CARIBBEAN FISHERIES UNIT
BELIZE

REVIEW OF THE DATA COLLECTION AND MANAGEMENT SYSTEMS OF THE MARINE FISHERIES IN SURINAME

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EXECUTIVE SUMMARY

This report is an output of the EDF-funded Integrated Caribbean Regional Agriculture and Fisheries Development Program (ICRAFDP). This project will provide technical assistance to the Fisheries Department and other national and local organizations associated within the fisheries sector through activities outlined in the Work Programme for Suriname. This report addresses two aspects of the work plan:

- 'Establishing or enhancing fisheries data collection and management systems;
- Establishing or enhancing licensing and registration systems for fishermen and fishing vessels.

The report provides a review of data collection and licensing and registration systems, identifies the needs of Suriname in these areas and outlines the activities that would address these needs. There have been several inputs from previous projects towards the establishment of data collection and licensing and registration systems for Suriname. This report takes the progress made in these into account and attempts to build on it.

In general the conclusion of this report is that the collection system for catch and effort data in Suriname, is fundamentally sound, but has suffered from a lack of coordination and management over the years. This appears to be due to the absence of a comprehensively conceived data and information system for fisheries that is driven by the need for information for management decision-making. That in turn should be determined by the management approaches described in the resource specific management plans, and by overarching information needs for strategic planning of fisheries.

Data collection and management activities have suffered from a lack of coordination and have tended to be reactive to the demands of external programs. Ideally, there should be an overall, comprehensive data and information system that meets the Departmental needs on an ongoing basis. Special activities and projects should not be undertaken at the expense of that system.

The Fisheries Information system developed by the FAO/UNDP Project in 1990 has provided a considerable amount of data on catch and effort. In general, there is the need to make these data available for analysis and to integrate them with a new catch and effort data system that should be developed based largely on the specifications of the old system. To achieve this, a new database system should be programmed, based upon the original FIS system to accommodate catch, effort, price, export data and fishery products and to produce basic reports and data outputs from these data.

In setting up the new system the programmer should be particularly mindful of the need for Suriname Fisheries Department staff to be able to manage the system. The programmer must provide clear documentation of how the system carries out any calculations that it does, and also of how to adapt the system to changes that may take place in the fishery. The changes that are most likely are the addition of new codes (vessel and gear types, landing sites, species, products) and the restratification of the landing sites.

In developing the new system the problems encountered with the old one should be addressed. Several years of data should be analysed to determine the extent of split landings by vessel and landing site to determine how serious a bias this is, and to make recommendations as to how to address the problem.

It should be noted that the biases and errors that may affect a data collection system usually cannot be 'fixed' once and for all, they can only be managed and kept at an acceptable minimum by ongoing attention to the activities of data collectors and perusal of data for anomalies. Therefore, there is the need to establish an ongoing system of monitoring of the data collection system and review of its outputs in order that problems can be identified and rectified in a timely fashion. Data collection activity for all sites to be sampled should be programmed in advance for all regions for periods of 4-6 months using the method described.

There is also the need for ongoing attention to data entry and exploratory analysis in order to detect and fix problems as soon as possible after they arise. Further consideration of refining the units of effort in the new system should be based on analysis of the existing data.

The existing data on the bycatch and discards in the Chinese seine fishery should be analysed as a precursor to determining the need for further studies on bycatch.

The present observer program appears to be a good way of acquiring information on bycatch and discards in the offshore trawl fisheries and should be continued as planned. The information generated thus far by the observer program should be documented in the Suriname Fisheries Report series, and there should be regular reports each year on the results of the analyses of the data collected by the observers so that it can be available for management decision-making.

The present vessel registration system should be computerised to make the registration procedure more efficient and accurate, and to make the data more readily available. It is recommended that landings by vessels licensed to fish in Surinamese waters and land their catches in Guyana be estimated by collaboration with the Guyana Fisheries Department and/or extrapolation form local vessels.

Apart from routine collection of price data on a weekly basis at major landing sites, the acquisition of economic data should be designed to meet specific needs until the requirements of an ongoing economics data collection system can, if needed, be determined. Similarly, the acquisition of sociological data should be designed to meet specific needs until the requirements of an ongoing data collection system can, if needed, be determined.

The draft Fisheries Management Plan (FMP) is an excellent start on the process of developing a comprehensive system of management for the various fisheries of Suriname. There is the need to add to the FMP a management unit that covers the large offshore pelagic species. To further develop the FMP There is the need for a thorough compilation and review of the data that have been collected thus far, the analyses that have been carried out and the advice that has been generated. This should be done for each Management Unit in the draft FMP. These compilations would provide the supporting technical information for the FMP. For example, the existing catch and effort data for the period 1991-2000 should be examined for trends in landings per unit effort by vessel and gear type and to the extent possible by geographical area. To facilitate the analyses that should be done, the Fisheries Department of Suriname should be provided with its own copy of The Statistical Package for the Social Sciences (SPSS) software.

In order to determine the biological sampling needs for the various species, there is the need to first clarify within the context of the FMP the management approaches and measures that will be used for each management unit and the role that the population analyses will play in management decision-making.

There should be a landing site information system and an ongoing process to acquire and compile incidental data on landing sites. A landing site survey was carried out by the Fisheries Department in 1995. It is recommended that the data from that survey be reformatted to facilitate analysis, that basic analysis be carried out to provide a summary description of the landing sites, and that a report be prepared with this information.

There should be an ongoing system to acquire and compile incidental data on Local and Traditional Ecological Knowledge. A computerised system should be put in place for bibliographic information.

There is the need for a comprehensive overall documented scheme for the management of fishery data and information for Suriname that incorporates all the various kinds of data identified in this report. There is the need to establish priorities for the staff with responsibility for data collection, management and analysis so that the maintenance of a functional, ongoing system for provision of information for management decision-making can be assured. These priorities should flow from the management plan, which should be realistic in terms of staff capabilities and numbers.

1 INTRODUCTION AND BACKGROUND

Within the EDF-funded Integrated Caribbean Regional Agriculture and Fisheries Development Program (ICRAFDP) there is a component designed to promote the sustainable utilization and management of the fisheries of the CARIFORUM countries. The overall objective of the fisheries program is optimal utilization of marine fishery resources in CARIFORUM countries through sustainable harvesting and post-harvest use. Fishery management to achieve this objective should be enhanced by strengthening the capacity of national Fisheries Departments and regional institutions that are responsible for formulation of fishery management policy and implementation. The CARICOM Fisheries Unit (CFU), located in Belize, Central America, is executing this project.

Through this project, sustainable fisheries development and management in Suriname will be enhanced by technical assistance to the Fisheries Department and other national and local organizations associated within the fisheries sector. This will be accomplished through the following activities as outlined in the Work Programme for Suriname (Fisheries Department of Suriname and CARICOM Fisheries Unit. 2000):

- Strengthening National and Regional Fishery Management Policy and Planning capability;
- Establishing and formalising Advisory/Decision-Making mechanisms at the national level;
- Establishing or enhancing fisheries data collection and management systems;
- Establishing or enhancing licensing and registration systems for fishermen and fishing vessels;
- Establishing mechanisms for participation of fishers and fishing industries in fishery management;
- Enhancing public awareness of fisheries management issues;
- Enhancing linkages and cooperation between Government fisheries officials and stakeholders in Suriname and Guyana;
- Strengthening human resource capability through training;
- Assessing the status and potential of critical resources; and
- Conducting research to generate information for policy formulation.

The present consultancy pertains primarily to WBS items 300 (Fisheries Management Data Systems) and WBS 320 (Licensing and Registration System). Specifically it is WBS 310/320 (Review the data collection and management systems).

The Terms of Reference for the Consultancy are provided in Appendix 1. The purpose and objectives of the consultancy are to:

- Review the onshore and offshore (Observer Program) data (catch, effort, biological, economic, social and licensing and registration) collection, and management systems of Suriname and make recommendations for improvement;
- Review the system for recording, storage, verifying, analysis and reporting of the data;
- Review the adequacy of the personnel available for field activities and the computerized systems in terms of skills and numbers available;

- Recommend the most suitable means of obtaining data on discards by the various gear types (e.g. njawaries, trawl nets) in the Industrial, Coastal and Brackish water Fisheries;
- Determine if adequate data exists to determine population parameters (growth, mortality, recruitment, maturity etc.) for the main commercial species, including those from large demersals and penaeid shrimp and advise on the appropriate studies to obtain such data for analysis;
- Review the type of economic data being collected and advise on the additional data to be collected in order to monitor the performance of the fleets in the respective fisheries as well as provide information for management;
- Clearly identify and characterize the strengths and weaknesses of the current data collection system at the different levels (field sampling, data management, analysis and reporting);
- Make recommendations for refining and strengthening the integration of the catch, effort, biological, economic and social data collection programmes.

These objectives were reviewed with the Director Fisheries, Fisheries Department Staff responsible for data collection management and research and the Data Manager from the CARICOM Fisheries Unit. It was agreed that the fourth bullet, pertaining to the adequacy of data for determining population parameters was beyond the scope of the present mission, but that the consultant could attempt to compile an overview of available data. It was also acknowledged in that meeting that there was very little by way of social and economic data. The Director of Fisheries indicated that although not included in the ToRs, an attempt to analyse the existing data to provide estimates of landings for recent years was a high priority activity for the Fisheries Department.

2 REVIEW OF CATCH AND EFFORT DATA COLLECTION SYSTEM

2.1 Historical overview

Documented efforts to establish fishery data collection systems in Suriname began in 1982 with input from FAO ((Chakraborty 1982). Subsequent projects addressed various aspects of data and information acquisition and analysis ((Charlier and Thakoersingh 1986,Charlier 1989, Charlier and Colli 2000). These efforts led to the development of a UNDP/FAO funded project "Establishment of a Fisheries Information and Resource Assessment System" generally referred to as the Fisheries Information System (FIS), for Suriname (FAO FI:SUR/87/001). The data collection and data management systems were designed in 1990 and data collection began in 1991 ((Mahon 1990a, Mahon et al 1990a, 1990b). After one year of operation the data collection system was reviewed and recommendations made for its improvement (Suriname Fisheries Department 1993, Charlier 1993).

Following the review, data collection activities were continued to the present with only minor modifications aimed at accommodating changes in the fisheries.

When the FIS was established, the data collected were entered into a database system programmed in Dbase with a Clipper user-interface. The data from 1991-1995 were entered into the database. In 1995 the individual with responsibility for the database left the Fisheries

Department and no remaining staff member was sufficiently proficient in its use to be able to continue to enter and extract the data. The local consultant who had programmed the database was engaged to extract the data for 1995 from the database into Excel spreadsheets. The resulting Excel format then became the basis for storage of subsequent data. Data for 1996 and 1997 however, remain on paper only. Data from 1998 and 1999 are stored in Excel in that format, and data from 2000 were being entered at the time of the mission.

2.2 Field visits

From earlier work in Suriname during the development of the Fisheries Information System in 1990, the consultant was familiar with the types of vessels, gear, fishing practices and landing sites. Therefore, further familiarisation focused on changes since 1990, and only areas where changes had taken place were visited. The observations made during these field visits are incorporated in Section 2.3.1 on changes in the fisheries.

Field visits included the Fisheries Center at New Amsterdam, Braamspunt, Commewijne left bank, the New Nickerie Central Market and other landing sites in the New Nickerie area.

2.3 The 1995 fishery landing site survey

A fishery landing site survey was carried out by the Fisheries Department in 1995. For each landing site, information was gathered in four categories:

- Identification of the landing site;
- Description of the landing site;
- General characteristics of fishing and landing; and
- Marketing and processing.

The information recorded was stored in Excel on a separate worksheet in the format shown in Appendix 2. This appendix also provides details of the information gathered under each of the above categories.

The information from the landing site survey can be useful to fishery management and development in Suriname in several ways.

(a) The survey data on the distribution of vessels and gear by landing site are highly relevant to the purpose of the present consultancy. They provide a sampling frame that indicates where sampling effort should be allocated in order to achieve the best coverage of fishing activities.

(b) The landing sites descriptions are basic information that a Fishery Department needs in order to maintain contact with and track changes in the industry.

(c) The marketing and processing information are also basic industry information for understanding post-harvest activities. This information is also valuable for estimating the total value, including value-added by processing and trade in the industry. This aspect of the survey will be revisited in the section on social and economic data.

Owing to manpower constraints in the Fisheries Department, the survey data have not yet been analysed. The present format is oriented towards presentation of the survey data, but does not facilitate its analysis. For analysis, the data should be converted to a database format, with variables in columns and landing sites in rows. Excel tables would suffice, as the data could then be analysed in Excel or imported into SPSS for analysis. However, if the decision is taken to use

a particular database software package, e.g. Microsoft Access or SQL Server, for storage of other types of fishery data, then this survey data could be stored in a database developed using the same software.

It is recommended that the 1995 landing site survey data be reformatted to facilitate analysis, that basic analysis be carried out to provide a summary description of the landing sites, and that a report be prepared with this information.

For the purpose of the present consultancy the data on numbers of boats and gear at various landing sites were extracted from the forms into an Excel table and a preliminary compilation prepared for use in reviewing the present data collection system. The tabulation of that information is shown in Appendix 3.

2.4 Review and revision of the system

The system that was designed and implemented in 1991 was reviewed from several perspectives. These included:

- The extent to which there had been changes in the fishing practices, landing sites, marketing activities;
- The extent to which the initial implementation and review of the system had identified problems that required attention; and
- Whether the present sampling design was appropriate to the present characteristics of the fisheries.

These issues are dealt with in turn in the following sections.

2.4.1 The FIS established in 1991

The Fisheries Information System that was established in 1991 has been described in detail in several other documents ((Mahon 1990a, Mahon et al 1990a, 1990b, Suriname Fisheries Department 1993, Charlier 1993). This descriptive material will not be repeated in full in this report. Only those aspects that are required for understanding the conclusions and recommendations of this review will be provided.

2.4.2 Changes in the fisheries of Suriname since 1991

There have been changes in the fisheries of Suriname that must be considered in this review and accommodated in any revision of the data collection system. Several of these changes were observed first-hand during the field visits.

The Fisheries Center at New Amsterdam was opened in 1998. It is managed by an independent Government company. About 6 SK (Guyana type) vessels land their catch there each week, mainly open drift netters. Several BV boats also land there. The fishers deal directly with the buyers who transport the fish. Most goes to processing and exporting companies in Paramaribo. Some catfish is processed in New Amsterdam. No records of landings are kept at the Center. The center provides good conditions for recording catch and effort data and also for biological sampling as necessary. Sites along the Commewijne left bank also remain unsampled, and there is no data collector assigned to the New Amsterdam/Commewijne left bank area. This

is expected to change shortly with a sampler being assigned to the area. This individual will be based at the Center, but will have transportation and thus be able to cover the entire area.

The fishing settlement at Braamspunt has grown in importance in recent years, with fishers relocating there from Pomona and Matapica. This landing site is visited regularly by a Fisheries Department official who usually stays for at least an entire day and deals with a wide range of fisheries matters. There is good accessibility to catches for the purposes of sampling and a single individual can monitor landings for the entire site throughout a day.

Over the years it has become evident to Fisheries Department staff that the New Nickerie Central Market (CM) itself is not as important a landing site as previously thought during the development of the data collection system. Although sampling was at that time planned for this and other sites in the New Nickerie area, it has not been carried out consistently. The boats that land at the Central Market there are BV boats fishing mainly in the Biggi Pan and adjacent freshwaters. The majority of landings in the area are at Zeedijk area where 40-50 boats fishing Chinese seines are based and land their catch.

