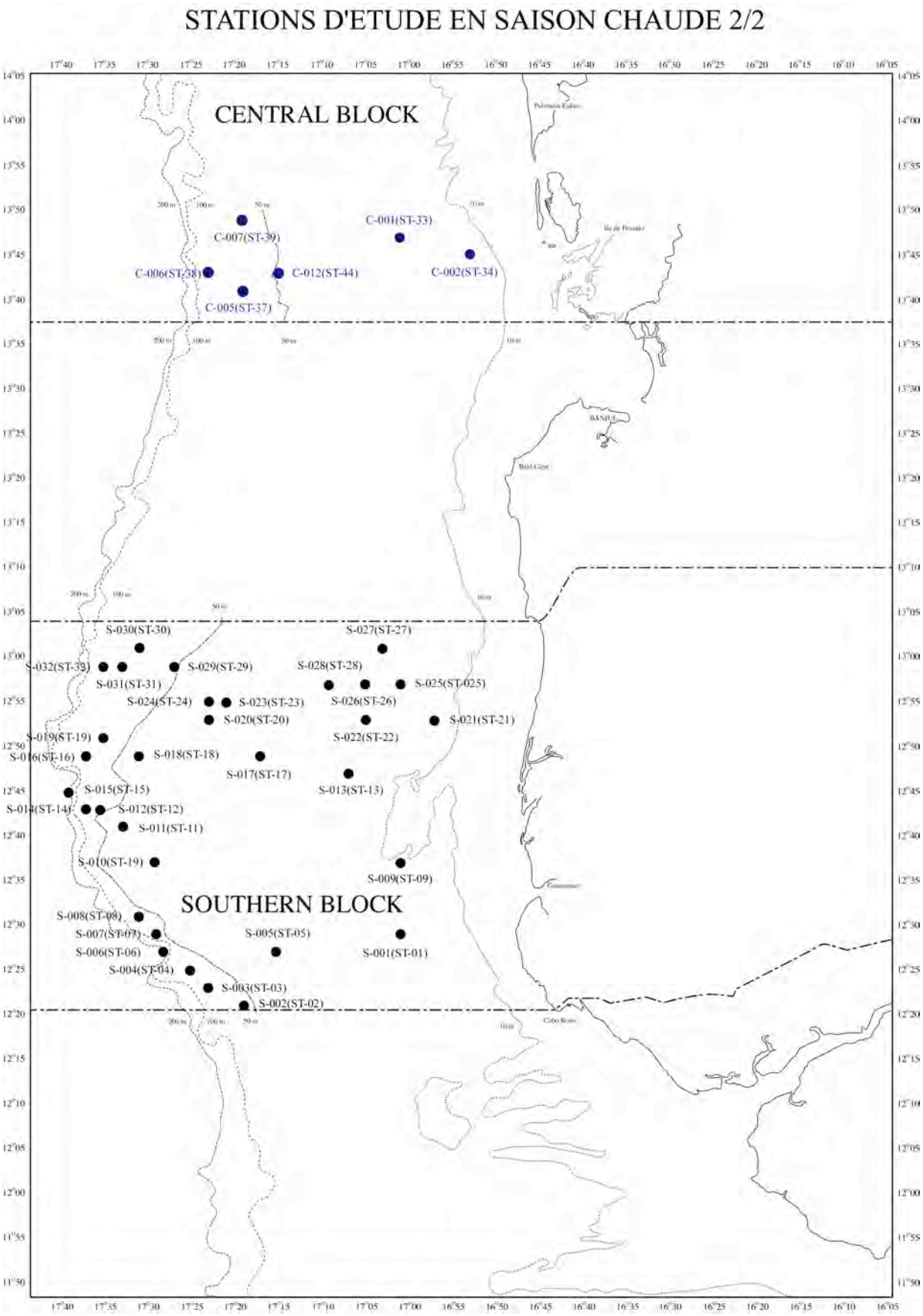


Figure 2-19-2 Warm Season Survey Stations (Southern Block and Part of the Central Block)

