UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

NORGAARD CONSULTANTS INC.

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PRE-FEASIBILITY STUDY ON PROCESSING OF SHARK MEAT TRINIDAD AND TOBAGO

UNIDO PROJECT TF/TRI/84/091

MAY 1989

PRE-FEASIBILITY STUDY ON
PROCESSING OF SHARK MEAT, TRINIDAD AND TOBAGO
TF/TRI/84/091

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1. EXECUTIVE SUMMARY

1.1 Project Short History

Shark appears to be a plentiful under-exploited resource in the Caribbean. At the request of Caribbean Food Corporation UNIDO agreed to investigate the possibility of industrial processing of shark.

The initial survey of Trinidad and Tobago indicated that the inshore shark resource was not sufficient to support a major new process plant long term.

It was therefore decided to extend the study to review the shark resource of Belize, Panama, Guyana and Jamaica.

1.2 Market and Plant Capacity

Although no detailed resource study of shark in Trinidad and Tobago exists, the investigations have shown conclusively that the present shark catch is declining and that the **inshore** resource is under pressure.

An industrial production will therefore have to rely on an expansion into the **offshore** resource of this country and possibly expansion of shark fishery in the other Caribbean countries.

The offshore resource can be harvested by an expansion of the fishing fleet into offshore and ocean going vessels. By an initial development of a fleet of 4 privately owned vessels it is estimated that about 500 tons of shark can be produced for the factory, without diverting shark from existing market.

The proposed process plant will therefore have an average capacity of 2 tons raw shark per day and a maximum peak capacity of 3 tons per day. It will operate 250 days per year and receive a total of 500 tons of shark as well as 250 tons of Fin Fish. The latter fish will be caught as a by-catch to the shark and will also provide a resource for processing and marketing during periods when shark may not be available.

There are no resource studies or reliable facts on the shark resource of Belize, Panama, Guyana and Jamaica. A new process plant in the region can therefore not be based on such questionable supplies of raw materials. It is therefore recommended that trial fisheries for shark in these other countries take place during the initial phase of the project i.e. the first three years of operation of the process plant.

If it is found that a sufficient shark fishery can be developed in either one of these countries and if a review of the actual operation of the pilot plant shows positive results then the plant can either be expanded to receive frozen shark carcasses from outside, or another plant can be built in the country with the most promising resource.

The market for processed shark meat is undeveloped at present. It is therefore impossible to get absolute figures for the potential market demand. However, a salted-dried shark product would alleviate the short fall of protein in the Caribbean region and greatly improve the dietary habits. With a combined population of 6.5 million people in the five countries under review, it is fairly safe to assume potential annual consumption of at least one lbs per capita, equal to 3,200 tons. The proposed plant capacity of 100 tons per year is therefore safely within the future market demand.

A certain amount of import substitution will also take place when a quality shark product starts to replace imported salted cod and other salt fish products, mainly imported from Canada. The initial main market for the salted shark product will be Trinidad & Tobago as well as Guyana.

1.3 Location and Site

The pilot process plant should be located on Trinidad near one of the fish landing places. It is important to have good road connections to the site, as fish will arrive by truck.

The site should be about one acre in area to allow for storage, parking and future expansion.

The site must be serviced with electric power supply and ample fresh water supply. Waste water drainage must be provided.

Alternatively, the process plant can be incorporated into an existing fish processing plant such as for example National Fisheries in Port-of-Spain.

If trial fisheries determine the viability of other process plants, a site for a future plant must be located, probably in Guyana.

1.4 Final Products, Materials and Input

The plant will receive 500 tons of fresh shark and 250 tons of fin fish annually. It will use 350 tons of salt and packaging materials.

Shark will be processed into salted-dried fillets, with an annual production of 100 tons. In addition the shark fins will be processed, dried and packed. A total of 15 tons of fins will be produced and exported every year.

From selected sharks the best hides will be processed and exported. It is estimated that the annual production of hides will be 2,500 per year initially.

Fin Fish will be filleted or stacked, packed and sold in the market or to supermarkets. Annually 200 tons of fin fish fillets will be sold.

1.5 Project Engineering

The Process Plant will be housed in a simple industrial building measuring 15 x 23 meters, and shown on Figure 9.2. The process to be used and the equipment installed is all low-tech which is easily and cheaply obtained, easy to operate and low cost in maintenance.

Half the building will be the Reception and Processing area consisting of various tables and tanks. Separate rooms are provided for Salting, Packaging and storage.

Refrigeration plant will serve the ice making plant and the chill store (0 degrees C). An electric dryer is also provided. Additional outside areas are provided for Drying Yard and for future installation of a smoking Kiln. A small office and restrooms are also provided.

1.6 Plant Organization

It is proposed that the plant is operated as a private business. A local business man with experience in fisheries and in fish trade can be used as the owner/manager.

The plant will operate on an 8 hour a day basis, for an estimated 250 days per year.

The Manager will organize the purchase of sharks from fishing vessels as well as the sale of products. Initially he will have to travel to the different landing places to build up the supply sources, but after awhile, when the plant is established as a viable unit, it is expected that the supplies will come regularly by previous arrangements to the plant.

The plant manager will be assisted by an Office Administrator for bookkeeping and office services. In the plant he will be assisted by the Plant Foreman.

1.7 Manpower

The plant will employ a total of 19 laborers and three managers, a total of 22 persons.

Training will be provided during the initial three months of operation by one expert from abroad.

In addition the project will create indirect jobs in the fishing industry and in the distribution trades.

In the fishing sector it is estimated that a total of four vessels will be targeting on shark, each with a crew of 6. With shoreside support the new employment in the fishing sector will be 30 jobs.

The transportation and service industry will need 4 additional jobs in handling and distribution.

The total of new jobs created by this project is therefore 56.

1.8 Financial and Economic Evaluation

The construction cost for plant and equipment is US$ 579,000. An additional $166,870 is required for working capital so a total investment of $745,870 is called for.

The annual income from sale of products in the third year will stabilize at $855,000.

The manufacturing costs are $667,480 per year, which leaves a gross profit of $187,520. Interest at 12% of the total capital amounts to $89,500 which leaves a balance of $98,000. After depreciation there is an additional profit of $46,300 for distribution.

The Internal Rate of Return of the project is 20,8% and Net Present Value, based on 12% return, is $435,300.

1.9 Implementation Schedule

The proposed implementation schedule for the recommendations are as follows:

YEAR 1:
- Plan the details of the proposed process plant
- Select an operator / manager
- Order equipment
- Prepare Fisheries Management Regime for shark
- Encourage conversion to shark fisheries

YEAR 2:
- Construct and build plant
- Commence offshore fisheries for shark
- Implement Fisheries Management Regime
- Trial fisheries in Belize,Panama,Jamaica,Guyana
- Develop sales outlets for salted products
- Commence production of products (after 1 1/2 years)

YEAR 3: First full year of operating plant
Continue and expand offshore fisheries
Continue trial fisheries in other countries

END OF YEAR 3: Analyze financial results of plant operation
Review offshore fisheries for shark
Review trial fisheries in other countries
Decision concerning expansion or new plant in other country.

1.10 Conclusions

The project is economically viable and should be implemented.

The risks involved relate purely to the status of the resource of sharks. By selecting a modest capacity of the plant and by relying on offshore sources of shark, the risks of a collapse of the present shark population has been greatly reduced.

Due to the vital interaction with the fishing sector, fishing vessels and the resource protective measures, the project can not be executed in isolation as a pure commercial enterprise. Cooperation with the local fishing authorities and with agencies such as FAO are absolutely essential, both in the planning as well as the implementation stage.

2. INTRODUCTION

2.1 Project Background

Shark constitutes a main source of fish protein in Trinidad, but demand appears to outstrip supplies. In general, shark appears to be a plentiful underexploited resource for protein throughout many countries of the Caribbean.

Recently, an untraditional method for hydrogenization of shark meat was proposed to the Caribbean Food Corporation which in turn has asked UNIDO for assistance in investigating the feasibility of such processing.

Aa a result of this enquiry, UNIDO agreed to investigate the possibility of industrial processing methods for shark in Trinidad, including a review of the hydrogenization process and requested Norgaard Consultants to undertake such a feasibility study.

The initial survey of Trinidad & Tobago indicated that the shark resource from this area available for industrial processing, may not be sufficiently reliable to support a new industry. It was therefore decided to extend the study to include a cursory review of the potential for including the countries of Belize, Panama, Guyana and Jamaica together with Trinidad.

2.2 Objectives

The **overall objective** of the study has been:

> To exploit the national resources of the sea territories surrounding Trinidad.

The **special objectives** of this study are to examine:

1. Whether the processing of selected shark meat is technically practical on a scale large enough to make it financially viable.

2. Whether a sufficiently large market exists at a price which will cover the costs of collection, freezing, processing, distribution and sale of the end product.

3. Whether the production costs of the process will be low enough to attract the serious interest of food processors and allow them to operate on a profitable basis.

and in addition,

4. Whether the inclusion of Belize, Panama, Guyana and Jamaica may be an advantage to the project.

2.3 Related Investigations

2.3.1 Other studies

The list of literature cited in Appendix A contains a summary of other investigations of relevance into the Trinidad seafood industry.

Of particular relevance to this study, because of it's timeliness and direction of work, is the Government of Trinidad & Tobago/U.N.D.P./F.A.O. project titled, "Development of the Artisanal Shark Fishery," which was prepared by the project office at the Caribbean Fisheries Training and Development Institute.

The objectives of that project were to develop shark meat products and processing methods, as well as consumer education to shark meat products, and quality awareness.

Also of value is the report by Richard Mounsey: "Development of the Artisanal Shark Fishery of Trinidad and Tobago", by FAO 1986. Mr Mounsey headed a research team to develop new shark fishing technology for the islands.

2.3.2 Pre-Feasibility Study

This feasibility study was undertaken by Norgaard Consultants of San Francisco, USA, under contract with UNIDO in Vienna, and in close cooperation with the Caribbean Food Corporation in Trinidad.

The initial study of Trinidad & Tobago was performed during 1986 and the extended survey in 1989.

The consultants team consisted of:

Erik Norgaard, M. Sc. (Eng) Team Leader
Dr Rudolf Kreuzer, Shark Utilization Expert
Sid Cook, M.S.(Ichtylogy) Shark Catching and Marketing
Benny Jensen, Fishing Industry Technologist
Dr Garrey Maxwell, Marine Biologist
Kurt Jacobsen, M.A.(Marine Affairs) Research

The study was prepared on behalf of UNIDO in Vienna with local support and guidance from UNIDO and UNDP personnel resident in the region.

The officers representing the Caribbean Food Corporation greatly facilitated this study and special thanks are due to Dr Arlington Chesney, Managing Director, Mr Kingsley Thomas, Projects Manager, and Mr Ian Thomasos, Project Analyst.

Support was also provided by Mrs Laleena Chin-Yuen-Kee, Fisheries Division, Ministry of Agriculture, Mr Navarro, President, National Fisheries Company, Mrs Fannie de Boer, Consumer Education, FAO, Mr Hans Horn and the staff of the Caribbean Fisheries Training and Development Institute.

The methodology and progress of the study was as follows:

Following literature research on the area and the shark resource, an initial meeting was held with UNIDO officials in Vienna. Thereafter the consultants team visited the project area. Data were collected through extensive interviews with the various local officials, fishing industry representatives and fishermen. Main fishing ports and markets were visited and a couple of actual fishing trips undertaken with local fishermen.

Meanwhile methods for shark processing and the markets for products were studied. Preparatory desk studies were also done for the additional countries, which were visited in 1989.

As the data were collected and analyzed, a couple of alternative scenarios for development were outlined and evaluated financially. After review the selected and recommended project was described and a financial analysis prepared for the final report.

2.3.3 Extended Country Survey

During the extended survey of the additional countries, the following persons were particularly helpful in providing information on their respective countries:

Belize: Vincent V.Gillett, Fisheries Administrator, Ministry of Agriculture, Forestry and Fisheries

Robert Usher, Executive Secretary, Northern Co-Op, Belize

Severo Pinto, Executive Secretary, Belize Fishermen Co-Op Association

Panama: Boris Ramirez, Deputy Director General of Marine Resources, Ministry of Commerce and Industry

Guyana: Reuben Charles, Chief Fisheries Officer, Ministry of Agriculture

Jamaica: Roy R. Moo Young, Director of Marine Fisheries, Ministry of Agriculture

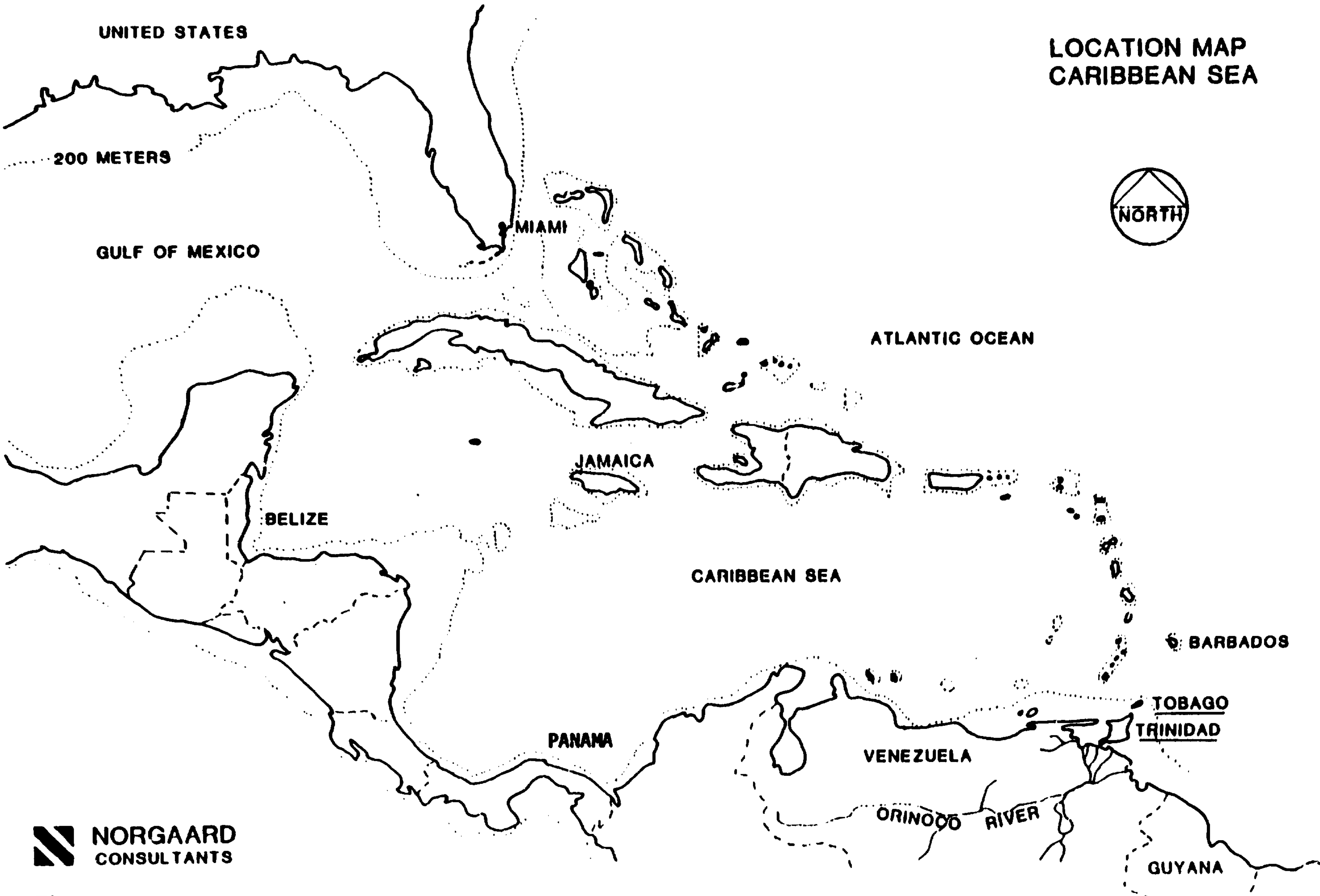

LOCATION MAP
CARIBBEAN SEA
NORTH
UNITED STATES
200 METERS
GULF OF MEXICO
MIAMI
ATLANTIC OCEAN
JAMAICA
BELIZE
CARIBBEAN SEA
BARBADOS
TOBAGO
TRINIDAD
PANAMA
VENEZUELA
ORINOCO RIVER
GUYANA
NORGAARD
CONSULTANTS

Figure 1

3. THE COUNTRIES OF INVESTIGATIONS

3.1 Trinidad & Tobago

3.1.1 Geography

Trinidad and Tobago are the most southerly islands in the Windward Island chain of the Caribbean Sea. Trinidad is located at 10 degrees 30 minutes North latitude and 61 degrees West longitude. Tobago lies 22 miles (35 km) off Trinidad's northeastern tip, at 11 degrees North latitude and 60 degrees West longitude.

Trinidad measures approximately 50 miles (80 km) by 37 miles (60 km) comprising an area of some 1850 square miles (4790 sq. km). Tobago, the smaller of the two islands, has an area of about 116 square miles (300 sq. km).

Three mountain ranges known as Northern, Central and Southern Ranges, traverse Trinidad in a somewhat parallel manner. The Northern Range consists of a series of hills running east to west at an average elevation of 1500 feet (457 m). The highest point is El Tuchuche, with a maximum elevation of 3084 ft (940 m). This northern area is mainly tree covered, rugged and jagged, abruptly dropping down to the coastline.

The Central Range runs diagonally across the island from the northeast tip, with a maximum elevation at Mt. Tamana of 1000 ft (305 m). This area is mostly the farming regions.

The Southern range consists of undulating hills through fields of sugar cane, marshes and tropical forests.

The shoreline of Trinidad and Tobago are typical for the Caribbean in the tropics, consisting of sandy beaches, lagoons, extensive mangrove areas and low-lying swampy regions.

3.1.2 Climate

Trinidad and Tobago has basically two seasons: a Dry season from January through May, and a Wet season from June through December.

There is a short spell called locally, "Petite Careme," in September and October, but even in the height of the wet season rain may be heavy but for short duration. The average rainfall is 82 inches (208 cm) per year.

The climate is tropical with high humidity which averages around 80%, but is tempered by the influence of the Trade Winds. The average annual high temperature being 88 degrees F (31 degrees C) and the annual low temperature being 71 degrees F (22 degrees C).

Table 3.1

TRINIDAD: AVERAGE HIGH AND LOW AIR TEMPERATURES

MONTH

	J	F	M	A	M	J	J	A	S	O	N	D
AVG. LOW	20	21	21	22	23	23	23	22	23	22	22	21
AVG. HIGH	30	30	31	32	32	31	31	31	32	32	31	30

(in degrees centigrade)

3.1.3 Hydrography

The Caribbean is a semi-enclosed area of the Atlantic Ocean. It is bounded by nine continental countries stretching from Mexico to Venezuela.

The Caribbean is characterized by having very deep waters. Approximately 50% of the Caribbean's waters exceed 2,000 m in depth, with 80% exceeding 1,000 m. In conjunction with these deep waters, the Caribbean islands generally lack extensive continental shelves.

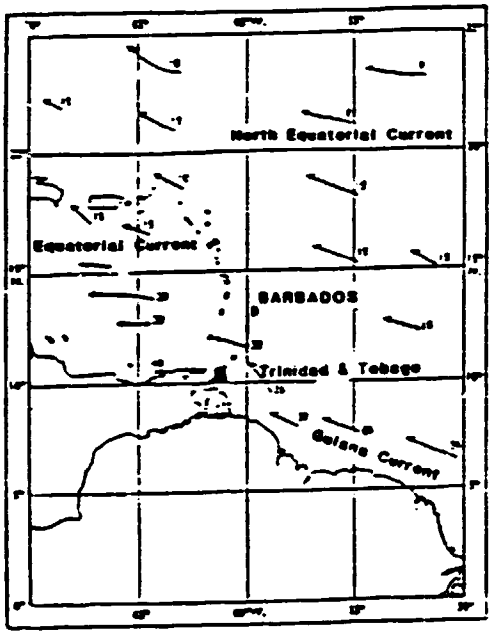
The narrow continental shelves are a limiting factor for the regions marine resource productivity. This region also lacks any major upwellings of a magnitude that would provide a significant nutrient input into the surface waters. Outflows from the Orinoco, Amazon and other South American rivers do provide nutrients to the regions waters, but also carry heavy sediment and silt loads.

The Guyana and the North Equatorial currents flow past Trinidad and Tobago towards the west-northwest at an average rate of 2 knots (1.0 m/sec) into the Caribbean.

The ocean surface temperatures around Trinidad and Tobago remain relatively stable year round with an annual average of 27 degrees C. The minimum usually occurs in February at about 25 degrees C and the maximum in September at 28 degrees C.

Figure 3.2

General Surface Current Circulation



Speeds in Miles/Day

3.1.4 Demography

The estimated total population in 1985 of Trinidad and Tobago was 1.2 million, of which some 95% live in Trinidad.

Port-of-Spain is Trinidad's capital city, and with it's suburbs has a 1985 population of approximately 400,000. This represents about 35% of the island's population.

The overall population density for Trinidad is thus 616 inhabitants per square mile (237 per sq. km.), with distribution of 49% urban and 51% rural.

Population growth rates for Trinidad have been estimated at 0.2% per annum.

Figures attainable from the World Bank Atlas, indicate that Trinidad and Tobago had per capita income of about US$ 7,000 in 1984. Literacy rate is high at 96% of the adult population and the labor force totalled about 472,000 persons in 1984 with an unemployment rate of 13% for the same year.

Labor Force: 1984	
Male	312,000
Female	160,000
Total =	472,000

Unemployment: 1984	
Male	37,600
Female	25,600
Total =	63,200

Labor Distribution: 1982

Agriculture, Forestry & Fishing	13.5%
Commerce	17.4%
Mining, Quarrying & Manufacturing	20.0%
Services	23.0%
Construction & Utilities	15.7%
Transportation & Communication	7.5%
Other	2.9%

	100.0%

3.1.5 Status of Trinidad Fisheries

For fishery statistical purposes, Trinidad and Tobago is included in the FAO statistical Area 31, (Western-Central Atlantic) from which some 2 million metric tonnes of fish are harvested annually.

Table 3.3

Catch from Statistical Area 31 1973-1983 '000's tonnes.

1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1,394	1,529	1,545	1,574	1,417	1,337	1,800	1,791	1,898	2,131	2,267

Source: FAO Fisheries Statistics Yearbook Vol.56.

The Caribbean sea area constitutes only a small part of Area 31 and the total fishery catch for the Caribbean is also a relatively small proportion for the total Area 31. Table 3.3 illustrates the annual combined catch for the Leeward and Windward island groups.

Table 3.4

Total Catch Caribbean Sector of Windward and Leeward Islands.
'000's tonnes.

1976	1977	1978	1979	1980	1981	1982
256,607	243,539	274,645	218,991	251.736	229,337	261.650

Source: FAO Fisheries Statistics Yearbook Vol.56.

The Windward island chain consists of the following island countries:

- Barbados
- Dominica
- Grenada
- Guadeloupe
- Martinique
- St. Lucia
- St. Vincent
- Trinidad & Tobago

Guadeloupe has consistently recorded the highest catch at about 9,000 mt, which represents 30% of the Chain's catch, while Martinique and Trinidad & Tobago each land of the order of 4,000 mt or 15% each of the Chain's catch.

Barbados has for many years been consistent around 3,000 mt, 12% of the Chain's landings until 1983 when landings increased to 6,500 mt or 21% of the Chain's landings. This increase appears to have been mainly due to increased landings of Flying Fish with the rapid increase in the numbers of long ranging ice-boats after the first ones were introduced into the Barbados fishing fleet in 1980.

