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ACRONYMS and ABBREVIATIONS (1/2)

A3PC3M	Association Professionnelle pour la Promotion de la Pêche Artisanale et du Crédit Maritime Mutuel en Mauritanie
ACFM	Advisory Committee on Fisheries Management / ICFS
ACG:BA	Appui à la Conservation, la Gestion et la Valorisation de l'Écosystème du Banc d'Arguin
AMM	Association des Mareyeurs Mauritaniens
ASECNA	Agence pour la Sécurité de Navigation Aérienne
BCM	Banque Centrale de Mauritanie
CEC	Commission of the European Communities
CFPM	Centre de Formation Professionnelle Maritime
CGTM	Confédération Générale des Travailleurs de Mauritanie
CNROP	Centre Nationale des Recherches Océanographiques et des Pêches
COPACE	Comité des Pêches de l'Atlantique Centre Est (CECAF:Fishery Committee for the Eastern Central Atlantic)
CRODT	Centre de Recherches Océanographiques de Dakar-Thiaroye
CSCP	Cadre Stratégique de Lutte Contre la Pauvreté
DCP	Direction de la Commande des Pêches
DEA	Département d'Exploitation et Aménagement (CNROP)
DEARH	Direction des Etudes et de l'Aménagement des Ressources Halieutiques (MPFM)
DPG	Déclaration de Politique Générale
DRVE	Département des Ressources Vivantes et Environnement (CNROP)
DSI	Département des Statistiques et Informatique (CNROP)
DSPCM	Délégation à la Surveillance des Pêches et au Contrôle en Mer
DVIS	Département de Valorisation et Inspection Sanitaire (CNROP)
EDF	European Development Fund
EEZ	Exclusive Economic Zone
ENEMP	Ecole Nationale d'Enseignement Maritime et des Pêches
EPBR	Etablissement Portuaire de la Baie du Repos
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FFD	Fardcau Fiscal Direct
FIAP	Fédération des Industries et Armement des Pêches
FIAPFICHE	Fédération des Industries Artisanales des Pêches
FNP	Fédération Nationale des Pêches
GDP	Gross Domestic Product
HIPC	Heavily Indebted Poor Countries
ICES	International Council for the Exploration of the Sea
IEO	Instituto Español de Oceanografía
IFAN	<i>Fundamental Institute of Black Africa</i>
IMROP	Institut Mauritanien des Recherches Océanographiques et des Pêches
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IODE	International Oceanographic Data and Information Exchange
IRM	Islamic Republic of Mauritania
IRR	Internal Rate of Return
ISRA	Institut Sénégalais de Recherches Agricoles
JAMARC	Japan Marine Fishery Resource Research Center
JICA	Japan International Co-operation Agency
JIS	Japan Industrial Standards
LASE	Laboratoire des Analyses Socio-Economiques
LIPAN	Ligue des Pêcheurs Artisans de Nouakchott
MAPA	Ministerio de Agricultura, Pesca y Alimentación (Reino de España)
MAST	Marine Science and Technology Programme (CFC)
MPFM	Ministère des Pêches et de l'Économie Maritime
MPN	Marché au Poisson à Nouakchott
NDB	Nouadhibou
NGO	Non-Governmental Organization
NKC	Nouakchott
NODC	National Oceanographic Data Centre (IODE / IOC / UNESCO)
NORAD	Norwegian Agency for International Development
NPP	Nouvelle Politique des Pêches
OAFIC	Overseas Agro-Fisheries Consultants Co., Ltd.

