A COMPARATIVE STUDY OF THE FISHERIES OF MARTINIQUE AND SAINT LUCIA

A COMPARATIVE STUDY OF THE FISHERIES OF MARTINIQUE AND SAINT LUCIA

by

ROBERT GERALD CECIL

A Thesis Submitted to the Faculty of
Graduate Studies and Research
In Partial Fulfillment of the Requirements for the
Degree of Master of Arts

Department of Geography
McGill University
Montreal

August 18, 1966

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

LIST OF TABLES

Continued

LIST OF APPENDICES

PREFACE

The Department of Geography of McGill University has had a continuing programme of geographical investigations in the Caribbean since 1958, but with emphasis on the island of Barbados. During the summer of 1964, the Department, in cooperation with the University's Center for Developing Areas Studies, expanded its activities in the Southeastern Caribbean, sending a team of four students to Martinique and Saint Lucia to undertake a land use survey of peasant agriculture.

By extending its interests into these islands, the Department was able to initiate studies of Barbados' closest neighbours, and, more important, of areas having contrasting cultural backgrounds. Historically, Barbados has been an English island (1) and Martinique a French one (11). However, Saint Lucia bears both cultural imprints having changed hands thirteen times before the English took final possession in 1805 (30).

In addition to the land use survey, each member of the group studied a subject suited to his particular interest. The writer, having been associated with the Canada Department of Fisheries, elected to investigate the fisheries industries in these islands. However, one summer did not suffice to accomplish this task, and the writer returned to the islands during the summer of 1965.

The writer owes his greatest debt of gratitude to Professor Theo L. Hills, Department of Geography and Director of the Caribbean Section Center for Developing Areas Study McGill University, who arranged for travel funds and who provided advice and guidance during the entire project.

The writer is also indebted to the following staff members of the Department of Geography of McGill University: Professor Trevor Lloyd, Chairman, who provided financial aid, encouragement and advice; Mr. Bryn Greer-Wootten, lecturer, who through frequent discussions furnished invaluable help, and who aided in the study directly by instructing the writer in the use of the computer and interpretation of the subsequent results.

The author also wishes to thank Mr. Garnet Anthony Parr for proof reading this work, the members of the 1964 field survey for their cooperation, especially Father Romain Paquette S.J., the many government officials in Martinique and Saint Lucia who offered the utmost cooperation and Mr. R.C. Winsor, Director of the F.A.O. in Barbados.

Finally, the author's gratitude is extended to his wife, Melodie, who shared in the joys and difficulties of this work from its inception to its completion.

INTRODUCTION

Martinique became a full overseas department of France in 1946 (27:802), and Saint Lucia will soon change its status from a British colony to an independent Caribbean nation. Such political changes indicate that these small islands must rely ever increasingly upon their own resources to satisfy their needs.

Perhaps the most fundamental problem is the necessity of increasing food production in order to keep pace with the islands' rapidly growing population. The islands are small and densely populated. Martinique must support 292,062 people (79) on 425 square miles of land (70), and Saint Lucia must sustain the needs of 86,108 inhabitants (88) dispersed over 233 square miles of territory (30).

Located within the humid tropics (18), the islands are in one of the earth's natural regions where little is known experimentally about agricultural development (36). Also, due to colonial antecedents and subsequent economic necessities, the choicest lands are under plantation export crops and the poorer lands are relegated to the peasantry for subsistence agriculture. Furthermore, both islands have large tracts of land which for a variety of reasons lie underdeveloped.

Consequently, under present land use conditions, the islands have little space to devote to animal husbandry. There are some small herds on individual estates, and most peasants raise

chickens, pigs and occasionally one or more cows. Nevertheless, the islands are deficient in husbandry products. Therefore, the islanders turn to the sea to provide them with a major source of animal nutrition.

The islands are supplied with fish in one of three ways: from imports of fresh and processed products, from locally based deep-sea fishing boats (Martinique), and from fleets of small fishing crafts operating from numerous sites along the coasts. These small vessels form the islands' traditional fisheries sector with which this work is primarily concerned. However, where necessary, the other sectors are discussed to place the traditional sector into proper perspective within the industry as a whole.

The study was designed to be presented on a comparative basis. However, Lowenthal, in referring to the Caribbean, wrote:

> Any general comparison must be essentially impressionistic, as much a work of art as a product of science (38:790) ... Jealousies, rivalries, fears, and, above all, mutual ignorance, tend to make each small island a museum in which archaic distinctions are carefully preserved (ibid., 789).

Lowenthal was primarily concerned with the range and variation of Caribbean societies. However, his implications of insular distinctiveness are of prime importance in fisheries research. The Food and Agricultural Organization of the United Nations is presently organizing a Caribbean-wide fisheries development project (32). Therefore, it is imperative to assess

whether "West Indian Fisheries" exists, or whether each island is so radically different in its approach to fishing that no standard techniques could be uniformly applied to the organization of a Caribbean-wide industry.

This study is an attempt at such an assessment. It investigates fisheries in two neighbouring islands, administered differently, that have traditional activities which are both similar and different.

The Analysis

Traditional fisheries are examined in the light of the marine environment and the available resource base that foster them, and in relation to the tools and techniques that sustain them. These factors include the basic variables which are associated with the location of fishing activity.

The distribution of fisheries is analysed by investigating the relationships between the actual number of boats as a variable dependent on a number of other factors.

This is followed by an assessment of production, marketing and viability, and a discussion of the relationships between the islands' administrations and traditional fisheries. Finally, the industries present position and future plans are presented.

Background Literature

No geographical study exists which deals specifically with the fishing industry in Saint Lucia. However, this activity

is discussed in a number of works which deal with the British West Indies fisheries in general. Several short articles, especially on the islands' fisheries schools, have appeared in the West Indies Fisheries Bulletin. Also, some oceanographical data has been published from time to time on the southeastern Caribbean.

The first exclusive geographical publication on Martinique's fisheries appeared in 1964 (13). It is mainly a compilation of census data translated into a number of location maps. There are other articles which have appeared in journals and reviews, but none deal with the industry as a whole. A good part of the data used in this work had to be taken from pamphlets, bulletins and reports published by the various organizations concerned with fisheries.