Other landing sites in this region include the now defunct Fisheries Center where a few BV and SK boats land, and sites on the Nickerie River upstream of the central market – four in Longmay and two in Paradise. The landings at the latter sites are mainly freshwater fishes (about 70 kg tilapia and 15 kg snook/tarpon/mullet per boat day according to Fisheries Department staff at the Central Market). When these boats fish at night, they land their fish at the Central Market next morning. However, when they fish in the day, or return from fishing too late to catch the morning activity at the CM, they may land their catch at the other sites for local sale or later transport to the CM. About six SK boats also land at sites on the Nickerie River. Their fish is trucked to processors in Paramaribo

Also operating in the area off New Nickerie are about 40 SK vessels that have been licensed to land their fish in Guyana. These present a special problem for data collection that cab be addressed in either or both of two ways:

- Collaboration with Guyana Fisheries Division to obtain data from their data collection system on landings by SK vessels (which should be clearly marked as such);
- Estimation of landings in Guyana based on catches and fishing practices of local Surinamese vessels fishing in the same area.

It is recommended that landings by vessels licensed to fish in Surinamese waters and land their catches in Guyana be estimated by collaboration with the Guyana Fisheries Department and/or extrapolation from local vessels.

Fisheries in the eastern area of Suriname between the Commewijne River and the border with French Guiana were discussed, but these sites were not visited. Owing to previous internal problems, these fisheries have not been as well integrated into mainstream Fisheries Department activities as have other areas of the country. The main areas of activity are apparently along the Marowijne River, chiefly at Galibi and Albina. There is a Fisheries Department official based in Moengo with responsibility for these areas. However, on the request of the Fisheries Department, sampling of these areas will not be dealt with in this consultancy.

Vessels commonly land their catch at the jetties of the private processors to which they sell their catch. These companies provide data on the landings at their sites. These data are recorded on special forms and collected monthly by the data collectors. Over the years, several

of these processors have gone out of business and new ones have opened. Thus the landing situation has changed. At the CEVIHAS site, new companies have opened for business, thus in order to track compliance of processors with the requirement to provide data, this site must now be treated as several companies as indicated in Appendix 3.

It was noted that since 1990, industrial finfish trawling had become more common, including the introduction of stern trawlers and that seabob trawling had been introduced. New data collection forms have been developed for these fisheries.

Some of the changes in the industrial fisheries, notably the introduction of the stern trawlers, have resulted in increases in landings of several species that were previously recorded in aggregate groups. These are: lane snapper, mackerel (*Scomberomorus*) and jacks. These species have been added to the data collection forms for the vessel categories that catch them.

Based on the information received from the Fridtjof Nansen surveys (IMR 1988), the Fisheries Department has introduced a new category of fishery or management unit "small pelagic fish" that covers the engraulid and clupeid resources, believed to comprise mainly *Sardinella* spp., and to have the potential to support a significant fishery. Fisheries remain to be developed on these resources.

The data collection forms presently in use have been adapted to include the species changes described above.

The draft Fisheries Management Plan for Suriname (Charlier 1999), includes 16 management units. Two of these pertain to pelagic fishes. The one termed "large pelagic fishes" gives scombrids as the main species and sphyraenids and carangids as the other species. In the Caribbean literature, these are usually referred to under the heading "coastal pelagic fishes" with the term "large pelagic fishes being used for tunas an tuna-like species (Mahon 1990b). These are often treated in two categories "large oceanic pelagics" and "large coastal pelagics". The former group usually includes species such as yellowfin tuna, skipjack tuna, albacore, bigeye tuna, swordfish and the billfishes. The latter group includes species such as blackfin tuna, dolphinfish, *Scomberomorus* species, little tuna, amberjacks, and rainbow runner.

There is the need to add a management unit that covers the large pelagic species. Although there is no fishing for these species by Surinamese vessels at present, many of them occur in waters of Suriname and are fished there by foreign vessels (Mahon 1996, Mahon and Singh Renton 1999). Present efforts by the CARICOM Fisheries Unit to participate in the activities of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and other regional initiatives regarding access to these pelagic fishes may stimulate interest in, and thus lead to the establishment of fisheries for them in Suriname.

2.4.3 The 1992 review

The 1992 review of the FIS that was conducted after its first year of operation identified several problem areas and provided recommendations for how they might be addressed (Charlier 1993). The present review revisited the conclusions and recommendations of the 1992 review to determine if they had been addressed and if not, whether they were still valid.

The 1992 review looked first at errors affecting effort estimates and then errors affecting landings per unit effort estimates (lpue). In each case, both systematic and sampling errors were considered. With regard to effort estimates (page 27, Section III.C.1), the systematic errors that were considered are listed below:

(a) The problem of boats landing at unrecorded places;

(b) Boats landing at monitored sites may be missed by data collectors;

(c) Incomplete reporting by industry;

(d) Split landings in which catch from a single trip is landed at two sites, leading to double counting of effort.

The extent to which (a) and (b) may actually have been the case was not estimated, but can clearly be a problem in any landing-site-based data collection system. With regard to (a), major landing sites usually persist over many years, but small ones can come and go. In order to deal with this there need to be either regular frame surveys, or an ongoing system of acquiring, recording and adjusting for changes in landing sites. The latter approach is probably most appropriate for Suriname and will be elaborated upon later. Biases (b) and (c) are standard problems that can only be addressed by vigilance on the art of the data collectors and by the system manager. Clearly with regard to (b) accurate reporting by data collectors of time spent at landing sites is essential. With regard to (c) it was reported in the present mission that one company, SUJAFI, claims not to land any fish from their shrimp trawling operations. However, it is known that some fish are kept for sale by the crew. The extent of this problem is not known.

As pointed out in the review, finding and correcting type (d) errors is a tedious process that must be carried out after the data are entered, by looking for landing dates for the same vessel that are too close together to be different trips. The review did not report on the frequency of split landings. In order to assess how serious a problem they really are, it would be useful to have an estimate of the frequency of occurrence of split landings according to vessel type and landing site, and thence whether there is the need to make some provision for automating the process of detecting and correcting them.

Several years of data should be analysed to determine the extent of split landings by vessel and landing site to determine how serious a bias this is, and to make recommendations as to how to address the problem.

There are various ways of evaluating the above biases by analysing the data that have been collected. For example, because the boat registration number is recorded, the numbers of trips by individual boats can be examined. Where these seem to be low, landing at unmonitored sites, or outside the country, may be a problem. The 1992 review found that numbers of trips per vessel were low for SK boats. Where they are high, or where in the case of SK boats trips occur close together, split landings may be taking place. Individual cases can be followed-up to determine the cause.

There is the need for ongoing attention to data entry and exploratory analysis in order to detect and fix problems as soon as possible after they arise.

The 1992 review also addressed the problem of sampling error in the estimates of effort. Total landings per stratum are estimated from landings per unit effort and estimates of total effort. Total effort is estimated from observed effort by using an Effort Raising Factor (ERF). At several sites, generally the ones with the highest landings, there is supposed to be daily recording of effort. Thus the effort is a census and ERF = 1. However, there may be gaps at these sites, due to sickness, vacation or other causes of absence from work on the part of the data collector. Ideally, when long absences, i.e. due to vacation, are anticipated, alternative arrangements should be made. When the absences are short, or alternative arrangements are not possible, in order to obtain the most reasonable possible estimates of effort, the missing days must be filled in with

the most reasonable possible estimate of effort. This may be interpolated, or long-term averages used, or if there is seasonal variability, the averages from that period in other years may be used.

At other sites, effort data is collected on a sample of days only. The 1992 review noted that at some sites the ERF was high (ERF >10 indicates about 3 days observation in the month). For small sites, it may only be feasible to visit for a few days each month. At these sites, a high ERF is more acceptable because landings are relatively low. The data collection system manager must make the necessary judgements regarding the best deployment of the data collectors among sites to minimise these types of errors.

As stated above for biases, the reduction of sampling error for estimates of effort requires that the data collection manager monitor data collection activities on an ongoing basis. This can be partly through field visits, partly through data recording logs, and partly through regular preliminary analysis of the data after it has been entered.

The biases and errors that may affect a data collection system usually cannot be 'fixed' once and for all, they can only be managed and kept at an acceptable minimum by ongoing attention to the activities of data collectors and perusal of data for anomalies.

There is the need to establish an ongoing system of monitoring of the data collection system and review of its outputs in order that problems can be identified and rectified in a timely fashion.

2.4.4 Units of effort

The present situation regarding the recording of units of effort is as follows:

- Stern trawlers report days at sea and also hours towed,
- Shrimp and seabob vessels report the number of days at sea,
- For the snapper fleet, there is no information on effort, even at the level of days fished,
- For other gear, the number of days fishing is recorded for each trip, and there is information on numbers of nets size of boat etc.

In the analyses conducted to date, the fishing day has been the unit of effort that has been used. This is considered to be an adequate level of detail for the purposes of estimating overall landings, and for determining large-scale trends in catch rates.

If there is the need to engage in more detailed spatial studies of catch rates, then there may be the need to refine the units of effort to take account of differences in gear characteristics and fishing practices at a finer scale than daily. **Further consideration of refining the units of effort should be based on analysis of the existing data.** There should be exploratory studies using the existing data to determine the effects of these characteristics on catch rates. These studies would need to take into consideration the effects of season, fishing characteristics, type and quantity of gear deployed in a multivariate statistical analysis aimed at determining the effects of the factors and the interactions among them. This would be a special focussed study rather than an ongoing activity.

2.4.5 Is the present sampling approach appropriate?

The sampling approach developed for the FIS in 1990 was reviewed. It is a site based approach that aims to gather information on activity at sites and to raise the average lpue

estimates for the various types of vessel and gear by the amount of effort observed or estimated at the site. This approach was compared to the approach developed in 1998 for Guyana, where fisheries are very similar. The approach for Guyana is vessel/gear based. Estimates of lpue for the various vessel/gear combinations, and the proportion of these vessel gear types observed to be out fishing is used to estimate average catch per month per vessel/gear type. This is then multiplied by the number of each vessel/gear type at each landing site to obtain estimates of landings per vessel/gear type per landing site.

The Guyana approach was not considered appropriate for Suriname for two reasons. The first is that in Suriname, vessels do not tend to land consistently at the same landing site all the time, so it is not appropriate to assign each vessel to a landing site. The Paramaribo Central Market is a case in point. Many vessels land there, but none are based there. They are based at widely scattered locations along the river, often the owner's home. Therefore, it is not possible to determine the proportion of a particular boat type that is out fishing on a particular day. Boats may be absent because they are fishing, or because they are at a home base.

Another example is the Saramacca River Canal. At times, boats can get through to and land their fish at sites in Paramaribo. At other times they cannot, and land their catch at the sluis on the canal.

After reviewing the present approach to data collection in Suriname and that used in Guyana it was concluded that the former approach as described in the FIS was best suited to the characteristics of the Suriname fishery.

2.4.6 Revisions to the field collection system

Any proposed system of data collection and management must consider the availability of human resources. For the Suriname Fisheries Department, Fisheries Research and Statistics Section this information is summarised in Table 1. Note that many of the data collectors have functions other than data collection. For these functions they report to the head of the appropriate section of the Fisheries Department.

The revisions that are required to the field aspect of the fishery catch and effort data collection system in Suriname are essentially adjustments in the deployment of sampling activity of the data collectors. In considering this redeployment, there are, as indicated in Table 1, constraints regarding the distribution and roles of the individuals who will be carrying out the data collection. There are data collectors stationed at some locations, principally the central markets at Paramaribo and New Nickerie, who have other responsibilities that require them to be there. Consequently, they cannot be redeployed. Data collectors are also constrained to sample locations within the districts to which they have been assigned. Therefore, it is not possible to distribute sampling effort among sites in a manner that is entirely proportional to the numbers of vessels to be sampled. Note also that there are three data collection options for landing sites:

- Both effort and landings are sampled on specific days;
- Effort is censused on all days and landings are sampled on some days;
- Both effort and landings are censused on all days.

Table 1. Summary of the human resources available to the Fisheries Research and Statistics Section (HQ = headquarters in Paramaribo, MC = motorcycle)

Positions			Duties	Qualifications & experience	Location	Trans-port
Head -- Research & Statistics			Supervise overall operation of statistics & research	B.Sc. (equiv.) + 15 yrs exp.	HQ	3 boats 1 vehicle
	Head -- Statistics		Supervise overall operation of statistics & carry out analysis & reporting of information	B.Sc. (in prog.) + Data Management course + 2 yrs exp.	HQ	
		Assistant	Assist with analysis & data entry	2 yrs Univ. + 1 yr quality management course + 2 yrs exp.	HQ	
		Data collector Marowijne District	Collect catch & effort data Liaison with industry Licensing & registration Enforcement	?	Moengo - office	1 boat
		Data collectors Commewijne District	Collect catch & effort data (both) Liaison with industry Enforcement (senior one)	Senior - JH + Police training Junior - JH	Margarita - office	I boat 1 MC
		Data collectors Paramaribo District — Central Market	Collect catch & effort data Liaison with industry	All JH, 2 have police training	CM	
		Data collectors Paramaribo District — Other areas	Collect catch & effort data Biological sampling Liaison with industry	All JH, 1 has police training	HQ	3 MC
		Data collectors Saramacca District — Sarammaca R.	Collect catch & effort data Liaison with industry Licensing & registration	SR, JH, police training	Calcutta - home	1 boat
		Data collectors Saramacca District — Boskamp	Collect catch & effort data Liaison with industry Licensing & registration	Tech. Coll. = JH	Boskamp - office	
		Data collector Coronie District	Collect catch & effort data Liaison with industry Licensing & registration	JH	? - office	1 MC
		Data collectors Nickerie	Collect catch & effort data (Junior two) Liaison with industry Licensing & registration (Senior one)	2 persons, 1 Supervisor, 1 DC, 1 has JH	CM	1 boat
		Data entry/ laboratory assistants	Compile, screen & enter data from data collectors Assist with laboratory procedures for biological research	3 persons, all JH with 22, 20, 8 yrs experience	HQ	
	Head -- Research		Supervise research operations & carry out analysis & reporting of research	Same as overall head	HQ	
		Observers	Collect biological & statistical information on vessels	3 have JH (technical stream) & > 25 years exp. as crew in fishing industry. 1 has PR + 2 years exp.	HQ	

Which of these approaches is employed at a particular landing site depends on several factors: The available data collection capacity, the importance of the site, and whether the deployment of Fisheries Department staff at the site for other purposes allow either effort or landings to be censused.

When either effort or landings are to be sampled, there is the need to deploy the data collectors to the sites in approximate proportion to their importance, i.e. the levels of landing activity that take place at the sites, preferably on randomly selected days. In the absence of accurate information on the numbers of landings by various vessel types at the landing sites, the numbers of vessels known to operate there is the best guide to the levels of activity and thus the levels of data collection that would be appropriate. The landing site survey of 1995 is presently the best estimate of the numbers of vessels at landing sites.

The recommended approach to deploying the data collectors is described by means of an example in Tables 2 and 3 for the Paramaribo North area with five landing sites. Table 2 shows the distribution of boats among the sites (from Appendix 3) and the proportional distribution of the available 25 days of sampling time among the sites.