ACRONYMS and ABBREVIATIONS (2/2)

ODA	Official Development Assistance
ONS	Office National de la Statistique
ORSTOM	Organisation de Recherche Scientifique des Terriroires d'Outre-Mer
PDPAS	Projet de Développement de la Pêche Artisanale Sud
PNBA	Parc National du Banc d'Arguin
PRA	Participation Research Acceleration
SMCP	Société Mauritanienne de Commercialisation du Poisson
SPPAM	Société pour la Promotion de la Pêche Artisanale en Mauritanie
SRCF	Sub-Regional Committee on Fisheries
STM	Sanyo Techno Marine, Inc.
UM	Ouguiya
UN	United Nations
UNCOPAM	Union Nationale des Coopératives de Crédit de la Pêche Artisanale en Mauritanie
UNESCO	United Nations Educational, Scientific, and Cultural Organization
US\$	United States dollar
USA	United State of America
WB	World Bank (IBRD: International Bank for Reconstruction and Development)
WHOI	Woods Hole Oceanographic Institution
WOA	World Ocean Atlas

1. INTRODUCTION

1.1 Background to the study

The Islamic Republic of Mauritania (hereinafter referred to as IRM) is located at the northwestern most part of Africa, and has a coastline facing the Atlantic Ocean and extending over approximately 740 kilometers. Its continental shelf is less than 200 meters deep, with a surface area of 34,300 km². Its Exclusive Economic Zone (EEZ) of 200 nautical miles spreads over an area of 234,000 km². In the Mauritanian sea area including the offshore region, the front is formed by the Canary Current going down toward the south (a cold current, the coldest period being from January to May) and the Guinea Current flowing up northwards (a warm current, the warmest season being from August to October), which allows one to predict a high yield potential capacity of this zone.

Fish production data for the IRM sea area indicate a total of 306,334 to 644,942 tonnes with mean of 518,354 tonnes in the 1986-2000 period. In this period, the industrial fisheries occupied 95 - 98% (mean of 97%) of the total production and the pelagic fish species accounted for 73 - 89% (mean of 82%) of the industrial fisheries production (ONS, 2001).

In 1998, the total volume of fishery products exported came up to 189,680 tonnes, corresponding to a total amount of 26,8 billion UM (ouguiya) and representing 34% of the total foreign revenue earned by IRM. As for the 26,735 tonnes of demersal fish species caught by bottom trawlers, although making up for only 4% of the total, their economical value is very high, especially for cephalopods. Those fishes are an *especially important source of revenue for artisanal fisheries (ONS, 2001: see table 8.1.3).*

At any rate, over recent years, catch of demersal fishes experienced a downward trend, and one can estimate the level of resources has decreased in all likelihood as a result of increasing catch effort. In its resource evaluation conducted in 1993, CNROP also refers to increase in fishing effort, particularly of octopuses, shrimps and sea breams (FAO, 1995).

With such a context as background, in April 1995 the Government of the IRM, in concert with the MPEM and the Ministry of Planning, adopted a 'Fishery Sector Development Policy Letter' whose priority is the sustainable utilization of fishery resources and the implementation of a system for their management. CNROP was then reorganized and consolidated, in order to promote fishery studies and research.

In March 1998, during a conference of donor countries organized mainly by the WB, the following actions were proposed so as provide a short-term resolution to the problem of diminishing catch: (1) that resource surveys be conducted; (2) a management system be implemented, and (3) a monitoring and surveillance system be reinforced. The accorded agreement specified the implementation of a rational management policy of fishery resources as a condition for the relief of the country's debt.

In response to these suggestions of the conference of donor countries, in June 1998, the Government of the IRM drew up the Strategy for the Management and Development in Sector of the Fishery and Maritime Economics laid much emphasis on: (1) a resources management plan by the revitalization of the fishery research, a reinforcement of the maritime surveillance and control, a development of the artisanal fishery, and an elaboration of the fisheries management, (2) a integration of the sector into the national economics by

the augmentation of additional value in the sector with the valorization of fishery products, a promotion of employment, and a consolidation and development of infrastructures, (3) an amelioration of the institutional, fiscal and financial frames in the sector, and (4) a preservation of the coast and a protection of the marine environment.

