NATIONAL REPORT OF GUYANA

Shrimp and groundfish fisheries of Guyana

by

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1 INTRODUCTION

1.1 Fisheries and the National Economy

The Fisheries Sub-sector is important to the economy and social well-being in Guyana. The economic contribution of the Sub-sector has grown in recent years. The importance of the Fisheries Sub-sector is evident in five key areas:

(i) Food Supplies
Fish is a major source of animal protein in Guyana, with the per capita annual consumption being approximately 45 kg in 1991.

(ii) Economy
The primary sector of the Sub-sector contributed 7% to the total Gross Domestic Product (GDP) in 1993, while the total value of fish products in Guyana in 1996 was G$ 11.6 billion.

Current production (1996) of the Fisheries Sub-sector was estimated at 61,483 tonnes, of which the Offshore Industrial Fishery landed 22,525 tonnes, the Inshore Artisanal Fishery landed 36,581 tonnes, and the Inland Fishery and Aquaculture 800 tonnes. Sub-sector production is shown in Table 1.

Table 1: Showing Fisheries sub-sector Production (tonnes) for the period 1993 – 1996

Product	Year			
	1993	**1994**	**1995**	**1996**
Prawns (tail weight)	1,821	1,890	1,874	1,260
Seabob & Whitebelly (Unprocessed)	5,614	6,737	9,344	14,501
Seabob & Whitebelly (Processed)	1,640	1,968	3,128	NA
Finfish (Industrial)	1,333	1,589	1,916	NA
Finfish (Artisanal)	35,818	36,533	35,332	34,947
Finfish (Inland) including Aquaculture	800	800	800	800

Source: Guyana Department of Fisheries Report, 1995 & DOF Statistics, 1997)

(iii) Exports
Guyana's 1996 export earnings from the Fisheries Sub-sector were approximately G$ 3.7 billion.

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(iv) Employment and Income

The fishing industry employs some 4,800 people in harvesting and 5,800 in processing and marketing. Also, many people benefit from fishing related occupations such as boat building, requisite supply and repair.

(v) Revenues Derived from the Fisheries

The Fisheries Sub-sector is a significant contributor to government revenues in Guyana through export levies and licence fees. Export levies of 10% on the reference value of shrimp, 5% on the reference value of ornamental fish and 1.5% on the reference value of finfish generate substantial revenues for the Government. In 1996, the total revenues earned were G$167 530 349. The export levies have been waived as of February 1997.

2. EXCLUSIVE ECONOMIC ZONE (EEZ)

Guyana has a coastline of 432 km and a continental shelf area of 48,665 sq. km. The average width of the continental shelf is 112.6 km, while the area of the EEZ is 138,240 sq. km. The living marine resources being exploited within the EEZ are mainly the demersal resources (shrimp and groundfish) and to a limited extent, the pelagic resources over the continental shelf and towards the continental slope.

2.1 Description of the Fisheries

The Fisheries Sub-sector of Guyana has three main components, each with further subdivisions as follows:

Marine Fishery
(i) The Offshore Industrial (Trawl) Fishery
(ii) The Inshore Artisanal Fishery

Inland Fishery
(i) Subsistence Fishery
(ii) Ornamental Fish Fishery

Aquaculture
(i) Brackish-water Culture
(ii) Fresh-water Culture

2.1.1 Description of the offshore industrial and inshore artisanal shrimp fisheries

The offshore industrial shrimp trawl fleet exploits mainly penaeids (*Penaeus spp.*) in the case of the penaeid trawl fleet and seabob (*Xiphopenaeus kroyeri*) in the case of the seabob/finfish trawl fleet. The whitebelly shrimp (*Nematopalaemon schmitti*) is also seasonally caught to a much lesser extent as incidental catch in the seabob/finfish fishery.

The Chinese seine vessels of the inshore artisanal fleet exploit both seabob and whitebelly shrimp. Some of the larger penaeid shrimp are occasionally caught in the Chinese seine fishery. Also, various finfish species, including juveniles, are caught.

2.1.2 Offshore industrial fishery

The Offshore Industrial Fishery consists of 127 trawlers (Table 3), 5 fish/shrimp processing plants and numerous wharves and dry docking facilities. The trawlers are 48 percent foreign owned. Foreign trawlers mainly exploit penaeid shrimp *(P. brasiliensis, P. notialis, P. schmitti, and P. subtilis)* with finfish and small amounts of squid (*Loligo spp.*) and lobster (*Panulirus spp.*) as by-catch. The locally owned trawlers mainly exploit seabob (*Xiphopenaeus kroyeri*) and various finfish species (*Macrodon ancylodon, Micropogonias furnieri, Nebris microps, Arius spp., Cynoscion spp.*,), with small quantities of penaeid shrimp as by-catch.

2.1.2.1 Vessel Description

The penaeid and seabob/finfish trawlers are the standard Gulf of Mexico type trawlers. The Japanese vessels are 19.81 m (65 ft.) in length. The American and local vessels range from 18.90 to 22.86 m (62-75 ft.) in length, with the American vessels being on the average 20.42 m (67 ft.) in length (Shepherd and Charles, 1996). The local vessels are powered by inboard Caterpillar diesel engines while the American fleet are powered by Cummings engines. The engine horsepower ranges from 365 to 425 HP. The finfish trawlers are Japanese built stern trawls. They are approximately 13.72 m (45 ft) long and are powered by 240 HP Yanmar diesel engines (Shepherd and Charles, 1996). Chinese seine vessels are small flat-bottomed dory type vessels 6.40 to 12.19 m (21 - 40 ft.) in length and are powered by sails or outboard engines (Frame survey, 1994).

2.1.2.2 Fishing gear

Nylon or polyethylene jib trawl nets with 4 to 5 cm (1.6 - 2.0 inches) stretched mesh in the wings and 2.5 - 3.5 cm (1 to 1 ½ inch) stretched mesh in the cod-end are used in both the penaeid and seabob/finfish fleets (DFB, 1994).Turtle Excluder Devices (TED's) are mandatory for the entire shrimp trawl fleet.

The finfish trawlers use stern trawl nets with 10.16 cm (4 inches) mesh size. The Chinese seine vessels use funnel shaped fyke nets with mesh size of 8 cm (3.15 inches) at the mouth and 1 cm (0.39 inches) at the tail end.

2.1.2.3 Fishing Operations

At the beginning of a shrimping operation, a small try-net is towed for 10 - 30 minutes to test the area for abundance of shrimp (DFB, 1994). The American fleet, starting in 1982, (and more recently a few of the local vessels) began using 4 *10.67 m (35 ft) nets at a time ("twin trawling"), while the Japanese and the local fleets tow 2 * 13.72 to 15.85 m (45 - 52 ft) nets at a time. In "twin trawling" a sledge is used between each pair of nets. The penaeid shrimp trawls are equipped with tickler chains which stir up the bottom substrate and cause the shrimp to jump into the nets. The seabob/finfish trawls are fitted with drop chains around the mouth opening of the nets. They tow 2 * 13.72 to 15.85 m (45 - 52 ft) nets at a time.