Table 2.Determining the frequency of sampling landing sites within the area covered by a data collector

Site	Boats present	Proportion of boats present	Days to be visited
Boomskreek	15	0.29	6
Sluis 2 (Pompgemaal)	25	0.48	11
Blauwgrond	8	0.15	3
Clevia	2	0.04	1
Ramadhin (bisoen)	10	0.19	4
Total	60	1.00	25

In Table 3, a field sampling schedule for the sites in Table 2 has been prepared for the month of March, 2001. There are two data collectors for the area; so two sites can be visited on any day. The schedule is prepared by writing the dates of all working days on bits of paper (twice for each date), placing them in a bag and drawing them at random. The table is filled in from the top left corner along each row to the bottom right corner. The process must be repeated for each sampling area throughout the country.

Table 3. Example for March 2001 of the method of assigning the dates for sampling within the area addressed in Table 2.

Site	Sample number											
	1	2	3	4	5	6	7	8	9	10	11	
Boomskreek	3	9	27	28	19	5						Dates on which sites are to be visited
Sluis 2 (Pompgemaal)	14	2	26	31	22	27	20	9	26	19	9	
Blauwgrond	16	22	20									
Clevia	15											
Ramadhin (bisoen)	13	20	23	21								

Clearly, there is some degree of subjectivity and expediency in the data collection program in the allocation and scheduling of sampling effort among landing sites, but the process described above should result in a reasonable allocation of sampling effort among sites, and in the sites being visited at random.

Data collection activity for all sites to be sampled should be programmed in advance for all regions for periods of 4-6 months using the method described above.

2.5 Estimation of bycatch and discards

Estimation of bycatch and discards is an issue for the offshore trawl fisheries for shrimp, seabob and finfish. It is also of concern for the for the estuarine Chinese seine fisheries and the njawarie fisheries. In the latter case, this gear will no longer be allowed within a year so there is no need to consider its further.

Collecting information on bycatch and discarding requires that either:

- Fishers collect and record the data;
- Fishers keep samples for later analysis by Fisheries Department, or that
- There be observers present during the sorting and discarding process of the fishery.

The latter option requires that the observers be out on the fishing vessels, or be in vessels that can access fishing locations. Placing observers on vessels, if even feasible, is costly and they can usually only be put in place for a small proportion of the total number of fishing trips.

An approach to the bycatch and discarding in the estuarine Chinese seine fisheries was described in the original sampling plan for the FIS (Mahon et al 1990a)(see also section 5 on Biological Data Collection). Data were collected for two years but not analysed. **The existing data on the bycatch and discards in the Chinese seine fishery should be analysed as a precursor to determining the need for further studies on bycatch.** These samples are from the Pomona area only. If the analysis shows that there is serious problem there, then a project should be carried out to examine bycatch and discarding from these gears in other areas where this gear is used, e.g. the Commewijne River, Boskamp, and Zeedijk. If, after those areas have been examined, an ongoing program of monitoring bycatch for these fisheries is considered to be necessary, it would have to be based on occasional sampling that would be used to estimate overall discarding. However, until the existing data have been analysed to assess the extent of the problem and its seasonal and spatial variability an ongoing sampling program cannot be properly designed.

The approach to assessing bycatch and discards in the industrial trawl fisheries has been to place observers on vessels. There are presently four observers (Table 1). An observer program has been in operation since 1993 and is described by Babb-Echteld et al (2000). The establishment and operation of observer programs has been an activity of the CFRAMP Shrimp and Groundfish Resource Assessment Unit, and Suriname has taken advantage of the information provided. Babb-Echteld et al (2000) provide an analysis of the data collected through 1999. **The information generated thus far by the observer program should be documented in the Suriname Fisheries Report series, and there should be regular reports each year on the results of the analyses of the data collected by the observers so that it can be available for management decision-making.**

The present observer program appears to be a good way of acquiring information on bycatch and discards in the offshore trawl fisheries and should be continued as planned.

3 REVIEW OF LICENSING AND REGISTRATION SYSTEM

3.1 The present system

Fishing vessels of all types have been registered annually since 1982. The system varies slightly depending on the vessel type.

3.1.1 Coastal (SK) vessels

- An application form is completed and brought to the Fisheries Department
- A member of staff from the Fisheries Department checks the vessel to ensure that the information on the registration form is correct.
- The applicant is sent to the Maritime Authority of Suriname (MAS) to register there
- MAS checks the vessel for compliance with safety requirements and issues a certificate of registration. if it is a new vessel, MAS assigns it a number..
- The applicant returns to the Fisheries Department with (a) the MAS certificate, (b) a tax clearance certificate, (c) proof of Surinamese citizenship, (d) birth certificate.
- If all is correct, a blue registration card is completed and filed. If there are any changes in information e.g. gear, engine, these are recorded.
- A license card is issued.

3.1.2 (BV) vessels

The procedure is approximately the same as described in section 3.1.1 above, except that:

- The information recorded differs for boats with fixed gear (Chinese seine) as a location must be assigned for each net;
- The license card is different.

3.1.3 Industrial vessels -- fish and shrimp trawlers

The procedure is similar to that described in section 3.1.1 above.

- The number of licenses to be issued each year is determined ahead of the licensing period, and requests for license applications are published.
- Application forms are completed (these different for shrimp and fish trawlers).
- The Fisheries Department indicates which vessels will be licensed.
- The certificate from MAS must be accompanied by a crew list.

3.1.4 Industrial vessels – snapper vessels

The licensing of the snapper vessels is facilitated by the Manager of CEVIHAS, who sends to the Fisheries Department a list of vessels that will be fishing in the current year. The present strategy is to provide provisional licenses only for periods of less than a year in order to promote better reporting of landings.

3.2 Proposed changes to the system

The review by McConney et al. (2001) addresses issues pertaining to inspection, safety equipment, etc. That review suggest that closer integration of the Fisheries Department and MAS systems, including databases would be desirable and could be more efficient that the present dual system. That review also addresses the need for training in vessel inspection. In this review, only matters pertaining to data and information acquisition and handling are considered.

The variables that are presently recorded are shown on the registration forms (is it really necessary to include these in this report?. There are also some additional variables for which information should be recorded at the time of registration. These relate to the requirements of the Fish Stocks Agreement as recommended by McConney et al (2001).

There is potential for increased efficiency in the registration and licensing process through integration and computerisation. Ideally, the licensing and registration process for all vessels could be combined into a single activity with the information being entered into a single database. One of the savings in efficiency would be to reduce the number of occasions on which the information is transcribed; thus saving time and reducing the potential for errors. The database should be set up so that it can so that it can be used by more than one user at a time over a network, even if the networking hardware and capability is not immediately available. The database that will contain the licensing and registration data should be structured so as to include the information that is presently collected on the licensing forms. The system could work as follows:

- On receipt of an application, a registration clerk would enter into the system via a screen entry form appropriate to the vessel type the data provided either verbally from the applicant or on an application form;
- An application form would be printed out in duplicate, one for the applicant to check for accuracy, the other for the Fisheries Department to use in inspecting the vessel;
- On return from MAS, fields indicating that the required certificates had been provided would be filled in and the license issued and printed by the system;
- A hard copy registration form, similar to the present blue card would be printed from the system and kept in a file as is currently done (this is desirable for quick manual checks and when the system is unavailable).

The tasks that will be required to establish this system include:

- Designing the system to be used including the database structure, entry forms for vessels, and output forms for application form;
- Selecting an appropriate software program. Given the simple form of the data, a hierarchical database structure may not be necessary. However, if database software with that capacity is acquired for use in the catch and effort database, the same software could be used for registration with only a single table structure;
- Setting up and testing the database in the selected software;
- Training staff in the use of the software.

It would be desirable to put the historical registration data into the new database. This would facilitate tracking the history of individual vessels, and of the fleet overall. However, depending on availability of human resources, this activity could be scheduled over a period of several ears working backwards from the present.

The vessel registration system should be computerised to make the registration procedure more efficient and accurate, and to make the data more readily available.

4 REVIEW OF SOCIAL AND ECONOMIC DATA COLLECTION

4.1 Economic data

Two types of economic data are generally of interest in fisheries management. The first is the prices of fish at the landing site and at each subsequent stage in the chain of sale through to the consumer or the export price. This information, together with information on the quantities of fish and fish products moving along various pathways is necessary in order to determine the total landed value of the fishery and the value added by processing and distribution.

A simple approach to this is to construct diagrams showing the paths along which fish and fishery products move from the fisher to the consumer or point of export. This was done during the design of the FIS and they are shown in Mahon et al (1990a). Systems can then be put in place to acquire information on quantity and unit price for each path segment. This organisational tool extends the collection of data from just the harvest sector to the entire industry. Different types of information gathering tools can be applied to different pathways as appropriate (Mahon 1991).

This approach was included in the original design of the FIS and the data were collected for a period of two years. Subsequently, collection of data on landed prices has continued only at major markets. If an estimate of the total value of the fishery, including value added is desired, the data already available could be analysed to determine if the proposed data collection system worked and to get information on the flows of fish along various pathways. It may not be feasible or necessary to attempt to collect this information in full every year. If the total landings are known, and the proportions and incremental value of fish moving along various pathways has been previously determined, estimates of total value can be made. The proportions on the various pathways can be checked at intervals of several years, and the incremental values can be checked from time to time to maintain the validity of the system. This is a minimal approach to obtaining an estimate of the gross value of the outputs of the industry. If a more detailed analysis including the value of associated activities such as boat building, gear construction, etc. is desired, it would have to be structured as a special program and would require the input of an economist.

The second type of economic data that is commonly desired for management is the economic efficiency of the various types of vessels in the fleet. This type of information is usually acquired through special focused studies that quantify the costs of operation and the value of the outputs over a period of at least a year. These studies can be used to determine the direction of fleet development in preference of the most efficient vessels, with due consideration to the social implications of fleet management. They can also be used to estimate the total cost of inputs to the industry and thence, by subtraction from the gross value of outputs, to assess the net value of the industry. However, this information is not usually included in ongoing data collection activities and if desired, the studies to acquire the data should be designed by an economist or financial analyst. No information of this type is presently available at the Fisheries Department.

Apart from routine collection of price data on a weekly basis at major landing sites, the acquisition of economic data should be designed to meet specific needs until the requirements of an ongoing economics data collection system can, if needed, be determined.

4.2 Sociological information

The Fisheries Department does not have any program for routine collection of sociological information. The vessel registration forms do include some information on the applicants. There is a wide variety of sociological information that can be directly or incidentally useful in managing fisheries. For example, demographic information can be used to project the future makeup of the fishery workforce and thus to plan for recruitment and training, or information on familial and institutional arrangements among fishers can be used to assess the impacts of proposed management measures.

These data are usually acquired through special studies rather than from ongoing data collection. They are usually costly to acquire, and there should be a clear and definable need for the information before studies to collect it are put in place.

In order to develop a database on the demographics and other characteristics of persons involved in the fishing industry, the Fisheries Department could explore the possibility of including fisheries questions on the national census.

A considerable amount of information on fishers and their communities may, however, be acquired by Fisheries Department staff as the going about their routine activities. This information should be documented and compiled in such a way as to be usable by decision makers. An approach to this will be discussed below under data management.

The acquisition of sociological data should be designed to meet specific needs until the requirements of an ongoing data collection system can, if needed, be determined.

5 REVIEW OF BIOLOGICAL DATA COLLECTION

Biological data are a basic requirement for assessing the potential of fishery stocks to produce a sustainable yield, and their status relative to that potential. In determining what data are required, it is first desirable to determine how the fishery will be managed. More specifically, there should be agreement on what reference variables will be used to set management targets and what control measures will be used to achieve the targets. This will determine the assessment model to be used, if any, and in turn the data required for that model. For example, if size limits (directly or via a gear characteristic such as mesh size) will be used to protect immature individuals, then data on maturity at size are the main requirement. These requirements should be clearly stated in the Fisheries Management Plan. It is not uncommon for data to be collected without a clear view of how it will be used. That often wastes time and money and frustrates everyone involved.

5.1 Overview of biological sampling

The initial FIS included the collection of certain biological data (Mahon et al.1990b), including:

- Sub-sampling to determine species composition in bycatch or when catch was recorded in aggregate groups (estuarine fykes, snapper, shrimp trawl landed bycatch;
- Finfish length frequencies (coastal fishery, snapper);
- Species composition, sex and length for offshore shrimp.

The species composition of the catch and discards in the estuarine fyke net fishery was sampled for two years (1991 and 1992) and the data recorded but not analysed. No data on length frequency and species composition were collected in the snapper fishery

The length frequency data for the eight finfish species from the coastal fishery listed by Mahon et al (1990a) were collected for two years (1991 and 1992). Length frequency data were also collected from the offshore trawl landed bycatch. These data have not been analysed. There was no sampling of finfish lengths in 1994 and 1995. During this period sampling focused on offshore shrimp. Finfish sampling resumed in 1996, but was carried out mainly by observers on trawlers. Target and discarded species were measured. There was no sampling of the artisanal fleet. In 2000 there was a three-month (mid-January to mid-April) special study of length frequencies for large demersal finfish at one processor. The whole catch of the vessel was measured. These fish had been gutted at sea, so there were no data on sex and maturity.

Seabob biological samples, primarily (cephalothorax) length frequencies are taken by the observer program. This sampling was started in 1998.

Shrimp are marketed in two forms, heads-on and heads-off in various size categories. These must be sampled in order to convert the weight by market category into numbers of individuals caught by species, sex and maturity stage. In the early 1980s there was period of a few years sampling at the processor. Sampling started again for 1991-1993, stopped for four years and restarted in 1998. Sampling is presently carried out at SAIL and SUJAFI companies 1 and 2.

Shrimps have been the primary focus of the WECAFC Ad Hoc Shrimp and Groundfish Working Group of the Guianas-Brazil Continental Shelf since its first meeting in 1986[1]. The activities of this Working Group have guided the sampling program for shrimp in Suriname. A review of the adequacy of biological sampling for shrimp would therefore require a thorough review of the objectives and outputs of the program of the WECAFC WG, and the extent to which the sampling has, or is likely to lead to the attainment of those objectives. That review is beyond the scope of this consultancy, and is scheduled for a WECAFC meeting of Ministers and Managers for the Working Group in Trinidad, March 26-29, 2001.

It is nonetheless possible to note that the FMP for penaeid shrimps outlines the most pressing problems for these resources, most of which could apparently be addressed with existing information. The plan indicates the need for growth and other population parameters for cohort analysis, but does not make clear how these analyses will be used in making decisions regarding the actions that are required to address the issues that are outlined.

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[1] The WECAFC WG was recommended by the fourth sesion of WECAFC , Colombia, 1984. It has met in 1986 in Miami, 1988 in Cayenne, 1992 in Paramaribo, Port of Spain in 1996,

5.2 Conclusions on biological sampling

There has been intermittent biological sampling of various species and species groups. Most of this sampling falls into the category of special project activities rather than ongoing sampling. Some of the data collected remain to be analysed. Some analyses have been carried out and have resulted in various reports. The majority of these are documented in the reports of the WECAFC Guianas-Brazil Working Group and CFRAMP Shrimp and Groundfish Subproject. However, there is also a number of studies and analyses that have been documented in various internal reports. These have not been organised or integrated into a comprehensive body of information on the fisheries of Suriname. Compiling this information and/or providing. a thorough analysis of the quality and/or usefulness of these analyses is outside the scope of the present consultancy.

