CHAPTER 8

TRANSFER OF TECHNOLOGY

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8.1 Demersal Fish Stock Survey

Figure 8-1 shows a view of the survey work.

8.1.1 Fish Catching 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.

Transfer of net recorder analysis methodology, as is described in the section on mid-water trawl, was conducted up to the acquisition of data. In future it will be necessary to utilize that data in order to develop fish catching technology and fishing gear.

Concerning technology for making bottom trawl nets, unlike fishing gear preparation technology, since it is necessary to consider theory such as calculation of the underwater weight of fishing gear and calculation of underwater resistance, etc., it is necessary to have human resources who fully understand the theory of fishing gear and fishing technology on the Senegalese side. Accordingly, this technology has not been transferred here.

8.1.2 Biological Survey

Mr. Massal Fall is the official CRODT counterpart concerning biological survey, however, in reality, 10 members of staff in addition to Mr. Fall were working on biological survey, etc. in the CRODT.

At the time of the second field survey, technical guidance was carried out with the emphasis placed on test navigation and treatment of samples in the CRODT wet laboratory. Via the pre-briefing and meetings during the actual work, the CRODT staff learned about the basic workflow regarding biological measurement of sampled specimens. Since the staff that took part in the project were accustomed to work at sea, the basic screening work, biological measurement and observations, etc. of caught fish proceeded smoothly. Regarding the scale and otolith sampling, which required some skill, 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.

Furthermore, the staff conducted sampling at landing sites on land in addition to the survey work at sea, and through this work they actively examined and understood the purpose and method of sampling. At the landing site in Mbour, CRODT staff consigned sampling of target fish to the permanently assigned personnel upon explaining in detail the sampling method. Since the permanent personnel were able to fully understand the workflow, they were able to conduct the sampling very smoothly. As was mentioned previously, at the end of the second field survey, the CRODT staff, while maintaining communications with landing site staff in each site, obtained samples of machoiron, measured the body length and wet weight, removed otoliths and the first spine of dorsal fin, determined sex, observed the degree of sexual gland development, and recorded the findings. After that, the CRODT staff aimed to further master each task via the third and fourth field surveys. There was a slight disturbance to the flow of work in the first half of the third field survey, however, conditions gradually improved until the CRODT staff were able to smoothly conduct all the work unaided by the second half of the fourth survey.

8.2 Training on mid-water trawl

Mid-water trawl was implemented over the period from 6 to 22 of September 2004.

8.2.1 Objective of Training in Mid-water trawl

In past surveys of pelagic fish stocks, the CRODT has used mid-water trawl gear in order to catch samples of pelagic fish shoals detected by scientific fish finders, however, attempts to cast nets into shoals have not been successful. Therefore, in this 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 gaugx and net recorder, etc. to the fish catching staff and processing it.

8.2.2 Survey of Underwater Status of mid-water Trawl Nets

Since mid-water trawl nets are dragged underwater, it is difficult to visually check actual conditions. Also, it is almost impossible to see shoals of pelagic fish. Accordingly, it is important to gauge the net status by using various kinds of equipment installed on the research vessel as well as fishing gear measurements. In the training here, various kinds of demonstration were carried out in order to recognize the importance of this (see Table 8-1).

(1) Wind direction and wind force

Upon measuring information obtained from the aerovane and conducting trawl while variously altering the course of the research vessel, the impact of the wind on the vessel's hull was

investigated. As a result, when wind is received from the side of the vessel, it is necessary to constantly adjust course by check helm, and when wind force is strong, it is forecast that the vessel hull will drift downwind, making it difficult to keep course during trawl. Moreover, in cases where course is set upwind, speed is reduced despite engine output remaining the same, whereas speed increases when course is set downwind. Generally speaking, it is easier to hold course during trawl or adjust course in line with shoal movement by setting the course in the direction of or opposite to the wind.

(2) Tidal current

Surface tidal currents (which coincide not with the direction of waves caused by wind but with the direction of swell) push the vessel hull in the tidal direction, whereas middle layer tidal currents cause resistance by acting on the otter boards and trawl net. Accordingly, information on tidal currents is extremely important, however, because there was judged to be a problem with the data displayed by the tide gauge on the research vessel, there was little choice but to rely on judgments by the Japanese personnel onboard based on their mid-water trawl experience in the past.

In the ocean area south of Dakar and north of the border with Gambia, where the mid-water trawl training was implemented, there is a tidal current that flows on average at 0.5 knots from the south-south-east, and there are intermixed zones where the main current meanders, zones where there are counter-currents, and zones where the current moves up and down depending on changes in water depth, and these zones are constantly interchanging. In waters where the main tidal current is predominant, if the net is trawled facing the upstream side of the tidal current, otter board fanning force increases and the interval between otter boards in the lateral direction widens; moreover, because dynamic lift of the campus kite attached to the head rope also increases, fanning force in the vertical direction at the net mouth increases and a more ideal net shape is obtained.

An ideal trawl course can be set when the tidal current direction and wind direction coincide, however, such cases are extremely rare and in general cases where tidal direction and wind direction differ, one or the other has a larger impact on trawl and it is necessary to set course upon making a comprehensive judgment.

(3) Setting of the net mouth depth during trawl

The net mouth needs to be set to the depth of the fish shoal. The run-out length of the warp rope determines the depth of the net mouth. When a shoal of fish is discovered, since data on the depth of the shoal are obtained from the fish finder, etc., it is necessary to determine the run-out length of warp rope at the start of net casting in advance, and to set the depth of the trawled net mouth at

around the same level as the depth of the fish. Data on the depth of the net mouth is obtained by utilizing a net recorder.

However, as was mentioned above, tidal currents cause upward lift acting on fishing gear to vary, and depth of the net mouth is not always proportional to the run-out length of warp rope. Accordingly, it is necessary for the fish catching staff to acquire sufficient experience enabling them to effectively utilize data from the tide gauge in order to determine the run-out length of warp rope in line with the trawled net depth according to various changes in tidal currents.

Moreover, upon measuring time from discovery of fish shoals, it was clarified in this training that roughly 30 minutes is required for moving to the net casting point (1.5~1.8 miles), casting the net, starting trawl and bringing the fishing gear close to the fish shoal. During these 30 minutes, it was frequently observed that fish shoals move away from the originally discovered point both horizontally and also vertically due to independent movement and under the influence of tidal currents, etc. Accordingly, it is necessary to finely adjust the vessel's course in order to keep up with fish shoals in the horizontal direction, and also to adjust the net trawl depth by altering the warp run-out length in order to follow shoal movements in the vertical direction.

In order to follow such movements of fish shoals, it is necessary to input a mark for the target shoal on the sonar screen when the shoal is found, to temporarily separate from the net casting point, and to capture this mark while casting and trawl the net until the point is re-approached. In order to capture the mark, i.e. capture the movement of the fish shoal, it is necessary to have sufficient experience allowing the sonar functions to be fully grasped and operations to be conducted in line with all conditions.

The important point here is, just because the fish shoal moves downwards, not to reduce the speed of the vessel with the aim of reducing fishing gear resistance and sinking the fishing gear. Since it is said that pelagic fish have the ability to swim at a speed of 4~5 knots, the chances of catching fish decrease if the trawl speed is lower than this (there are occasions when fish panic at the approach of fishing gear and swim into the net, but this is very rare).

(4) Maintenance and adjustment of fishing gear

At the start of the training, when the run-out length of the warp rope was set to 100 m, the otter boards were towed floating on the water surface and the overall balance of the fishing gear during towage was poor. Accordingly, the otter boards were brought onboard the vessel in order to adjust moving parts such as the otter board brackets, etc. and moving coupling such as the swivels used to connect rigging. After doing this, the otter boards could be towed steadily underwater.

The net during towing was floating. The head rope above the net mouth was lifted upwards by buoyancy of the floats and upward lift of the kite, while the ground rope composed of chains under the net mouth was sunk by its own weight underwater. The balance between the head rope and the ground rope kept the net mouth steadily open in the vertical direction (in the gear used here, floats and chains were attached above and below the net pendant in order to assist the balance). Moreover, force for fanning the net mouth in the horizontal direction is obtained from the fanning force of the otter boards. Achieving a balance of these fanning forces in the horizontal and vertical directions is important in mid-water trawl, and catch efficiency deteriorates if this balance is poor.

The CRODT side requested that mid-water trawl also be conducted in shallows of 20~30 m, however, since vessel speed would need to be reduced in order to ensure fish catching work safety on the deck when casting and hauling nets, the otter boards would not have enough fanning force to keep the ground rope from sinking to the bottom. If the seabed consists of rocky reefs, since contact of the ground rope with the bottom may lead to net damage, it was decided not to conduct trawl in the requested waters (When the sinking force of the ground rope is reduced, since the overall fishing gear loses its balance, no adjustment of sinking force was implemented).

(5) Measurement of fishing gear during trawl

In order to grasp the state of fishing gear during trawl, the Study Team taught the Senegalese personnel the measurement method and theoretical calculation technique. As a result, the Senegalese members were able to acquire data on the fishing gear during trawl unaided.

1) Measurement of the warp rope angle of entry into the water:

The depth of the otter boards can be calculated from the run-out length and angle of entry of the warp rope into the water. Combined with information on depth of the net mouth from the net recorder, this can be utilized in adjusting the length of the upper and lower net pendants and so on.

2) Horizontal fanning angle of warp rope:

From the run-out length and horizontal fanning angle of the warp rope, it is possible to calculate the distance between the otter boards, and consequently the distance between wing tips at the net mouth. These data are essential for obtaining the ideal shape of the net mouth, and it is important to continue seeking the appropriate trawl speed, etc. that is necessary for obtaining the ideal net mouth shape.

8.2.3 Training in Use of Equipment

Because the Senegalese crewmembers actively used the sonar and net recorder in surveying the state of the fishing gear during mid-water trawl as described above, it is considered that the transfer of technology proceeded better than expected and the counterparts improved their technical capacity a lot.

(1) Sonar

After observing the state of the net underwater during mid-water trawl, training in sonar fish finding was implemented and the Senegalese crewmembers acquired the basic techniques of fish finding.

(2) Net recorder

As was mentioned earlier, the net recorder can measure the depth and vertical fanning force (net height) of the net mouth and also shows the state of fish entry into the net. The net recorder is an indispensable instrument for acquiring data essential to improving and developing fishing gear, and thinking regarding the acquisition and utilization of such data can also be applied to development of seine nets.

The crewmembers also mastered the basic technique of net recorder image analysis. However, since pelagic fish shoals can swim at the same speed as the dragged net, they sometimes appear to be constantly swimming in the net mouth. In other words, since images from a net recorder attached to the net mouth tend to give the false impression that fish are caught in the net, once the vessel thinks the catch is finished and slows down to haul the net, the fish sometimes escape. Although this didn't happen during the training here, it should be possible to grasp the characteristics of aversive behavior by different fish species by using the net recorder more, and such experience is considered essential for enhancing mid-water trawl technology.

(3) Log

Vessel speed can be measured as either ground speed or log speed. Ground speed is obtained by multiplying the distance moved in terms of latitude and longitude by time. This information is acquired from GPS and is used to calculate the sweep area of bottom trawl, etc. As for log speed, this adds the impact of tidal currents to the ground speed obtained from GPS and is essential data for calculating the underwater resistance and lift force of the mid-water trawl gear. In future, it will be necessary to emphasize log information when determining vessel speed during mid-water trawl.

8.2.4 General Training

Fish shoals are constantly on the move. In other words, the mid-water trawl net mouth must be constantly adjusted with the shoal while predicting the movement and aversive behavior of the fish and responding to irregular patterns. No set theory applies to such behavior and it is natural for net casting to frequently fail at the start. Repetition of such failures, investigation of causes and measures to counter them is the path to improving mid-water trawl technology.

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 (see the photographs in Figures 8-2 and 8-3).

8.2.5 Future mid-water Trawl Development

In order to improve mid-water trawl technology, it is necessary to painstakingly repeat the aforementioned basic method. For this reason, in addition to personnel who understand the practical use of fishing gear and fishing methods, it is essential to foster and develop human resources who can theoretically analyze, improve and develop fishing gear and fishing methods.

8.3 Age Determination and Growth Analysis

8.3.1 Transfer of Technology of the Age determination Method based on Otolith

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.

8.3.2 Transfer of Technology of the Age determination Method based on Scales

Transfer of technology concerning age determination based on scales was implemented for three CRODT counterparts with respect to thiof in the first half of the fourth field survey (June-July 2004) and with respect to otolithe in the second half of the fourth field survey (September-October 2004). During these activities, guidance and transfer were carried out regarding the parts of the fish body for sampling scales, scale sampling, scale washing, slide glass attachment, microscope observation, microscopic photography, composition of shot photographs, selection of measurement axes on photographs, screening of fine characteristics of scale profile on axes, recognition of age display areas, age determination, estimation of individual fish growth history based on the assessed age radius and so on.

In terms of the transfer of technology procedure, guidance and transfer were completed for all necessary processes as described above, however, the difficulty of age determination based on scales lies in accurately identifying scale profile, which complexly changes according to the type of fish and stage of development. The only way that such identification technology can be acquired is to accumulate experience of various types of fish. It is hope that the CRODT counterparts will acquire such experience and become able to independently assess the age of fish based on scales.

8.3.3 Transfer of Technology of the Technique for Assessing Fish Growth based on the Results of Otolith and Scale Age determination

Transfer of technology concerning the method for analyzing growth history from the results of age determination (whether by otolith or scales) and estimating the growth parameter was conducted simultaneously with the transfer of technology for age determination based on scales (two times). The counterparts practiced computation based on the FORTRAN program, which was created in order to estimate fish growth equation parameters, i.e. L-infinity ($L_{(\infty)}$), growth coefficient (k) and t-zero ($t_{(0)}$) utilizing traditional methods of fish growth analysis, i.e. the Ford Walford Plot and von Bertalanffy Plot. The completed FORTRAN program and computation manual, “FORTRAN Program for Senegal Fish Growth Analysis, Operation Manual for Senegal Fish Growth Analysis” (English version) was presented to CRODT as a CD-ROM.

8.4 Analysis of Initial Stock Numbers according to Age Group

Transfer of technology concerning estimation and analysis of initial stock numbers by age group was implemented during the seventh field survey (October-November 2005). At a workshop that was staged on the fourth day of the field survey at DPM, general and comprehensive introduction and explanation was carried out on the stock assessment methodology (Cohort analysis) that was applied

by the Study Team. Then on the following three days, theoretical and practical guidance based on computer operation was provided to four counterparts (one researcher and three technicians) concerning the method for estimating the three assessment elements (growth analysis, age composition and initial stock number by age group).

The Study Team providing the following materials to CRODT concerning the transfer of technology for Cohort analysis.

- FORTRAN Programming Soft (1 soft, CD-ROM, Manual)
  Pro Fortran, Complete Software Development Kit, Absoft Corporation, U.S.A.
- Program File (3 kinds, CD-ROM)
  CH-Growth, CH-AgeComp, CH-Cohort
- Manual for Program File (3 kinds, CD-ROM)
  Manual_CH-Growth, Manual_CH-AgeComp, Manual_CH-Cohort
- Data File, Senegal Stock Assessment (All the data-files employed, CD-ROM)
  Thiof, Pagre, Thiekem, Otolithe-OT, Otolithe-SC, Machoiron, Sole, Sompatt
- Senegal Workshop on Stock Assessment (3 kind, Slide Shows, CD-ROM)
  Methodology on Stock-Assessment, Verification on Methodology, Otolithe OT vs. SC

8.5 Underwater Survey Technology

As was mentioned above, underwater survey is indispensable in order to gauge the current conditions and effects of artificial reef. For the personnel who perform such survey work, not only is it necessary to have diving skills, but also it is essential to acquire and hone underwater photography techniques and learn the names, ecology and biological know-how of marine life. Until now CRODT has conducted diving classes for a few staff members and general pleasure divers, however, in order to conduct follow-up survey of installation conditions and fish gathering conditions around the small reef that was installed off Yenne (as part of the activities of this development study) and the artificial reef that was installed off Bargny in 2002 by OFCA, it was deemed necessary to acquire more specialized know-how and technology. Against this background, as a result of holding discussions with the CRODT, three members led by Mr. Abdoulaye Sarre were selected as the underwater survey team in the sixth field survey, and transfer of technology was implemented on artificial reef surveying.

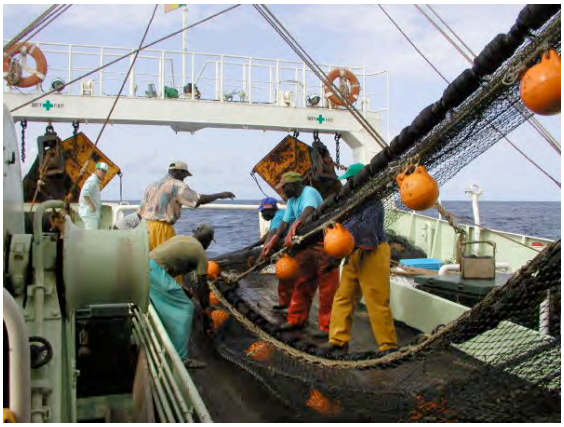
- Abdoulaye Sarre Officer, CRODT
- Ousseynou Ndiaye Deckhand, ITAF DEME
- Ousseynou Faye Deckhand, ITAF DEME

Messrs. Ndjaye and Faye had already taken pleasure diving classes, however, because they had hardly done any diving in two years since then and Mr. Sarre had not yet received a class, the first part of the transfer of technology consisted of making a simple English manual explaining basic underwater physical environment and diving equipment, and conducting classroom lectures on this. After that, diving familiarization training was carried out on July 20-21 on the beach in front of the CRODT. At this time, since it was deemed that Mr. Sarre, who had no previous experience, needed further training, individual lessons were arranged for him a further three times on July 26, August 1 and August 5. After that, Mr. Sarre also attended classes at a general diving school in the interval between the sixth and seventh field surveys.

After that, the underwater survey work was implemented during the seventh field survey. In this, the counterparts 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. Moreover, simultaneously with transfer of the above diving know-how and technology, training was conducted in how to use the compressor (supplied in the study) for filling air to air cylinders used in scuba diving work.

Mr. Sarre, the leader of the diving team, compiled a compressor user manual in French based on the things he learned in this training.

Through the above work, the CRODT diving team understood basic work procedure, survey methods and equipment control methods. However, due to the nature of diving work, since a lot of experience is required for safety measures and equipment management and extensive biological and physical know-how is required to conduct underwater surveying, 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. In order to contribute to this enhancement of staff capability, it will be necessary to strengthen technology upon compiling an underwater survey strengthening plan like that shown in the attached documents in Chapter 9.