The literature review is incorporated in the body of the text in each relevant chapter.

Summary of Research Procedures

The first summer of field work was used to conduct a preliminary survey of the industry. During this time, several fishing sites were visited, many officials connected with fisheries were contacted, and all available local literature was consulted and sorted. With the help of Saint Lucia's fisheries officer, a field census of boats and fishermen was conducted to verify and supplement the official records kept in the island's police stations.

During the second field excursion all major, and many minor, fishing sites were visited. After interviewing several

fishermen at each location, the data was compiled, and verified during discussions with administrators involved in the various facets of the fisheries industry.

The writer contacted people in government, commerce, boat building, marketing, fisheries schools, the clergy, and many others having an association with fisheries. Consequently, many of the statements, and several of the measurements, appearing in this work are derived from these interviews instead of published sources.

CHAPTER 1

NATURE OF THE MARINE ENVIRONMENT

Martinique and Saint Lucia are located in the South-eastern Caribbean. They belong to the Windward Islands which form the most southern extension of the Lesser Antilles which in turn belong to the chain of West Indian Islands (figure 1).

The greater West Indian location is significant for vessels that are capable of long distance fishing. However, the majority of the traditional fishermen rely on the resource base which is limited to the geographical region that extends from Dominica to Saint Vincent (figure 2).

In this area, Martinique profits from the twenty-five mile wide Dominica Channel, while Saint Lucia has access to the benefits of the twenty-one mile Saint Vincent Passage. Martinique and Saint Lucia are separated from each other by the twenty-one mile Saint Lucia Channel whose harvest they share. The two islands have access to the Caribbean Sea lying to the west, and to the Atlantic Ocean that stretches to the east.

Topography of the Caribbean Sea

The Caribbean Sea consists of five deep basins separated by four distinct ridges; these basins vary in depth between more than 1,640 fathoms to more than 2,730 fathoms. The Caribbean is separated from the even greater depths of the Atlantic

Figure I

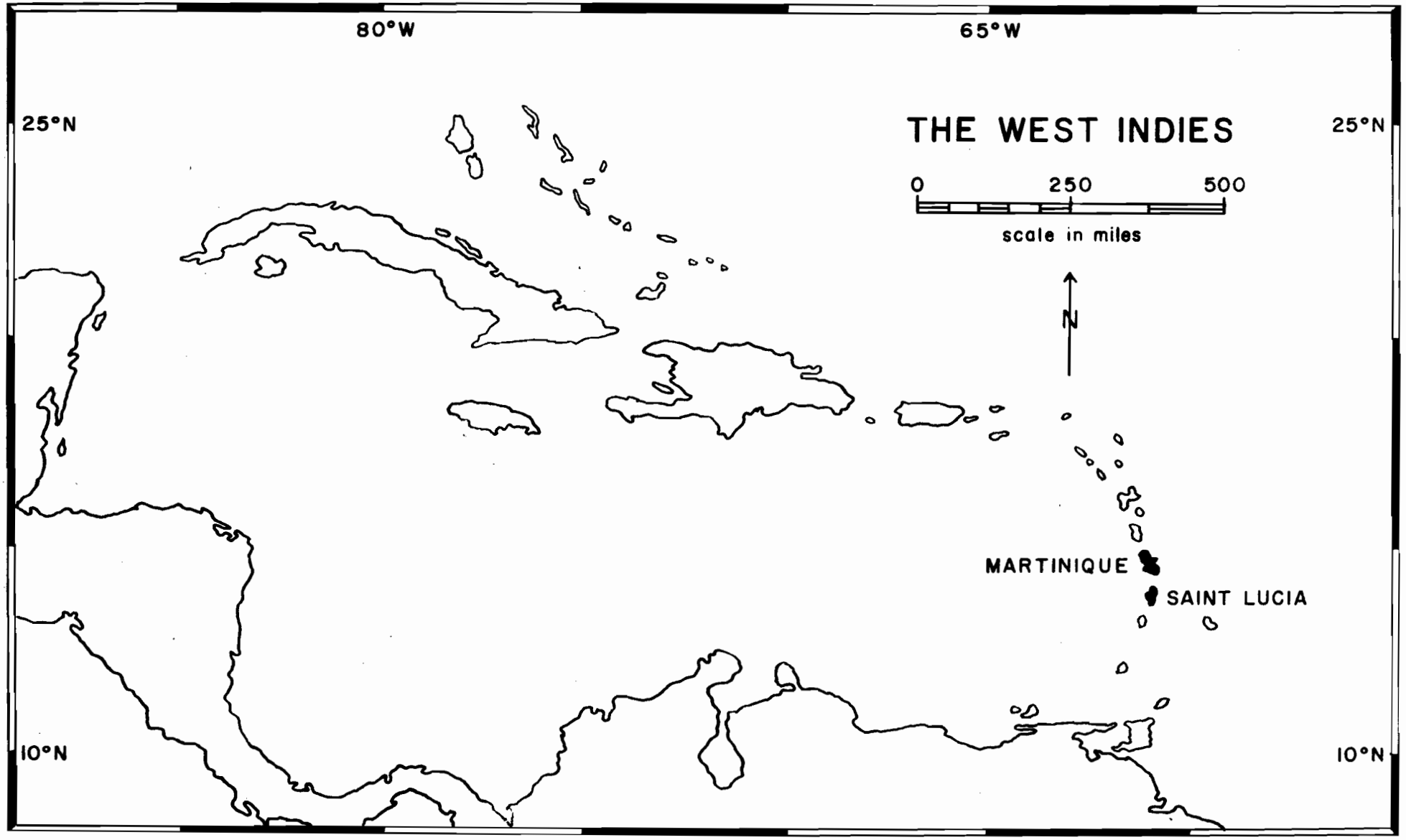
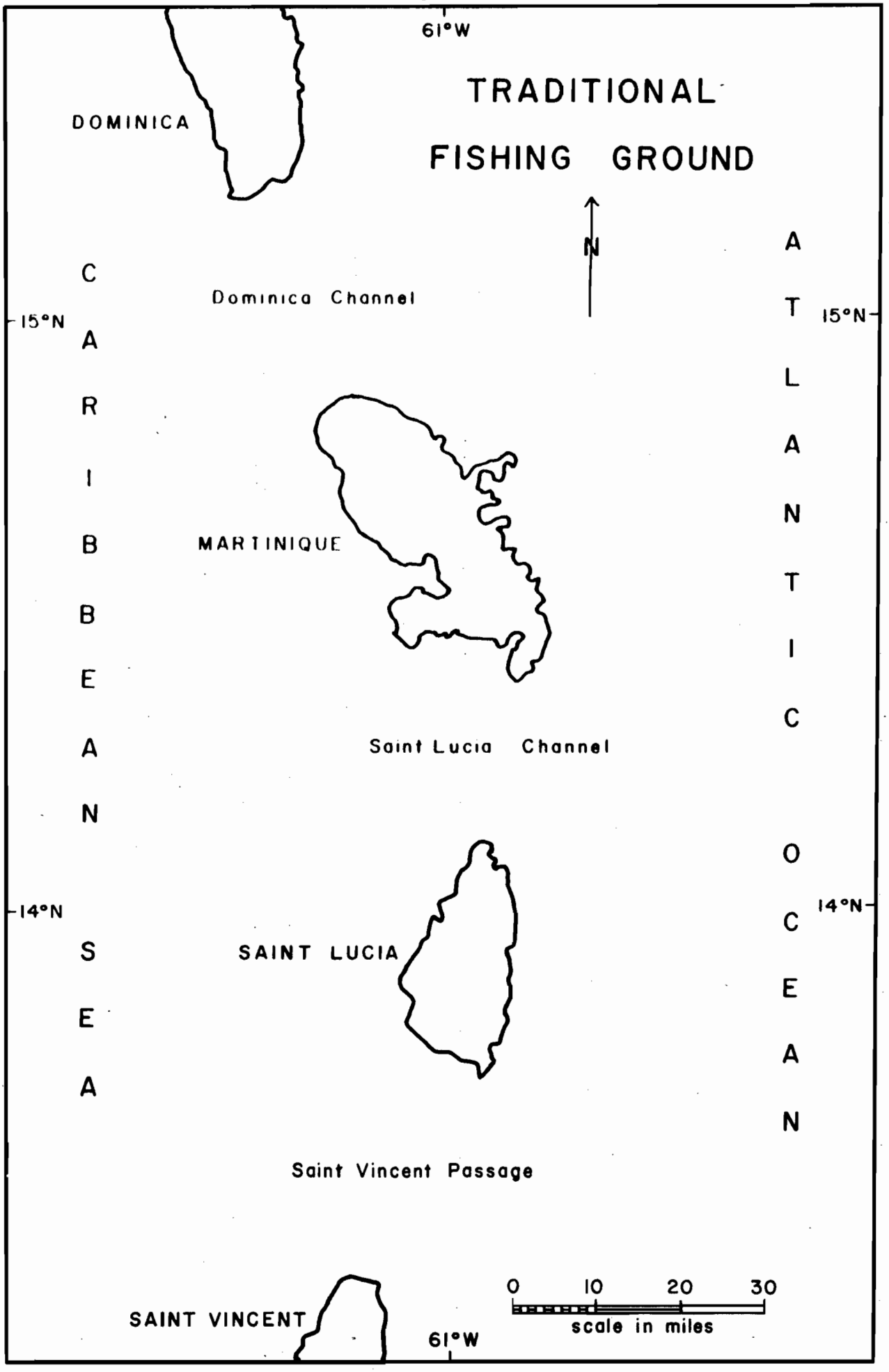