Table 2: Total Number of Trawlers

Year	Total number of vessels
1986	128
1987	129
1988	119
1989	118
1990	122
1991	115
1992	120
1993	114

(DOF Statistics, 1996 and WECAFC, 1995)

In 1994, 28 local vessels were operative, while in 1995 and 1996, 25 and 27 vessels were operative respectively.

The 1994 census of the Inshore Artisanal Fishery covered 253 Chinese seine vessels. DOF estimates put the number of these vessels at 354 for the year 1996.

Appendix 1: The Statistical Fishing Zones of Guyana

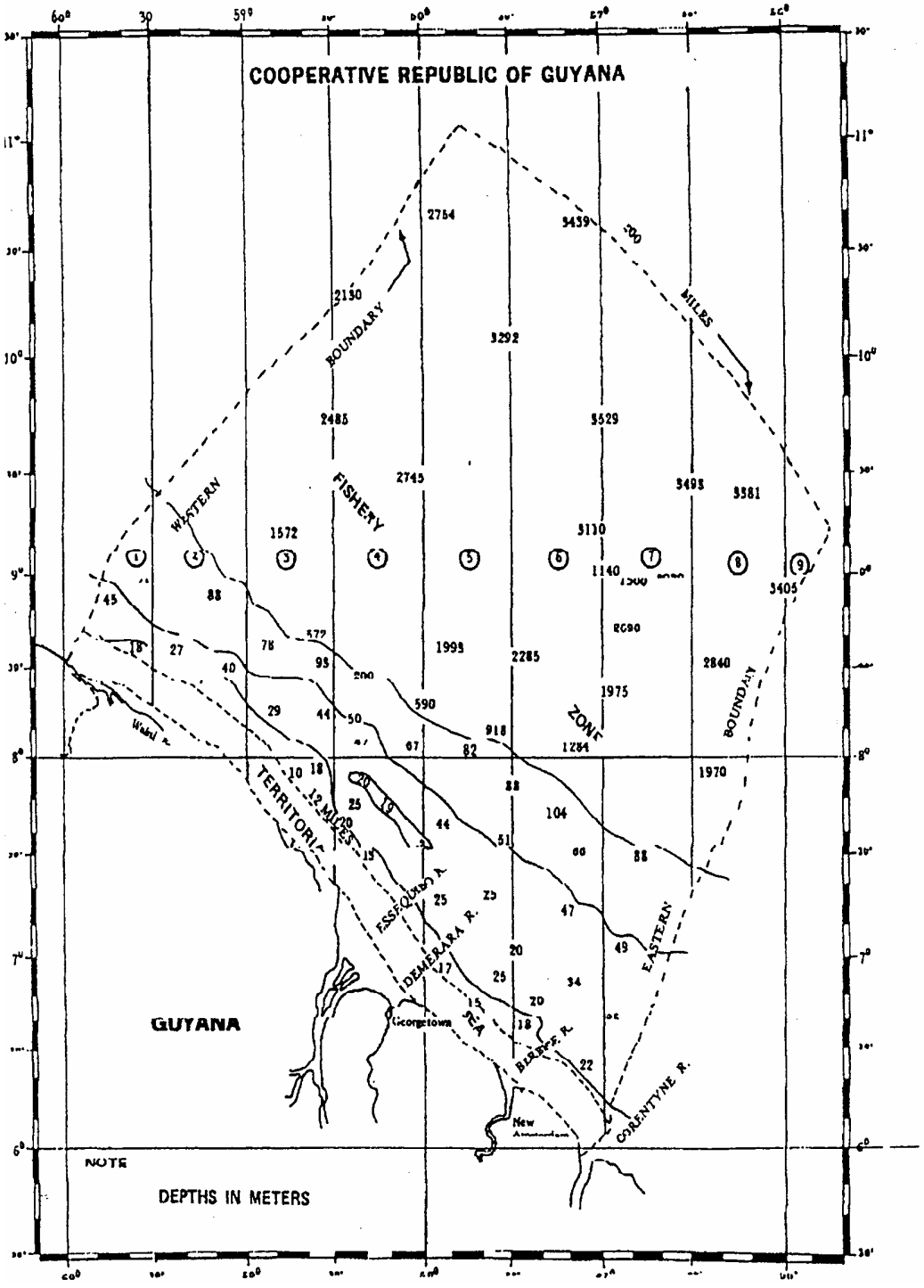

Figure 1: The statistical fishing zones of Guyana

Table 3: Type of Vessel by Year and Fishery Classification

Year	Type of Vessel			Total
	Penaeid Shrimp	Seabob/Finfish	Finfish	
1994	72	45	6	123
1995	72	47	6	125
1996	73	48	6	127

(DOF Statistics, 1996)

2.1.2.4 Crew

Penaeid shrimp trawl vessels normally have a crew of 5 while seabob vessels and finfish vessels carry 5 - 6 and 4 - 5 respectively. Chinese seine vessels carry 2 - 4 crew.

2.1.2.5 Fishing strategy

The EEZ, for statistical purposes, has been divided into Fishing Zones which are defined according to the degrees of longitude within which they lie, with each zone being separated from the other by an interval of 30 degrees (Shepherd and Charles, 1996) See Figure 1 for the Statistical Fishing Zones of Guiana.

Penaeid trawl vessels operate from 40 to 145 km offshore at depths of 18 to 91 m. The Japanese fleet tends to trawl much further offshore than the American and local fleets. The bottom areas are usually mud or a mixture of sand and mud (DFB 1994). Trawlers tend to operate in Fishing Zones 1-6 in January, moving gradually eastward to Zones 4-8 in April, returning to Fishing Zones 1-7 in May. In June, July, and August, the fleet tend to operate in Fishery Zones 1-8, shifting to Fishing Zones 2-6 from September to November and moving to Fishing Zones 3-8 in December. In the early 1980's operations were much more concentrated to the east in Fishery Zones 5-9. Most shrimp are caught at night (DFB 1994).

The industrial seabob fishery began in 1985 (Charles, 1990). Seabob trawlers operate 15-30 km from shore in 13-18 m of water. Fishing operations begin in Fishing Zone 4 in January, gradually moving east to Fishing Zone 5 in March and Fishing Zone 6 in April. The fleet returns to Fishing Zone 4 in May, and fishes there until August, after which the fishing operations cease, except for some effort in Fishing Zone 4 in November. Most seabob are caught by day (DFB 1994).

Chinese seine fishing takes place at or around the mouths of rivers, because the operations are heavily dependent upon the influence of the river currents. The nets are attached to poles set in the river at distances of approximately 1 mile from shore.

The target species caught by the 73 penaeid shrimp trawlers are *P. brasiliensis, P. notialis, P. schmitti, and P. subtilis*, with assorted finfish, small amounts of squid (*Loligo spp.*) and lobster (*Panulirus spp.*) as by-catch.

The 48 local trawlers target seabob (*Xiphopenaeus kroyeri*) and various finfish species (*Macrodon ancylodon, Micropogonias furnieri, Nebris microps*, *Arius spp., Cynoscion spp.*), with small quantities of *Penaeus spp*. as by-catch. Only 28 of these vessels are currently in operation. The local shrimp vessels tend to shift their operations from seabob to penaied shrimp (*Penaeus spp.*) during the seasons when the seabob resources are scarce. The 6 finfish stern trawlers target *Macrodon*

ancylodon, Micropogonias furnieri, Nebris microps, Arius spp.*, Cynoscion spp.* Only 2 of these vessels are currently in operation.