Net casting

Net raising

Caught fish

Transfer of technology for warp angle measurement

Figure 8-1 Photographs of the Demersal Fish Stock Survey

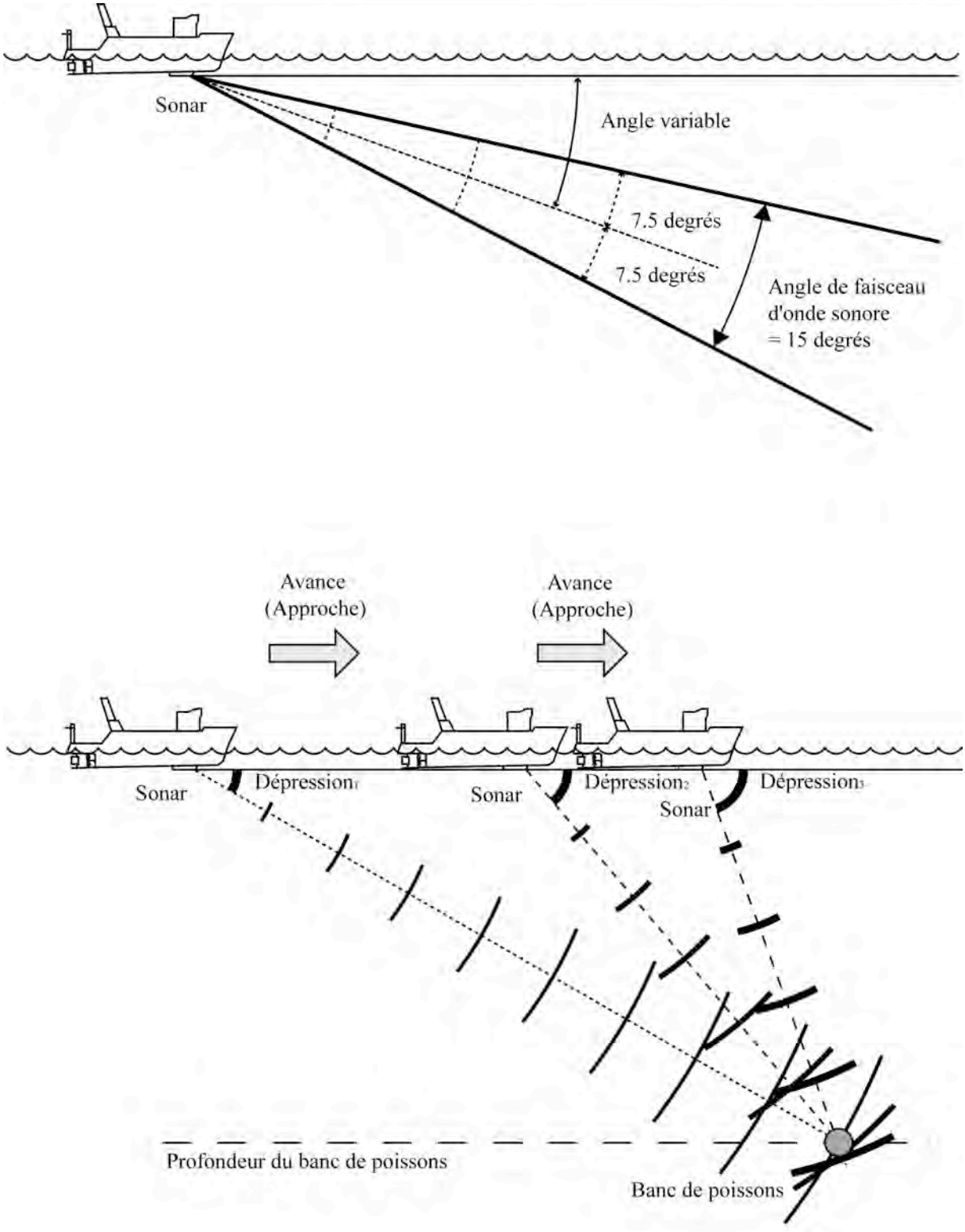


Figure 8-2 Mid-water Trawl Diagram (1)

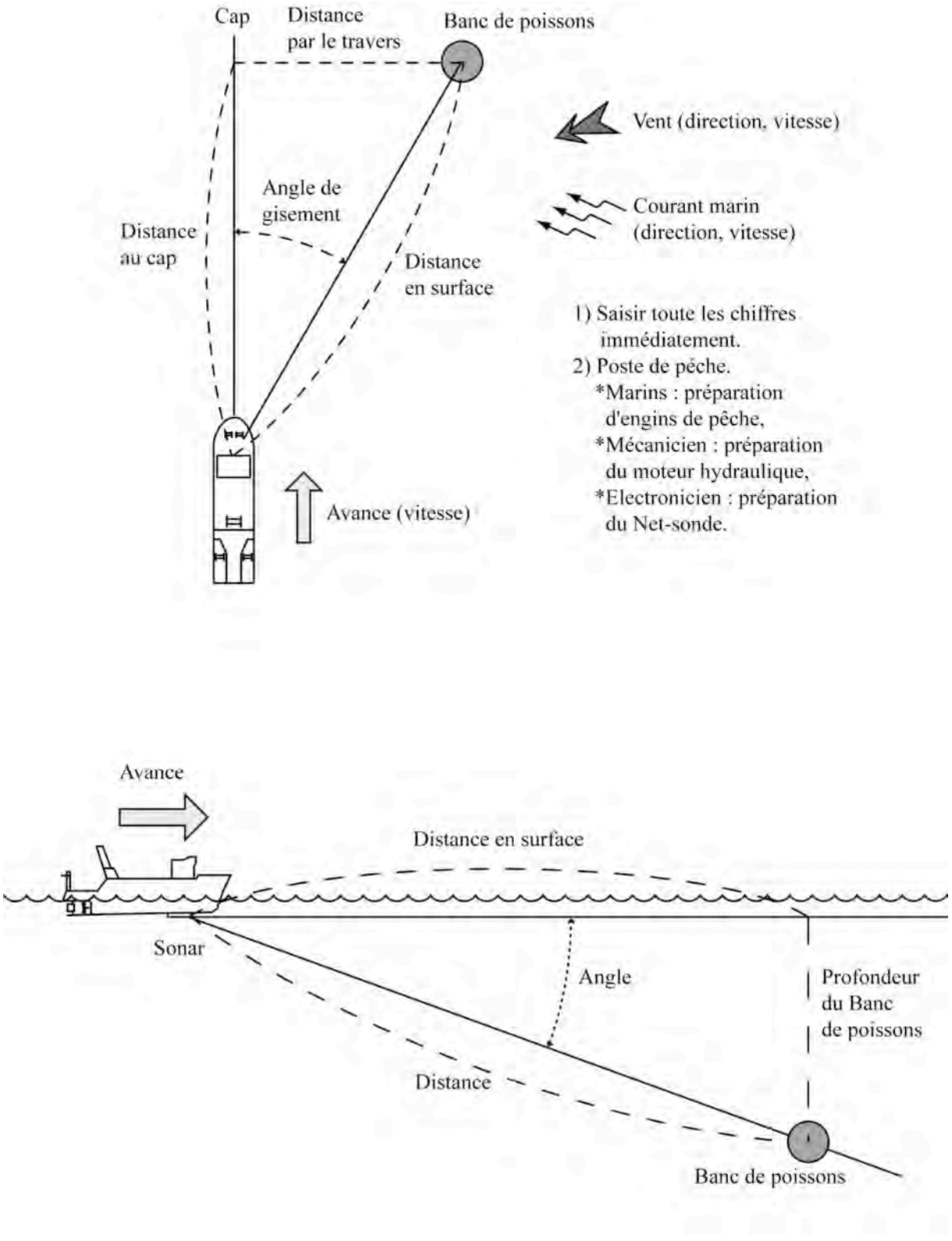


Figure 8-2 Mid-water Trawl Diagram (2)

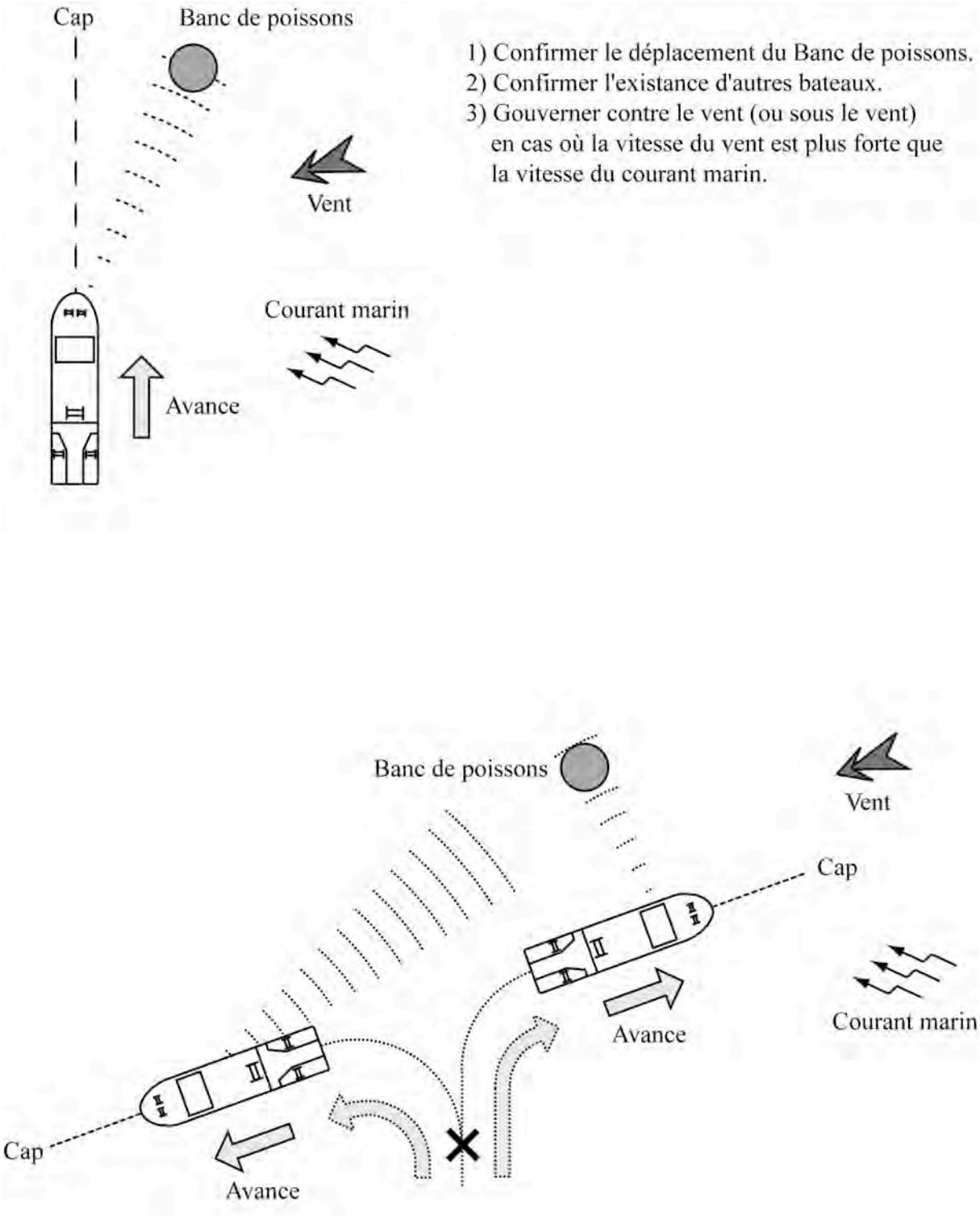
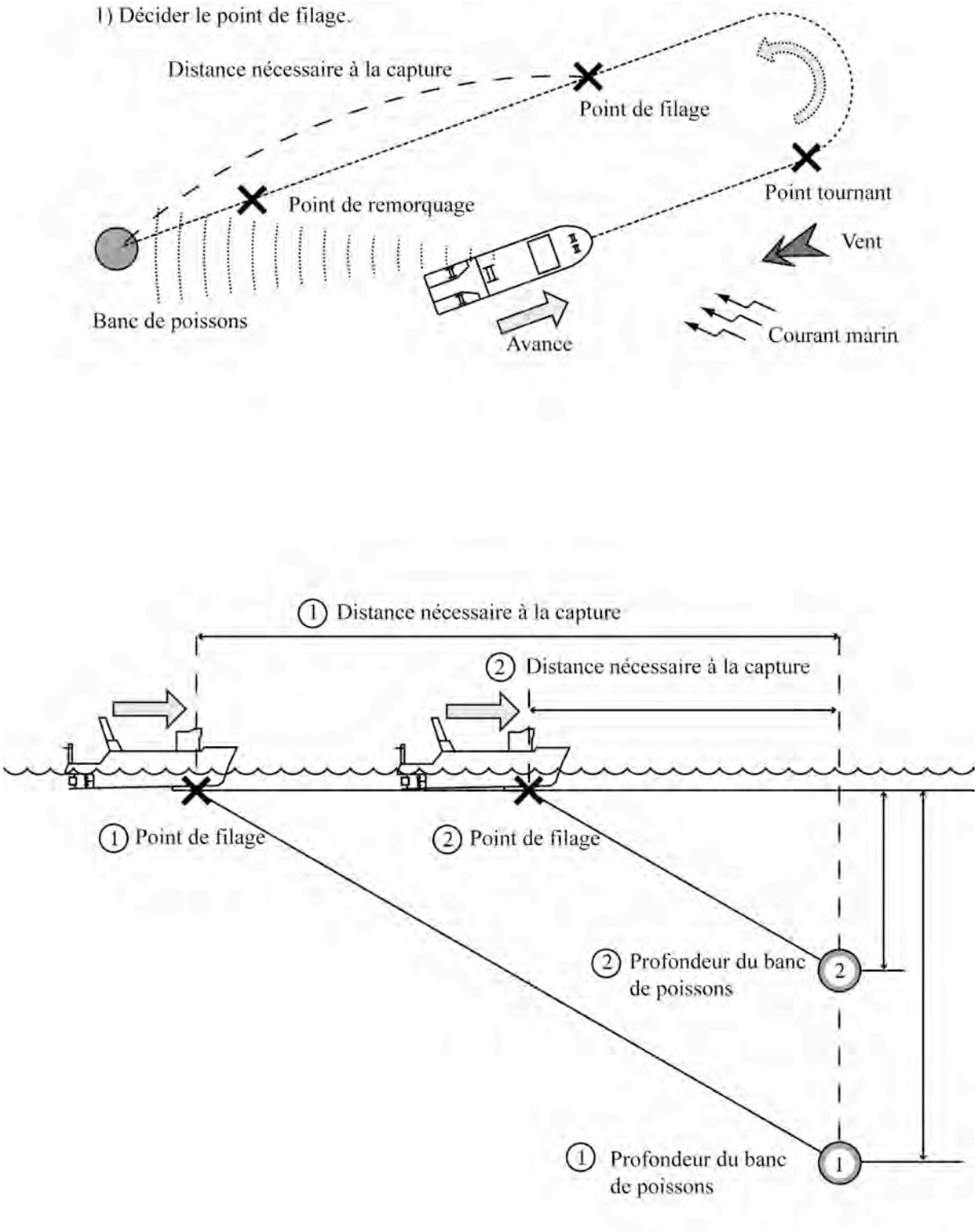


Figure 8-2 Mid-water Trawl Diagram (3)



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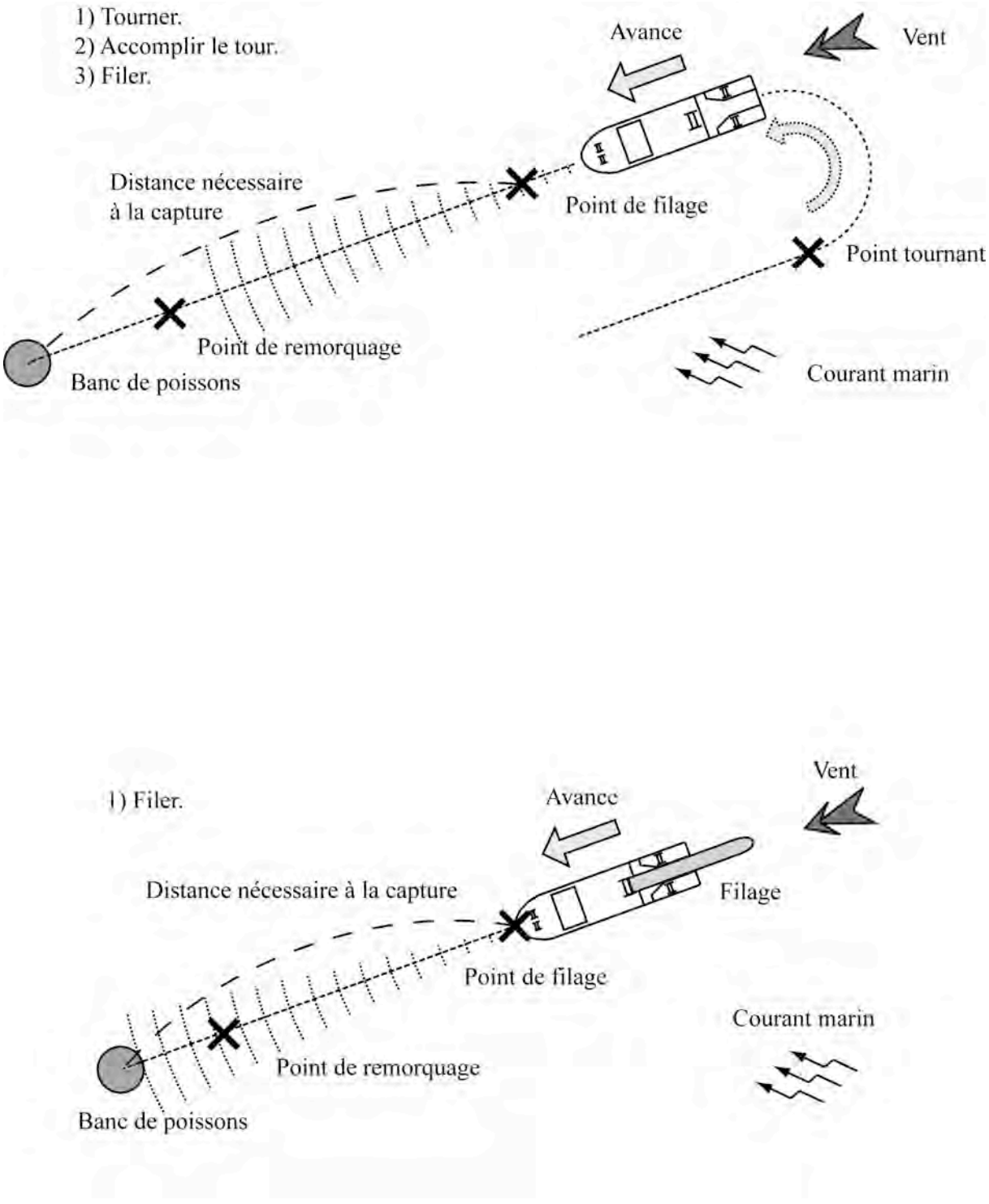


Figure 8-2 Mid-water Trawl Diagram (5)

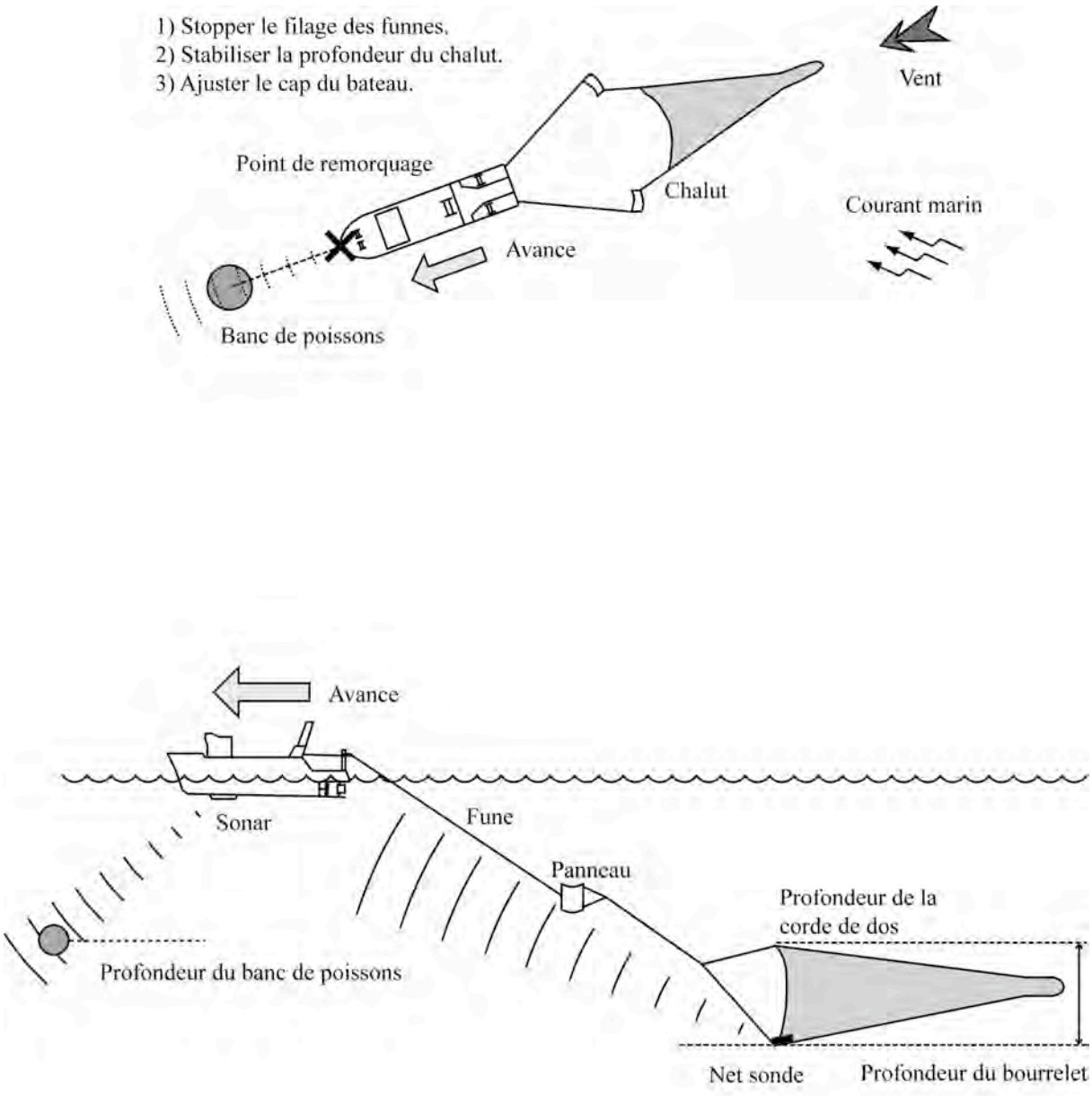


Figure 8-2 Mid-water Trawl Diagram (6)