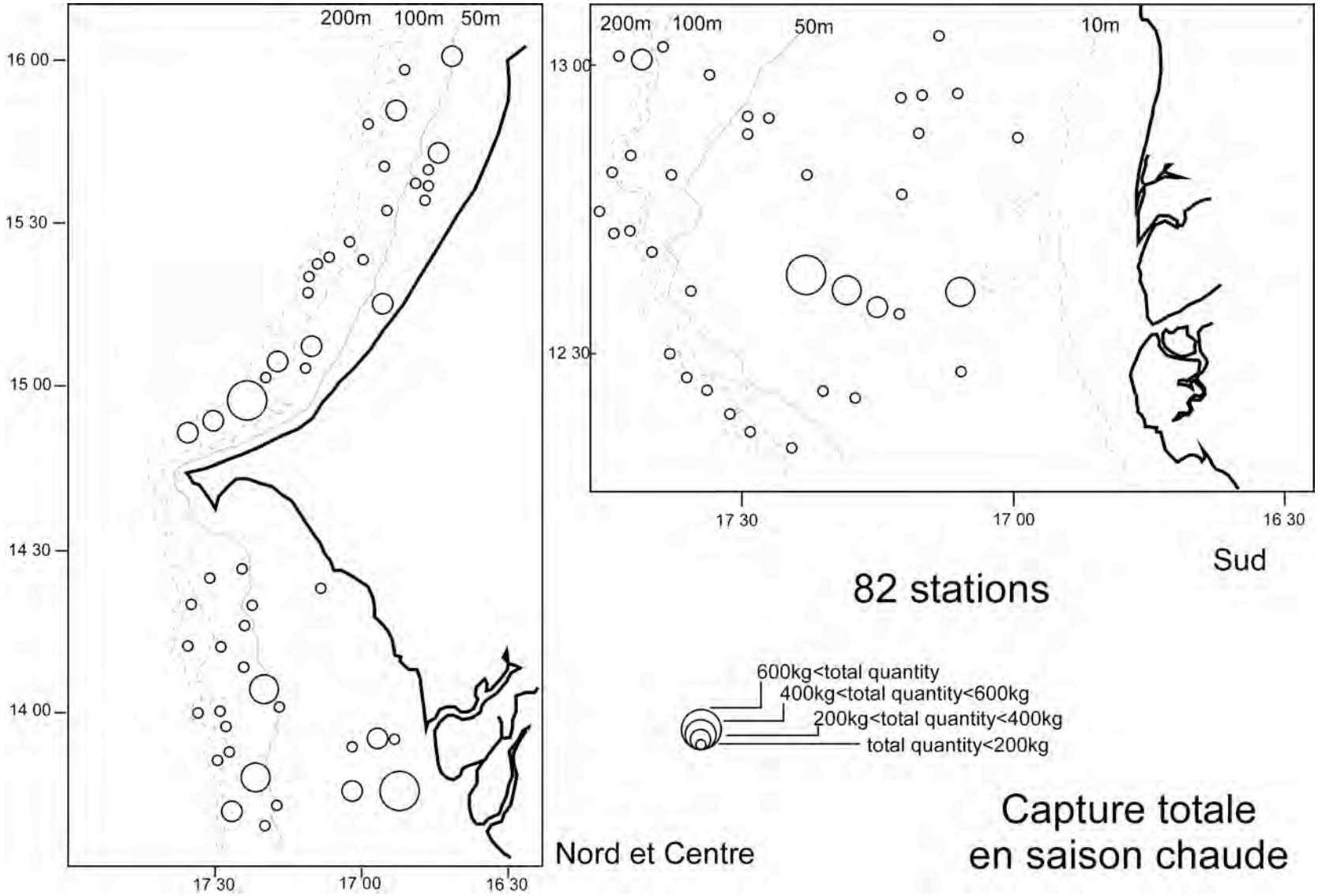


Figure 2-20 Total Catches at Each Station in the Warm Season Survey

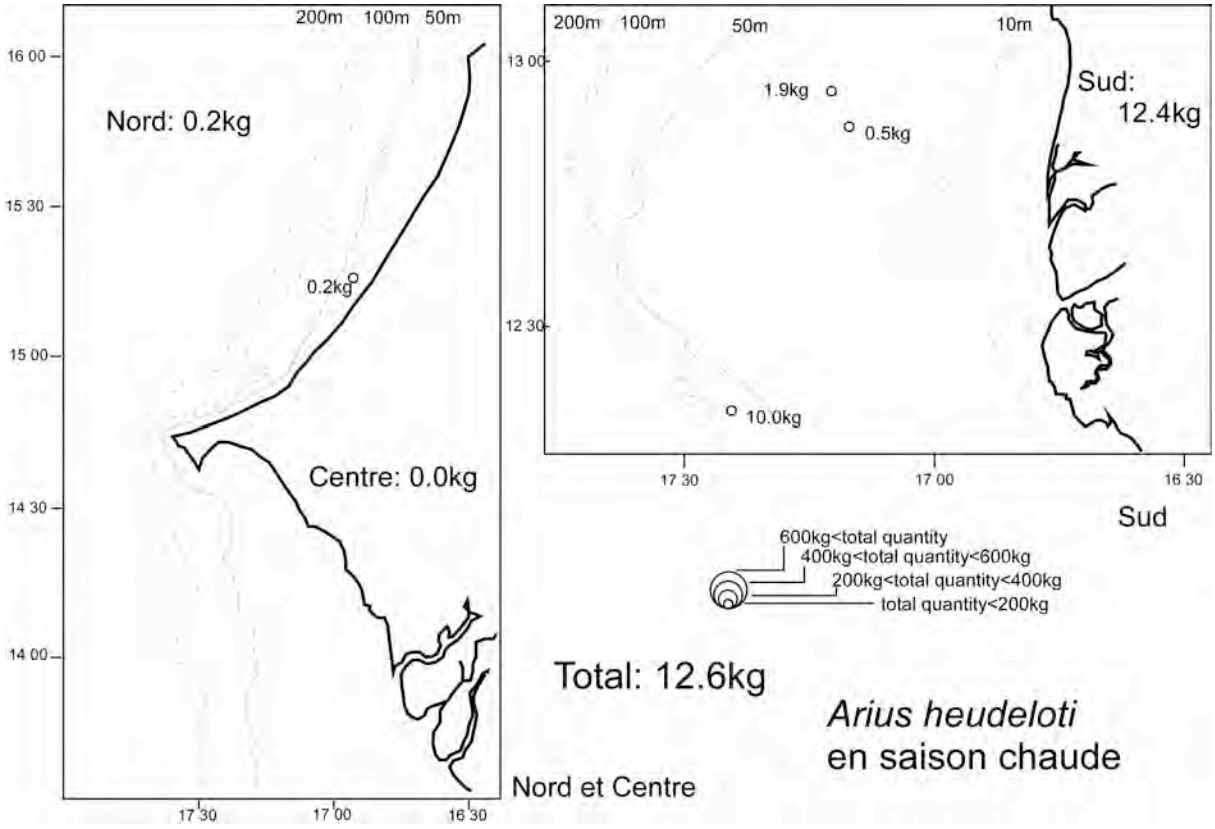


Figure 2-21 Distribution of Machoiron Catches in the Warm Season Survey

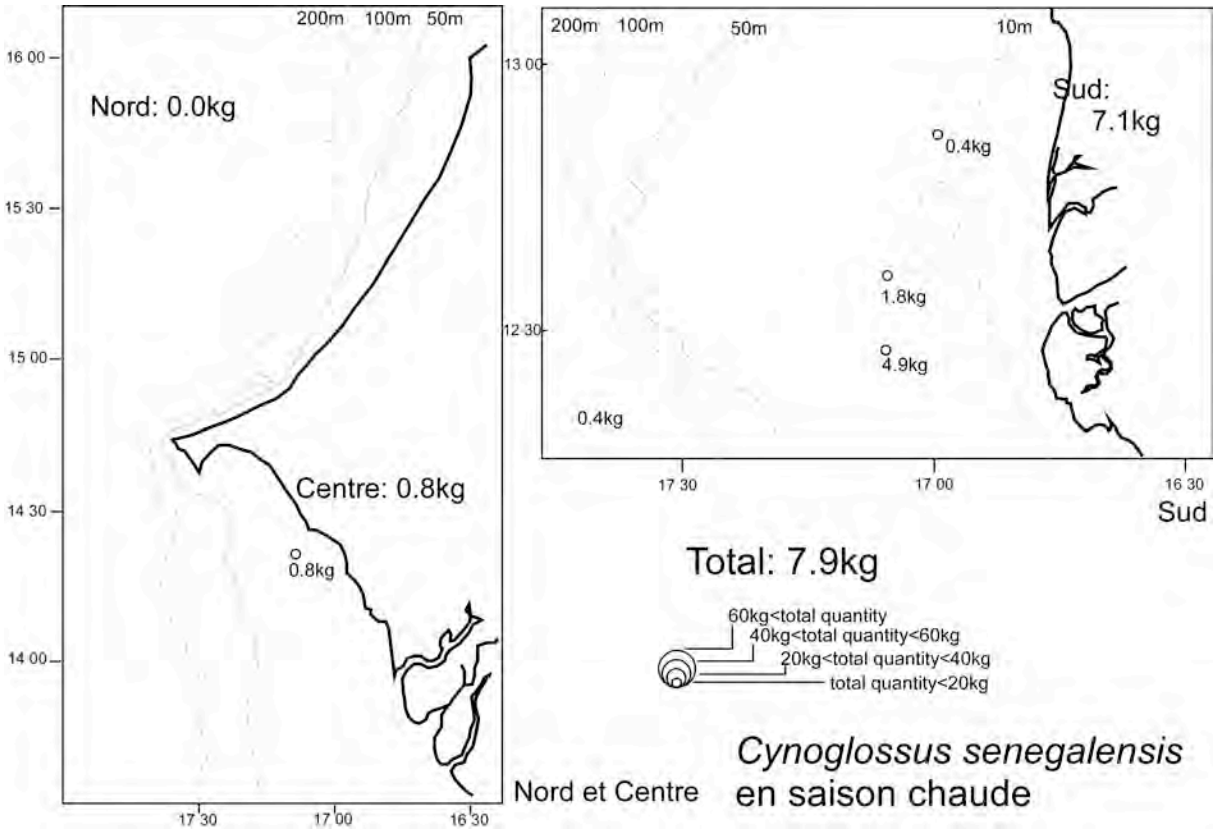


Figure 2-22 Distribution of Sole Catches in the Warm Season Survey

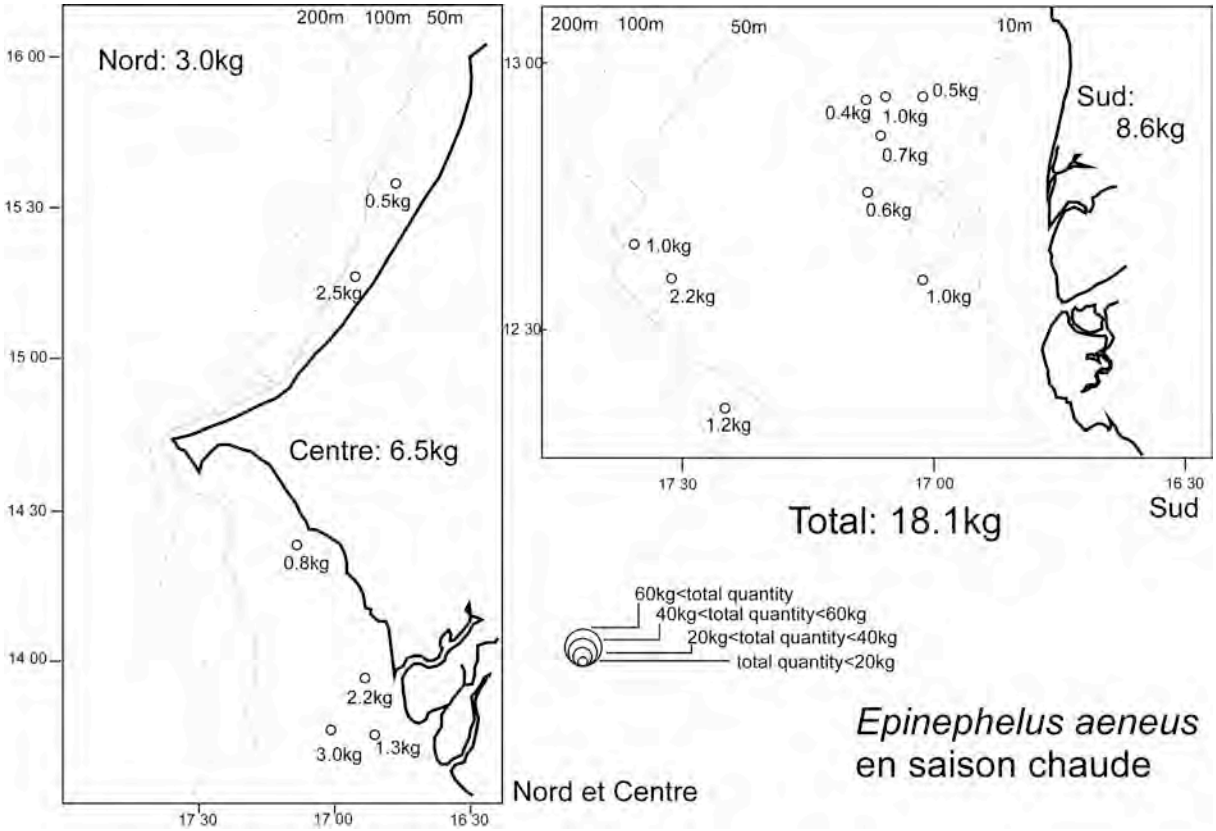


Figure 2-23 Distribution of Thiof Catches in the Warm Season Survey

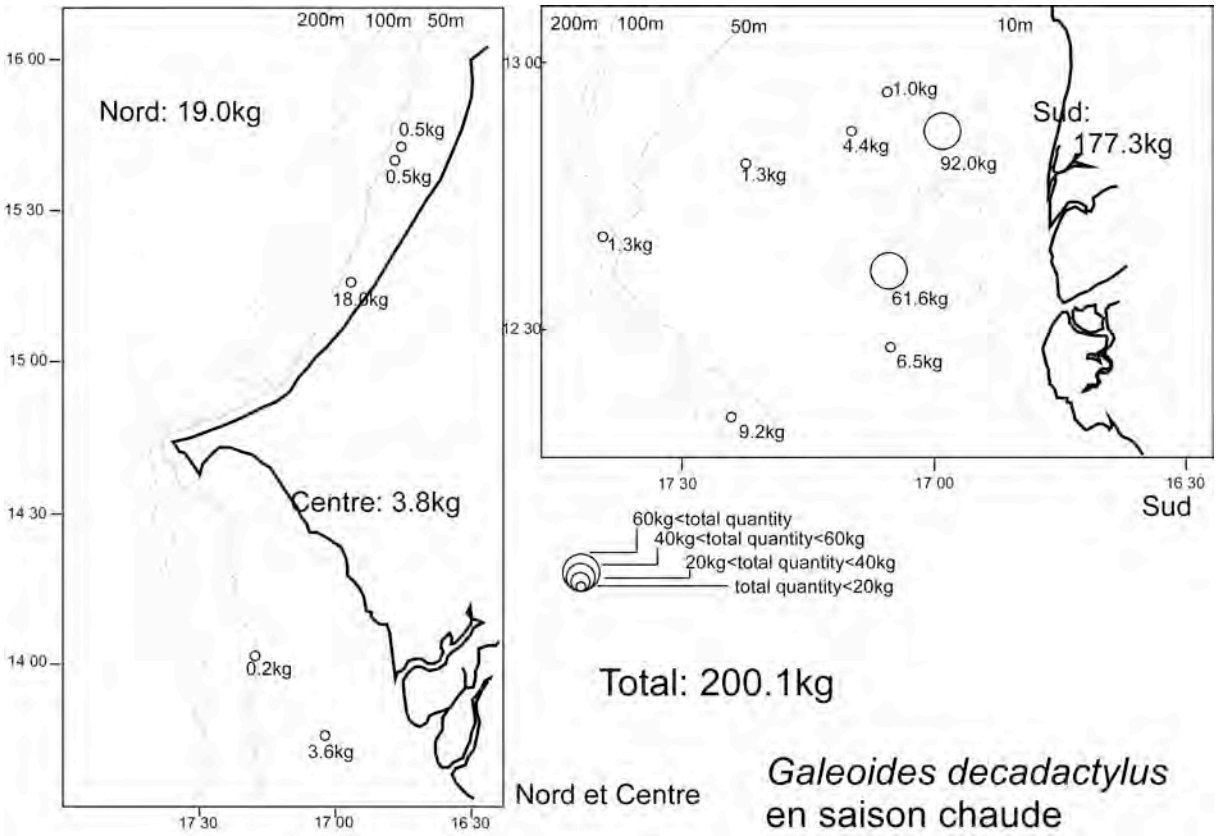


Figure 2-24 Distribution of Thiekem Catches in the Warm Season Survey

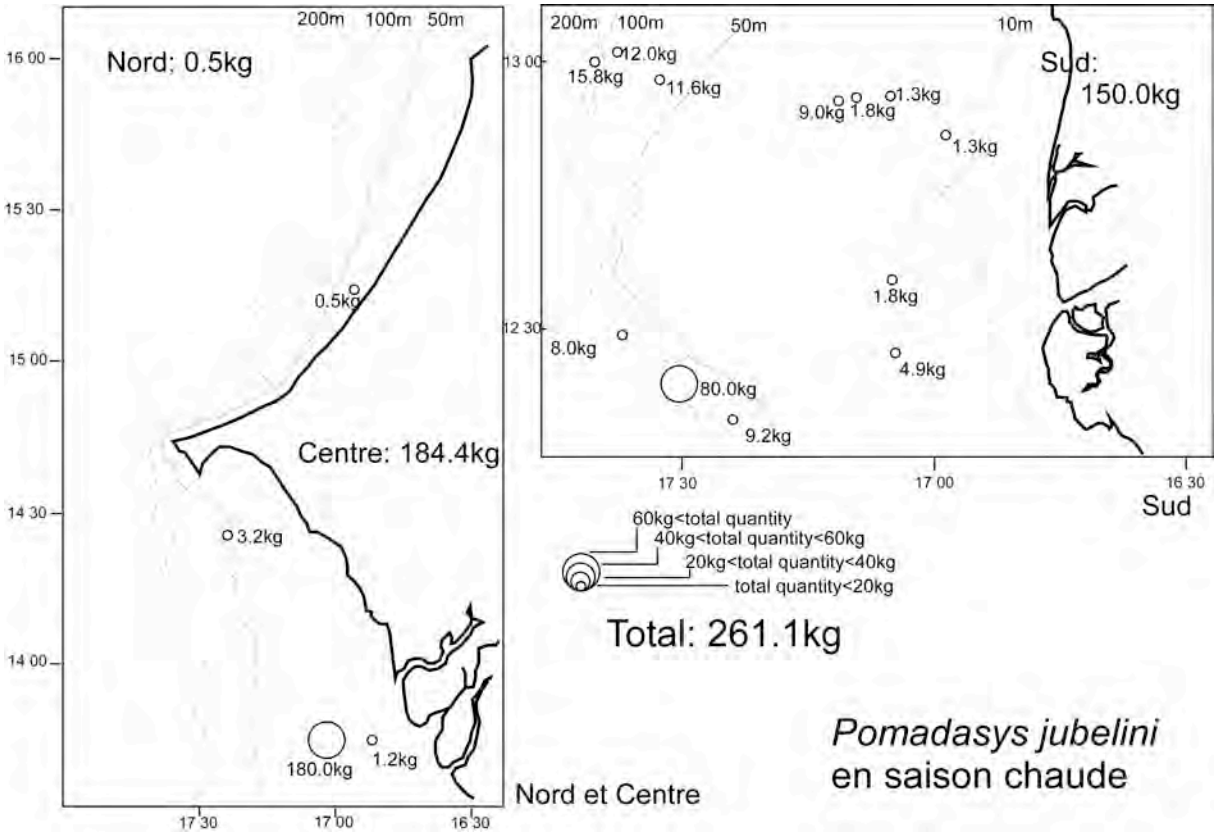


Figure 2-25 Distribution of Sompatt Catches in the Warm Season Survey

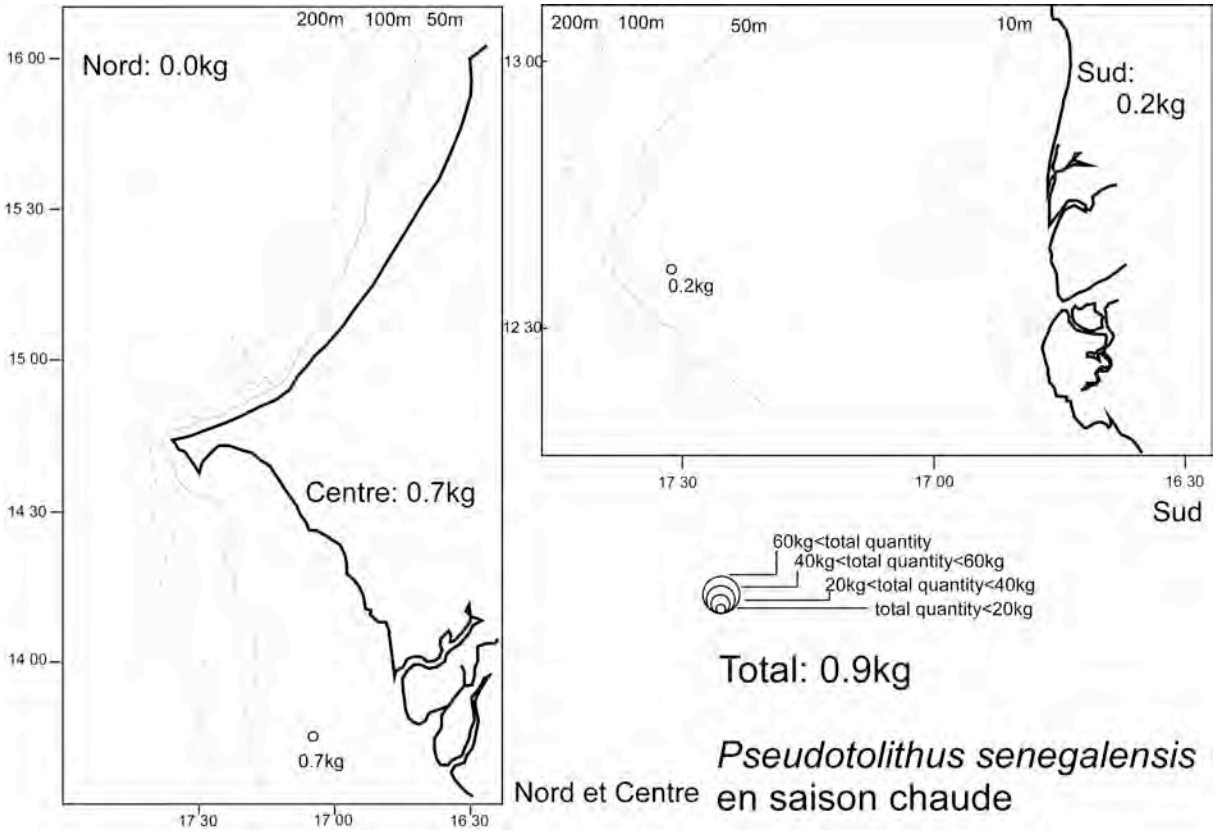


Figure 2-26 Distribution of Otolithe Catches in the Warm Season Survey

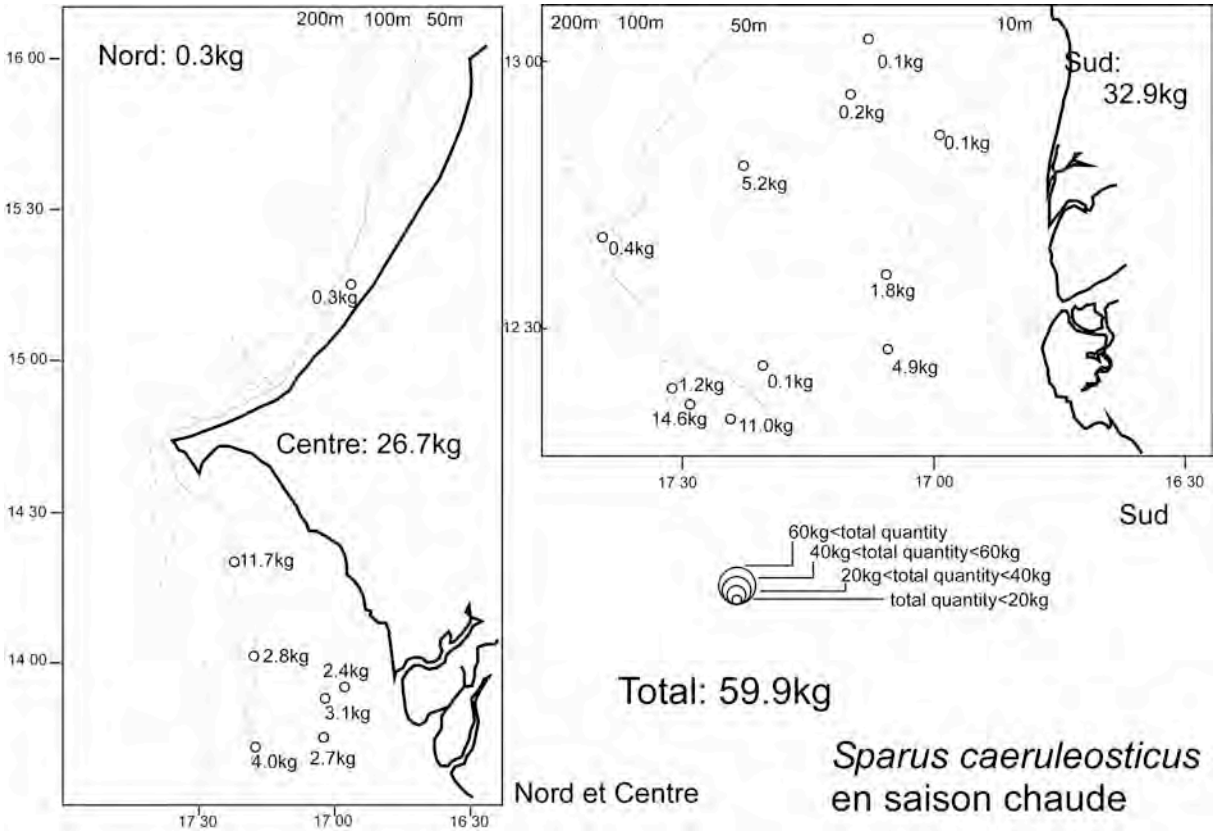


Figure 2-27 Distribution of Pagre Catches in the Warm Season Survey

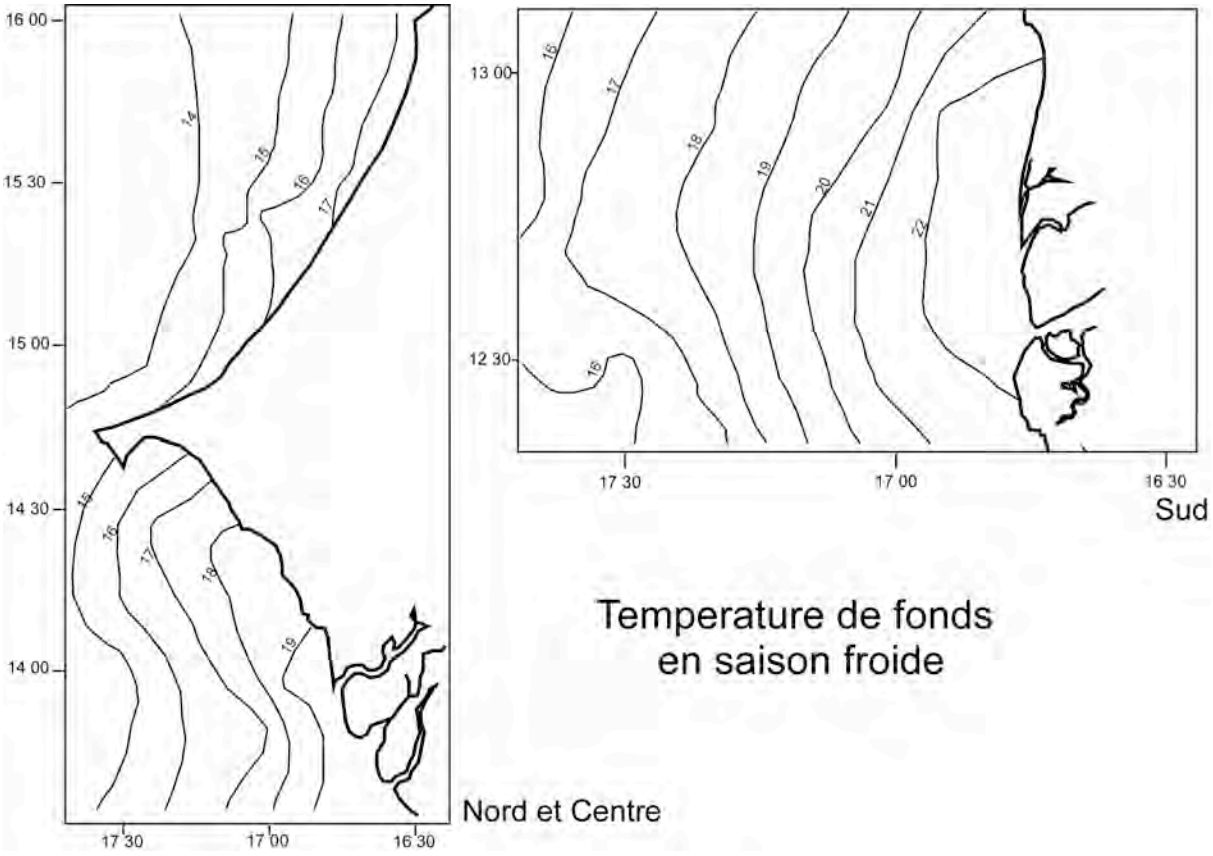


Figure 2-28 Distribution of Bottom Layer Water Temperature in the Cool Season Survey