It was under these circumstances that, in September 1998, the Government of the IRM requested to the Government of Japan to conduct a highly urgent fishery resources survey focusing on demersal fish species, and, based on its results, to suggest proper measure to establish management plan for said resources, comprising resource estimation, management and monitoring. In response, in June 1999 the Government of Japan sent a preparatory study team to the IRM through JICA. That mission verified the contents of the request and had discussions with concerned officers of the Government of the IRM on the details of the implementation of the Study. As a result, concerned parties of both countries came into agreement for the implementation of the Study, and concluded and signed the Scope of Work (S/W) and the Minutes of the Meeting (M/M) on 7 July (JICA, 1999).

1.2 Objectives of the study

The objectives of the Study were the following:

- (1) To conduct a survey of the main resources relevant to commercial fish species, precisely estimating the available stocks, in order to ensure an enduring yield of demersal fishes within the 200 nautical miles of the Mauritanian EEZ;
- (2) To clarify the situation concerning the utilization of resources by both artisanal and industrial fisheries on the coast and offshore, within the framework of the current system, in order to precisely know the condition of those resources, in accordance with the item (1) above;
- (3) To perform a general evaluation of the findings of this survey and to elaborate, from both an objective and technical standpoints, a practical policy for the management of fishery resources to be adopted by the IRM, taking into account the national plans for Mauritanian fisheries and research results;
- (4) To carry out a Transfer of Technology to concerned personnel of DEARH and CNROP, so that, by the end of the Study, the IRM could follow up this study jointly conducted by the two countries and proceed to examine and evaluate the local fishery resources.

1.3 Policy for the implementation of the study

The policy for the implementation of the Study for the Fishery Resources Management Plan in the IRM has been basically established in the S/W and M/M documents concluded on 7 July 1999 on the subject. Any modification in contents or in procedures arising in the course of the Study itself would be adopted after discussion and agreement between concerned parties of both countries.

The Research Team was formed by personnel belonging to DEARH, CNROP and JICA. All team members were fully aware of the context and the background leading to the implementation of the Study and proceeded in a relationship of mutual understanding and trust, essential to the harmonious progress of their

joint work.

The present Study was conducted with basis on the Inception Report (itself elaborated upon the S/W and the M/M) and also on the methodological guidelines for implementation as developed by the Sea-borne, Laboratory and Landing Site Surveys. In addition, the person in charge of Generalization and Resources Management, taking into account the overall results, outlined a Policy for the Management of Fishery Resources.

The main points of each Survey and the specific role of the Generalization and Resources Management are mentioned below.

(1) Sea-borne Survey

Stock evaluation of the target species, collection of biological data, clarification of the relationship between demersal fishes and the oceanic environment, data collection on mesh selectivity and, based on the results obtained, analysis and evaluation of the current situation of fishery resources. Related transfer of technology.

(2) Laboratory Survey

Establishment of a method for age determination for the target species, age determination and related transfer of technology.

(3) Landing Site Survey

While the Sea-borne Survey dealt with the collection of biological data, the Landing Site Survey clarified the socioeconomical aspects of the current situation of artisanal and industrial fisheries with respect to the utilization and distribution of fishery resources. Evaluation of the impact on both the artisanal and industrial fisheries caused by the introduction of fishery regulations, and the effects of resource management. Related transfer of technology.

(4) Generalization and Resources Management

Proposal of a practical management policy based on a general assessment of the findings of the Study and on a reevaluation of past studies and fishery regulations, with predictions for the future. Transfer of technology on resource management.

1.4 Components of the study

1.4.1 The study area

- (1) The survey area for the Sea-borne Survey was defined on the continental shelf and on the continental slope at a depth varying from 3 to 600 m within the 200 nautical miles of the Mauritanian EEZ (see Figure 3.1).
- (2) The Laboratory Survey was conducted mainly on the samples collected during the Sea-borne Survey.
- (3) The Landing Site Survey took place mainly in the areas of artisanal and industrial fisheries in the regions of NDB, NKC and Banc d'Arguin, and whenever necessary also in other areas of artisanal fisheries.

1.4.2 The target species

There were a total of 22 species studied, comprising fourteen fishes, three cephalopods and five crustaceans (see Table 3.3).