Table 3.5

Fish Landings at the countries in the Windward Islands.
1977 - 1983

	1977	1978	1979	1980	1981	1982	1983
Barbados	3166	3663	4342	3735	3411	3480	6522
Dominica	1047	1070	642	1445	1514	1545	1545*
Grenada	3241	3509	4202	1753	1674	1801	1801*
Guadeloupe	9525	9000**	8500**	8000**	8300**	8800**	8653
Martinique	2167	3928	4684	4684*	4684*	4684*	4684*
St Lucia	2500	2600	2600	2400	2404	2404	2635
St Vincent	581	698	547	547*	547*	547*	647*
Trindad &Tabago	4303	4823	3840	4461	4461*	4461*	4461*
Totals	26,530	29,311	29,357	27,025	26,995	27,722	30,848

* Repeat of prvious data ** Estimate from available data

Source: FAO Fisheries Statistics Yearbook 56.

FAO statistics for Trinidad for 1983 show landings of 446_ mt. It is not possible in most cases to compare landings of specific types of fish between most countries in the region because fish are often listed only as "marine" or "freshwater."

Table 3.6

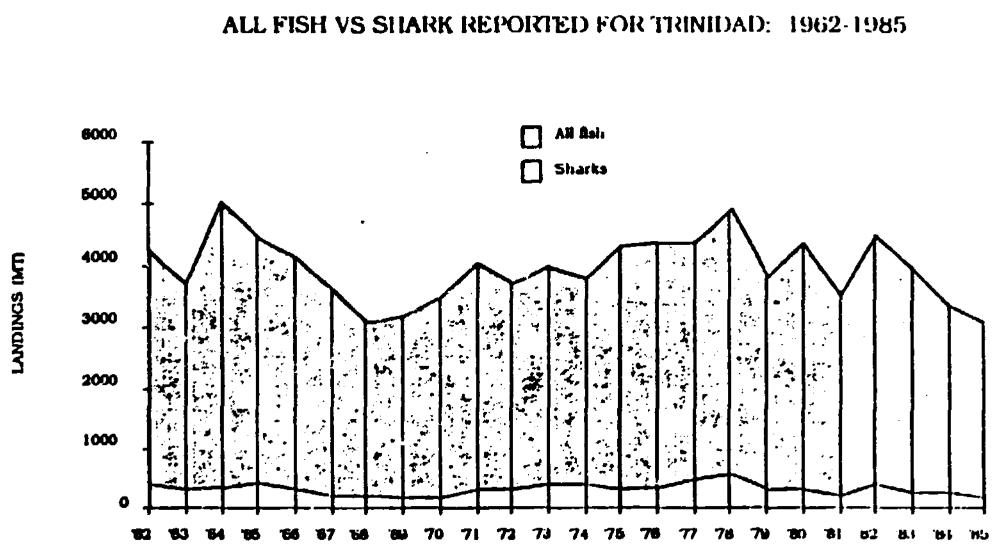
TRINIDAD TOB								
FRESHWATER FISHES NEI	PISCIS	13	-	-	-	-	-	-
DEMERSAL PERCOMORPHS NEI	PERCIFORMES	33	185	615	685	685R	685R	685R
JACKS, CREVALLES, NEI	CARANX SPP	34	183	150	277	277R	277R	277R
CLUPEOIDS NEI	CLUPEOIDEI	35	218	129	187	187R	187R	187R
ATLANTIC SPANISH MACKEREL	SCOMBEROMORUS MACULATUS	36	1953	1208	1337	1337R	1337R	1337R
SEERFISHES NEI	SCOMBEROMORUS SPP	37	175	143	141	141R	141R	141R
SHARKS, RAYS, SKATES, ETC	PISCIS	38	624	379	368	368R	368R	368R
MARINE FISHES NEI	PISCIS	39	1238	861	1016	1016R	1016R	1016R
NATANTIAN DECAPODS NEI	NATANTIA	45	267	355	452	452R	452R	452R
TOTAL		S	4823	3840	4461	4461R	4461R	4461R

The fishermen of Trinidad & Tobago catch between 22 to 25 species of fish and invertebrates of which 72.1% of the reported 1985 catch consisted of: Carite, Kingfish, Red Snapper, Cavalli, Herring, Shark and Shrimp. The remaining 27.9% was comprised of such fish as "salmon" (a type of Weakfish of the genus Cynoscion), Mullet, Bonito, Cro Cro, Moonfish, Jacks and Groupers. This second category is often referred to only as "miscellaneous" in the statistics for the past years.

The status of catches in Trinidad is difficult to describe in terms of precise landings because fishermen tend to under-report their catches and most do not keep adequate records such as logbooks. The problem is typified by the great variance in statistics from one reporting agency to another.

For example, in 1984 FAO reported a nominal catch for Trinidad & Tobago of 4,461 mt, while the Government reported a nominal catch of 3,088 mt and the U.S. National Marine Fisheries Service reported a nominal catch of 1,500 mt.

Figure 3.7



In addition, there is the factor of local fishermen landing fish caught from Trinidad waters, across the Columbus Channel in Venezuela where they can get ice readily and more importantly be paid in U.S. currency. This practice removes an unknown amount of captured local stocks from the Trinidad reporting system.

The combination of under-reporting and landings in foreign nations may indicate nominal landings of fish in Trinidad could be higher than reported by 30% to 50%. This tends to lend credence to the FAO estimates as being the most correct.

However, there is no way to verify this without extensive work in the field, which is beyond the scope of this project. Caution must however be used with the FAO statistics since they show a static catch since 1979, the last date when FAO apparently updated their Trinidad statistics.

Indications are that the catch is declining in Trinidad according to discussions the Consultants had with processors, local fishermen, Fisheries Division employees, Caribbean Fisheries Training and Development Institute staff and with local FAO employees.

Although the Government statistics from Trinidad are most probably too low, one can assume that the under-reporting is consistent from year to year, since it is likely that local fishermen would settle into patterns of under reporting. If this is in fact the case, then the trends indicated by the rise and fall in catch from year to year would be expected to be valid indicators in relative terms of catch rates.

Total reported catches have been showing a decline since 1982. There is concern that inshore stocks are becoming depleted. Offshore stocks are not currently under pressure since most fishing vessels in Trinidad are small day boats participating in the inshore fishing.

Foreign longliners mostly from Taiwan, Japan and Korea, call on Trinidad to offload catches of Tuna (Albacore) and/or by-catch species caught on the high seas, and at the same time to refuel with low cost fuel. These landings are recorded in the official statistics, but do not affect the fish resources of Trinidad since the vessels fish from Bermuda down to Argentina. The longliners average 400 GRT with an average fish hold capacity of 250 mt. They contribute a considerable portion of the fish entering the Trinidad marketing structure.

Trinidad & Tobago is a large importer of fish and fish products, but is a negligible exporter of such items, except for the transhipment and re-export of tuna products. (See Table 3.6). Since the country imports 58% of it's total supply of fish products it has been of some concern to the government to reduce imports while concurrently encouraging an increase in domestic production.

To offset the imports of fish by replacing them with locally caught species would entail increasing production by a factor of 2.3 times the 1983 catch. If only salted/dried/smoked fish is taken into account, the fishery would have to increase 71% over 1983 levels.

It is likely that such an increase in fishing pressure would accelerate the decline of the inshore fishery causing one or more stocks to collapse. Since demand for fish will remain, even if the local fisheries suffer severe reversals, one would expect that the demand would have to be met by increasing imports.

3.2 Belize

3.2.1 Geography and History

		1983	Growth rate 1973-82
Population		153,000	2.1%
GNP, at market price, mill.	US	$ 170	6.4%
GNP per capita,	US	$ 1,140	4.2%

Belize lies on the eastern or Caribbean coast of Central America, bounded on the north and part of the west by Mexico, and on the south by Guatemala. The inner coastal waters are shallow and sheltered by a line of coral reefs, dotted with islets called "cayes", extending almost the entire length of the territory. There is a low coastal plain, much of it is covered by mangrove swamp, but the land gradually elevates into open sprawling country 250 feet above sea level.

The Maya mountains and the Cockscombs form the backbone of the southern half of the territory, the highest point being Victoria Peak (1,122 meters) in the Cockscombs. The Cayo District in the west includes the Mountain Pineridge ranging from 305 to approximately 914 meters above sea-level. The northern districts contain considerable areas of low tableland.

The total area of the mainland and cayes is 22,963 square kilometers or 8,860 square miles. The climate is sub-tropical, tempered by trade winds from the Caribbean Sea. The country has an annual mean temperature of 79F, average humidity of 83% and an annual rainfall varying from 50 inches in the north to 180 inches in the deep south.

The population of Belize in 1980 was 153,000 with approximately 28%, 40,000 living in Belize City, the commercial capital, and formerly the nations capital. Fifty miles from Belize city lies Belmopan, the new capital of Belize (since 1970) and its steadily increasing population was recorded at 5,000 in 1980. Belmopan is the official seat of Government.

3.2.2 Political Framework

Belize achieved constitutional independence on September 21, 1981. As such, Belize is now a member of the Commonwealth, the United Nations, and the Non-Aligned Movement. The country is a sovereign democratic state and it is operated according to the principles of parliamentary democracy based on the Westminster model.

There are two political parties, the People's United Party (PUP) and the United Democratic Party (UDP). Universal adult suffrage was gained in 1954, and since that year the PUP has won all general elections.

3.2.3 Economy

Belize operates a mixed economy where Government co-operates with, and facilitates, the private sector. Within this context, the Government directs its efforts at stabilizing the economy to stimulate growth, redistribute the income by taxation, increase income and jobs, rescue where possible ailing industries, supply some basic commodities at subsidized prices, and to regulate vital activities.

Belize's economy is dominated by agriculture where it represents a large percentage of the GDP, and provides employment for 30 per cent of the population. The principal products produced are sugar cane, bananas, oranges, grapefruit, rice, corn, beans and beef. Agriculture currently provides some 65% of the country's total foreign exchange earnings, and expansion of this sector is one of the principal aims of development planning.

3.2.4 Present Fisheries

The total landings recorded by FAO for Belize is about 1,300 tons per year. The largest quantity are scaled fish of which approx. 500 tons are landed and consumed locally. Lobsters and Prawns are exported.

A growing quantity of fish and shellfish are landed from fishing vessels from Honduras and Mexico, for purpose of re-exporting under Belize origin.

No appreciable landings of shark are recorded because there is a total lack of demand. Shark appears as an accidental catch with other species. There are, however, a few examples of exports of small amounts of shark to Mexico at Lent.

Shark observed in Belize are mainly small (3 feet) and are Blacktip, Hammerheads, Sandsharks and Nursesharks.

No resource study has been performed for Belize and there is thus no scientific knowledge of the actual quantities available of shark or other fishes.

3.3 Panama

3.3.1 Geography

		1983	Growth rate 1973-82
Population		1,964,000	2.3%
GNP, at market price, mill.	US $	4,070	4.8%
GNP per capita,	US $	2,070	2.5%

The size of Panama is 29,209 sq mi/75,650 sq km.
The republic occupies the Isthmus of Panama, which connect Central and South America. To the west and east of Panama respectively are Costa Rica and Columbia; The Panama Canal zone bisects the country.

The capital and largest city is Panama City. In the west are rugged mountains (Chiriqui is 11,410 ft/3,478 m high) of volcanic origin, which yield in the middle of the country to low hills; there is a low mountain range in the east. Lowlands line both the Caribbean and the Pacific coast and there are numerous offshore islands. The climate is generally tropical with abundant rainfall.

Panama is divided into 9 provinces:

Name	Capital	Name	Capital
Bocas del Toro	Bocas del Toro	Herrera	Chitre`
Chiriqui	David	Los Santos	Las Tablas
Cocle`	Penonome'	Panama	Panama
Colon	Colon	Veraguas	Santiago
Darien	La Palma		

3.3.2 Economy

Only about a quarter of the land is used for agriculture. On the upland savannas, cattle are grazed and subsistence crops (notably rice), sugar cane, cocoa, and coffee are grown. Bananas are grown on the Pacific Coast. The country has various light industries.

Bananas are the leading export, followed by shrimp and fish products, sugar, and coffee. Manufactured goods, raw materials, and foodstuffs are imported. Much of the trade is with the United States. In 1977 the per capita gross national product was $1,600.

3.3.3 Political structure

The internal politics of the republic have been stormy, with frequent changes of administration. U.S. forces were landed in 1908, 1912, 1918, 1958, 1960 and 1989. Steps were taken by the United States to placate Panamanian discontent by establishing uniform wages and employment opportunities in the Canal Zone and by reaffirming Panama's titular sovereignty over the zone.

General Omar Torrijos Herrera emerged as the dominant political figure in 1968. A series of negotiations aimed at resolving the conflict over the Canal was begun in 1973. In 1977 the United States and Panama signed a treaty under which the canal would revert to Panama by the year 2000.

3.3.4 Present Fisheries

The total landings for Panama in 1985 according to FAO were 282,000 tons. A large quantity of this volume is tuna being transshiped by foreign vessels to avoid the charges of the Canal.

Shrimps are also a major catch and important export product for Panama. Most of the fishery is in the Pacific Ocean.

Shark catches are irregular, depending on market demand. It is estimated that max 10 tons per month is being caught and some processing of dry salted shark takes place at Vacamonte Port.

No resource studies exist for Panama so there is no knowledge of the possible future catch of shark.

3.4 Guyana

3.4.1 Geography

		1983	Growth rate 1973-82
Population		801,000	0.8%
GNP, at market price, mill.	US $	410	-0.5%
GNP per capita,	US $	520	-1.3%

The size of Guyana is 83,000 sq mi. Guyana is located in NE South America, on the Atlantic Ocean. The capital is Georgetown. On the east Guyana is separated from Surinam by the Courantyne River. The Akarai Mountain forms the southern border with Brazil. Several rivers make up much of the western border with Brazil and Venezuela, and the Essequibo River flows through the center of the country.

3.4.2 Economy

Agriculture and mining are the principal economic activities. Sugar cane, rice, and coconuts are the leading crops, and cattle and other livestock are raised. Bauxite, manganese, gold and diamonds are mined. There are large forest resources (notable greenheart and balata). The processing of bauxite and sugar cane are the largest industries; the bauxite industry was nationalized in the early 1970s.

3.4.3 Political structure

After World War II significant progress toward self-government was begun. Under 1952 constitution, elections were held and a government formed. However, the British deemed the government pro-communist and suspended the constitution. Subsequently a new political party emerged.

Self government was granted in 1961. Proportional representation was introduced in 1964 in response to charges that the electoral system was unfair. After the 1964 election a political coalition was made. Full independence was negotiated in 1966.

Antagonism between the Indians, who control a substantial portion of the nations trade, and the blacks led to frequent clashes and bloodshed in the 1960s, but violence subsided by the 1970s. The boundaries with Venezuela and Surinam became a matter of dispute in the 1960s, with Venezuela laying claim to some 60% of Guyana's territory. Tensions on both fronts eased in 1970 when a 12-year truce was declared with Venezuela and a mutual troop withdrawal agreement was made with Surinam.

Guyana has a parliamentary form of government. The popular elected national assembly, chosen by proportional representation, elects the President, who is the head of state. ana is also a member of the British Commonwealth.

3.4.4. Present Fisheries

Landings of fish recorded by FAO for Guyana in 1985 amounted to 41,000 tons. An important export earner is prawns, of which 1,800 tons of tails and 620 tons of smaller peeled prawns were exported in 1988.

There is no directed shark fishery but the area along the coast is reported to be very rich in sharks, from the Orinoco to Trinidad. The export of sharkfins last year of 3 tons indicate a catch of 100 tons. This is mainly a by-catch to the prawn trawlers, who cut off the fins and discharge the shark carcass due to lack of facilities onboard and the absence of an attractive market.

A local fish plant states that they produce about 5 tons of salted dried shark very month and that the demand from the inland mines can not be met with this volume.

3.5 Jamaica

3.5.1 Geography

		1983	Growth rate 1973-82
Population		2,264,000	1.4%
GNP, at market price, mill.	US $	2,940	-2.6%
GNP per capita	US $	1,300	-4.0%

Jamaica has an area size of 4,232 sq mi, and is located in the West Indies south of Cuba and west of Haiti, in the Caribbean Sea. The capital is Kingston.

Although largely a limestone plateau more than 3,000 feet above sea level, Jamaica has a mountainous backbone that extends along the island from the west and rises to the Blue Mountain in the east. A narrow plain along the northern cost and several larger plains near the south shore are Jamaica`s major agriculture zones.

3.5.2 Economy

Jamaica`s major crops are coffee, sugar cane, from which rum and molasses are also made, bananas, ginger, citrus fruits, cocoa, pimento, and tobacco. Most of the these crops are grown on large plantations.

Small peasant farms produce some ginger, bananas, and sugar cane for export but mainly raise such subsistence crops as yams, breadfruit, and cassava.

Since large, easily accessible deposits of bauxite were discovered in 1942, Jamaica has become one of the world's leading suppliers of this ore. Along with the alumina made from it, bauxite accounts for about half of Jamaica's foreign exchange. Tourism is the second biggest earner of exchange.

3.5.3 Political structure

A new constitution in 1884 marked the initial revival of local autonomy for Jamaica. Despite labor and other reforms, riots recurred, notable those of 1938, which were caused mainly by unemployment and resentment against British racial policies. A royal commission investigated the 1938 riots and recommended an increase in economic development funds and a faster restoration of representative government for Jamaica.

In 1944 universal suffrage was introduced and a new constitution provided for a popular elected house of representatives. In 1962 Jamaica won complete independence. Jamaica is a member of the Commonwealth of Nations.

3.5.4 Present Fisheries

Fisheries are not well developed in Jamaica, which only reports landings of 9,500 tons for 1985. About 2,000 tons are produced from aquaculture.

Jamaica is a net importer of fish, which imported more than 17,000 tons of fish last year (1988).

Shark is only caught as an incidental catch to other fisheries as there is no market on the island for shark. Even sharkfins are imported for Chinese restaurants.

4. THE SHARK RESOURCES

4.1 General Background

Sharks and Rays are among the modern representatives of a group of vertebrate animals in the class Chondrichthyes, which has no true bone in the skeleton. This group traces its origins back 350 illion years. Today there are about 350 species of sharks out of 815 or so species of Chondrichtyans.

In addition to having no true bone, other characteristics of sharks include:

- o lack of bladder (hydrostatic organ) to maintain neutral buoyancy
- o the ability to alter their internal osmotic balance by diverting urea from the kidney system to body tissue
- o toothlike scales that give their hides a "sandpaper" texture
- o semi-rigid fins that act as planing surfaces to give it lift as it swims

4.2 Biology and Life History Factors Important to Shark Fisheries

Since sharks are negatively buoyant due to lack of a gas bladder, other systems have evolved to help overcome problems of maintaining a vertical position in the water column. First, sharks have large oil-filled livers often rich in Vitamin A (shallow water species) or Squalene (deep water species). The liver helps to reduce the shark's density and improve its buoyancy.

It is a physiological irony in sharks that a wellfed individual has a more robust liver and hence expends less energy on maintaining its vertical position than a starved shark with a depleted liver.

It has been suggested that in areas where heavy fishing activity depletes stocks of normal prey species for sharks, that there may be a disproportionate adverse effect upon the vigour of the shark stocks. However, data to quantify and qualify this is lacking at present.

Secondly, sharks improve their buoyancy by altering the osmotic concentration of their body fluids by diverting urea to the body tissues from the kidney system.

It is this residual urea in the tissues, after the shark has been killed, that makes early, careful handling of sharks after capture of such importance to maintaining quality of the meat. If a shark is not bled, cleaned and cooled quickly in the field, urea in the shark will be acted upon by bacteria resulting in the formation of ammonia. Shark which is not otherwise spoiled can still be rendered quite un palatable to the taste and offensive to the smell by such "ammoniation."

Most species of sharks must also continue to swim in order to pass enough water bearing oxygen over their gill surfaces to avoid suffocation, since they lack the ability to pump large quantities of water by muscular action. This is important to the practice of fisheries because certain types of gear kill sharks quite rapidly (gillnet), while others allow the sharks to survive for extended periods after capture before the gear is retrieved (longline). This will determine how long the gear is to be left in the water to assume the landing of sharks in the best condition (see section 5.2 for additional details).

Sharks exhibit several characteristics of growth, maturity and reproduction of special importance to developing shark fisheries. Sharks tend to grow slowly and to be long lived, they also tend not to mature until they reach more than 60 to 65% of their mean maximum size for a given species, which tends to support the belief that sharks of most species probably do not become sexually active and reproductive until 7 to 10 years of age or older. The females tend to mature later than males. In one well-studied species, the Soupfin shark, Galeorhinus zyopterus, males mature at 13 years but females do not mature until 23 years of age.

Individuals of this species are believed to live for 35 to 50 years of age in the wild. Because of their later maturity at larger body sizes, in sharks it is especially important to regulate fisheries to avoid catching the small, and hence, sexually immature sharks in order to protect the future reproductive potential of the stocks. Further, the fecundity, the number of young produced per reproductive cycle, is low in sharks and embryonic development is slow, often taking a year or more to produce a shark capable of living as a free-swimming individual.

The sharks of importance to the Caribbean fishery are all live bearers of young (either vivivaparous (placental) or ovoviviparous (non-placental).

As a result of these factors of growth, maturity and reproduction as well as longevity, shark stocks are sensitive to overfishing and stocks that are poorly managed can become depleted rapidly. Once the stock is depleted, recovery is slow. Once the fishery has collapsed it is entirely possible that it will not recover suitably to support a new fishery within the working life of that generation of fishermen.

Using the Soupfin shark fishery of the U.S. West Coast in the 1930's as an example, it took less than 10 years to destroy a large part of the stocks of one of the West Coast's most abundant sharks, and 40 years later the stocks are only now becoming fishable again in Southern California. Also, there is evidence that individual Soupfins are smaller now than their predecessors in the 1930's fishery. One of the key factors in the ruin of this fishery was overharvesting, but another important factor was that the fishery was conducted in nursery areas as well as in areas where adults were found. This harvested not only juvenile Soupfins but also pregnant females which can carry 35 to 85 young each.

As the economics of the fishery became unattractive and the need for shark liver declined with the development of synthetic Vitamin A, the fishery was abandoned and the stocks could then begin to move to establish a new equilibrium.

Where a fishery persists even after stocks are depleted much more damage can be done. Such is the case of the fishery in the Irish Sea for the common skate, Raia batis. The fishery started at the end of the 19th Century and flourished initially. However, as fishing pressure for the skate and other fish increased, and technology for capture improved, the common skate stock depleted. However, fishing continued at high levels for other types of fish that could be taken with bottom trawls and by the 1950's the common skate had completely disappeared from the Irish Sea. This is the only known example of fishing pressure leading to a wild marine species to extinction.

4.3 Species Indigenous to the Caribbean Region.

There are 33 species of sharks indigenous to Trinidad and Tobago and adjoining offshore areas of the southern Caribbean and the Western Central Atlantic. Two species are deepwater types for which no current fishery exists (Cookie Cutter Shark, Isistuis braziliensis, and Roughtail Shark, Galeus arae). One species is a rare epi-pelagic visitor for which it would be uneconomical to develop a fishery interest (Whale Shark, Rhiniodon typus) although it is fished in limited numbers with harpoon in Pakistan, India and Senegal. One bizarre species of common shallow water shark found in the Columbus Channel between Trinidad and Venezuela (Daggernose, Isogomphodo oxyrinchus) is sometimes taken in the Trinidad fishery but is not considered a very good food fish.