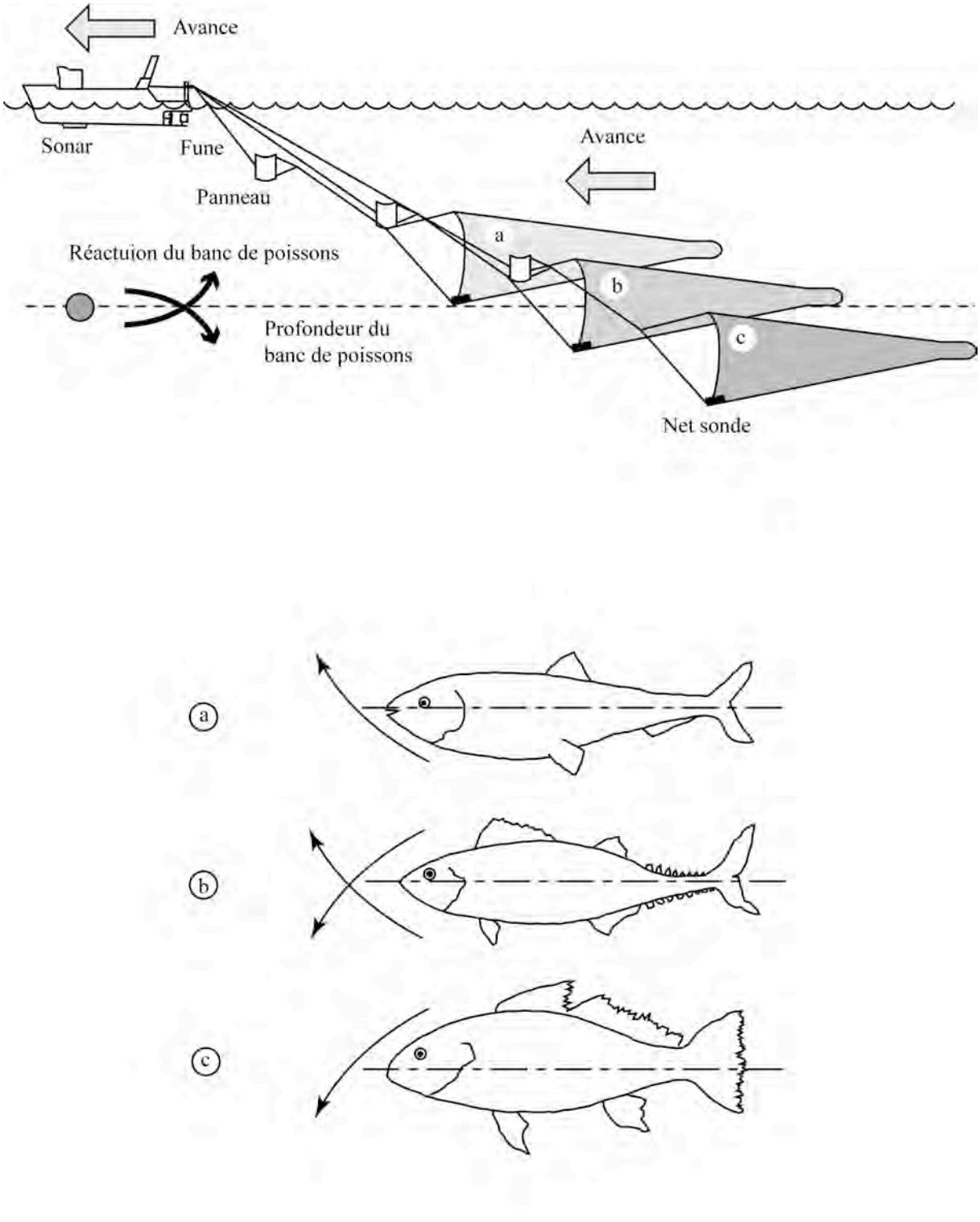
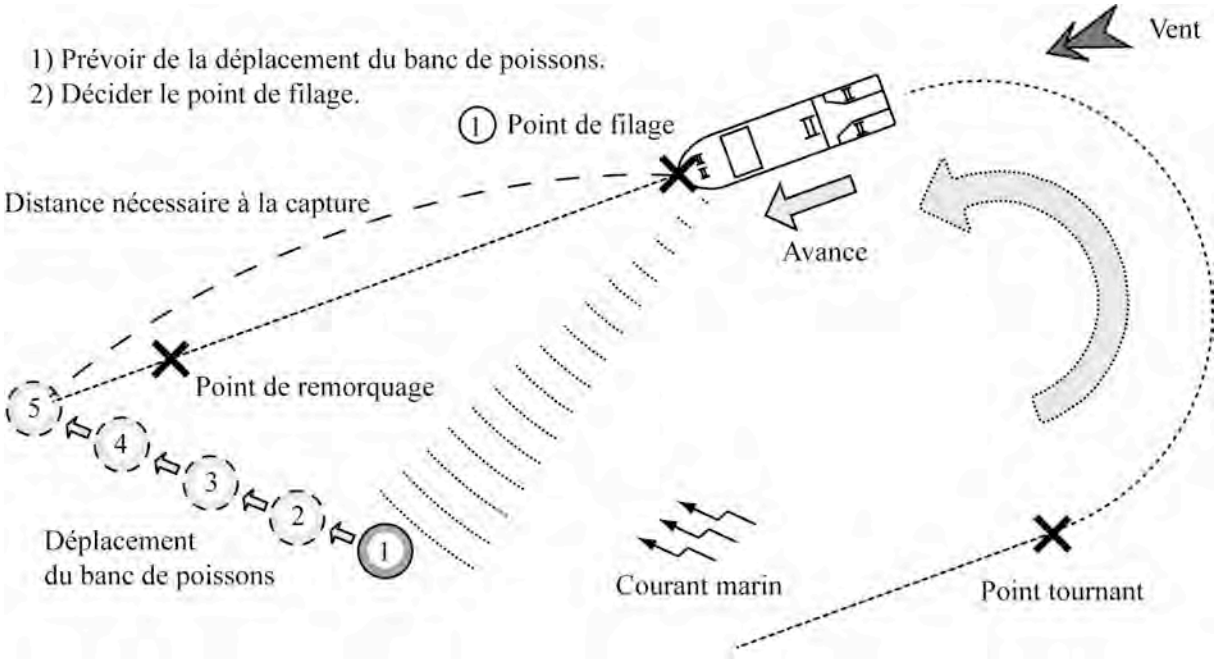


Figure 8-2 Mid-water Trawl Diagram (7)



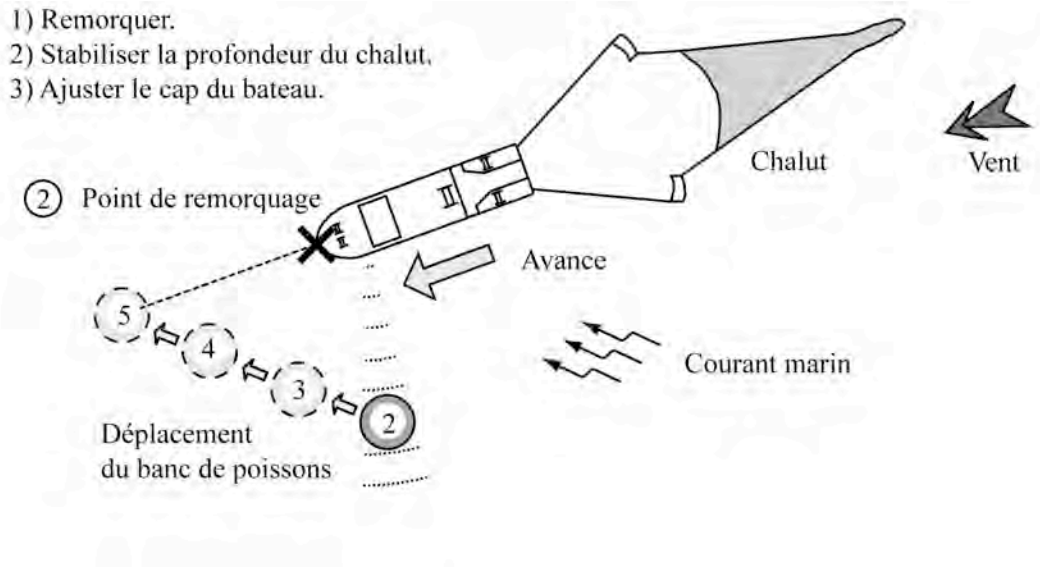
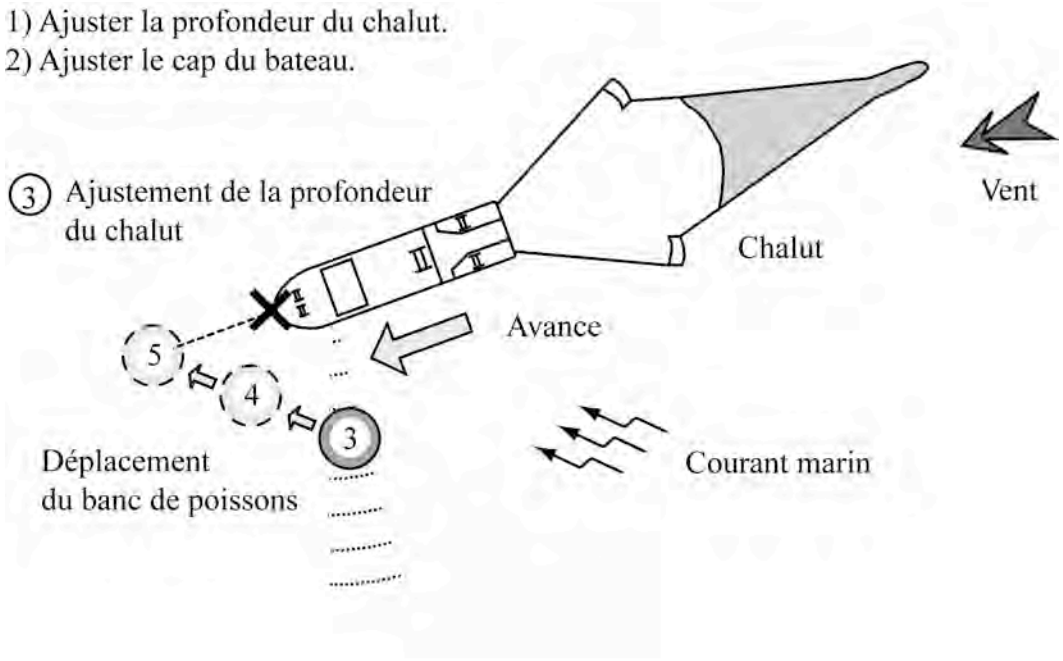
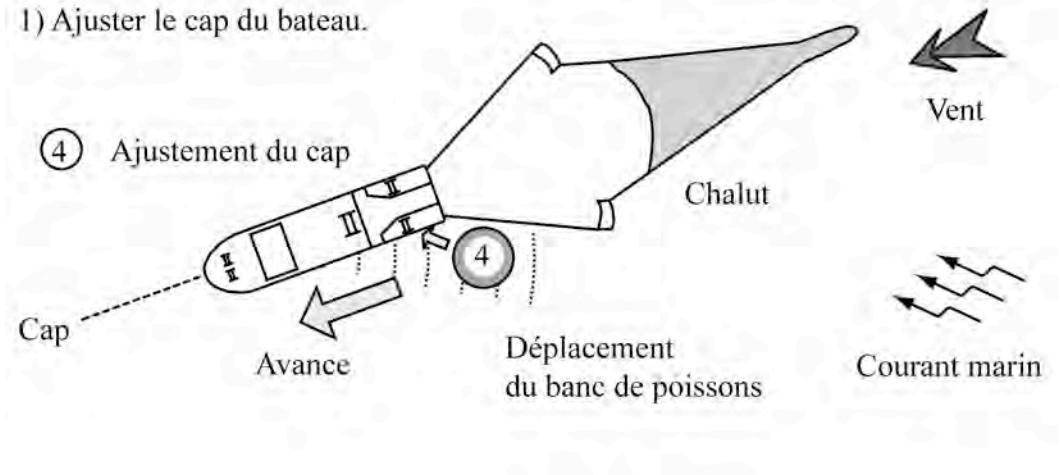


Figure 8-2 Mid-water Trawl Diagram (8)





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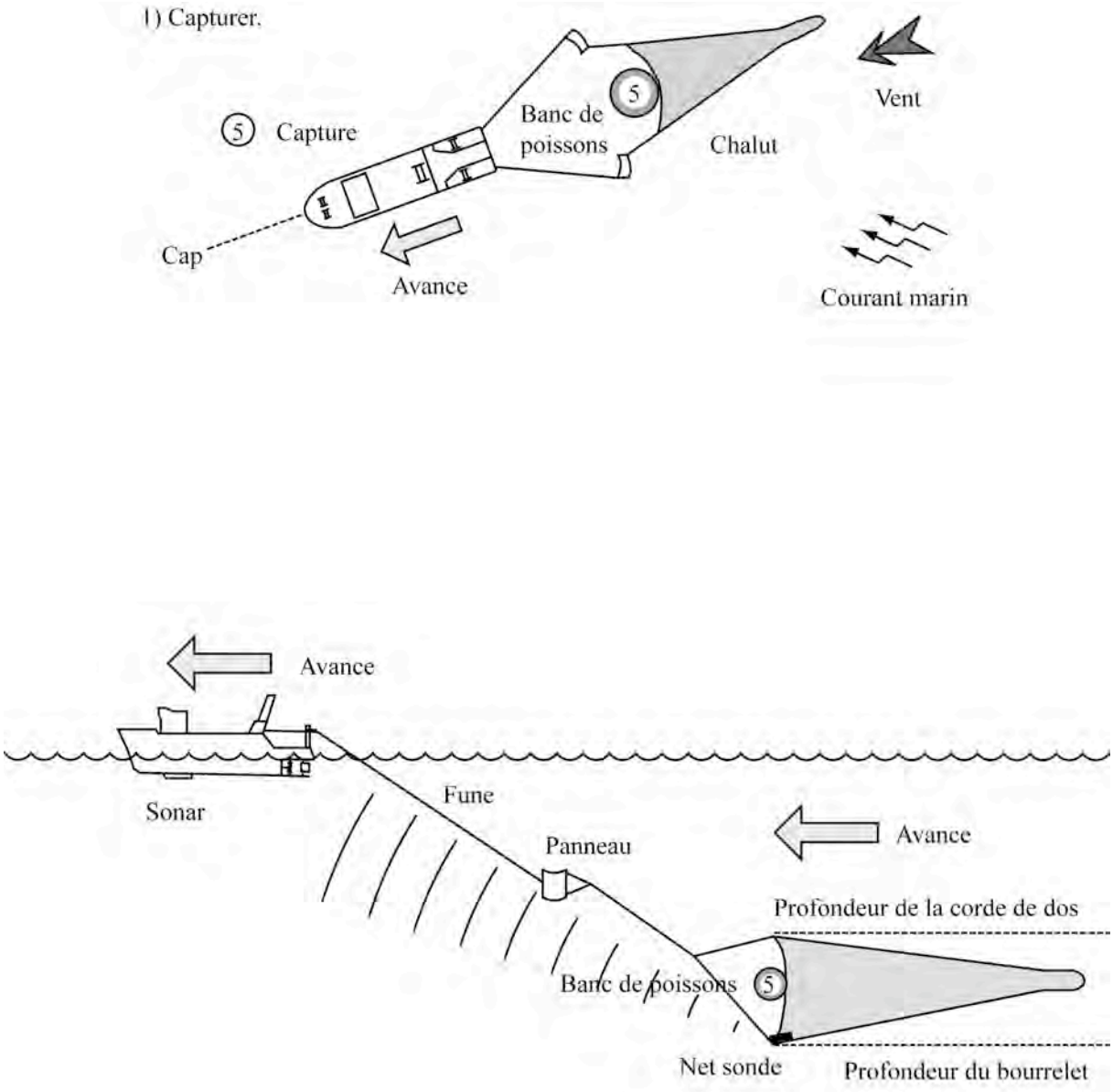
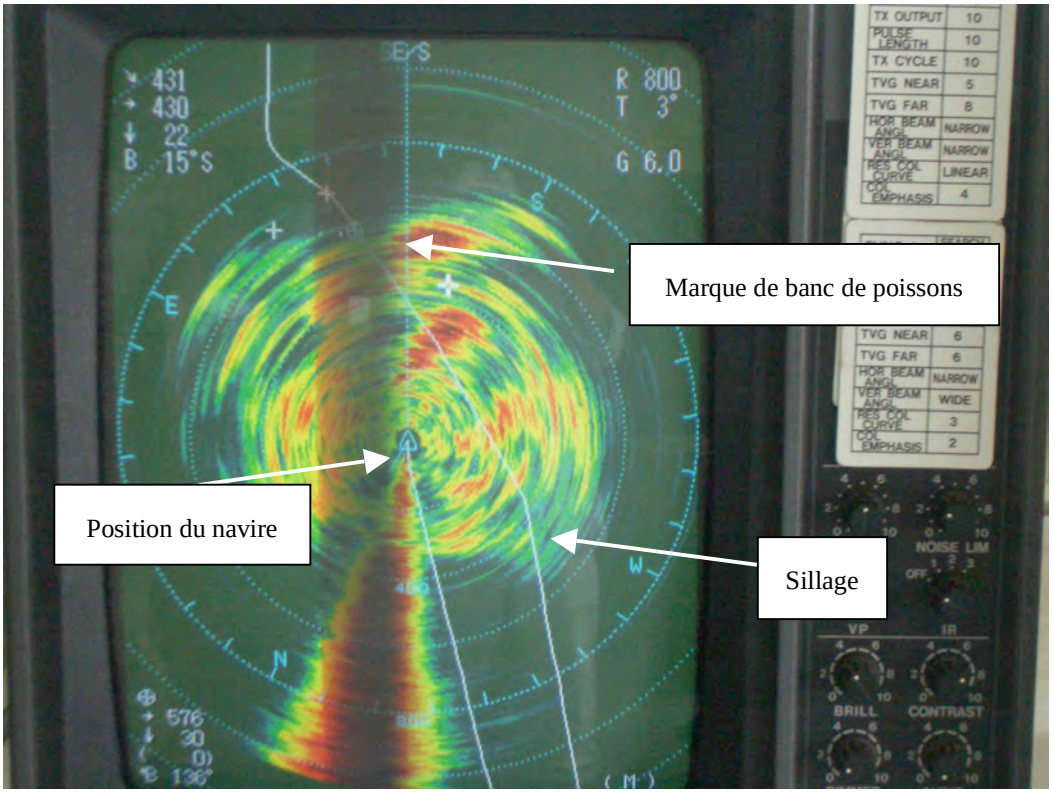
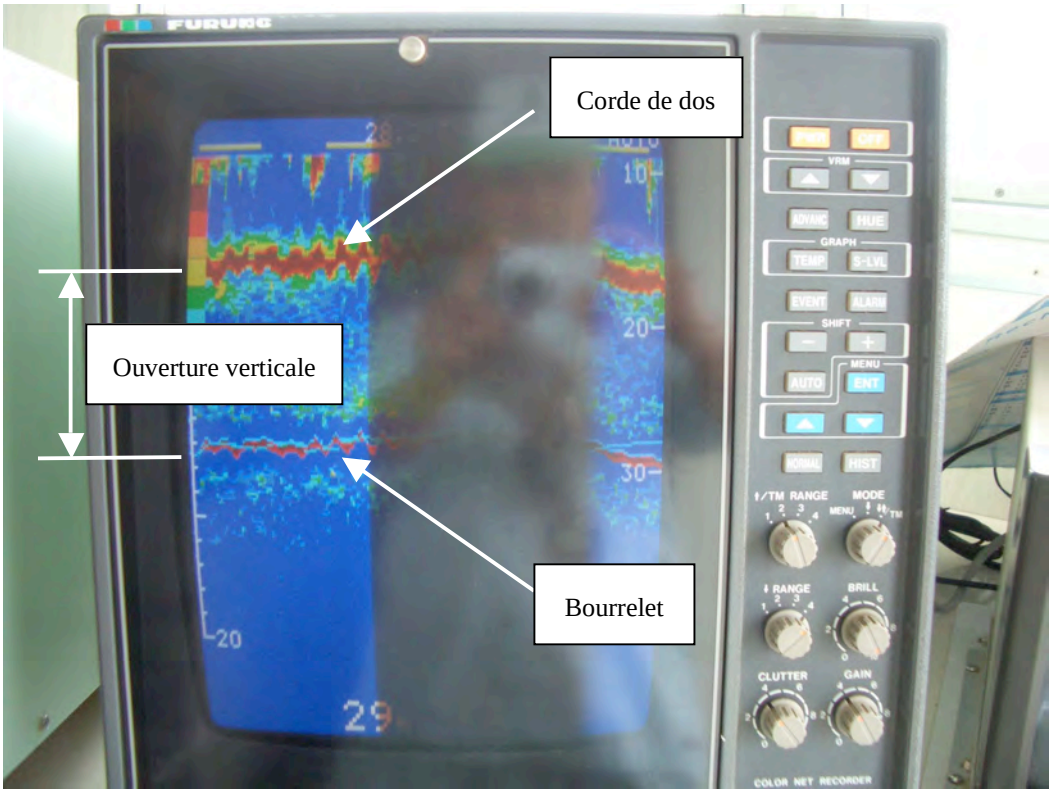