1.4.3 Implementation of the study

This Study comprised four seasonal surveys over a two-year period (2000-2001). There are two seasons in a year, namely the cold season (from March to May) and the warm season (from September to November). However, the Landing Site Survey for the second year was conducted during the transitional period between seasons, in two phases – one between the cold season and the warm season, and the other between the warm season and the cold season.

The main components of the Study were the Sea-borne Survey (resources survey, biological survey, oceanographic observation and mesh selectivity experiment), the Laboratory Survey (age determination of the target species) and the Landing Site Survey (oral interviews, length composition study, data and documentation gathering). For more details refer to Chapters 2 to 6 for the Sea-borne Survey, Chapter 7 for the Laboratory Survey, and Chapter 8 for the Landing Site Survey.

1.5 Research team members and task assignment

Listed below are the names and respective task assignments and affiliations of the Mauritanian and the Japanese members of the research team, as well as those of JICA officials in charge of supervising the Study.

1.5.1 Research team

- (1) Generalization and Resources Management (evaluation and management of resources, elaboration of management policies)

Mr. Sidi El Mectar Mohamed Abdallahi (DEARH)

Mr. Keisuke Okada (STM) – until July 2000

Mr. Keiichiro Mori (STM) – after August 2000

- (2) Resources Survey and Analysis I (methodology for survey and analysis of offshore demersal fish resources)

Mr. Cheikh Abdallahi Ould Inejih (CNROP)

Mr. Osamu Arakawa (STM)

- (3) Resources Survey and Analysis II (methodology for survey and analysis of coastal demersal fish resources)

Mr. Ebaya Ould Sidina (CNROP)

Mr. Tetsuro Fujino (STM)

- (4) Biological Survey (age determination in particular)

Mr. Abdoulaye Wague (CNROP)

Mr. Naohiko Watanuki (OAFIC)

(5) Fishing Techniques, Gear and Methods (fishing operations and trawling study techniques)

Mr. Moustapha Ould Bouzouma (CNROP)

Mr. Kenji Okamura (OAFIC)

(6) Observation of the Oceanographical Environment (oceanographical observation and oceanographical environment techniques)

Mr. Mohamed Ould Mahfoudh (CNROP)

Mr. Katsushi Yoshikawa (STM)

(7) Fishing Communities and Sociology of Fisheries (on-site socioeconomical survey and study of catch and utilization by artisanal and industrial fisheries, with predictions)

Mr. Thiam Ismaila (CNROP)

Ms. Lena Westlund (OAFIC)

Mr. Mohamed Ould Cheikh (CNROP) – since April 2001

Mr. Keizo Takahashi (STM) – since April 2001

1.5.2 Planning and coordination

(1) IRM

Mr. Cherif Ould Toueilib (DEARH)

Mr. Mohamed M'Barek Ould Soueilim (CNROP)

Mr. Diop Samba Mika (CNROP)

(2) Japan

Mr. Jun Yokoyama (JICA) – until March 2001

Mr. Masaru Honda (JICA) – after April 2001

1.5.3 Supervising committee

(1) Generalization and Resources Management

Mr. Shintaro Suzuki (formerly of the Resources and Environment Research Division, Resources Development Department, Fisheries Agency, currently in the Fisheries Research Agency, Head Office)

(2) Resources Evaluation

Mr. Daiji Kitagawa (Chief of Stock Assessment Section, Hachinohe Branch, Tohoku National Fisheries Research Institute, currently also in the Fisheries Research Agency)

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2. OCEANIC ENVIRONMENT AND FISHING GROUND ENVIRONMENT IN THE SEA-BORNE SURVEY AREA

2.1 Objectives

The Sea-borne survey area was included in the EEZ of 200 nautical miles of the IRM, which receives two opposing sea currents – the Canary Current (cold), going southwards, and the Guinea Current (warm) running north – and where often upwellings are formed by the predominant northerly winds blowing parallel to the coastline. This oceanic environment is overall favorable to fisheries. The present oceanographic observation was carried out in order to understand the oceanic environment of the area, considering that it is the main cause of the distribution limits of nectobenthos, which are the subject of the resources survey by bottom trawl.