The remaining 31 species of inshore, offshore and oceanic sharks are potential candidates for commercial fisheries (see Table 4.1). Of the species listed in Table 4.1 only 12 make up approximately 80% of the annual catch : (Caribbean Reef shark, Sandbar shark, Bull shark, Blacktip shark, Blacknose shark, Smalltail shark, Caribbean Sharpnose shark, Tiger shark, Nurse shark, Smalleye Hammerhead, Bonnethead and Gummy shark (Narrowtooth Smooth-hound).

Other sharks observed by Consultants in the wholesale fish market at Port-of-Spain (Sea Lots) and at Trifish Company in Sangre Grande included : Scalloped Hammerhead, Scoophead, Great Hammerhead, Spinner shark and Silky shark. The first 3 species came from the Trinidad gillnet fishery, the last two species from the Tobago longline fishery.

Table 4.1

SHARKS OF POTENTIAL COMMERCIAL INTEREST TO TRINIDAD FISHERIES (BY PRINCIPAL LOCALES TAKEN)

INSHORE SPECIES/OFFSHORE SPECIES	BIOLOGICAL NAME	PRODUCTS
SANDBAR SHARK	CARCHARINUS PLUMBEUS	H, L, O, F
SAND DEVIL	SQUATINA DUMERIL	H, M
NURSE SHARK	GINGLYMOSTOMA CIRRATUM	H, M, L, O,
DUSKY SMOOTH-HOUND	MUSTELUS CANIS	H, M,
SMALLEYE SMOOTH-HOUND	MUSTELUS HIGMANI	H, M,
NARROWFIN SMOOTH-HOUND	MUSTELUS NORRISI	PT/DL
BLACKNOSE SHARK	CARCHARINUS ACRONOTUS	H, M,
BIGNOSE SHARK	CARCHARINUS ALTIMUS	M, O, S,
SILKY SHARK	CARCHARINUS FALCIFORMIS	H, F, L, O,
BUTT SHARK	CARCHARINUS LEUCAS	H, L, F, C, M,
BLACKTIP SHARK	CARCHARINUS LIMBATUS	H, L, F, O, M,
DUSKY SHARK	CARCHARINUS OBSCURUS	H, L, F, O,
CARIBBEAN REEF SHARK	CARCHARINUS PEREZI	H, L, G, M,
SMALL TAIL OR "PUPPY"SHARK	CARCHARINUS POROSUS	H, O, M,
TIGER SHARK	GALEOCERDO CUVIER	H, L, F, O, M,
LEMON SHARK	NEGAPRION BREVIROSTRIS	H, L, F, C, M,
BRAZILIAN SHARONOSE SHARK	RHIZOPRICNODON LALANDII	H, M,
CARIBBEAN SHARPNOSE SHARK	RHIZOPRIONODON POROSUS	H, M,
SCALLOPED HAMMERHEAD	SPHYRNA LEWINI	H, L, F, O, M,
SCOOPHEAD	SPHYRNA MEDIA	H, M,
GREAT HAMMERHEAD	SPHYRNA MOKARRAN	H, L, F, O, M,
BONNETHEAD	SPHYRNA TIBURO	H, M,
SMALLEYE OR "GOLDEN" HAMMERHEAD	SPHYRNA TUDES	H, M,
SPINNER SHARK	CARCHARINUS BREVIPINNA	H, L, O, F,
OCEANIC SPECIES		
BIGEYE THRESHER	ALOPIAS SUPERCILIOSUS	H, L, O, F,
COMMON THRESHER	ALOPIAS VULPINUS	H, L, O, F,
SHORTFIN MAKO	ISURUS OXYRINCHUS	H, L, O, F, C,
OCEANIC WHITETIP	CARCHARINUS LONGIMANUS	H, L, F, O, M,
BLUE SHARK	PRIONACE GLAUCA	H, L, F, O, M,

1) - Scources: Compagno (1984); Virginia Slosser, NMFS, pers. comm.
2) - Products: (Not all may be suitable to Trinidad Fishery)
H = Human food, M = Meal, L = Leather, O = Liver oil, F = Fins,
C = Curios (teeth), S = Shagreer
PT/DL = Probably taken/details lacking.

4.4 Shark Landings

4.4.1 Background and Present Landings

Sharks have figured in the fisheries of Trinidad for as long as it has been an independent nation (1962). For these past 24 years shark has averaged about 9.5% of reported total yearly landings kept by the Central Statistical Office of the Republic of Trinidad and Tobago. This has ranged from a low of 6.7% in 1970 to a high of 12.9% in 1978. In 1982 shark was 10.3% of the total catch of 4015 mt reported. In 1983 it was 8.0%. In 1984 it was 10.0% and in 1985 it was 7.6% of the total catch.

However, the total reported catch was falling in 1983-1985 by - 10.2% (1983), - 16.2% (1984) and - 7.3% (1985). At this same period reported shark landings were falling by -28.5% (1983), rising by + 4.1% (1984), and falling by - 28.6% (1985).

The generally reported landings of fish for this period fell by a an average of - 11.2% per year, however, the shark fishery during the 1983-1985 period fell an average of 17.7% per year. Although there was a slight increase in reported landings of shark between 1983 and 1984, this was likely a temporary occurrence caused by increased effort as new fishermen entered the fishery during the FAO artisanal shark fishery project. There were steep declines in catches reported in two of the three years between 1982 and 1985. In 1985 the reported catch was only 53% of that reported in 1982. (see Figure 5, Table 4.2)

Table 4.2

TABLE 4.2

REPORTED ANNUAL SHARK LANDINGS IN TRINIDAD AND TOBAGO : 1962-85

YEAR	REPORTED CATCH (MT)	% CHANGE FROM PREVIOUS YEAR
1962	404.06	-
1963	343.06	- 15 %
1964	356.37	+ 4 %
1965	452.75	+ 27 %
1966	331.64	- 27 %
1967	268.[illegible]6	- 19 %
1968	246.00	- 8 %
1969	213.62	- 13 %
1970	221.56	+ 4 %
1971	319.82	+ 44 %
1972	319.06	0 %
1973	422.35	+ 32 %
1974	408.25	- 3 %
1975	340.64	- 17 %
1976	391.36	+ 15 %
1977	494.07	+ 26 %
1978	567.70	+ 15 %
1979	344.39	- 39 %
1980	344.47	0 %
1981	267.58	- 22 %
1982	414.52	+ 55 %
1983	296.59	- 28 %
1984	308.77	+ 4 %
1985	219.86	- 29 %

24 YEAR TOTAL 7,977.03
YEARLY AVERAGE 332.38

In 1985 reported catches were at their peak in January - March and fell off rapidly, remaining low till years end. (Figure 4.4, Table 4.3).

Table 4.3

TABLE 4.3

REPORTED MONTHLY CATCHES OF SHARK IN TRINIDAD AND TOBAGO: 1985

MONTH	REPORTED CATCH (MT)	% CHANGE FROM PREVIOUS MONTH
JANUARY	30.94	-
FEBRUARY	24.10	- 22 %
MARCH	38.61	+ 60 %
APRIL	24.47	- 37 %
MAY	15.94	- 35 %
JUNE	9.58	- 40 %
JULY	14.77	+ 54 %
AUGUST	15.61	+ 6 %
SEPTEMBER	11.52	- 26 %
OCTOBER	13.10	+ 14 %
NOVEMBER	11.15	- 15 %
DECEMBER	10.07	- 10 %
1985 TOTAL	219.86	

Source - Central Statistical Office, Republic of Trinidad and Tobago

In view of the increase of effort that would be expected to accompany the 47 pirogues and one 12 m gillnetter that are reported to have geared up and entered the fishery during this period, the Catch Per Unit of Effort (CPUE) appears to have declined dramatically. This would tend to indicate that the inshore fishery stocks are most likely becoming depleted. Such a depletion would be expected to adversely affect resident shark populations more than migratory shark populations, since resident sharks are exposed to fishing pressure for longer periods of the year.

REPORTED TRINIDAD SHARK LANDINGS: 1985

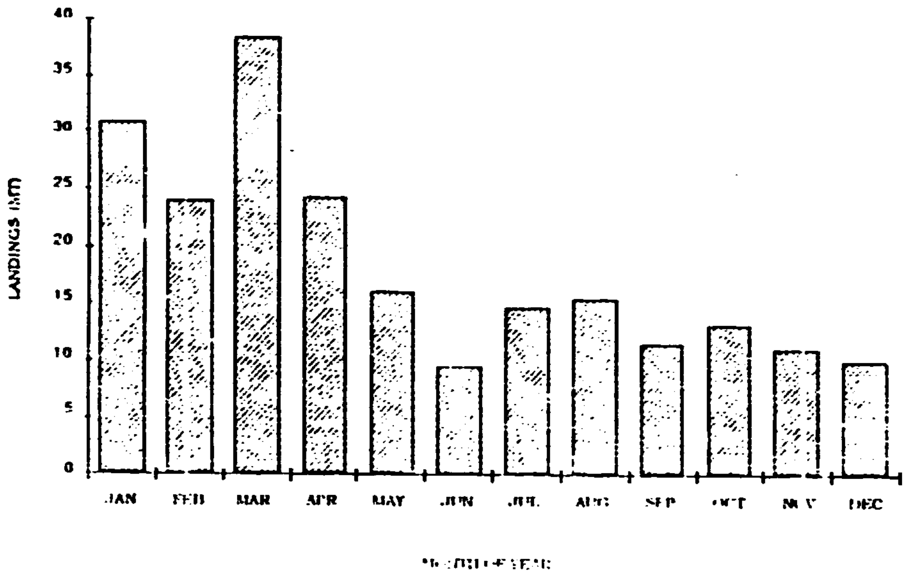


FIGURE 4.4

REPORTED TRINIDAD SHARK LANDINGS: 1962-1985

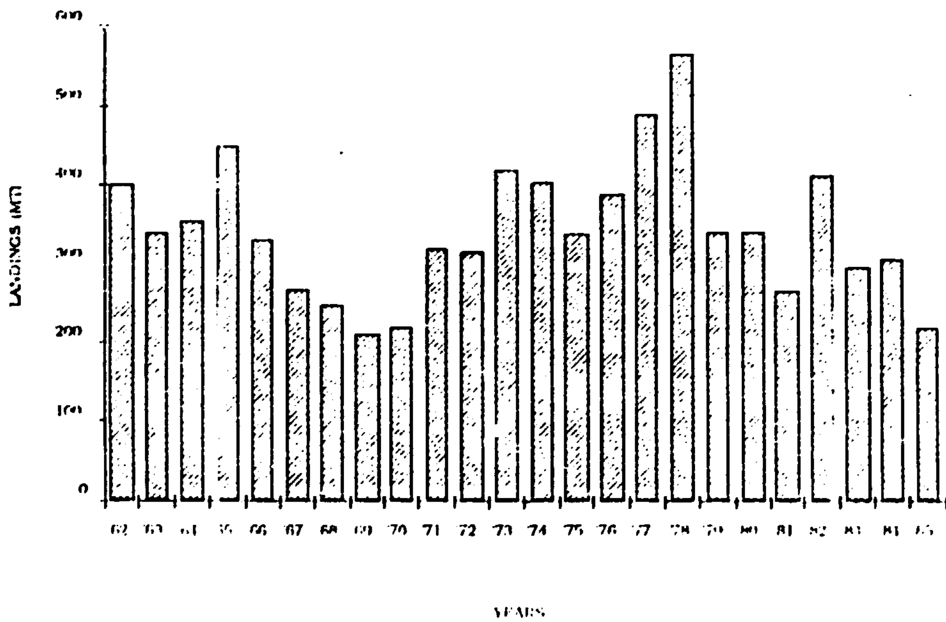


FIGURE 4.5

A considerable portion of the shark landed in Trinidad at present is being caught by foreign nations on the high seas, as far away as Bermuda and Argentina. The major source of this shark is the incidental catch of Taiwanese (and occasional Korean) longline vessels. It is delivered to National Fisheries Company in Port-of-Spain.

The following statistics were provided by National Fisheries Company Staff:

Vessel size (average) : 170 ft (52.7 m)
Vessel Gross Registered Tonnage (avg.) : 400 GRT
Net Hold Capacity (avg.) : 250 mt (range = 200 - 350 mt)
Fleet Size : 35 vessels
Visits/vessel/year (avg.) : 2.5
Sharks/vessel/visit (avg.) : 7 mt
Average Total Delivery/year : 612.5 mt (35x7x2.5)

Shark Species : Mostly offshore and oceanic pelagic species such as Shortfin and Longfin Mako, Bigeye and common Thresher, Silky, Oceanic Whitetip, Blue, Spinner and Dusky.

The above data indicate that even with the most liberal rational adjustments for under-reporting of the local catch, more than 50% and maybe as much as 60% of the shark utilized in Trinidad is not locally caught.

At present there are believed to be 60 vessels (of which 59 are pirogues) involved actively in the fisheries for sharks in Trinidad and Tobago. However, during interviews by the Consultants with many people associated with the fishing industry, it appears that only a few boats account for the majority of "locally caught" shark being landed in Trinidad gillnet fishery.

In addition to the vessels utilizing the inshore fishery, at least 4 blue water vessels may be entering the currently unexploited offshore and oceanic fisheries for shark. This is discussed further in Section 4.5.

4.4.2 Determining Present Catches

As with the general fishery of Trinidad and Tobago, it is difficult to state precisely the landings of sharks due to under reporting and inadequate records by fishermen. Also an unknown fraction of the Trinidad shark catch finds its way across the Columbus Channel to be landed in Venezuela where ice is readily obtainable and payments for fish can be arranged in U.S. currency.

This combination of factors indicates that shark landings may be somewhat higher than reported in the Government statistics. For example the 1983 FAO statistics report a shark and ray catch of 368 mt, while Trinidad statistics show only 296 mt, a discrepancy of 20%.

At present it would be difficult to determine the true level of landings without extensive fieldwork, which is beyond the scope of this project. If we can assume the under reporting and foreign landings to represent a consistent pattern of behaviour as was discussed earlier for the general fishery, then we are able to look in relative terms at landing information to discover trends but not absolute landings of shark. (see Figures 4.2 and 4.5)

4.4.3 Seasonality of the Present Fishery

The FAO project on the artisanal fishery recommended that the Tobago fishery operate from January through October, taking off the heavy weather months of November and December for holidays and equipment repair. The Trinidad fishery was recommended to operate from January to early summer, then to target on more profitable fish, like mackerel, in mid summer, and then convert back to shark from late summer through October. November and December were recommended for holidays and equipment repair to avoid heavy weather.

4.5 Potential Future Landings

With increasing indications that the general fisheries and inshore shark fisheries are declining, the future shark fishery of Trinidad will have to turn increasingly to offshore and oceanic stocks to remain viable to grow. There are 12 species of sharks that qualify as offshore or oceanic pelagics to the east and north of Trinidad and Tobago, including Sandbar, Silky, Blacktip, Dusky, Scalloper Hammerhead, Great Hammerhead, Spinner, Bigeye Thresher, Common Thresher, Shortfin Mako, Oceanic Whitetip and the Blue Shark.

In addition there are 3 species of bottom dwelling offshore sharks of potential interest: Bignose, Dusky Smoothehound and Smalleye Smoothehound.

Many of these species which are also currently taken inshore in Trinidad, however, individuals tend to be larger bodied offshore. Although the preference among consumers in Trinidad and Tobago leans toward small sharks (i.e. juveniles), this preference is at least partially responsible for the decline of the inshore fishery for sharks.

If fishing without stringent gear and mortality controls is continued, the inshore fishery will collapse inshore stocks and become economically untenable for local artisanal fishermen to pursue. In fact the fishery may already be entering a seriously troubled phase. It is extremely unlikely that the inshore fishery for shark will meet domestic needs in the future. Therefore it will be necessary to cut back on consumption of shark eventually to the point of effectively eliminating it from local diets, or consumers are going to have to adjust their preferences to accommodate larger sharks caught offshore.

There are indications that consumers are willing to adjust to eating larger sharks as long as they are butchered into usable sized portions. As mentioned before, at present National Fisheries Company receives over 600 mt of large sharks that are landed as incidentals by the 35 vessels Taiwanese longline fleet that fishes for Albacore on the high seas from Bermuda to Argentina.

If the offshore and oceanic fishery for sharks is developed, it should be able to land enough tonnage of Western Central Atlantic and Southern Caribbean shark to offset the decline of inshore shark fisheries. Mounsey (1986) noted that when large migratory species came through Tobago waters in the winter it raised catch weights considerably in the FAO project.

There are currently 4 individuals interested in modifying blue-water vessels for offshore and oceanic shark operations, at least seasonally. Mr Jon Cohan has recently received approval for financing of a multipurpose 20 to 25 m fishing vessel through Caribbean Food Corporation (CFC) in Port-of -Spain, Trinidad. There are also three operators of shrimp trawlers (12.5 to 22.5 m) in Trinidad who are interested in converting to shark fishing gear.

The total landings would depend upon the number of vessels fishing and the number of trips per year per vessel. However, for reference U.S. offshore vessels involved in shark fisheries for many of the same species found in Trinidad have averaged 6,500 lbs (2,950 kg) to 40,000 (18,140 kg) per average 3 to 6 day trip, depending upon vessel size and duration of the trip.

Using a 4 vessel fleet (such as described above) making 10 trips per year seasonally fishing for shark (devoting other seasons to tuna, shrimp, billfish, etc.) with an average vessel haul of 17,000 lbs (7,710 kg) of cleaned, field dressed shark (in slush or frozen), we would expect a catch of 1,020,000 lbs (462,590 kg) of shark in the round and a landing at 0.4 recovery rate of 680,000 lbs (308,390 kg) of cleaned shark suitable in quality for either domestic use or for export.

4.6 Future Shark Landings from Region

Other Caribbean region countries could develop their own shark processing, or a joint regional shark processing center could receive shark and offer continuous market for expanded shark fisheries.

Enquiries to Belize, Panama, G·yana and Jamaica have shown that none of these countries have any resource studies and thus no knowledge of their future potential landings of sharks.

Any regional approach to shark fisheries will therefore of necessity first of all require a trial fisheries period to observe the quantities, the types and the sustainability of the shark resources, before any major process plants can be developed.

The following analysis therefore rely entirely on verbal information and estimates by local fisheries people. There is no scientific basis for assuming these figures. For each country an estimate has been made of the initial shark catch which it is assumed could be provided in the first parts of a shark fisheries project, i.e. during a trial period.

4.6.1 Belize

The present catch is totally negligible and unknown. It can be estimated that it may be possible to expect 100 tons per year in a trial period, if the price of US$ 0.50 per lbs is guaranteed.

4.6.2 Panama

Present landings of shark is of the order of 1-200 tons. With a directed effort and a guaranteed demand it is estimated that 200 tons per year could be made available for a trial fishery.

4.6.3 Guyana

Present catch may be of the order of 100 tons. The fishing grounds are proven to be rich in sharks and it would appear justified to estimate that 400 tons could be landed on an annual basis for the trial fisheries.

4.6.4 Jamaica

There are little or no landings at present. The potential fishery is total guess work but could be set at say 100 tons for the first year of a trial fishery.

4.6.5 Region

In conclusion it is therefore estimated that a total of 800 tons could be provided from the Region, in addition to the 500 tons estimated for Trinidad, giving a total of 1,300 tons.

5. VESSELS AND GEAR

5.1 Present Fishing Fleet

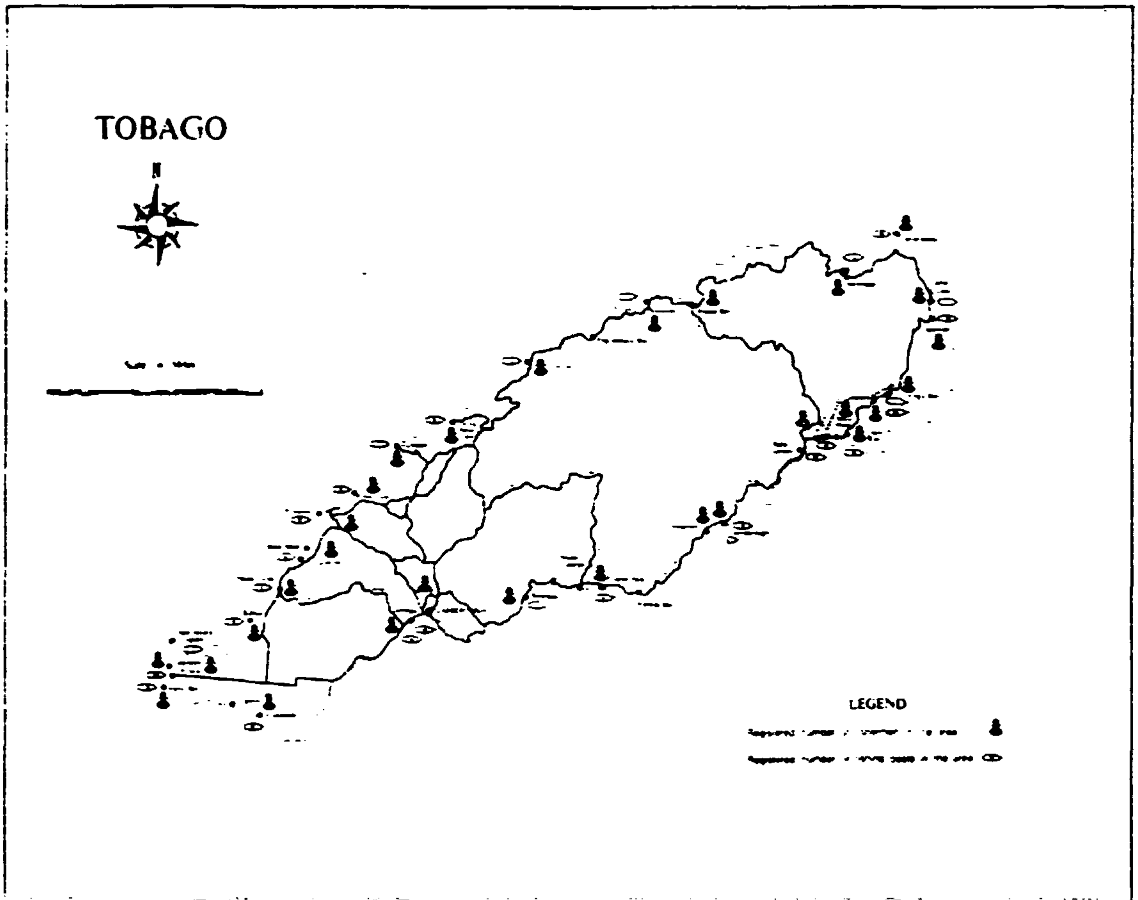
There are two general categories of domestic fishing vessels presently operating in Trinidad and Tobago: small dayboats typified by the open piroque utilizing the inshore fishery exclusively; and the medium sized multipurpose vessels (12 to 25 m) typified by the shrimp trawler but capable of being rigged out with several types of gear, which can sustain trips of many days duration. Further, there is at least one modified 12 m gillnetter capable of trips of several days duration operating in the near shore fishery. Major fishing beaches are listed in Figure 5.1.