Both American and Japanese trawlers make an average of 3 - 4 hauls per day, with each haul being of 4 - 6 hours duration. The local penaeid shrimp vessels make an average of 3 hauls per day, with each haul being of about 4 hours duration. The American and the local vessels average 8 trips per annum, while the Japanese vessels average 6 trips per annum. The American vessels spend 35 - 42 days at sea,

while the Japanese tend to spend much longer times at sea, usually 40 - 50 days. The locally owned penaeid shrimp vessels would spend an average of 30 days at sea. The seabob trawlers spend 5 - 9 days at sea, but an average trip lasts 7 days. A typical seabob vessel makes 2 - 3 trips per month, and an average of 30 trips per annum. The Chinese seine vessels operate with the tide and as such they make 1 or 2 trips per day, with each trip lasting between 6 - 12 hours (Table 4).

Table 4: Fishing Trip Characteristics by Fleet

Vessel Type	Nationality	Average trips/yr	Average trips/month	Average days/trip	Average hauls/day	Average duration of haul (hrs)
Penaeid Shrimp	American	8	NA	35 - 42	3 - 4	4 - 6
	Japanese	6	NA	40 - 50	3 - 4	4 - 6
	Local	8	NA	~ 30	3	4
Seabob/ finfish	Local	30	2 - 3	5 - 9 avg. 7	4	3 - 3.5
Chinese Seine	Local	300	~ 18	0.25 - 0.5	1 set	6 - 12 avg. 9

Source: DOF, 1997

2.1.2.6 Processing

Penaeid shrimp are headed on board and frozen. At the processing plant, the tails are machine graded into commercial size categories. The white shrimp *(P. schmitti)* are graded separately from the other 3 species *(P. brasiliensis, P. notialis,* and *P. subtilis).* The seabob catch is stored on ice on board vessel. At the processing plants, the catch is machine peeled and graded into commercial size categories. The shrimp catch from the Chinese seine is landed fresh, and is sold to hucksters and to middlemen or representatives of processing plants.

There are 4 major industrial processing plants, namely:

(i) Georgetown Seafoods and Trading Company Ltd. (GS&TCL), an American company which processes the penaeid shrimp catch and more recently the finfish by-catch from its fleet of 55 vessels.

(ii) Marine Food Products Ltd. (MFPL) which processes the penaeid shrimp catch from the Japanese fleet. This plant also processes finfish from the stern trawlers and some amount of fish that is purchased from inshore artisanal vessels.

(iii) Noble House Seafoods (NHS) which processes the seabob catch from its fleet of 16 vessels. This plant also processes finfish that is purchased from inshore artisanal vessels.

(iv) BEV Enterprises which processes the seabob catch from the other local vessels (with the exception of the NHS vessels), and hand grades the penaeid shrimp by-catch brought in by those vessels. This plant also processes seabob and finfish that are purchased from the Chinese seine vessels.

2.1.2.7 Marketing

Upwards of 95 % of the penaeid shrimp are exported, primarily to the USA, and smaller amounts to Japan, Canada and CARICOM countries. For 1996, 1,366 tonnes of penaeid shrimp were exported. Approximately 90 % of the seabob is exported, primarily to the USA, and smaller amounts to CARICOM countries. For 1996, 2,836 tonnes of seabob and whitebelly shrimp were exported (Table 5).

Table 5: Exports of Marine Products (tonnes), 1989-1996

Item	1989	1990	1991	1992	1993	1994	1995	1996
Penaeid Shrimp	1 892	1 665	1 922	1 526	1 630	1 483	1 819	1 366
Seabob & Whitebelly	719	669	1 073	1 238	1 239	1 408	2 408	2 836
Finfish & By-products	943	1 521	2 367	3 151	3 080	3 485	NA	3 632
Crabmeat	4	2	10	16	11	9	27	0.14
Total Exports	3 558	3 857	5 372	5 931	5 960	6 385	4 254	7 834

Source: DFB, 1994, Guyana Department of Fisheries, 1995, and DOF Statistics, 1996)

2.2 Objective for the Management and Development of the Fisheries Sub-sector

The overall objective for the management and development of the Fisheries Sub-sector is to achieve sustainable levels of production, productivity and real incomes of fishery producers and other groups involved in the delivery of products to domestic and export markets, thereby contributing to national production, income and welfare.

Another objective is to substantially improve the functioning of the Fisheries Department of the Ministry of Agriculture and other public sector institutions serving the Fisheries Sub-sector through the provision of adequate legislation, sufficient human resources, modern facilities and improvement in the systems for accountability. Also, one other objective is to ensure that the scientific and technological base of fisheries is improved through adequate funding and organisational improvements to research and extension systems so as to enable the Sub-sector to compete, on an equal footing, in the global economy.

2.2.1 Specific objective

The management objective for penaeid shrimp is to stabilise landings/production, whereas that for seabob and finfish is to increase production. In the case of penaeid shrimp and seabob, the fishery is mainly export oriented (foreign exchange). For finfish, the goal is improved nutrition for the population, increased employment and incomes and aggregate output thereby stimulating growth of the national economy.

The seabob and demersal finfish fisheries would be reserved mainly for Guyanese operators. In the case of the penaeid shrimp fishery which already has foreign participation, in any pull-outs by companies/individuals both foreign and local from the limited entry fleet, the preference for replacement will go to a Guyanese company/ individual. The Chinese seine is the only known means in Guyana of harvesting the whitebelly shrimp (*Nematopalaemon schmitti*). Thus, in addition to the likely socio-economic aspects, there would appear to be some need for the use of the gear.

Regulation will therefore look at first limiting the number of licences to those operators already in the fishery while attempting to reduce support for any new or renewal of Chinese seine operations. Limits on the number of seines per vessel will also be considered.

2.2.2 Current management

The penaeid shrimp resource is either being fished at its optimum sustainable yield or above.

The seabob resource which was relatively under-exploited (mainly by Chinese seines) in the past is now being more fully exploited (Chinese seines and trawlers) with the advent of a number of seabob processing plants. Until more is known about the seabob resource some caution would have to be exercised in terms of fleet expansion (Phillips, Aiken and Mahon, 1992).

The state of the finfish resource (groundfish, pelagic & deep-slope) taken as by-catch or by directed trawling would have to be determined in relation to the activities of the Inshore Artisanal Fishery and the Snapper/Grouper Fishery**.**

In keeping with the Fisheries Act 1958 and Maritime Boundaries Act 1977, trawlers are registered and licensed, with the type of licence depending on foreign or local ownership, length of vessel and base of operation. Fishermen are also licensed. Transhipment at sea is prohibited by law.

All shrimp trawlers are required to use TED's when trawling. They are also required to land 32,000 lbs of by-catch per annum as a licencing condition.