There is the need for a thorough compilation and review of the data that have been collected thus far, the analyses that have been carried out and the advice that has been generated. This should be done for each Management Unit in the draft FMP. These compilations would provide the supporting technical information for the FMP.

Compilation of supporting technical information for the Management Units of the FMP should include reviews of studies on the same species carried out in neighbouring countries. For example, the findings of Caribbean red snapper assessments carried out in French Guiana (Perodue 1994) and Brazil, might be an adequate starting point for management, depending on the management regime that is feasible.

Biological sampling aimed at addressing specific questions, and thus carried out as discrete projects is an appropriate way to build up a body of knowledge on the fisheries of Suriname. Such projects should be formulated to address specific questions, carried out in a discrete time-frame and documented, including the advice that results from the findings.

In contrast, ongoing biological sampling would be carried out on a continuous, indefinite basis to meet the demands of a clearly specified management model or process. How the data would be used each year (or whatever time interval is appropriate) would be known in advance, and at the appropriate time, the analyses would be run, the results generated and the management advice provided.

Thus the biological sampling needs for a management unit could be a combination of special projects and ongoing sampling. The present FMP identifies a wide range of needs for biological information for the major species, but does not specify the management framework within which the information will be used. As such, it is a useful compendium of possible analyses. However, the human resources needed to address the data collection and analysis needs implied in the FMP would greatly exceed those available; possibly by an order of magnitude. Therefore, for each management unit, there is the need to be very specific about how the research outputs will be used in management, then to prioritise the outputs that are needed. This exercise will be the objective of other components of the ICRAFDP. Therefore, this report will not attempt to further develop the FMP-based requirements for biological sampling. However, the following example based on the FMP for the Large Demersal Fish exemplifies the present lack of clarity in the FMP as a guide to the problems of determining the data that are required from the present FMP.

The FMP states that the objective for the Large Demersal Fish management unit should be MEY rather than MSY (notwithstanding that MSY should be a limit rather than a target). It

does not say how MEY should be estimated. It does, however, conclude that a reduction in effort is needed. Thus it identifies a Management Reference Direction rather than a Target Reference Point (Berkes et al 2001). The question of how to determine when the MEY is reached is not addressed. This can be determined in a variety of ways that may require different data. At the same time however, the plan identifies seven areas for research:

- Catch and effort data,
- Impact of trawler fleets on juveniles,
- Selectivity studies to determine optimum mesh size,
- Species distributions and movements by area and depth,
- Studies on recruitment,
- Local growth and mortality,
- Economic data.

Addressing these research requirements for the 4-5 species in this management unit alone would require a data gathering and analysis exercise that would far exceed the present human resources of the Fisheries Department, particularly in analysis. Unless considerably greater detail is provided regarding the purpose of these various research areas, and how the outputs will be used in management, a biological data collection system to address these areas could result in the collection of great deal of data that would never be used for management.

In order to determine the biological sampling needs for the various species, there is the need to first clarify the management approaches and measures that will be used for each management unit and the role that the population analyses will play in management decision-making.

6 DATA MANAGEMENT AND ANALYSIS

The two major aims of the catch and effort data collection and management system are to:

- Provide reports of monthly landings by landings site, vessel type, gear type and species, and;
- Provide indices of abundance for the major species in the various management units.

The reports should be prepared at least quarterly, with an overall annual report at the end of each year. In this section the treatment of the data that have already been collected is considered first. Then the treatment of new data is considered. Finally a variety of data collection and management issues are addressed.

6.1 Catch and effort data

6.1.1 Past data 1991-2000

The catch and effort data that have been collected under the FIS and subsequently are in a variety of formats (see section 2.1). The data for recent years are presently in Excel sheets in the form specified by the FIS project. The procedure for providing estimates and reports will be the same as described in the report by Mahon et al (1990b). However, there are several options for the practical aspects of how these data will be handled and how estimates and reports will be

made from them. These options apply also to how the new data will be handled, and will be referred to in the discussion of that issue in the next section.

Option 1: Keep the data in Excel and carry out the estimates manually in Excel through a series of steps that can be specified.

Option 2: Keep the data in Excel and program the procedure through a series of macros.

Option 3: Keep the data in Excel and export it to SPSS where the procedure can be programmed into SPSS syntax and run.

Option 4: Create a new database structure in a software program that will be the main data management software used by the Fisheries department and export to SPSS for analysis as in option 3 above.

Option 5: Same as option 4 above, but use the system to produce the reports

Regardless to the option, the past data (1991-2000) will have to be reformatted. The format should be compatible with that which will be used to enter the data that will be collected in the future.

The request that the estimation of landings and landings per unit effort be explored using the existing data was addressed. The data for 1998 were in 14 Excel workbooks with 12 worksheets each for the months of the year. In each worksheet, samples were in columns and details of the vessel, gear and catch were in rows. The procedure used was to create a single Excel spreadsheet with the details of the vessel, gear and catch and columns or variable, and the samples as rows or cases. Additional variables were introduced to identify each sample as to location and date. The spreadsheet thus created was imported into the software package Statistical Package for the Social Sciences (SPSS) within which the analysis was carried out.

The estimation of landings per unit effort (lpue) for various boat and gear types proved to be relatively straightforward. The results of this analysis are presented in Table 4. When compared to similar estimates for 1991, the findings indicate substantial declines in lpue for most vessel and gear that target marine finfish (in bold). For example, the average landing per day for decked Guyana vessels fishing drift nets declined from 268 kg in 1991 to 98 kg in 1998. If the differences in lpue between 1991 and 1998 are an accurate reflection of changes in the stock biomass over that period, and Charlier's 1993 assessment that the stocks of inshore demersal finfish were being fully exploited in the early 1990s is correct, then serious depletion of these resources has occurred over the past seven years.

Table 4. Comparison of lpue (landings in kg/day) by boat and gear type between 1991 (Charlier 1993) and 1998 (this project).

Boat type	Gear	Trips in 1998	LPUE 1998 (kg/day)		Mean LPUE 1991
			SD	Mean	
Guyana -- decked	Driftnet	105	87	**98**	**268**
Guyana -- open	Driftnet	842	65	**76**	**120**
	Njawarie	364	107	126	92
Korjal	Driftnet	1,471	82	**71**	**139**
	Large fyke	1,294	74	**27**	**128**
	Medium fyke	1,037	54	137	62
	Small fyke	3,466	107	98	51
	KI	1,981	64	55	50
	Longline	219	96	124	88
	Njawarie	7	243	170	?

In contrast, catch rates have increased for several vessel gear combinations that exploit primarily freshwater fishes. There is no obvious explanation for this increase. Changes in gear and fishing characteristics may have occurred.

The above analysis indicates that there is considerable merit in further analysing the existing catch and effort data with a view to determining if there are trends of declining lpue that is consistent with the observed differences in lpue between 1991 and 1998. More detailed analysis may also reveal geographical differences in rates of change in biomass and thus differences in impact among areas. Trends may also emerge for freshwater resources. The preparation and analysis of this data will require a substantial commitment of time on the part of Fisheries Department staff and will probably require assistance from an expert who is familiar with these sorts of analyses.

The existing catch and effort data for the period 1991-2000 should be examined for trends in landings per unit effort by vessel and gear type and to the extent possible by geographical area.

The catch and effort data should also be useful for estimating total landings by vessel category and landing site provided that the sampling was carried out in such a way that the necessary information is available for raising the average lpue to totals. Table 5 shows the distribution of samples among landing sites for 1998. Relatively few sites were sampled, but in most cases they were major sites. It is important to bear in mind that even if the sampling program was followed rigorously, the aim would be to have an adequate number of samples within strata, and that not all sites would necessarily be sampled. There are also substantial gaps in the months during which data were collected at some sites. For example, at Zeedijk there are data for only January to March. In order to estimate total landings from this sampling coverage it will be necessary to extrapolate from the existing data to missing sites and months. This requires that assumptions be made about levels of fishing activity at unsampled sites and about the catch rates in the areas fished by vessels from those sites.

Table 5. the numbers of trips sampled per month per landing site in 1998

Landing site	Month												Total
	J	F	M	A	M	J	J	A	S	O	N	D	
Paramaribo/CM	470	477	450	482	569	436	525	579	553	497	428	460	5,926
Paramaribo Zuid				2	8	4		2	11	11			38
Sluis/Boomskreek	7	22		43	23				39	37	25		196
Margareta/Comm.	24	30	23	42	81	92	126	107	90	95	60	87	857
R&W/Recht. Comm.	146	125	249	199	190	181	193	196	47	120	329	384	2,359
Pomona	108	90	126			114	102	138	156	138	84	156	1,212
Saramacca/Calcutta				15	21	27	23	21	21	9	9		146
Boskamp	233	253	147	43	23	178	239	332	329		112	128	2,017
Coronie-Totness	15	41	49	43	34	22	20	51	18	22	14		329
Zeedijk Nickerie	56	201	8										265
Moengo/Cottica			4	14	18	9							45
Total	1,059	1,239	1,056	883	967	1,063	1,228	1,426	1,264	929	1,061	1,215	13,390

Whereas, more comprehensive coverage of landing sites would clearly be desirable, the fact that several major sites are well covered probably means that the data can still be used to derive reasonable estimates of landings for the country. At least, in reporting the estimates,

distinction can be made between the amount of landing estimated at sampled sites and the amount coming from unsampled sites. If the former proportion is relatively high, as can be expected, then the estimates may be a reasonable reflection of the real situation.

During the mission, a procedure was worked out for estimating national landings using the existing catch and effort data summarised in Table 5 and the 1995 landing site survey information on the numbers of vessels at landing sites. The procedure was developed for use in SPSS and the commands were saved in SPSS syntax files so that they could be run again later when the data have been edited and for other years. The commands files can also be modified if necessary. This procedure was developed and tested in collaboration with the head of the Statistics Section whose responsibility is to provide reports on landings and lpue.

The procedure, including the SPSS syntax required is provided in Appendix 5. The actual digital file was provided to the Fisheries Department at the end of the consultancy mission. The procedure was run using the 1998 data, but the results are not provided in this report because they were considered to be too preliminary for inclusion. In preparing the data for the run, numerous data quality problems were encountered. The majority of these were data entry errors. For example, codes were not used consistently in entering the data. This can be corrected manually by sorting screening, searching and replacing etc. in SPSS. Other problems require hands-on case-by-case scrutiny of the data. Finding and fixing these types of errors would normally take place during routine data screening procedures if the data were being used on a regular basis.

The preliminary analysis of the catch and effort data file for 1998 s indicate that it should be possible to use the existing data to generate estimates of landings for the years for which data are available. This will require a considerable investment on the part of Fisheries Department staff in editing and analysing the data, and may require occasional inputs from an expert familiar with the estimation of small-scale fishery landings.

The existing data on landings per unit effort should be edited, compiled and used to prepare a time series of landings by vessel and gear for the landings sites and regions of the country.

6.1.2 Future data management system

There is the need to develop a database system for the catch and effort data that will be collected in future. This should also be designed to accommodate past data, once those data have been edited, so that the entire time-series is in a single system. The required system will be very similar to the one that was designed for the FIS in 1990. It will require several types of tables and data entry forms for the various types of data that will be entered into each table. A question that must be answered at an early stages is whether the system should be developed purely as a data entry, storage and export system, or whether it should have the capability of generating reports of landings by performing the calculations necessary to raise estimates of lpue to estimates of landings. Therefore, the list of options for data handling and analysis provided at the beginning of the previous section must be reviewed and an option selected.

The option that is selected is partly a matter of preference on the part of the Fisheries Department, but also has technical implications. If the calculations and raising are done manually in a spreadsheet package such as Excel, or through a series of pre-programmed steps in a statistical package such as SPSS, the operator is required to understand the procedure and can monitor the intermediate outputs along the way. This makes it easier to detect problems, and it

also makes it easier for the operator to modify the system to respond to changes in the fishery. It also means that the operator will be more readily able to address demands for non-standard analyses. It could also be argued that the operator could as easily learn to carry out the steps in the data management software, which it assumed will be either Microsoft Access or Microsoft SQL Server. However, if the data management software does not have the capacity for analysis other than direct estimation and reporting, then the operator will have to be familiar with both the database system software and the analysis software.

Regardless what option is selected, there system must be thoroughly documented so that it can be adapted to changes that may take place, and so that a new operator/manager can become familiar with the system by using the documentation. Matters of process and data inventory are also relevant here and will be discussed in a subsequent section.

As a caveat, in establishing the new system it should be noted that what is being proposed here is virtually identical in principle to what was proposed and implemented in 1991 for the FIS. At that time, the system was designed using a standard database software package (dBase IV) and a commercially available front end (Clipper). The system failed due to over-reliance on a single operator and inadequate documentation. Unless steps are taken to ensure that this does not happen again, the problem could as easily recur with the new system, as it did with the old one.

The differences between the old system and new one will be primarily in the details of species codes, assignment of landing sites to strata, etc., not in the fundamental structure. Therefore, the structure of the original FIS database tables is reproduced in Appendix 6, with notes on differences that may occur. In order to implement the system in a new software program, there will be the need for the programmer assigned to the task to become familiar with the original system and the ways that it handled the data as documented by Mahon et al (1990a, 1990b). This can either be replicated in the new system or aspects of the programming improved upon to take advantage of advances in software capability using the features of the new system to achieve the same result more efficiently.

A new database system should be programmed, based upon the original FIS system to accommodate catch, effort, price, export data and fishery products and to produce basic reports and data outputs from these data.

In setting up the new system the programmer should be particularly mindful of the need for Suriname Fisheries Department staff to be able to manage the system. The programmer must provide clear documentation of how the system carries out any calculations that it does, and also of how to adapt the system to changes that may take place in the fishery. The changes that are most likely are the addition of new codes (vessel an gear types, landing sites, species, products) and the restratification of the landing sites.

6.2 Licensing and registration system

The revision and computerisation of the vessel registration system has already been described in Section 3.2 above.

6.3 Social and economic

In developing the database for catch and effort data, a table should be included for recording price data by year, month, landings site and species as per Appendix 6. Otherwise,

until the requirements for ongoing collection of social and economic data are specified, any sociological and economic data would be project-based and should be compiled as discrete entities that are documented and archived after analysis and reporting are completed. These special data sets should be included in the data management inventory described below.

6.4 Biological data

Until the requirements for ongoing collection of biological data beyond catch data are specified, these data would be project-based and should be compiled as discrete entities that are documented and archived after analysis and reporting are completed. These data sets should be included in the data management inventory described below.

6.5 Other kinds of data

Catch/effort and vessel registration data are only part, albeit an important part, of a comprehensive data and information system needed to support the mandate of the Fisheries Department for management and develop of fisheries in Suriname. There is a variety of other kinds of information that should be acquired, compiled, synthesised stored managed and made available on demand for decision-making. Several of these have been discussed in specific sections above (biological, economic, sociological data). Three other kinds of information will be addressed here:

- Landing site information;
- Local or traditional ecological knowledge;
- Bibliographic information.

6.5.1 Landing site information

There should be a system that includes information on landing sites. This could be a computerised system of tables, but should also include a hard copy filing system with a separate folder per landing site. As Fisheries Department staff go about their duties, they should be tasked with recording any new information about landing sites that they encounter incidentally, and should be encouraged to make enquiries to this effect. Their findings should be recorded in writing as notes and inserted into the appropriate folder. Periodically, perhaps once a year when the data collection system is up for review, these files should be reviewed and the system updated from the notes that have accumulated over the year. In that way, the Fisheries Department can stay abreast of changes in the landing sites without expending a large effort on a landing site survey.