2.2 Methods

The observation area and research vessels were the same utilized in the resources survey described in Chapter 3.

2.2.1 Observation items

The observation items were: water temperature and salinity, water current direction and speed, pH, chlorophyll-a (pheophytin, an included component, was not specially specified below), and also nutrient salts (nitrites $\text{NO}_2\text{-N}$ and nitrates $\text{NO}_3\text{-N}$). Meteorological observations such as the weather, temperature, atmospheric pressure and wind, were conducted during the trawl operation.

2.2.2 Observation period

The observation was conducted in two phases: Phase 1 in 2000 and Phase 2 in 2001, each comprising a cold season (March–May) and a warm season (September–October).

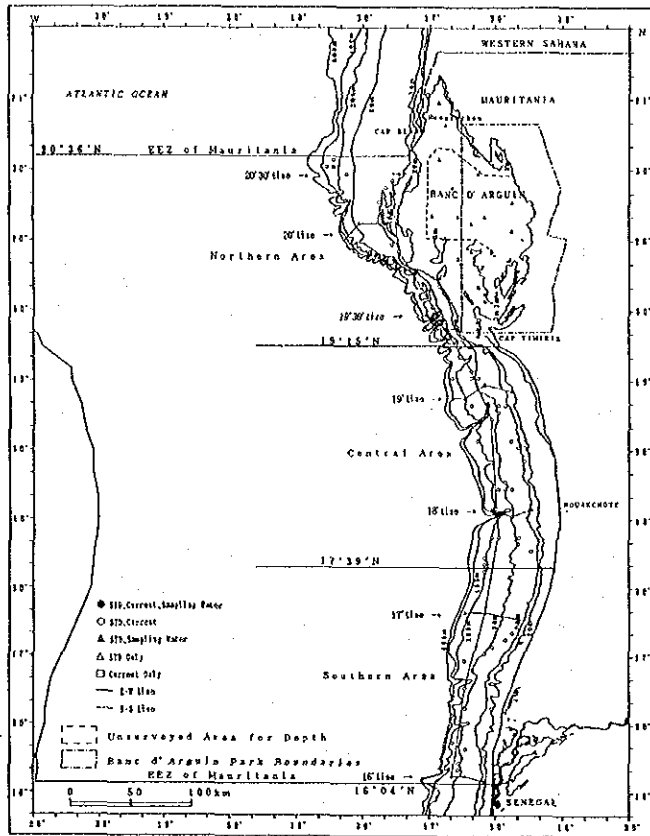
2.2.3 Location of observation

Figure 2.1 indicates the location of the observation stations. Water temperature and salinity observations were made at the trawl stations during the resources survey, at every 1 m from the surface to the bottom of the sea. Water current direction and speed were in principle measured at all trawl stations explored by the *Al-Awam*. Three observation layers were considered: upper layer (4 m below surface), middle layer (about 50% of the water depth) and lower layer (about 70% of the water depth). Samplings on pH, chlorophyll-a and nutrient salts were done by applying observation lines (total, 7) to the trawl stations near the 16°, 17°, 18°, 19°, 19°30', 20° and 20°30' northern latitudes, as shown in Figure 2.1. In principle, this sampling was done on 3-4 stations along each line. Sampling depths were the surface and those at the following depths: 10 m, 20 m, 50 m, 100 m, 200 m, 300 m, 400 m, 500 m and 600 m. Meteorological observations were performed during the trawl operations.