Figure 8-2 Mid-water Trawl Diagram (10)

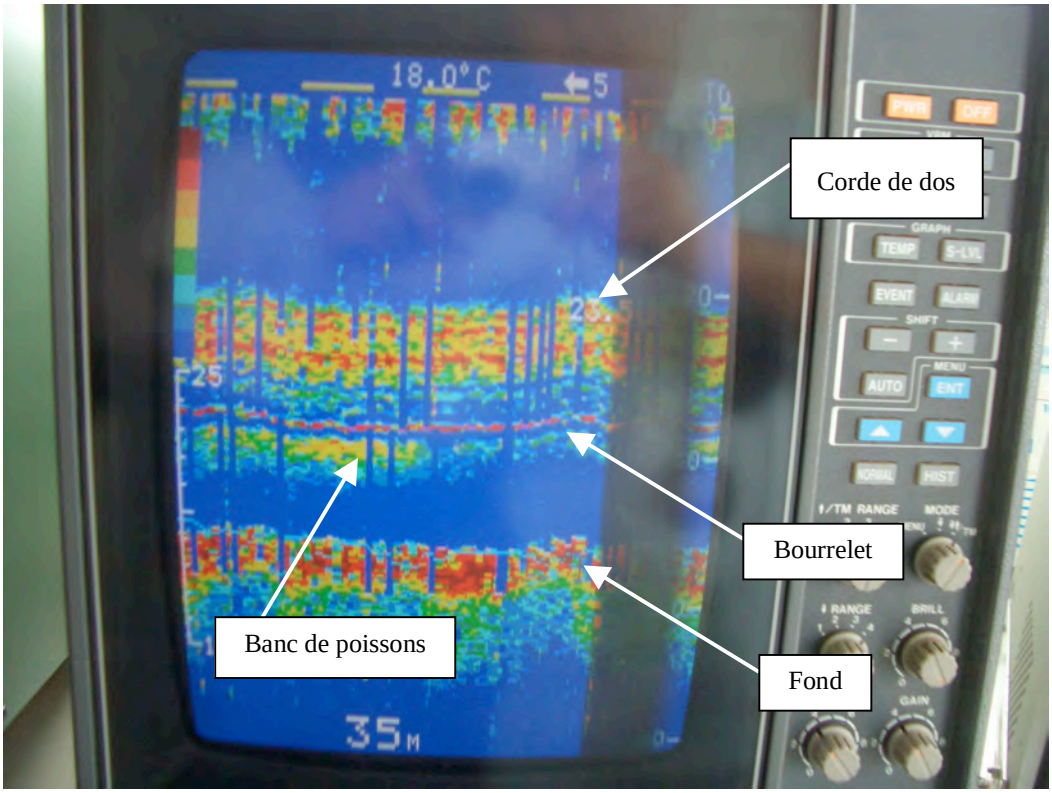


Re-approche au banc de poissons (par le Sonar)

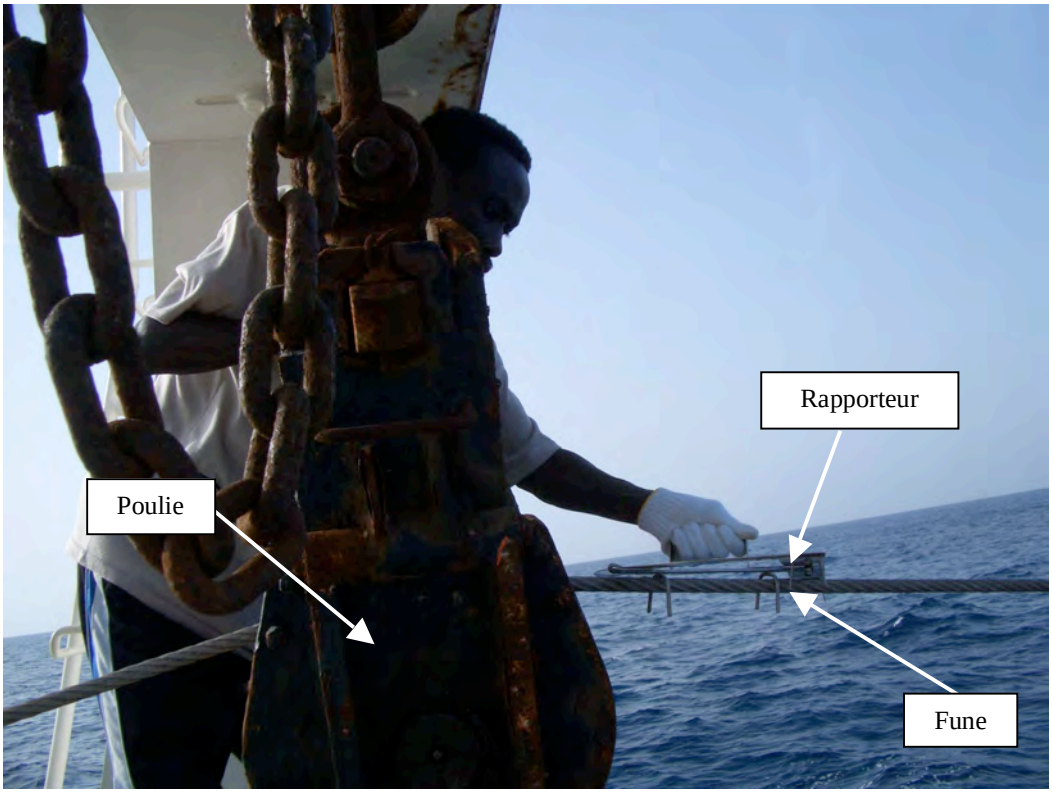


Ecran du Net-sondeur

Figure 8-3 Mid-water Trawl Photographs (1)



Le banc de poissons passé dessous le bourrelet



Mesure de la distance entre les panneaux

Figure 8-3 Mid-water Trawl Photographs (2)

Table 8-1 Mid-water trawl Demonstration

CHALUT PELAGIQUE (Vitesse de navire par GPS : 3,5nœuds) Courant : inprécis

Longueur des funes	N°	Cap de navire (°)	Vent Direction (°)	Vent Vitesse (m/s)	Courant Direction (°)	Courant Vitesse (m/s)	Heure Fin de filage	Heure Stabilisé de filet	Heure temps* (m : s)	Pas de hélice (°)	Filet Profondeur C. de dos(m)	Filet Profondeur Bourrelet(m)	Filet Hauteur (m)	Remarque
100mètres	1	225	040	2.0	228*	2.11*	11:00	11:02*	01:50*	8.0	17*	34*	17	
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					
150mètres	1	225	040	2.0	-	-	11:15	11:18*	03:00*	8.0	25*	42*	17	
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					
200mètres	1	225	040	2.0	-	-	11:32	11:32*	11:37*	9.2	51*	65*	14	
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					
250mètres	1	225	030	1.4	224*	1.20*	11:50	11:57*	7:50*	8.8	90*	103*	13	
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					
300mètres	1						:	:	:					
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					

* : Filet n'est pas stabilisé (plongée)

CHALUT PELAGIQUE (Vitesse de navire par GPS : 4,0nœuds) Courant : inprécis

Longueur des funes	N°	Cap de navire (°)	Vent Direction (°)	Vent Vitesse (m/s)	Courant Direction (°)	Courant Vitesse (m/s)	Heure Fin de filage	Heure Stabilisé de filet	Heure temps (m : s)	Pas de hélice (°)	Filet Profondeur C. de dos(m)	Filet Profondeur Bourrelet(m)	Filet Hauteur (m)	Remarque
100mètres	1	030	300	1.8	-	-	13:16	13:19	2:54	8.3	37	47	10	
(1'20")	2	120	200	0.2	180*	2.87*	13:58	14:01	3:00	8.0	39	49	10	
	3						:	:	:					
	4						:	:	:					
150mètres	1	030	270	2.0	-	-	13:30	13:36	6:00	8.3	46	59	13	
(1'50")	2	120	-	-	-	-	14:15	14:21	6:22	8.2	48	58	10	
	3						:	:	:					
	4						:	:	:					
200mètres	1	030	240	2.0	039*	1.56*	13:38	13:45	6:50	8.6	60	72	12	
(2'25")	2	120	330	2.0	116*	2.10*	15:21	15:27	5:51	9.3	63	74	11	
(2'26")	3						:	:	:					
(2'25")	4						:	:	:					
250mètres	1						:	:	:					
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					
300mètres	1						:	:	:					
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					

CHALUT PELAGIQUE (Vitesse de navire par GPS : 5,0nœuds) Courant : inprécis

Longueur des funes	N°	Cap de navire (°)	Vent Direction (°)	Vent Vitesse (m/s)	Courant Direction (°)	Courant Vitesse (m/s)	Heure Fin de filage	Heure Stabilisé de filet	Heure temps (m : s)	Pas de hélice (°)	Filet Profondeur C. de dos(m)	Filet Profondeur Bourrelet(m)	Filet Hauteur (m)	Remarque
100mètres	1						:	:	:					Panneaux seront flottés
	2						:	:	:					Panneaux seront flottés
	3						:	:	:					Panneaux seront flottés
	4						:	:	:					Panneaux seront flottés
150mètres	1	230	300	2.0	180*	3.17*	10:35	10:38	2:50	13.5	31	39	8	
(1'42")	2	320	325	2.4	308*	2.59*	11:27	11:31	3:25	12.5	33	41	8	
(1'47")	3	050	340	8.6	112*	2.10*	13:45	13:47	2:20	12.2	22	34	12	Courant contraire
(1'56")	4	140	000	12.0	139*	2.73*	14:22	14:24	1:10	12.8	15.5	28	12.5	Courant contraire
200mètres	1	230	340	2.3	-	-	10:49	10:51	1:30	13.5	34	42	8	
(2'25")	2	320	355	2.9	165*	0.64*	11:38	11:41	3:00	13.2	37.5	46	8.5	
(2'23")	3	050	345	9.5	305*	2.49*	13:53	13:55	2:00	12.8	27	40	13	Courant contraire
(2'22")	4	140	030	14.0	207*	4.59*	14:32	14:35	2:50	12.9	26	38	12	Courant contraire
250mètres	1	230	-	-	185*	2.30*	11:03	:	:	13.5	Filet arrive au fond		-	
(3'37)	2	320	355	3.0	321*	2.21*	11:47	11:51	4:16	12.5	55	65	10	
(3'34")	3	050	343	10.0	014*	1.70*	14:08	14:10	2:00	12.8	38	51	13	Courant contraire
(3'50")	4	140	010	13.0	204*	2.63*	14:50	14:52	1:57	13.5	36	48	12	Courant contraire
300mètres	1						:	:	:					
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					

CHALUT PELAGIQUE (Vitesse de navire par GPS : 4,5nœuds) Courant : inprécis

Longueur des funes	N°	Cap de navire (°)	Vent Direction (°)	Vent Vitesse (m/s)	Courant Direction (°)	Courant Vitesse (m/s)	Heure Fin de filage	Heure Stabilisé de filet	Heure temps (m : s)	Pas de hélice (°)	Filet Profondeur C. de dos(m)	Filet Profondeur Bourrelet(m)	Filet Hauteur (m)	Remarque
100mètres	1	300	120	0.2	306*	2.40*	15:50	15:52	1:35	11.5	25	37	12	
(1'08")	2	320	350	3.0	-	-	07:55	07:57	2:16	11.0	28	38	10	
(1'10")	3	140	320	1.7	029*	2.60*	08:55	09:00	4:50	10.5	30	41	11	
(1'12")	4	230	320	2.2	076*	2.30*	:	:	:		Panneaux sont flottés			
150mètres	1	300	Calm		306*	2.11*	16:03	16:05	1:58	11.5	32	44	12	
(1'45)	2	320	350	2.5	-	-	08:05	08:08	2:20	12.0	33	42	9	
(1'47")	3	140	300	1.6	130*	3.11*	09:07	09:11	3:26	11.0	34	42	8	
(1'49")	4	230	295	2.2	229*	2.32*	10:02	10:06	4:22	12.0	29	38	9	
200mètres	1	300	Calm		-	-	16:10	16:11	1:03	12.0	38	50	12	
(2'20")	2	320	320	2.5	328*	2.31*	08:20	08:22	1:33	11.6	34	43	9	
(2'22")	3	140	290	1.2	131*	2.44*	09:22	09:27	4:22	11.0	39	48	9	
(2'24")	4	230	300	2.0	-	-	10:14	10:24	9:48	11.8	41	50	9	
250mètres	1						:	:	:					
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					
300mètres	1						:	:	:					
	2						:	:	:					
	3						:	:	:					
	4						:	:	:					

CHAPTER 9

RECOMMENDATIONS

CHAPTER 9
RECOMMENDATIONS

9.1 Recommendations concerning the Fisheries Research Setup

The CRODT, which is organized under the jurisdiction of the ISRA (Institut Senegalais de Recherches Agronomique), is responsible for conducting biological survey and research of fisheries stocks in Senegal. In administrative terms, it belongs under the Ministry of Agriculture, however, stock survey expenses are covered under the budget of the Ministry of Maritime Economy. The Ministry of Agriculture and Ministry of Maritime Economy have an agreement that the Ministry of Maritime Economy will secure the budget required for fisheries stock assessment. Accordingly, it is prescribed that the CRODT carries out the rational management of fisheries stocks in the territorial waters and fishing zone of Senegal as well as survey and research for effectively utilizing fisheries products and raising profits in the fisheries field.

Concerning the Medium Term Sustainable Development Action Plan for Fisheries and Aquaculture in Senegal that was compiled by the Ministry of Fisheries and Maritime Transport (the present Ministry of Maritime Economy) in 2000, it has been pointed out that the following restrictions are placed on the activities of the CRODT.

- Because the ordinary budget of the CRODT is linked to counter funds of fisheries agreements, it is always an uncertain element. In other words, no usable budget can be secured until fishing agreements are concluded. The CRODT does not possess an independent source of funding that it can use in its own survey projects.
- The equipment owned by the CRODT for survey work is very limited.
- There is a shortage of human resources.
- Due to its affiliation under the Ministry of Agriculture, the CRODT lacks the flexibility and autonomy to deal with important issues.

The following recommendations have been made with respect to future action plans.

- It is necessary to review the agreement concerning the framework between the Ministry of Maritime Economy and the CRODT.
- With a view to freeing the CRODT budget from funding linked to fisheries agreements with foreign countries, it is necessary to guarantee CRODT activities under the state budget.
- Start programs in order to deepen biological and socioeconomic know-how of the environment.
- Establish a survey group to conduct research on fisheries propagation and prepare an action plan.
- Determine fishing ground development plans based on scientific know-how.

Based on the above action plans and the experiences of this Study, recommendations are made concerning improvement of the future work of the CRODT.

9.1.1 Coastal Demersal Fish Stock Survey

Regarding assessment of coastal demersal fish stocks at depths of less than 200 m, it is necessary to adopt a combination of collecting and analyzing catch statistics on the Senegalese government side and estimating stocks by the direct method based on marine surveys. In particular, now that the importance of fisheries resource management is being recognized, rather than implementing one-off surveys, it is necessary to implement ongoing marine surveys aimed at gauging changes in stock volumes over time for around 10 years (at least 5 years) in order to grasp the dynamic state of coastal fish stock volumes. It is clear from the results of the interviews of artisanal fishermen and corporate fishermen that fishermen are interested in the trends of such assessment.

Although there are no technical problems regarding the continuation of marine surveys, there is concern that economic difficulties caused by inflated fuel and repair parts prices, etc. will hinder this work. In future, it is desirable that careful preparations be made and surveys targeting at least the 82 stations in Senegalese waters that were covered in the project be implemented two times per year (in the cool season and warm season) based on the self-effort of the Senegalese government side.

Furthermore, with a view to implementing resource management in collaboration with neighboring countries in the future, it is necessary to build a working level setup for jointly implementing marine surveys aimed at assessing stock volumes with neighbors, and Senegal is expected to play a leading role in this. Under these conditions, as a first step, it is anticipated that Senegal implements a marine survey of coastal waters off Gambia, which is closely related to Senegal in terms of stock volume assessment, and provides the resulting stock assessment data to the Gambian side. Also, it is anticipated that these two countries build a setup for jointly implementing stock management.

9.1.2 Offshore Demersal Fish Stock Survey

As artisanal fishermen have come to acquire larger pirogues and more powerful engines in recent years, they are moving further out to sea in search of fishing grounds and coming to compete more and more with corporate fishing boats over operating areas. In future, since it is thought that corporate fishing boats will advance further out to sea, the assessment of offshore demersal fish stocks has become an important duty of the CRODT. The following recommendations are given concerning the implementation of offshore demersal fish stock surveys using the fisheries research vesselresearch vessel in future.

(1) Survey of seabed terrain and depth in offshore waters and creation of seabed maps (fishing ground maps)

In offshore waters, since there are numerous steep slopes, etc., it is thought that seine nets can only be trawled in very limited areas. Accordingly, in addition to identifying points where trawl can be performed, it will be important to compile seabed maps (fishing ground maps) with the intention of preventing fishing gear accidents as much as possible.

(2) Preparation of warp rope and confirmation of current lengths.

Warp rope is marked at 50 m intervals, however, it is necessary to reconfirm the locations of marking and prepare the warp rope once again. Moreover, because warp rope ends (on the otter board side) are more subject to stress the more frequently that trawl is conducted, there is a greater risk of breakage accidents occurring. When trawl net works at deep levels, the run-out length of warp rope also increases and it is necessary to retain around 500 m of rope on the warp winch drum while trawling to be on the safe side. Accordingly, it is necessary to accurately record the currently available length of warp rope.

(3) Preparation and effective utilization of ground rope on the continental slope

Generally speaking, since there are many rocky crags and much mud sediment at deep levels, it is necessary to use normal trawl nets as the main nets for coastal trawl, and also consider replacing with ground rope on flat areas and the continental slope. Some researchers doubt the catch efficiency of ground ropes intended for use on the continental slope because they are unable to catch flatfish and other species that stick closely to the seabed. Such researchers recommend the use of flat area ground ropes, however, against the background of limited budget for making and repairing fishing gear, it is worth considering making effective use of continental slope ground ropes in order to reduce the risk of net breakage. However, in areas where the bottom sediment is stable and there is little risk of net breakage, it may be necessary to implement catch efficiency comparison tests by alternately trawling the same type of main net fitted with flat area ground rope and continental slope ground rope.