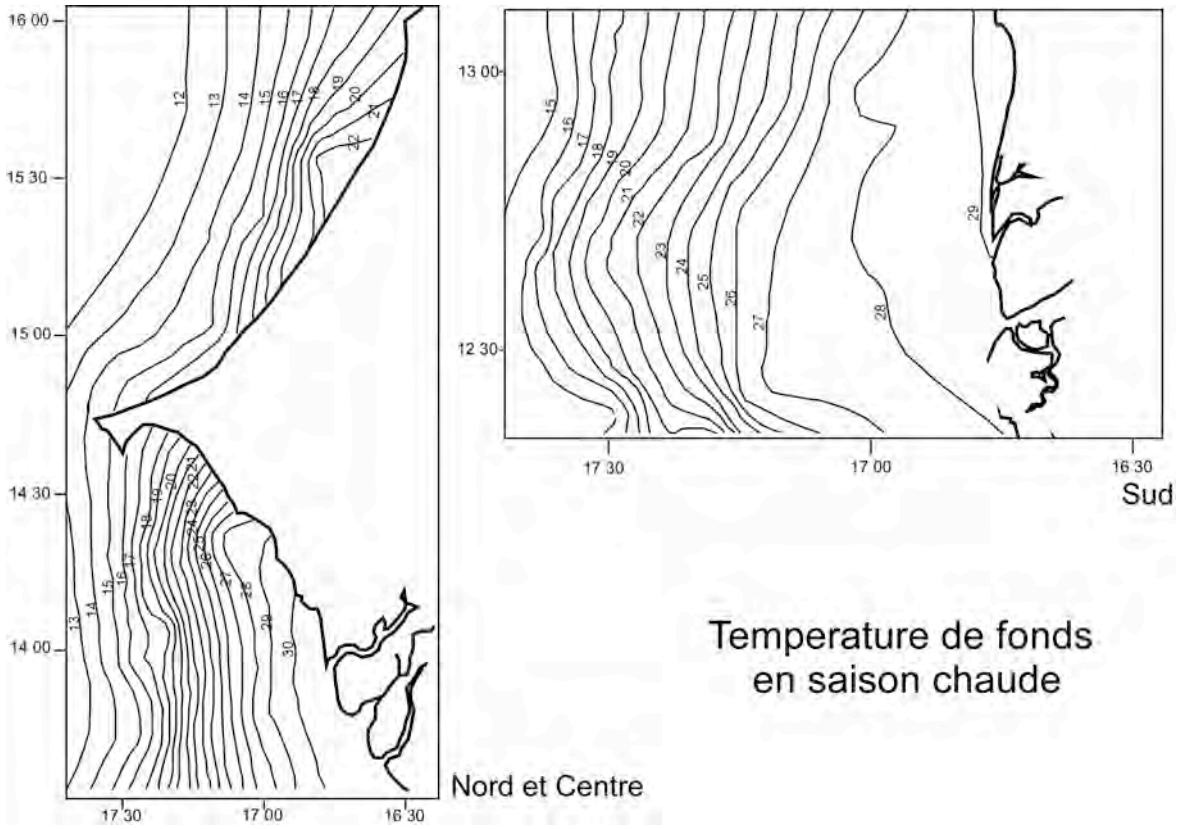


Figure 2-29 Distribution of Bottom Layer Water Temperature in the Warm Season Survey

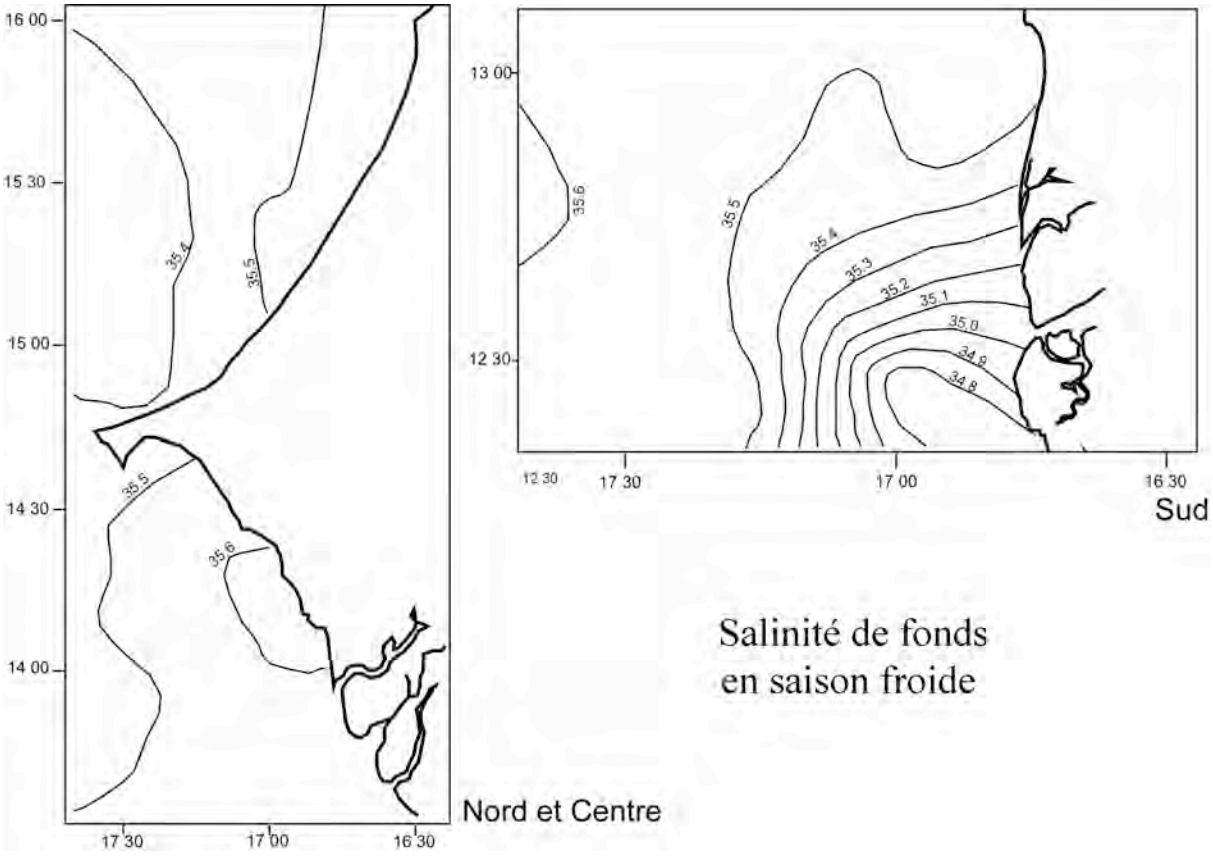


Figure 2-30 Distribution of Bottom Layer Salinity in the Cool Season Survey

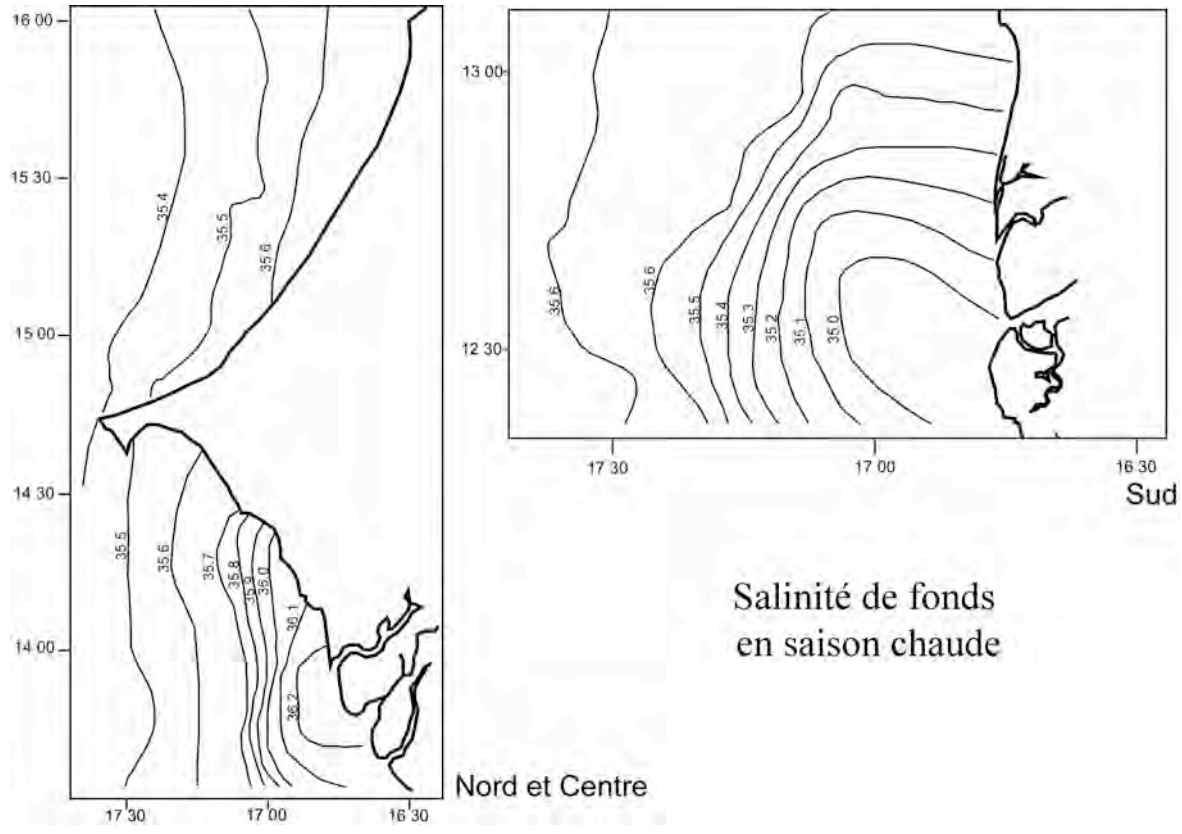


Figure 2-31 Distribution of Bottom Layer Salinity in the Warm Season Survey

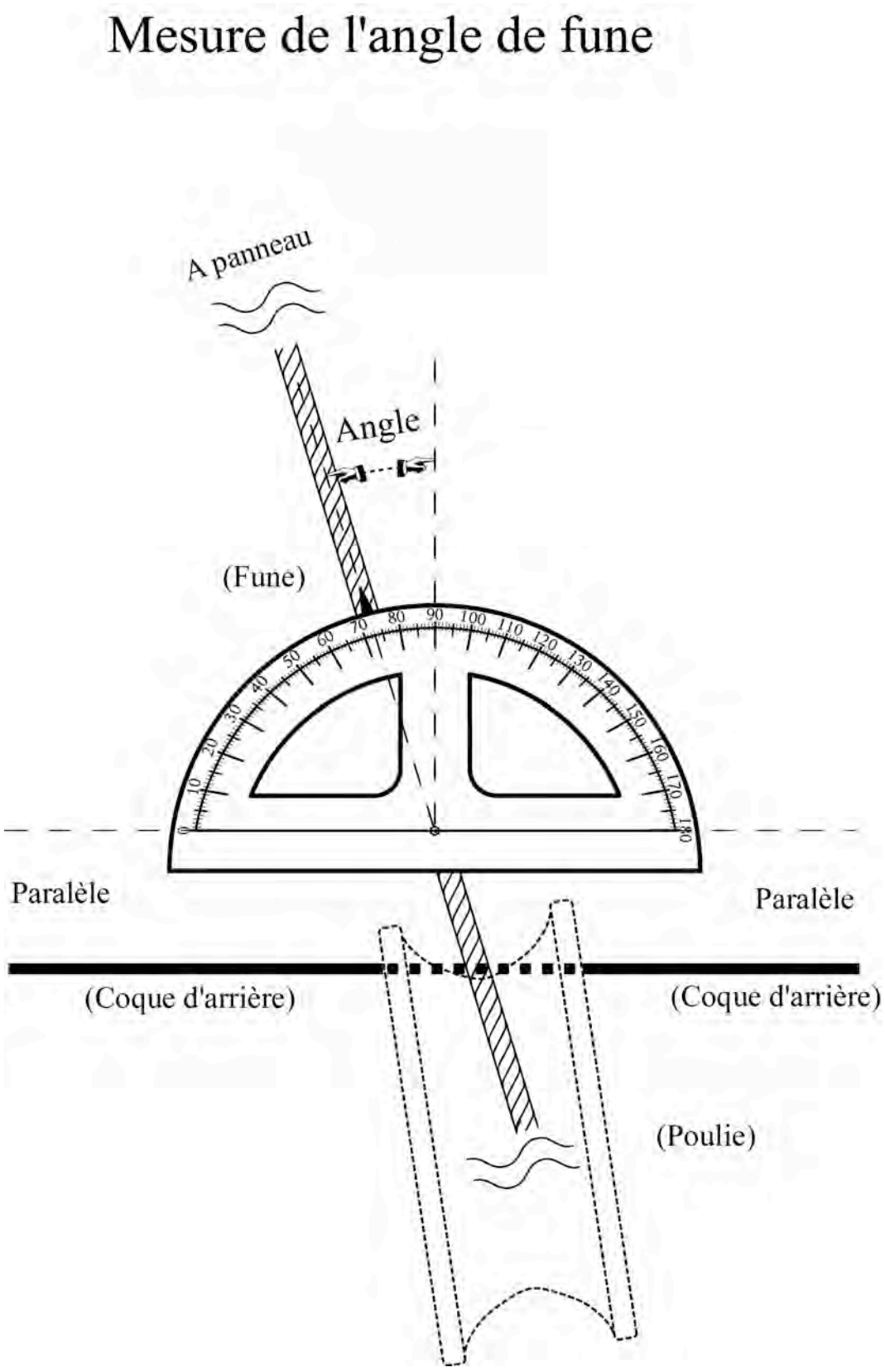
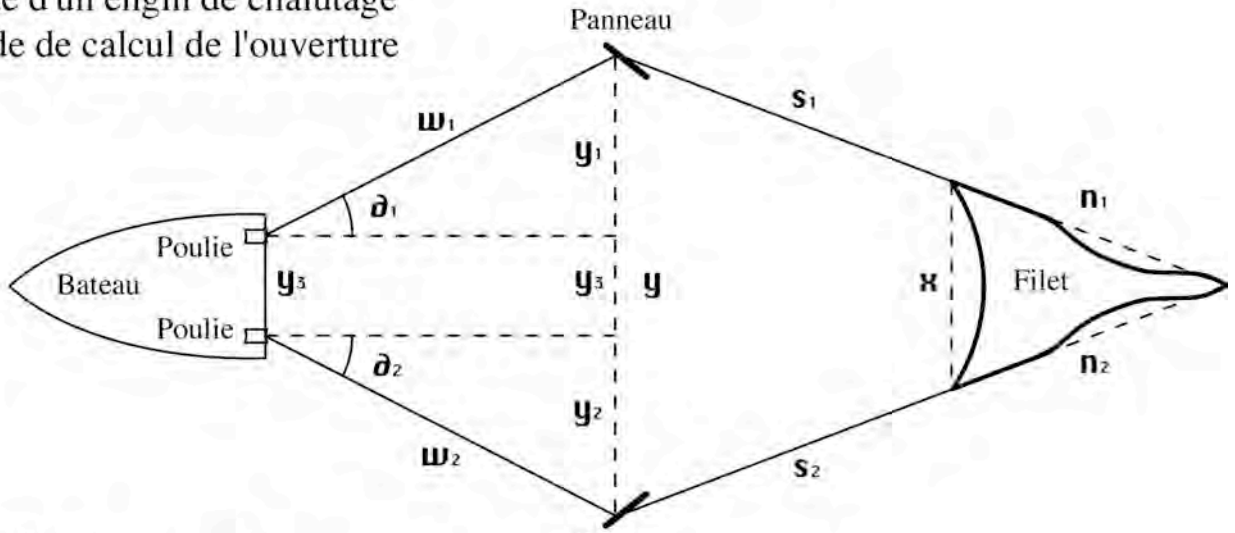