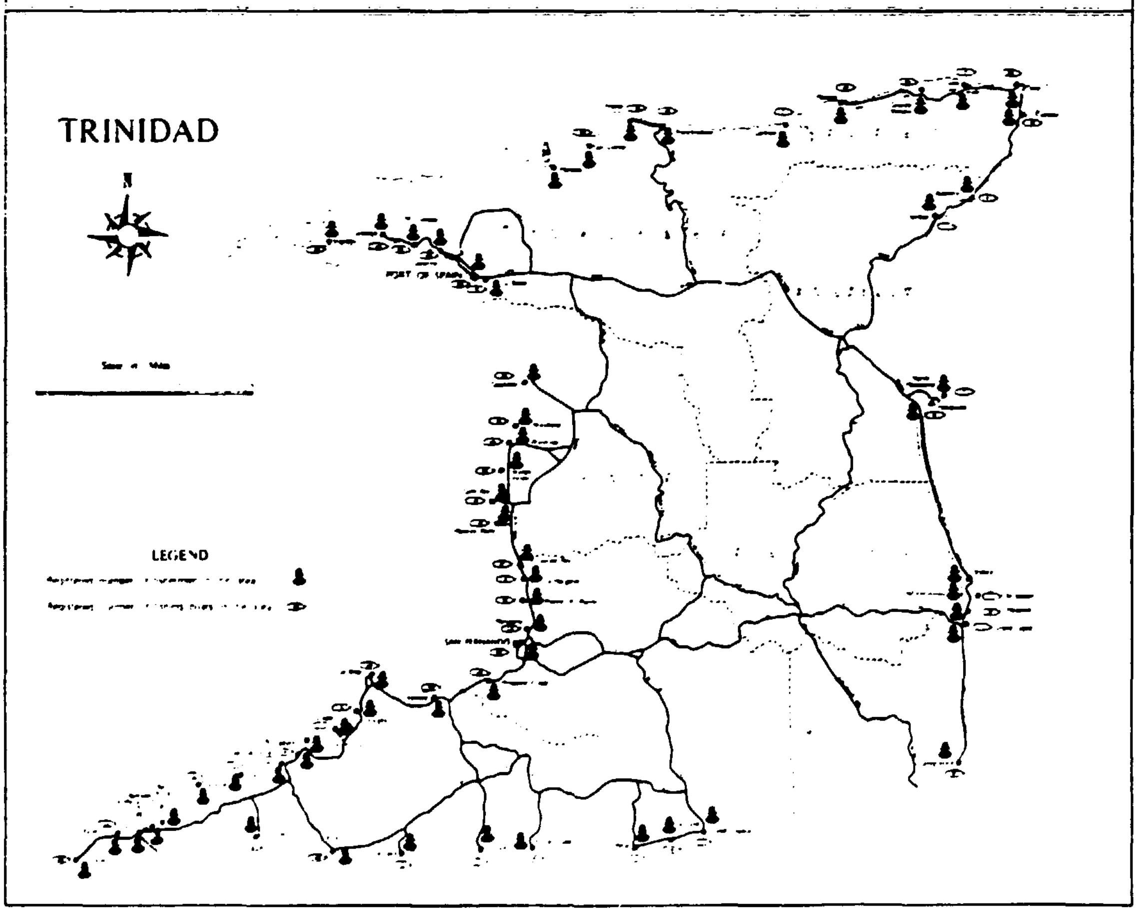
With the exception of the gillnetter, the boats involved in the inshore shark fishery of the country are open piroques of 8.5 to 10 m length. The vessels usually operate with a crew of three (a skipper and two hands) and rarely venture beyond 7 to 8 miles (12 to 13.5 km) from the coast.

The vessels may be powered variously with one 60 to 75 BHP outboard or two 48 BHP outboard motors. More powerful motor systems are required for boats operating off the north and east sides of Trinidad and around Tobago where currents and/or outflow effects from Rio Orinoco are particularly strong and water velocities of 3 to 7.5 knots (1.6 to 3.9 m/s) are not uncommon.

FIGURE 5.1

MAPS SHOWING FISHING BEACHES





5.2 Present Shark Fishing Methods and Gear

There are two different methods of shark fishing currently practiced in the country as a result of the FAO project from 1983-1986. In Tobago **longline** fitted with 8/0 hooks is the preferred method. In Trinidad bottom **gillnet** of 4.5 to 6 inches (114 to 152 mm) stretch has been used, with larger mesh sizes favored.

5.2.1 Vessels of the Inshore Fishery

The open pirogue is the predominant vessel type. Length may vary from 8.5 to 10 m (27 to 31 ft) and beam width varies from 2.3 to 2.8 (7 to 9 ft). The draught of these vessels ranges from 0.46 to 0.52 m (1.5 to 1.67 ft). The material used in the hull varies between painted wood and fiberglass coated wood. The power plants observed varied from single outboard motors of 60 to 85 BHp to twin outboard motors of 40 to 48 BHp. (Yamaha, Evinrude and Chrysler motor products were seen).

Vessel layout consists of some type of covered bow which may contain a true storage locker or just provide stowage forward. Most vessels are not equipped with hydraulic winches forward (although some piroques patterned after the FAO experimental fishing vessel have been so equipped). Such winches when present are equipped with a drive motor and are used to help in gear retrieval.

Some vessels are equipped with isothermic fish containers that allow ice or ice-water-salt-slushes to be carried for the purpose of cooling fish and sharks at the time they are "boarded". However, most vessels of the pirogue type observed in the fishery do not have adequate ice storage containers to accommodate the catch.

The isothermic containers have a fish capacity of about 305 kg (1200 lbs). At the stern is a cockpit of sorts that allows room for a fuel tank and auxiliary fuel supplies (often US 5 gallon cans) and a standard transom with outboard motor mounts.

Gillnet fishing by the 12 m vessel, "Brefney", will also need to be included in any discussion of the inshore shark fishery of Trinidad. The "Brefney" is of steel hulled construction with a maximum beam width of about 10 feet (63.5 m).

This vessel owned by John Rudden has been extensively modified. The stern has been fitted with a net drum of about 5 1/2 ft (1.7 meter) diameter upon which can be wound, up to 8060 feet (2,500 m) of monofilament gillnet. The drum is operated by a gasoline powered engine operating through a variable torque transmission. This allows the drum to turn at variable speed with a controllable amount of force.

This vessel has a fish hold that can be chilled (by block ice). Depending upon how the fish are stacked and the amount of ice carried, the hold has a "useful" capacity of 3,000 to 7,000 lbs. (1,360 to 3,180 kg) of fish. The vessel is crewed by a skipper and 2 to 4 hands. It is capable of making 3 to 6 day trips.

5.2.2. Gillnet Specifications

The standard observed gear for the Trinidad fishery consisted of 600 to 1,000 ft (186 to 310 m) monofilament nets of anywhere between 4.5 to 6 inch (114 to 152 mm) stretch web. Occasionally the ends of the nets consist of up to 12 inch (305 mm) stretch web, however such large gillnet is not productive in the inshore fishery. The nets are 20 to 25 meshes deep. Usually 2 to 3 nets were observed per boat (1,800 to 3,000 ft or 560 to 930 meter).

The fishing boat used by FAO during its experiments, carried 6,400 ft (2,000 m) of net, but that appears to be an exception and not the rule in Trinidad. The FAO specifications for gillnet rigs were as follows for a 1,290 ft (400 m) gillnet:

1. 60.0 lbs (27.2 kg) of 6 inch (152 mm), 0.9 mm twine diameter monofilament gillnet of 20 meshes depth;
2. 600 m of 5/16 inch (9.0 mm) 3 strand twisted polypropylene rope (yellow);
3. 450 m of 1/4 inch (6.35 mm) strand twisted nylon rope;
4. 100, model 250 Nelco floats;
5. 50 lbs (22.6 kg) of net leads;
6. 2 small anchors;
7. 3 marker buoys;
8. 8.8 lbs (4 kg) of slinging twine.

In practice, the Consultants observed variation in these nets from the FAO model. The nets often had quite a bit of damage to them (holes) that would render them less of a barrier to the passage of fish. At least come of the damage is caused by the method of deployment. The net is fed over the port gunwale which often appears to be roughed from peeling paint and chipped wood. Since the currents are strong, the net pays out quite rapidly. The result is that the monofilament becomes bruised and frayed from friction and sharp edges, thus shortening the life of the net.

5.2.3 General Gillnetting Methods

FAO recommends setting the net in 5 to 25 fathom depths (9.3 to 46.5 m). The recommended areas are along the North and East coasts of Trinidad. Such recommendations would place the fishery within 10 miles (16.7 km) of the coast. This is in fact being done. Fishermen are rarely going beyond 6 to 7 miles (10 to 11.6 km) out. A typical net setting pattern entails setting a net in the morning then retrieving a net that has been set overnight. The sharks are removed from the net and either placed in an ice filled isothermic container to chill or (more often) placed in the bottom of the boat uncleaned. When the latter happens the fish usually lie in the sun until they are removed at the mooring site (fishing village). The net from which the fish have just been removed is then reset.

The boat often returns to the dock with one load of fish and then returns to check the nets in the afternoon. They may reset one or both of these for the coming night. The day sets have a soak-time of 14 to 18 hours before retrieval. Most sharks caught in gillnets die rapidly from suffocation, and it has been cautioned that excessive soak-time yields poorer quality shark (see section 6 for details).

A successful boat may land upwards of 1,000 lbs of shark in a one day effort among its day and night sets, an unsuccessful boat may land 50 to 300 lbs of shark, an amount considered too low to be economical for a vessel with a crew of 3 when hard overhead costs are calculated. The majority landings of shark in Trinidad seem to be made disproportionately by only a few boats.

This uneven distribution of landings is not unknown in fisheries, being traceable to three principal causes: uneven effort, skill of the fishermen and decline of stocks.

Many factors play upon the fishery that cause effort to be uneven during periods when the fishery is being pursued (essentially from January to May and August to October of the calendar year) including : mechanical breakdowns, severe weather, illness, availability of more desirable species, economic problems and fishable days missed for various reasons. All of these factors were noted by the Consultants while observing the fishery on site.

Not all fishermen are equally adept at the art of fishing, so a variation of success even in the soundest of fisheries is to be expected. As stocks begin to decline in a stressed fishery, for awhile we would expect the most skilled fishermen to continue making acceptable catches.

However, as the decline in stocks progressed a lower percentage of fishermen would be bringing in good catches. The least skilled and least diligent fishermen would feel the effects first. And, as stocks declined further eventually the best fishermen would begin to suffer also. This is, in fact, what appears to be currently happening in Trinidad.

5.2.4 Longline Specifications (per 100 hooks)

1. 600 m #30 tarred trawl lines;
2. 100, 8/0 snap-on, swivel connectors;
3. 200 m 7 x 7 strand stainless steel flex cable of 1/16 inch (1.6 mm) diameter;
4. 1/16 inch (1.6 mm) copper sleeves;
5. 100 hollow-point 8/0 tuna hooks (pattern # 92025 kr);
6. 2 small anchors;
7. 3 marker buoys;
8. 300 m of buoy line.

5.2.5 General Longlining Methods

Because of the variations in ocean conditions (i.e. water clarity, depth, etc.) the species of sharks around Tobago are of a moderately different species composition. The Tobago fishery is better adapted to longlining than gillnetting. (It may be useful to treat it as a distinct fishery from Trinidad for the purpose of management.)

The FAO recommendations for the Tobago fishery are that it operates from January to October to avoid the heavy weather months at the end of the year. The area of best fishing is off the Southern and South-western side of the island in depths of 2 to 50 fathoms (3.7 to 9.3 m). This would allow fishing in an area up to about 16 miles (26.7 km) from the coast. The fishery largely operates closer than 10 miles(16.7 km) to Tobago.

Equipment in use appears to closely follow the FAO recommendations for the use of 1/16 inch (1.6 mm) multistrand stainless steel flex cable gangions topped off with 8/0 tuna hooks (triple strength) with hollow-ground points (retain sharpness better).

The Tobago fishery for sharks tends to land grouper and large snapper as well as other bony fishes in considerable quantity. During the FAO project it was noted that the value of select species of bony fish could be greater than the value of sharks captured at least part of the time.

The Tobago fishery does not seem to be as much in trouble as the Trinidad fishery appears to be. In large part this is probably due to the natural selectivity of longline gear that limits the capture of fish either larger or smaller than the targeted size. Large fish tend to break the hooks. Small fish tend to be unable to ingest the hook sufficiently to remain on the longline.

The average longline is deployed for less than 48 hours. A fundamental difference between longline and gillnet lies in the rate at which the gear kills animals caught on it. The survival rate of sharks is much higher on longline (at the time of retrieval) than on gillnet.

Sharks caught on longline tend to be either freshly killed or still alive even after a relatively long soak-time (up to 8 hours). Therefore longlined shark tends to be of better quality than gillnetted shark at the time it is taken from the water.

5.3 Potential Future Shark Fishing Fleet and Gear

The future fleet fishery for shark in Trinidad and Tobago will be considerably different than it is today.

First, the **inshore fishery**, which has been the primary focus for commercial shark up to the present, will not be able to sustain economical landings for most fishermen over the next 5 years, if current trends persist (see section 8.2 for management recommendations in detail).

All indications point to a decline in both the bony fish and shark fishery inshore. In the case of sharks entirely too many juveniles and late term pregnant females are being caught due to fishing in nursery areas and with gear that does not permit juveniles to escape.

There are three major alternative scenarios which might reasonably occur in the Trinidad & Tobago:

A) **No management plan will be implemented.** In this scenario the fishery for sharks would be expected to collapse within a relatively short number of years.

   Since fishing pressure would continue as fishermen pursue inshore stocks at a time when they are severely stressed and the stocks would not be able to recover, it would become a race to see if the fishermen or the stock would be first to give out.

B) **A management plan will be implemented, but without sufficient** enforcement infrastructure. This is likely to be unsuccessful since local fishermen might violate the plan and fish with illegal gear or in restricted areas with little fear of consequences. At best this would be expected to slow the collapse of the fishery but not by any means prevent it. The fishery might continue for one or two extra years before lack of profitability would drive most fishermen out of the inshore areas.

C) **A sound management plan with sufficient enforcement** infrastructure will be implemented. Such a plan would restrict gear, regulate mortality, fix seasons, restrict fishing in sensitive areas, and define and enforce penalties for violations. Such plans are not easy to develop or implement and they do require funding. However, sound fishery management plans are the only viable option available for protecting and enhancing stocks so that future fisheries will stand a chance of being sustainable.

Where a long lived animal, such as the shark is concerned, it may take many years for detectable improvements to be recognized. In the case of the School shark (Gallorhirus galeus) fishery, in Northern Australia, management decisions implemented in the 1940's did not begin to produce marked results until the beginning of the 1960's, a period of about 14 years. However, this fishery today stands as an example of a fishery for sharks which has continued to be exploitable up to present times.

An important point is that in the short term, whether the fishery inshore for sharks is managed or not, there are going to be adverse trends in landings and economics expected. This is not to say that all is bleak for the fishery. What it does mean is that the principal effort has to be redirected into offshore fisheries operating more than 15 to 20 miles (25 to 33.4 km) off the coasts of Trinidad and Tobago.

This offshore Fishery will not be accessible to piroque fishing but will require vessels capable of operating offshore or in the ocean (blue water vessels). Vessels will be required of a size of 12 meter (40 feet) or more in length with the ability to sustain fishing trips of 3 to 21 days duration.

Considering the type of fisheries development possible in the Caribbean, two types of blue water fisheries can be distinguished: an offshore and an oceanic fishery.

The **offshore** fishery will consist of vessels that are about 12 meter in length. They will operate more than 15 miles off the coast. Sharks and fin fish will be caught and preserved in ice or chilled seawater onboard. These vessels will make fishing trips of 5 or 6 days maximum.

Ideally, these vessels will be of a multipurpose design typified by the superstructure being placed well forward and having a large open back deck. Vessels so configured are capable of being rigged out with many different types of gear, including pelagic and other trawls, pelagic and bottom longline and drift and bottom gillnet. (see Figures 5.2 and 5.3).

These vessels can rig various gear at different seasons to target on different species of opportunity such as sharks, tuna, billfishes, etc. and thus would not become dependent upon only one type of fishing to sustain the vessel.

Varying the target species also tends to improve the economic potential of the vessel by allowing it to choose fisheries based upon market price and species availability. Finally, the ability to shift species targeted may have the added benefit of reducing fishing pressure n a given stock.

The offshore shark fishery would principally utilize pelagic longline gear to capture shark species like Mako and Silky, etc, but also could utilize drift gillnet of 10 to 12 inch (254 mm to 305 mm) stretch to capture sharks such as Bigeye and common Thresher shark. The gear utilized would by determined by area and season fished.

The **ocean fishery** will employ freezer vessels. These vessels will operate in the open sea of the Western Central Atlantic (FAO Fishing Area 31), further distant than the offshore vessels. Sharks and fin fish will be caught and preserved by freezing. These vessels could make fishing trips of up to 21 days or more. Handling and processing of these vessels require freezing equipment installed on board.

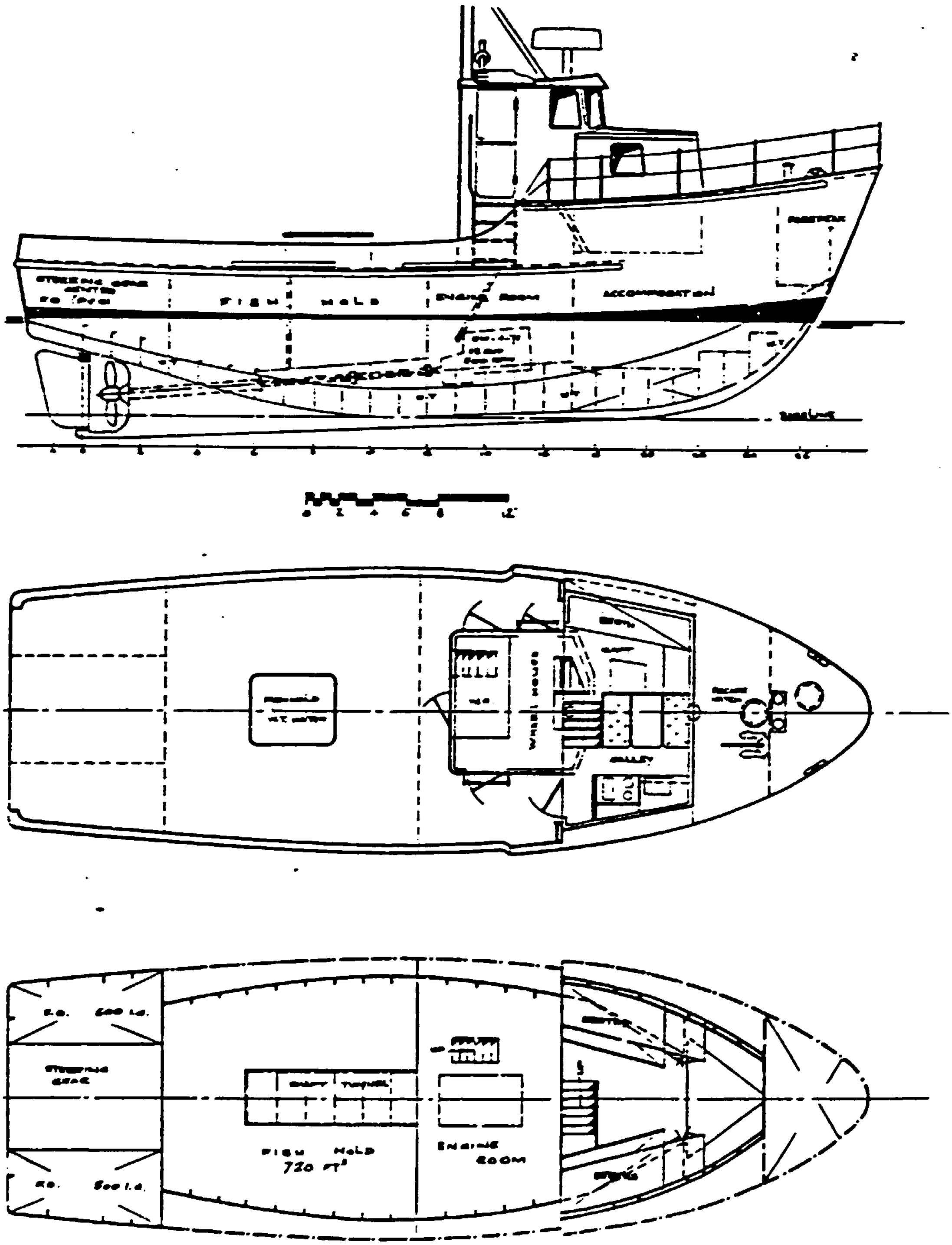
Blue-water vessels require better navigational and communications equipment than coastal boats and thus more advanced training of skipper and crew. It would also be advantageous to have a sounding system (sonar) for locating fish when operations were directed to schooling species.

Fishermen currently active in inshore fisheries could be utilized to crew such vessels for owners under the competent supervision of a blue-water capable ship's master. This would reduce the adverse economic effects of the decline of the inshore fisheries that are to be expected in the next few years, but would increase the need for skilled mariners.

The development of an offshore fishery in Trinidad and Tobago and some other Caribbean countries appears feasible within the near future. However the development of an ocean fishery using freezer vessels also require cold store facilities on shore. Fish freezing and holding equipment already is installed at National Fisheries Company (NFC) in Trinidad and at private companies in Guyana.

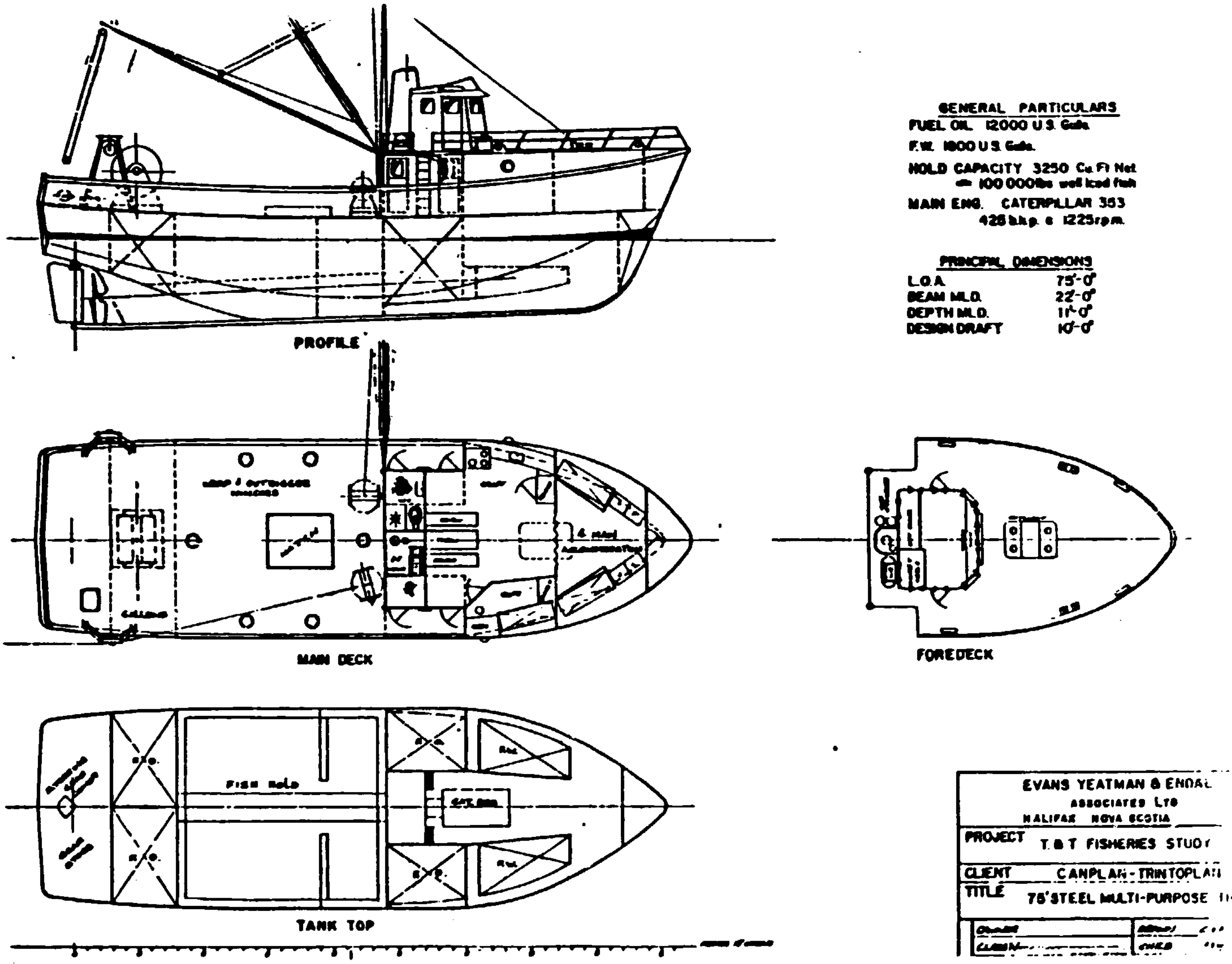
A reduced, managed fishery effort between 2 and 6 miles from the coast with emphasis on exploiting offshore and oceanic stocks of sharks and bony fishes might give the inshore fishery a chance to recover vitality in near shore stocks.