(4) Adjustment of warp rope run-out length during trawling

When dragging trawl net at deep levels, it is thought appropriate to set the drag speed at 3.0~3.5 knots and adopt a warp run-out length equivalent to 2.2~2.3 times the water depth. Moreover, because the currently used vertical otter boards tend to get caught in bottom muddy sediment during trawling, it is necessary to pay ample attention to changes in boat speed during trawling in order to prevent net accidents from occurring.

(5) Biological survey activities onboard corporate fishing boats

These survey activities are not directly implemented by the CRODT research vessel but are supplementary survey activities. Rather than having CRODT personnel board corporate fishing boats in order to monitor operations at depths greater than 200 m in Senegalese waters, it may be better to have such boats implement biological survey activities with a scientific objective. In such cases, in order to keep the impact on commercial activities to a minimum, it is necessary to limit sampling and body length and weight measurements as much as possible and to develop new biological survey methods such as totaling production quantities according to each species and so on.

Moreover, it is desirable that joint resource management activities be implemented in offshore waters deeper than 200 m off the coast of Gambia too. Such work, implemented upon holding discussions with the Gambian government, should entail the implementation of marine surveys by the Senegalese side and provision of stock assessment data to the Gambian side.

9.1.3 Pelagic Fish Stock Survey

Survey of pelagic fish resources should commence from the implementation of sample catching in order to augment data obtained at measurable scientific fish depths and acquiring biological data. If such data can be accumulated, there will be hardly any need to conduct sampling catching and it will be possible to switch to survey work using only measurable scientific fish depths, thereby increasing the efficiency of survey cruise. Accordingly, it is urgently necessary to establish sampling methods, but also, in order to prevent damage to fishing gear, it is desirable to conduct sampling using mid-water trawl gear upon detecting fish shoals at depths of 40 m or more.

Furthermore, in cases where joint surveys of pelagic fish stocks are continuously implemented with the R/V Dr. Fridtjof Nansen, data sharing and utilization shall be continued.

Also, it is desirable that joint resource management activities be implemented in Gambian waters too. Such work, implemented upon holding discussions with the Gambian government, should entail the implementation of pelagic fish stock assessment surveys by the Senegalese side and provision of stock assessment data to the Gambian side.

9.1.4 Organizational Strengthening concerning Marine Survey

The Joint Committee on Research vessel Operation, which is composed of members from the CRODT and DPM, is responsible for compiling the annual operation plan for the research vessel. Now that fisheries resource management is becoming more important in Senegal, because it is necessary to

estimate stock volumes, conduct ongoing survey of movements in stock volumes over the medium to long term and reflect the findings in fisheries stock management policies, it is necessary to strengthen the relationship between the CRODT and DPM and the organization of the joint committee and to compile medium to long-term operation plans.

Furthermore, in the absence of any department in the CRODT devoted to managing operation of the research vessel, management personnel who are responsible for various projects and are inundated with all sorts of work are unable to conduct efficient and comprehensive operation planning, and the organization is not properly functioning in terms of the following points:

1) Repair and maintenance management including ordering and purchase of repair parts and space parts and dock planning
2) Equipment control including purchase and transportation of fuel and ship supplies, etc.
3) Compilation of assignment, rest and training plans for crewmembers and labor control matters concerning working time, etc.
4) Document control for port exit and entry procedures, etc.
5) Preparation of draft budgets for operation and maintenance
6) Preparation of operation plan materials for use in the joint committee

Accordingly, it is necessary to immediately establish within the CRODT an "Operation Control Section" (provisional name) to conduct the above work, and to man this section with personnel possessing overall ability in terms of shipping, fishing, equipment and materials, labor affairs and accounting, in order to efficiently manage operations.

9.1.5 Budget Strengthening concerning Marine Survey

When compiling the annual operation plan for marine survey work, it is important to compute an operation expense estimate and prepare a budget plan. Accordingly, the CRODT personnel responsible for compiling operation plans and budgets should periodically meet with officers of the research vessel and give consideration to repair and maintenance plans in the medium to long term. Needless to say, since fluctuations will arise in the compilation of operating expenses as a result of price changes and need for emergency repair parts, etc., it is necessary to take a flexible approach to budget planning by for example revising the budget plan once every quarter and so on. Figures for each operating expense item in the initial budget plan are set set as shown below.

Out of the direct operating cost items incurred in the cool season and warm season demersal fish stock surveys, fuel consumption was as follows.

	Fuel consumption (liter)	Operating days	Daily consumption (liters)
Cool season survey	40,117	23	1,744
Warm season survey	42,326	26	1,628

Accordingly, daily fuel consumption in offshore and coastal demersal fish stock surveys shall be calculated as 1,750 liters.

Assuming operating time of 24 hours and implementation of sample catching while conducting measured scientific fish finding at a speed of 10 knots, the daily fuel consumption in pelagic fish stock surveying is estimated as 4,000 liters. Moreover, based on transects (survey itinerary maps) of pelagic fish stock surveys implemented by the Senegalese government in coastal waters in the past, it is estimated that a single survey of pelagic fish stocks will cover 1,800 nautical miles and take 15 days. Lubricating oil consumption is assumed to be 1% of fuel consumption based on experience.

Taking into account the above, in the event where the minimum “assessment of coastal demersal fish stocks,” “assessment of offshore demersal fish stocks” and “assessment of pelagic fish stocks” are carried out, it is estimated that the total annual operating cost will be 251,000,000 Fcfa (see Table 9-1). However, because it was not possible to obtain detailed data concerning past repair costs and repair parts costs in the past, it will be necessary for the said “Operation Control Section” in the CRODT to re-implement detailed investigation upon discussing with the research vessel officers and hammer out a medium to long-term operating budget.

Concerning budget compilation for operating expenses, the CRODT and DPM joint committee must examine obtaining funding from international agencies and donors as well as concession fees from foreign fishing boats. Moreover, in order to reduce consumption levels of fuel and so on, it will be necessary to improve efficiency levels through, for example, increasing the number of sailing days and reducing traveling times during surveys while taking care not to place a burden on the health of crewmembers, or increasing the number of stations handled per day and so on. Such enhancement of efficiency will also lead to reduction of food expenses and sailing allowances for crewmembers.

Higher efficiency can also be achieved by taking a separate viewpoint. In other words, investigate and archive seabed topography and bottom sediment, etc. whilst moving during each survey trip, in order to abbreviate and save time on the seabed investigations implemented before survey trawling. Since the archiving of data will lead to reduction of fishing gear accidents and cost burden for repair fishing gear, this should be implemented independently by the CRODT.

9.1.6 Mapping of Fishing Grounds

During the trial navigation that was implemented in 2003 as well as the cool season and warm season marine surveys and mid-water trawl training implemented in 2004, the Japanese Study Team members attempted to record depth and seabed conditions and enter them in fishing ground maps as much as possible (see Table 9-2), however, these maps still cannot be effectively utilized because they do not cover all the sea area. When these partially completed fishing ground maps are compared with the latest ocean maps (1997 version), the position of contour lines shows a mis-alignment of 3 miles in parts, so it will be essential to correct the total area of each depth zone before implementing coastal demersal fish stock surveys by the sweep area method. Accordingly, in future it will be important for the Senegal side itself to record position, depth and bottom sediment as far as possible during survey navigation and survey work in order to fulfill its duty of finishing the fishing ground maps. Moreover, since the semi-finished fishing ground maps are stored on the personal computer of the research vessel, it is desirable that the CRODT counterparts complete them by adding new information as they obtain it.

9.1.7 Securing Representative of Body Length Composition of Specimens

In order to estimate the body length composition of specimens, it is necessary to improve the rationality of specimen sampling work in length measuring situations. It is necessary to pay more attention to securing the required number of specimens, covering the scope of body length and achieving universal sampling of specimens, etc. It is also necessary to pay more attention to spatial and time dispersion of measurement sites. Examples of the problems arising from deficiencies in these areas are numerously pointed out in Chapter 3.

Specific improvement measures are as follows:

(1) Increase the number of fish measured for primitive length composition.

- In order to estimate the body length composition of caught fish (landed fish) without bias, set the number of specimens sampled per measurement at 30 or more.
- Repeat the same measurements three times per month (10^{th}, 20^{th} and end of month).
- Establish at least three measurement points (northern, central, southern) at landing sites on the Senegalese coast.

(2) Archive records of primitive body length measurements in the primitive form.

- Concerning the results of body length measurement, retain and archive records of body length composition (number of fish) in the primitive form.

- Convert caught quantities into fish numbers annually rather than monthly in order to obtain annual totals.
- Establish the above two points as systems within the CRODT.

(3) Improve and build statistical data on catches

- DPM should adopt a setup whereby it can collect catch statistics for commercially important fish according to the fish species and the type of fishery (industrial, artisanal, foreign industrial).
- Since the DPM and the CRODT use different methods for estimating species-separate catches and therefore have discrepant statistical values, take steps to integrate and build statistical values between both agencies.

9.1.8 Guaranteeing Biological Basis of Argument

It is necessary to gather more diverse and greater quantities of biological and ecological knowledge and information on the species of fish targeted by fishing. More efforts need to be devoted to gathering and accumulating information concerning the distribution of species, seasons and places of reproduction, numbers of conceived eggs, size of eggs, geographical and vertical distribution of eggs, geographical and vertical distribution of fry and young fish and so forth. Acquiring abundant quantities of such information will greatly enhance the quality of stock assessment. Moreover, such information will undoubtedly prove useful in establishing fishery regulations such as closed seasons and closed zones, etc.

9.1.9 Strengthening of Underwater Survey Capability

During the Study period, transfer of technology in underwater survey methodology using an aqualung was implemented for one researcher and one survey crewmember. The implementation training term was too short to enable wide-ranging training, however, both members were able to learn the basics of underwater observation. Underwater surveying is indispensable in artificial reef projects and this has been a desired need for some time now, however, an independent survey setup was finally established during this project. In future, as more and more marine protection zones (AMP) and artificial reefs, etc. are established in Senegal, the need for underwater surveying will increase even more. By utilizing the surveying capacity acquired here, it is desirable that scientific surveys of coastal waters be implemented in future. A concrete plan is indicated at the end of this chapter.

9.1.10 Recruitment of Young Researchers

Many of the CRODT researchers are getting old and will attain compulsory retirement age in a few years time. Since much field survey work in the fisheries sector requires a lot of physical strength, it is desirable to recruit more young researchers. It is desirable to conduct active exchanges with the biology department of Dakar University in order to recruit promising students.

9.1.11 Collaboration with Neighboring Countries (especially cooperation with Gambia)

Since Gambia is situated so that it is surrounded on two tides by Senegal, its sea area is sandwiched between the fishing zone of Senegal on both the north and south sides. In the Study, no survey work was implemented in these Gambian waters because they were not targeted. Since Gambia does not have any agencies for carrying out marine fisheries surveys, it has hardly any marine stock data and relies totally on estimates derived from data in Senegalese waters. Since fisheries stocks are not distributed along artificially set national border lines, it will be necessary to simultaneously survey Gambian waters too in order to gauge accurate stock volumes. It is desirable that stock surveys be carried out in Gambian waters in cooperation with the Gambian side, on condition that the CRODT publicly discloses surveyed data through the local fisheries committees (CSRP).

9.1.12 Transfer of research agency

Stock analysis in this study showed that demersal fish stocks in Senegal have reached a critical state. In future it will be necessary to tighten various regulations and make sure that stock management is carried out. In order to implement such measures, a setup for constantly monitoring trends in stocks must be established. It will be necessary for the research department (CRODT) to work closely with the administrative department (DPM) in order to consistently implement stock surveys and analysis and promptly reflect the findings in measures. For the time being, it will be necessary to increase the frequency of stock surveys by the survey ship and, for this purpose, to establish a setup such as a joint committee for conducting regular discussions between the CRODT and DPM. And in the future, it is desirable that the fisheries stock research and administration departments are integrated into one. Various discussions have already been conducted regarding the amalgamation of the research agency in the past, and now that current stock management and stock assessment have reached an extremely important phase, it is sincerely hoped that the research agency in the field of fisheries is transferred from the Ministry of Agriculture to the Ministry of Maritime Economy and International Transport. It is necessary for the two ministries to holds talks with a view to realizing this.

9.2 Recommendations concerning Fisheries Administration

The Department of Marine Fisheries (DPM) is the department responsible for marine fisheries administration. The DPM for many years placed the emphasis of policy on fisheries development; however, from the second half of the 1990s it gradually shifted its focus from development geared to increasing catches to the establishment of sustainable fisheries. Its main activities in recent years have included the following:

① Review of marine fisheries related legislation
② Implementation of administration in accordance with international rules
③ Development of fisheries infrastructure
④ Project surveying, planning and assessment
⑤ Ratification of international agreements
⑥ Collection, arrangement and announcement of fisheries statistics
⑦ Issue of licenses for commercial fishing

In 2004, in consideration of the growing importance of resource management work, the Ministry of Maritime Economy decided to reorganize the DPM and install a fisheries coordination department, however, due to budge problems and so on, this reform has not yet been put into effect.

Concerning coastal resource management, in line with the government policy of decentralizing administration, local fisheries councils (Conseils locaux de peche artisanale) were established in main landing areas and management of artisanal fisheries was transferred to these agencies from 2005. These councils were introduced based on the findings of survey and research work that was implemented for some years under assistance from France and the EU. It is uncertain at present what kind of functions these organizations will fulfill in the future. This approach is basically a bottom-up approach consistent with the decentralization policy of the government, and it is thought that a lot of time will still be required for it to spread over the whole country.

Government-led resource management in the artisanal fishery will mainly consist of registering fishing boats and controlling catch pressure through controlling the issue of concessions that are planned from now on. By doing this, the government hopes to establish a top-down management setup for limiting the catch effort, and it is anticipated that the artisanal fishery, which until now was a free sector open to anyone, will be transformed into a controlled sector under the government.

Meanwhile in regional fishing villages, it is thought that fine-tuned resource management based on the bottom-up approach under fishermen's initiative as demonstrated during this project will become more widespread. In the World Bank project GIRMAC, it is planned to implement resource management

based on fishermen's initiative in a number of villages over the coming five years. In this approach, it is anticipated that the government can limit its economic input and management costs. However, indirect support by the central government is essential in order to develop autonomous management by fishing communities, and in DPM the development of personnel to work in this field will be an important issue. The areas that the DPM needs to actively tackle in future are as follows.

9.2.1 Improvement in the quality of regional branch personnel

Regional branch personnel serve as the pipes that link fisheries on the ground to administrative authorities. The DPM, which is the central administrative agency for fisheries in Senegal, has a pyramid organization of regional branches, prefectural branches and local branches (Poste de controle) according to administrative units in that order. Of these, the local branches are most accessible to fishermen (including processing and distribution operators). Due to budget and personnel constraints, many of these branches are manned by only one person and moreover they must cover a wide range of fishing villages and landing sites without adequate means of transport and so on. As a result, these branches are unable to adequately fulfill their duties. Moreover, their duties extend widely to include collection of fisheries statistics data, issue of tax-free gasoline tickets and so on.

Local branch personnel have an extremely important role to play in the implementation of joint resource management between administration and the field. In future, it will be necessary for these personnel to acquire scientific resource management techniques and know-how to enable them to provide advice on concrete resource management in addition to the routine duties described above.

9.2.2 Reorganization corresponding to decentralization

Decentralization in the fisheries sector is slow compared to in other sectors. Thanks to intervention by donors and NGOs, community-based resource management is gradually attracting more attention, but it is still necessary to obtain central government approval even for setting recently popular AMP (marine protection zones). In this situation, authorization is a time-consuming process and it is impossible to respond to timely topics such as protection of spawning seasons.

Fortunately, new approaches as can be seen in GIRMAC and local fisheries councils are in the formative stage. The DPM needs to build a setup for supporting such activities from the viewpoint of personnel arrangement and distribution of concessions, etc.

9.2.3 Response to the ageing of personnel

Because recruitment of public servants was frozen for a long time due to structural adjustment by the World Bank/IMF, the average age of DPM personnel is advanced. Currently, since the retirement age of public servants has been raised from 55 to 60, there is no problem regarding the performance of services, however, almost all officer-class employees will retire in the coming 10 years. Meanwhile, because there are hardly any younger members in the 30s to 40s age group, a generation break will arise and work execution may fall into temporary difficulty when the older generation reaches retirement age. In order to avoid this, it is necessary to aggressively recruit young employees and adopt a long-term approach to human resources development.

9.2.4 Securing of necessary budget for resource management

It is desirable that the Department of Fisheries conduct a detailed investigation of existing preferential measures for artisanal fishermen that came to light in this Study, fully assess their impact and commence policies towards their removal in future. Meanwhile, the Ministry of Finance needs to conduct negotiations in line with the removal of these preferential measures and make sure that a budget that corresponds to the increase in income (increase in tax revenue) from their removal is allocated to the artisanal fisheries stock management policies of the DPM. Once such a budget is secured, it will be possible for the DPM to implement stock management plans geared to artisanal fishermen based on independent funds.

9.2.5 Implementation of resource management plan (Co-management)

Since the industrial fisheries sector of Senegal has only a limited number of fishing boats that are only able to land catches at Dakar port, should be easy to implement various regulations and conduct stock management under government initiative. Meanwhile, concerning stock management in the artisinal fisheries sector, considering that this has conventionally been regarded as a free access sector, it has been shown that co-gestion, whereby fishermen conduct autonomous stock management and the government supports these activities, is the most democratic and effective approach. It is necessary for administrative agencies to immediately build setups for supporting stock management activities in fishing villages by securing budgets, assigning personnel and aggressively conducting training and dissemination, etc. Moreover, it is necessary to give official approval to fishermen’s organizations that conduct stock management, to provide financial and technical support to organizations, and to prepare legislation that takes into account protection.

9.2.6 Installation of artificial reef

The Atlantic Ocean off the coast of Senegal has traditionally been blessed with abundant fisheries resources, however, repeated industrial trawling has devastated the seabed and led to the disappearance of rocky crags that provide hiding places for demersal fish. In the project, efforts were made to build artificial habitats for demersal fish by sinking concrete blocks and gabion. As a result, sightings of demersal fish species that had disappeared in recent years were confirmed around the artificial reefs and it was demonstrated that artificial reefs are an effective means of regenerating depleted stocks. When installing artificial reefs, it is desirable to use materials such as concrete blocks and natural stones, etc. that can be acquired at a low price locally and are easy to process and transport. Because larges-size materials are expensive as well as troublesome to transport and put into place, it is better to secure large total capacity through utilizing large quantities of smaller size objects. In consideration of the ease of work at sea, priority should first be given to installing artificial reefs on the sandy seabed off the southern coast (petite côte). Concerning the northern coast, costs would be more expensive because waves are high and it is difficult to secure the safety of work at sea. In this case, it would be necessary to consign work to a construction company that can mobilize large-scale machinery and floating cranes, albeit at a higher cost. After installing artificial fish reefs, it is necessary for beneficiaries to control the surrounding seawaters. Various methods are available, however, at the very least it is necessary to properly establish the rule not to use nets for fishing.