80°W
65°W
25°N
25°N
THE WEST INDIES
0
250
500
scale in miles
N
MARTINIQUE
SAINT LUCIA
10°N
10°N

Figure 2


61°W
TRADITIONAL
FISHING GROUND
DOMINICA
N
CARIBBEAN SEA
ATLANTIC OCEAN
Dominica Channel
15°N
15°N
MARTINIQUE
Saint Lucia Channel
14°N
14°N
SAINT LUCIA
Saint Vincent Passage
SAINT VINCENT
61°W
0 10 20 30
scale in miles

by the Antilles Arc, a ridge that runs from Cuba to Grenada. The arc is continuous between the two water bodies, and interposes a sill or threshold between them.

The critical sill depths have not been definitely established; however, recent estimates place the depths between 765 and 1,257 fathoms (111:29). These sill depths have an important influence on the water renewal in the interior basins.

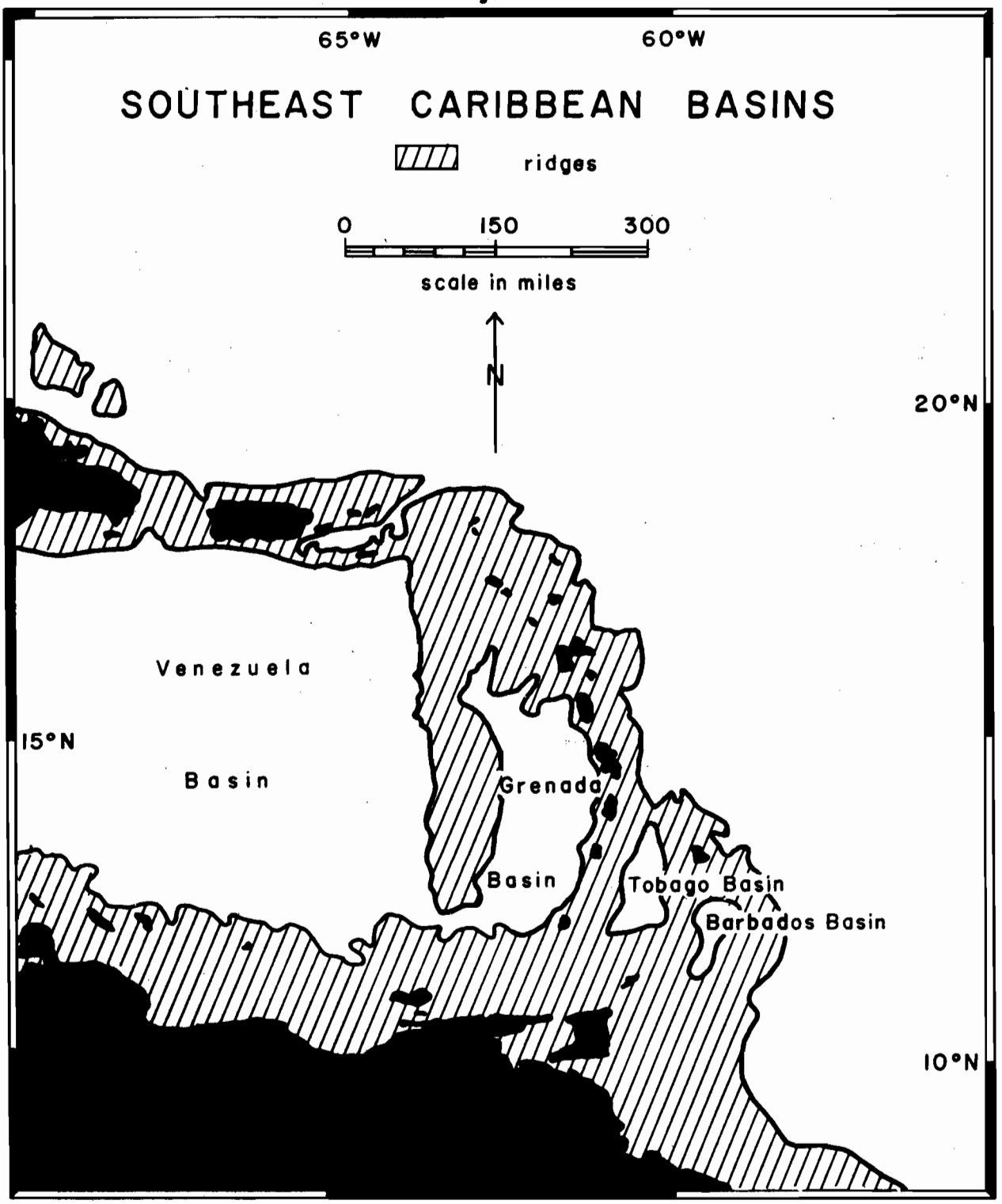
Outside the arc, on the Atlantic side, are to be found other basins and ridges whose topography influences the movement of water in the Caribbean area. Among these, the Tobago and Barbados basins have a direct relationship to the Lesser Antilles (figure 3), (ibid.:71). Isobaths indicate that these basins deepen in a westerly direction, and the shallow areas begin at about the 1,090 fathom line.

Movements of Water Masses