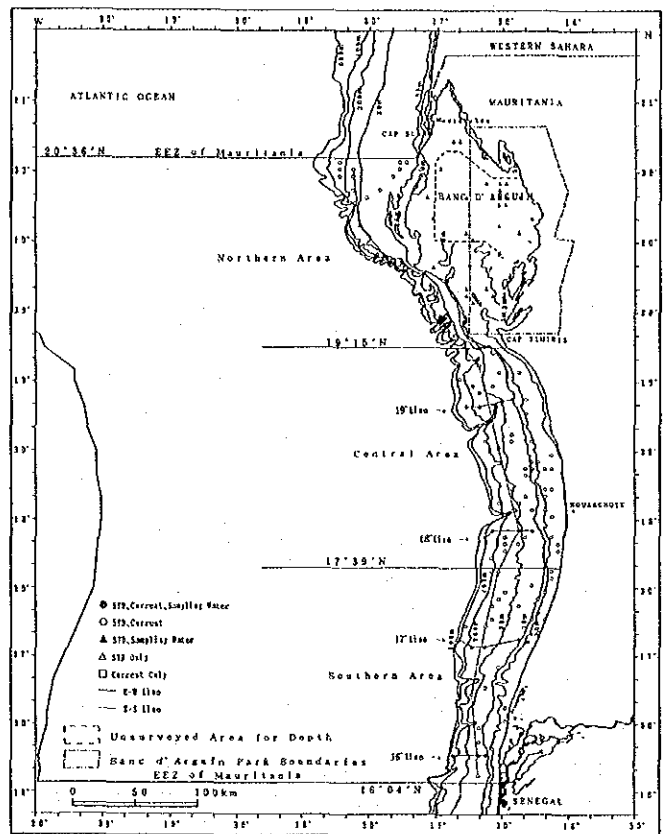
2.2.4 Observation methods

Position of the research vessels was determined by Global Positioning System (GPS). Measuring instruments and observation methods utilized for each observation item are indicated below. The Appendix Table 2.1 describes the specifications of the instruments employed in the observation.