The results of the 1995 landing site survey provide a good starting point for the landing site information system.

There should be a landing site information system and an ongoing process to acquire and compile incidental data on landing sites.

6.5.2 Local or traditional ecological knowledge;

The value of the ecological knowledge of fishers and others associated with the fishing industry is becoming increasingly recognised by fishery mangers. It is referred to as Local

Ecological Knowledge (LEK) or if handed down for generations, as Traditional Ecological Knowledge (TEK). A comprehensive fishery information system would seek to acquire as much LEK and TEK as possible. This can be done through specific studies, but these are time consuming. Alternatively, as Fisheries Department staff go about their duties, they should be encouraged to seek and record any such information. Exchanges oriented towards acquiring TEK and LEK are also good bases for interaction with fishers. As for the landing site system described above, a file folder system could be set up to accommodate LEK/TEK. The files could be arranged by species or other topics, and notes placed in the file. Periodically, the files could be reviewed and the information synthesised. When sufficient information was acquired on a particular topic or species, a report could be prepared.

There should be an ongoing system to acquire and compile incidental data on Local and Traditional Ecological Knowledge.

6.5.3 Bibliographic information

A wide variety of bibliographic information is relevant to the management of fisheries. This includes reports produced by the Fisheries Department itself, consultant reports, materials produces by organisations such as FAO, conference proceedings, journal articles, etc. There is a considerable amount of information on similar fisheries in neighbouring countries or other regions of the world that can be great value in informing fishery management decision-making in Suriname, e.g. the study cited for snapper in French Guiana under the discussion of biological data collection. Efforts should be made to compile and become familiar with this information. Many of the documents and papers are readily available on request.

The Fisheries Department already has a library with a considerable quantity of useful material. References from this library and for the above-mentioned material this material could be accommodated in a single computerised bibliographic system. There are several off-the-shelf software packages that allow easy storage, search and retrieval of bibliographic information. One with which the consultant is familiar, Reference Manager[2], allows for a wide variety of information types, including maps and photographs. This or a similar package should be used to organise bibliographic information that is relevant to Suriname fisheries. It should be possible to quickly retrieve information and to produces bibliographies on topics of concern.

A computerised system should be put in place for bibliographic information.

Clearly, the computerisation of the fisheries library would be a substantial task, and it is not proposed that this be undertaken as a matter of priority. However, it is proposed that a computerised bibliographic system be established and that new materials be entered into it as they are acquired. Since many of these will be reprints, a physical reprint storage system will be necessary if they are to easily accessible.

6.6 Integration and management

Ready access to up-to-date information of all sorts is considered to be the foundation of informed fishery management decision-making. To achieve this, Fisheries Department to

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[2] Research and Information Syatems, 2355 Camina Vida Roble,Carlsbad, CA 92009 USA sales@risinc.com or www.risinc.com

integrate the management and reporting for the variety of types of information that are required for fishery management. All the data and information elements discussed in this report should be seen as a single system with the purpose of supporting fishery management decision-making (Table 6).

There should be an overall document that described the fishery data and information system, its various elements, how data are to be acquired, managed, retrieved and disseminated. The document should describe the frequency and timing of updates and revision to the system. For example, in the case of the catch and effort component, there should be monthly monitoring of the return of forms, and quality checks on the data on those forms, there should be quarterly reports from the system, and an annual review and revision of the system that examines changes in gear, landing sites, stratification, distribution of vessel, etc.

Responsibility for the maintenance of this overall system should be clearly delegated to a senior individual, and that individual should delegate responsibility for subcomponents. There should be an annual report on the status of data and information pertaining to the fisheries of Suriname. There would also be an inventory of the various types of data that were included in the overall system, so that all users could access information quickly and be sure that nothing of importance was being missed. This inventory would include a brief description of all special datasets, e.g. biological data collected for a particular study, and where it is archived.

This report provides a starting point for the preparation of the document that describes the contents and procedures for overall "Fishery Data and Information Management System for Suriname".

Table 6. An overview of the data and information elements for fisheries management addressed in the present report

Data/information	Purpose	Data management
Catch and effort data	Monitor trends in abundance, estimate landings by various fisheries, areas and fleet components	Trip Interview Program (TIP) or similar database system >> regular reports
Biological data	To address specific data requirements of the management plan by proving input to models	TIP or purpose specific data sets >> specific assessments of fisheries as required by the FMP
LEK/TEK	As for biological data above, as a cross check to biological data and models, and to provide general qualitative knowledge of resources in support of management	File folder system with notes >> computer text file >> synthesised reports on specific topics
Landing site information	To understand the field situation as a context for fisheries management, and the need for development and upgrading to provide safe, sanitary and convenient working conditions for fishers and other industry participants	File folder system with notes >> computer text file >> annual reports on landing sites
Vessel information	To provide a basis for assessing fishing effort and capacity, and to track developments in the fleet.	Licensing and Registration System (LRS) >> annual reports on the fleet and fishing capacity
Bibliographic information	To provide a local, regional and international information context for all aspects of fisheries management and development	Bibliographic management system >> extracted bibliographies on specific topics as required
Prices	To track the performance of the fishing industry, including estimation of the total value of landings and value added.	

There is the need for a comprehensive overall documented scheme for the management of fishery data and information for Suriname that incorporates all the various kinds of data identified in this report.

If resources should become available in the future, it is desirable to link the system described with a Geographical Information System, so that all aspects of data and information that can be spatially referenced can be used for mapping. Once the resources are available and the use of GIS direction is adopted, there would be the need to plan the system. An example of the first steps in that process, as developed for Jamaica, is provided by Mahon et al (1999).

6.7 Analyses and outputs

Outputs should focus at first on regular standard reporting of basic information on landings, catch rates, trends in the fisheries. The reporting intervals will vary according to the subject. For landings, quarterly reports are desirable. For many other topics annual reports are appropriate. These could be combined into a single annual report on the fisheries.

Beyond standard reporting, there is the need to focus on basic exploratory analysis of the data on the fisheries of Suriname. This should include a significant descriptive component. In the absence of capacity to carry out sophisticated technical stock assessment and bioeconomic analyses, basic information on trends in the landings, catch rates, fleet, landing sites, prices, exports, etc. of fishing industry are essential for informed decision making. See Section 7.8 below for the relationship of these activities to staffing levels in the Suriname Fisheries Department.

The Statistical Package for the Social Sciences (SPSS) appears to be the data analysis package of choice for the Suriname Fisheries Department. Staff members there are already experienced in the use of this software, and other institutions in Suriname have users who are well versed in SPSS and can provide assistance. However, the Fisheries Department does not have its own copy of SPSS.

The Fisheries Department of Suriname should be provided with its own copy of The Statistical Package for the Social Sciences (SPSS) software.

The production of miscellaneous reports in diverse formats that do not belong to a series generally leads to the loss of the information when staff leave or simply after a period of time. Reports that are produced should be in the Fisheries Department Report series, and catalogued in the bibliographic database. This does not require a major commitment to report production and copying. Reports can be reproduced on demand while only one or two hard copies are held in a secure location. If desired, a second series for lesser reports, possibly entitled, Suriname Fisheries Department Research Documents could be initiated, and the Report series left for more substantial outputs. Even reports that are published in meeting proceedings, e.g. FAO Fishery Reports of WECAFC meetings, CFRAMP Workshops, should be given a series cover and placed in the appropriate series (numerous copies do not have to be made). That way, all the outputs of the Fisheries Department will be in the series and can be easily accessed and reviewed.

6.8 Adequacy of human resources for data collection management and analysis

The availability of human resources for fishery data collection and analysis in the Suriname Fisheries Department is summarised in Table 1. The numbers of individuals available for data collection appear to be more than adequate. At some landing sites, effort is being collected by census when sampling would be adequate. However, owing to the multiple responsibilities of the persons collecting data they are also required to be at the landing sites for other purposes. Therefore, there does not appear to be much opportunity to shift effort away from data collection into other activities. Furthermore, if the Fisheries Department desires to expand the data collection system to include export data, and data from secondary transactions in fishery products as originally planned for the FIS, these data collectors will be needed to obtain those data.

The area of weakness regarding human resources is in the area of analysis and reporting. The number of staff available for these activities is not sufficient to support an extensive and active research program. The management of an ongoing data collection program such as has been described in this document, and the preparation of regular reports on amounts and trends in landings and landings per unit effort, fleet activities and changes, observer activities and findings, landing sites changes, etc., will leave little additional time for special research

activities, such as the stock assessments that have been promoted by the WECAFC Ad Hoc Working Party on Guianas-Brazil Shrimp and Groundfish. Indeed, it may be the case that the demands of the activities of that WG that have diverted staff away from the routine, but essential information management and generation activities needed in support of fisheries management decision-making.

The priorities for the activities of these staff members should be determined by the requirements of the fisheries management plan for information. In turn, the plan should be geared towards approaches that can be sustained by the levels of staffing that are available. If management in based on complex models and analyses that cannot be supported by present numbers of staff or their levels of training, management failure is assured. Even worse, when, as may have been the case in the years following he establishment of the FIS, staff devote time to these activities at the expense of ongoing information systems, the basic information needs of management are compromised. Guidance with regard to establishing management framework that is appropriate for small-scale fisheries in developing countries is available in Berkes et al (2001).

There is the need to establish priorities for the staff with responsibility for data collection, management and analysis so that the maintenance of a functional, ongoing system for provision of information for management decision-making can be assured. These priorities should flow from the management plan, which should be realistic in terms of staff capabilities and numbers.

Staff with primary responsibility for managing data collection systems, and for analysing and reporting data, generally require training at the graduate level, where the emphasis is on research. Training can be acquired on the job through participation in workshops and self-guided study, but usually lacks the theoretical basis required to fully understand the procedures and methodologies. If the Fisheries Department wishes to have the capacity to manage its own data collection systems and to carry out the basic analyses required in support of fisheries decision-making, it should seek to upgrade the qualifications of the staff in charge of the research and statistics sections to MSc level. This discussion does not address the requirement for staff with the capability to carry out stock assessment analyses. This requires specialised training over and above that described here.

7 SUMMARY OF RECOMMENDATIONS

In general the conclusion of this consultancy is that the collection system for catch and effort data in Suriname, is fundamentally sound, but has suffered from a lack of coordination and management over the years. This appears to be due to the absence of a comprehensively conceived data and information system for fisheries that is driven by the need for information for management decision-making. That in turn should be determined by the management approaches described in the resource specific management plans, and by overarching information needs for strategic planning of fisheries.

Data collection and management activities have suffered from a lack of coordination and have tended to be reactive to the demands of external programs. Ideally, there should be an overall, comprehensive data and information system that meets the Departmental needs on an ongoing basis. Special activities and projects should not be undertaken at the expense of that system.

Following is a list of the main recommendations. These have been extracted from the preceding text where they have been previously presented in bold type.

1. It is recommended that the 1995 landing site survey data be reformatted to facilitate analysis, that basic analysis be carried out to provide a summary description of the landing sites, and that a report be prepared with this information.
2. It is recommended that landings by vessels licensed to fish in Surinamese waters and land their catches in Guyana be estimated by collaboration with the Guyana Fisheries Department and/or extrapolation from local vessels.
3. There is the need to add a management unit that covers the large pelagic species.
4. Several years of data should be analysed to determine the extent of split landings by vessel and landing site to determine how serious a bias this is, and to make recommendations as to how to address the problem.
5. There is the need for ongoing attention to data entry and exploratory analysis in order to detect and fix problems as soon as possible after they arise.
6. The biases and errors that may affect a data collection system usually cannot be 'fixed' once and for all, they can only be managed and kept at an acceptable minimum by ongoing attention to the activities of data collectors and perusal of data for anomalies.
7. There is the need to establish an ongoing system of monitoring of the data collection system and review of its outputs in order that problems can be identified and rectified in a timely fashion.
8. Further consideration of refining the units of effort should be based on analysis of the existing data.
9. Data collection activity for all sites to be sampled should be programmed in advance for all regions for periods of 4-6 months using the method described above.
10. The existing data on the bycatch and discards in the Chinese seine fishery should be analysed as a precursor to determining the need for further studies on bycatch.
11. The information generated thus far by the observer program should be documented in the Suriname Fisheries Report series, and there should be regular reports each year on the results of the analyses of the data collected by the observers so that it can be available for management decision-making.
12. The present observer program appears to be a good way of acquiring information on bycatch and discards in the offshore trawl fisheries and should be continued as planned
13. The vessel registration system should be computerised to make the registration procedure more efficient and accurate, and to make the data more readily available.
14. Apart from routine collection of price data on a weekly basis at major landing sites, the acquisition of economic data should be designed to meet specific needs until the requirements of an ongoing economics data collection system can, if needed, be determined.
15. The acquisition of sociological data should be designed to meet specific needs until the requirements of an ongoing data collection system can, if needed, be determined.
16. There is the need for a thorough compilation and review of the data that have been collected thus far, the analyses that have been carried out and the advice that has been

generated. This should be done for each Management Unit in the draft FMP. These compilations would provide the supporting technical information for the FMP.

17. In order to determine the biological sampling needs for the various species, there is the need to first clarify the management approaches and measures that will be used for each management unit and the role that the population analyses will play in management decision-making.
18. In order to determine the biological sampling needs for the various species, there is the need to first clarify the management approach and measures that will be used in each case and the role that the population analyses will play in management decision-making.
19. The existing data on landings per unit effort should be edited, compiled and used to prepare a time series of landings by vessel and gear for the landings sites and regions of the country.
20. A new database system should be programmed, based upon the original FIS system to accommodate catch, effort, price, export data and fishery products and to produce basic reports and data outputs from these data.
21. In setting up the new system the programmer should be particularly mindful of the need for Suriname Fisheries Department staff to be able to manage the system. The programmer must provide clear documentation of how the system carries out any calculations that it does, and also of how to adapt the system to changes that may take place in the fishery. The changes that are most likely are the addition of new codes (vessel and gear types, landing sites, species, products) and the restratification of the landing sites.
22. There should be a landing site information system and an ongoing process to acquire and compile incidental data on landing sites.
23. There should be an ongoing system to acquire and compile incidental data on Local and Traditional Ecological Knowledge.
24. A computerised system should be put in place for bibliographic information.
25. There is the need for a comprehensive overall documented scheme for the management of fishery data and information for Suriname that incorporates all the various kinds of data identified in this report.
26. The Fisheries Department of Suriname should be provided with its own copy of The Statistical Package for the Social Sciences (SPSS) software.
27. There is the need to establish priorities for the staff with responsibility for data collection, management and analysis so that the maintenance of a functional, ongoing system for provision of information for management decision-making can be assured. These priorities should flow from the management plan, which should be realistic in terms of staff capabilities and numbers.

8 IMPLEMENTATION

The recommendations provided in section 7 comprise a series of task or activities to be undertaken by the Fisheries Department and CARICOM CFU. These are summarised in Table 7. For each task, the priority is indicated in decreasing order as: immediate, as soon as resources

permit, and when possible. An estimate of the amount of time input that is likely to be required for each task is also provided as an aid to scheduling the task.

Table 7. Summary of task to be undertaken with indication of timing and an estimate of the duration of input.