Figure 2-32 Warp Rope Spread Angle Measurement Method

Représentation schématique d'un engin de chalutage complet montant la méthode de calcul de l'ouverture horizontale du filet



Angle de la fune horizontale de tribord : ∂_1

Angle de la fune horizontale de bâbord : ∂_2

Longueur de fune ; $w_1 = w_2$

Ecartement de panneau de tribord : y_1

Ecartement de panneau de bâbord : y_2

Distance entre deux poulies de fune : y_3

Distance entre deux panneaux : y

Longueur de patte de panneau, bras et entremise : $s_1 = s_2$

Longueur de ralingue de côté : $n_1 = n_2$

Ouverture verticale de filet (Distance entre bouts d'ailes) : x

$$y_1 = w_1 \times \sin\partial_1,$$

$$y_2 = w_2 \times \sin\partial_2,$$

$$y = y_1 + y_2 + y_3,$$

$$x = y \times n_1 / (s_1 + n_1)$$

Figure 2-33 Method for Calculating Distance between Wing Tips

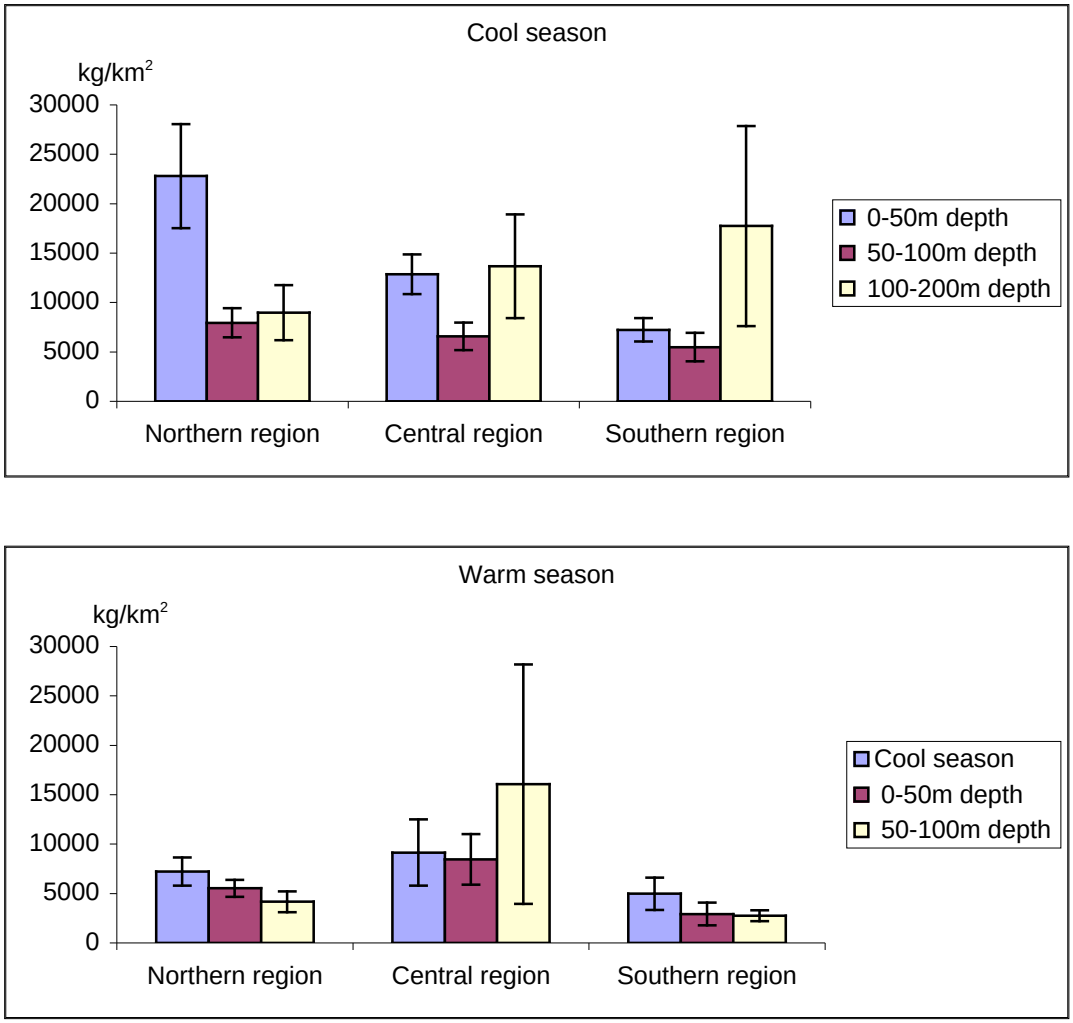


Figure 2-34 Estimated Stock at Each Depth Layer per Unit Area in Each Survey Area

Table 2-1 List of Survey Team Members

N°	Prénom et Nom	Fonction	
1	Mr. Theodore NGOM	Commandant	Captain
2	Mr. Issa DIAGNE	Captain	Second Captain
3	Mr. Abdou Abasse FOFANA	Chef Mécanicien	Chief Engineer
4	Mr. Gabriel GOUDIABY	Adjoint Mécanicien	Second Chief Engineer
5	Mr. Youssou SAMB	Lieutant de pêche	Fish mate
6	Mr. Ndaraw FALL	Maître d'équipage	Boatswain
7	Mr. Ismaïla GUEYE	Matelot Breveté	Able seaman
8	Mr. Ismaïla MBENGUE	Matelot	Seaman
9	Mr. Ousseynou FAYE	Matelot	Seaman
10	Mr. Mamadou NIANG	Matelot	Seaman
11	Mr. Serigne LO	Matelot	Seaman
12	Mr. Ngandj GUEYE	Matelot	Seaman
13	Mr. Mamadou Saliou BA	Matelot	Seaman
14	Mr. Oussey NDIAYE	Graisseur	Oiler
15	Mr. Adama Sy	Graisseur	Oiler
16	Mr. Alassane SENE	Cuisinier	Cook
17	Mr. Lansana DIEDHIOU	Serveur	Galley boy
18	Mr. Massal FALL*	Chercheur	Researcher
19	Mr. Serigne SYLLA*	Techinicien Supérieur	Superior technician
20	Mr. Ibrahima SOW*	Techinicien Supérieur	Superior technician
21	Mr. Cheikh NDOUR *	Techinicien Supérieur	Superior technician
22	Mr. Mor SYLLA*	Techinicien	Technician
23	Mr. Moïse BIAGUI*	Techinicien	Technician
24	Mr. Fallou NIANG*	Techinicien	Technician
25	Mr. Alassane SYLLA*	Techinicien	Technician
26	Mr. Modiabel DIOP*	Techinicien	Technician
27	Mr. Ibra FALL*	Techinicien	Technician
28	Mr. Mandièmé FAYE*	Techinicien	Technician

* The capacity of biological and marine surveyors was seven, but the members alternated between voyages.

Table 2-2 Setting of Survey Stations

TIRAGE DES STASIONS DE CHALUTAGE EN SAISON FROIDE ET CHAUDE

Date d'exécution : le 17 novembre 2003
Lieu d'exécution : CRODT
Présences : Dr. Djiby Thiam, CRODT
: Kazunori UWATOKO, OAFIC

Zone	10~50 m		50~100 m		100~200 m	
	Stations		Stations		Stations	
Nord	1	556-003	1	538-014	1	500-025
	2	538-010	2	556-012	2	516-021
	3	530-009	3	530-014	3	520-020
	4	532-010	4	522-017	4	502-024
	5	514-014	5	548-013	5	524-017
			6	558-008	6	522-020
			7	536-011	7	518-022
			8	502-023	8	546-015
			9	500-024		
	(Remplacement)		(Remplacement)		(Remplacement)	
	(1)	540-009	(1)	600-011	(1)	510-025
	(2)	536-011	(2)	534-014	(2)	500-027
	(3)	548-006	(3)	548-012	(3)	532-017
			(4)	506-021	(4)	532-018
Zone	10~50 m		50~100 m		100~200 m	
	Stations		Stations		Stations	
Central	1	408-016	1	426-027	1	412-032
	2	346-017	2	352-029	2	440-035
	3	420-026	3	416-027	3	452-032
	4	442-033	4	342-028	4	352-029
	5	404-016	5	400-031	5	420-032
	6	438-024	6	340-024	6	456-027
	7	422-020	7	412-029	7	400-032
	8	404-017	8	358-029		
			9	348-026		
			10	432-029		
			11	404-024		
			12	408-027		
	(Remplacement)		(Remplacement)		(Remplacement)	
	(1)	402-024	(1)	416-029	(1)	356-030
	(2)	354-017	(2)	424-030	(2)	400-030
	(3)	342-024	(3)	452-026	(3)	436-035
	(4)	356-014	(4)	424-028		
			(5)	436-033		
			(6)	356-024*		
Zone	10~50 m		50~100 m		100~200 m	
	Stations		Stations		Stations	
Sud	1	256-017	1	220-027	1	238-035
	2	246-020	2	302-032	2	226-030
	3	252-019	3	242-035		
	4	302-018	4	242-034		
	5	248-025	5	242-033		
	6	256-019	6	246-033		
	7	252-028	7	300-035		
	8	236-031	8	222-028		
	9	256-020	9	224-029		
	10	240-033	10	248-035		
	11	254-027	11	230-032		
	12	228-017	12	236-034		
	13	254-028	13	250-034		
	14	226-024				
	15	248-032				
	16	236-017				
	(Remplacement)		(Remplacement)		(Remplacement)	
	(1)	250-023	(1)	302-031	(1)	228-033
	(2)	256-014	(2)	258-031	(2)	244-036
	(3)	238-023	(3)	230-031	(3)	238-036
	(4)	258-016	(4)	258-030		
	(5)	222-014	(5)	258-033		

Table 2-3 Cool Season Marine Survey Data (1)

JOURNAL DE PECHE DE FOND

Date of Operation / Date d'opération		Number of Operation / Numéro d'opération	Hydraulic survey / Etude hydraulique	Number of station / Numéro de station	Depth zone (Plan and actual)	Zone de la profondeur (programme et exécution)	Position of Start of net towing Lat. (N) / Position de pose du chalut Long. (W)	Time of towing the net / Heure de pose du chalut	Time of towing the net (min.) / Temps de trainage (min.)	Bottom materials / Matériaux du fond	Biginning of trawling Depth (m) / Lors de la pose du chalut Profondeur (m)	Finishing of trawling / Lors du relevage du chalut	Length of warp (m) / Longueur de fune (m)	Cours (°) / Direction(°)	Operation of net / Vitesse (Kt)	Opération de chalut / Distance (km)	Distance between wing tips (m) / Distance entre pointes d'ailes (m)	Dimention of trawling (km²) / Dimention de la pêche (km²)	Height of head rope (m) / Hauteur d'ouverture verticale du filet (m)	Air temperature (°) / Température de l'air (°)	Water temperature, surface (°) / Température de l'eau de mer, surface (°)	Water temperature, bottom (°) / Température de l'eau de mer, fond (°)	Weather condition / Conditions de mer	Wind directions Directions du vent	Beaufort scale / Sea conditions / Etat de la mer	Atmosphere pressure (hPa.)	Position of Start of net towing Lat. (N) / Position de pose du chalut Long. (W)	Remarks / Remarques
1	25	ZONE NORD																										
		0		556-003	10~50	10~50	15-56.4 016-33.	07:45	5	Rock	16.0	16.5	100	015	-	4.00 3.704	10.29	0.0381	-	17.0	17.0	-	b	NNE	2	2	1015.6	15-56.6 016-33.3	Remplacer à 540-009, Accident du dommage de filet et de la coupe de câble à caude de l'existence de roche au fond
		N-001	STD	558-008	50~100	50~100	15-58.6 016-43.	09:55	30	Sand	61.0	65.0	200	015	4.00	3.704	10.29	0.0381	-	19.2	17.8	15.91	b	N/E	3	2	1005.6	16-00.5 016-43.1	
		N-002	STD	556-012	50~100	50~100	15-57.6 016-50.	12:00	30	S	94.5	94.0	300	190	3.86	3.574	17.78	0.0635	3.0	23.1	17.8	14.81	b	N/E	2	2	1016.1	15-55.7 016-51.9	
		N-003	STD	548-013	50~100	50~100	15-50.0 016-53.	13:50	30	S	91.0	91.8	300	190	3.94	3.648	19.40	0.0708	3.0	24.1	17.1	14.70	b	N'th	2	2	1014.5	15-48.1 016-53.7	
		N-004	STD	546-015	100~200	100~200	15-48.1 016-56.	15:30	30	S	103	105	300	195	3.68	3.408	24.21	0.0825	3.0	23.5	18.3	14.57	b	WNW	2	2	1015.5	15-46.2 016-57.3	
		N-005	STD	540-009	10~50	10~50	15-41.6 016-45.	18:05	30	S/Mad	39.6	37.2	150	180	3.72	3.445	11.35	0.0391	3.0	20.5	17.8	16.16	b	WNW	2	2	1012.4	15-39.7 016-45.6	Remplacer de 556-003
	26	N-006	STD	538-010	10~50	10~50	15-40.0 016-47.	07:35	30	S/M	45.0	42.8	150	175	4.00	3.704	13.47	0.0499	3.0	16.5	17.4	15.83	b	NNE	2	2	1015.0	15-38.1 016-47.5	
		N-007	STD	536-011	50~100	50~100	15-37.8 016-49.	09:00	30	S	51.0	51.8	150	180	3.80	3.519	16.90	0.0595	3.0	17.8	17.3	15.39	b	N/E	2	2	1015.2	15-36.0 016-49.9	
		N-008	STD	538-014	50~100	50~100	15-39.9 016-55.	10:55	30	S	89.6	91.0	300	180	3.60	3.334	17.71	0.0590	3.0	19.0	17.2	14.72	b	N/E	3	3	1016.3	15-38.0 016-55.5	
		N-009	STD	530-014	50~100	50~100	15-31.8 016-55.	12:40	30	M	82.2	81.5	250	180	3.90	3.611	14.98	0.0541	3.0	21.8	17.8	14.91	b	N/E	2	2	1015.5	15-30.0 016-55.5	
		N-010	STD	532-010	10~50	10~50	15-33.9 016-47.	14:55	30	S	34.0	32.6	150	185	4.00	3.704	11.30	0.0419	3.2	22.8	18.5	15.81	b	WNW	2	2	1015.1	15-32.1 016-47.8	
		N-011	STD	530-009	10~50	10~50	15-31.6 016-45.	16:10	30	S	23.8	21.0	100	185	4.00	3.704	11.72	0.0434	3.2	21.9	18.0	16.62	b	WNW	2	2	1012.6	15-29.7 016-45.9	
	27	N-012	STD	524-017	100~200	100~200	15-25.5 017-01.	07:50	30	S	104	104	300	188	3.80	3.519	16.03	0.0564	3.0	19.0	18.8	15.73	b	N/E	2	2	1016.7	15-23.7 017-01.6	
				522-017	50~100		Impossibilité de pêcher à cause du manque de la largeur de moin de 100m de profondeur																						Remplacer à 522-016
		N-013	STD	522-016	50~100	50~100	15-23.9 016-59.	09:30	30	M	95.4	91.6	300	165	3.60	3.334	15.95	0.0532	3.0	19.7	18.6	15.65	b	N/E	3	3	1017.7	15-22.0 016-59.3	Remplacer de 522-017
				522-020	100~200		Impossibilité de pêcher à cause du manque de la largeur de moin 200m de profondeur																						Remplacer à 522-019
		N-014	STD	522-019	100~200	100~200	15-23.7 017-05.	11:40	30	S/M	146	140	350	180	3.66	3.389	14.44	0.0489	3.2	20.0	18.6	13.41	b	NNE	2	2	1017.3	15-22.0 017-06.0	Remplacer de 522-020
		N-015	STD	520-020	100~200	100~200	15-21.9 017-07.	13:15	20	S/M	168	151	450	175	3.90	2.408	18.61	0.0448	3.0	22.0	18.8	15.46	b	N/E	2	2	1016.1	15-20.4 017-07.5	Relevage précoce à cause de l'existence de roche au fond
				518-022	100~200		Impossibilité de pêcher à cause du manque de la largeur de moin de 200m de profondeur																						Remplacer à 518-021
		N-016	STD	518-021	100~200	100~200	15-19.9 017-09.	14:57	30	S/M	174	186	450	173	3.40	3.148	18.28	0.0575	3.0	24.8	19.0	13.39	b	N'th	2	2	1014.8	15-18.1 017-09.4	Remplacer de 518-022
		N-017	STD	516-021	100~200	100~200	15-17.9 017-09.	16:38	26	S/M	189	151	400	160	3.97	3.186	20.97	0.0668	2.8	23.7	19.0	14.33	b	N'th	2	2	1013.5	15-16.2 017-09.7	
	28	N-018	STD	514-014	10~50	10~50	15-14.2 016-55.	07:28	30	S	29.9	38.4	150	000	3.54	3.278	11.23	0.0368	3.0	16.2	17.3	15.76	b	E'st	1	1	1016.0	15-16.2 016-55.2	
				502-023	50~100		Impossibilité de pêcher à cause de la non-existence de moin 100m de profondeur																						Remplacer à 502-021
		N-019	STD	502-021	50~100	50~100	15-03.5 017-09.	10:34	26	S	96.5	96.4	250	175	3.85	3.090	14.98	0.0463	2.0	20.1	17.6	14.52	b	WNW	2	1	1017.9	15-01.9 017-09.7	Remplacer de 502-023
		N-020	STD	502-024	100~200	100~200	15-02.1 017-15.	12:23	28	S	114.0	121	300	005	3.64	3.146	11.04	0.0347	2.2	22.2	17.6	13.96	b	WNW	2	2	1011.9	15-03.9 017-15.1	
		N-021	STD	500-025	100~200	100~200	15-02.3 017-17.	13:47	29	S/M	125.0	129	350	180	3.89	3.482	14.85	0.0517	2.2	22.0	17.8	13.87	b	N'th	2	2	1016.2	15-00.4 017-17.5	
				500-024	50~100		Impossibilité de pêcher à cause de la non-existence de moin de 100m de profondeur																						Remplacer à 506-021
		N-022	STD	506-021	50~100	50~100	15-06.3 017-09.	16:33	27	S	99.0	99.0	300	015	4.09	3.409	16.10	0.0549	2.2	20.5	18.3	14.39	b	NNW	2	2	1011.0	15-08.1 017-08.8	Remplacer de 500-024
	29	ZONE CENTRALE																										
		C-001	STD	456-027	100~200	100~200	14-55.7 017-21.	07:55	29	S	132	186	350	005	3.70	3.312	12.95	0.0429	2.8	18.9	18.5	13.59	b	N'th	1	1	1015.7	14-57.4 017-20.6	
				452-032	100~200		Impossibilité de pêcher à cause du manque de la largeur de moin de 200m de profondeur																						Remplacer à 450-032
		C-002	STD	450-032	100~200	100~200	14-51.5 017-30.	10:32	28	S	157	130	350	180	3.98	3.440	12.84	0.0442	3.0	23.0	18.5	13.59	b	NNE	2	2	1017.0	14-49.6 017-31.7	Remplacer de 452-032
				440-035	100~200		Impossibilité de pêcher à cause de l'existence de la câble sous-marin																						Remplacer à 452-030
		C-003	STD	452-030	100~200	100~200	14-53.5 017-27.	12:45	28	M	148	130	400	180	3.79	3.276	16.57	0.0543	2.7	21.2	18.5	13.66	b	NNE	2	2	1016.5	14-51.8 017-27.7	Remplacer de 440-035
				442-033	10~50		Impossibilité de pêcher à cause de l'existence de la câble sous-marin																						Annuler
				452-030	10~50		Impossibilité de pêcher à cause de l'existence en mer des filets des pêcheurs artisanaux																						Annuler
2	6			424-030	50~100		Impossibilité de pêcher à cause de l'existence de la câble sous-marin																						Annuler