The trawler fleet is demarcated in terms of their operations (penaeid shrimp, seabob/ finfish, finfish) and the vessel license indicates this. The penaeid shrimp fleet operate as a limited entry fleet with the upper limit having been set at 100. The seabob/finfishing fleet operates as a limited entry fleet with the upper limit being set at 30. This number is influenced not only by the paucity of information on the seabob resource, but also by the fact that these vessels operate within the nursery grounds of the marine fishery (Phillips, Aiken and Mahon, 1992). The Chinese seine fleet is operated on an open access basis.

Fishing vessels have to be registered and licensed. Crew are also licensed. Chinese seine operators are required to have fish pen permits for each pen set up.

2.2.3 Proposed management of the fishery

2.2.3.1 Penaeid shrimp

Current levels of information indicate that a limited entry fixed fleet approach should be maintained, with consideration being given to:

- prohibition of trawling for penaeid shrimp from 18 fathoms shoreward;
- a closed season for penaeid shrimp.

The limit of 100 vessels currently in use needs to be reviewed (Phillips, Aiken and Mahon, 1992).

Considering the economic importance of shrimp on the Guiana-Brazil shelf, there is need for a regional management approach.

2.2.3.2 Seabob

As a precaution, the limited entry fixed fleet approach should be maintained, with consideration being given to:

- the restriction of trawling for seabob to areas of high adult abundance with a view to reducing conflicts with artisanal fishermen and damage to nursery areas and juveniles.

The limit of 30 vessels should be reviewed.

2.2.3.3 Finfish

In the case of directed trawling for demersal finfish, a limited entry fixed fleet approach may be taken as a precaution, with consideration being given to:

- the restriction of trawling with a view to reducing conflicts with artisanal fishermen and damage to nursery areas and juveniles;

- mesh size regulations and appropriate finfishing trawls;

- adjusting fishing effort to account for by-catch taken in the penaeid shrimp and seabob fisheries.

As these fisheries develop, it may become necessary to apply more complex methods such as fleet quotas, and transferrable quotas which would allow more economically efficient use of the resource.

There is need to generate bio-economic data to facilitate bio-economic modeling (Phillips, Aiken and Mahon, 1992).

The issues of illegal foreign fishing, transshipment at sea (“over the side sales at sea”) and conflicts with artisanal fishing operations need to be urgently addressed.

2.2.3.4 Environmental considerations

Degradation of coastal habitats (mangroves and other wetlands) which are known to serve as nursery areas for many of the species harvested in the Offshore Industrial Trawl Fishery can be expected to impact negatively on the yields of the Fishery. The interaction with coastal aquaculture (brackishwater culture) both in terms of the destruction of the wetland area and the collection of eggs, fry and juveniles from the sea for culturing would also have to be carefully monitored and controlled as this activity can have adverse effects on the fishery.

The approach to ensuring adequate conservation of these habitats should be an integrated one in keeping with the concepts of coastal zone management.

The environmental impact of the use of sledges in the shrimp trawl fishery needs to be closely examined, especially with respect to possible habitat degradation.

2.3 Description of the Inshore Artisanal Fishery

Guyana is divided into ten (10) administrative regions (Figure 2). Marine fishing occurs off the coast of six (6) of these regions.

The Inshore Artisanal Fishery is made up of an estimated 1 331 boats ranging in size from 6-18 m and powered by sails, outboard, or inboard engines. The 1994 Inshore Artisanal Fishery Census only captured a total of 936 vessels (Table 6). Activity in the inshore artisanal fishery is pursued exclusively by Guyanese. All the boats are made from wood and are manufactured locally. The fishing gear in use includes pin seines, Chinese seines/fyke nets, cadell lines/"demersal longlines", drift nets/gillnets, circle seine and handlines/snapper lines.

A flat-bottom dory powered by sail, paddle, or small outboard engine is used for Chinese seine, cadell lines and a few pin seines to give more manoeuvrability over shallow, muddy and sandy bottom areas. These boats which operate close to shore are not equipped with ice boxes.

A V-bottom boat, ranging in size from 7.63 -9.15m (25 - 30 ft) and with no cabin but with an ice-box and powered by an outboard engine is used by smaller gillnet (gillnet nylon) fishermen. A larger V-bottom vessel size 12.2 - 15.25 m (40 – 50 ft), with an inboard engine and cabin is used for larger gillnet and handline operations. Physical characteristics of the boats, their method of propulsion, length of the fishing trip, crew size, catch composition and the principal fishing grounds of the Guyana Artisanal fleet are provided in Table 7.

There are about 4 500 artisanal fishermen and of these about 1,000 are boat owners. Sixty to seventy percent of the boat owners are members of Fishermen's Cooperatives which acquire and sell fishing requisites to their members (DFB, 1994).

There is onshore infrastructure (wharves, ramps, workshops, fuel depots, requisite shops, ice machines and storage bins, and fish storage bins) at eight sites along the coast for this Fishery. Five (5) of these complexes have been leased to the fishermen's cooperatives within whose boundaries they fall for management and operations. Joint-venture arrangements have been proposed for the remaining three (3) complexes.