As Walford pointed out, the fisheries resources of the oceans are affected by a wide variety of biological, chemical and physical factors (59). The combination of these factors, at any one time, accounts for the variations in abundance, availability and quality of marine organisms. These factors in turn are highly influenced by the movement of water masses, for marine environments never exist in isolation; they are intimately linked to distant waters by the action of currents.

The main water mass movements to the region under study

Figure 3


65°W
60°W
SOUTHEAST CARIBBEAN BASINS
ridges
0
150
300
scale in miles
N
20°N
Venezuela
15°N
Basin
Grenada
Basin
Tobago Basin
Barbados Basin
10°N

were described by Brown:

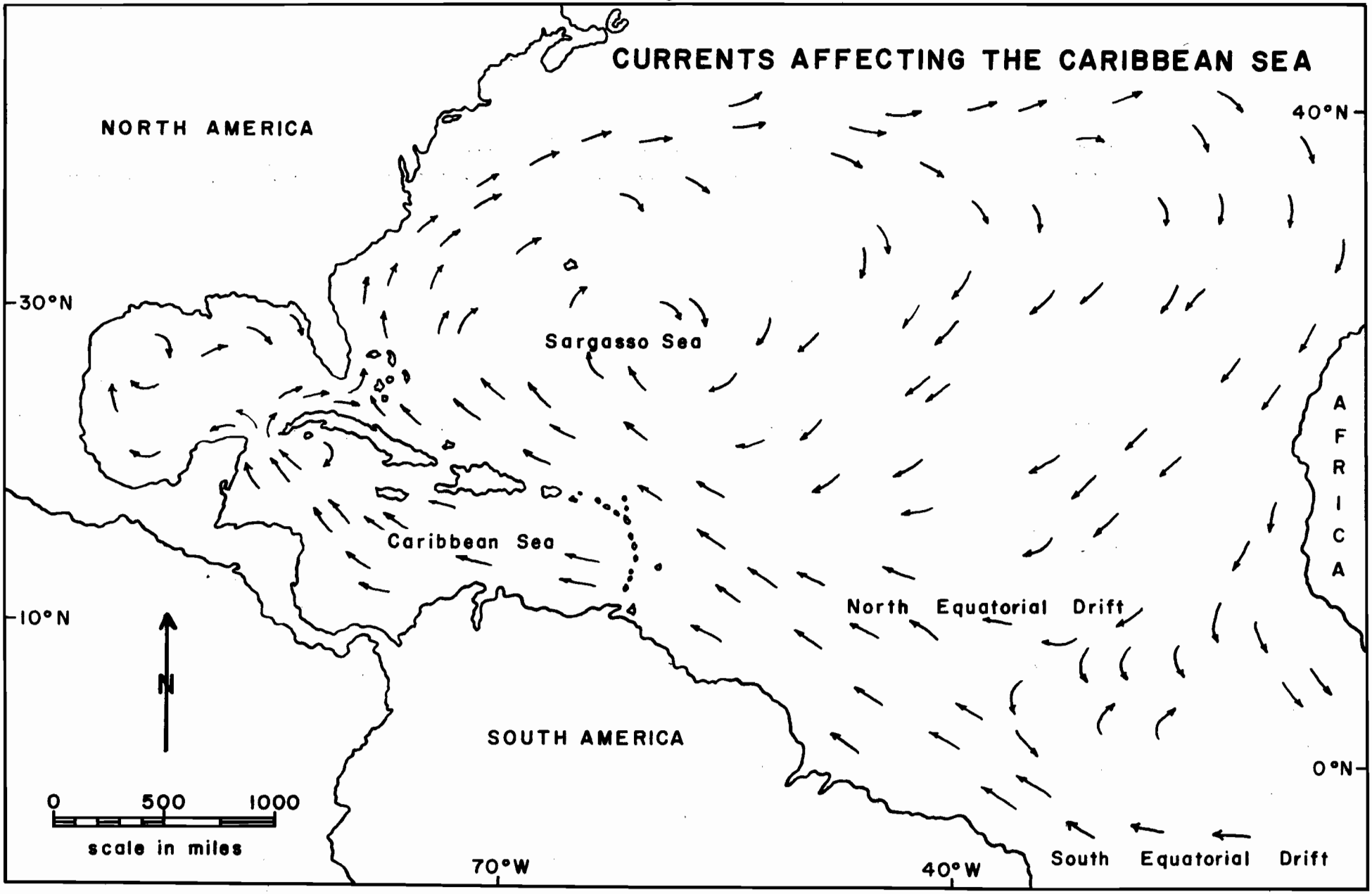
> A great mass of water impinges upon the Lesser Antilles from the Atlantic and pours over the sills through the gaps between them. These waters are derived from the North and South Equatorial Drifts which although they arrive in the Caribbean side by side have separate origins; the North Atlantic Drift is part of a North Atlantic circular swirl centered on the Sargasso Sea; the waters of the South Atlantic Drift are derived from the Benguela Current of West and South Africa (8:6) (figure 4).