Table 2-3 Cool Season Marine Survey Data (2)

JOURNAL DE PECHE DE FOND

Date of Operation / Date d'opération	Number of Operation / Numéro d'opération	Hydraulic survey / Etude hydraulique	Number of station / Numéro de station	Depth zone (Plan and actual)	Zone de la profondeur (programme et exécution)	Position of Start of net towing Lat. (N) / Position de pose du chalut Long. (W)	Time of towing the net / Heure de pose du chalut	Time of towing the net (min.) / Temps de trainage (min.)	Bottom materials / Matériaux du fond	Depth (m) Beginning of trawling / Profondeur (m) Lors de la pose du chalut	Depth (m) Finishing of trawling / Profondeur (m) Lors du relevage du chalut	Length of warp (m) / Longueur de fune (m)	Operation of net Direction(°) / Opération de chalut Cours (°)	Operation of net Vitesse (Kt) / Opération de chalut	Distance (km)	Distance between wing tips (m) / Distance entre pointes d'ailes (m)	Dimention of trawling (km²) / Dimention de la pêche (km²)	Height of head rope (m) / Hauteur d'ouverture verticale du filet (m)	Air temperature (°) / Température de l'air (°)	Water temperature, surface (°) / Température de l'eau de mer, surface (°)	Water temperature, bottom (°) / Température de l'eau de mer, fond (°)	Weather condition / Conditions de mer	Wind directions Directions du vent	Beaufort scale / Sea conditions Etat de la mer	Atmosphere pressure (hPa.)	Lat. (N) / Long. (W)	Remarks / Remarques
			340-024	50~100		Impossibilité de pêcher à cause de l'existance des roches au fond																					Remplacer à 340-026
	C-004	STD	340-026	50~100	50~100	13-42.0 017-19.	08:07	28	M	70.8	72.3	200	185	3.92	3.388	19.90	0.0674	2.8	19.8	18.8	15.78	bc	ENE	2	2	1013.8	13-40.2 017-19.1	Remplacer de 340-024
	C-005	STD	342-028	50~100	50~100	13-41.9 017-23.	09:43	27	M/Shell	90.8	90.8	250	000	3.78	3.150	18.83	0.0593	2.3	21.2	18.8	15.32	bc	E'st	2	2	1014.5	13-43.5 017-23.1	
	C-006	STD	348-026	50~100	50~100	13-48.0 017-19.	11:30	30	Sh/M	71.7	68.0	200	010	3.86	3.574	14.33	0.0512	2.8	21.6	18.7	15.78	bc	E'st	2	2	1014.4	13-50.0 017-19.4	
	C-007	STD	352-029	50~100	50~100	13-52.0 017-24.	13:08	27	M/Sh	95.5	94.1	250	005	3.60	3.000	14.77	0.0443	3.2	23.0	19.8	15.16	bc	E'st	2	2	1013.7	13-53.7 017-24.3	
	C-008	STD	352-029	100~200	100~200	13-54.2 017-26.	14:33	29	R/Sh/M	103	105	300	178	3.79	3.393	17.80	0.0604	2.5	23.1	20.6	14.67	bc	ENE	2	2	1012.4	13-52.4 017-26.0	
	C-009	STD	346-017	10~50	10~50	13-48.0 017-01.	18:20	30	M/R	23.6	24.8	150	180	3.76	3.482	13.70	0.0477	2.3	24.0	20.4	16.54	bc	N'th	2	2	1010.6	13-46.0 017-01.1	
7			400-032	100~200		Impossibilité de pêcher à cause de la non-existence de moin de 200m de profondeur																					Remplacer à 400-031
	C-010	STD	400-031	100~200	100~200	13-59.9 017-28.	08:17	14	R/Sh	125	123	350	345	3.86	1.668	16.65	0.0278	2.3	21.5	21.6	14.60	bc	NE	2	2	1014.1	14-00.7 017-28.9	Remplacer de 400-032, Relevage précoce à cause de l'existance de roche au fond
			406-031	50~100		Impossibilité de pêcher à cause de la non-existence de moin de 100m de profondeur																					Remplacer à 400-029
	C-011	STD	400-029	50~100	50~100	14-00.2 017-25.	09:48	29	M/Sh/R	88.8	89.5	250	008	3.68	3.294	16.45	0.0542	2.5	21.9	19.8	15.11	bc	ENE	2	2	1015.1	14-02.0 017-25.4	Remplacer de 400-031
	C-012	STD	358-029	50~100	50~100	13-59.6 017-25.	11:18	27	M/Sh/R	91.5	89.3	250	170	3.56	2.967	15.06	0.0447	2.3	24.0	19.4	15.19	bc	NE	3	3	1015.0	13-58.0 017-25.8	
	C-013	STD	354-017	10~50	10~50	13-54.2 017-01.	15:12	30	M/Sh/R	19.8	18.9	100	000	4.28	3.963	9.13	0.0362	3.0	24.6	20.8	17.55	bc	NNE	1	1	1012.2	13-56.2 017-01.4	Remplacer de 442-033
8			356-014	10~50		Impossibilité de pêcher à cause de l'existence en mer des filets des pêcheurs artisanaux																					Remplacer à 356-015
	C-014	STD	356-015	10~50	10~50	13-56.1 016-57.	08:02	30	M/Sh	14.3	13.4	100	000	4.00	3.704	8.61	0.0319	3.1	20.0	19.6	19.04	bc	ENE	2	2	1014.2	13-58.1 016-57.2	Remplacer de 356-014
	C-015	STD	404-016	10~50	10~50	14-04.2 016-59.	09:32	30	Sh/R/M	15.4	13.9	100	000	3.82	3.537	13.38	0.0473	3.2	21.8	18.8	18.55	bc	ENE	2	2	1015.2	14-06.1 016-59.4	
	C-016	STD	404-017	10~50	10~50	14-06.1 017-01.	10:34	30	Sh/M/R	16.5	16.8	100	180	3.80	3.519	12.39	0.0436	2.5	24.0	19.6	18.57	bc	NE	2	2	1015.9	14-04.1 017-01.4	
	C-017	STD	408-016	10~50	10~50	14-08.1 016-59.	11:58	30	M/Sh/R	14.1	13.1	100	000	3.90	3.611	10.76	0.0389	2.4	24.2	18.8	18.24	bc	ENE	2	2	1014.9	14-10.0 016-59.6	
	C-018	STD	408-027	50~100	50~100	14-08.4 017-21.	15:09	28	M/S	77.5	79.7	250	000	3.94	3.405	17.75	0.0604	2.5	25.3	19.8	16.28	bc	ENE	2	2	1012.2	14-10.2 017-21.6	
			404-024	50~100		Impossibilité de pêcher à cause de l'existance des roches au fond																					Remplacer à 404-025
	C-019	STD	404-025	50~100	50~100	14-06.1 017-17.	16:54	30	M/Sh	67.0	66.1	200	170	3.52	3.260	17.77	0.0579	2.3	24.0	21.0	16.43	bc	NNW	2	2	1011.1	14-04.3 017-17.8	Remplacer de 404-024
9	C-020	STD	412-029	50~100	50~100	14-12.1 017-24.	07:40	30	M	91.5	89.2	300	000	3.64	3.371	17.80	0.0600	2.3	19.8	20.4	16.31	bc	N'th	2	2	1013.0	14-14.0 017-24.7	
	C-021	STD	412-032	100~200	100~200	14-12.0 017-30.	09:38	29	M/S	119	122	300	000	3.66	3.276	15.90	0.0521	2.5	21.9	19.2	15.76	bc	N'th	3	3	1014.0	14-13.8 017-30.8	
	C-022	STD	420-032	100~200	100~200	14-19.9 017-31.	11:39	30	M	128.0	128	350	000	3.80	3.519	18.53	0.0652	2.4	23.2	20.9	15.56	bc	NNW	3	3	1014.1	14-21.8 017-31.5	
	C-023	STD	424-030	50~100	50~100	14-23.8 017-27.	13:29	21	M/R	95.7	92.0	300	010	3.97	2.573	14.58	0.0375	2.4	23.6	20.6	16.19	bc	NNW	2	2	1013.1	14-25.2 017-27.6	Remplacer de 432-029, Relevage précoce à cause de l'existance de roche au fond
	C-024	STD	416-027	50~100	50~100	14-18.2 017-21.	15:28	30	R/M	62.5	63.7	200	180	3.86	3.574	15.55	0.0556	2.3	22.5	19.8	16.73	c	NW	2	2	1011.1	14-16.3 017-21.6	
	C-025	STD	420-026	10~50	10~50	14-20.2 017-19.	16:57	30	R/M	47.1	47.6	150	000	3.66	3.389	13.75	0.0466	2.3	23.2	19.6	17.26	c	NW	2	2	1010.6	14-22.0 017-19.2	
10	C-026	STD	422-020	10~50	10~50	14-22.1 017-07.	07:50	22	M/S	16.6	16.1	100	000	4.09	2.777	11.86	0.0329	2.4	19.8	19.4	18.28	c	N'th	2	2	1013.2	14-23.6 017-07.4	Relevage précoce à cause de l'existence en mer des filets des pêcheurs artisanaux
	C-027	STD	426-027	50~100	50~100	14-26.2 017-21.	10:10	30	M	64.2	64.3	200	000	3.84	3.556	16.65	0.0592	2.4	21.1	19.3	17.21	bc	N'th	2	2	1014.5	14-28.2 017-21.6	
14	ZONE SUD																										
	S-001	STD	228-017	10~50	10~50	12-30.0 017-00.	07:53	30	M	14.6	13.9	100	180	3.70	3.426	12.90	0.0442	2.4	21.8	21.4	21.43	c	N'th	2	2	1014.1	12-28.1 017-00.8	
			226-027	50~100		Impossibilité de pêcher à cause de l'existance des roches au fond																					Remplacer à 220-026
	S-002	STD	220-026	50~100	50~100	12-21.8 017-19.	11:30	30	M/R	57.3	66.8	200	150	3.78	3.500	16.60	0.0581	2.5	23.9	20.8	16.56	c	N'th	3	3	1015.5	12-20.0 017-19.1	Remplacer de 220-027
	S-003	STD	222-028	50~100	50~100	12-22.1 017-23.	13:05	25	M/R	78.0	61.0	250	000	3.60	2.778	15.10	0.0419	2.2	24.2	21.0	16.52	c	NNW	3	3	1014.5	12-23.6 017-23.1	Relevage précoce à cause de l'existance de roche au fond
	S-004	STD	224-029	50~100	50~100	12-23.8 017-24.	14:21	30	M/R	73.8	58.8	250	000	3.46	3.204	16.41	0.0526	2.4	23.8	21.1	16.48	c	NNW	3	3	1013.1	12-25.5 017-25.1	à cause de l'existence de roche au fond
15	S-005	STD	226-024	10~50	10~50	12-25.9 017-15.	07:20	30	M/R	22.7	21.7	150	000	4.10	3.797	11.30	0.0429	2.5	19.9	20.6	18.20	bc	N'th	2	2	1013.0	12-27.9 017-15.0	
			226-030	100~200		Impossibilité de pêcher à cause de la non-existence de plus de 100m de profondeur																					Remplacer à 226-031

Table 2-3 Cool Season Marine Survey Data (3)