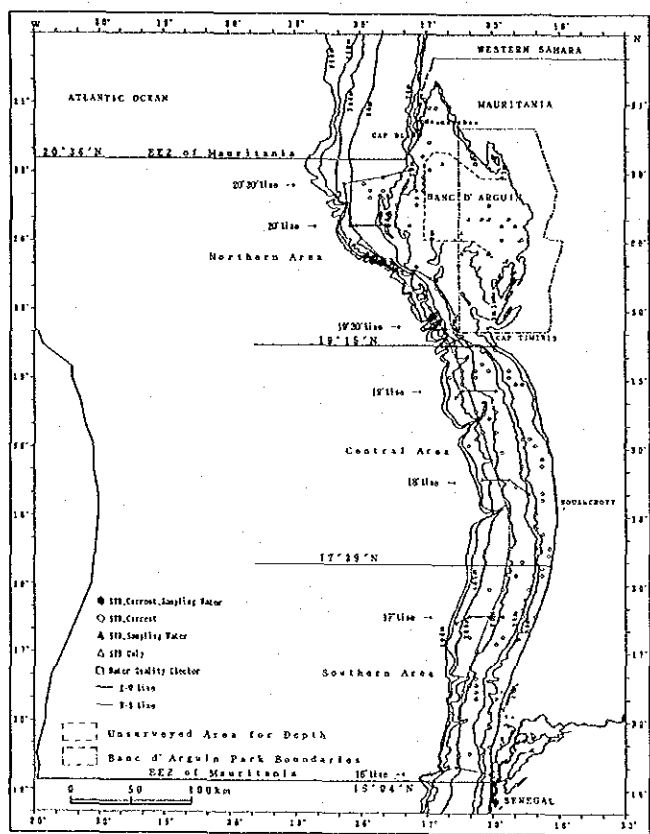
(A) Phase 1 cold season



(B) Phase 1 warm season



(C) Phase 2 cold season



(D) Phase 2 warm season

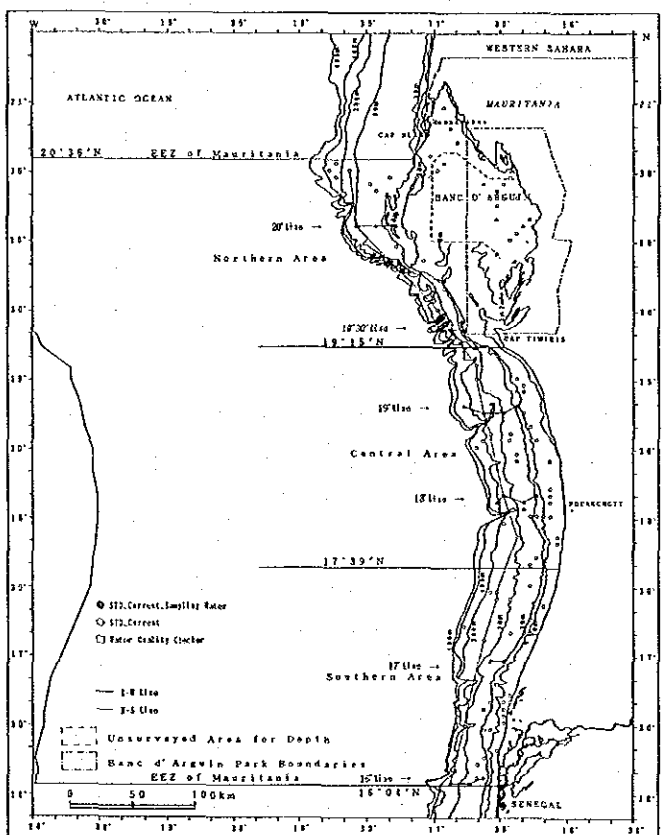


Figure 2.1 Summary deployment of oceanographic observation stations.

(1) Water temperature and salinity

Water temperature and salinity were measured with a water thermometer and salinometer. When this instrument could not be used, water temperature and salinity were measured by a water quality checker at samples taken from the various depths (including 1 m below surface) by a Niskin or Van Dorn water bottle. Water temperature measurements by means of a stick thermometer and salinity analysis of water samples were reiterated many times during the study in order to correct the values obtained by water thermometer, salinometer and water quality checker. Water temperature at about 2 m below surface was measured opportunely with a digital water thermometer installed on the bottom of the *Al-Awam*.

(2) Water current direction and velocity

Those variables were measured by a Color Doppler Current Profiler installed on the bottom of the *Al-Awam*.

(3) pH, chlorophyll-a, nutrient salts, etc.

A pH-meter was employed to measure the pH of water samples collected by Niskin bottles from the sampling depths. Chlorophyll-a from those samples was analyzed at the DVIS/CNROP laboratory following on-board filtration. Nutrient salts in the samples were analyzed in the same laboratory after being stored in sampling bottles.

(4) Meteorology

Meteorological observations on board were made by sight. Temperature, atmospheric pressure, wind direction and speed were recorded by means of, respectively, a thermometer, a barometer, and a wind vane and anemometer installed on the RVs.

In addition, on-land data at NDB and NKC collected by the Mauritanie Service Exploitation Météorologique/ASECNA from 1 January 2000 to 31 October 2001 (daily observations every 3 hours) were also gathered and analyzed.

2.2.5 Methods of analysis

Figure 2.2 shows how water temperature and salinity data were treated according to the Manual of Quality Control of CEC *et* IOC (1993). Their analysis was done on corrected observed readings. Considering the peculiar characteristics of the observation instruments, data for the surface and bottom (especially for the last data near the bottom, the effect of buoyant sediments is conceivable.) were of poor quality and not utilized for analysis. σ_t was also calculated from water temperature and salinity readings, and utilized for analysis. The International Equation of State of Seawater (UNESCO, 1980) was employed for σ_t calculation.

Analysis of horizontal and vertical (sectional) distribution of water temperature and salinity, pH, chlorophyll-a and nutrient salts was conducted by means of the Ocean Data View v.5.1 software application, distributed over the Internet by R. Schlitzer (Alfred Wegener Institute for Polar and Marine Research). The T-S diagram was subjected to statistical treatment via MS-Excel.