Figure 2: Administrative regions

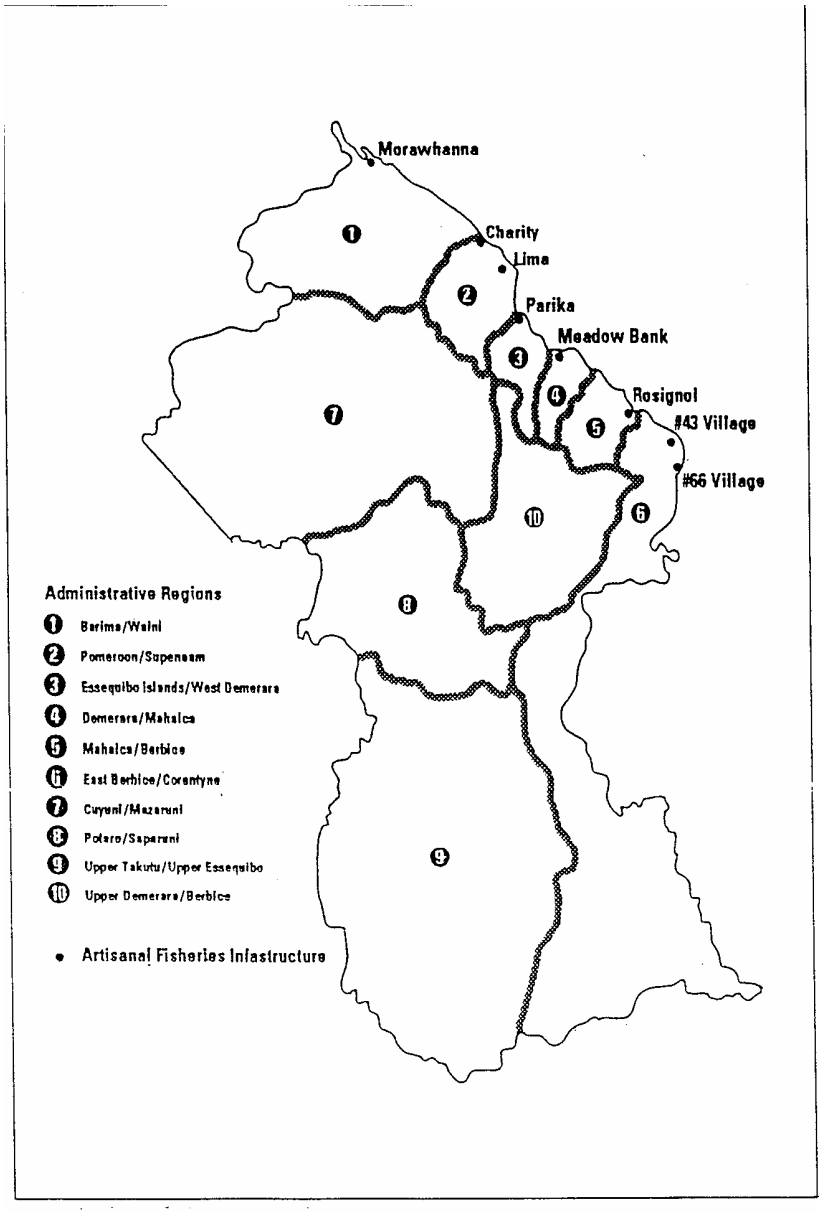

Table 6: Inshore Artisanal Fleet

REGION	Number of Vessels by Gear Type by Region				TOTAL
	Chinese Seine	Pin Seine	Cadell	Gill net	
2	20	7	9	52	88
3	69	5	14	51	133
4	86	6	27	250	368
5	38	7	18	64	127
6	40	21	11	121	193
7	0	0	0	20	20
TOTALS	**253**	**46**	**79**	**558**	**936**

Source: DOF, 1994

2.3.1 Fishing area

The EEZ, for statistical purposes, has been divided longitudinally into nine (9) Fishing Zones, each separated by 30 degree intervals (Shepherd and Charles, 1996; Figure 1). Artisanal fishers operate on the continental shelf at distances up to 56 km (30 miles) from the shore, all along the coast.

2.3.2 Seasonality

The most productive period generally runs from March through October which is the period when most of the common species (*X. kroyeri, N. schmitti, Macrodon ancylodon, Cynoscion virescens, Micropogonias spp.*, etc.) are available to the fishery. Most Scombrid species (*Scomberomorus brasiliensis, Scomberomorus cavalla*, etc) are abundant from May to September. During the months of November to February, most finfish species are relatively scarce and the fishing effort has to be increased to obtain a reasonable catch. This coincides with the period when the winds are high and the seas rough (Shepherd and Charles, 1996).

2.3.3 Gear types in the inshore artisanal ffishery

There are six types of artisanal fishing gear, namely: (i) Chinese seine/fyke net, (ii) pin seine, (iii) cadell, (iv) gillnet (nylon and polyethylene), (v) handline, (vi) circle seine. Handlines and circle seines are very few in number.

The description of each gear type/fishery is as follows:

2.3.3.1 Chinese Seine

This is the only gear type used in the Inshore Artisanal Shrimp Fishery of Guyana. Chinese seines are funnel-shaped nets, 16 m (52 ft) long and 4-6 m (13.1-19.6 ft) wide at the mouth. The mesh size gradually tapers from 8 cm at the mouth to 1 cm at the funnel. A flat-bottom dory vessel powered by sail, paddle, or small outboard engine is used in the fishing operations. Based on the 1994 Inshore Artisanal Fishery Census, there were 253 Chinese seine vessels, accounting for 27% of the artisanal fleet (Table 6).

(i) Fishing strategy

These fishing operations work in relation to the tide and involve between 6 to 12 hours per day fishing. Some operators fish both tides per day. The seines are attached to poles and set on mud banks, mainly in the river mouths, where tidal currents sweep the fish and shrimp into them. The

seines are set at depths between 2 and 6 fathoms, at a distance of about one mile from the shore. The crew size on these vessels ranges between 2 and 4.

(ii) Catch

The catch consists primarily of *N. schmitti* (whitebelly shrimp), *Xiphopenaeus kroyeri* (seabob), *Macrodon ancylodon* (bangamary), *Nebris microps* (butterfish). An undetermined amount of juvenile fish is caught in the Chinese seine fishery and is discarded or used to produce "fish meal".

(iii) Processing

The whitebelly shrimp is landed whole. It is then dried and the shell removed. The shell or shrimp meal is used as livestock feed. The dried shrimp is sold either locally or exported. The fish is landed whole and sold fresh.

(iv) Marketing

The marketing of shrimp and fish by the Chinese seine operators is done by several channels depending on the landing site.

Shrimp/fish is sold as follows:

- directly to processing plants (Cottage Industry) where it is dried and marketed locally or exported to countries such as USA and Holland. This is one of the major marketing channels for Chinese seine operators in Region 3;
- by fishers to consumers;
- by fishers to vendors who retail it to the public from market stalls, roadside tables or from door to door.

2.3.3.2 Cadell line

The cadell or demersal longline fishing vessels range in size from 6.71-9.15 m (22 – 30 ft). During the 1994 Inshore Artisanal Fisheries Census, 79 vessels were counted. This accounted for 8% of the total artisanal fleet. A flat-bottom dory vessel powered by sail, paddle or small outboard engine is used for cadell line.

A cadell line consists of a horizontal/ground line anchored at each end, with a series of about 800 dangling/vertical lines, set with baited hooks at 2 m. outwards. Each vessel carries between 4-5 wooden trays with each tray having from 2-6 main lines.

(i) Fishing strategy

Before each trip, the hooks are baited and stored in the trays. Keybrand hooks are normally used. Bait includes bangamary, mullet and shrimp. These vessels operate on a daily basis with each fishing trip lasting for approximately l2 hrs. Most of the fishing activities occur at night and sometimes during the day. Fishing occurs between l0-l2 miles from the coast in waters approximately 5 - l0 fathoms deep. Crew size on a cadell vessel ranges from 2 to 4.

(ii) Catch

The catch consists mainly of *Arius parkieri* (gillbacker), *Bagre bagre* (catfish), *Arius proops* (cuirass), (*Arius phrygiatus*) kwakwari and various species of shark which are landed headless and gutted.

(iii) Processing

The catch is landed either sorted or unsorted depending on the landing sites. Most fish caught by this gear type are landed whole with the exception of the various shark spp. These vessels are not equipped with iceboxes. Shark is processed into dried shark, the fins of the shark are removed along with the bones. These processed products are exported but some dried shark is consumed locally.

(iv) Marketing

Fresh fish is sold directly from the wharves and landing site to processing plants and retailers. Fresh fish is also sold directly to exporters from the landing sites.

2.3.3.3 Gillnet fishery

The gillnet is the most productive gear in the artisanal fishery of Guyana. More than half of the total catch is caught with gillnets. Based on the results of the 1994 Artisanal Frame Survey, it was estimated that there is a total of 921 artisanal fishing vessels, of which 586 (64 %) are equipped with gillnets.