FIGURE 5.2



26 ft FISHING VESSEL FOR OFFSHORE FISHING

FIGURE 5.3



75 ft MULTIPURPOSE VESSEL FOR OCEAN FISHING

6. SHARK UTILISATION

6.1 Present Handling and Quality of Shark

Any discussion of shark utilisation must address the quality of product entering the market. In Trinidad and Tobago post-harvest handling ranges from exceptional to appalling.

Well handled fish should immediately be cleaned and chilled on ice or at least cooled in ice or a salt water ice slush within a few minutes after it is removed from the water. This minimizes bacterial activity on urea in the shark and greatly reduces the possibility that ammonia will form before further processing can take place. The recent FAO project stressed teaching fishermen proper field-dressing techniques, and the better fishermen use it.

However, the majority of fishermen interviewed did not use the FAO technique. The common way shark was unloaded at the dock was as whole unbled fish which had laid on deck in the sun and the heat for 2 to 4 hours while the boat finished tending its gear on the fishing grounds (day fishermen), or at least had laid on deck at ambient temperatures (25 to 27 degrees C) while fishermen hauling their gear at night worked the grounds.

The combination of a long "soak time" of dead sharks in warm water after they die in the gillnets and the practice of laying the fish out on deck rather than icing them down (preferably slushing them) resulted in low quality sharks being delivered dockside in the Trinidad fishery. Once the boats land these fish the sharks often remain in the round in wholesale markets for another 2 to 5 hours before being purchased and removed.

Realistically, sharks were being held in the round for 24 hours from the time they succumbed in the nets until a consumer purchased them or before anyone cleaned them. Although the sharks are pretty strong of smell and fairly well ammoniated after such a length of time, consumers still appeared quite content to purchase them.

Traditionally in Trinidad fish that were cleaned before being presented at market were held suspect of having something wrong with them. Fish is also judged to be freshest if presented in its bloodiest condition when butchered at the market.

A large part of the FAO shark project in Trinidad was directed towards development of quality product forms and education of consumers in handling and preparing shark for quality use.

Consumer demand for higher quality fish appears slowly to be gaining a foothold in Trinidad, and, as time goes by the quality of fish delivered to market will likely improve. One example observed by the project team at the wholesale market at Sea Lots, Port-of-Spain, is illustrative of this phoenomenon. Most of the shark observed in the market was well ammoniated and bloody or still in the round. Vendore were asking TT$1.50 to TT$2.00 per lb and more often than not getting less than requested (as low as TT$1.00 per lb). However, there was one vendor who had nicely cleaned shark, that smelled very little, if at all. The shark were laid out amid crushed ice on the metal table. He was asking and getting TT$3.00 per lb. His customers were primarily restaurant purchasing people. He had no trouble selling out his entire stock during the visit.

Higher quality shark is thus finding a market in Trinidad increasingly and at preferential prices.

One of the limiting factors that plagues delivery of quality shark is the limitation on the availability of ice for fishermen. According to the Fisheries Division there are seven ice facilities in Trinidad and one in Tobago with potential for access by the fishing community.

Not all of these were operational as of August 1986. The largest ice plant of the eight is the 160 ton capacity ice station at the National Fisheries Company (NFC) plant in Port-of-Spain. It was non-operational during the first visit in the summer of 1986.

Table 6.1

ICE FACILITIES POTENTIALLY SERVING THE FISHING COMMUNITY AS OF 1986

LOCATION	PRINCIPAL FORMS	COMMENTS
National Fishery Company Sea Lots Port of Spain	Block Ice Flaked Ice	160 Ton Storage 48 Ton/Day
Electric Ice Company Ariapita Avenue Port of Spain	Block Ice Only	-
Eastern Main Road Sargie Grande	Block Ice Only	-
Furnes Withy Company Sea Lots Port of Spain	Block Ice Only	-
San Fernando Ice Company By-Pass Road San Fernando	Block Ice Only	-
Cocorile Road Auria	Block Ice Cubed Ice	-
Trifish Company Paul Street Sargie Grande	Block Ice Cubed Ice	6,000 lb block 2,000 lb cubic per day. Local ice Co.
National Insurance Property Company (NIPDEC) Tobago	Block Ice Only	-

Source: Fisheries Division, Ministry of Agriculture, Lands and Food Production

6.2 Utilisation (Present)

The principal utilisation of domestic caught shark in Trinidad & Tobago is for meat and some fins. Meat and fins and teeth/jaws are used from the shark landed by the Taiwanese longliners. For the most part though, non-meat products are not utilised in Trinidad at the present time. In the other Caribbean countries surveyed there is no appreciable utilization of shark.

Meat - the primary way in which shark meat is utilised in the country is as fresh or frozen product, although several processed meat products were developed as a result of the FAO artisanal shark project.

These products are:

- sun dried salt shark
- smoked sun dried salt shark
- sea ham
- salmon analogue

Fins - One buyer, Mr. Lee Choo, in Port-of-Spain is interested in securing fins from sharks caught domestically and brought in by the foreign longliners. Other than this one individual interest in shark fins it appears that most fins are discarded at present.

Hides - Three problems presently preclude the recovery of leather quality hides from Trinidad sharks. First, a large part of the catch is comprised of small sharks which will not yield hides of sufficient size to satisfy the market. To be useful a hide must measure 4.5 ft or more (> 1.4 m) in length. This corresponds to a shark of at least 5 ft to 5.5 ft (1.6 to 1.7 m) in length in the round (Ocean Leather, 1980; Cook and Conway, 1983).

Secondly, much of the shark in the Trinidad fishery is gillnet caught which means that dead sharks are hanging for at least several hours in warm water in the nets prior to retrieval. By the time the animal is processed the hide may already show signs of excessive softening (mushiness). This reduces or eliminates the value of the skins.

Thirdly, post-catch handling is not consistent. Often it is very poorly accomplished. It is not uncommon for sharks to lay about in the sun in the bottom of the boat for one or more hours before they are unloaded. This causes otherwise usable hides to sunburn and soften before they can be recovered.

Due to the fact that recovering a top grade leather from shark is an involved process, only a handful of companies have ever mastered the technology. The oldest and largest of these is Ocean Leather Corporation of New Jersey (USA). Shark leather producers set high standards for quality of finished skins and will not hesitate to reject shipments of dubious quality.

Liver Oils - The livers of many species of shallow water sharks contain oils which are rich in Vitamin A (netinol). About 3/4 of Trinidad & Tobago's sharks have livers suitable for extraction of vitamin oils.

At various times in the 20th century sharks have been exploited for their livers, although the production of synthetic Vitamin A has decreased the need for natural sources in the past 30 to 40 years. There is also a negligible amount of Vitamin D in sharks liver oil. Squalene the much touted ingredient sold in various health food outlets, only occurs in viable quantities in deep-sea shark species.

Livers must be removed from the shark soon after it is taken from the water in order to be of high enough quality to be useful. Most sharks in Trinidad are not cleaned for several hours or more after they are "boated" thus rendering the livers worthless for vitamin oil extraction.

Teeth and Jaws - There is some market for teeth and dried cleaned jaws from sharks in Trinidad, especially valuable are the larger sets from large sharks taken by the Taiwanese longliners. Some jaws from locally caught sharks are also dried and mounted on wooden wall plaques for sale. The utilisation of this product is not well developed although a large jaw may sell for as much as TT$100.00

Scrap and Offal - The waste material not used for meat or other product forms can be turned into one of two items. The first is reduction to fish meal for animal feed supplements. The second method is to place the wastes from fish in organic or mineral acids to preserve and hydrolise. The mixture is then partially dehydrated and mixed with other ingredients such as Defalton to produce livestock silage for pigs and poultry and fish farms. To be profitable, the shark offal would have to be mixed with waste from other fishes for either process to gain enough raw material to be cost effective. At present in Trinidad the offal from fish and shark is thrown out, usually by dumping into the nearest bay or lagoon.

6.3 Product Forms of Shark Meat

Fresh Shark - enters the market in three ways:

First there are smaller sharks sold in the round. Sharks from 0.3 to 1.5 m in length were observed in the market in Port-of-Spain in this form.

Second are partially cleaned trunks that have been headed, gutted and finned. These sharks are apparently brought to the deck before they are cleaned. Most of those appearing in the market are very bloody, a condition which local customers believe indicates a fresh quality product, but which in fact indicates a poor quality, often ammoniated fish.

The third way in which fresh shark shows up in the market is as fully cleaned, well-handled fish. Vendors who produce quality shark command better prices and do not appear to have any problem selling their products. Such vendors are the rare exceptions and not the rule in Trinidad.

Frozen Shark - This is a common way for shark to be sold in supermarkets in Trinidad. Steaks of about 1 inch (2.5 cm) thickness are displayed in styrofoam trays wrapped in clear plastic film. The principal suppliers of shark in frozen form is National Fisheries Company. Much of this shark is delivered from the foreign longliners.

Often the packages examined in the supermarkets in Trinidad were not fully frozen. Sometimes shark is marketed under the pseudonym "sea flake" of "flake".

Basiri Mohamed of Trifish in Sarge Grande also produces "portioned" shark (frozen) from shark he gets from his own boats and local fishermen from Manzanilla. This is exceptionally well handled fish that may be sold in chunks, fillets or steaks in styrofoam trays with plastic wrapping.

Sundried Salt Shark - This is one of the products developed by FAO and the Fisheries Division (of Trinidad). The filleted product is liberally salted and placed in wooden or plastic tubs for at least one week. After a week, the accumulated brine is removed and excess salt is shaken off. The shark is placed on racks in a sunny and preferably windy place during the dry season, for 3 to 4 days out of the reach of animals. The goal of this process is to reduce residual moisture content to 20%. When completed the product should be dry and firm to the touch with little odour.

Smoked Salt Shark - Preparation up to the point of drying is the same as for salt shark above. However, during the rainy season it is not possible to dry the shark outdoors. So it is dried for 2 to 3 days in an 1,100 lb capacity Altona or similar smoker fuelled with coconut husks and "bogasse" (pulp) from sugar production, two items in great supply in Trinidad. The process must be regulated so that temperatures do not exceed 35 degrees C (cold smoking).

Sea Ham - This product is a hot smoked shark made from 3 cm thick fillets that are lightly salted, then smoked for 2 to 3 hours at 70 to 80 degrees C to produce a cooked product. Again the fuel is coconut husks and "bogasse". Freshly smoked Sea Ham is widely accepted as a sandwich meat or hors d'oeuvres in Trinidad, but most supermarkets carrying the products prefer to display it frozen in a styrofoam tray wrapped in plastic film. Since Sea Ham has no added preservatives it must be stored under refrigeration if it is to be used quickly, or frozen if it is to be kept for long periods of time.

Salmon Analogue - This product is made from salt shark fillets and is particularly suited to the use of Hammerheads such as the Smalleye, (Sphyrna tudes). After the fillets have been salting for several days in a tub they are removed and washed to get rid of excess salt. Next they are placed in an automatic meat slicer and cut into 10 cm x 2 cm strips. The pieces of shark are placed on a screen covered wooden tray and dipped for 15 minutes into a solution of 1 gr: 8 l Sealach's Dye water (a standard dyeing process for imitating salmon colour).

The slices are then air dried for 30 minutes to obtain a smokey flavour. After smoking, the slices are brushed with vegetable oil to prevent drying out and wrapped in plastic on a styrofoam tray. It must be stored frozen until use. It is gaining acceptance as a high value gourmet delicacy and makes an ideal party hors d'oeuvres.

6.4 Comments on the Mococain Hydrogenisation Process

From time to time new suggestions for theuse of shark meat are proposed. As part of this study for UNIDO, the Consultants were asked to look into the technical and economic feasibility of using a process hypothesised by John W. Mococain in a 1984 study.

A complete analysis of the proposed process was undertaken by the project team as well as by Dr. Herbert Hansen, Professor of Agricultural Engineering at Oregon State University, and Dr. David Crawford of the Astoria Seafood Laboratory of Oregon State University. A detailed report on the investigation can be found in Appendix D.

Conclusions of the study are:

1. Contrary to Mr. Mococain's claim of having patented this process, no such patent either under his name or under the subject heading of hydrogenisation could be found in a worldwide search of the Library Information Retrieval System (LIRS) database computers;

2. Mr. Mococain's process does not correspond to any current terminology used in the Food Sciences to describe protein chemistry processes.

3. A comparison of Mr. Mococain's process (so far as can be determined from the ambiguous way in which it is presented) to all known processes indicates that there is a high probability that the proposed technique violates more than one law of chemistry and physics;

4. Mr. Mococain's paper is filled with extraneous, irrelevant quotations of materials that serve no purpose, contains several errors and arithmetic mistakes, and lacks testable scientific methodology;

5. Mr. Mococain appears unaware of the economics of shark marketing and product development. Even if the process were possible, it would produce a product which would be prohibitively expensive to market based upon historical experience in other nations.

6. We conclude that this process is scientifically, technologically and economically worthless.

7.0 INDUSTRIAL SHARK PROCESSING

7.1 Proposed Pilot Plant

It is recommended that an initial pilot plant be set up in Trinidad for the processing of an average of 2 tons shark per day as well as other fin fish received with the catch.

The shark will be provided from Trinidad and Tobago as the offshore shark fishery gradually develops and it will be supplemented by frozen shark from other Caribbean region countries. If the assumptions concerning the shark fishery stand up to the test of time, the pilot plant itself will be profitable and can then be expanded, or another larger, 5 tons per day plant can be built in Trinidad and/or in Guyana.

The Pilot Plant will need funding to partly subsidize the commencement of shark fisheries on a larger scale in these countries, but if successful the project will be self financing fairly soon.

The development of the offsnore fishery with boats of 40 ft or more in length and fishing 15 miles or more from coast will require proper facilities for offloading, handling and holding the shark and fish until processed. Such facilities are also essential to improve the quality of product and thereby consumer acceptance.

The proposed vessels should make fishing trips of up to 5 days maximum. If the fish is properly handled and chilled on board the fishing vessels and during offloading and transport, the fish can be stored for 2 days in the chill room at the processing plant before being salted.

The greater the care of the product from catching to delivery to plant, the greater the final quality of the product.

It is possible that not all products can immediately be packaged and sold after salting. Therefore the capacity of the salting bins and containers must be large enough to keep salted fillets for more than 6 days in the salting room, before they can be dried.

The Pilot Processing Plant is designed to handle and process a mixed catch of sharks of different sizes and larger fin fish. The primary products will be salted-dried fillets from sharks and fin fish, fresh carcasses of small sharks and dried shark fins.

Also shark or fin fish fillets which are only salted can be processed and can be sold as cheap products. Moreover, fillets and steaks from small sharks can be produced for marketing as fresh products.

With regular provision of high quality shark products an increasing number of consumers will accept the shark products and demand will increase.In the light of further positive market developments, the plant is designed large enough to allow the production of new products from sharks such as specialty products at a later stage.

Equipment for processing such products is however not foreseen since the required consumer data are unknown. A plant with a capacity for handling max. 3 tons per day will not require freezing facilities.

From the economic point of view it appears necessary that the plant operate for about 250 days per year. This requires in the offshore fishery about 200 fishing days, if all the fish were fresh from local sources. With supplies from other countries and possibility of freezing at NFC's plant, the number of local fishing days can be reduced.

7.2 Plant Layout

The vessels fishing for the plant will discharge their catches at one of the landing places. From there the fish will be transported in ice to the process plant.

The composition of the catches depend on the fishing areas and the gear used. For this project it has been assumed that the catches consist on average of 70% sharks and 30% fin fish and that the proportion of large to small sharks is about 2:1.

The sharks will be bled and gutted on board the fishing vessels. Fin fish will be landed whole. The entire catch will be well iced or kept in refrigerated sea water on board vessels.

At the Reception area of the plant the fin fish will be sorted according to species and separated between fish to be used for filletting and others destined whole for the fresh fish market.

Those quantities which can be processed within the next few hours will be weighed, washed, covered with fresh ice and moved to the process lines in their boxes. The rest will be iced and put into the chill room until the fish can be processed.

Small and large sharks will be separated according to sizes and as far as product requirements according to species and quality. The different lots will be weighed and washed.

Small sharks which can be processed immediately will be transported to the trimming line where carcasses will be prepared for the fresh fish market. The prepared carcasses will immediately be put into the chill room and covered with ice. The remaining small sharks will be iced in boxes and stored in the chill room until processing is possible.

The larger sharks will be handled in the same manner but separately.

Fins of marketable size will be cut from all sharks as far possible and transported to the fin processing line.

Some quantities of shark fillets from certain species can only be salted (60% moisture content) and will be marketed as cheap products.

Certain Oriental markets have a preference for sun dried shark fins. To prepare this product a small drying yard is provided. If weather conditions do not allow it, fins are dried in the dryer.

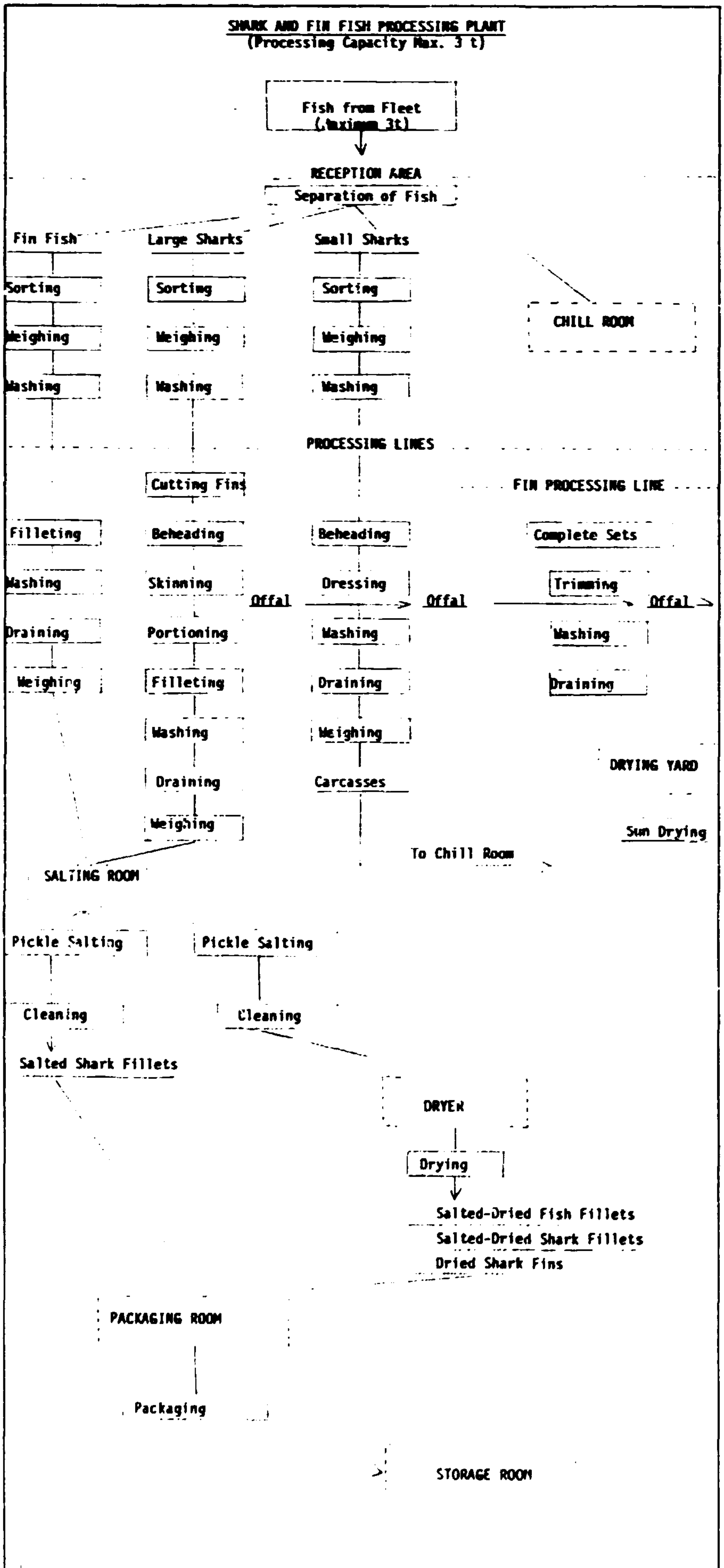
In the plant layout shown on Fig 7.2, space has been set aside for setting up smoking facilities, Altona smoking oven or Torry smoking Kiln.

The plant shown is flexible and large enough to produce the different types of cured shark and fish products.

It is assumed that the offal will be delivered to a fish meal plant or disposed of in other manners.