This type of water movement is not ideal for sustaining large fish concentrations. As Walford explained (59) the best areas for extensive commercial fishing are located in higher latitudes where winter causes the surface waters to become heavier and denser. As this water layer sinks, it is replaced from below by rising lighter water which, being rich in nutrients, brings a renewed cycle of biological production.

Other areas are fortunate in having different mechanisms that produce the same effects. For example, Northwest prevailing winds along the California coast push water which is subjected to the action of the earth's rotation; the overall effect is to create upwelling which is associated with heavy production of organisms and rich fisheries resources.

Some areas rely on the meeting of currents from different directions to provide mixing which results in the rising of deep water that enriches the surface layers. This type of movement has contributed to the very high productivity of fishing grounds such as

Figure 4


CURRENTS AFFECTING THE CARIBBEAN SEA
NORTH AMERICA
40°N
30°N
Sargasso Sea
AFRICA
Caribbean Sea
10°N
North Equatorial Drift
N
SOUTH AMERICA
0°N
0
500
1000
scale in miles
70°W
40°W
South Equatorial Drift

those off the northern islands of Japan. On the other hand, this type of water mass action in the Windwards does not lead to highly prolific fishing grounds.

The role of water masses in the general productivity of the Caribbean area was reviewed by Whiteleather and Brown (60). They reported that the deep and bottom waters of the Atlantic below 1,000 fathoms are rich in nutrients, but they lie at too great a depth to influence the water which may come within the zone of sunlight penetration. This water spills intermittently over the sills between the islands of the Caribbean arc, thereby gradually displacing upwards the water masses of the Caribbean; but the net effect of this movement is believed to be too gradual to constitute a major upwelling.

The Atlantic water masses entering the Eastern Caribbean Sea above 1,000 fathoms, known as the intermediate layer, move uniformly westward without material change of depth, the vertical water structure being stable. The next distinct layer is composed of South Atlantic central water derived from the subtropical convergence between latitudes 30°S to 40°S. Finally, the discontinuity layer, about 80 fathoms thick, is intermediate in nutrient content between the surface water above, which is poor, and the central waters below which are rich.

In addition to the east-west flow of the prevailing currents, the waters near the islands may experience local currents. Movements in northerly and southerly directions are common around

Barbados, and distances travelled by fish in one or two days are generally greater in the north and south directions (37:383). If similar currents occur near Martinique and Saint Lucia, they may have a strong influence on the day to day distribution of fish.

The Role of Plankton

The quantity of fish in a given area depends on the supply of basic food known as plankton. Plankton can be divided into two groups: zooplankton or drifting animals (including the eggs and larvae of larger creatures), and phytoplankton which consist of drifting plants. As the zooplankton themselves live on phytoplankton, it is the phytoplankton stock which is the final pasture on which all sea creatures ultimately depend (41:3).

An additional pasture is provided by the plants that grow on the seabed. These sea plants need sunshine, and can generally occur at a maximum depth of 50 fathoms in the tropics.

Growing phytoplankton are found in the upper sunlit layer of the sea, to a maximum depth of about 40 to 50 fathoms, though zooplankton may exist at considerable depths below this, feeding on sinking dead plankton. The bulk of zooplankton are, however, also obliged to live in or near the sunlight penetrated zone, where lies their main food supply.

In addition to sunlight, the growth of phytoplankton is affected by the nutrient substances and gases dissolved in the

sea, and by the temperature of the water. These in turn are affected by such factors as the movement of water masses, the amount of river discharge from adjacent land areas (of no consequence in Martinique and Saint Lucia), and by the extent of the continental shelves.

Influence of Continental Shelves on Plankton and Fish

Morgan has summarized the influence of continental shelves on plankton and fish stocks as follows:

> For a given sea area, the continental shelves are generally much greater producers than the open oceans. Organic remains from the euphatic zone (sunlight zone) are only partly decomposed in their short fall to the bottom, so there is much food for small seabed creatures which finally feed fish. The shelf sea-floor thus forms a rich producing horizon, and one within convenient reach of vessels. The 100 fathom depth contour has long been generally accepted as the approximate edge of the continental shelf; but is of course, an arbitrary figure. There are exceptions, nevertheless the 100 fathom contour is normally a satisfactory general indication of the limit of the intensive shelf type of fishing. (41:19).

The width of the continental shelf is, then, an extremely important factor in the general intensity of fishing activity in an area. As a rule narrow shelves have an adverse effect on the supply of demersal fish, but fortunately for the countries concerned other factors are favourable to the development of pelagic fish.