	Task/activity	Timing	Duration
1	Continue catch effort data collection with modifications described	Immediate	Ongoing
2	Prepare comprehensive documented scheme for the management of fishery data and information for Suriname.	As soon as resources permit	1 month
3	Establish an ongoing monitoring of the data collection system and review of its outputs	Immediate	1 week
4	Establish process for ongoing attention to data entry and exploratory analysis	Immediate	1 week
5	Program data collection activity for all sites to be visited	Immediate	Ongoing intermittent
6	Program new database system for catch and effort data.	Immediate	CARICOM CFU
7	Estimate landings by licensed vessels fishing in Suriname waters and landing in Guyana	When possible	2 weeks
8	Analysis to determine the extent of split landings	When possible	2 weeks
9	Analyse existing data re refining the units of effort	When possible	2 weeks
10	Analyse existing data on the bycatch and discards in the Chinese seine fishery	When possible	2 weeks
11	Analyse existing catch and effort data for the period 1991-2000.	As soon as resources permit	3 months
12	Provide Statistical Package for the Social Sciences (SPSS) software.	Immediate	CARICOM CFU
13	Continue present observer program	Immediate	Ongoing
14	Document information generated thus far by the observer program.	As soon as resources permit	2 months
15	Develop management approaches and measures for each management unit.	As soon as resources permit	Long-term, 1-2 weeks per management unit
16	Generate supporting technical reports for the FMP management units	As soon as resources permit	Long-term, 1-2 weeks per management unit
17	Add to FMP a management unit that covers the large pelagic species.	As soon as resources permit	See above
18	Compile and review biological data, analyses and resulting advice thus far.	As soon as resources permit	Part of 16
19	Computerise vessel registration system	Immediate	CARICOM CFU
20	Establish a landing site information system and ongoing data collection process	As soon as resources permit	1 week
21	Analyse and report on 1995 landing site survey	As soon as resources permit	2 weeks
22	Establish LEK/TEK information system and ongoing data collection process	As soon as resources permit	1 week
23	Establish computerised system for bibliographic information.	As soon as resources permit	Long-term, ongoing

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APPENDIX 1: TERMS OF REFERENCE FOR CONSULTANCY TO REVIEW THE DATA COLLECTION AND MANAGEMENT SYSTEMS OF THE MARINE FISHERIES IN SURINAME

1. Introduction and Background

The Fisheries Component of the Integrated Caribbean Regional Agriculture and Fisheries Development (ICRAFD) Programme main objective is to extend the activities of the CARICOM Fisheries Resource Assessment and Management Program (CFRAMP) to include the Bahamas, Suriname, Dominican Republic and Haiti to ensure their integration into the regional initiative to improve the sustainable development and utilization of the fisheries resources of the region. The project will also extend benefits in fisheries surveillance and enforcement, marketing, processing, and training to all the CARIFORUM countries that have already benefited under the CIDA supported CFRAMP project.

In an effort to provide information for management and decision-making on a continuous basis, the Project will assist the Fisheries Division to strengthen its data collection systems to collect data on length, weight, maturity and hard parts for selected species of fish and shellfish in the respective fisheries. The resulting data, along with catch, effort, economic, social and environmental data should permit qualitative and quantitative evaluation of the impact of the fishery on the population structure, including estimates of fishing mortality, current abundance and status of exploitation, trends in recruitment and projected future abundance, and allowable catch under given management regimes. Biomass dynamic models, length based assessment techniques/models as well as bio-economic models will be utilized in these assessments.

The purpose of the Fisheries Data Management Systems subproject is to improve the Data Collection and Management Systems in Suriname to provide fisheries data for assessment and management as well as an effective tool for monitoring and regulating the fishing effort. This Consultancy will commence this process by reviewing the Data Collection and Management Systems in Suriname.

2. Purpose and Objective

The purpose of this assignment is to:

- Review the onshore and offshore (Observer Program) data (catch, effort, biological, economic, social and licensing and registration) collection, and management systems of Suriname and make recommendations for improvement;
- Review the system for recording, storage, verifying, analysis and reporting of the data;
- Review the adequacy of the personnel available for field activities and the computerized systems in terms of skills and numbers available;
- Recommend the most suitable means of obtaining data on discards by the various gear types (e.g. njawaries, trawl nets) in the Industrial, Coastal and Brackishwater Fisheries;
- Determine if adequate data exists to determine population parameters (growth, mortality, recruitment, maturity etc.) for the main commercial species, including those from large

demersals and penaeid shrimp and advise on the appropriate studies to obtain such data for analysis;

- Review the type of economic data being collected and advise on the additional data to be collected in order to monitor the performance of the fleets in the respective fisheries as well as provide information for management;
- Clearly identify and characterize the strengths and weaknesses of the current data collection system at the different levels (field sampling, data management, analysis and reporting);
- Make recommendations for refining and strengthening the integration of the catch, effort, biological, economic and social data collection programmes.

2.1 The Approach

- Under the general direction of the Scientific Director, Data Manager and the Biologist from the CFU, the consultant will be contracted for fifteen (15) day to undertake the assignment and prepare the necessary report. The Consultant will spend seven (7) days in Suriname and eight (8) days for report preparation.
- The Consultant will work in close collaboration with the Director of Fisheries, Data Manager (CARIFORUM-CFU), Fisheries Officers and Data Collectors/Observers to conduct the assignment and facilitate technology transfer to these personnel. Although the Consultant will work in close collaboration with the above-mentioned personnel, it is understood that the Consultant is responsible for producing the outputs of this assignment.
- The resource person will visit Suriname where s/he will conduct a thorough review and analysis of the data collection program in keeping with the above stated objectives. This will include review and preliminary analysis of the data from the Marine Fishery Census 1995, the existing Licensing and Registration System, the existing catch, effort, biological and economic data collection programs, including the data collection forms and logbooks, the computerised databases and reports, including the Draft Fisheries Management Plan of Suriname. Visits to landing sites, wharves and processing plants to observe data collection activities and interaction between the fisheries personnel and the fishers will also be made.

2.2 Expected Outputs

The outputs of this Consultancy will be:

1. Review and analysis of the data collection and management program for the industrial, coastal and brackishwater fisheries, including the data collection forms and logbooks, the field data collection programs, computerised databases and reports in Suriname, with recommendations for refinement.
2. Suggestions for the most suitable means to obtain data on the discards at sea by the various gear types in the industrial, coastal and brackishwater fisheries.

3. Indication as to whether adequate data exists to conduct selectivity studies for the gillnet fleet for large demersals, trawls and njawarie nets of different types, and/or provide advice on the appropriate studies to gather such data for analyses.
4. Indication as to whether adequate data exists to determine growth and mortality parameters for the main commercial species, including those from the large demersals, small soft-bottomed demersals fish and penaeid shrimp, and/or provide advice on the appropriate studies to obtain such data for analyses.
5. Review the types of economic data being collected and provide advice on the additional data to be collected in order to monitor the performance of the fleets in the respective fisheries as well as provide information for management.
6. Suggestions for refining the data collection elements regarding fishing effort.
7. An Implementation Plan, with schedule, to integrate the improved onshore and offshore catch and effort, biological and associated economic (and social) data collection programs into a comprehensive fisheries data collection system for the industrial, coastal and brackish water.

2.3 Reporting

On completing this activity the consultant will present the following reports:

- A brief Mission Report describing the aims and objectives of the mission, the activities executed, accomplishments problems and difficulties encountered.
- A comprehensive report documenting the aims and objectives, methodology, results, discussion of findings and recommendations. This report will include the expected outputs described above. The report will also include an implementation plan with sequenced activities, budget and schedule.

The Reports of this assignment shall be produce in Microsoft Word 97/2000 for Windows format on diskette and in hard copy. Four (4) hard copies of the Comprehensive Report are required, and must be submitted to reach the CFU office in Belize City, Belize by February 28th, 2000.

2.4 Time Allotment

The consultancy shall run for 15 person days, from December 4, 2000 to February 28, 2001.

2.5 Qualification and Experience

The Consultant should have an advanced degree in fisheries science. Experience in setting up data system preferable in developing countries is essential. Experience in working in Suriname would be an asset.

APPENDIX 2: LANDING SITE SURVEY FORM – 1995 SURVEY

Frame survey of fishery landing sites in Suriname

I. Identification of the landing site

Name
District
Limits
Code
Date survey
Name surveyor

II. Description of the landing site

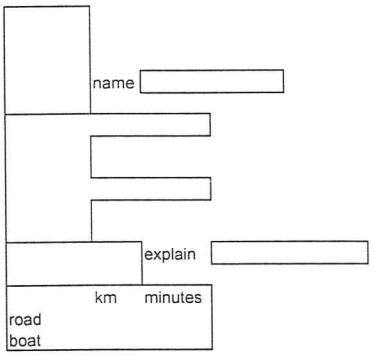
Type — Public (A) / private (B)
Portion coast (A) / structure (B)
Extension (meters)

Environment — Sea/estuary/river/kreek/channel (S/E/R/K/C)
Sand/mud/other (S/M/O)

Infrastructure — Jetty Type
Number
Length (meters)
Other Type
Number
Length (meters)

Activity depends on hour, tide, day, moon phase (H/T/D/M)

Accessible : by car, (motor)cycle, 4WD, boat, feet (C/M/W/B/F)
distance from Paramaribo (Fisheries Department)



III. General characteristics of fishing and landing

Type of boat
Fishing gear
Approximate # units
Fishing grounds
Distance fishing grounds — km / minutes

Main fishing — seasons (months)
moon phases
tidal phases

Average # landings (during season/phase)
Per day per unit
Per week per unit
Per day, all units
Per week, all units

Approximate landing time
relati
on to tide
moon phase
season

Remarks — part landed other place
landing in days
other

List of all Guyana boats decked
open

Stern trawler	Outrigger trawler			SN	GG	Open Guyana			Korjaal								
	Shrimp	Fin-fish	Sea-bob	Handline	DR	DR	NJ	LL	JJ	FK	FN	DR	LL	Comb	K	HT	Other

DR NJ LL

IV. Marketing and processing

Type of boat

Fishing gear
% kept by fisherman/family
for auto-consumption
for processing
for auto-consumption
for sale — retail
bulk
place
frequency

% retailed fresh by fisherman/family
place

% sold to following type(s) of bulk buyer(s)
Processor for export
for local market
exporter (fresh/frozen)
Retailer
place
approximate # buyers

Stern trawler	Outrigger trawler			SN	GG	Open Guyana			Korjaal								
	Shrimp	Fin-fish	Sea-bob	Handline	DR	DR	NJ	LL	JJ	FK	FN	DR	LL	Comb	K	HT	Other

APPENDIX 3: TABULATION OF VESSELS BY LANDING SITES DATA FROM THE 1995 LANDING SITE SURVEY

District	Name	Name	Stern trawl	Deep sea shrimp	Outrigger trawl shrimp	Outrigger trawl fish	Outrigger trawl seabob	Snapper	Decked Guyana	Open Guyana drift net	Open Guyana njawarie	Open Guyana longline	Korjal jagi jagi	Korjal fk	Korjal fn	Korjal driftnet	Korjal longline	Korjal combined gear	Korjal k	Korjal haritete	Korjal other	Total	Stratum
Commewijne	Margarita sluis	Margarita																	1			1	Commewijne lagoon
	Margarita brug	Margarita																	50			50	
	Kronenburg	Kroonenburg																	20			20	
	Ellen sluis	Ellen													1			1				2	Commewijne left bank
	Zoelen	Zoelen											1		10		1					12	
	Marienburg	Marienburg													7			1				8	
	Turkowweg 111	Commewijne																1				1	
	Turkowweg 112	Commewijne													1							1	
	Breinburg	Commewijne								2		1	1		3	2	10					19	
	Visserij Centrum Commewijne	Commewijne							10	3					2		7					22	
	Naast veersteiger Kabel	Commewijne													2							2	
	Baka srosie I	Commewijne													10							10	
	Baka srosie II	Commewijne													16	1	1					18	
	Rust en Werk Sluis 2	Commewijne													24							24	Commewijne right bank
	Rust en Werk Sluis 1	van Alen													1							1	
	Schaapstede	Shapstede																1				1	
	Rust en Werk steiger	Commewijne													3							3	
	Kandra (Matapica strand)	Matapica kreek/kanaal													10	4						14	Matapica
	Braamspunt strand	Suriname													6							6	Pomona
	Braamspunt parwa oever	Suriname											5		25		5					35	
	Pomona	Resolutie kreek/Suriname R.												24	6	3	5					38	
Coronie	Afdamming																						Afdamming
	Totness kanaal 1	Totness								3	2					5	1					11	Coronie canals
	Totness kanaal 2 (zeekant)	Atlantische Oceaan														2						2	

District	Name	Name	Stern trawl	Deep sea shrimp	Outrigger trawl shrimp	Outrigger trawl fish	Outrigger trawl seabob	Snapper	Decked Guyana	Open Guyana drift net	Open Guyana njawarie	Open Guyana longline	Korjal jagi jagi	Korjal fk	Korjal fn	Korjal driftnet	Korjal longline	Korjal combined gear	Korjal k '	Korjal haritete	Korjal other	Total	Stratum
	John																						
	Ingi Kondre 2de sluis	Ingi Kondre																					
	Burnside																						
	Paal nul																						
Nickerie	Clara Sluis	Corantijne: en kreek ???													3						2	5	Corentine R.
	C.M. Nickerie	Nickerie											3		5				7			15	Nickerie lagoon
	Waldeck	Nickerie																	2			2	
	Paradise	Nickerie																	2			2	
	Longmay I	Nickerie																	2			2	
	Longmay II	Nickerie																	3			3	
	Karan Anjar	Nickerie																	1			1	
	de Boer	???								2						1						3	Nickerie River
	Waterloo sluis	???											1						2			3	
	Visserij Cetrum	Nickerie											2		2							4	Zeedijk Nickerie
	Zeedijk (Post Rotterdam)	Nickerie											5		65	1	1		2			74	
Paramaribo	Paramaribo CM								3	40	10									5		58	Paramaribo CM
	Platte Brug									3	5											8	
	Boomskreek	Suriname							4	3												7	Paramaribo North
	Sluis 2 (Pompgemaal)	Suriname							11	14												25	
	Blauwgrond	Suriname								2					2	4						8	
	Clevia	Clevia													2							2	
	Ramadhin (bisoen)	Suriname							4	6												10	
	Kasisingh	saramacca								3	2											5	Paramaribo South
	de Molen (Bert)	Suriname							11													11	
	Sluizencomplex	Saramacca							4	4	4											12	
	Caribean Seafood																						Industrial
	Murfish	Suriname				3																3	
	Omicron	Dominee																					

District	Name	Name	Stern trawl	Deep sea shrimp	Outrigger trawl shrimp	Outrigger trawl fish	Outrigger trawl seabob	Snapper	Decked Guyana	Open Guyana drift net	Open Guyana njawarie	Open Guyana longline	Korjal jagi jagi	Korjal fk	Korjal fn	Korjal driftnet	Korjal longline	Korjal combined gear	Korjal k	Korjal haritete	Korjal other	Total	Stratum
	Cevihas	Suriname						120														120	
	TASA (Cevihas)		3																			3	
	Jahafish (Cevihas)		1																			1	
	Rampersad Trading (Cevihas)		1																			1	
	Atlantic/Nelo (Cevihas)					1																1	
	Dong Hee (Cevihas)			1																		1	
	Domburg (Holsu)		2																			2	
	Sujafi	Suriname			45																	45	
	SAIL				50																	50	
	Srefidensi (SAIL)					2																2	
	SIS/Namona						9															9	
	GSF Jaglust						15															15	
Saramacca	Boskamp village	Coppename										4	30		5			12				51	Boskamp
	Boskamp ferry																			s			
	Pralala	Pralala													4							4	Saramacca River
	Calcutta	Saramacca														5						5	
	La Proviance															3							
	Uitkijk															3							
	Stoepenveer (Monkshoop)	Saramacca																		2		2	
Maro-wijne	Moengo (market)																						Marowijne
	Galibi																						
	?																						
Total			7	1	95	6	24	120	47	85	23	5	48	24	215	34	31	16	92	7	2	876	

APPENDIX 4: VARIABLES TO BE INCLUDED IN THE VESSEL REGISTRATION DATABASE

Type of fishery (commercial sea, shrimp trawling, coastal, etc.)
Name of applicant
Address of applicant
Name of master of vessel
Address of master of vessel
Type of vessel*
Date built*
Port of registry of vessel*
Country of registry of vessel*
Registration number of vessel*
Vessel ID marks*
Vessel length*
Vessel GRT*
Engine horsepower*
Engine type
Engine brand
Number of crew inc. master*
Number of foreign crew
Navigation and position fixing equipment*
Communication equipment*
Radio frequencies*
Call sign*
Construction material*
Hold capacity*
Catch storage method*
Types of gear, specifications and quantity*
Area to be fished
Species to be fished

*These items are required under the UN Fish Stocks Agreement

APPENDIX 5: PROCEDURE FOR ESTIMATING NATIONAL LANDINGS FROM THE CATCH AND EFFORT DATA.