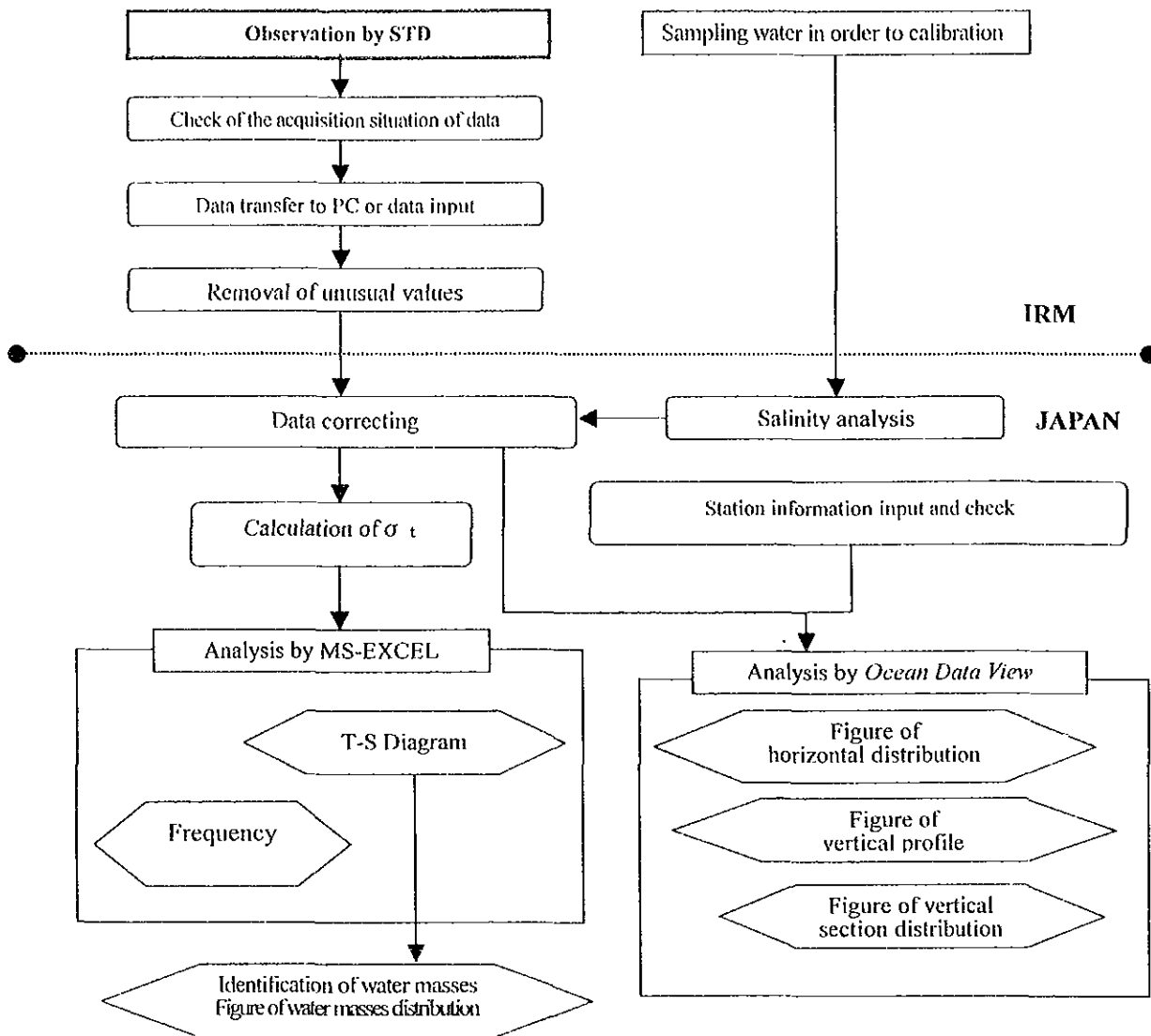


Figure 2.2 Flow chart on the processing of water temperature and salinity data.

2.2.6 Oceanographic observation team

The following team members were responsible for the observation design, implementation of observation and analysis, and examination of results.

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 Bambaye Ould Hamady
 Lam Mamadou
 Harouna Tounkara
 Ball Abou Cire

JICA: Katsushi Yoshikawa (STM)