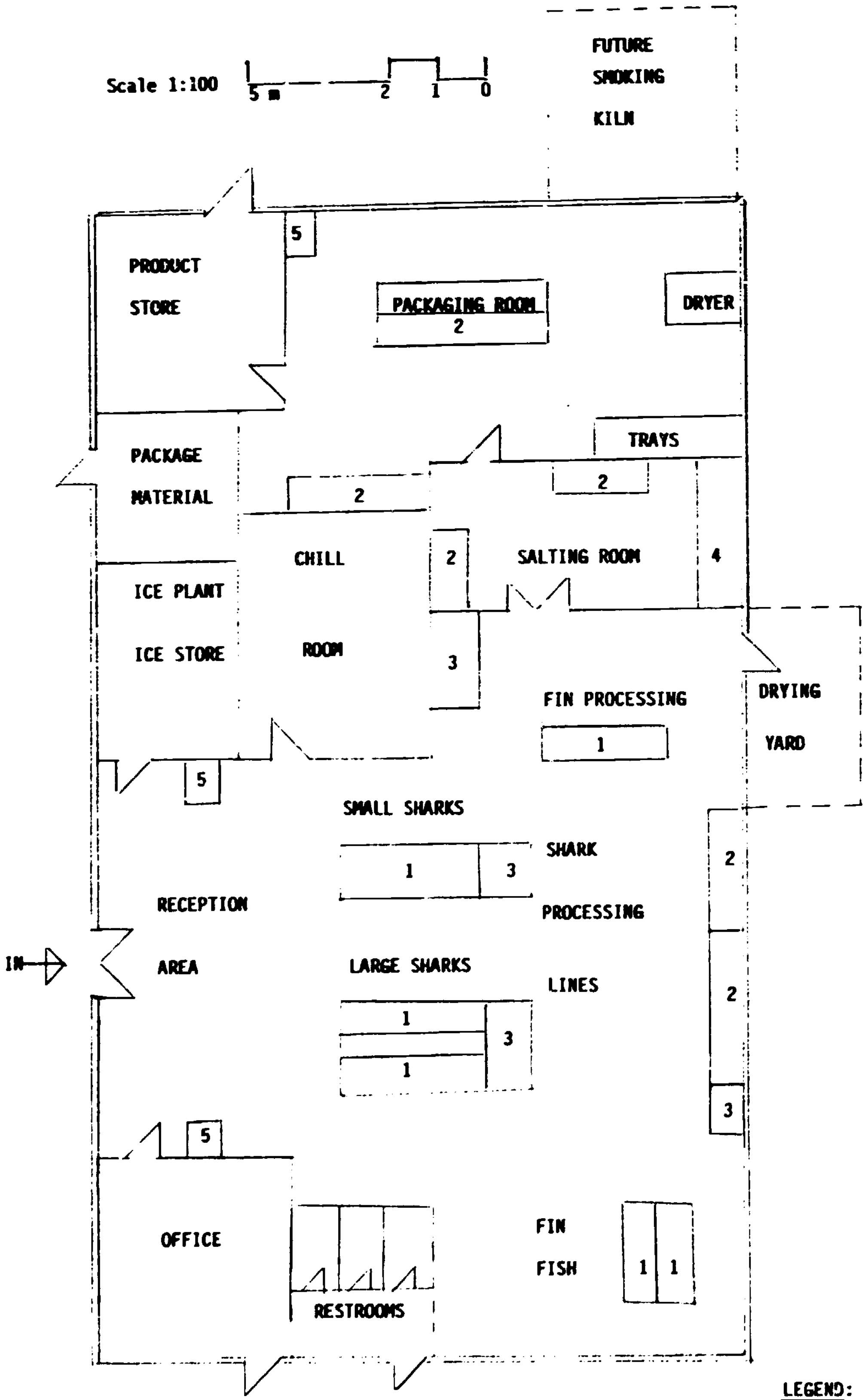
The Product Flow is shown on Fig. 7.1.

FIGURE 7.1



SHARK AND FIN FISH PROCESSING PLANT

FIGURE 7.2



SCHEMATIC PLANT LAYOUT

LEGEND:

1. FILLETING TABLES
2. WORKING TABLES
3. WASHING/BRINING TANK
4. SALTING TANKS
5. SCALES

7.3 Detailed Process Description

7.3.1 Salting-Drying Plant

The Process Lay-out is described in the diagram and the characteristics are as follows:

Products	:	Dried-salted shark and fin-fish fillets
Processing capacity	:	3 Tons per day
Raw material	:	Iced sharks and fin-fish
Working days	:	250 days per year
Total personnel	:	22

Reception area

Here, the iced raw material arrives. Ice and fish are separated. Sharks and fin-fish have been separated on board fishing vessels. Sharks and fish have been gutted on board. The raw material is weighed and recorded. That part which can be processed immediately is washed and transported to the processing area. The rest is re-iced, small sharks and fish in boxes, larger sharks in bulk. The re-iced raw material is stored in the chillroom until it can be processed.

As a matter of principle, the raw material delivered to the plant should preferably be processed the same day. The necessary arrangements need to be discussed between the plant manager and the fishermen. Sharks will be processed prior to fin-fish.

Processing Area

Different shark species and different sizes are treated in somewhat different ways. Here a general workflow is described.

Fins to be dried are cut first and transported to the fin processing line.

The sharks are beheaded (they have been gutted at sea), the belly cavity is carefully cleaned and washed. The skin is removed (stripped or pealed off) and the dark meat cut away (offal).

The white meat is cut into fillets. Larger species are cut into longitudinal chunks (20-25 cm long). Thicker fillets are cut horizontally to slices of 2-3 cm thickness in order to facilitate salting and drying. The fillets are briefly washed in brine. Then they are placed in a container and soaked for 2-6 hours in a 10% brine. The brine must be cooled with ice or kept in the chill room.

After a certain amount of fillets have been soaked, the brine must be changed. Different meat, e.g. from larger hammerheads should be kept for 24 hours in a 10% brine in the chillroom. After soaking, the fillets are ready for salting.

The soaked fillets are drained for about 10 minutes and weighed.

Salting Room

In Trinidad and Tobago pickle curing is recommended. On the salting table, fine grade salt of high quality is wrapped into the flesh of each fillet. Salt quality is of utmost importance for obtaining good quality end products. For Salt quality: see handbooks.

These fillets are carefully placed for final salting in alternating layers of fish and salt in the salting tank, starting with a layer of salt on the bottom of the salting tank. Excess salt must be available between each layer of fillets and on the top layer of the fillets. Coarser salt can be used. The brine formed is not allowed to drain off.

The fillets are weighed down so that the brine will cover them. The fillets remain for a minimum of 6-7 days in the brine, but can be stored longer if required. For further processing, the brine is drained off and the excess salt is shaken off from the fillets. It can be dried and used again. The fillets are now ready for drying.

Dryer/Drying Area for Fins

Drying of fillets. The fillets are laid on trays for placing them into the dryer. Drying time and drying temperature required to reach the desired moisture content in the final products need to be determined by trials. As a guide the following may serve: drying temperatures between 25 and 30 degrees C and a relative humidity at the air inlet of the dryer of between 45 and 55 %.

The fillets are dried to the moisture content required by the market. Hard dried fillets have a water content of 30% and less. The drying time of salted fillets can be shortened by the use of press piling between drying. After the water content has been reduced to about 55% the fillets are press piled, thereafter they continue drying in the dryer. In humid weather fins are dried in the dryer, otherwise outside.

Packing Room/Storage Room

The dryer can be located within the packing room for the fillets and the fins.

Packing and storage are of great importance in the warm humid climate of Trinidad and Tobago. The storage room for unpacked salted dried fish must be dry and well ventilated and should have a relative humidity of below 75% (about 50%).

A suitable packaging material for salted-dried fillets is a medium density polyethylene film. Fillets for sale in supermarkets can be wrapped with cellophane on styrofoam trays.

Space for storing salt and for packaging material needs to be provided.

Waste disposal is an important consideration. For this plant the production of fishmeal in an existing fishmeal plant is assumed.

Processing of Dried Fins

Dried fins of good quality are a valuable product and have a ready market. Hammerhead sharks, for example, have valuable fins. All fins of suitable size should be collected. When processing, fins are cut first and carried to the fin processing line.

Fin Processing Line

This line comprises: Table for handling the fins, wash basin and trimming table.

It is important that the fins are cut in the right way, in a curve. Complete sets of fins need to be prepared. In the basin the fins are washed in a 3% brine and may soak for some time. On the trimming table all traces of skin and meat are carefully removed. Then the fins are ready for drying. The market has a definite preference for sun dried fins. Therefore a small space for drying the fins in the open should be reserved adjacent to the plant.

Cutting and preparing fins are well documented, but it is advisable to employ a worker experienced in the preparation of fins. He also knows the value of the various fins, and prepare complete sets in the right way.

Manpower

Reception Area	:	3 persons
Processing Area	:	5 persons
Salting Room	:	1 person
Dryer/Drying	:	2 persons
Packing	:	2 persons
In-Plant Transport	:	1 person
Cleaning	:	2 persons
Watchman	:	2 persons
Administration	:	1 person
Foreman	:	1 person
Plant Manager	:	1 person
Ice Plant	:	1 person
Total	:	22 people

Assumed one 8 hour shift per day. Development of the work force should be kept flexible.

Equipment for Salting-Drying Plant:

Supply side	:	2	Pick up Trucks
		500	Fish Boxes (25 kg)
		2	large containers (500 kg)
Reception Area	:	1	Electronic scale (200 kg)
		3	Trolleys with hydraulics
Ice Plant and	:	1	4 tons per 24 hours Flake ice plant
Chill Room		1	10 tons ice store
		1	30 m sq Chill Room
Processing Area	:	3	Working tables (Beheading, trimming)(2 x 1.5 m)

		3	Working tables (Filletting) (2 x 1.0m)
		6	Containers (150 liters) (washing/soaking)
		50	Trays (fillets) (non-metallic)
		1	Table (2 x 1 m) (weighing fillets)
		20	Containers (cylindric, 50 liters, collecting offal)
		1	Scale (50 kg) for weighing fillets
		100	Containers, large for transporting offal
		20	Filletting knives
		4	Large bladed knives
			Sundry tools
Salting Room	:	5	Concrete curing tanks
		2	Working tables (non-metallic) (1.5 x 1 m)
		20	Non-metallic trays
Dryer	:	1	Mechanical dryer, 3.0 tons capacity, complete
Packing Room	:	2	Working tables (2 x 1 m)
		1	Hand cart (300 kg)
		20	Non-metallic trays
Fin Processing Line	:	1	Working table (1.5 x 1 m)
		2	Containers (50 liters)
		10	Knives, different
Packaging	:		Consumer packs and master cartons
			Plastic film
			Packing table (1.5 x 3.5 m)

Conclusion

A Pilot Plant of moderate size as described herein for processing salted-dried shark and fin-fish fillets from local fish resources contributes to the accomplishments of a rational utilization of domestic resources by avoiding waste.

It facilitates cutting down on imports. Provided that a constantly high level of processing will be maintained the plant appears to be economically viable and will permit a rational decision to be taken to expand or duplicate the facility after 3-4 years.

7.4 Future Freezer Salting-drying Plant

If the future supply of shark develops either by the development of freezer vessels landing frozen shark or by importing frozen carcasses from other Caribbean countries, a larger plant should be considered. This would be of 5 ton capacity and have freezer and thawing facilities.

Increased supplies of sharks and fin-fish would have to come from offshore waters and from fishing grounds outside territorial waters of the country, e.g. from the waters off Guyana.

A plant processing fish from these resources implies higher investment costs, careful maintenance, more sophisticated management. But it offers great flexibility in the utilization of the raw material and enables the production of highest quality products. These products, new on the local market, will be accepted and will meet the quality requirements on export markets.

The plant will not increase fishing pressure on local shark stocks, but it may process local catches if required.

A wide range of products can be processed which would meet needs and tastes of all sections of the consumers, particularly also if salted-dried shark products would be processed. This allows the use of all sharks and the production of products of varying prices but of equally fresh quality. Surplus could be exported.

The problem of supply may be solved with the help of National Fisheries Corporation which has already offered to provide one of their trawlers for fishing sharks. Two trawlers may be sufficient for regular supply at the beginning.

Characteristics

Products	:	Shark fillet blocks IQF shark fillets IQF shark steaks Frozen shark carcasses if required Fin-fish fillets (frozen) Dried-salted shark fillets Dried shark fins
Processing capacity	:	5 tons per day
Raw material	:	Frozen sharks and fin-fish
Working days	:	250 working days per year
Total personnel	:	28

This plant will be supplied with frozen shark, to be delivered from offshore areas or from foreign longliners. Frozen shark to be kept in coldstores at correct temperatures until such times as they are required for treatment in the processing area.

The process is similar to the one described previously, except for the addition of freezers and of a room for thawing of frozen shark. These are best left under a warming shower overnight and then thawed in a batch of warm water before processing. Careful temperature control throughout the process is imperative.

8. MARKETS AND DISTRIBUTION

8.1 Domestic Markets and Distribution

At present Trinidad's shark markets fall into three categories: wholesale, retail and restaurant trade.

Attempts to develop institutional markets (i.e. schools, hospitals, etc.) have not been very successful due to inconsistent quality of product delivered. Export markets also do not play a very big role in marketing due to quality control problems, competition from domestic markets for raw product and generally less than satisfactory prices for overseas markets in the Caribbean compared to domestic market prices.

Each of the domestic markets will be discussed separately.

8.1.1 Wholesale Markets

Wholesale markets in Trinidad consist of basically two types:

1. Processors such as National Fisheries Company and Trifish who buy from fishermen and foreign longliners and sell to retailers or market.

2. Vendors who buy from fishermen and then display the fish at centralized wholesale market locations such as Sea Lots, Port-of-Spain, and Orange Valley. Sometimes an individual or company will act in both capacities.

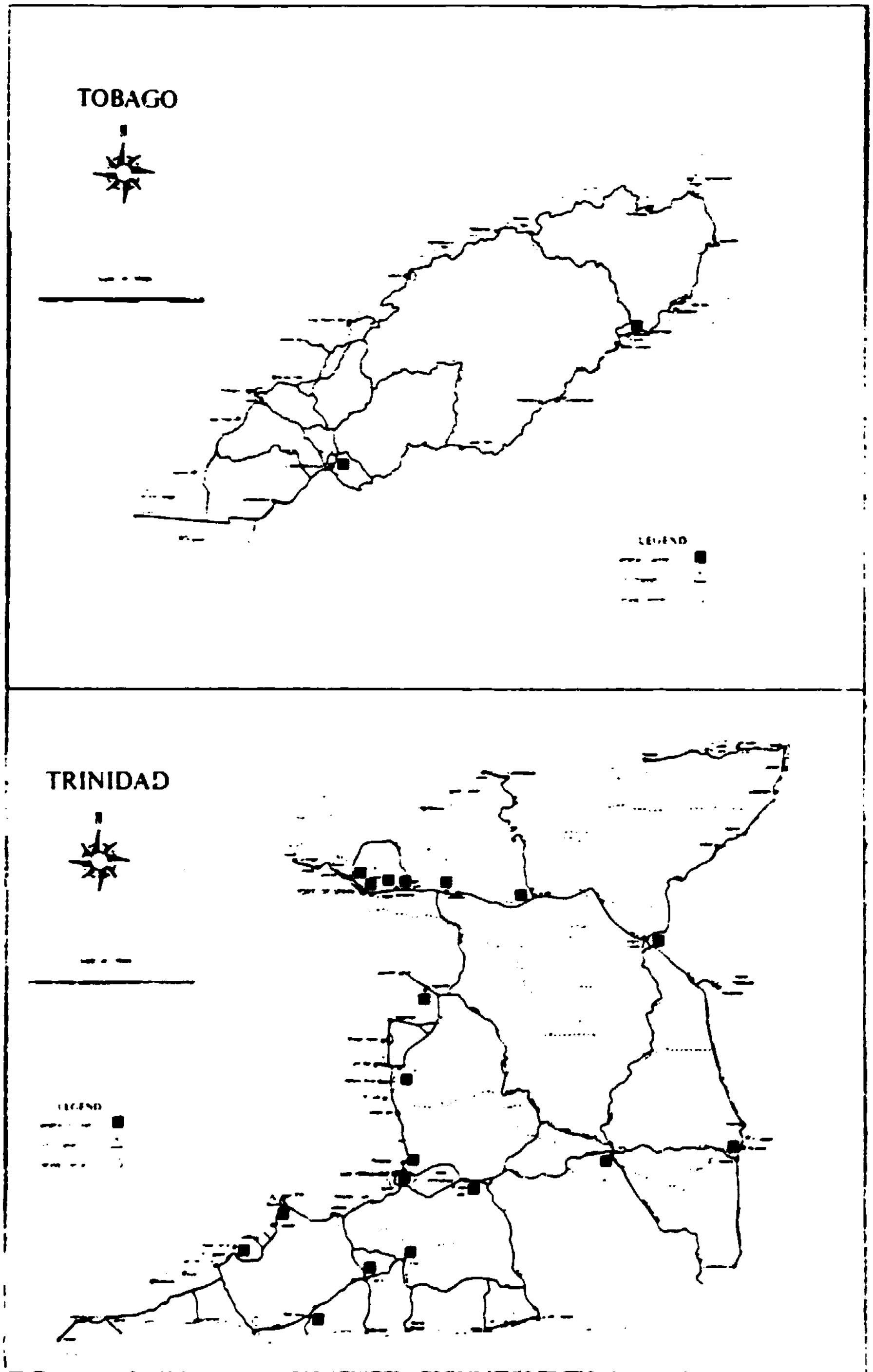
Such is the case of Trifish Company of Paul Street in Sangre Grande which buys and processes fish from fishermen at Manzanilla for a broad variety of customers but also occupies a vending space at the wholesale market at Sea Lots to sell to other vendors and directly to customers who will actually consume the fish rather than reselling it. (see Figure 8.1)

The general form in which shark is marketed on a wholesale basis is in the round for sharks of less than 5 ft (1.4 m) length and as partially cleaned trunks (loins) for large sharks.

While some vendors handle shark superbly, for the most part handling is poor in these markets. Trunks from partly cleaned sharks are often seen lying about on the concrete floors, a poor hygienic practice.

FIGURE 8.1

MAPS SHOWING MARKETS AND FISHING CENTRES



It is in the wholesale markets that one confronts most openly consumer attitudes about shark quality. In Trinidad a well-handled, cleaned fish is regarded by consumers and intermediate vendors as being of poor quality. The common belief is that the fish was cleaned to hide some defect in it. As such, the most marketable form of shark is one that is completely uncleaned (in the round).

The next most marketable form is one that has been cleaned but left bloody because locals believe that the bloodier the fish is, the fresher it is.

In the case of shark, leaving the animal uncleaned or leaving it bloody after cleaning are two certain formulae for creating rotten tasting fish. A large part of the consumer education effort of the FAO project was devoted to showing consumers how much better fish tastes, if it is properly handled.

Some inroads were made in this important area and as a result some consumers are beginning to demand better quality fish. However, much work remains to be done and it will undoubtedly take many more years to modify consumer attitudes about what constitutes a quality fish.

One of the big drawbacks in current consumer preference for fish and handling by market lies in the fact that many people in Trinidad have an aversion to eating fish, in particular shark, because they think that the rotten taste is the way fish normally tastes.

A disconcerting aspect of consumer behavior regarding shark in Trinidad is that the market currently favors very small sharks.

In fact, in Tobago, when Richard Mounsey brought in large sharks on the FAO experimental fishery, he had a very hard time selling them.

Since consumer demand is for small shark, the fishery targets on small sharks which are nearly always sexually immature fish. This will soon become a self-solving consumer problem although certainly not a desirable solution. In essence, if small sharks are not protected from exploitation, the fishery will collapse and sharks of small body size will simply become unavailable to consumers.

The price of shark was quite variant depending upon quality. Really awful shark was selling in August 1986 at TT$1.00 to TT$1.50 per lb and well handled shark was selling for up to TT$3.00 per lb. During certain seasons processors also produce smoked and salted shark to meet demand for religious use.

8.1.2 Retail Markets

These include grocery stores, fish retail stores and the roadside vendors. A major supply of shark that winds up in grocery stores comes from the Taiwanese longline fleet by way of National Fisheries Company. This shark is often well cleaned (but not always) by the longliners and frozen prior to reaching NFC. The form of presentation is either as fillets or as steaks or chunks frozen in a styrofoam tray covered with plastic film.

Shark on sale in several stores was not fully frozen and in several cases large blood spots were apparent when the package was viewed.

Locally caught shark is also provided by domestic processors like Trifish Company who package it as frozen fillets and/or steaks for retail consumption. This shark is of very high quality.

The average price of shark in supermarkets in August 1986 was TT$6.67 per lb (TT$14.68 per kg).

Consumers in supermarkets were more subdued in their responses about shark. Some said that it was good eating and that they looked for it especially; others indicated that they bought whatever was on sale.

The other way in which fish is retailed is by vendors using roadside carts or the backs of trucks. These fish lie in the sun ungutted and uncleaned for up to several hours at midday. The smell of these carts is appalling and the fish is undoubtedly well on its way to spoiling by the time a purchaser gets it home. Yet, even though one would expect such enterprises to be unattractive to consumers, there is no lack of customers for such businesses.

8.1.3 Restaurant Trade

Many restaurants in Trinidad offer shark as a menu selection. For the most part such markets <u>must</u> serve high quality fish or customers simply will not continue to order it. Usually one sees shark steaks, shark popovers and shark burgers as a common selection in "everyday" restaurants. In the fine restaurants there may be shark-fin soups, shark prepared in continental recipes. It appears to be popular no matter how it is fixed as long as the quality is good.

There are at the other end of the spectrum some restaurants that serve appallingly bad fish. One eatery tried by a project team member offered "shark burgers" which tasted awful and in fact turned out to be made of bony fish not shark.

8.2 Market Development

8.2.1 Domestic

The policy set down by the FAO project for educating consumers to be more fastidious in their purchase of shark should be continued. When consumers begin to expect quality fish the market will respond by providing such quality fish.

Market development will depend upon the ability of the country to manage its near-shore fishery and for the fishing community to develop offshore fish resources. If the market cannot provide the shark to satisfy domestic demand to some degree the market will likely change as consumers turn to other fish.

Historically, this is what has happened when suppliers cannot fill the demand they have created for sharks. If new supplies of shark are developed by going further offshore in the fishery the following areas would be expected to benefit from a quality shark product:

1. retail consumer market

2. school, hospital and other institutional food service programs

There likely will be continued interest in producing salted (dry cure) shark to reduce (but not eliminate) reliance upon imports of salt fishes. Also gourmet and snack food products as demonstrated by FAO project would be favored to continue to grow in acceptance with consumers over time.

8.2.2 Exports

With current reliance upon only a dwindling inshore stock there is no possibility of developing attractive export markets for shark. Such markets demand a uniform high-quality product and a consistent supply. To develop an export market to the USA, Europe and/or Asia will require:

a. Development of offshore and oceanic fisheries for sharks from a larger area of the Caribbean as well as the West Central Atlantic, and

b. Concentration of effort upon guaranteeing a high quality product (see 10.2 Fishery recommendations for details).

The USA market in particular is responsive to shark imports and currently shark is imported to the USA from Central America, New Zealand and Australia to meet a market demand which is not being addressed by local fishermen.

9. FINANCIAL EVALUATION

The Shark Processing Plant recommended in this study and described in Section 7 has been analyzed financially. The results can be found in the following pages.

In accordance with the scope of this study, the following is a Preliminary Financial Analysis. Further details must be developed and calculated in the actual project preparation, if UNIDO decides to proceed with this project.

9.1 Capital Requirements.

The costs of the Fixed investments in building and equipment, but excluding land value, is US$ 579,000.

It is estimated that a working capital to cover three months of expenditure is required, namely $166,870. This is also nearly equal to the negative cash flow during the first two years.

The total requirement for Capital for this project is therefore $745,870.

This capital can either be provided as an institutional 100% loan to the new industry, or the Executing Agency may enter into a Joint Venture agreement with a private businessman in Trinidad to develop the project. In this case the businessman would provide certain equity, perhaps 25%, $185,000 and the balance will be a loan.

For the sake of clarity of calculations, it has however been assumed that the full $745,870 is considered a loan to be serviced with 12% interest.

9.2 Annual Income.

The main income will accrue from sale of salted-dried shark, for which there is market in the Caribbean.

The shark fins will also be processed and sold as well as hides from the better parts of the sharks.

An additional business will be preparation of and sale of fin fish, filleted or as steaks.

The ice being produced at the plant can also provide an additional income.

The total gross revenue in a standard year is estimated to be $855,000. During the running in of the plant and the start up phase it is assumed that the plant will work at 50% capacity during the first year, 75% second year and only reach full production in the third year.

9.3 Annual Expenses.

Purchase prices for fish are based on realistic assessments of the present prices as well as the additional price to be paid in order to obtain quality fish in future. The fish purchased are all fresh, not frozen.

The plant will use 19 hourly paid laborers and three staff on a monthly salary.

An allowance of 10% has been made to cover sundry items such as wastage of fish and unexpected expenses.

The total manufacturing costs for the standard year is $667,480.

The interest on the full capital requirement is $89,504 per year. Depreciation has been set at 10 years for equipment and 20 years for the building. The total annual operating expenses, including interest and depreciation is thus $808,684 which leaves a net profit of $46,316, - after interest and depreciation.