Extent of the Continental Shelves

The islands of the West Indies are not well endowed

with continental shelves. In the Windward Islands, the shelves are very narrow or practically non-existent in many areas, thus limiting the fishing grounds for demersal fish to less than fifteen miles from shore (24:214).

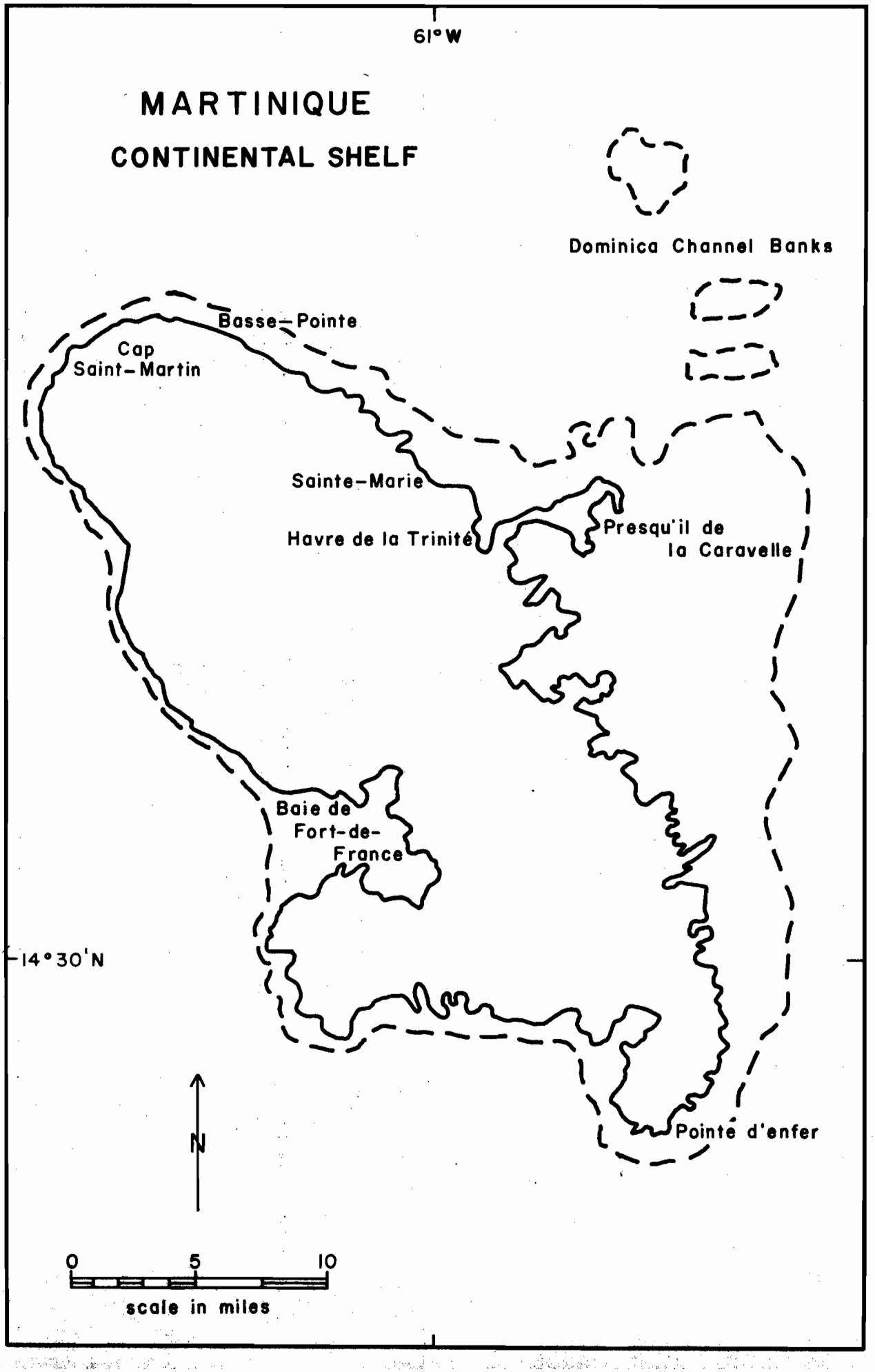
Martinique's continental shelf (figure 5) varies in width from a few yards to less than twelve miles. On the Atlantic Coast, it is over two miles wide at Pointe d'Enfer from where it increases more or less steadily northward until it broadens to more than ten miles just south of the Presqu'il de la Caravelle. Immediately north of the peninsula in Havre de la Trinité, widths narrow to three or four miles after which they decrease to a little over two miles off Sainte-Marie. From this point the shelf maintains a fairly steady average width of one to two miles up to Basse Pointe.

On the Dominica Channel coast or north coast (Basse Pointe to Cap Saint-Martin), the shelf is quite uniform. In this area the outer edge varies between a little less than one mile to a little more than a mile.

On the Caribbean coast, the shelf reaches its narrowest dimensions; to such a degree, that at several points the measurement of width is expressed as a matter of yards. Nowhere on this coast does the shelf extend beyond one mile. However, the entire Bay of Fort de France (over 25 miles square) records depths well below the 100 fathom mark.

On the Saint Lucia Channel coast or south coast, the

Figure 5


61°W
MARTINIQUE
CONTINENTAL SHELF
Dominica Channel Banks
Basse-Pointe
Cap
Saint-Martin
Sainte-Marie
Havre de la Trinité
Presqu'il de
la Caravelle
Baie de
Fort-de-
France
14°30'N
N
Pointe d'enfer
0
5
10
scale in miles

shelf is rarely over one mile wide.

Saint Lucia also has a very narrow continental shelf (figure 6). At its narrowest points the shelf is measured in yards, while in its largest reaches it extends for little more than five miles.

On the Atlantic coast between Moule à Chique and Salibus Point, the shelf measures up to five miles. Beyond Salibus Point, it has an average two to three mile width northward to Hardy Point.