Table 9-1 Estimate of Annual Operating Expenses

Estimate of Annual Operating and Maintenance Costs for the Fisheries Research vessel ITAF DEME

1. Survey navigation planning

1) Survey navigation for demersal stock assessment (water depth: 10~200m)

	(Days)	Daily fuel consumption (liters)
Cool season survey	22	1,750
Warm season survey	23	1,750

2) Survey navigation for demersal stock assessment (water depth: 200m~)

	(Days)	Daily fuel consumption (liters)
Cool season survey	22	1,750
Warm season survey	23	1,750

3) Survey navigation for pelagic stock assessment

	(Days)	Daily fuel consumption (liters)
Cool season survey	15	4,000
Warm season survey	15	4,000

2. Estimation of research vessel operation and maintenance expenses

1)	Fuel cost:	Days	Daily fuel consumption	Unit price	Total
		90	1,750	300	47,250,000
		30	4,000	300	36,000,000
					83,250,000
2)	Lubricating oil cost				
	Consumption:	(90 x 1750) + (30 x 4000) x 0		2,775 liters	
	Cost:	2,775 x 500	=		4,162,500
3)	Expendables cost:				4,000,000
4)	Fishing gear cost:				9,000,000
5)	Sailing allowance	120 x 24 x 8,000	=		23,040,000
6)	Food expenses:	120 x 24 x 2,500	=		7,200,000
7)	Repair costs:				10,000,000
8)	Replacement parts purchase costs:				10,000,000
9)	Hull insurance cost:				100,000,000
	Total annual cost				250,652,500

Table 9-2 Water Depth Records (1)

Fiche de measure de profondeur

Date		N°	Position				Profonde	Conformite	Remarque
Mois	Jour		Latitude. N		Longitude. W			la carte marine	
11	6	1	14	8.5	17	30.6	116.0	170m	
		2	14	6.9	17	30.7	127.0	180m	
		3	14	6.2	17	24.7	89.3	87m	
		4	14	6.2	17	22.9	82.8		
		5	14	6.2	17	22.6	80.2	78m	
		6	14	7.0	17	22.5	80.9	75m	
		7	14	7.7	17	21.8	76.5	78m	
		8	14	8.1	17	21.2	74.3		
		9	14	8.4	17	16.6	48.3	52m	
		10	14	7.7	17	16.6	49.1	53m	
		11	14	7.3	17	16.4	48.7		
		12	14	6.9	17	16.9	54.0		
		13	14	1.2	17	5.1	26.3		
		14	14	1.7	17	4.9	25.5		
		15	14	2.4	17	4.8	25.4		
		16	14	4.2	17	4.6	23.7		
	7	17	14	27.5	17	8.9	22.3		
		18	14	28.0	17	9.3	23.9		
		19	14	29.8	17	10.3	26.8	23m	
		20	14	33.9	17	11.5	22.1	19m	
		21	14	34.3	17	11.7	20.9		
		22	14	34.8	17	11.9	20.7		
1	24	23	14	40.3	17	23.5	19.4		
		24	14	39.4	17	23.7	27.0		
		25	14	38.2	17	24.6	31.0		
		26	14	37.1	17	25.3	32.3		
		27	14	37.5	17	27.3	37.8		
		28	14	39.6	17	31.6	66.4		
		29	14	41.0	17	34.2	67.2		
		30	14	45.4	17	35.3	108.0		
		31	14	46.8	17	34.0	111.0		
		32	14	47.5	17	33.4	120.0	210m	
		33	15	0.7	17	20.4	200.0	160m	
		34	15	1.9	17	19.0	150.0		
		35	15	3.2	17	17.6	130.0	115m	
		36	15	4.6	17	15.9	123.0		
		37	15	5.0	17	15.5	130.0		
		38	15	6.4	17	14.0	124.0		
		39	15	7.9	17	12.3	120.0		
		40	15	9.4	17	10.7	118.0		
		41	15	12.2	17	7.9	105.0		
		42	15	15.3	17	4.8	105.0	98m	
		43	15	17.2	17	3.1	103.0	93m	
		44	15	18.4	17	2.0	100.0	90m	
		45	15	20.0	17	0.5	95.5		
		46	15	21.1	16	59.4	90.0	85m	
		47	15	23.6	16	57.5	80.0	74m	
		48	15	26.6	16	53.9	59.7		
		49	15	35.3	16	44.9	27.8		
		50	15	39.2	16	41.1	23.5		
		51	15	42.1	16	38.3	20.5	17m	
1	25	52	15	46.1	16	35.4	16.0		
		53	15	56.4	16	33.3	16.0		Caillou et roche
		54	15	56.6	16	33.3	16.5		Caillou et roche
		55	15	58.6	16	43.0	61.0	54m	Sable
		56	16	0.5	16	43.1	65.0	63m	Sable
		57	15	50.1	16	58.5	93.4	160m	
		58	15	57.6	16	50.9	94.5		Sable
		59	15	55.7	16	51.9	94.0		Sable
		60	15	53.9	16	51.8	92.4		
		61	15	50.0	16	53.2	91.0		Sable
		62	15	48.1	16	53.7	91.8		Sable
		63	15	49.0	16	56.4	100.0	120m	
		64	15	48.1	16	56.8	103.0	130m	Sable

Table 9-2 Water Depth Records (2)

Date	N°	Position		Profonde	Conformite	Remarque
Mois Jour		Latitude. N	Longitude. W		la carte marine	
	65	15 46.2	16 57.3	105.0	150m	Sable
	66	15 45.4	16 56.6	100.0	130m	
	67	15 44.7	16 54.5	90.0		
	68	15 44.1	16 52.7	80.0	82m	
	69	15 43.4	16 50.6	70.0		
	70	15 41.6	16 45.3	39.6		Sable et bourbe molle
	71	15 39.7	16 45.6	37.2		Sable et bourbe molle
	72	15 38.8	16 41.6	23.3		
	73	15 38.7	16 40.3	20.0		
	74	15 38.6	16 39.8	19.3		
26	75	15 40.0	16 47.3	45.0		Sable et bourbe molle
	76	15 38.9	16 48.5	50.0	46m	Sable et bourbe molle
	77	15 38.1	16 47.5	42.8		
	78	15 37.8	16 49.1	51.0		Sable
	79	15 36.0	16 49.9	51.8		Sable
	80	15 37.5	16 52.1	68.0		
	81	15 38.7	16 53.4	77.0		
	82	15 39.9	16 55.3	89.6		Sable
	83	15 38.0	16 55.5	91.0	80m	Sable
	84	15 31.8	16 55.2	82.2	78m	Bourbe molle
	85	15 30.0	16 55.5	81.5	76m	Bourbe molle
	86	15 30.3	16 54.3	72.0		
	87	15 31.9	16 51.1	50.0	44m	
	88	15 33.9	16 47.3	34.0	29m	Sable
	89	15 32.1	16 47.8	32.6	28m	Sable
	90	15 31.6	16 45.7	23.8		Sable
	91	15 29.7	16 45.9	21.0		Sable
	92	15 26.6	16 57.6	88.0	82m	
	93	15 26.6	16 59.4	100.0	90m	
	94	15 24.8	17 0.2	100.0	95m	
	95	15 23.9	16 59.3	95.4	93m	
	96	15 22.0	16 59.3	91.6	82m	
27	97	15 25.5	17 1.1	104.0	95m	Sable
	98	15 23.7	17 1.6	104.0	98m	Sable
	99	15 23.9	17 59.3	95.4		Bourbe molle
	100	15 22.0	17 59.3	91.6		Bourbe molle
	101	15 22.2	17 1.0	100.0	90m	
	102	15 23.0	17 2.9	110.0	103m	
	103	15 23.4	17 3.8	120.0	117m	
	104	15 24.0	17 5.1	150.0	135m	
	105	15 24.6	17 6.1	200.0	190m	
	106	15 24.9	17 6.1	230.0		
	107	15 23.7	17 5.4	146.0	130m	Sable et bourbe molle
	108	15 20.4	17 7.5	151.0	130m	Sable et bourbe molle
	109	15 20.4	17 8.9	170.0	160m	
	110	15 21.1	17 9.7	200.0	190m	
	111	15 18.2	17 9.6	200.0	185m	
	112	15 22.0	17 6.0	140.0	125m	Sable et bourbe molle
	113	15 21.9	17 7.4	168.0	165m	Sable et bourbe molle
	114	15 19.9	17 9.3	174.0	165m	Sable et bourbe molle
	115	15 18.1	17 9.4	186.0		Sable et bourbe molle
	116	15 17.9	17 9.3	189.0		Sable et bourbe molle
	117	15 16.2	17 9.7	151.0	142m	Sable et bourbe molle
28	118	15 14.2	16 55.1	29.9		Sable
	119	15 16.2	16 55.2	38.4	36m	Sable
	120	15 13.8	16 58.9	60.3	55m	
	121	15 12.0	17 1.7	80.0	67m	
	122	15 11.5	17 2.4	81.5	70m	Roche
	123	15 10.8	17 3.4	89.0	79m	Roche
	124	15 9.9	17 4.0	95.0	81m	Existence de la bouéepour pêche
	125	15 8.9	17 6.2	100.0	90m	
	126	15 7.5	17 8.1	100.0	95m	
	127	15 7.0	17 9.0	97.0		
	128	15 6.0	17 9.3	100.0	90m	
	129	15 5.7	17 11.0	104.0		
	130	15 5.1	17 9.7	100.0	95m	

Table 9-2 Water Depth Records (3)

Date		N°	Position				Profonde	Conformite	Remarque
Mois	Jour		Latitude. N		Longitude. W			la carte marine	
		131	15	3.5	17	9.5	96.5	80m	Sable
		132	15	1.9	17	9.7	96.4	80m	Sable
		133	15	1.3	17	11.9	100.0	90m	
		134	15	1.2	17	14.1	106.0		
		135	15	2.1	17	15.1	114.0		Sable
		136	15	3.9	17	15.1	121.0	117m	Sable
		137	15	2.3	17	17.2	125.0		Sable et bourbe molle
		138	15	0.4	17	17.5	129.0		Sable et bourbe molle
		139	14	59.4	17	15.7	130.0	118m	
		140	14	59.2	17	13.5	106.0	99m	
		141	15	0.2	17	12.7	103.0	95m	
		142	15	1.3	17	11.9	100.0		
		143	15	2.4	17	10.6	100.0	79m	
		144	15	4.6	17	9.3	98.0	82m	
		145	15	6.3	17	9.2	99.0		Sable
		146	15	8.1	17	8.8	99.0		Sable
		147	15	8.1	17	8.9	100.0	100m	
	29	148	14	56.7	17	21.6	146.0	140m	
		149	14	55.7	17	21.2	132.0	118m	Sable
		150	14	57.4	17	20.6	186.0	200m	Sable
		151	14	56.3	17	22.6	151.0	135m	
		152	14	55.6	17	24.5	153.0	145m	
		153	14	54.2	17	28.1	172.0	148m	
		154	14	53.5	17	29.9	194.0		
		155	14	53.4	17	30.4	200.0	180m	
		156	14	51.5	17	30.9	157.0		Sable
		157	14	49.6	17	31.7	130.0		Sable
		158	14	53.5	17	27.3	148.0		Bourbe molle
		159	14	51.8	17	27.7	130.0		Bourbe molle
		158	14	50.6	17	31.9	126.0	135m	
		159	14	49.6	17	30.7	125.0	110m	
		160	14	46.3	17	34.7	107.0	105m	
		161	14	37.9	17	29.2	46.1	45m	
		162	14	35.7	17	25.4	37.0		
		163	14	35.6	17	23.0	36.7		
		164	14	35.6	17	21.2	35.0		
		165	14	35.6	17	15.8	30.0		
2	5	166	14	16.8	17	10.6	30.8		
		167	14	15.7	17	9.9	30.1		
		168	14	13.8	17	8.9	28.0	25m	
		169	14	13.1	17	8.5	27.6	24m	Pente plus ou moins
		170	14	12.2	17	8.1	21.2		Roche
		171	14	11.0	17	7.5	23.8	20m	
		172	14	8.5	17	6.6	24.2		
		173	14	7.2	17	6.3	25.2		
		174	14	4.8	17	4.8	23.9		
		175	14	2.9	17	3.6	23.0		
		176	13	59.2	17	1.5	18.6		
		177	13	56.2	16	59.9	17.4		
		178	13	52.4	16	58.0	15.4		
2	6	179	13	45.5	17	4.2	28.7		
		180	13	44.9	17	5.6	32.2	30m	
		181	13	43.7	17	7.9	35.0		Caillou
		182	13	42.8	17	9.8	37.8		Caillou
		183	13	41.7	17	12.1	43.8	35m	
		184	13	40.8	17	14.0	50.0	48m	Caillou
		185	13	40.2	17	15.4	54.6		Roche
		186	13	40.0	17	16.3	63.8		Mur (4m)
		187	13	39.9	17	17.3	67.5		Mur (2m)
		188	13	40.5	17	19.0	72.0		
		189	13	42.0	17	19.0	70.8		Bourbe molle
		190	13	40.2	17	19.1	72.3		Bourbe molle
		191	13	40.9	17	21.7	86.0		
		192	13	41.9	17	23.1	90.8		Bourbe molle et coquille
		193	13	43.5	17	23.1	90.8		Bourbe molle et coquille
		194	13	44.3	17	22.0	87.5		

Table 9-2 Water Depth Records (4)

Date	N°	Position				Profonde	Conformite	Remarque
Mois	Jour	Latitude. N		Longitude. W			la carte marine	
	195	13	45.6	17	20.8	80.0		
	196	13	48.0	17	19.2	71.7		Coquille et bourbe molle
	197	13	50.0	17	19.4	68.0		Coquille et bourbe molle
	198	13	52.0	17	24.2	95.5		Bourbe molle et coquille
	199	13	53.7	17	24.3	94.1	105m	Bourbe molle et coquille
	200	13	54.1	17	25.5	100.0	220m	
	201	13	54.2	17	26.0	103.0		Caillou, coquille et bourbe molle
	202	13	52.4	17	26.0	105.0	220m	Caillou, coquille et bourbe molle
	203	13	51.6	17	25.7	100.0	210m	
	204	13	48.5	17	4.1	30.0	22m	
	205	13	48.9	17	1.7	24.6	20m	
	206	13	48.0	17	1.3	23.6	20m	Bourbe molle et caillou
	207	13	46.0	17	1.1	24.8	20m	Bourbe molle et caillou
7	208	13	57.6	17	25.1	84.0	110m	
	209	13	58.1	17	26.7	100.0	220m	Escarpement (de 100m à 200m de profo
	210	13	58.4	17	27.9	200.0	230m	
	211	13	58.5	17	28.1	265.0	130m	
	212	13	58.6	17	28.4	248.0		
	213	13	58.8	17	29.1	300.0		
	214	13	59.3	17	30.8	478.0		
	215	14	0.1	17	30.6	400.0	300m	
	216	13	59.9	17	30.1	350.0		
	217	13	59.6	17	29.4	300.0		
	218	13	59.5	17	29.0	200.0		
	219	13	59.9	17	28.6	125.0		Caillou et coquille
	220	14	0.7	17	28.9	123.0		Caillou et coquille
	221	13	59.7	17	27.7	108.0		
	222	13	59.5	17	26.8	100.0		
	223	13	59.5	17	26.0	93.0		
	224	14	0.2	17	25.4	88.8	105m	Bourbe molle, coquille et caillou
	225	14	2.0	17	25.4	89.5		Bourbe molle, coquille et caillou
	226	13	59.6	17	25.8	91.5	110m	Bourbe molle, coquille et caillou
	227	13	58.0	17	25.8	89.3	120m	Bourbe molle, coquille et caillou
	228	13	54.6	17	3.6	25.4		
	229	13	54.2	17	1.1	19.8		Bourbe molle, coquille et caillou
	230	13	56.2	17	1.4	18.9		Bourbe molle, coquille et caillou
8	231	13	56.1	16	57.1	14.3		Bourbe molle et coquille
	232	13	58.1	16	57.2	13.4	10m	Bourbe molle et coquille
	233	14	4.2	16	59.2	15.4	12m	Coquille, caillou et bourbe molle
	234	14	6.1	16	59.4	13.9	12m	Coquille, caillou et bourbe molle
	235	14	6.1	17	1.3	16.5	14m	Coquille, bourbe molle et caillou
	236	14	4.1	17	1.4	16.8	14.5m	Coquille, bourbe molle et caillou
	237	14	8.1	16	59.4	14.1	12.5m	Bourbe molle, coquille et caillou
	238	14	10.0	16	59.6	13.1	10m	Bourbe molle, coquille et caillou
	239	14	8.4	17	21.4	77.5		Bourbe molle et sable
	240	14	10.2	17	21.6	79.7	78m	Bourbe molle et sable
	241	14	9.5	17	21.2	75.0		
	242	14	9.2	17	20.9	76.5		
	243	14	8.8	17	20.3	73.5		
	244	14	8.3	17	19.7	70.0		
	245	14	7.1	17	18.2	68.4		
	246	14	6.1	17	17.8	67.0		Bourbe molle et coquille
	247	14	4.3	17	17.8	66.1		Bourbe molle et coquille
9	248	14	12.1	17	24.7	91.5		Bourbe molle
	249	14	14.0	17	24.7	89.2		Bourbe molle
	250	14	13.4	17	25.2	95.3		
	251	14	13.2	17	26.4	100.0	97m	
	252	14	12.8	17	28.2	103.0		
	253	14	12.4	17	29.5	105.0	110m	
	254	14	12.3	17	30.1	110.0		
	255	14	12.1	17	30.5	114.0		
	256	14	11.5	17	30.7	117.0	200m	
	257	14	12.0	17	30.7	119.0	110m	Bourbe molle et sable
	258	14	13.8	17	30.8	122.0		Bourbe molle et sable
	259	14	19.9	17	31.3	128.0		Bourbe molle
	260	14	21.8	17	31.5	128.0		Bourbe molle

Table 9-2 Water Depth Records (5)

Date	N°	Position				Profonde	Conformite	Remarque
Mois	Jour	Latitude. N		Longitude. W			la carte marine	
	261	14	14.3	17	31.1	130.0		
	262	14	15.2	17	31.1	130.0		
	263	14	16.0	17	31.1	138.0		
	264	14	17.2	17	31.1	136.0		
	265	14	18.0	17	31.1	132.0		
	266	14	22.9	17	29.0	100.0	103m	
	267	14	23.4	17	28.1	97.0	100m	
	268	14	23.8	17	27.7	95.7		Bourbe molle et caillou
	269	14	25.2	17	27.6	92.0		Bourbe molle et caillou
	270	14	23.8	17	26.3	90.0		
	271	14	22.9	17	25.4	85.4		
	272	14	21.9	17	24.5	80.0	78m	
	273	14	20.9	17	23.7	70.0		Roche (500m de distance)
	274	14	20.3	17	23.2	67.0		Roche (1km de distance)
	275	14	19.9	17	22.9	63.1		Roche
	276	14	19.2	17	22.3	63.2		
	277	14	18.2	17	21.5	62.5		Caillou et bourbe molle
	278	14	16.3	17	21.6	63.7		Caillou et bourbe molle
	279	14	17.1	17	20.8	59.7		Roche
	280	14	18.2	17	19.8	50.0	53m	Roche (jusqu'à prochaine position)
	281	14	19.1	17	19.6	48.5	53m	Roche (de dernière position)
	282	14	20.2	17	19.2	47.1		Caillou et bourbe molle
	283	14	22.0	17	19.2	47.6		Caillou et bourbe molle
10	284	14	22.3	17	7.5	16.6		
	285	14	22.1	17	7.5	16.6		Bourbe molle et sable
	286	14	23.6	17	7.4	16.1		Bourbe molle et sable
	287	14	24.5	17	8.2	20.0		
	288	14	24.6	17	9.6	25.0		
	289	14	24.7	17	10.6	30.0	28m	
	290	14	24.9	17	12.3	31.4		
	291	14	25.0	17	13.1	35.0		Caillou
	292	14	25.2	17	15.2	39.1		Caillou
	293	14	25.0	17	15.4	40.0		
	294	14	25.5	17	17.6	45.0		Roche
	295	14	25.7	17	18.6	50.0	47m	Roche
	296	14	25.8	17	20.0	54.8	52m	Roche
	297	14	25.6	17	20.0	55.4		
	298	14	25.5	17	21.0	60.0		Cassure?
	299	14	26.2	17	21.4	64.2	60m	Bourbe molle
	300	14	28.2	17	21.6	64.3	60m	Bourbe molle
14	301	12	30.6	17	0.6	14.0	10m	
	302	12	30.0	17	0.7	14.6		Bourbe molle
	303	12	28.1	17	0.8	13.9	11.5m	Bourbe molle
	304	12	26.6	17	3.4	15.0	13.5m	
	305	12	25.5	17	7.6	17.9	15.2m	
	306	12	24.4	17	11.5	20.0	19.0m	
	307	12	23.4	17	16.1	27.0	28m	
	308	12	23.2	17	16.9	30.0	31m	
	309	12	23.0	17	17.4	35.0		
	310	12	23.0	17	18.0	40.0	36m	
	311	12	23.0	17	19.5	50.0	49m	
	312	12	21.2	17	22.8	83.5		
	313	12	21.8	17	19.8	57.3		Bourbe molle et caillou
	314	12	20.0	17	19.1	66.8		Bourbe molle et caillou
	315	12	22.1	17	23.0	78.0		Bourbe molle
	316	12	23.6	17	23.1	61.0		Roche
	317	12	22.2	17	21.1	57.0		Escarpement de 57m à 63m de profonde
	318	12	23.1	17	24.4	76.7		
	319	12	24.5	17	24.3	62.0		Roche
	320	12	23.8	17	24.7	73.8		Bourbr molle et caillou
	321	12	25.5	17	25.1	58.8		Bourbe molle et caillou
	322	12	24.3	17	21.4	50.0	49m	
	323	12	24.1	17	18.3	32.0	35m	
15	324	12	23.1	16	54.0	16.9		
	325	12	25.9	17	15.0	22.7		Bourbe molle et caillou
	326	12	27.9	17	15.3	21.7	20m	Bourbe molle et caillou