JOURNAL DE PECHE DE FOND

Date of Operation	Date d'opération	Number of Operation / Numéro d'opération	Hydraulic survey / Etude hydraulique	Number of station / Numéro de station	Depth zone (Plan and actual)	Zone de la profondeur (programme et exécution)	Lat. (N) Position of Start of net towing / Position de pose du chalut Long. (W)	Time of towing the net / Heure de pose du chalut	Time of towing the net (min.) / Temps de trainage (min.)	Bottom materials / Matériaux du fond	Depth (m) Bigining of trawling / Lors de la pose du chalut	Profondeur (m) Finishing of trawling / Lors du relevage du chalut	Length of warp (m) / Longueur de fune (m)	Operation of net / Opération de chalut: Cours (°) / Direction(°)	Vitesse (Kt)	Distance (km)	Distance between wing tips (m) / Distance entre pointes d'ailes (m)	Dimention of trawling (km^2) / Dimention de la pêche (km^2)	Height of head rope (m) / Hauteur d'ouverture verticale du filet (m)	Air temperature (°) / Température de l'air (°)	Water temperature, surface (°) / Température de l'eau de mer, surface (°)	Water temperature, bottom (°) / Température de l'eau de mer, fond (°)	Weather condition / Conditions de mer	Wind directions / Directions du vent	Beaufort scale	Sea conditions / Etat de la mer	Atomosphare pressure (hPa.)	Lat. (N)	Long. (W)	Remarks / Remarques
		S-006	STD	226-031	100~200	100~200	12-26.0 017-29.	09:41	29	M/S	102	100	300	345	3.66	3.276	16.18	0.0530	2.2	21.5	20.8	15.50	bc	N'th	2	2	1014.1	12-27.8	017-29.9	Remplacer de 226-030
		S-007	STD	230-032	50~100	50~100	12-30.0 017-30.	11:06	30	S/M	53.0	52.2	200	345	3.90	3.611	15.64	0.0565	-	22.1	20.7	16.70	bc	N'th	2	2	1014.4	12-31.7	017-31.7	
				~~236-034~~	50~100		Impossibilité de pêcher à cause de la non-existence de moin de 100m de profondeur																							Remplacer à 230-031
		S-008	STD	236-031	10~50	10~50	12-35.9 017-29.	13:08	30	S/M	40.4	39.9	150	000	3.82	3.537	15.88	0.0562	2.4	24.0	20.7	17.00	bc	N'th	2	2	1013.4	12-37.8	017-29.8	
				~~230-031~~	50~100		Impossibilité de pêcher à cause de la non-existence de plus de 50m de profondeur																							Remplacer de 236-034, remplacer à 228-031
		S-009	STD	228-031	50~100	50~100	12-30.2 017-30.	15:08	30	M/S	50.4	58.3	150	164	3.94	3.648	15.31	0.0559	3.0	24.8	21.0	15.66	bc	NNW	2	2	1011.2	12-28.3	017-29.6	Remplacer de 230-031
	16			~~238-035~~	100~200		Impossibilité de pêcher à cause de la non-existence de plus de 100m de profondeur																							Remplacer à 238-036
				~~238-036~~	100~200		Impossibilité de pêcher à cause de la non-existence de moin de 200m de profondeur																							Remplacer de 238-035, remplacer à 244-036
		S-010	STD	240-033	10~50	10~50	12-40.1 017-32.	08:50	30	S/M	46.5	46.2	150	000	3.74	3.463	15.08	0.0522	2.3	24.0	21.3	17.07	b	W'st	2	2	1012.6	12-41.9	017-32.4	
				~~242-033~~	50~100		Impossibilité de pêcher à cause de la non-existence de plus de 50m de profondeur																							Remplacer à 258-033
		S-011	STD	242-034	50~100	50~100	12-41.9 017-35.	10:18	30	S/M	50.0	51.2	200	320	3.85	3.565	15.55	0.0554	2.2	22.5	21.4	16.93	b	NW	2	2	1014.1	12-43.7	017-35.9	
		S-012	STD	242-035	50~100	50~100	12-42.1 017-36.	11:38	30	S/M	71.7	55.0	200	355	3.70	3.426	15.63	0.0535	2.5	23.9	21.8	16.89	b	NNW	1	1	1014.0	12-43.9	017-36.9	
				~~246-033~~	50~100		Impossibilité de pêcher à cause de la non-existence de plus de 50m de profondeur																							
		S-013	STD	248-032	10~50	10~50	12-48.1 017-30.	13:26	30	S/M	47.6	49.2	150	000	3.74	3.463	16.14	0.0559	2.5	24.2	21.9	17.43	b	NNW	1	1	1012.0	12-49.9	017-30.9	
		S-014	STD	244-036	100~200	100~200	12-45.5 017-38.	16:47	30	S/M	104	110	300	190	3.66	3.389	16.18	0.0548	2.2	24.9	22.5	15.52	b	NNW	1	1	1010.1	12-43.7	017-39.9	Remplacer de 238-036
	17	S-015	STD	248-035	50~100	50~100	12-48.3 017-37.	08:11	30	S/M	62.3	69.3	200	000	3.64	3.371	15.55	0.0524	2.2	22.4	21.8	15.81	b	NW	2	2	1012.6	12-50.1	017-37.7	
		S-016	STD	250-034	50~100	50~100	12-50.0 017-35.	09:33	30	S/M	58.1	62.9	200	000	3.68	3.408	15.49	0.0528	2.2	21.8	21.2	16.40	b	NW	1	1	1013.8	12-51.8	017-35.4	
				~~300-035~~	50~100		Impossibilité de pêcher à cause de la non-existence de moin de 100m de profondeur																							Remplacer à 300-034
				~~300-034~~	50~100	50~100	13-00.0 017-36.	11:34	11	S/M/R	99.9	99.9	300	030	3.71	1.260	12.95	0.0163	2.2	25.0	21.8	-	b	NW	2	2	1014.2	13-00.6	017-35.6	Remplacer à 302-031, Annuler à cause de l'accident du dommage de filet par des roches au fond
				~~302-031~~	50~100		Annuler à cause de l'extence de la frontiàre entre du SENEGAL et de la GAMBIE																							Remplacer à 258-034
		S-017	STD	258-034	50~100	50~100	12-58.0 017-35.	13:10	30	S/M	79.5	88.0	250	005	3.72	3.445	16.43	0.0566	2.2	24.8	21.8	16.20	b	WNW	1	1	1013.1	12-59.9	017-35.0	
		S-018	STD	258-033	50~100	50~100	12-58.0 017-33.	14:32	30	S/M	68.0	72.8	200	000	3.72	3.445	16.52	0.0569	2.5	24.4	21.7	16.30	b	WNW	1	1	1012.3	12-59.9	017-33.5	Remplacer de 242-033
				~~302-032~~	50~100		Annuler à cause de l'extence de la frontiàre entre du SENEGAL et de la GAMBIE																							Remplacer à 300-032
		S-019	STD	300-032	50~100	50~100	13-00.1 017-31.	15:51	30	S/M	64.5	67.1	200	000	3.80	3.519	16.60	0.0584	2.2	23.8	21.7	16.35	bc	WNW	1	1	1011.3	13-02.0	017-31.4	Remplacer de 302-032
	18	S-020	STD	258-030	50~100	50~100	13-00.0 017-26.	07:49	30	S/S-weed	52.5	51.1	150	185	4.04	3.741	14.55	0.0544	2.3	20.8	20.1	17.32	bc	NNW	2	2	1012.8	12-58.0	017-26.7	Remplacer de 246-033
		S-021	STD	254-028	10~50	10~50	12-55.9 017-23.	09:10	30	S/Sw	44.3	43.3	150	170	3.94	3.648	16.15	0.0589	2.0	21.2	20.0	17.69	bc	NNW	2	2	1013.5	12-53.9	017-23.4	
		S-022	STD	252-028	10~50	10~50	12-54.0 017-23.	10:23	30	S	43.4	41.8	150	180	3.76	3.482	16.94	0.0590	2.2	22.8	20.3	17.82	bc	NNW	2	2	1014.0	12-52.1	017-23.4	
		S-023	STD	254-027	10~50	10~50	12-54.0 017-21.	11:34	30	S	41.0	41.8	150	005	3.78	3.500	16.14	0.0565	2.2	22.8	20.6	17.68	bc	NNW	2	2	1013.9	12-55.9	017-21.4	
	19	S-024	STD	236-017	10~50	10~50	12-36.1 017-01.	07:40	30	M	14.0	13.1	100	000	3.88	3.593	12.73	0.0457	2.5	21.7	22.0	21.69	bc	WNW	2	2	1011.8	12-38.0	017-00.7	
		S-025	STD	246-020	10~50	10~50	12-46.0 017-06.	09:36	30	M/S	19.0	19.4	100	000	3.80	3.519	13.43	0.0473	2.5	21.9	21.6	20.27	b	WNW	1	1	1012.2	12-47.9	017-06.8	
		S-026	STD	248-025	10~50	10~50	12-48.0 017-16.	11:32	30	S/M	30.8	33.7	100	345	3.98	3.685	12.90	0.0475	2.5	22.4	21.7	18.61	b	NW	1	1	1012.3	12-49.9	017-17.2	
		S-027	STD	252-019	10~50	10~50	12-52.2 017-05.	13:45	30	S/M	19.9	20.1	100	005	3.82	3.537	13.96	0.0494	2.5	23.5	21.7	19.73	bc	NW	3	3	1011.6	12-54.1	017-05.2	
	20	S-028	STD	256-020	10~50	10~50	12-56.0 017-07.	12:12	30	S	23.5	23.5	100	010	3.70	3.426	12.91	0.0442	2.5	23.8	22.6	19.41	b	W'st	1	1	1013.2	12-57.9	017-07.0	
		S-029	STD	256-019	10~50	10~50	12-58.1 017-05.	13:16	30	S	22.1	21.2	150	170	3.60	3.334	14.55	0.0485	2.4	25.0	23.0	19.77	c	WNW	1	1	1012.8	12-56.3	017-05.2	
		S-030	STD	256-017	10~50	10~50	12-55.9 017-01.	14:33	30	S	20.4	20.0	150	000	3.46	3.204	16.15	0.0517	2.2	24.0	23.0	19.78	c	WNW	1	1	1011.7	12-57.6	017-01.4	
				~~302-018~~	10~50		Annuler à cause de l'extence de la frontiàre entre du SENEGAL et de la GAMBIE																							Remplacer à 300-018
		S-031	STD	300-018	10~50	10~50	13-00.1 017-02.	15:41	30	S	19.5	21.4	150	330	3.40	3.148	14.55	0.0458	2.4	23.1	23.0	19.25	bc	NNW	1	1	1011.0	13-01.6	017-03.3	Remplacer de 302-018
		ES-32	STD	252-014	10~50	10~50	12-54.9 016-55.	17:40	30	S	13.0	13.4	150	180	3.80	3.519	16.14	0.0568	2.3	22.7	23.5	22.36	bc	NNW	1	1	1011.0	12-53.0	016-54.9	Machoirons
	21	ZONE CENTRALE																												
		EC-28	STD	344-013	10~50	10~50	13-44.4 016-52.	11:44	31	S	14.8	16.2	150	295	3.62	3.464	12.04	0.0417	-	21.8	21.0	18.58	b	N'th	3	3	1016.9	13-45.0	016-54.0	Machoirons

Table 2-6 Warm Season Marine Survey Data (1)

JOURNAL DE PECHE DE FOND

Date of Operation / Date d'opération	Number of Operation / Numéro d'opération	Hydraulic survey / Etude hydraulique	Number of station / Numéro de station	Depth zone (Plan and actual)	Zone de la profondeur (programme et exécution)	Lat. (N) / Position of Start of net towing / Position de pose du chalut / Long. (W)	Time of towing the net / Heure de pose du chalut	Time of towing the net (min.) / Temps de trainage (min.)	Bottom materials / Matériaux du fond	Bigining of trawling / Lors de la pose du chalut — Depth (m)	Finishing of trawling / Lors du relevage du chalut — Profondeur (m)	Length of warp (m) / Longueur de fune (m)	Cours (°) / Direction(°)	Operation of net / Vitesse (Kt)	Opération de chalut / Distance (km)	Distance between wing tips (m)	Distance entre pointes d'ailes (m)	Dimention of trawling (km²)	Dimention de la pêche (km²)	Height of head rope (m)	Hauteur d'ouverture verticale du filet (m)	Air temperature (°) / Température de l'air (°)	Water temperature, surface (°) / Température de l'eau de mer, surface (°)	Water temperature, bottom (°) / Température de l'eau de mer, fond (°)	Weather condition / Conditions de mer	Wind directions Directions du vent	Beaufort scale	Sea conditions / Etat de la mer	Atomosphare pressure (hPa.)	Lat. (N) / Long. (W)	Remarks / Remarques
7 31	**ZONE SUD**																														
	S-001	STD	228-017	10~50	10~50	12-29.90 017-01.	09:15	30	S/M	15.4	15.5	150	180	3.48	3.222	7.32	0.0236	-	29.5	27.9	27.87	c	SW	3	2	1015.2	12-28.12 017-01.12	
	S-002	STD	220-026	50~100	50~100	12-22.45 017-19.	12:17	30	Sand	50.5	67.9	150	196	3.80	3.519	14.50	0.0510	2.0	29.5	27.8	19.07	c	W'st	3	2	1017.0	12-20.65 017-19.81	
	S-003	STD	222-028	50~100	50~100	12-22.64 017-22.	13:55	26	S	70.0	54.0	250	000	3.49	2.801	16.45	0.0461	1.8	26.0	27.8	20.19	r	NNW	2	2	1015.4	12-24.21 017-22.68	
	S-004	STD	224-029	50~100	50~100	12-23.92 017-25.	15:27	30	S/R	74.1	54.0	250	350	3.76	3.482	16.41	0.0571	1.5	27.0	27.9	20.34	c	W'st	2	2	1014.1	12-25.83 017-25.12	Accident du dommage de filet par des roches au fond
8 1	S-005	STD	226-024	10-50	10-50	12-25.91 017-15.	07:24	30	S	22.6	22.5	150	000	3.60	3.334	10.55	0.0352	1.8	26.3	27.8	26.81	c	NE	2	2	1013.8	12-27.72 017-14.68	
	S-006	STD	226-031	100-200	100-200	12-25.85 017-29.	10:02	27	S/R	102	104	300	335	3.53	2.942	15.99	0.0470	1.8	29.0	27.6	15.66	bc	ENE	2	2	1014.0	12-27.37 017-29.95	
	S-007	STD	228-031	50-100	50-100	12-27.86 017-29.	11:34	30	S/R	62.6	50.0	250	005	3.76	3.482	16.36	0.0570	1.5	30.0	27.73	19.27	c	ESE	2	2	1014.5	12-29.70 017-29.49	
	S-008	STD	230-032	50~100	50~100	12-29.87 017-31.	12:58	30	S	54.6	50.7	200	000	3.60	3.334	14.56	0.0485	1.8	28.9	27.16	18.86	c	SSE	2	2	1014.1	12-31.63 017-31.47	
2	S-009	STD	236-017	10-50	10-50	12-36.08 017-00.	07:12	30	S	13.5	13.3	150	350	3.74	3.463	12.15	0.0421	-	25.5	27.83	27.83	c	SSE	3	3	1013.8	12-37.94 017-00.62	
	S-010	STD	236-031	10-50	10-50	12-35.98 017-29.	11:27	30	S/M	39.7	39.6	150	340	3.64	3.371	10.51	0.0354	1.8	27.0	27.66	20.61	bc	SSE	4	3	1014.2	12-37.78 017-29.29	
	S-011	STD	240-033	10~50	10~50	12-40.12 017-32.	12:55	30	S/M	46.4	46.4	150	350	3.64	3.371	14.54	0.0490	1.6	28.0	27.7	20.66	bc	S'th	4	3	1014.0	12-41.94 017-32.81	
	S-012	STD	242-034	50-100	50-100	12-41.82 017-35.	14:33	30	S	51.1	50.1	200	340	3.68	3.408	14.57	0.0497	1.8	26.7	27.5	18.22	c	S'th	4	3	1014.0	12-43.68 017-35.91	
3	S-013	STD	246-020	10-50	10-50	12-45.90 017-07.	07:30	30	S	18.6	19.6	150	355	3.60	3.334	15.31	0.0510	-	27.8	27.7	27.69	c	SSW	3	2	1015.5	12-47.66 017-06.65	
	S-014	STD	242-035	50~100	50-100	12-41.85 017-36.	12:00	30	S	64.3	54.1	200	350	3.50	3.241	17.55	0.0569	1.7	27.0	27.7	18.63	c	SW	3	2	1017.0	12-43.64 017-36.55	
	S-015	STD	244-036	100-200	100-200	12-43.62 017-38.	14:08	30	S/R	106	104	300	345	3.50	3.241	12.95	0.0420	1.7	26.0	27.7	15.09	r	N'th	3	3	1015.2	12-45.40 017-38.72	
	S-016	STD	248-035	50-100	50-100	12-47.94 017-37.	15:43	30	S/M	59.7	64.1	200	350	3.52	3.260	17.76	0.0579	1.8	25.8	27.7	17.00	r	N'th	2	2	1014.0	12-49.71 017-37.12	
4	S-017	STD	248-025	10-50	10-50	12-47.94 017-16.	07:07	30	S/R	31.2	33.0	150	347	3.64	3.371	12.94	0.0436	1.8	27.5	27.4	25.56	c	SSW	3	2	1013.9	12-49.77 017-16.88	Accident du dommage de filet par des roches au fond
	S-018	STD	248-032	50-100	50-100	12-48.06 017-30.	10:17	30	S	48.0	49.3	150	000	3.46	3.204	13.72	0.0440	2.0	28.8	27.7	19.83	bc	SW	2	2	1014.3	12-49.77 017-30.67	
	S-019	STD	250-034	50-100	50-100	12-50.04 017-34.	11:48	30	S	57.4	62.4	200	335	3.68	3.408	18.84	0.0642	1.7	27.8	28.0	16.55	bc	SW	3	2	1014.2	12-51.85 017-35.13	
	S-020	STD	252-028	10-50	10-50	12-51.73 017-23.	14:10	30	S	41.4	42.4	150	350	3.56	3.297	12.87	0.0424	1.9	28.1	28.1	21.33	bc	SW	3	2	1013.5	12-53.52 017-22.97	
5	252-014		10-50																										Remplacer à 252-015, Annuler à cause de l'existence en mer des filets des pêcheurs artisanaux
	S-021	STD	252-015	10-50	10-50	12-54.25 016-56.	07:39	27	S	15.1	16.1	150	190	3.47	2.892	13.72	0.0397	-	26.7	28.2	27.94	bc	WNW	2	2	1013.4	12-52.70 016-57.12	Remplacer de 252-014
	S-022	STD	252-019	10~50	10~50	12-52.05 017-05.	09:35	26	S	20.6	21.2	150	350	3.60	2.889	15.29	0.0442	1.5	27.5	28.0	27.67	c	SSW	2	2	1014.5	12-53.61 017-04.98	
	S-023	STD	254-027	10-50	10~50	12-53.97 017-20.	12:18	31	S	40.5	42.0	150	330	3.74	3.579	12.93	0.0463	1.8	27.5	27.9	20.87	bc	SSW	3	2	1014.2	12-55.90 017-21.02	
	S-024	STD	254-028	10-50	10~50	12-56.02 017-22.	13:37	30	S	44.5	44.0	150	195	3.64	3.371	12.82	0.0432	1.8	28.7	28.1	20.62	bc	SSW	3	2	1013.6	12-54.29 017-23.56	
6	S-025	STD	256-017	10-50	10~50	12-56.04 017-01.	07:11	30	S/R	19.4	20.1	150	350	3.58	3.315	12.12	0.0402	2.0	26.0	28.2	27.99	c	SW	2	2	1014.8	12-57.83 017-01.11	
	S-026	STD	256-019	10-50	10~50	12-58.03 017-04.	08:43	30	S	22.2	21.4	150	190	3.60	3.334	11.23	0.0374	2.0	26.9	28.0	27.99	c	W'st	3	2	1015.9	12-56.23 017-04.96	
	S-027	STD	300-018	10-50	10~50	13-00.19 017-03.	10:31	30	S/R	21.2	22.1	150	000	3.60	3.334	11.30	0.0377	2.0	26.4	28.2	28.01	r	S'th	4	3	1016.2	13-01.97 017-02.88	
	256-020		10-50																										Remplacer à 256-021, Annuler à cause de l'existence en mer des filets des pêcheurs artisanaux
	S-028	STD	256-021	10-50	10~50	12-58.03 017-08.	12:41	30	S	26.5	29.2	150	230	3.58	3.315	12.15	0.0403	1.7	28.2	27.9	25.69	c	SSW	3	2	1016.2	12-56.86 017-09.86	Remplacer de 256-020
7	S-029	STD	258-030	50-100	50-100	12-58.06 017-27.	07:32	30	S	51.6	53.8	200	350	3.59	3.324	14.52	0.0483	1.8	26.2	27.8	18.55	r	WSW	3	2	1016.2	12-59.85 017-27.85	
	S-030	STD	300-032	50-100	50-100	12-59.86 017-30.	09:04	30	S/R	61.3	65.1	200	345	3.74	3.463	15.36	0.0532	1.9	27.1	27.8	18.50	c	W'st	3	2	1017.0	13-01.74 017-30.70	
	S-031	STD	258-033	50-100	50-100	12-59.81 017-33.	10:36	30	S	69.1	67.4	250	195	3.50	3.241	13.67	0.0443	1.6	27.2	28.0	16.69	c	NW	2	2	1017.6	12-58.05 017-33.25	
	S-032	STD	258-034	50-100	50-100	12-58.07 017-34.	11:58	30	S/R	77.5	87.5	250	345	3.64	3.371	13.75	0.0464	1.6	27.1	28.08	15.23	c	SW	2	2	1017.9	12-59.90 017-34.85	