There are several types of gillnet operations. These are as follows:

- gillnet polyethylene inboard engine
- gillnet polyethylene outboard engine
- gillnet nylon outboard engine
- circle seine -modified gillnet nylon outboard
- tangle seine -modified gillnet nylon outboard

The gillnet vessels of Guyana can be conveniently grouped into two size categories, large 12-16 m (38.4-52.5 ft) and small 8-10 m (26.2-32.8 ft). Large gillnet vessels, using gillnet polyethylene (GNP) are diesel-powered inboard engine vessels with insulated ice boxes capable of carrying up to 5 tonnes of ice. Most of these vessels are equipped with compasses. The length of their trip is 10-12 days. Typically and a gillnet (polyethylene) vessel will have a crew size ranging between 4-6 which consists of a captain and workmen.

There are also gillnet polyethylene outboard engine vessels known as "cabin cruisers". These vessels are equipped with ice boxes and fish for 5-6 days. Crew size ranges from 4-6.

Small gillnet vessels using gillnet nylon (GNN) are equipped with outboard motors up to 48 horsepower, and fish and land their catches along the entire coast of Guyana (Table 8). These vessels with small ice boxes remain at sea for 2-3 days at a time, while others without ice boxes land their catches about every 12 hours. A gillnet (nylon) vessel will have a crew size of 4 consisting of a captain and three workmen (Chakalall and Dragovich, 1979). Both types of gillnets are called “drift seine”.

A circle seine is a modified nylon gillnet used in the Corentyne River. Fishermen have developed circle seines of different types and sizes to catch schooling fish when they are abundant.

Gillnets polyethylene (inboard and outboard) vary in length from 1 000 to 1 600 m and are 4 m deep with a stretched mesh size of 20 cm (6 – 8 inches). Polyethylene nets are preferred by the fishermen because the nets last longer and tangle less than those made of nylon. Gillnet (nylon), a modified version of the gillnet gear type, measure about 300 m in length and have smaller mesh sizes 8 cm (2.5-4 inches). These are being used by some fishermen near the inshore area. Gillnets are very selective, catching only fish of a distinct size.

(i) Fishing strategy

The structure of a gillnet is very simple. It is a single wall of net which comprises several sheets of netting joined together. It has floats for buoyancy as well as sinkers to enable it to expand vertically when submerged under the water. The depth of the net is determined according to the density of fish schools and the depth of the swimming layer of fishes to be

Table 7: Characteristics of the Artisanal Fishing Fleet of Guyana

No. of Vessels		Method of propulsion	Length of Vessels (m/ft)	Gear Type	Trip length	Catch Composition	Crew Size	Method of preser-vation	Estimated annual landings (1996) (tonnes)	Principal Fishing Area
Frame Survey	1996 Estimate									
	11	Inboard Diesel	14/45	Handlines	12-18 days	snappers, groupers	8	Ice	299	Edge of continental shelf, rocky areas (areas between 10 and 20 fathoms)
558	78	Inboard Diesel Lister Piter, Perkins 210 hp	12-15/40-50	Gillnet polyethylene (inboard)	10-12 days	grey snapper, sea-trout, gillbacker, tarpon, Spanish-mackerel, croaker, snook, shark spp.	4-6	Ice	1,137	Area between 10 and 20 fathoms.
	469	Outboard engine 48 hp	8-11/35	Gillnet polyethylene (cabin-cruiser)	6 days	grey snapper, sea trout, pagee, tarpon, croaker, gillbacker, Spanish mackerel.	4-6	Ice	9,114	Area between 10 and 20 fathoms
	244	Outboard engine 25 hp	30m	Gillnet nylon	1 day	bangamary, sea-trout, butterfish.	4	Ice	7,951	Area between 10 and 15 fathoms
253	354	Sail, outboard engine 6 - 9 hp	6.40-12.19 m (21-40ft.)	Chinese seine	6 – 12h	whitebelly, seabob, immature fish, bangamary, butter-fish, catfish	2-4	Fresh	finfish-7,951 seabob-1,460 whitebelly-1,749	Estuaries, river mouths and banks on the coast.
79	111	Outboard engine 6 - 9 hp	6 - 9/15 - 30	Cadell	12h	catfishes, sharks spp.	2-4	Fresh	6,355	Areas between 5 and 10 fathoms.
46	64	Sail, outboard engine	6 - 9/15 - 30	Pin Seine	12h	mullet, snook, queriman, catfish, croaker, bangamary	2	Fresh	299	Intertidal zones

Modified from Chakalall, 1979

caught. The net can be made to rest on the bottom layer, to hang in midwater, or to float in the surface layer. The ease of handling the gear is also to be taken into account. A gillnet catches fish that swim into it. The fish is usually caught by its gill. When the fish swims up to the net it sticks its head right into one of the meshes. When the fish tries to pull its head out of the mesh the thin twine cuts into its skin; its gills and fins get caught in the mesh. The fish stays in the net until it is pulled up.

Fish are also caught when the net wraps around them as in the case of the tangle seine. Drift gillnets are not secured by anchors, but are allowed to drift at the mercy of the winds and/ or currents. They are by and large operated at the surface or mid-layer of the water. Since the gear is not anchored, fishing places are considerably extensive. It is possible to set the net chasing a school of fish.

With a circle seine, the net is lowered into the water from the back of the vessels in such a way that it will surround the fish school. The fish encircled will try to escape out of the net and become entangled as well as gilled.

(ii) Fishing area

Drift seining is practiced along the coast in deep waters 31-39 km (19-24 miles) offshore in areas between the 18-36 m (10-20 fathoms) isobaths. Circle seine and tangle seine operations are usually practiced in the Corentyne area.

There is a large concentration of gillnet vessels in Region 4 followed by Regions 6, 5 and 2 (Table 8).

Table 8: Breakdown of Gillnet Vessels by Region

Region	No. of Gillnet Vessels
2	52
3	51
4	300
5	64
6	119
Total	586

(iii) Catch

The gillnet fishery accounts for approximately 60% of the artisanal landings. For the gillnet polyethylene (inboard and cabin cruiser), the catch consists mainly of *Cynoscion acoupa* (grey snapper), *Centropomus spp*. (snook), *Scomberomus brasiliensis* (spanish mackerel), *Caranx hippos* (cavalli), *Arius parkieri* (gillbacker), *Carcharhinus limbatus* (blacktip shark), *Rhizioprionodon porosus (*Caribbean sharpnose sharks) *Micropogonias furnieri* (bashaw), *Megalops atlanticus* (cuffum), *Cynoscion virescens* (sea trout), *Lobates surinamensis* (pagi), *Epinephelus spp*.(jew fish). Swim bladders (fish glue) are landed either fresh or dried. Some GNP vessels practice direct fishing for shark.

For the gillnet (nylon), the catch consists mainly of *Macrodon ancylodon* (bangamary), *Nebris microps* (butterfish) and *Cynoscion virescens* (sea trout).

For the circle seine, the catch consists of *Micropogonias furnieri* (bashaw), *Hypophthalmus edentatus* (highwater), *Aridae spp.* (lau lau and bringle) and *Macrodon ancylodon* (bangamary).

(iv) Processing

Fish from the gillnet vessels are landed either whole, gutted or headless. Shark spp. are landed headless and gutted, grey snapper and sometimes snook and sea trout are landed gutted. Gillbacker is landed whole. Since these vessels are equipped with iceboxes the fish are stored on ice at sea.