Table 9-2 Water Depth Records (6)

Date	N°	Position		Profonde	Conformite	Remarque
MoisJour		Latitude. N	Longitude. W		la carte marine	
	327	12 27.4	17 18.0	23.5		
	328	12 26.9	17 20.2	30.0	28m	
	329	12 26.2	17 23.9	50.0	48m	
	330	12 25.8	17 25.6	56.5		
	331	12 27.4	17 29.8	61.0		Cassure de 4m de hauteur?
	332	12 25.2	17 28.1	80.0	120m	
	333	12 25.2	17 29.2	100.0	220m	
	334	12 26.0	17 29.5	102.0		Bourbe molle et sable
	335	12 27.8	17 29.9	100.0	90m	Bourbe molle et sable
	336	12 28.1	17 30.0	84.0		
	337	12 28.4	17 30.2	65.0		Cassure de 4m de hauteur?
	338	12 30.0	17 30.7	53.0	60m	Sable et bourbe molle
	339	12 31.7	17 31.7	52.3		Sable et bourbe molle
	340	12 30.9	17 31.1	50.0	51m	
	341	12 35.3	17 34.1	170.0	49m	Précipice de 100m à 200m de profondeu
	342	12 35.3	17 33.9	100.0	49m	Précipice de 100m à 200m de profondeu
	343	12 35.3	17 33.9	90.0	49m	Précipice de 100m à 200m de profondeu
	344	12 35.2	17 32.6	50.0	48m	
	345	12 35.3	17 29.8	41.0		
	346	12 35.9	17 29.7	40.4		Sable et bourbe molle
	347	12 37.8	17 29.8	39.9		Sable et bourbe molle
	348	12 35.6	17 29.9	41.1		
	349	12 33.9	17 29.9	44.9		
	350	12 32.6	17 29.9	47.0		
	351	12 31.3	17 29.8	48.2		
	352	12 29.9	17 29.7	50.0	52m	
	353	12 30.2	17 30.0	50.4		Bourbe molle et sable
	354	12 28.3	17 29.6	58.3	65m	Bourbe molle et sable
16	355	12 37.9	17 34.0	50.0	48m	
	356	12 37.7	17 35.5	60.0		
	357	12 37.7	17 35.6	70.0		
	358	12 37.7	17 35.8	80.0	75m	
	359	12 37.7	17 35.9	90.0		
	360	12 37.6	17 36.1	100.0	79m	
	361	12 38.2	17 36.4	105.0	90m	Précipice de 100m à 200m de profondeu
	362	12 38.9	17 34.4	50.0	50m	
	363	12 40.1	17 32.9	46.5		Sable et bourbe molle
	364	12 41.9	17 32.4	46.2		Sable et bourbe molle
	365	12 42.4	17 34.0	46.3	48m	
	366	12 43.8	17 35.4	50.0	60m	
	367	12 41.9	17 35.5	50.0		Sable et bourbe molle
	368	12 43.7	17 35.9	51.2	60m	Sable et bourbe molle
	369	12 42.8	17 36.6	57.3	62m	
	370	12 42.5	17 36.9	70.0	65m	
	371	12 42.3	17 36.9	100.0	70m	
	372	12 42.1	17 36.9	80.0	80m	
	373	12 42.0	17 36.8	70.0	75m	
	374	12 45.0	17 34.4	50.0	58m	
	375	12 42.1	17 36.7	71.7	78m	Sable et bourbe molle
	376	12 43.9	17 36.9	55.0	82m	Sable et bourbe molle
	377	12 45.8	17 32.4	48.3		
	378	12 46.4	17 31.1	47.0		
	379	12 48.1	17 30.9	47.6		Sable et bourbe molle
	380	12 49.9	17 30.9	49.2	48m	Sable et bourbe molle
	381	12 48.8	17 32.4	50.0		Plat
	382	12 48.6	17 32.8	50.0	50m	
	383	12 47.7	17 34.7	53.0	55m	
	384	12 47.1	17 35.7	55.0	62m	
	385	12 46.8	17 36.9	57.3	88m	
	386	12 46.8	17 38.2	70.0		
	387	12 46.8	17 38.4	80.0		
	388	12 46.8	17 38.6	90.0		
	389	12 46.8	17 38.9	100.0	80m	Précipice de 100m à 200m de profondeu
	390	12 45.5	17 38.6	104.0		Sable et bourbe molle
	391	12 43.7	17 39.9	110.0		Sable et bourbe molle
	392	12 45.5	17 38.7	100.0	82m	Précipice de 100m à 200m de profondeu

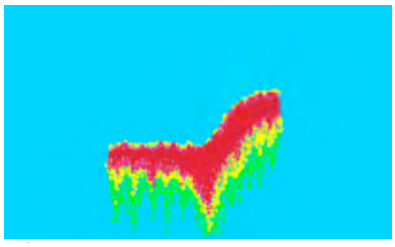
Table 9-2 Water Depth Records (7)

Date	N°	Position				Profonde	Conformite	Remarque
Mois	Jour	Latitude. N		Longitude. W			la carte marine	
	393	12	44.3	17	38.6	100.0	90m	
	394	12	44.9	17	38.6	100.0	88m	
17	395	12	49.9	17	37.5	69.0		
	396	12	48.3	17	37.2	62.3		Sable et bourbe molle
	397	12	50.1	17	37.7	69.3		Sable et bourbe molle
	398	12	50.0	17	35.2	58.1	60m	Sable et bourbe molle
	399	12	51.8	17	35.4	62.9		Sable et bourbe molle
	400	12	52.6	17	36.0	67.0	59m	
	401	12	53.2	17	36.2	70.0	75m	
	402	12	54.2	17	36.3	74.5	83m	
	403	12	54.9	17	36.5	76.5	90m	Roche
	404	12	55.2	17	36.5	80.0	92m	
	405	12	56.0	17	36.6	87.8	100m	
	406	12	56.3	17	36.7	90.0	105m	
	407	12	57.0	17	36.6	93.0	110m	
	408	12	57.6	17	36.6	95.0	150m	
	409	12	58.2	17	36.5	96.5	170m	
	410	12	59.5	17	36.3	100.0	190m	
	411	13	0.0	17	36.0	100.0		Sable et bourbe molle
	412	13	0.5	17	35.7	99.9		Roche
	412	13	0.6	17	35.6	100.0		Sable et bourbe molle
	413	12	58.0	17	35.2	79.5		Sable et bourbe molle
	414	12	59.9	17	35.0	88.0		Sable et bourbe molle
	415	12	58.6	17	34.0	72.8		
	416	12	58.0	17	33.4	68.0		Sable et bourbe molle
	417	12	59.9	17	33.5	72.8		Sable et bourbe molle
	418	13	0.1	17	31.5	64.5		Sable et bourbe molle
	419	13	2.0	17	31.4	67.1		Sable et bourbe molle
	420	13	0.3	17	24.6	50.0		
18	421	12	59.9	17	24.5	50.0		
	422	13	0.0	17	26.3	52.5		Sable et algur
	423	12	58.0	17	26.7	51.1		Sable et algur
	424	12	57.6	17	26.3	50.0		
	425	12	56.9	17	24.6	47.1		
	426	12	55.9	17	23.5	44.3		Sable et algur
	427	12	53.9	17	23.4	43.3		Sable et algur
	428	12	54.0	17	23.3	43.4		Sable
	429	12	52.1	17	23.4	41.8		Sable
	430	12	54.0	17	21.5	41.0		Sable
	431	12	55.9	17	21.4	41.8		Sable
19	432	12	36.1	17	1.1	14.0		Bourbe due
	433	12	38.0	17	0.7	13.1		Bourbe due
	434	12	39.0	17	1.0	11.8		
	435	12	41.9	17	3.2	15.2		
	436	12	44.2	17	5.5	18.6		
	437	12	46.0	17	6.9	19.0		Bourbe molle et sable
	438	12	47.9	17	6.8	19.4		Bourbe molle et sable
	439	12	47.6	17	7.6	20.0		
	440	12	47.5	17	14.0	27.6		
	441	12	47.6	17	15.3	29.0		Oudulation
	442	12	48.0	17	16.8	30.8		Sable et bourbe molle
	443	12	49.9	17	17.2	33.7		Sable et bourbe molle
	444	12	50.9	17	11.3	26.0		
	445	12	51.3	17	7.9	22.0		
	446	12	52.2	17	5.4	19.9		Sable et bourbe molle
	447	12	54.1	17	5.2	20.1		Sable et bourbe molle
20	448	12	56.0	17	7.2	23.5		Sable
	449	12	57.9	17	7.0	23.5		Sable
	450	12	58.1	17	5.4	22.1		Sable
	451	12	56.3	17	5.2	21.1		Sable
	452	12	55.9	17	1.5	20.4		Sable
	453	12	57.6	17	1.4	20.0		Sable
	454	13	0.1	17	2.5	19.5		Sable
	455	13	1.6	17	3.3	21.4		Sable
	456	12	57.0	16	57.5	16.2		
	457	12	56.2	16	56.6	14.7		

Table 9-2 Water Depth Records (8)

Date		N°	Position				Profonde	Conformite	Remarque
Mois	Jour		Latitude. N		Longitude. W			la carte marine	
		458	12	54.9	16	55.0	13.0		Sable
		459	12	53.0	16	54.9	13.4		Sable
	21	460	13	40.4	16	52.9	16.8		
		461	13	43.1	16	50.0	12.9		Sable
		462	13	44.4	16	52.2	14.8		Sable
		463	12	45.0	17	54.0	16.2		Sable
8	5	464	12	54.3	16	56.8	15.1		
		465	12	52.7	16	57.1	16.1		
	6	466	12	58.0	17	8.5	26.5		
		467	12	56.9	17	9.9	29.2		
	12	468	13	48.6	17	19.4	71.3		
		469	13	49.6	17	19.9	70.4		
	13	470	13	44.1	17	14.8	49.3		
		471	13	42.4	17	14.7	49.7		
		472	14	4.0	17	14.7	46.3		
		473	14	2.2	17	14.7	46.2		
		474	13	55.9	16	55.5	12.4		
		475	13	57.6	16	54.9	12.0		
	20	476	15	44.5	16	56.5	100.0		
	22	477	15	36.1	16	48.2	42.1		
		478	15	38.0	16	48.2	45.8		
		479	15	37.1	16	49.3	50.0		
		480	15	34.4	16	53.3	70.0		
		481	15	23.7	17	0.8	100.0		
	23	482	15	18.5	16	59.2	80.0		
		483	15	18.0	16	58.3	70.0		
		484	15	17.0	16	56.3	50.0		
		485	15	19.7	17	1.5	100.0		
	24	486	15	1.1	17	12.2	100		
		487	15	7.4	17	5.3	90		
		488	15	7.5	17	4.0	80		
		489	15	7.8	17	1.1	50		
	25	490	14	59.2	17	17.7	200		
		491	14	58.8	17	20.0	800		
		492	14	57.5	17	21.0	200		

Image of bottom



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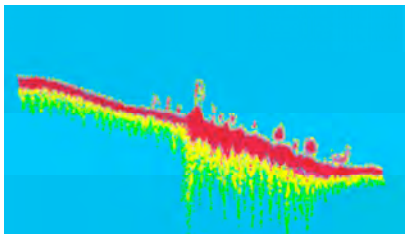

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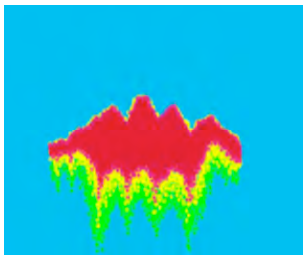

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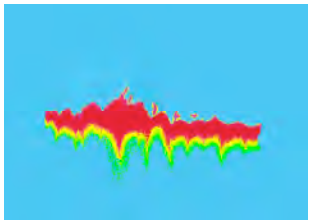

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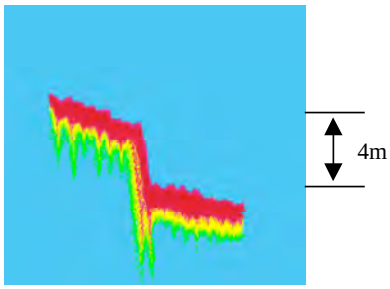

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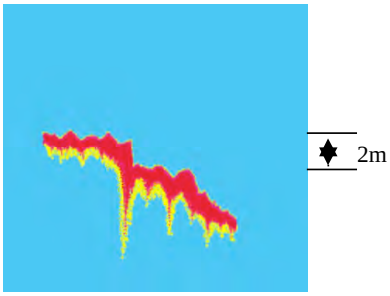

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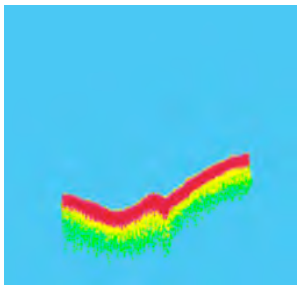

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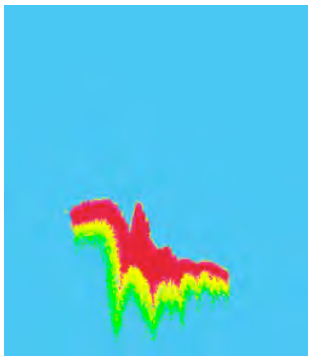

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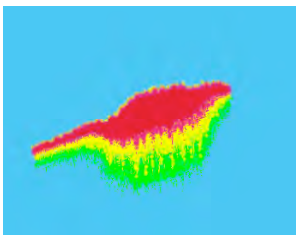

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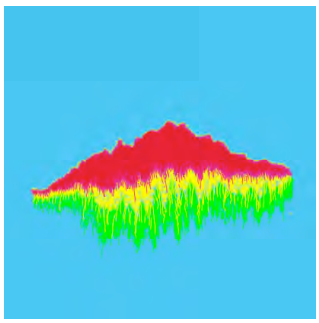


N°275 (14°19’90’’017°22’90’’)

Figure 9-1 Seabed Terrain Tracked by Fishfinder

(Appendices)

Coastal Survey Capacity Strengthening Project

(1) Background and Objectives

In the Study, an artificial reef was installed off the coast of Yenne based on resident participation with a view to realizing coastal resource management based on joint effort between coastal fishermen and administrative agencies. Similarly, a fish reef was installed off the coast of Bargny in 2001 by OFCA (Overseas Fisheries Consultants Association). As was described in the section describing the survey results, monitoring in the Study found that biomass around these two artificial reefs was far greater than around nearby natural reefs, proving that artificial reefs off the coast of Senegal are highly effective.

Coastal waters of around 20 m in depth that include the artificial reef installation site in the Study are the most active waters for coastal artisanal fishermen, and efficient methods of stock management were explored in the development study. In order to gauge the effectiveness of this kind of management plan, it is essential to periodically monitor local ocean characteristics and the living conditions of marine life and objectively gauge biomass over time.

However, the CRODT, which is in charge of fisheries stocks survey and research in Senegal, possessed hardly any experience of quantitative biological surveying including underwater surveying in coastal shallows until this development study was implemented. In this Study, an underwater survey team was established and given OJT training within the CRODT, however, because it is important to acquire experience in underwater surveying, it will be necessary to carry out further more practical drills and training for the team members. Moreover, around three counterparts received transfer of technology during this survey, however, it will be necessary to increase the number of trained counterparts possessing expert knowledge in order to commence and continue biological surveys in various shallow sea areas in future.

Acquisition of underwater survey and other survey techniques for coastal areas enables application to artificial reef surveys, marine protection zone surveys and surveys of shellfish in coastal shallows, and in future it may be possible to stage a workshop for related personnel from not only Senegal but also neighboring countries.

For the above reasons, in this strengthening project, the following survey work shall be implemented together with CRODT personnel: 1) monitoring survey around artificial reefs installed in the past, 2) biological survey in marine protection zones to be newly established, and 3) biological survey of bivalves, which are an important fisheries stock; and moreover, transfer of

technology based on OJT shall be conducted into survey and analysis techniques in coastal shallows.

(2) Target agency

Oceanographic Research Center in Dakar-Thiaroye (CRODT)

(3) Project sites

- Yenne, Bargny, other artificial reef installation sites
- Other coastal marine protection zones to be newly established
- Bivalve fishing grounds

(4) Outline of the activities

Activities in this project shall be implemented over the following five processes:

① Diving familiarization
② General ocean survey
③ Understanding and mastering of basic survey techniques based on OJT
④ Understanding of data analysis techniques
⑤ Compilation of future project plans

An outline of each process is given below.

① Diving familiarization

This is intended to familiarize personnel with diving technology, which is essential for survey of coastal shallows. It is desirable for the counterparts to have scuba diving experience and possess diving certificates from an authorized diving technology certification agency. Moreover, the basic know-how needed to safely implement surveys, photographic technology, and techniques for maintaining and managing compressors and diving gear shall also be transferred. In particular, concerning safety measures, in addition to raising the know-how and technology of each member, the emergency notification setup and management system at the CRODT and related agencies shall be reinforced.

② General ocean survey

Trainees will learn methods for gauging seabed conditions in target waters, positioning survey sites, and recording general observation items such as water temperature and salinity, etc.

③ Understanding and mastering of basic survey techniques based on OJT

In addition to collecting general ocean environmental data such as water temperature and salinity, etc. at the target sites, personnel shall understand basic survey techniques such as recording of seabed and shellfish living conditions by diving (fixed point observation method, belt transect method) and sampling of attached life forms (quadrant method). Also, they shall conduct line-fishing surveys in order to calculate the parameters required for converting the body length and weight of living organisms. Surveys shall be carried out throughout the year or seasonally in order to build up data.

④ Understanding of data analysis techniques

From the data obtained in the above surveys, personnel shall describe seabed conditions in the target areas, compile and arrange observed fish lists, gathered fish counts and fish gathering places, etc., and estimate the biomass from the computed body length and weight conversion formulas. Furthermore, data obtained in the year-round and seasonal surveys shall be arranged and used to analyze seasonal variations in biomass based on biological statistical techniques such as the dispersion analysis method and multiple comparison method, etc.

⑤ Compilation of future project plans

Based on the above data analysis results, the sustainable fisheries volume in target waters shall be estimated, then the results of survey and analysis shall be announced and disseminated to representatives and related persons of the CRODT, DPM and coastal artisanal fishermen. Upon doing this, draft plans for future fish reef projects, marine protection zone projects and fishing ground management shall be compiled.

(5) Implementation Schedule

In this project, first of all a project implementation team shall be established, the overall plan shall be compiled and discussions held with other assistance agencies. After that, monitoring indicators shall be prepared in order to gauge the progress of the project. Also, the project sites and necessary equipment shall be confirmed. After this preparation work is finished, the above five processes, i.e. diving familiarization, general ocean survey, understanding and mastering of basic survey techniques based on OJT, understanding of data analysis techniques, and compilation of future project plans, shall be implemented. Of these activities, general ocean survey and understanding and mastering of basic survey techniques based on OJT shall be carried out every quarter from the second year to the first half of the third year in order to gauge seasonal changes in the target areas. From the third year, in addition to conducting data analysis, draft

plans of future projects shall be compiled based on data so far collected and analyzed, and workshops shall be staged for related persons.

Moreover, in order to learn about the latest conditions in Japan, which has various experience of coastal ocean surveying, training in Japan of around one month shall be planned at the end of the first year.