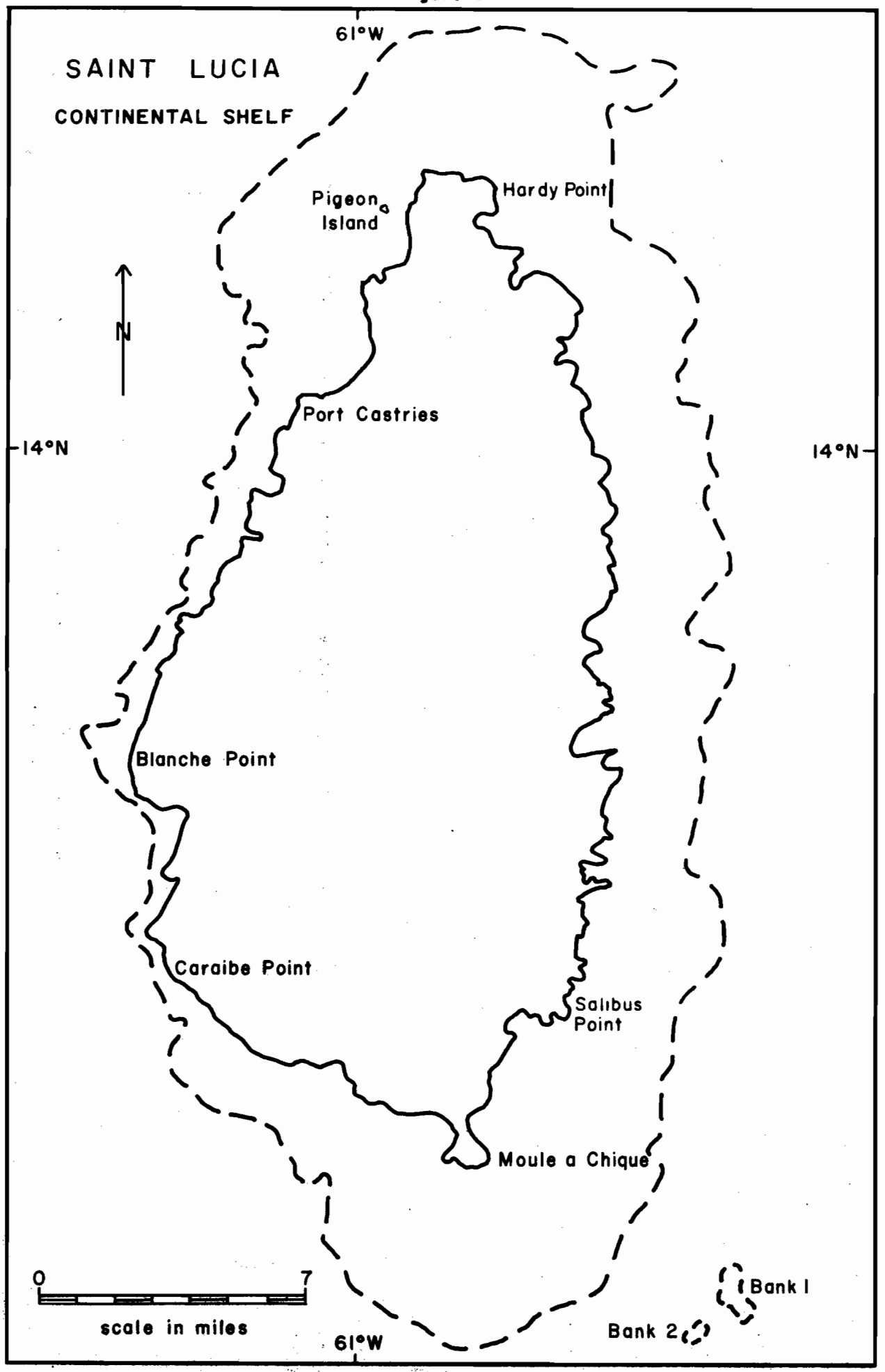
On the Saint Lucia Channel coast or north coast the shelf is semi-circular in form, and averages three to five miles in length.

On the Caribbean coast the shelf is widest - two to four miles - in the area between Port Castries and Pigeon Island. South of Castries, it averages a little more than a mile until Blanche Point; in this area the shelf narrows to its smallest dimensions - less than one mile - until it reaches Caraibe Point where it becomes slightly larger. On the Saint Vincent Channel coast or south coast the shelf broadens steadily, increasing from one half a mile to four miles, from Caraibe Point to Moule à Chique (the southern extremity of the island).

Fishing Grounds

In these islands, in addition to the available shelf space, fishermen ply the nearby deeper waters in search of larger

Figure 6


61°W
SAINT LUCIA
CONTINENTAL SHELF
Pigeon Island
Hardy Point
N
Port Castries
14°N
14°N
Blanche Point
Caraibe Point
Salibus Point
Moule a Chique
0
7
scale in miles
61°W
Bank 1
Bank 2

species of fish.

Also, Taylor (57) reports that Saint Lucian fishermen, operating out of Vieux Fort, have access to three shallow productive areas in the Saint Vincent Channel which are referred to as banks no. 1, no. 2 and no. 3. Taylor provides a very rough locational sketch of these banks, which does not permit a determination of the exact geographical position of these fishing grounds. However, hydrographic charts for the area (107)(109) indicate two small shallow regions in the Saint Vincent Channel, which may be the banks in question (see banks 1 and 2, figure 6).

Martinique's fishermen also have access to banks beyond the island's continental shelf. These banks, three in number, located in the Dominica Channel northeast of Martinique, are known as the Siberian Bank, the Dien-Bien-Phu Bank and the American Bank (see figure 5).

As far as traditional fishermen are concerned, their resource base is limited to the above areas. Barring the odd exception, fishermen do not utilize the shelf areas of neighbouring islands, for none of these islands have large shelves and what is available is used for local fishing purposes.

The few deep-sea vessels operating from these islands must travel to distant waters to obtain large catches of big fish. For the most part, these vessels cruise the Caribbean in search of shoals of pelagic fish. Any attempts at large

scale shelf fishing must be directed to the northeast coast of South America which is readily accessible (250 to 350 miles), and endowed with a continental shelf which is large enough to support commercial fisheries (34).