(v) Marketing

Price is the main determinant of the choice of the marketing channels but convenience is also an important factor. The marketing of fish caught by the gillnet vessels is carried out through several channels
Fish are sold as follows:

- directly by the fisher to the consumer;
- by the fisher to a vendor or huckster who retails it to the public from market stalls, roadside trays or peddles from door to door;
- by the fisher to processing plants (Cottage Industries and BEV Enterprise Ltd) which may sell in the domestic market but more typically export the fish. The fish is cleaned and frozen. Sometimes it is dried (as in the case of shark spp.). The processing plants tend to buy the large fish leaving the smaller fish to the hucksters.

A small percentage of fishermen/owners retail on their own. The major exporters in the Cottage Industry are F. Jhumman, K. Seepersaud, E. Lord, Jhasshri and A.A Shakoor.

2.3.3.4 Pin seine fishery

Pin seine fishing is practised mainly in Regions 2 and 6. Pin seine or beach seine comprises the smallest number of vessels of the artisanal fleet. According to the results of the 1994 Artisanal Frame Survey there are 46 pin seine vessels which accounts for 5% of the artisanal fleet of Guyana (Table 6).They are usually 2 m in depth and 2 000 m in length, with a stretch mesh size of 9 cm or less.These vessels are mainly between 6.40 to 12.19 m (21-40 ft) in length and are driven by outboard engine or sail.

(i) Fishing strategy

The net is set at high tide in the intertidal zone. A row of stakes arranged in a semicircle holds the net in a vertical position. During the ebbing tide the fish are trapped and then retrieved from the mud flats by the use of a “catamarang”, which is an upward-curved mud-riding board of about 2 m (6.6 ft) in length and 60 cm (23.6 inches) wide fitted with a fin underneath and a box for storing fish. The fishermen pick up their catch from a kneeling position on their catamarangs.

(ii) Catch

Their catch includes *Mugil spp.* (mullet), *Mugil sp*. (queriman), *Centropomus sp.* (snook), *Macrodon ancylodon* (bangamary), *Micropogonias furnieri (*croaker), and catfishes of the family *Ariidae*. There are also discards of juvenile fishes of which the species and amounts are not known.

2.3.3.5 Handline fishery

Fishing boats known as handliners are l8 m in length and fish between 18-36 m (l0-20 fathoms) near the edge of the continental shelf. Handliners are equipped with insulated ice boxes which hold up to 5 tonnes of ice. Each fishing trip is l2-l5 days. Each boat is equipped with eight polyethylene handlines, one handline per fisherman. Each line carries l6 hooks, size 4 or 5.

(i) Catch

Their catch consists mainly of *Lutjanus spp.* (snappers) and *Epinephelus spp.* (groupers).

(ii) Marketing

The fish landed from handline vessels are sold directly to the processing plant (BEV Enterprise). Most of the fish is exported, with a small amount being sold locally mainly to hotels and restaurants.

2.4 Management Objective for the Inshore Artisanal Fishery

The management objective for the artisanal fishery is to increase the landings to a sustainable level which would enable the fishery to contribute to improve nutrition for the population, export earnings, increase employment and aggregate output thereby stimulating growth of the national economy.

The strategy would be to initiate management actions that would lead to rationalisation in the development of the fleet so as to exploit the resources more effectively while seeking to put in place onshore infrastructure and equipment and ensuring their effective utilisation.

2.4.1 Management Options

Priorities would be given to the identification and elimination and/or reduction of destructive gear while developing an effective gillnet (polyethylene) fleet.

2.4.1.1 Chinese seine fishery

The Chinese seine is the only known means in Guyana of harvesting the whitebelly *(N.schmitti*). Thus, in addition to the likely socio-economic aspect, there would appear to be some need for the use of the gear (Phillips, Aiken and Mahon, 1992).

Regulation could therefore look at first limiting the number of licences to those operators already in the fishery while attempting to reduce support (financial and other requisites) for any new or renewal of Chinese seine operations. Limits on the number of seines per vessel could also be considered.
Later, by means of survey/investigations the areas of high shrimp concentrations can be identified and mapped as well as the seasons determined. Operations could then be restricted to these locations and seasons of abundance.

2.4.1.2 Cadell Line Fishery

Cadell line fishing should be encouraged but hook size regulations could be looked into as a means of ensuring only larger sizes of the species caught are targeted.

2.4.1.3 Nylon nearshore gillnet fishery

More indepth study of this situation would be required. If found to be necessary then regulations on mesh size and length of seine could be put in place. Also, the number of licences issued can be restricted.

2.4.1.4 Polyethylene gillnet/driftnet fishery

Regulations on mesh size should be addressed as a means of conserving the resource because of likely good economic returns and because of the ease of implementing mesh size regulation. Later, limitations on effort could also be addressed.

2.4.1.5 Shark Fishery

This resource should be carefully examined since it is likely that it can be exploited through specific targeting by different gear types. Reducing of targeting by imposing limits on the proposition of landed catch or limiting the number of processing plants utilizing shark licences could be considered.

2.4.1.6 Mackerel

This fishery may be targeted since there is an increased demand for the species. This resource should be monitored to obtain more information.

3. DATA COLLECTION PROGRAMME

The objective of the programme is to consolidate and expand the existing programs of data collection and information gathering for assessment and updating of the Fisheries Management Plans for the Offshore Industrial and Inshore Artisanal Fisheries for Shrimp and Groundfish.

3.1 Offshore Industrial Fishery

A species identification/composition exercise is to be started shortly to identify and determine the species composition of shrimp and finfish being caught and landed by gear type .

Catch and effort data are collected using vessel and plant logbooks. An observer programme is being developed for the trawl fleet which would serve to verify the logbook data as well as collect biological data on the catch.

An in-plant biological data collection program (BDC) for three penaeid shrimp species (*P. notialis, P. subtilis* and *P. brasiliensis*) is currently underway (Table 9). A biological data collection program for selected finfish species and seabob will be implemented in the near future.

The processing plants submit data on fish and shrimp prices per commercial size category. Data on price per species for finfish are collected from the markets and landing sites.

Basic economic and social data were collected during the Census of the Inshore Artisanal Fishery in 1994 and the Survey of Women in the Fisheries Sub-sector in 1994. Some social and economic data on fishers are stored in the Licensing and Registration System (LRS).

3.1.1 Sampling methodology of in-plant BDC for *P. brasiliensis, P. notialis,* and *P. subtilis*

Biological data (see Table 9) are being collected to enable us to apply Crustacean Stock Assessment Techniques Incorporating Uncertainty (Ehrhardt and Legault, 1996).

Table 9: Showing the types of Biological data available

Years	Months	Length & weight frequencies by commercial size category		Source of Data
		Pink Shrimp	White Shrimp	
1996	Oct.	✔	No	In-plant shrimp BDC
	Nov.	✔	No	In-plant shrimp BDC
	Dec.	✔	No	In-plant shrimp BDC
1997	Jan.	✔	No	In-plant shrimp BDC
	Feb.	✔	No	In-plant shrimp BDC

There are several years of historical shrimp landings data (1981-1997) (Table 10) which are recorded in pounds of tails per commercial size category. Those landings are recorded in two species groupings: (i) Pink shrimp, which are really three species *(P. brasiliensis, P. notialis,* and *P. subtilis*), and (ii) white shrimp *(P. schmitti)*.