Implementation Schedule

Project year	First Year				Second Year				Third Year			
Activity item/Quarter	1	2	3	4	1	2	3	4	1	2	3	4
Establishment of project implementation team												
Compilation of overall plan/Consultation with other assistance agencies												
Setting of indicators and formulation of the project progress												
Selection of project sites/Confirmation of necessary equipment												
Diving familiarization												
Training in Japan												
General ocean survey												
Understanding and mastering of basic survey techniques based on OJT												
Understanding of data analysis techniques												
Compilation of future project plans												
Staging of workshop												
Completion assessment												

Annex

1) Study team member list
2) Scope of Work for the Study (S/W) (English and French version)
3) Minutes of the Meetings on Scope of Work (M/M) (English and French version)
4) Minutes of the Meeting on the Inception Report (English and French version)
5) Minutes of the Meeting on the modification of Inception report (French only)
6) Minutes of the Meeting on the Pilot Projects (French only)
7) Minutes of Meeting on the Draft Final Report (English and French version)

1) Study team member list

Name	Assignment	Company
Yasuo ISHIMOTO	Team Leader	Overseas Agro-Fisheries Consultants Co., Ltd.
Naohiko WATANUKI	Resource Management/ Fishing Techniques	Overseas Agro-Fisheries Consultants Co., Ltd.
Masashi SATO	Fishery Organizations/ Participatory Development	Overseas Agro-Fisheries Consultants Co., Ltd.
Tokio KITAMADO	Socio-economy/ Fishery economy	IC Net Limited
Shigeru IWASAKI	Fishery Statistics/ Information Treatment	System Science Consultants Inc.
Shiro CHIKUNI	Stock Assessment	Fuyo Ocean Development and Engineering Co., Ltd.
Kazunori UWATOKO	Fishing Techniques/ Fishing Gear and Method	Overseas Agro-Fisheries Consultants Co., Ltd.
Hiroaki TERASHIMA	Biological Survey	IC Net Limited
Hiroyuki KAWASAKI	Biological Survey *	IC Net Limited
Wakao HIGASHIJIMA	French Interpreter	SASAKI Agency Co., Ltd.
Ryo ISHIMOTO	Coordinator	Overseas Agro-Fisheries Consultants Co., Ltd.

*Mr. Kawasaki joined the team for a short period as a back up of Mr. Terashima during his medical treatment

SCOPE OF WORK
FOR
THE STUDY
ON
FISHERIES RESOURCES ASSESSMENT AND MANAGEMENT
IN
THE REPUBLIC OF SENEGAL

AGREED UPON BETWEEN
MINISTRY OF FISHERY
OF
THE GOVERNMENT OF SENEGAL
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

DAKAR, FEBRUARY 14, 2003

P. Dr. Ndiaga GUEYE
Director of Marine Fisheries,
Ministry of Fishery,
SENEGAL

Dr. Katsuhiro KISO
Team Leader,
Preparatory Study Team,
Japan International Cooperation Agency,
JAPAN

Mr. Daouda DIOP
Director of Economic and Financial Cooperation,
Ministry of Economy and Finance,
SENEGAL

I. INTRODUCTION

In response to the request of the Government of Senegal, the Government of Japan has decided to conduct the Study on Fisheries Resources Assessment and Management in the Republic of Senegal (hereinafter referred to as "the Study") together with the Government of Senegal in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Senegal.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVES OF THE STUDY

The objectives of the Study are

1. To assess the major marine fisheries stock in the Exclusive Economic Zone of Senegal based on the indirect and direct methods,

2. To elaborate practical fisheries resources management plan for sustainable development of fisheries in Senegal, and

3. To transfer relevant technology to the Senegal counterpart personnel in order to develop capacities of fisheries resources assessment and management through on-the-job training in the course of the Study.

III. OUTLINE OF THE STUDY

1. Study Area

Exclusive Economic Zone of Senegal and fishing communities in the coastal area.

2. Scope of the Study

In order to achieve the objectives above, the Study shall consist of the following activities.

(1) Fisheries stock assessment

a. To review ongoing data collection systems of fisheries statistics carried by both Ministry of Fishing and Oceanographic Research Center in Dakar-Thiaroye (CRODT).

b. To review current survey activities for stock assessment by the research vessel ITAF DEME.
c. To review previous fisheries resources assessment curried by Senegal side.
d. To prepare action programs for improving data collection systems in the fish landing sites, taking account of the capacities of Senegal side and their facing constraints.
e. To present technical guidance aiming to improve survey activities for the fisheries stock by the research vessel including preparation of operation plan and necessary practice on the sea.
f. To prepare operation plan for ITAF DEME for further resources survey by CRODT after the Study activities.
g. To evaluate biomass and fish distribution and to estimate fish abundance of major fisheries stock based on the data obtained by the vessel surveys. To estimate parameters of an equation ($E=(F/Z)\times(1-S)$) of selected species based on the data obtained by the statistics (indirect method). It is also expected to find promising unexploited resources based on the available data.

(2) Fisheries resources management
a. To collect existing information on artisanal and industrial fisheries including socio-economic condition of fishing communities, fisheries related organizations and present activities of resources management.
b. To conduct socio-economic surveys on artisanal fisheries in selected communities regarding fishing activities, fishermen's organizations, indigenous experience and know-how of resources management. To conduct survey on industrial fisheries in order to collect information on their management.
c. To identify supporting system for fishermen's resources management by governmental and non-governmental organizations including their advantages and disadvantages.
d. To conduct a pilot project on fisheries resources management in potential communities based on the participatory approach.
e. To elaborate practical fisheries resources management plan for sustainable development of fisheries.
f. To organize seminar(s) on fisheries resources management with participation of various stakeholders in fisheries sector.

IV. STUDY SCHEDULE

The Study will be carried out during a period of approximately forty (40) months, in accordance with the attached tentative work schedule (ANNEX).

V. REPORTS

JICA shall prepare and submit the following reports to the Government of Senegal. All the reports shall be prepared in French. The Final Report shall be in French and in English:

1. Inception Report; Twenty (20) copies.
2. Progress Report (1); Twenty (20) copies.
3. Progress Report (2); Twenty (20) copies.
4. Interim Report; Twenty (20) copies.
5. Progress Report (3); Twenty (20) copies.
6. Draft Final Report; Twenty (20) copies.
   The government of Senegal will provide JICA with its comments on Draft Final Report within one (1) month after receipt of the Draft Final Report.
7. Final Report; Fifty (50) copies in French and twenty (20) copies in English within two (2) months after receipt of the comments from the Government of Senegal on the Draft Final Report.

VI. UNDERTAKING OF THE GOVERNMENT OF SENEGAL

1. To facilitate the smooth conduct of the Study; the Government of Senegal shall take necessary measures:

   (1) To permit the members of the Japanese Study Team to enter, leave and sojourn in Senegal for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees;
   (2) To exempt the members of the Japanese Study Team from taxes, duties and any other charges on equipment, machinery and other material brought into Senegal for the implementation of the Study;
   (3) To exempt the members of the Japanese Study Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the team for their services in connection with the implementation of the Study;
   (4) To provide necessary facilities to the Japanese Study Team for the remittance as well as utilization of the funds introduced into Senegal from Japan in connection with the implementation of the Study;

2. The Government of Senegal shall bear claims, if any arises, against the members of the Japanese Study Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study,

except when such claims arise from gross negligence or willful misconduct on the part of the Japanese Study Team.

3. Department of Marine Fisheries shall, at its own expense, provide the Japanese Study Team with the following, in cooperation with other organizations concerned:

(1) Security-related information on as well as measures to ensure the safety of the Japanese Study Team;
(2) Information on as well as support in obtaining medical services;
(3) Available data and information related to the Study;
(4) Counterpart personnel;
(5) Suitable office space with necessary office equipment and furniture in Dakar;
(6) Credentials or identification cards.

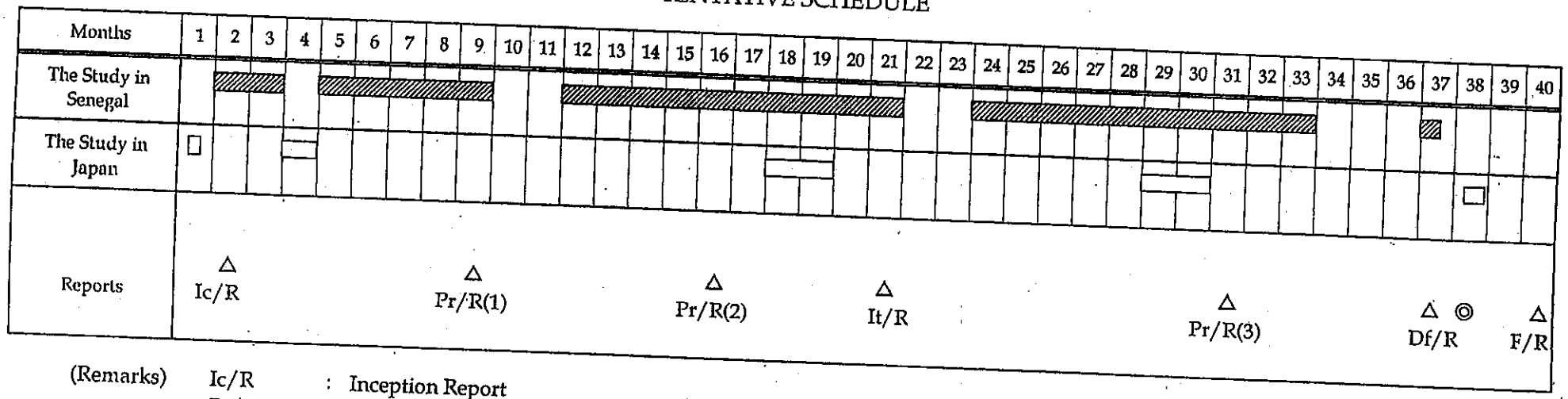
VII. OTHERS

1. JICA and Department of Marine Fisheries shall maintain constant communication and consult with each other in respect of any matters that may arise from or in connection with the Study.

2. The Scope of Work is made both in English and French. In case of any discrepancies arising in translation, the English version shall prevail.

ANNEX

TENTATIVE SCHEDULE



(Remarks)

Ic/R	:	Inception Report
Pr/R(1)	:	Progress Report(1)
Pr/R(2)	:	Progress Report(2)
It/R	:	Interim Report
Pr/R(3)	:	Progress Report(3)
Df/R	:	Draft Final Report
◎	:	Comments on Df/R by the Government of Senegal
F/R	:	Final Report

ETENDUE DU TRAVAIL
DE L'ÉTUDE DE L'EVALUATION ET DE LA GESTION DES RESSOURCES HALIEUTIQUES DU SÉNÉGAL

CONVENUE ENTRE
LE MINISTERE DE LA PECHE DU GOUVERNEMENT DU SÉNÉGAL
ET
L'AGENCE JAPONAISE DE LA COOPERATION INTERNATIONALE

DAKAR, 14 FEBRIER 2003

P. Dr. Ndiaga GUEYE
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Equipe d'étude préparatoire,
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Japon

M. Daouda DIOP
Directeur de la Coopération Economique et Financière,
Ministère de l'Economie et des Finances,
Sénégal

I. Introduction

En réponse à la requête du Gouvernement du Sénégal, le Gouvernement du Japon a décidé d'effectuer, à la République du Sénégal, l'Etude d'évaluation et de gestion des ressources halieutiques (appelée "Etude" ci-après) en collaboration avec le Gouvernement sénégalais, en se conformant aux lois et règlements concernés en vigueur au Japon.

L'Agence Japonaise de la Coopération Internationale (appelée "JICA" ci-après), organisation officielle responsable pour la mise en œuvre des programmes de la coopération technique du Gouvernement japonais, effectuera l'Etude en étroite collaboration avec les autorités concernées du Gouvernement sénégalais.

Le présent document définit l'étendue du travail de l'Etude.

II. Objectifs de l'Etude

Les objectifs de l'Etude sont:

1. Evaluer les principales ressources halieutiques de la zone économique exclusive du Sénégal avec les méthodes directe et indirecte,

2. Elaborer un plan de gestion pratique des ressources halieutiques pour assurer le développement durable de la pêche au Sénégal

3. Transférer la technologie nécessaire aux homologues sénégalais pour améliorer la capacité d'évaluation et de gestion des ressources halieutiques avec la formation on-the-job réalisée au cours de l'Etude.

III. Généralités de l'Etude

1. Zone de l'Etude

Zone exclusive économique du Sénégal et les communautés de pêcheurs de la zone côtière

2. Etendue de l'Etude

Pour atteindre les objectifs précisés ci-dessus, l'Etude se compose des activités

suivantes:

2-1. Pour l'évaluation des ressources halieutiques:

a. Revoir les systèmes actuels de collecte des données pour les statistiques de la pêche utilisés par le Ministère de la Pêche et par le Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT).

b. Revoir les activités de l'évaluation des ressources menées actuellement avec le navire de recherches "ITAF DEME",

c. Revoir les recherches portant sur l'évaluation des ressources halieutiques déjà faites par la partie sénégalaise,

d. Etablir des programmes d'action pour améliorer les systèmes de collecte des données utilisés aux sites de débarquement, conçus en prenant en considération les capacités de la partie sénégalaise et les contraintes existantes,

e. Fournir des conseils techniques pour améliorer les activités de recherches sur les ressources halieutiques menées avec le navire de recherches "ITAF DEME", y compris l'élaboration d'un plan de campagnes et des pratiques en mer,

f. Elaborer un plan de campagnes d'ITAF DEME pour les futures recherches sur les ressources qui seront menées par le CRODT après les opérations d'échnatillonage,

g. Evaluer la biomasse et la distribution des poissons et estimer l'abondance des espèces des principaux stocks avec les données collectées par le navire de recherches. Estimer les paramètres de l'équation E=(F/Z)X(1-S) des espèces choisies avec les données obtenues par les statistiques (la méthode indirecte). Il serait souhaitable que des ressources prometteuses et non exploitées soient découvertes à partir des données.

2-2. Pour la gestion des ressources halieutiques:

a. Collecter les informations existantes sur les pêches artisanales et industrielles, y compris celles sur les conditions socio-économiques des communautés de pêcheurs,

les organisations de pêcheurs et les activités actuelles de la gestion des ressources,

b. Réaliser des recherches socio-économiques au niveau de la pêche artisanale et des communautés de pêcheurs choisies concernant les activités de la pêche, les organisations des pêcheurs, le expérience propres des pécheurs et leur savoir-faire sur la gestion des ressources et effectuer des enquêtes auprès des pêches industrielles pour collecter des informations sur leurs gestions des ressources,

c. Identifier les systèmes de soutien gouvernemental ou non gouvernemental pour la gestion des ressources faite par les pêcheurs, tout en précisant les points forts et faibles de chaque système,

d. Réaliser un projet-pilote avec une approche participative dans les cummunautés de pêcheurs qui sont susceptibles de donner des résultats positifs,

e. Elaborer un plan pratique de gestion des ressources halieutiques pour assurer le développement durable des pêches et

f. Organiser un ou des séminaire(s) sur la gestion des ressources halieutiques invitant des intéressés du secteur de la pêche.

IV. Calendrier des études

Les études seront effectuées au cours d'une période d'environ 40 mois selon le calendrier de travail donné à titre indicatif en Annexe.

V. Rapports

La JICA préparera et remettra les rapports cités ci-dessous au gouvernement sénégalais. Tous les rapports seront rédigés en français sauf le rapport final qui sera rédigé en français et en anglais.

1. Rapport initial: vignt (20) exemplaires
2. Rapport d'avancement I: vignt (20) exemplaires
3. Rapport d'avancement II: vignt (20) exemplaires
4. Rapport intermédiaire: vingt (20) exemplaires

5. Rapport des études sur le terrain I: vignt (20) exemplaires
6. Rapport des études sur le terrain II: vignt (20) exemplaires
7. Projet du rapport final: vingt (20) exemplaires

   Le gouvernement sénégalais donnera à la JICA ses commentaires sur ce projet du rapport final dans le délai d'un mois après la réception dudit projet.
8. Rapport final: cinquant (50) exemplaires de la version française et vignt (20) de la version anglaise

   Ce rapport sera remis au Gouvernement du Sénégal dans un délai de deux (2) mois après la réception des commentaires mentionnés ci-dessus.

VI. Prise en charge par le Gouvernement du Sénégal

1. Pour faciliter la mise en oeuvre de l'Etude, le Gouvernement du Sénégal prendra les mesures nécessaires suivantes :

(1) Autoriser l'entrée , le séjour et la sortie à la République du Sénégal des membres de l'Equipe japonaise d'étude dans le cadre de leur mission , et les exempter des obligations de déclarations applicables aux étrangers et des frais consulaires ;

(2) Exonérer les membres de l'Equipe des droits et taxes imposables sur les équipements, les machines et autres matériels entrés sur le territoire sénégalais dans le cadre de l'Etude ;

(3) Exonérer les membres de l'Equipe des impôts sur le revenu et des droits de toute sorte imposés ou prélevés sur les émoluments ou allocations payés aux membres de l'Equipe d'étude pour leurs services dans le cadre de l'Etude ; et

(4) Faciliter les démarches nécessaires aux membres de l'Equipe pour déposer et utiliser les fonds importés au Sénégal depuis le Japon dans le cadre de l'Etude .

2. Le Gouvernement du Sénégal assurera la prise en charge de l'indemnisation en cas de réclamation de dommages et intérêt faite aux membres de l'Equipe dans l'accomplissement des actes posés au titre de la convention au cours de la mise en oevre de l'Etude, à l'exception des fautes résultant de négligences graves, d'infractions volontaires imputables aux membres de l'Equipe.

3. La Direction des Pêches maritimes en coopération avec les autres organismes concernés, mettra à leurs frais, ce qui suit à la disposition de l'Equipe japonaise de l'Etude :

(1) Informations relative à la sécurité et mesures pour assurer la sécurité de l'Equipe ;

(2) Informations et appui relatifs à l'accès aux services médicaux ;

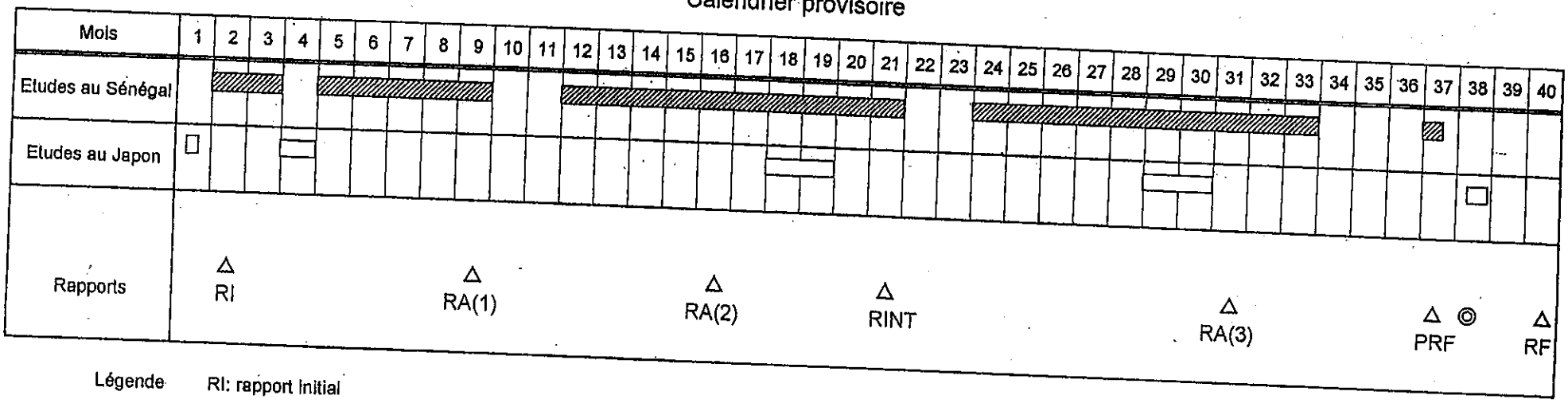
(3) Données et informations disponibles relatives à l'Etude ;
(4) Personnel servant d'homologues de l'Equipe ;
(5) Bureaux convenables avec équipement et mobilier nécessaires ; et
(6) Cartes de séjour ou cartes d'identité appropriées.

VII. Autres

1. La JICA et la Direction des Pêches maritimes doivent garder toujours la communication et se concerter sur tous les points surgis éventuellement au cours de la réalisation de l'Etude ou concernant l'Etude.

2. La présente étendue du travail est rédigée à la fois en français et en anglais. En cas de divergence de l'interprétation entre deux version, la version anglaise prévaudra.

Calendrier provisoire



Légende
RI: rapport initial
RA(1): rapport d'avancement des études (1)
RA(2): rapport d'avancement des études (2)
RINT: rapport intermédiaire
RA(3): rapport d'avancement des études (3)
PRF: projet du rapport final
◎: commentaires du gouvernement sénégalais sur le projet du rapport final
RF: rapport final