9.4 Twenty Year Cash Flow.

A 20 year analysis shows a positive cash flow developing from the beginning of year 3. Assuming a complete 100% loan at 12 %, the additional annual return is 6.16%.

The Internal Rate of Return for the whole project is 20.77% and the net present value, at 12% interest, is $435,274.

9.5 Future Expansion.

Following a successful operation of the proposed plant and satisfactory results with the supply of shark to the plant, a decision can be taken to expand the existing plant to greater capacity, including freezing and thawing facilities for importing frozen shark from other Caribbean nations. Alternatively, another plant can be built in say Guyana, based upon the experience gained from this plant.

TABLE 9.1

PRELIMINARY FINANCIAL ANALYSIS FOR PILOT PLANT FOR INDUSTRIAL SHARK PROCESSING PLANT,		CAPACITY: 3 TONS P D MAX
FIXED INVESTMENTS	RATE	AMOUNT US $
LAND		NIL
BUILDING (13.5 X 23 M)	$400	$124,000
EQUIPMENT		$305,000
FURNITURE ETC		$40,000
VEHICLES		$30,000
PROF FEES	10%	$80,000
TOTAL FIXED INVESTMENT		$579,000
WORKING CAPITAL (three months)		$166,870
CAPITAL EMPLOYED		$745,870

TABLE 9.2

ANNUAL INCOME			
SALES:			
SALTED-DRIED SHARK FILLETS			
20% of 500 tons = 100 tons	$3,500	$350,000	
DRY SHARK FINS			
3% of 500 tons = 15 tons	$20,000	$300,000	
SHARK HIDES			
10 X 250 DAYS= 2,500	$12	$30,000	
FIN FISH PRODUCTS			
sales to fresh market: 200 tons	$750	$150,000	
SALE OF ICE			
500 TONS	$50	$25,000	
TOTAL GROSS REVENUE		$855,000	$855,000

TABLE 9.3

ANNUAL EXPENSES			
FACTORY COSTS:			
Purchase of shark: 500 tons	$500	$250,000	
purchase of fin fish: 250 tons	$350	$87,500	
purchase of salt: 350 tons	$100	$35,000	
packing materials		$25,000	
			$397,500
LABOR COSTS:			
19 laborers x 250 days = 4.750 days	$14	$66,500	
3 manager and foremen x 12 = 36 mont	$1,800	$64,800	
			$131,300
OTHER COSTS			
Vehicles running costs		$12,000	
Maintenance and repairs		$30,000	
Electricity		$8,400	
Water		$3,600	
Office costs, telephone		$12,000	
Insurance, legal, prof fees		$12,000	
			$78,000
Spoilage and sundry, 10% of costs			$60,680
TOTAL MANUFACTURING COSTS			$667,480
FINANCE CHARGES:			
Interest: 12% of	$745,870	$89,504	$89,504
			$756,984
Depreciation: 20 yrs of building	$124,000	$6,200	
10 years equipment	$455,000	$45,500	
		$51,700	$51,700
TOTAL OPERATING COSTS			$808,684
GROSS REVENUES			$855,000
OPERATING COSTS			$808,684
NET PROFIT			$46,316

TABLE 9.4

INDUSTRIAL SHARK PROCESSING PLANT

TWENTY YEAR CASH FLOW

YEAR	GROSS REVENUE	MANUFAC. COSTS	12% INTEREST	NET CASH FLOW	DEPRECIAT	ADDITIONA RATE OF RETURN
0				($579,000)		
1	$427,500	$498,730	$69,480	($140,710)	$51,700	-26.73%
2	$641,250	$583,105	$86,365	($28,220)	$51,700	-10.69%
3	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
4	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
5	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
6	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
7	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
8	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
9	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
10	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
11	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
12	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
13	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
14	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
15	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
16	$855,000	$667,480	$89,752	$97,7[illegible]	$51,700	6.16%
17	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
18	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
19	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
20	$855,000	$667,480	$89,752	$97,768	$51,700	6.16%
INTERNAL RATE OF RETURN				8.81%	20.77%	
NET PRESENT VALUE AT 12%				($144,724)	$435,274	
NET PRESENT VALUE AT 10%				($61,424)	$613,922	
NET PRESENT VALUE AT 8%				$48,216	$844,072	

10.0 RECOMMENDATIONS

The following **ACTION PLAN** should be implemented:

A. Develop Offshore and Ocean fishery for shark, as described in Section 5.3

B. Institute Fisheries Management as reccommended in section 10.2 below.

C. Construct Shark Processing Plant as described in Section 7.

D. Encourage Trial Fisheries for shark in Belize, Panama, Guyana and Jamaica.

The above actions should be taken concurrently, i.e. during the first three years of project.

E. Assess results of fisheries policies and trial fisheries

F. Review financial performance of Shark Processing Plant.

G. If E. and F. are satisfactory, either

- expand the Shark Processing Plant in Trinidad,
- or, build a new and additional plant in another country.

10.1 Recommendations for Processing Plant

10.1.1 Supplies

Several problems have been identified in Trinidad & Tobago regarding the utilization and consumption of sharks.

1) The problem of shark resources and their present and future exploitation.
2) The consumer acceptance of shark in the processed form.
3) The problem of protein supply to the Caribbean countries in general and the need to avoid food imports of animal protein.
4) The need for quality maintenance of the fish from catch through marketing.
5) Consumer education to make them understand and demand quality and to learn of the health benefits from fish consumption, including shark products.

These problems are all inter related and the reason why resources, fisheries, processing and product development must be considered jointly.

In fact, product form and product quality are influenced or even determined by the resources, the type of fisheries and the handling practices.

This study has shown that the industrial development of shark meat in Trinidad can not rely on the existing shark fishery. It will require the development of an offshore fishery more than 15-20 miles from the coast and an ultimate regional development of shark fishing in other countries such as Belize, Panama, Guyana and Jamaica.

Such a fishery will require larger vessels with ability to preserve the catch on board on ice or in refrigerated sea water. The regional approach will also require cooperation between the fisheries sectors of different countries to encourage shark fisheries and to be prepared to sell and ship products initially to other coutries. Ultimately more than one plant could be expected in 2-3 countries.

10.1.2 Product Forms

Sharks of mixed size, but mainly of medium and large sizes and fin fish of larger sizes would be landed. Quality maintenance of the landed catch is essential and will require proper processing facilities, whether in existing or new plants.

Using the mixed catch of the landings will result in a variety of products. Small sharks and marketable fin fish will be sold in the round in the market. Medium sized sharks will be processed into fillets and steaks and sold fresh. Sharks and fin fish not required for the fresh market will be filleted and the fillets salted and dried.

Smoked products and other specialty products have no regular market in Trinidad, so there is no way to forecast the acceptability of these product forms which should be included only for an experimental basis. Too many product form will require more experienced management, which may not be easy to obtain, so the plant should be based on a simple number of product form only.

10.1.3 Proposed Plant

Section 7 describes the proposed pilot plant with a capacity of 500 tons per year. The final plant(s) will most likely be an increased version of this plant, but modified after the initial years of experience with regional resource and the market development.

The plant described is capable of handling and processing mixed catches of sharks and fin fish, to be expected from the regional shark fishing effort.

The average capacity will be 2 tons per day, with 250 days of work per year, i.e total of 500 tons per year. Trials in Mexico have indicated that small plants of 5 tons capacity per week can be operated profitably.

To cope with peak situations, the capacity of the plant will be 3 tons per day.

It is recommended that the initial pilot plant for two tons per day be constructed in Trinidad and that shark fisheries to provide the future resources be encouraged in all five countries initially with guaranteed delivery prices for shark to the plant.

Once the pilot plant has assisted in documenting the economics and developing the shark fisheries in the region, the decision should be taken to either expand the present plant to 5 tons per day or to build a new plant, perhaps in Guyana.

10.2 Recommendations for Fisheries Management

Although outside the scope of this study, the Consultants feel compelled to provide their recommendations for the fisheries management of the future shark fishery.

Without a sustainable and guaranteed future supply of shark there will be no future for the shark plant and the project therefore has a vital interest in a strict shark fisheries management.

10.2.1 The Problem

The inshore fisheries appears to be at a critical cross-road. Although detailed stock assessments of Trinidad and Tobago's commercial species of sharks and bony fish have not been completed at the date of this report, there are strong indications that inshore fisheries are declining. Both the general (total) and shark fisheries have reported a declining catch in recent years while simultaneously there has been an increase in fleet size. Such an increase in numbers of boats produces an increase in fishing pressure. Mounsey (1986) estimated the inshore fleet at 1500 vessels and employing 4200 full and part-time fishermen.

Since specific effort records are not available, we must treat the total fishery as if all boats participated equally. Most shark fishermen appear to be having a difficult time making the fishery profitable. If we use the catch statistics in 1985 for shark of 219.9 mt and assume that all boats fished equally, then the average catch per boat per year would by only 3.67 mt. Taking Mounsey's (1986) figure of 185 days in the fishing year, that would mean that the average boat only landed 95 to 97 lbs (43.2 to 44 kg) of shark per day.

Even allowing for an unrealistically liberal estimate of 100% under reporting, the average boat would only land 7.33 mt per year or about an average of about 190 to 194 lbs (86.4 to 88.2 kg) per day during a 185 day year. This is one tenth (1/10) of the projection made by the FAO project for the average shark catch for a boat operating in Trinidad and Tobago.

As was mentioned earlier, only a few boats appear to be accounting for a disproportionately large percentage of the local shark catch of the country. With a large increase in fleet size of inshore shark boats by 47 pirogues and one gillnetter during 1983 to 1985 and a declining reported catch during 2 of those 3 years, a dramatic decline in catch per unit of effort (CPUE) has undoubtedly occurred.

10.2.2 The Alternatives

With the foregoing in mind, there are two alternatives open to the government of Trinidad and Tobago:

Substantial fisheries management which may save the fisheries, or **no management regime** and the inshore fisheries will be seriously damaged most probably to the point of collapse for sharks and several bony fish species. It will not be an easy decision for Trinidad to make because politics and economics intervene in that decision process.

If no management regime is developed and implemented in the inshore fishery the following scenario is the most likely to occur:

1. In the immediate term the Government would not feel much "fallout" by pursuing the course of non-decision.

2. As the rate of decline of the inshore fisheries accelerates, any short term benefits from pursuing a non-decision course in management would be expected to rapidly turn into both a political and economic liability as the fishing industry falls upon hard times.

3. The perceived need to manage that would follow the events of items 1 and 2 above, would be expected to be typified by two conditions; a) a strategy of "management by desperation" characterized by limit prerogatives and stop gap measures which often do more harm than good, and b) a fishery which may be damaged beyond its ability to recover.

If on the other hand a course of management is chosen, it will have to be implemented with less than complete knowledge of the dynamics of the fish stocks involved. The work to prepare the details for such management would be expected to last 2 to 3 years.

10.2.3 The Proposed Fisheries Management

The principal focus of the following recommendations on possible management plans is centered upon sharks, since that is the subject of this UNIDO project. There are also some recommendations for bony fishes where there is an appropriate adjunct to the shark fishery and one cannot be treated without the other.

1. **Gear Restrictions:** In Trinidad there is currently much 4.5 inch (114 mm) stretch dimension monofilament net as well as 5.5 inch (140 mm) and 6 inch (152 mm) used in the bottom gillnet fishery. The effect of this gear configuration is that it is harvesting a size of shark which should not be captured at all. For heavy current areas such as north and east of Trinidad, a gillnet of no less than 7.5 to 8.0 inch (190 to 203 mm) stretch should be used.

   In the Tobago longline fishery the average weight of a shark of 16 lbs (7.1 kg) would indicate that some types of shark are predominantly being caught at too small a size. To limit this, two options are open to fishermen; a) use a uniformly larger hook size, such as 9/0, or b) mix 8/0 and 9/0 hooks on the same longline with no more than 50% being of the 8/0 size.

   In the case of the bony fishes of Trinidad continued use of small dimension mesh gillnet will perpetuate the harvest of immature sharks that are caught incidentally to target species, i.e. Dolphin fish, Kingfish, Weakfish, etc. To modify the gear requirements of the shark fishery without modifying the gear of the bony fish fishery will result in the destruction of shark resources inshore as surely as implementing no management restrictions at all.

2. **Gear Composition:** The problem with current gear composition only affects the gillnet fishery in Trinidad. Considerable amounts of gillnet are being lost north and east of Trinidad. While the loss of gear does represent a hardship financially on the fishermen, the greater threat lies in the damage it does to the fishery itself.

"Lost" gillnets continue to capture and kill marine animals for some time after they are lost. Where the gear is primarily monofilament in nature this can continue for years after the gear is lost, because monofilament resists being broken down by the sea.

Two approaches to dealing with this problem should be considered separately or in combination:

a) Better, more secure methods of marking the gear for easy retrieval should be implemented. More dependable buoys that resist submergence should be used. Current buoys on the terminal ends of the net are simply inadequate.

b) The second approach is to consider replacing monofilament with other types of netting which if lost would degrade in a reasonable amount of time.

3. **Inshore Fishing Season:** The inshore season should be regulated downward so fishing is not permitted at times of year when pregnant females and juveniles are in abundance in the range from 2 to 10 miles offshore. It may require serious restriction of season in the near future to allow the inshore stocks to recover and stabilize.

4. **Fishing in Nursery Areas** within 2 miles of the beach should be prohibited completely. This will allow juvenile sharks the best chance of growing in sufficient numbers to reproductive ages. Also, pregnant females would be spared to give birth.

5. **The Mangrove Swamps** of Trinidad and Tobago represent areas of high potential importance to the reproduction of several species of commercially valuable fish and sharks. All reasonable efforts should be made to protect these waters from indiscriminate fishing and degradation of water and habitat quality through industrial and agricultural chemical and silt pollution (see Jones et al 1984 and Wood 1977 for detailed information on the wetlands of Trinidad and Tobago).

6. **Development of Offshore Shark Resources** in the Western Central Atlantic should be considered. This would allow the inshore fishery a chance to recover by reducing fishing pressure inshore. It would open a considerable resource of shark and fish to the people of Trinidad and Tobago. This fishery does require larger vessels than the pirogues, that are equipped for blue-water work.

   The gear used for sharks offshore should be confined to pelagic or bottom longline, depending upon the depths to be fished. Due to the larger size of individual sharks offshore and the potential for larger per set catches, gillnet is not really a preferred gear.

   Another drawback to the use of gillnets is that they may capture an entire school of sharks. This is far too much for a single boat to handle in a reasonable time. Consequently, most of the sharks spoil or at least ammoniate on deck before they can be cleaned, resulting in a low quality product being landed ashore.

10.3 Conclusions of Recommendations

A modest plant such as detailed in Section 7 of this report, would be feasible only if pressure is taken off inshore stocks of sharks and bony fish by:

a. developing offshore fish resources.
b. implementing sound fisheries management as described in section 10.2.
c. Empowering law enforcement authorities to assure general compliance with management regime and equipping them to carry out the tasks effectively.
d. Improve quality of handling of raw material to assure high quality products which consumers will accept and continue to purchase.
e. Develop a processing methodology that utilizes both bony fish and sharks for maximum efficiency.
f. Utilize all reasonable portions of the raw material being delivered to the dock for products including where applicable hides, meat, fins, oils, meals from processing offal, i.e. heads, bones, bony fish entrails, skin from non-leather hides, etc.
g. Sufficient facility provisions should be made to clean and freeze surplus shark delivered by the offshore and strictly managed inshore fisheries. This surplus can be utilized at times during the year when weather or other factors prevent consistent delivery to assure sufficient raw material.
h. Excess frozen shark not required to meet market demand and reasonable finished product reserves can be packaged and sold domestically without further processing or exported to customers in Europe or USA who deal in frozen fish (institutional clients).

i. The facility should not become overly automated at the cost of jobs which can be done reasonably by humans since the society would benefit more from productively employed people than from high-tech efficiency. At the same time care must be taken to avoid surplus labor that increases costs without improving production.

The proposed pilot plant of 2 tons per day can be developed while the fisheries management is being introduced, but a larger size plant, e.g 5 tons per day should not be in operation before the fisheries management regime is operative and has proved successful.

APPENDIX A

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APPENDIX B

NOTES FROM MEETINGS

BELIZE

Meeting with Fishermen's Co-operatives in Belize City:

Robert Usher, Executive Secretary
Northern Co-op, Belize City

Ruben Gonzales, Executive Secretary
Caribena Co-Op, San Pedro

Severo Guerrero, Member of Management Committee,
Caribena Co-Op, San Pedro

Gaston Argona, Member, Management Committee,
Northern Co-Op

Villamar Godfrey, Member Management Committee
Placencia Co-Op

Severo E. Pinto, Executive Secretary
Belize Fishermen Co-Op Association

Only minimal sales of shark in Belize because there are good supplies of other fresh fish and shark is not a popular diet.

Any shark industry, and increase in catch will have to rely on export markets. Some minor export of shark has taken place from Placencia to Honduras, during Lent.

Also previous attempts to export shark to Mexico but their currency collapsed.

A factory started in Mexico (Cancun) to produce shark mince meat for sausages but the difficulty was to get consumer to accept the product.

Types of shark in Belize:

Blacktip (primarily), Hammerheads, Sandshark, Nurseshark. The popular gamefish Tigershark is rare.

Sizes:

Most sharks are small (3 lbs).

Catch is in gill nets, as accidental catch. To catch larger sharks in quantities will require new investment in boats and gear.

Prices:

To make it economically feasible, the fishermen need min 50 US cents per lb.

Potential catch.

If all co-op members got involved, the possible catch is estimated to be

San Pedro :	5-8,000	lbs per week
North :	10,000	" " "
National	10,000	" " "
Placencia	5,000	
Max total	30,000	lbs per week

Say for 9 months , Max 500 tons per year.

If the shark market develops, the shark fishery would have to extend offshore, as only catch at present is inshore, with small boats. Only day trips, with some ice. Sharks are caught together with Swordfish but thrown away because there is no market.

Recent sighting of a 35 ft long Whaleshark has been reported.

Present sales of shark in Belize estimated at max. 25,000 lbs per year. The "controlled" price is B$ 1.05 /lbs (= US $ 0.525 per lb)

Fishermen need guarantee that permanent market for shark product has been established, otherwise they will not invest in gear and processing.

Shipping : Refrigerated containers can be shipped every two weeks to Jamaica and to Barbados.

Most popular local fish are Groupers, Snappers, Jacks. Also Lobster & Prawns, - but many of these exports are re - exports, originally from Mexico or Honduras, sent through Belize for currency reasons.

Fishing grounds : All along the Barrier Reef. Some boats catch 100 - 150 sharks of 7 - 8 lbs per night, but throw these away. Bigger sharks are outside Barrier Reef.

Total Belize catch approx. 1 million lbs of scaled fish (excl. shellfish). So the same fleet could theoretically catch 1 m lbs shark, but what about daily fish supply, then ?

Central Market used by independent fishermen.

Meeting with:

Vincent V. Gillett
Fisheries Administrator
Fisheries Department, Ministry of
Agriculture, Forestry & Fisheries,
Belize City

No resource study has been undertaken because there has been no demand. Only very small scale shark operations and only for small export at Lent to Honduras, Mexico and Guatemala.

Recently however, the Department has received enquiries for shark from abroad.

Belize needs a guaranteed market, and a large scale trial fisheries for shark.

Recent serious buyer wanted 8,000 kgs of shark per month, frozen H & G, Carcasses, U.S.

Recent expert estimated Belize could produce 50 tons shark/year but this may be a little on the high side with the present catch capacity.

Statistics do not specify Shark, but only the category "Dry Salted" which is mainly Shark. 1987 Statistics shows this export as 5,100 lbs. 1984 Statistics showed Dry Salted exports as 86 lbs (!)

One individual fisherman states he can provide 500 lbs shark/week (12 t/ year).

Other Statistics:

1987 :	Frozen Scale Fish (some of this Shark)	41,000 lbs
	Fresh Scale Fish	1,797 lbs
	Lobster	468,000 lbs
	Shrimp	218,000 lbs

Statistics Local Sales (only these recorded)

1987 Totals			361,213 lbs
Fin fish		lbs	B $ (=0.5 US $)
	Grade A	113,000	170,000
	B	92,000	124,000
	C	19,000	20,000

PANAMA

March 9, 1989

Meeting March 9, 1989 in Panama City with:

- o Boris Ramirez
  Deputy Director General of
  Marine Resources,
  Ministry of Commerce & Industry
  15 th Floor, Lottery Building,
  Cooper Avenue

- o Armando Ciniglio
  Industrias del Mar S/A
  Port of Vacamonte
  P. O. Box 289, Panama 5 A
  Panama
  Tel: 51 - 1055

- o Manuel Recarey
  Diomondi, S.A.
  M/N Breogan
  P.O. Vacamonte.
  Tel: 265563 (h)

8 - 10 different fisheries companies had been contacted but only these two showed an interest in Shark.

Ciniglio started a Shark processing plant (Especies Maritimes S.A.) about 10 years ago but the company apparently went bankrupt about 5 years agc. We visited the derelict plant, located 2 miles East of Vacamonte fishing port. Only floor, walls and some roof structure remains.

According to Ciniglio, the business was ruined by the big wholesale fish distributors with political influence. Originally he had customs protection against competitive imports of salted fish. However, big distributors had bigger profit margin on imported salt dried cod etc., and were able to manipulate classification.

Price required is US $ 1.20 per lb for salt dried fillets. Price now has reached $ 1.50 / lb fillet.

Shark are caught on longliners using Bonito as bait. The Shark is filleted on board, fins removed and fillet salted on board. Trips in Pacific are 15 - 18 days in 72 ft boats. They are all company boats for longlining with 700 hooks. Would like longer boats with 5,000 hooks. Factory process 28 hours.

Shrimp boats catch shark as by-catch, cut off fins and discard shark. Shrimp boats are not ideal as holding tanks are too narrow for shark. They need conversion.

Fishermen need US 50 c / lb H & G. They only do fins now but could do 100,000 lbs/ trip of 15 days if market right. All from Bays in Pacific.

Shark species:

Black Tip Shark (3- 5 ft), most common
Bull Shark, Lemon Shark (5 - 8 ft)
Tiger Shark (7 - 15 ft) also
Dusky & Silky (5 - 6 ft)

At present only fins are used commercially and sold to Chinese buyer from Hong Kong. Fillets before use are pressed and then dried in oven. - a dried product.

Season is all year, except February - April as water too cold.

All good fishing is in Pacific. Only smaller boats operate in Caribbean and often winds are too strong for small boats. Thus only 5-6 months fishing in Caribbean. Also there is lack of infrastructure in Caribbean but not on Pacific Coast.

No resource study for Pacific. Some Japanese study of Caribbean showed small shark population. Two years ago they exported 2 containers of frozen shark carcass to Spain at 62 c/lbs FOB. Shark is part of fin fish statistics

Government had plans for shark process plant in Western region but it never got started, due to administrative problems.

Export planned for Jamaica failed due to lack of currency. Mexico good market but too many restrictions and lack of hard currency.

Statistics : Export 1987:

Fins and stomach of shark	7 tons
to U.S.	6 tons
to Hong Kong	1 ton.

Many foreign tuna boats land dried fins, from shark caught as a by-catch.

Panama Currency - Balboa $ = 1 US$

Meeting with:

Georgios Lymberopulos
Procesadore Vacamonte S.A.

Large shrimp and fish plant. Does approximately 25,000 lbs dry shark meat per month.

Claims that they can catch 10 times or more if price and market is right.

Needs $1.30/lb finished product. Interested in possibility of Joint Venture with foreign company who can provide the market for shark products.