The current in-plant shrimp biological data collection programme is aimed at generating (i) species composition and species/gender composition within each commercial size category and (ii) tail length frequencies and individual tail weights for each species/gender composition within each commercial size category. These sampling activities are carried out each week at the processing plant.

For the commercial size categories U-12 to 26/30, the recommended sample size is 4 boxes (5 lbs each) per commercial size category. For the commercial size categories 31/40 to 71/90, the

Table 10: Showing the types of catch & effort data available

Year	Months	Types of Data Available				
		Effort			Catch	
		Number of vessels	Number of trips	Number of Landings	Landings/Catch of shrimp tails (tonnes) by commercial size category	
					Pink Shrimp[1]	White Shrimp[2]
1981	Jan. - Dec.			✓	✓	✓
1982	Jan. - Dec.			✓	✓	✓
1983	Jan. - Dec.			✓	✓	✓
1984	Jan. - Dec.			✓	✓	✓
1985	Jan. - Dec.			✓	✓	✓
1986	Jan. - Dec.	✓		✓	✓	✓
1987	Jan. - Dec.	✓		✓	✓	✓
1988	Jan. - Dec.	✓		✓	✓	✓
1989	Jan. – Dec	✓		✓	✓	✓
1990	Jan. – Dec	✓		✓	✓	✓
1991	Jan. – Dec	✓	✓	✓	✓	✓
1992	Jan. - Dec.	✓		✓	✓	✓
1993	Jan. – Dec	✓		✓	✓	✓
1994	Jan. – Dec	✓		✓	✓	✓
1995	Jan. – Dec	✓		✓	✓	✓
1996	Jan. – Dec	✓		✓	✓	✓
1997	Jan. - Dec.	✓		✓	✓	✓

NB. Pink Shrimp[1] = combination of *P. brasiliensis, P. notialis,* and *P. subtilis*
White Shrimp[2] = *P. schmitti*

recommended sample size is 2 boxes (5 lbs each) per commercial size category. The contents of each box (shrimp tails) is weighed, and the tails are then separated into species ; each species is then further separated by sex.

After separation of the tails into species and sex, both individual tail lengths and individual tail weights are taken for the first box (box #1) sampled in each commercial size category, while for boxes 2, 3 and 4, only individual tail lengths are taken.

3.2 Inshore Artisanal Fishery Data Collection Program

A species identification/composition exercise is to be done shortly to identify and determine the species composition of shrimp and finfish being caught and landed by gear type .

Catch and effort data are collected using vessel logbooks and a stratified random sampling which serves to verify the logbook data as well as to estimate the landings (Table 12). A biological data collection program (BDC) for selected finfish species is also underway (Table 11).

Basic economic and social data were collected during the Census of the Inshore Artisanal Fishery in 1994 and the Survey of Women in the Fisheries Sub-sector in 1994. Some social and economic data on

fishers are stored in the Licensing and Registration System (LRS). Data on ex-vessel and retail prices are being collected at landing sites and markets.

3.2.1 Description of the Stratified Random Sampling

Using data on landing sites (primary fishing units), vessel/fishing gear (secondary fishing units) and related information from the June-September 1994 Census of the inshore artisanal fishery, a stratified random sampling program was devised using the RANCLUS software. Landing sites were stratified as primary, secondary or tertiary sites, with the criteria for stratification being based on the number of gear types and number of vessel by gear types at a landing site. In regions 5, 4 and 3, primary sites are sampled 12 days per month, secondary sites 8 days per month and tertiary sites 4 days per month. In Regions 6 and 2, each stratum is sampled 4 days per month. Sampling is based on both space and time. The program was implemented in August 1995.

Sampling in Regions 6 and 2 is being done by the fisheries personnel based in these Regions, with supervision being done by the Data Collection Supervisor/Data Manager, Angela Hackett, based at headquarters. Sampling in Region 5,4 and 3 is being done by fisheries personnel from headquarters, under the overall supervision of Ms. Hackett.

Selection of vessels for sampling is not always done at random and the most available vessel is sampled because of:

(i) resistance of fishers to sample their catch;
(ii) competition between vendors and data collectors.

The Division hopes to solve these problems through its Community Awareness and Involvement Programme.

Biological data (length data) are being collected for the following species bangamary (*Macrodon ancylodon*), grey snapper (*Cynoscion acoupa*), gillbacker (*Arius parkieri*), butterfish (*Nebris microps*), sea trout (*Cynoscion virescens*) and snook (*Centropomus pectinatus*).

The Department is working towards a more decentralised approach to its sampling , whereby Regions 2 and 6 will function as subunits, with each subunit being responsible for data collection, entry and storage. Disk copies of data will be submitted to headquarters at the end of each month.

3.3 Data Storage and Management

The data collected in the field are being entered into three software applications:

(i) Trip Interview Program (TIP) - catch and effort (artisanal and industrial) and biological data;
(ii) Licencing and Registration System (LRS) - licence and registration, social and economic data;
(iii) EXCEL - biological data from the shrimp sampling in the processing plants.

The objective of data management is to ensure that the data collected and computerized are available whenever needed. The data collected are used to generate monthly and annual production reports as well as for use in stock assessment models**.**

3.4 Resources (Personnel, Equipment)

The Data Collection Program is staffed by:

1 Data Manager
2 Data Entry Clerks
5 Data Collection Supervisors
2 Fisheries Officers
7 Data Collectors

The office and field equipment includes:
5 Computers
2 Vehicles

Table 11: Showing the types of biological data available

Year	Month	Length frequency by species					Source of data
		M. ancylodon	*N. microps*	*C. virescens*	*C. acoupa*	*C. pectinatus*	
1995	May	✓	✓			✓	Stratified Random Sampling for Artisanal Fishery
	Jun		✓	✓			
	Jul	✓	✓	✓	✓	✓	
	Aug	✓	✓			✓	
	Sep.						
	Oct.						
	Nov.	✓	✓	✓	✓	✓	
	Dec.			✓	✓		
1996	Jan.	✓	✓				
	Feb.	✓	✓	✓	✓	✓	
	Mar.	✓	✓	✓	✓	✓	
	Apr.	✓	✓	✓	✓	✓	
	May	✓	✓	✓	✓	✓	
	Jun.	✓	✓	✓	✓	✓	
	Jul.	✓		✓	✓	✓	
	Aug.	✓	✓	✓	✓	✓	
	Sep.	✓	✓	✓	✓	✓	
	Oct.	✓		✓	✓	✓	
	Nov.	✓	✓	✓		✓	
	Dec.			✓			

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Table 12: Showing the types of catch & effort data available

Year	Types of data available		
	Effort	Catch	
	Number of Vessels	Landings/Catch data for Finfish	
		Artisanal logbook	Sampling Programme
1981	✓		
1982	✓	✓	
1983	✓	✓	
1984	✓	✓	
1985	✓	✓	
1986	✓	✓	
1987	✓		
1988	✓		
1989	✓		
1990	✓		
1991			
1992	✓		
1993			
1994	✓		
1995		✓	✓
1996	✓	✓	✓
1997			✓