Table 2-6 Warm Season Marine Survey Data (2)

JOURNAL DE PECHE DE FOND

Date of Operation / Date d'opération	Number of Operation / Numéro d'opération	Hydraulic survey / Etude hydraulique	Number of station / Numéro de station	Depth zone (Plan and actual)	Zone de la profondeur (programme et exécution)	Position of Start of net towing Lat. (N)	Position de pose du chalut Long. (W)	Time of towing the net / Heure de pose du chalut	Time of towing the net (min.) / Temps de trainage (min.)	Bottom materials / Matériaux du fond	Bigining of trawling Depth (m) / Lors de la pose du chalut Profondeur (m)	Finishing of trawling / Lors du relevage du chalut	Length of warp (m) / Longueur de fune (m)	Operation of net Direction(°) / Cours (°)	Vitesse (Kt)	Distance (km) / Opération de chalut	Distance between wing tips (m) / Distance entre pointes d'ailes (m)	Dimention of trawling (km²)	Dimention de la pêche (km²)	Height of head rope (m) / Hauteur d'ouverture verticale du filet (m)	Air temperature (°) / Température de l'air (°)	Water temperature, surface (°) / Température de l'eau de mer, surface (°)	Water temperature, bottom (°) / Température de l'eau de mer, fond (°)	Weather condition / Conditions de mer	Wind directions Directions du vent	Beaufort scale / Sea conditions / Etat de la mer	Atomosphare pressure (hPa)	Lat. (N)	Long. (W)	Remarks / Remarques
	ZONE CENTRALE																														
11	C-001	STD	346-017	10-50	10~50	13-48.13	017-00.	07:22	30	S/Sh	22.3	23.2	150	180	3.51	3.250	13.59	0.0442	2.0	27.7	28.52	28.26	bc	WNW	4	3	1013.9	13-46.42	017-00.56	
	C-002	STD	344-013	10-50	10~50	13-44.08	016-53.	09:12	30	S/M	14.7	14.9	150	345	3.60	3.334	12.94	0.0431	-	29.9	29.2	29.15	bc	W'st	4	3	1012.6	13-45.87	016-53.52	
	C-003	STD	354-017	10-50	10~50	13-54.11	017-01.	11:29	30	S/M	20.0	20.5	150	340	3.56	3.297	12.95	0.0427	1.7	29.8	28.0	27.45	c	W'st	4	3	1013.5	13-55.83	017-01.74	
	C-004	STD	356-015	10-50	10~50	13-57.00	016-57.	13:06	30	Sh/S	12.6	14	150	200	3.80	3.519	12.82	0.0451	-	29.6	28.8	28.74	c	WNW	4	3	1011.2	13-56.13	016-57.62	
12	C-005	STD	340-026	50~100	50~100	13-41.96	017-19.	07:01	30	R/S	73.3	72.0	250	190	3.52	3.260	11.07	0.0361	1.7	27.9	28.5	16.52	bc	W'st	3	2	1010.3	13-40.29	017-19.72	
	C-006	STD	342-028	50~100	50~100	13-41.74	017-23.	08:37	30	S/R	90.2	92.5	300	345	3.60	3.334	14.55	0.0485	1.7	28.2	28.5	15.50	bc	W'st	3	2	1011.0	13-43.46	017-23.76	
	C-007	STD	348-026	50~100	50~100	13-47.97	017-19.	10:31	30	S/R	71.3	70.4	250	350	3.45	3.195	13.75	0.0439	-	30.7	28.8	16.23	bc	SE	2	1	1012.5	13-49.64	017-19.90	
			352-029	50-100																										filet et câble par des roches au fond
	C-008	STD	352-029	50~100	50~100	13-52.20	017-24.	13:03	30	S/R	95.2	93.4	300	000	3.45	3.195	16.15	0.0516	1.5	30.9	28.9	15.20	bc	SSE	3	1	1012.5	13-53.92	017-24.34	
	C-009	STD	352-029	100~200	100-200	13-53.76	017-25.	14:35	30	S/R/Sh	102	104	300	180	3.37	3.121	16.10	0.0502	-	29.4	28.77	14.84	bc	SSE	4	3	1011.8	13-52.06	017-25.97	
13	C-010	STD	404-025	50-100	50~100	14-04.16	017-16.	07:24	30	S/R	63.0	63.7	200	345	3.64	3.371	9.20	0.0310	1.7	26.3	28.2	17.36	bc	ESE	3	2	1014.5	14-05.97	017-17.08	
			404-017	10-50																										Remplacer à 402-024, Annuler à cause de l'existence en mer des filets des pêcheurs artisanaux
			404-016	10-50																										Remplacer à 250-021, Annuler à cause de l'existence en mer des filets des pêcheurs artisanaux
			408-016	10-50																										Remplacer à 250-021, Annuler à cause de l'existence en mer des filets des pêcheurs artisanaux
	C-011	STD	402-024	10-50	10~50	14-03.98	017-14.	12:04	30	R/S	46.3	46.2	150	175	3.52	3.260	15.32	0.0499	1.7	28.4	28.4	21.28	C	SSE	4	3	1015.3	14-02.23	017-14.67	Remplacer de 404-017. Accident du dommage de filet par des roches au fond
	C-012	STD	342-024	10-50	10~50	13-44.09	017-14.	15:17	30	R/S	49.3	49.7	150	180	3.44	3.185	13.65	0.0435	2.0	28.0	28.8	20.90	bc	S'th	5	3	1013.8	13-42.37	017-14.70	Remplacer de 404-016
	C-013	STD	356-014	10-50	10~50	13-55.88	016-55.	18:35	30	S/Sh	12.4	12.0	150	020	3.60	3.334	11.35	0.0378	-	28.8	29.2	29.25	bc	SSW	4	3	1014.0	13-57.58	016-54.88	Remplacer de 408-016
14	C-014	STD	358-029	50-100	50~100	13-58.38	017-24.	07:44	30	S	83.2	87.3	250	350	3.57	3.306	12.41	0.0410	1.7	27.5	28.4	16.73	bc	SSW	3	2	1015.9	14-00.17	017-25.16	
			400-029	50-100																										Accident du dommage de câble par des roches au fond
	C-015	STD	400-029	50-100	50~100	14-02.37	017-25.	10:11	30	S/R	89.7	89.4	300	170	3.60	3.334	16.19	0.0540	-	28.2	28.4	15.72	c	SSW	4	2	1018.3	14-00.57	017-25.57	
	C-016	STD	400-031	100~200	100-200	14-00.48	017-28.	11:52	30	R/Sh	111	108	350	005	3.66	3.389	12.93	0.0438	1.7	29.6	28.4	14.94	c	SSW	4	2	1018.0	14-02.25	017-28.80	Accident du dommage de filet par des roches au fond
	C-017	STD	408-027	50-100	50~100	14-08.17	017-21.	14:11	30	S/R/Sh	72.9	76.4	250	000	3.76	3.482	15.08	0.0525	1.5	30.0	28.6	18.44	c	SSW	4	2	1017.0	14-10.07	017-21.20	
15	C-018	STD	412-029	50-100	50~100	14-14.12	017-25.	07:22	30	S/R	95.3	98.4	300	200	3.66	3.389	12.92	0.0438	1.6	27.8	28.4	16.19	bc	W'st	3	2	1017.4	14-12.31	017-25.86	
	C-019	STD	412-032	100~200	100-200	14-12.21	017-31.	09:21	30	S/R	125	129	400	355	3.58	3.315	14.59	0.0484	2.0	27.8	28.4	14.54	bc	W'st	4	3	1018.3	14-10.00	016-59.60	
	C-020	STD	420-032	100~200	100-200	14-20.13	017-31.	11:17	30	S/Sh	120	118	400	355	3.59	3.324	14.56	0.0484	1.8	28.2	28.5	14.66	bc	WNW	4	3	1018.2	14-21.92	017-31.04	
	C-021	STD	416-027	50~100	50~100	14-18.16	017-20.	13:40	21	S/R	59.3	60.5	200	180	3.69	2.392	14.41	0.0345	-	29.5	28.6	20.13	bc	WNW	3	3	1017.0	14-16.87	017-20.74	
16	C-022	STD	422-020	10-50	10~50	14-21.87	017-07.	07:20	17	Sh/S	15.7	16.8	150	335	3.71	1.947	12.15	0.0237	1.6	27.0	28.2	28.22	bc	NW	4	3	1014.5	14-22.86	017-07.45	Relevage précoce à cause de l'existence en mer des filets des pêcheurs artisanaux
	C-023	STD	420-026	10-50	10~50	14-19.75	017-18.	09:33	30	R/S/Sh	48.7	46.7	150	005	3.53	3.269	15.31	0.0500	1.5	29.2	28.2	20.89	bc	NW	4	3	1015.1	14-21.53	017-18.58	
	C-024	STD	424-030	50~100	50~100	14-23.96	017-26.	11:39	30	S/Sh	93.0	87.5	300	005	3.59	3.324	14.58	0.0485	1.6	27.9	28.5	15.91	c	WNW	3	2	1015.0	14-25.75	017-26.50	
			426-027	50~100																										Relevage précoce à cause de l'existance de roche au fond
	C-025	STD	426-027	50~100	50~100	14-26.06	017-21.	14:00	30	S	63.7	62.3	200	005	3.53	3.269	16.60	0.0543	1.7	29.9	28.5	17.84	c	WNW	3	2	1013.8	14-27.80	017-21.35	

Table 2-6 Warm Season Marine Survey Data (3)