STEP 1: Splits date field in file 'artisanal landings 1998.sav' into separate day month year variables.

```
COMPUTE DY = XDATE.MDAY(datum) .
EXECUTE .
COMPUTE MN = XDATE.MONTH(datum) .
EXECUTE .
COMPUTE YR = XDATE.YEAR(datum) .
EXECUTE .
```

STEP 2: Filters out the secondary landings 'artisanal landings 1998.sav'.

```
USE ALL.
COMPUTE filter_$=(lantype = 1).
VARIABLE LABEL filter_$ 'lantype = 1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMAT filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE .
```

STEP 3: Saves file as 'interim 98.sav' to prevent overwriting original file after next step.

```
SAVE OUTFILE='C:\My Documents\Suriname\FIS\interim 98.sav'
  /COMPRESSED.
```

STEP 4: Converts all landings to landings per day.

```
COMPUTE xykrff = xykrff / dagengev. COMPUTE xykrfd = xykrfd / dagengev. COMPUTE nascff
= nascff / dagengev. COMPUTE nascfd = nascfd / dagengev. COMPUTE pesuf = pesuf /
dagengev. COMPUTE pesmf = pesmf / dagengev. COMPUTE crabf = crabf / dagengev.
COMPUTE inktvis = inktvis / dagengev. COMPUTE cyacf = cyacf / dagengev. COMPUTE ctacg =
ctacg / dagengev. COMPUTE cysnf = cysnf / dagengev. COMPUTE cysng = cysng / dagengev.
COMPUTE nebrf = nebrf / dagengev. COMPUTE cyvif = cyvif / dagengev. COMPUTE cyvig =
cyvig / dagengev. COMPUTE maanf = maanf / dagengev. COMPUTE mifuf = mifuf / dagengev.
COMPUTE scjuf = scjuf / dagengev. COMPUTE wuidf = wuidf / dagengev. COMPUTE wuidg =
wuidg / dagengev. COMPUTE arpkf = arpkf / dagengev. COMPUTE arpkg = arpkg / dagengev.
COMPUTE arprf = arprf / dagengev. COMPUTE argrf = argrf / dagengev. COMPUTE arcof =
arcof / dagengev. COMPUTE arpsf = arpsf / dagengev. COMPUTE babaf = babaf / dagengev.
COMPUTE cuidf = cuidf / dagengev. COMPUTE cuidg = cuidg / dagengev. COMPUTE lusyf =
lusyf / dagengev. COMPUTE lusyg = lusyg / dagengev. COMPUTE lupuf = lupuf / dagengev.
COMPUTE lupug = lupug / dagengev. COMPUTE rhauf = rhauf / dagengev. COMPUTE suidf =
suidf / dagengev. COMPUTE suidg = suidg / dagengev. COMPUTE haemf = haemf / dagengev.
COMPUTE sparidf = sparidf / dagengev. COMPUTE priacf = priacf / dagengev. COMPUTE epitf
= epitf / dagengev. COMPUTE epitg = epitg / dagengev. COMPUTE losuf = losuf / dagengev.
COMPUTE lompoe = lompoe / dagengev. COMPUTE meatf = meatf / dagengev. COMPUTE
meatg = meatg / dagengev. COMPUTE cespf = cespf / dagengev. COMPUTE muspf = muspf /
dagengev. COMPUTE scspf = scspf / dagengev. COMPUTE scspg = scspg / dagengev.
COMPUTE cahif = cahif / dagengev. COMPUTE overcara = overcara / dagengev. COMPUTE
racaf = racaf / dagengev. COMPUTE bluefish = bluefish / dagengev. COMPUTE barracud =
barracud / dagengev. COMPUTE riemvis = riemvis / dagengev. COMPUTE sardine = sardine /
dagengev. COMPUTE sharf = sharf / dagengev. COMPUTE sharg = sharg / dagengev.
```

```
COMPUTE sparie = sparie / dagengev. COMPUTE muidf = muidf / dagengev. COMPUTE muidg
= muidg / dagengev. COMPUTE plsuf = plsuf / dagengev. COMPUTE homlf = homlf / dagengev.
COMPUTE ererf = ererf / dagengev. COMPUTE homcf = homcf / dagengev. COMPUTE
toekoena = toekoena / dagengev. COMPUTE ormaf = ormaf / dagengev. COMPUTE aequf =
aequf / dagengev. COMPUTE holif = holif / dagengev. COMPUTE cacaf = cacaf / dagengev.
COMPUTE hothf = hothf / dagengev. COMPUTE fuidf = fuidf / dagengev. COMPUTE trie = trie /
dagengev. COMPUTE cuids = cuids / dagengev. COMPUTE muids = muids / dagengev.
COMPUTE cuidr = cuidr / dagengev. COMPUTE muidr = muidr / dagengev. COMPUTE muidz =
muidz / dagengev.
EXECUTE .
```

STEP 5: Aggregates the trip by trip data (artisanal landings 1998.sav) to give average lpue per stratum, month, vessel type, gear type for all species and species groups (table saved as 'lpue stratum.sav').

```
AGGREGATE
 /OUTFILE='C:\My Documents\Suriname\FIS\LPUEstratum.sav'
 /BREAK=stratum mn boottype vistuig
 /xykrff_1 = MEAN(xykrff) /xykrfd_1 = MEAN(xykrfd) /nascff_1 = MEAN(nascff)
 /nascfd_1 = MEAN(nascfd) /pesuf_1 = MEAN(pesuf) /pesmf_1 = MEAN(pesmf)
 /crabf_1 = MEAN(crabf) /inktvi_1 = MEAN(inktvis) /cyacf_1 = MEAN(cyacf)
 /ctacg_1 = MEAN(ctacg) /cysnf_1 = MEAN(cysnf) /cysng_1 = MEAN(cysng) /nebrf_1
 = MEAN(nebrf) /cyvif_1 = MEAN(cyvif) /cyvig_1 = MEAN(cyvig) /maanf_1 =
 MEAN(maanf) /mifuf_1 = MEAN(mifuf) /scjuf_1 = MEAN(scjuf) /wuidf_1 =
 MEAN(wuidf) /wuidg_1 = MEAN(wuidg) /arpkf_1 = MEAN(arpkf) /arpkg_1 =
 MEAN(arpkg) /arprf_1 = MEAN(arprf) /argrf_1 = MEAN(argrf) /arcof_1 =
 MEAN(arcof) /arpsf_1 = MEAN(arpsf) /babaf_1 = MEAN(babaf) /cuidf_1 =
 MEAN(cuidf) /cuidg_1 = MEAN(cuidg) /lusyf_1 = MEAN(lusyf) /lusyg_1 =
 MEAN(lusyg) /lupuf_1 = MEAN(lupuf) /lupug_1 = MEAN(lupug) /rhauf_1 =
 MEAN(rhauf) /suidf_1 = MEAN(suidf) /suidg_1 = MEAN(suidg) /haemf_1 =
 MEAN(haemf) /sparid_1 = MEAN(sparidf) /priacf_1 = MEAN(priacf) /epitf_1 =
 MEAN(epitf) /epitg_1 = MEAN(epitg) /losuf_1 = MEAN(losuf) /lompoe_1 =
 MEAN(lompoe) /meatf_1 = MEAN(meatf) /meatg_1 = MEAN(meatg) /cespf_1 =
 MEAN(cespf) /muspf_1 = MEAN(muspf) /scspf_1 = MEAN(scspf) /scspg_1 =
 MEAN(scspg) /cahif_1 = MEAN(cahif) /overca_1 = MEAN(overcara) /racaf_1 =
 MEAN(racaf) /bluefi_1 = MEAN(bluefish) /barrac_1 = MEAN(barracud) /riemvi_1
 = MEAN(riemvis) /sardin_1 = MEAN(sardine) /sharf_1 = MEAN(sharf) /sharg_1 =
 MEAN(sharg) /sparie_1 = MEAN(sparie) /muidf_1 = MEAN(muidf) /muidg_1 =
 MEAN(muidg) /plsuf_1 = MEAN(plsuf) /homlf_1 = MEAN(homlf) /ererf_1 =
 MEAN(ererf) /homcf_1 = MEAN(homcf) /toekoe_1 = MEAN(toekoena) /ormaf_1 =
 MEAN(ormaf) /aequf_1 = MEAN(aequf) /holif_1 = MEAN(holif) /cacaf_1 =
 MEAN(cacaf) /hothf_1 = MEAN(hothf) /fuidf_1 = MEAN(fuidf) /trie_1 =
 MEAN(trie) /cuids_1 = MEAN(cuids) /muids_1 = MEAN(muids) /cuidr_1 =
 MEAN(cuidr) /muidr_1 = MEAN(muidr) /muidz_1 = MEAN(muidz)
 /catcases=N.
```

STEP 6: Aggregates the trip by trip data (artisanal landings 1998.sav) to give total effort (days fished) per stratum, landing site, month (table saved as 'effortLS.sav').

```
AGGREGATE
 /OUTFILE='C:\My Documents\Suriname\FIS\EffortLS.sav'
 /BREAK=stratum ls mn boottype vistuig
 /dageng_1 = SUM(dagengev)
 /effcases=N.
```

STEP 7: Merges 'effortLS.sav' (open file) with 'LPUEstratum.sav' (keyed file) to produce a file with lpue and effort by stratum, landing site, month, boat type and gear type (table saved as 'lpue effort.sav').

```
MATCH FILES /TABLE=*
 /FILE='C:\My Documents\Suriname\FIS\LPUEstratum.sav'
 /BY stratum mn boottype vistuig.
EXECUTE.
```

STEP 8: Aggregates in two stages the data in 'artisanal landings 1998.sav' to give the number of days sampled (DER) per landings site per month. Table saved as 'der 1998.sav'.

```
AGGREGATE
 /OUTFILE='C:\My Documents\Suriname\FIS\AGGR.SAV'
 /BREAK=stratum ls mn dy
 /yr_1 = N(yr).
```

Second stage aggregates output from first stage (AGGR.SAV)

```
AGGREGATE
 /OUTFILE='C:\My Documents\Suriname\FIS\der 1998.sav'
 /BREAK=stratum ls mn
 /dy_1 = N(dy).
```

STEP 9: Has three runs
7.1 Merges 'der 1998.sav' (open file) and 'ald 1998.sav' (keyed file).
7.2 Computes the effort raising factor ERF (aggregated variable must be renamed to erf before running compute),
7.3 Makes all erf <1 to equal 1
Table is saved as 'erf 1998.sav'.

```
MATCH FILES /FILE=*
 /TABLE='C:\My Documents\Suriname\FIS\ald 1998.sav'
 /BY ls mn.
EXECUTE.

COMPUTE erf = ald / der .
EXECUTE .

RECODE
 erf (.5 thru .99999=1) .
EXECUTE .

SORT CASES BY
 stratum (A) ls (A) mn (A) .
```

STEP 10: Merges 'lpue effort98.sav' (open table) with 'erf 1998.sav' (keyed table) to put the erf for each landing site and month into the former table. Table saved as 'Total lan 1998.sav'

```
MATCH FILES /FILE=*
 /TABLE='C:\My Documents\Suriname\FIS\erf 1998.sav'
 /BY stratum ls mn.
EXECUTE.
```

STEP 11: Calculates in file 'Total lan 1998.sav' total effort per landing site per month per vessel type per gear type.

```
COMPUTE toteff = dageng_1 * erf .
EXECUTE .
```

STEP 12: Calculates in file 'Total lan 1998.sav'total landings for each spp/group by multiplying lpue by effort. NB conversion factors from gutted to whole could be included at this stage.

```
COMPUTE txykrff = xykrff_1 *toteff. COMPUTE txykrfd = xykrfd_1 *toteff *10. COMPUTE tnascff
= nascff_1 *toteff. COMPUTE tnascfd = nascfd_1 *toteff *10. COMPUTE tpesuf = pesuf_1 *toteff.
COMPUTE tpesmf = pesmf_1 *toteff. COMPUTE tcrabf = crabf_1 *toteff. COMPUTE tinktvi =
inktvi_1 *toteff. COMPUTE tcyacf = cyacf_1 *toteff. COMPUTE tctacg = ctacg_1 *toteff *1.18.
COMPUTE tcysnf = cysnf_1 *toteff. COMPUTE tcysng = cysng_1 *toteff *1.18. COMPUTE tnebrf
= nebrf_1 *toteff. COMPUTE tcyvif = cyvif_1 *toteff. COMPUTE tcyvig = cyvig_1 *toteff *1.18.
COMPUTE tmaanf = maanf_1 *toteff. COMPUTE tmifuf = mifuf_1 *toteff. COMPUTE tscjuf =
scjuf_1 *toteff. COMPUTE twuidf = wuidf_1 *toteff. COMPUTE twuidg = wuidg_1 *toteff *1.18.
COMPUTE tarpkf = arpkf_1 *toteff. COMPUTE tarpkg = arpkg_1 *toteff *1.18. COMPUTE tarprf =
arprf_1 *toteff. COMPUTE targrf = argrf_1 *toteff. COMPUTE tarcof = arcof_1 *toteff. COMPUTE
tarpsf = arpsf_1 *toteff. COMPUTE tbabaf = babaf_1 *toteff. COMPUTE tcuidf = cuidf_1 *toteff.
COMPUTE tcuidg = cuidg_1 *toteff *1.18. COMPUTE tlusyf = lusyf_1 *toteff.
COMPUTE tlusyg = lusyg_1 *toteff*1.18. COMPUTE tlupuf = lupuf_1 *toteff. COMPUTE tlupug =
lupug_1 *toteff *1.18. COMPUTE trhauf = rhauf_1 *toteff. COMPUTE tsuidf = suidf_1 *toteff.
COMPUTE tsuidg = suidg_1 *toteff *1.18. COMPUTE thaemf = haemf_1 *toteff. COMPUTE
tsparid = sparid_1 *toteff. COMPUTE tpriacf = priacf_1 *toteff. COMPUTE tepitf = epitf_1 *toteff.
COMPUTE tepitg = epitg_1 *toteff*1.18. COMPUTE tlosuf = losuf_1 *toteff. COMPUTE tlompoe =
lompoe_1 *toteff. COMPUTE tmeatf = meatf_1 *toteff. COMPUTE tmeatg = meatg_1 *toteff
*1.18. COMPUTE tcespf = cespf_1 *toteff. COMPUTE tmuspf = muspf_1 *toteff. COMPUTE
tscspf = scspf_1 *toteff. COMPUTE tscspg = scspg_1 *toteff. COMPUTE tcahif = cahif_1 *toteff.
COMPUTE toverca = overca_1 *toteff. COMPUTE tracaf = racaf_1 *toteff. COMPUTE tbluefi =
bluefi_1 *toteff. COMPUTE tbarrac = barrac_1 *toteff. COMPUTE triemvi = riemvi_1 *toteff.
COMPUTE tsardin = sardin_1 *toteff. COMPUTE tsharf = sharf_1 *toteff. COMPUTE tsharg =
sharg_1 *toteff *1.18. COMPUTE tsparie = sparie_1 *toteff. COMPUTE tmuidf = muidf_1 *toteff.
COMPUTE tmuidg = muidg_1 *toteff *1.18. COMPUTE tplsuf = plsuf_1 *toteff. COMPUTE thomlf
= homlf_1 *toteff. COMPUTE tererf = ererf_1 *toteff. COMPUTE thomcf = homcf_1 *toteff.
COMPUTE ttoekoe = toekoe_1 *toteff. COMPUTE tormaf = ormaf_1 *toteff. COMPUTE taequf =
aequf_1 *toteff. COMPUTE tholif = holif_1 *toteff. COMPUTE tcacaf = cacaf_1 *toteff.
COMPUTE thothf = hothf_1 *toteff. COMPUTE tuidf = fuidf_1 *toteff. COMPUTE ttrie = trie_1
*toteff *2. COMPUTE tcuids = cuids_1 *toteff *2.5. COMPUTE tmuids = muids_1 *toteff *2.5.
COMPUTE tcuidr = cuidr_1 *toteff *5. COMPUTE tmuidr = muidr_1 *toteff *5. COMPUTE tmuidz
= muidz_1 *toteff *2.
EXECUTE .
```