No experience with Atlantic Coast.

Meeting with

Michael Bragg
Papagayo Seafood, Costa Rica

Has market in the US for Grouper, Snapper, etc. Not for shark.

GUYANA

Meeting March 14, 1989 with:

Reuben Charles,
Chief Fisheries Officer
Fisheries Department
Ministry of Agriculture
D'Urban Street
Georgetown
Guyana

Shark fishing and processing industry started in Surinam but has failed. Does not know why. Management or Marketing problems?

Shark resource is excellent. The shelf area from the Amazon, Orinoco to Trinidad and Tobago is described as the best shark area in the world.

There is no directed Shark fishery, only by- catches from the shrimp and other fishery.

However, a small fishermans Co-Op 12 miles from Georgetown do fish for Shark and sell locally. Cottage industry of salted Shark Steaks. Supplied to mining camps in Interior Gold Mines and some minor export. Shark dried on wooden frames, covered with twine mesh.

Salt imported from Cuba is very coarse and needs to be ground. Charles believes they use too much salt.

No direct knowledge of the extent of shark resource or age of population.

Guyana Fisheries do some salting.

Recent enquiry from Norwegian group for shark fins only. They would not take the rest of Shark, so Fisheries could not agree on project.

Price levels for Salted Shark is about G$ 20 / lb (approx. US$ 1/lb)

Small artisanal boats can catch about 500 lbs per day in Gillnets. Shark sizes 3 - 4 ft length.

Shrimp Fishery is about 36 miles off the Coast. There are lots of Sharks all year round.

Shark fins export last year of 3 tons. As fins represent 3% of fish, this indicates shark caught of approx. 1,000 tons.

Salted Shark export estimated to be 5-6 tons last year but there are no records.

Fishing Ports: Houston Inshore Fishport (Funded by EEC) has dock, coldstore, ice, freezer and large area for processing. Operated by the Greater Georgetown Co-op Fisheries Society. G.N.F.Co also has dock and process plant.

Possible site for Regional Shark Process Plant: In terms of resource he favors Trinidad and Tobago or Guyana.

Export last year was 1800 tons of Prawn Tails and 620 tons of smaller peeled prawns.

In conclusion, Guyana would be very interested in shark processing plant, if the resource was studied and found reliable.

Visit to Guyana National Fisheries Co. on March 14, 1989:

Trevor Niro, Manager

They produce 10,000lbs of Salted Shark per month. They can't meet demand, especially from the Mines in the Interior.

Fillets are left in Salt barrels for about 30 hours, then oven dried in AFOS ovens and weighed and packed loose in clear packages.

Factory has large, neat looking production of frozen fish, Groupers, Snappers and also Shrimp packing and peeling.

JAMAICA

Meeting:

Foo Young, Director, Marine Fisheries

Andre Kong, Fisheries Officer

Only incidental catches of Shark, while longlining for Snappers, Groupers, but there is no market for shark. Small specialty markets to restaurants in Montego Bay sometimes. Recently a fisherman caught a 400 lb Hammerhead but there is no market for meat, so it had to be destroyed.

CARICOM working towards shared waters for fishermen, so maybe Trinidad and Tobago Shark fishermen could come here and help with development of the catch?.

There is no market. Even cured Shark Fins for Chinese restaurants are imported. There is strong public feeling against Shark meat. Jamaica is net importer of fish, total imports about 34 m lbs of fish last year, from Belize, etc., Salted fish imports from Canada, Swordfish from the Dominican Republic.

Lobsters and Concs exported.

Local production of fish about 21 m lbs per year; 17 m lbs from marine fisheries, 4 m cultured.

Jamaica would welcome efforts to catch Shark and thus take pressure off reef fisheries.

Questioned about the resource, he stated that they don't know.

TRINIDAD

Meeting with CARIBBEAN FOOD CORPORATION

May 26, 1986

Kingsley Thomas (Manager for Projects)
Ian Thomasos(Project Analyst)

CFC would like to study feasibility and rationale for using sharkmeat inexpensively and therefore they were interested in the Hydrogenization process. When a shark precess technique is found commercially feasible, CFC will look for a private equity partner, e.g National Fisheries or similar.

There is an FAO/UNDP Shark utilization project in progress. CFC provided list of officials and fisheries people to meet.

National Fisheries Co. Ltd

Fernando Navarro (Chief Ex. Officer)

Processing about 1,500 tons raw fish per year. Shark is bought at tt$2 per lbs, headed and gutted onboard. It is sold fresh or frozen fillets or smoked.

March 13, 1989
Caribbean Food Corporation

Arlington Chesney, Managing Director.

- Kingsley Thomas has left for Jamaica

- Tomassos emigrated to Canada

CFC is still interested in Shark Processing in the region. Understands and agrees that Trinidad and Tobago resource is too small, too young, too uncertain for large scale commercial exploitation. The region imports large amounts of salted fish, which should be replaced by local production.

In terms of location of a regional shark production plant, he is in favor of Trinidad or Guyana, maybe especially the latter. He believes that they have resource, market and need protein. He is not in favor of Panama which is not part of the Caricom Trade agreement region.

APPENDIX C

CORRESPONDENCE

Department of
Agricultural Engineering

Oregon State University

Corvallis, Oregon 97331-3906

503 754 2041

July 21, 1986

Mr. Sid F. Cook
Argus-Mariner, Consulting Scientists
1023 NW 25th Street
Corvallis, OR 97330-4323

Dear Mr. Cook:

I have, as of this date, completed my review of the paper entitled, "Terminal Report, Feasibility Study on the Hydrogenization of Shark Fillet in Selected CARICOM Countries" written by Mr. John W. Mococain and dated June 1984. My review is related to the physical aspects of the processing described in this paper.

It is my opinion, that the preparation process described in this paper can be accomplished from the mechanical/physical standpoint. That is that the curring and mixing of the shark fillets as briefly described on page 16 of the report is feasible. The challenge that I have encountered is in the accompanying chemical process which is referred to on pages 15 and 16, and the indicated additional physical processes which are not detailed.

I have conducted a Library Information Retrieval Search (LIRS) in the areas of agriculture, food science and chemistry, and have found no reference to a hydrogenization process for the removal of urea and other materials from shark, fish or meat. The reference to such a process having been developed in 1976 is not substantiated in the report and this seems to be the determining factor of the feasibility of the total concept recommended.

Questions which I see need to be answered include:

1. What are the chemicals which need to be added to the diced shark meat?

2. Will these chemicals indeed remove the urea and other contaminates in 30 to 50 seconds?

3. How are these chemicals and contaminates then removed from the diced meat?

4. What is the function of the sawdust which is added to the meat as mentioned on page 17 in chart No. 4?

5. How is the sawdust to be removed from the mix?

6. How is the diced and spiced meat handled after said hydrogenization?

In conclusion, it appears that the initial cutting and mixing process is feasible, however, the hydrogenization process and further processing need to be examined and tested to see if they indeed are feasible.

Yours truly,

Herbert E. Hansen

Herbert E. Hansen
Associate Professor

heh/jw

28 July 86

TO: Sid F. Cook, Consulting Scientist
ARGUS-MARINER
Consulting Scientists
P.O. Box 393
Corvallis, OR 97339-0393

FROM: [signature]
David L. Crawford, Ph.D.
331-8th Street
Astoria, OR 97103

SUBJECT: Review of "Terminal Report" entitled "Feasibility Study on the Hydrogenization of Shark Fillet in Selected CARICOM Countries"; Project FZ-A 43-A-305-822; CFR NO. 7075.

In summary, this report covers the demonstration of a "new" procedure for processing shark meat. They call this process "hydrogenization" and the process produces a "hydrogenized product" or a product that has been "hydrogenixed (obviously a new and creative chemical term not yet in wide use)". This, it is reported to be important for processing shark "because of its peculiar fish properties and high content of urea, ammonia and other contaminants". The investigator reported that this process was carried out in a simple "meat cutter-mixing machine" and that the "total content of urea, ammonia, taste and smell of fish can be easily removed from shark fillets". The process can be carried out rapidly since "process of hydrogenization of a given volume of shark meat takes anywhere from 30 seconds to 50 seconds depending upon the bowl capacity of the machine". They confirm that "a formulated compound of special chemical products is used to remove the afforementioned contaminates from shark fillet during the cutting-mixing-hydrogenization operation". They further report that the processing of shark fillets by hydrogenization results in a "tasteless paste or raw material-after spicing-can then be industrially processed into a wide range of human edible foodstuffs in a similar manner to those produced with beef, chicken, pork, veal and other types of meats".

The word the authors use to describe the process they propose ("hydrogenization") appears to be a new word. One would assume they are refering to hydrogenate, meaning to combine with, treat with or expose to the action of hydrogen or to carry out the process of hydrogenation or to hydrogenize. A compound can be hydrogenized by the act of hydrogenizing, but "hydrogenization" is a new term for this process.

If hydrogenation is the process they are refering to, it (1) would not react with or remove the compounds they are refering to (urea, ammonia, etc.), (2) could not be carried out under the conditions they describe for the process and (3) certainly not in the equipment they describe. Hydrogenation is usually accomplished for the most reactive compounds with hydrogen of pressures of at least one atmospere over an active metal catalyst. If such a process would be attempted, catalysts would be quickly "poisoned" in the presence of fish flesh. It is ludicrous to consider hydrogenation "in a silent cutter" without a catalyst at the pressures required. The only food product subjected to hydrogenation is plant oils which are converted to more solid fats to impart stability toward oxidative rancidity and to meet characteristics need for preparing baked products. This process is carried out under rather anhydrous conditions with hydrogen over a nickel catalyst. Hydrogen adds easily to their methylene separated unsaturation under these conditions. The compounds specificly named, ammonia and urea, are not electrophilic and will not add hydrogen.

The only possible process the author of this report could be referring to by the term "hydrogenization" would be one in which hydrogen ion (H+) is added to the product. This could be accomplished within the frame work of the processing system outlined, but would only consist of adding an approriate amount of inorganic or organic acid. The addition of acid (hydrogen ion) would neutalize ammonia and amines largely responsible for the "fishy" odor of fish by making them less volitile. <u>Such a process would not remove these compounds.</u> This is not a new procedure by any means. In Great Britain and Australia where shark are used for fish-and-chips, it is customary to use malt vinegar (largely acedic acid) as a condiment. This custom was developed out of a need to reduce the ammonical flavor and odor developed from the enzymatic conversion of urea to ammonia while the fish was being consumed. Ammonia is produced from urea largely while shark is being masticated by ureases in the saliva. Individual preceptions of the degee of ammonical flavor vary greatly because of very different saliva concentration of urease among individuals.

It would be possible the convert urea in shark meat to ammonia by adding ureas during the process described, but not within the time frame or at the temperatures indicated. Ammonia could then be removed using scraped suface heating unit operations under a vacuum, but would produce a cooked product. However, the system described for "hydrogenization" would not accomplish this task by any means. The removal of ammonia would require heat and reduced pressures.

The investigators lay the majority of blame for the underutiliztion of shark on "its peculiar fish properties and high content of urea, ammonia and other contaminaants". This is not true. I have no idea what they mean by "peculiar fish properties", but steaks from many species of shark are now considered a gourmet food commanding a rather high price. Their urea content is relatively low and only functions in osmoregulation in a manner similar to trimethylamine oxide contained in other marine species. Ammonia is only present when the fish are handled poorly. Ammonia is produced when you eat shark meat, otherwise it is produced through microbial and, to a lesser extent, in situ enzymatic action under poor handling conditions.

The investigator report that the "total content of urea, ammonia, taste and smell of fish can be easily removed from shark fillets". This statement is not supported by one shread of evidence. The investigators present no analytical data on the quantities of ammonia, urea and "other conaminants" before and after processing. No documented sensory evauations were preformed to confirm the absence of taste and odor or if sensory characteristics of shark fillets were objectionable in the first place.

The standard specifications for "hydrogenixed material" are not even reported (moisture, ash, fat and protein content; emulsifying capacity; reological properties at various temperatures; cooked textural attributes, etc.). The authors appear to have completely ignored the basic information need to sell an intermediate protein source to a food fabricator.

The investigator appears to have no conception of the metric system scale. For example, he states that "Salted and smoked shark fillet of mature specimens, normally between 50 cm to 1.6 cm long, has been used as a source of food by the less privileged sectors of the world since time immemorial". He further indicates in the "Executive Summary" that: "There is a large number of artisanal fishermen interested in the harvesting of large sharks (over 2 m and up)". "These individuals fall in the category of professional fishermen that use boats from 8m to 9m long (equipped with ice carrying capacity)." Now really, how is one going to obtain a fillet from a fish 1.6 cm long? Note that 1.6 cm equals 0.62992 inches. How is an "artisanal fishermen" going to and a shark 2 m and up in a boat only 6 to 9 m long that is carrying ice and still have room to accomodate himself? Can you immagine being in a 9 m boat with a 6 m shark. These statements were made even with the presence of a definition of equivalents in the report.

The principle investigator of the project appears to have the same understanding of economics as the metric system scale. For example, under section 3.1.4 he indicates that a price $1.00 (Belize)/kilo would assure a supply of whole shark. Under 3.1.13, "The established local cost of raw material (shark fillet) was increased by 30% (handling, etc.) to arrive at the revised kilo cost of the final product." He listed a cost of $1.30 (Belize)/kilo for raw material (shark fillets). At a yield of 33% for shark fillets (Chart 2), the $1.00 (Belize)/kilo for whole shark would yield a raw material (fillet) cost of $3.03 (Belize)/kilo without adding labor, freezing, packaging and storage costs. The investigator conveniently used the price of whole shark for shark fillet to improve his economics forcast.

In summary, this report appears to be based upon miss statements, half truths and "new and creative chemical terminology" surrounded with useless and unsubstantiated information. It contains no difinitive data on the value the process ("hyrogenization") in question preforms. The investigator has not defined the product to be produced or shown in any way that it has any level of commercial value through product specifications or product concept evaluations. Ecomonic assumptions are stated as fact without any reliable varification and are often miss stated. In my opinion, this report is worth less than the paper it is written on.

APPENDIX D

CONSULTANT'S ANALYSIS OF MOCOCAIN'S REPORT

ANALYSIS

This report comprises a technical and economic review and analysis of a document prepared by Mr. John W. Mococain for the Organization of American States in June 1984. Their project number is: F2-A 43-A-305-822/CPR No.: 7075.

The terminal report by Mr. Mococain was analyzed by a team consisting of Mr. Sid F. Cook (marine biologist specializing in fisheries development and products from sharks and other fishes), Dr. Herbert E. Hansen (professor of agricultural engineering at Oregon State University) and Dr. David L. Crawford (seafood chemist at the Astoria Seafoods Laboratory of Oregon State University).

The analysis raises several points which would appear to preclude the proposed technology from being practiced in the real world. They are:

Chemical and Physical:

1) The terminology used by Mococain to describe his process doe not correspond to any known process applicable to food chemistry. This makes it very difficult to know what his process entails by comparing it to standard methods;

2) If in fact the process referred to in the terminal report is supposed to be "hydrogenation" the following statements can be made:

2.1) Hydrogenation refers to the process commonly used to stabilize fats against oxidation by saturating them with hydrogen and thereby solidifying them (under pressure).

2.2) the process of hydrogenation will not remove or neutralize the compounds in question (urea, ammonia, TMAO) because they are not electrophilic and will not add atomic hydrogen.

2.3) Even if hydrogenating were possible it could not be carried out under the conditions or in the equipment that Mococain specifies.

3) The only process involving hydrogen in any form that Mococain could possibly be referring to involves adding of hydrogen (hydronium) ions, H+, through treating with the appropriate amount of an inorganic or an organic acid solution. If this is the proposed mysterious hydrogenization process the following statements can be made:

3.1) Conceivably such a process might nuetralize the odor of ammonia and amines, but under no circumstances would it remove them.

3.2) If such is the case, then by no means is this a new technology only out since 1976 as Mr. Mococain states. It has been used for a great many years to neutralize fish taste and odor. Two well known examples are: the use of lemon juice (citric acid and ascorbic acid) and the use of malt vinegar (acetic acid) on fish and in fish and chips shoppes (McCormack et al. 1963; McClane and deZanger 1977; Cook and Conway 1985).

3.3) Such a treatment of raw fish (shark) would begin at least to chemically alter the proteins by a well-known process referred to as hydrolysis (the breaking down of a protein in the presence of a suitable acid into its component amino acids). Two examples of the hydrolysing of proteins are: the production of "fermented fish sauces" in Southeast Asia and the action of stomach acid (mostly hydrochloric acid) on proteins in preparation for digestion. This might or might not yield a product suitable for food, and might even conceivably reduce the usefulness of the meat for human food.

4) Urease (an enzyme that breaks down urea into ammonia) could be used. However then the ammonia produced would have to be removed by a combination heat-treating and exposure to a vacuum environment. The following conditions would be important:

4.1) Any product so treated would be cooked by the time the process was fininshed.

4.2) Since ammoniation of shark is one of the things any treating regimen to prevent degradation of the meat seeks to avoid, you probably couldn't sell processors on this method anyway purely on the basis of their concern for what it would do to public acceptance of the product (regardless of how well you removed the ammonia).

4.3) In any event such a process would be impossible under the conditions and in the equipment described.

5) There would seem to be no obstacle that would prevent the physical act of mixing and cutting meat and chemicals in the described meat mincing machine. However, it would serve no useful purpose to improving the quality of the treated shark as noted in items 2 to 4 above. As such it would add a nonuseful processing step and increase cost of production.

6) We can find no defensible reason to add sawdust to the shark mix, especially since no provision is mentioned for recovering the sawdust from said mixture. The addition of sawdust would:

6.1) reduce the food value of the meat mixture since it is in most cases a combination of 80%-85% cellulose and 15%-20% lignin, both of which are indigestible to humans. The sawdust could not be seen to be any thing other than an inert filler;

6.2) It would be expected to raise the cost of production while yielding a less nutritious product;

6.3) One analogue of which we are aware involves its use as a "natural fiber" filler in a major brand-name bread in the United States several years back. The U.S. government, citing that there was no scientific evidence to support the manufacturer health claims, ordered the sawdust removed to prevent misleading advertising practices.

7) Since Mr. Mococain proposes to reduce the shark in his process to a paste (item 2.3.3.09 on page 14) one cannot help but wonder if he is referring to a "surimi" paste. If this is the case then the following should be noted:

7.1) Many sharks have flesh with poor "reforming" properties and must therefor be mixed with other components and other fish to make a suitable surimi product.

7.2) The sharks that are most likely to wind up in "surimi" products are those that are larger bodied and not suitable for production as fillets and steaks. These sharks usually have considerable amounts of fibrous materials interstriated in the meat (Harlon Pearce, Harlon's Old New Orleans Fish House, personal communication) which makes it harder to produce a surimi product of the proper texture (Ken Hildebrand, Oregon Sea Grant, personal communication; Sus Kato, National Marine Fisheries Service, personal communication).

8) Mr. Mococain appears not to be well-versed in the subject of sharks as human food products, including:

8.1) He asserts that the only portion of the shark which is useful for human food products is the fillet. This is not true. He fails to account for shark steaks, fins, and fish meals suitable for human food additive purposes (Haq and Madhihassan 1962; Virginia Slosser, NMFS, pers. comm.)

8.2) He asserts that due to "its peculiar fish properties" that shark has been unable to be utilized widely as a food (page 12, item 2.3.3.08 for example). This is simply not supported by FAO statistics. In 1982 over 623,000 mt of shark was caught worldwide for food purposes (FAO 1982; Cook and Conway 1985). Somewhat over half of the 350 or so species of sharks currently recognized are utilized somewhere in the world for human food (Compagno 1984).

8.3) In Mococain's Chart 2 (page 13) he lists canned products as a use for shark meat. So far efforts to can shark have been largely unsuccessful due to the tendancy for the product to ammoniate in the can (McCormack et al. 1963; Cook and Conway 1985). Some limited efforts have been tried recently to use shark as part of prepared stews in jars

(Gordievskaya 1973) and in the third world (Kreuzer and Ahmed 1978) but these have not been promising because they cannot be stored for a reasonable shelf-life expected of other canned goods. Gordievskaya (1973) states that even with extensive deureafying processing it was not possibie to lower the urea content of shark flesh below about 1000 mg%. It is this residual urea that provides the substrate for ammonia production in sealed containers.

9) No scientific evidence or fact or extrapolation thereof supports Mr. Mococain's contention that the total content of urea, ammonia, taste and smell can easily be removed from shark fillets (see 8.3 above).

10) No supporting data defining specifications for the proposed product are set down. More particularly none of the test methods and procedures that are accepted practice in developing food products appear to have been carried out. In the absence of these important data there is no way to compare Mococain's proposed technology to known industry standards.

11) From a purely scientific standpoint Mr. Mococain appears not to be competant in the use of metric measuring systems. He mistates values for length and other parameters by one of more orders of magnitude. This further compromises the value of his report.

Economics:

12) The use of a hydrogenized product that is reduced to a paste (surimi?) indicates that Mr. Mococain has no concept of the comparative costs of shark to bony fishes for this purpose. The true raw product cost of shark is 13x to 44x the cost of bony fishes such as pollack, Theragra chalcogramma, which is a common surimi product base. Example based upon a standard 20% recovery of surimi product from initial ex-vessel raw product:

pollack, exvessel = $0.04/lb ($0.09/kg) or $0.20/lb ($0.44/kg) after processing.

sharks, exvessel = $0.50-1.75/lb ($1.10-3.86/kg) or $2.50-8.75/lb ($5.51-19.29/kg) after processing.

Source: U.S. example (Ken Hildebrand, Oregon Sea Grant, personal communication)

Except for traditional uses, such as in Japan, where economics is not the primary reason for production, who is going to buy a product that will retail for 15x to 50x the cost of bony fish surimi products?

13) Mr. Mococain either intentionaly to deceive the OAS or because of a poor understanding of the economics of shark processing stated production costs that are unrealistic and inaccurate. They fail to take into account the true cost of the raw material, i.e., (processed weight/exvessel weight) times exvessel price. They have also failed to take into account key costs

such as labor, freezing, packaging and storage. In doing so the forecasts have been "rigged" to appear more appealing and favorable than they would ever be expected to be in real practice.

Finally, the report has been badly "puffed," that is to say it is filled with extraneous, irrelevant, unsubstantiated and unusable information. This has apparently been done to obscure and hide the fact that the main premise of the proposed technology is weak and faulty. In the formal study of the science of logic this is referred to as a "red herring." It also entails the fallacies of "begging the question" (hiding the fact that a premise may not be true through the use of an artifice or trick to deceive), "appeal to ignorance" (when the arguement uses the fact that nothing can be proved about an assertion as evidence in support of some conclusion about that assertion), "appeal to the people" (which occurs when an argument plays upon certain psychological needs of the reader or listener aimed at getting the person to accept a conclusion without critical examination), "amphiboly" (occurs when a 'yes' conclusion to the argument depends upon the misinterpretation of ambiguous statements), and "false dichotomy" (occurs when two alternate statements are presented as premises of an argument as if they were jointly exhaustive of all possibilities available. When either statement is disproved it leaves the reader or the listener to accept the other alternative even though it is not true) (Hurley 1985).

CONCLUSIONS/RECOMMENDATIONS

This proposed technology for the "hydrogenization" of shark fillets as represented in John Mococain's report to OAS is technologically, scientifically, and economically worthless. It defies several laws of chemistry and physics.

Our recommendations are:

1) For OAS to accept that they have been defrauded either through the incompetance or intentional act of the author of the original report detailed in the 1984 document; and

2) That Mr. Mococain's report be completely disregarded in planning and implementation of shark fisheries in the CARICOM countries.