JOURNAL DE PECHE DE FOND

Date of Operation / Date d'opération	Number of Operation / Numéro d'opération	Hydraulic survey / Etude hydraulique	Number of station / Numéro de station	Depth zone (Plan and actual) / Zone de la profondeur (programme et exécution)		Lat. (N) Position of Start of net towing / Position de pose du chalut Long. (W)	Time of towing the net / Heure de pose du chalut	Time of towing the net (min.) / Temps de traînage (min.)	Bottom materials / Matériaux du fond	Bigining of trawling Depth (m) / Lors de la pose du chalut Profondeur (m)	Finishing of trawling / Lors du relevage du chalut	Length of warp (m) / Longueur de fune (m)	Operation of net / Opération de chalut: Cours (°)	Direction(°)	Vitesse (Kt)	Distance (km)	Distance between wing tips (m) / Distance entre pointes d'ailes (m)	Dimention of trawling (km²) / Dimention de la pêche (km²)	Height of head rope (m) / Hauteur d'ouverture verticale du filet (m)	Air temperature (°) / Température de l'air (°)	Water temperature, surface (°) / Température de l'eau de mer, surface (°)	Water temperature, bottom (°) / Température de l'eau de mer, fond (°)	Weather condition / Conditions de mer	Wind directions Directions du vent	Beaufort scale	Sea conditions / Etat de la mer	Atomosphare pressure (hPa.)	Lat. (N) Long. (W)	Remarks / Remarques
	ZONE NORD																												
20	N-001	STD	558-008	10~50	10~50	15-58.1 016-43.	07:09	30	S	59.2	61.4	200	000	3.52	3.260	10.28	0.0335	1.8	26.9	27.8	17.49	b	W'st	2	1	1015.9	15-59.90 016-42.98	
	N-002	STD	556-012	50~100	50~100	15-58.0 016-50.	09:12	30	S/R	94.3	94.0	300	190	3.65	3.380	11.35	0.0384	1.8	28.2	27.7	15.38	bc	NNE	2	1	1017.2	15-56.27 016.51.41	
	N-003	STD	548-013	50~100	50~100	15-49.9 016-53.	11:05	30	S	90.0	88.5	300	180	3.60	3.334	16.19	0.0540	-	28.8	28.0	15.46	bc	NE	2	1	1017.0	15-48.17 016-53.21	
	N-004	STD	546-015	100-200	100-200	15-48.1 016-57.	12:47	30	S/R	106	107	350	180	3.65	3.380	16.67	0.0563	1.7	28.8	28.3	14.54	bc	WNW	2	2	1014.1	15-46.33 016-57.43	
	N-005	STD	538-014	50~100	50~100	15-39.9 016-55.	14:48	30	S	87.8	87.6	300	180	3.72	3.445	14.57	0.0502	1.7	28.2	28.1	15.55	bc	W'st	2	2	1014.6	15-38.07 016-55.19	
21	N-006	STD	540-009	10~50	10~50	15-40.0 016-45.	07:27	30	S/M	36.2	40.4	150	355	3.55	3.287	14.53	0.0478	1.7	26.2	28.0	20.12	r	SE	3	3	1014.7	15-41.86 016-45.42	
	N-007	STD	538-010	10~50	10~50	15-40.2 016-47.	08:48	30	M/S	44.8	42.0	150	180	3.59	3.324	14.53	0.0483	1.6	25.3	27.9	19.92	c	S'th	4	3	1014.6	15-38.44 016-47.19	
	N-008	STD	536-011	50~100	50~100	15-38.2 016-49.	10:04	30	M/S	52.2	50.8	200	183	3.52	3.260	16.67	0.0543	1.6	26.0	27.7	18.59	c	SSW	4	3	1015.2	15-36.52 016-49.56	
	N-009	STD	532-010	10~50	10~50	15-34.1 016-47.	11:32	30	M/S	34.6	31.5	150	185	3.54	3.278	14.50	0.0475	1.6	26.0	28.0	22.31	c	WSW	4	3	1015.0	15-32.39 016-47.41	
22			240-03	10~50																								Remplacer à 530-011; Annuler à cause de l'existence en mer des filets des pêcheurs artisanaux
	N-010	STD	536-011	10~50	10~50	15-36.1 016-48.	08:16	30	M	42.1	45.8	150	355	3.68	3.408	12.91	0.0440	1.8	28.0	27.5	21.14	bc	NW	4	3	1010.5	15-37.98 016-48.24	Remplacer de 530-009
	N-011	STD	530-014	50~100	50~100	15-31.9 016-54.	10:25	30	M	79.6	77.8	250	185	3.71	3.435	9.75	0.0335	2.1	28.3	27.5	16.47	bc	NW	3	2	1011.8	15-30.11 016-55.12	
	N-012	STD	524-017	100-200	100-200	15-25.8 017-00.	12:22	30	S/M	105	102	350	185	3.54	3.278	14.85	0.0487	1.8	28.6	27.7	15.10	bc	WNW	2	2	1011.3	15-24.06 017-01.17	
	N-013	STD	522-016	50~100	50~100	15-24.0 016-59.	13:56	30	M/S	94.5	90.6	300	180	3.61	3.343	14.58	0.0487	1.6	28.4	27.9	15.42	bc	WNW	2	1	1010.3	15-22.19 016-59.08	
23	N-014	STD	514-014	10~50	10~50	15-14.0 016-55.	07:20	30	S	29.9	36.7	150	000	3.74	3.463	13.75	0.0476	2.1	27.5	28.0	19.54	f	WNW	2	1	1011.8	15-15.96 016-55.16	
	N-015	STD	522-019	100-200	100-200	15-22.2 017-04.	09:34	28	S/Sh	123	133	400	350	3.68	3.181	14.56	0.0463	1.9	28.0	27.7	14.86	bc	W'st	2	1	1013.2	15-23.96 017-04.45	
	N-016	STD	520-020	100-200	100-200	15-21.9 017-06.	11:18	30	S/Sh	146	132	450	190	3.66	3.389	16.09	0.0545	2.0	28.2	27.8	14.85	bc	W'st	2	1	1013.9	15-20.08 017-06.42	
	N-017	STD	518-021	100-200	100-200	15-19.7 017-08.	13:09	30	S/Sh	159	165	500	195	3.72	3.445	17.61	0.0607	1.8	29.4	28.3	13.86	bc	W'st	2	1	1012.4	15-17.89 017-08.85	filet
24	N-018	STD	516-021	100-200	100-200	15-17.6 017-09.	07:46	30	S	170	142	500	185	3.56	3.297	15.11	0.0498	1.8	27.6	27.8	14.22	bc	NW	2	1	1013.3	15-15.84 017-09.37	
	N-019	STD	502-024	100-200	100-200	15-03.8 017-14.	10:27	30	S	119	112	400	185	3.57	3.306	12.44	0.0411	1.5	28.0	28.0	14.60	bc	WNW	2	1	1014.2	15-02.06 017-15.20	
	N-020	STD	502-021	50~100	50~100	15-01.9 017-08.	12:28	30	S	91.8	97.2	300	350	3.72	3.445	12.96	0.0446	1.6	28.0	28.3	14.84	bc	NW	3	2	1012.5	15-03.75 017-09.07	
	N-021	STD	506-021	50~100	50~100	15-05.8 017-08.	13:58	30	S	99.3	99.8	300	005	3.70	3.426	12.96	0.0444	1.5	28.0	28.2	14.94	bc	NNW	4	3	1011.5	15-07.74 017-08.04	
25	N-022	STD	500-025	100-200	100-200	15-01.7 017-16.	07:24	30	S/Sh	121	135	400	180	3.49	3.232	16.73	0.0541	1.8	27.5	28.0	14.25	bc	NW	2	1	1012.4	15-00.01 017-16.91	
	ZONE CENTRALE																												
	C-026	STD	456-027	100-200	100-200	14-56.5 017-22.	09:44	30	S	149	133	500	090	3.52	3.260	15.13	0.0493	-	28.2	28.0	14.33	bc	NW	3	2	1014.0	14-56.42 017-20.30	
	C-027	STD	452-030	100-200	100-200	14-54.0 017-26.	12:06	30	S/M/R	149	129	450	165	3.56	3.297	13.71	0.0452	1.7	29.2	28.2	14.77	bc	WNW	2	1	1014.3	14-52.24 017-26.68	
			450-03	100-200																								l'accident du dommage de filet
	C-028	STD	450-032	100-200	100-200	14-50.0 017-31.	15:05	30	S/M/R	136	154	500	030	3.46	3.204	17.75	0.0569	-	28.0	28.4	14.33	bc	NW	3	2	1012.0	14-51.45 017-30.83	

Table 2-13 Estimated Demersal Fish Stock According to the Sweep Area Method (1)

Total catch		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	2795.198	1890.304	2083.113	1521.545	2104.915	2972.490	2863.890	2104.875	965.483
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	47166862.000	15376145.792	10637534.717	56151142.904	15376524.127	12361895.634	5592784.574	4988135.153	91727126.928
	Averaged estimated stock (kg/km^2) on each depth	22799.814	7939.485	8973.902	12856.901	6584.832	13664.828	7235.286	5490.934	17743.294
	Standard error	5256.862	1472.770	2790.001	2007.591	1398.845	5256.422	1190.145	1448.973	10133.105
Warm season	Total catch	1752.643	2052.910	2782.290	940.110	1030.950	845.470	1545.640	993.060	124.170
	Total Dimention of trawling (km^2)	0.380	0.540	0.342	0.269	0.368	0.412	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	4373.128	2380.353	991.242	2102.531	1876.158	1131.868	787.785	902.065	5120.847
	Total estimated stock on each depth	40339647.021	18108768.940	16118781.642	14712397.517	10509234.309	4651084.771	3739081.384	2472548.911	14288888.421
	Averaged estimated stock (kg/km^2) on each depth	7220.782	5532.581	4163.964	9152.217	8451.679	16057.896	4973.883	2930.718	2759.620
	Standard error	1425.297	864.042	1048.868	3358.713	2553.863	12121.398	1625.962	1158.000	546.763

Arius heudeloti		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	31.133	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Standard error	19.692	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Warm season	Total catch	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	3129.931	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	1.401	0.000	0.000	0.000	0.000	0.000	7.166	28.011	0.000
	Standard error	1.401	0.000	0.000	0.000	0.000	0.000	5.946	28.011	0.000

Cymbium spp		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	72.800	0.000	0.000	28.100	3.800	687.300	41.900	11.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	1228445.196	0.000	0.000	1037003.254	27759.223	2858321.094	81824.956	26067.812	0.000
	Averaged estimated stock (kg/km^2) on each depth	559.312	0.000	0.000	251.493	10.698	3520.029	93.028	37.504	0.000
	Standard error	331.066	0.000	0.000	131.917	10.698	3448.313	66.690	37.504	0.000
Warm season	Total catch	11.300	0.000	0.000	95.300	3.600	0.000	67.400	27.800	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	176841.106	0.000	0.000	906293.488	31755.687	0.000	163048.372	69217.227	0.000
	Averaged estimated stock (kg/km^2) on each depth	80.398	0.000	0.000	524.121	309.698	0.000	219.093	79.057	0.000
	Standard error	28.461	0.000	0.000	419.102	291.888	0.000	77.220	69.915	0.000

Table 2-13 Estimated Demersal Fish Stock According to the Sweep Area Method (2)

Cynoglossus senegalensis		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	1.415	0.000	0.000	1.000	0.250	2.680	5.600	0.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	23877.060	0.000	0.000	36904.030	1826.265	11145.498	10936.032	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	10.868	0.000	0.000	7.994	0.690	13.735	14.847	0.000	0.000
	Standard error	10.868	0.000	0.000	7.994	0.690	13.332	9.149	0.000	0.000
Warm season	Total catch	0.000	0.000	0.000	0.800	0.000	0.000	7.100	0.000	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	0.000	0.000	0.000	7607.920	0.000	0.000	17175.719	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	0.000	0.000	0.000	7.501	0.000	0.000	32.557	0.000	0.000
	Standard error	0.000	0.000	0.000	7.501	0.000	0.000	26.076	0.000	0.000

Epinephelus aeneus		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	0.395	0.000	0.000	6.700	0.000	0.000	8.060	15.100	16.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	6665.328	0.000	0.000	247257.004	0.000	0.000	15740.075	35783.997	1520102.917
	Averaged estimated stock (kg/km^2) on each depth	3.142	0.000	0.000	48.934	0.000	0.000	18.940	40.476	291.971
	Standard error	3.142	0.000	0.000	38.586	0.000	0.000	10.949	18.637	291.971
Warm season	Total catch	3.000	0.000	0.000	6.500	0.000	0.000	7.350	1.200	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	46948.966	0.000	0.000	61814.351	0.000	0.000	17780.498	2987.794	0.000
	Averaged estimated stock (kg/km^2) on each depth	21.016	0.000	0.000	34.719	8.954	0.000	22.735	3.719	0.000
	Standard error	17.153	0.000	0.000	18.547	8.954	0.000	8.265	3.719	0.000

Galeoides decadactylus 續		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	42.400	0.000	0.000	33.600	0.000	57.000	78.725	0.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	715468.081	0.000	0.000	1239975.421	0.000	237049.763	153739.133	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	325.653	0.000	0.000	311.378	0.000	293.059	202.490	0.000	0.000
	Standard error	325.653	0.000	0.000	291.776	0.000	293.059	129.247	0.000	0.000
Warm season	Total catch	19.000	0.000	0.000	3.800	0.000	0.000	168.100	9.200	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	297343.452	0.000	0.000	36137.621	0.000	0.000	406653.283	22906.421	0.000
	Averaged estimated stock (kg/km^2) on each depth	132.988	0.000	0.000	19.121	0.000	0.000	529.595	25.770	0.000
	Standard error	124.732	0.000	0.000	18.000	0.000	0.000	328.564	25.770	0.000

Table 2-13 Estimated Demersal Fish Stock According to the Sweep Area Method (3)

Murex spp 類		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	0.000	0.000	0.600	57.000	0.600	9.400	0.000	0.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	0.000	0.000	3063.934	2103529.732	4383.035	39092.417	0.000	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	0.000	0.000	1.818	476.282	1.686	42.402	0.000	0.000	0.000
	Standard error	0.000	0.000	1.818	326.680	1.686	34.059	0.000	0.000	0.000
Warm season	Total catch	0.000	0.000	0.000	43.200	1.200	0.000	0.000	0.000	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	0.000	0.000	0.000	410827.688	10585.229	0.000	0.000	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	0.000	0.000	0.000	214.764	5.114	0.000	0.000	0.000	0.000
	Standard error	0.000	0.000	0.000	142.065	5.114	0.000	0.000	0.000	0.000

Octopus vulgaris		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	4.200	20.400	18.500	3.700	54.700	29.000	11.300	72.200	11.400
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	70871.838	165938.058	94471.300	136544.912	399586.715	120604.266	22067.351	171099.642	1083073.328
	Averaged estimated stock (kg/km^2) on each depth	36.745	89.703	82.664	29.343	172.425	111.628	25.479	192.245	214.351
	Standard error	36.745	35.369	23.895	18.762	31.365	32.608	17.417	29.262	170.555
Warm season	Total catch	65.300	11.600	28.500	110.000	19.400	31.600	32.900	12.800	1.100
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	1021922.496	118247.362	156783.701	1046089.020	171127.871	183069.881	79588.894	31869.802	126582.727
	Averaged estimated stock (kg/km^2) on each depth	644.873	62.781	147.924	459.334	80.555	185.940	148.914	36.694	26.190
	Standard error	631.715	20.363	46.034	369.736	18.661	34.684	124.060	10.836	26.190

Penaeus notialis		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	27.260	1.000	0.000	0.900	1.800	0.000	2.900	0.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	459991.978	8134.219	0.000	33213.627	13149.106	0.000	5663.302	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	209.547	4.202	0.000	8.287	5.105	0.000	8.092	0.000	0.000
	Standard error	115.339	4.202	0.000	8.287	3.652	0.000	6.966	0.000	0.000
Warm season	Total catch	7.200	0.000	0.000	1.260	0.600	0.000	3.000	0.000	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	112677.519	0.000	0.000	11982.474	5292.615	0.000	7257.346	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	61.040	0.000	0.000	3.324	2.552	0.000	15.227	0.000	0.000
	Standard error	36.681	0.000	0.000	3.152	2.018	0.000	14.255	0.000	0.000

Table 2-13 Estimated Demersal Fish Stock According to the Sweep Area Method (4)

Pomadasys jubelini 누		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	0.000	0.000	0.000	25.950	0.000	0.300	18.600	0.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	0.000	0.000	0.000	957659.588	0.000	1247.630	36323.250	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	0.000	0.000	0.000	203.857	0.000	1.542	51.952	0.000	0.000
	Standard error	0.000	0.000	0.000	87.357	0.000	1.542	40.399	0.000	0.000
Warm season	Total catch	0.500	0.000	0.000	184.400	3.200	0.000	13.400	136.600	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	7824.828	0.000	0.000	1753625.594	28227.278	0.000	32416.145	340110.548	0.000
	Averaged estimated stock (kg/km^2) on each depth	3.501	0.000	0.000	911.165	9.066	0.000	42.067	366.969	0.000
	Standard error	3.501	0.000	0.000	904.225	9.066	0.000	28.056	198.186	0.000

Pseudotolithus senegalensis		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	116.033	0.600	0.000	1.700	0.000	0.450	7.900	0.000	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	1957969.524	4880.531	0.000	62736.852	0.000	1871.446	15427.617	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	907.276	2.521	0.000	16.274	0.000	2.314	22.345	0.000	0.000
	Standard error	467.018	2.521	0.000	11.238	0.000	2.314	18.051	0.000	0.000
Warm season	Total catch	82.000	0.000	0.000	0.700	0.000	0.000	3.800	0.000	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	1283271.741	0.000	0.000	6656.930	0.000	0.000	9192.638	0.000	0.000
	Averaged estimated stock (kg/km^2) on each depth	576.007	0.000	0.000	3.519	0.000	0.000	13.760	0.000	0.000
	Standard error	511.506	0.000	0.000	3.519	0.000	0.000	9.485	0.000	0.000

Sparus caeruleostictus 참		Northern region			Central region			Southern region		
		0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth	0-50m depth	50-100m depth	100-200m depth
Cool season	Total catch	0.915	0.000	0.000	64.275	8.400	67.730	12.575	35.865	0.000
	Total Dimention of trawling (km^2)	0.249	0.461	0.443	0.237	0.652	0.477	0.807	0.761	0.108
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	15439.936	0.000	0.000	2372006.553	61362.494	281673.342	24557.251	84992.918	0.000
	Averaged estimated stock (kg/km^2) on each depth	7.720	0.000	0.000	546.046	22.722	343.919	32.774	94.187	0.000
	Standard error	4.896	0.000	0.000	268.220	14.411	315.851	21.415	62.869	0.000
Warm season	Total catch	0.300	0.000	0.000	26.700	0.000	0.000	6.040	26.800	0.000
	Total Dimention of trawling (km^2)	0.269	0.368	0.412	0.920	0.540	0.342	0.651	0.725	0.089
	Total research sea area on each depth (km^2)	2102.531	1876.158	1131.868	4373.128	2380.353	991.242	787.785	902.065	5120.847
	Total estimated stock on each depth	4694.897	0.000	0.000	253914.335	0.000	0.000	14611.456	66727.399	0.000
	Averaged estimated stock (kg/km^2) on each depth	2.101	0.000	0.000	126.437	0.000	0.000	17.389	79.058	0.000
	Standard error	2.101	0.000	0.000	48.434	0.000	0.000	14.789	52.495	0.000

CHAPTER 3

ANALYSIS AND ASSESSMENT MADE ON THE STOCKS