STEP 13: Computes species groups by which landings will be reported

```
COMPUTE Seabob = txykrff + txykrfd .
EXECUTE .
COMPUTE Witibere = tnascff + tnascfd .
EXECUTE .
COMPUTE sciaenid = tcyacf + tctacg + tcysnf + tcysng + tnebrf + tcyvif +
 tcyvig + tmaanf + tmifuf + tscjuf + twuidf + twuidg .
EXECUTE .
COMPUTE ariids = tarpkf + tarpkg + tarprf + targrf + tarcof + tarpsf + tbabaf
 + tcuidf + tcuidg .
EXECUTE .
```

```
COMPUTE lutjanid = tlusyf + tlusyg + tlusyg + tlupuf + tlupug + trhauf +
 tsuidf + tsuidg .
EXECUTE .
COMPUTE othmar = thaemf + tsparid + tpriacf + tepitf + tepitg + tlosuf +
 tlompoe + tmeatf + tmeatg + tcespf + tmuspf + tscspf + tscspg + tcahif +
 toverca + tracaf + tbluefi + tbarrac + triemvi + tsardin + tsparie + tmuidf + tmuidg.
EXECUTE .
COMPUTE shark = tsharf + tsharg .
EXECUTE .
COMPUTE freshwat = tplsuf + thomlf + tererf + thomcf + ttoekoe + tormaf +
 taequf + tholif + tcacaf + thothf + tuidf .
EXECUTE .
```

STEP 14: Exports data file to Excel for further analysis

```
SAVE TRANSLATE OUTFILE='C:\My Documents\Suriname\FIS\tot lan 1998.xls'
 /TYPE=XLS /MAP /REPLA /FIELDNAMES.
```

APPENDIX 6: TABLES COMPRISING THE DATABASE DESIGNED FOR THE FIS IN 1990 (MAHON ET AL 1990).

The tables presented below comprise the database system that was designed for the FIS. The new system should be very similar in structure. There are some changes that may be required and some tables in the old system that may not be desired in the new one. Comments below each table in regular font are part of the original system. Those provided in italics are observations pertaining to the development of the new system. The files presently have .DBF extensions. These and other aspects of structure will change as the system is adapted to a new software package. These are issues to be addressed by the database programmer. These tables and the details provided by Mahon et al (1990) will guide the programmer in setting up the system. However, it is to be expected that there will be the need for specialised input later regarding the programming and use of this system.

Table 1. Catch datafile for all fisheries (CAYYMM.DBF)

Field Name	Type	Length	Dec.	Description
LANSPP	C	5		Species code as per species datafile
LANLAND	N	6	0	Landings in kg
LANLINK	C	10		Unique effort record identifier to link landings and effort records

- LANLINK will take the form of FTYYMM , FT = fishery form type (EP, CP, CM) YY = year, MM = month followed by a sequential record number within the corresponding effort file (created automatically).

New comments

- *This is an essential table for the system. However, the old system creates a new table each month. Nowadays, digital storage is not a problem and it may be more tractable to have a new table each year only. If so then a new field would have to be added fro the month.*
- *There may be more modern and efficient ways to create the links between this and the next table in new database systems*

Table 2. Effort datafile for all fisheries (EFYYMM.DBF)

Field Name	Type	Length	Dec.	Description
EFFFNUM	N	7	3	Form number
EFFDD	N	2		Day 1-31
EFFLOC	C	6		Landing site number
EFFCOLL	C	1		Primary of secondary landing (P or S)
EFFLIC	C	6		License number (vehicle or boat)
EFFBTYP	C	2		Boat type (e.g.KJ OG GG etc.)
EFFGTYP	C	2		Gear type (DR KI SN LL NJ FK FS FN)
EFFGNUM	N	3	0	Number of gear fished
EFFTPDUR	N	2	0	Number of days fished
EFFNFISH	N	2	0	Number of fishermen
EFFLINK	C	10	0	Unique record identifier to link with landing records same as LANLINK above

New comment

- *This table is also essential in the new system, see comments re months and links for table 1 above.*

Table 3. Export permit datafile (EXYY.DBF)

Field Name	Type	Length	Dec.	Description
EXFTYPE	C	2		EXP (Export data)
EXREC	C	1		P for permit data, C for customs data
EXFNUM	N	3		Form number
EXMM	C	2		Month, 1-12
EXDD	C	2		Day 1-31
EXNAM	C	25		Exporter code
EXCUR	C	3		Export currency (US$, UKP, NFL, etc.)
EXDEST	C	10		Export destination by city or country
EXTRANS	C	1		Mode of transportation (road, air, sea)

New comments

- *This table will only be required in the new system if the Fisheries Department wouldlike to have a way of including export data in the system.*
- *This could be included now, or added later, depending on the level of programming effort that is available to develop this sytem.*

Table 4. Export product datafile (EXSUBYY.DBF)

Field Name	Type	Length	Dec.	Description
EXFNUM	N	3		Form number
EXPROD	C	6		Type of product as per species codes
EXAMT	N	6	0	Amount of product in Kg
EXVAL	N	6	0	Declared total value in EXCUR (Table 3)

New comments

- *As above, this table will only be required in the new system if the Fisheries Department wouldlike to have a way of including export data in the system.*

Table 5. Price datafile (PRYY.DBF)

Field Name	Type	Length	Dec.	Description
PRMM	C	2		Month
PRDD	C	2		Day
PRLOC	C	3		Landing site code
PRSPP	C	5		Species code
PRICEW	N	5	2	Wholesale (ex vessel) price in guilders/kg
PRICER	N	6	2	Retail price in guilders/kg

New comments

- *This table will only be required in the new system if the Fisheries Department wouldlike to have a way of including price data in the system.*

Table 6. Aggregate datafile containing monthly estimates for effort and related variables by landing site, boat,

gear, and species (MNEFFYY.DBF).

Field Name	Type	Length	Dec.	Description
MEMM	C	2		Month, 1-12
MEREG	C	2		Region
MELOC	C	6		Landing site code
MEBTYP	C	2		Boat type code
MEGTYP	C	2		Gear type code
METTEFF	N	5	0	Total estimated effort
MECOL	C	1		Primary or secondary landing
MESPP	C	5		Species code
MELAND	N	7	0	Estimated monthly landings in kg
MEER	C	6		Error code

New comments

- *This is an intermediate table used by the system in calculating outputs. This table may not be neceessary if the new software can be set up so as to preclude the ned for it. Note however, that the data in this table are in the form that is most likely to be required for analysis and reporting. Therefore, it may still be useful for the data to be stored in this form so that it can be easily extracted*

Table 7. Aggregate datafile containing monthly estimates for CPUE and related variables by stratum, boat, gear, and species (MNCPUEYY.DBF).

Field Name	Type	Length	Dec.	Description
MCMM	C	2		Month, 1-12
MCSTRAT	C	2		Stratum
MCBTYP	C	2		Boat type code
MCGTYP	C	2		Gear type code
MCSPP	C	5		Species code
MCCOL	C	1		Primary or secondary landing
MNTOTC	N	8	0	Total monthly landings
MNTOTEF	N	6	0	Total monthly effort (observed)
MNSS	N	3	0	Number of observations in average CPUE
MNCV	N	5	1	Coefficient of variation of CPUE
MNER	C	1		Error code

New comments

- *Same as above*

Table 8. Effort raising factor (ERF) datafile (MNERFYY.DBF)

Field Name	Type	Length	Dec.	Description
MNMM	C	2		Month
LSCODE	C	3		Landing site code
HERF	N	5	2	Effort raising factor
MECOL	C	1		Primary or secondary landing
ERFER	C	1		Error code

New comments

- *Effort raising factor (ERF) is an integral part of the landings estimation procedure. If the system will be required to do the calculations required to provide estimates of landings then depending on how the system is programmed,this table will ned to be included, either explicityly or temporarily during calculations.*

Table 9. Species codes datafile (SPPCODE.DBF)

Field Name	Type	Length	Dec.	Description
SPCODE	C	5		Species code with standard length of four chars plus a blank which will be filled with a code indicating type of processing
SPCNAME	C	30		Species common name
SPSNAME	C	40		Species scientific name
SPGRP1	C	5		Group code for 1st level aggregation
SPGRP2	C	5		Group code for 2nd level aggregation
SPGRP3	C	5		Group code for 3rd level aggregation
SPGRP4	C	5		Group code for 4th level aggregation
SPSH	L	1		Valid species in shrimp trawl fishery
SPFT	L	1		Valid species in fish trawl fishery
SPCF	L	1		Valid species in coastal fishery
SPSN	L	1		Valid species in snapper fishery
SPES	L	1		Valid species in estuarine fishery
SPPA	L	1		Valid species in pannen fishery
SPFR	L	1		Valid species in freshwater fishery
SPSE	L	1		Valid species in secondary landings
SPCF	N	5 3		Conversion factor to whole fresh weight

- Species database must be indexed on species code (always in upper case)
- Datafile will be accessed during production of secondary datafiles to obtain conversion factors for species marked as processed.
- Will be accessed during reporting process. Species will be grouped according to the grouping variable indicated by SPGROUP
- Users will have the option of selecting common name, scientific name, or both during reporting.
- Species group codes for the grouping levels will be stored in four datafiles (SPGRCOD1.DBF, etc.)
- During data entry, only records for valid species are written into the catch datafile, including those with zero catch.

New comments

- *Tables 9-17 are lookup tables for codes. These or some similar feature are necessry to serve as a lookup for pick lists, or validation during data entry.*
- *However this is handled, it must be possible for the users in Suriname Fisheries Department to add codes to these tables.*

Table 10. Species group code/name datafiles (SPGRCOD1.DBF, etc.)

Field Name	Type	Length	Dec.	Description
SPGRP1	C	5		Group code for 1st level of aggregation
GRP1NAM	C	30		Group name for group code SPGRP1

Table 11. Gear type code datafile (GRCODE.DBF)

Field Name	Type	Length	Dec.	Description
GRCODE	C	2		Gear code
GRNAME	C	20		Gear name in English
GRNAMD	C	20		Gear name in Dutch
This datafile will be accessed to validate codes during data entry. GRCODE should always be referred to in upper case.				

Table 12. Boat type code datafile (BTCODE.DBF)

Field Name	Type	Length	Dec.	Description
BTCODE	C	2		Boat type code, always in upper case
BTNAME	C	20		Boat type name in English
BTNAMD	C	20		Boat type name in Dutch
Same as for gear datafile above				

Table 13. Landing site code datafile (LSCODE.DBF)

Field Name	Type	Length	Dec.	Description
LSCODE	C	3		Landing site code; unique within Suriname
LSSTRAT	C	2		The number of the stratum to which thelanding site belongs
LSNAME	C	20		Name of landing site
LSREG	C	2		Code for region where landing site occurs

- This datafile is accessed to validate landing site codes during data entry
- This file is accessed to detemine the appropriate stratum for each landing site during the estimation if CPUE and landings
- Restratification can be achieved by editing the file and changing the stratum numbers assigned to the landings sites.
- This file will be accessed to determine the region in which a landing site occurs. Regrouping into different regions can be achieved by editing this field as described above for stratum.
- Can be accessed to provide landing site name for reporting

Table 14. Datafile of strata (STCODE.DBF)

Field Name	Type	Length	Dec.	Description
STCODE	C	2		Stratum code
STNAME	C	20		Stratum name

- In the estimation process, this file will have to be scanned. For each record, a complete estimation process will take place: - averaging CPUE by boat, gear and species within each stratum

Table 15. Datafile of regions (RGCODE.DBF)

Field Name	Type	Length	Dec.	Description
RGCODE	C	2		Region code
RGNAME	C	20		Region name-

Table 16. Datafile of available landing days (ALD.DBF)

Field Name	Type	Length	Dec.	Description
ALDKEY	C	4		Year (YY) and month (MM)
ALDALL	N	2		Number of days in the month
ALDCM	N	2		ALDALL minus number of Sundays And holidays (for central market estimates)

- This datafile will be accessed during estimation to supply the available landing days need to calculate the effort raising factor.

Table 17. Fishery type datafile (FTCODE.DBF)

Field Name	Type	Length	Dec.	Description
FTCODE	C	2		Fishery type code
FTNAME	N	15		Fishery type name
FTBOAT	N	15		Valid boats in fishery type, e.g. OG GG
FTGEAR		30		Valid gears in fishery type

- The information in this datafile will be used during data entry to designate the fishery type for the record being entered.
- The variables FTBOAT and FTCODE are character strings containing all the respective codes separated by a blank.

Table 18. Datafile species on each form type (FORM.DBF)

Field Name	Type	Length	Dec.	Description
SPCODE	C	5		Species code
CM	L	1		Species included on Central Market form
PR	L	1		Species included on processors form
ES	L	1		Species included on estuarine fishery form
CO	L	1		Species included on coastal fishery form
PA	L	1		Species included on pannen fishery form
SH	L	1		Species included on shrimp fishery form

- The information on this datafile will be used to determine which species are shown on the entry screens for the various types of forms. The user can change this by changing the logical values in the various fields with the utility function supplied.

New comments

- *This table will probably not be necessary depending on how the programmer deals with entry forms.*