Discussion

Martinique and Saint Lucia are under the influence of westward moving water masses which do not encourage the development of fisheries resources such as those found off the coasts of Japan or in such areas as the Grand Banks near Newfoundland. Consequently, neither island is in a position to develop large scale commercial fisheries operations in their immediate waters.

However, each island has its own continental shelf configuration which influences the availability of plankton and, consequently, yields different quantities of demersal fish to each island, and to the different fishing villages on each island. Also, access to deeper waters and to larger pelagic species is a direct function of the width of the continental shelves.

Finally, traditional fisheries operations, conducted from any point on either island, are subjected to: local variations in currents; the topography of the sea; the combination of biological, chemical and physical factors; all of which influence the life cycles and movement habits of the species that ultimately make up the catches brought in.

CHAPTER 2

RESOURCES OF THE SEA

Close to one hundred edible species of fish are found in the waters surrounding Martinique and Saint Lucia.[1] While several species predominate, others are harvested only on rare occasions. To date, no single study exists which positively reveals the relative proportions of available commercial fish species. However, some qualitative work on the distribution of species has been carried out.

Studies Conducted by Oceanographical Vessels

In 1951 the first French ship of its kind to sail West Indian waters, the Président-Théodore-Tissier, undertook a one month analysis of the fish populations of the French West Indies (52). This study pointed to the existence of important concentrations of tuna, bonito, and mackerel. Four species were found to be especially important: yellowfinned

---

1. See appendix I for a detailed comparative classification of fish species found in the waters around Martinique and Saint Lucia. Much confusion arises over the classification of fish species in this region. Several methods are used, notably: preferred English or French name, common English or French name, Creole name (with colloquial variations in each island), and systematic name (often controversial). Because of this confusion, where possible, the preferred English name will be used, and no systematic nomenclature will enter into the body of the text.

tuna, spotted bonito, barriolet and white tuna. Later work by the United States experimental ship Oregon confirmed the French vessel's findings; the Americans indicated that the species mentioned formed the largest proportions of pelagic fauna off the coasts of West Indian islands (ibid.).

Research in Martinique has been in the hands of the Head of the Laboratory operated by the Institut Scientifique et Technique des Pêches Maritimes. Between 1954 and 1956 inshore work was carried out with a small marine dory "Mère Balaou" and further afield in the Caribbean with the tunny fisher "Mamie". However, no reports have been published on these activities (95).

From November 1957 to February 1959, the 206 ton tunny fishing "Gouverneur Général Eboue", specially equipped for tropical seas, was used for research in the Caribbean. Unfortunately its commercial operations hampered the scientific activity it was hoped to carry out, and on the whole the results were disappointing. Nevertheless, it identified large concentrations of marketable fish some distance off the coast of Venezuela and the adjacent islands, in particular Blanquilla, Marguerita and Tortuga (ibid.).

Tuna, Bonito and Mackerel

The work carried out by the French and American research vessels has shown that tuna, bonito and mackerel constitute major fisheries resources in the Caribbean. Data from the Oregon have indicated that at least eight species of tuna and bonito are known

to occur in the Caribbean Sea and adjacent Atlantic waters. Tuna is a widely distributed resource, for the appearance of large numbers of tuna in Caribbean offshore waters indicates the existence of a diverse but substantial sub-surface population (54).

Morice (43) published the Président-Théodore-Tissier's findings on the distribution, in the Martinique-Saint Lucia area, of tuna, bonito and mackerel. He indicated that most of the species are present in varing quantities all year round. However, their weight, and hence their exploitation, fluctuates with the seasons and with their areal distribution in the shallow and deep waters surrounding the islands. Morice's data are summarized in table 1.

Pelagic and Demersal Fish Species

In addition to the resources already discussed, the seas around the islands offer a great variety of pelagic and demersal fish. For instance the banks off the islands provide sizeable quantities of large red fish - such as oldwife, yellowtail snappers and couvalli - in their rocky seaweed covered bottoms. As well as red fish much demersal fish is to be found wherever there is a rocky bottom at a depth of 40 to 100 fathoms (95).

A multiplicity of species is found in the islands' waters. Some yield fairly large harvests while others offer few individuals.

TABLE 1

TUNA, BONITO AND MACKEREL RESOURCES

Usual Names	Distributional Characteristics
Blackfinned tuna, Blackfinned bonito.	Spawn in the Lesser Antilles. Surface pelagic fish. Travel in dense shoals which are found on shallow shelves and banks, and in deep waters.
Yellowfinned tuna, Yellowfinned tunny.	Spawn in the Lesser Antilles. Present all year off the coasts of both islands.
White bonito, Barriolet, Banjo.	Spawn in Martinique and Guadeloupe, and in neighbouring islands. Have their entire life cycle in the Caribbean. Often extremely dense shoals are present.
Spotted bonito, Thon blanc.	One of Martinique's most common pelagic species. Few, but very dense shoals.
Spanish Mackerel.	Need large continental shelf to complete life cycle. These fish are of secondary importance to Martinique.
Mackerel species known as sierra or pintado, Thazard.	Natural habitat is the Greater Antilles, but also found in the Lesser Antilles. Considered to be toxic in the Virgin Islands.
Mackerel species known as kingfish or ocean robin, Thazard rélé.	Ubiquitous fish found in all the oceans of the world.

Some are found all year round, and others occur seasonally. They vary in weight and in habitat preferences, and they exhibit differential locational patterns around the islands. The most productive and important species include: balaou, cigar fish, dolphin, flying fish, garfish, goggle-eyed jack and wahoo (42).

Crustaceans

Crustaceans are found in Martinique's and Saint Lucia's waters. This food resource includes: spring lobsters, conches, shrimps and crabs. These latter are of two varieties, land and sea. The land variety is ubiquitous in the sea coast areas of both islands, and is harvested by both fishermen and non-fishermen alike.

None of these resources provides the basis for any sizeable auxiliary fishing industry. However, the waters around Martinique are reported to abound with reasonable quantities of crustaceans (56:41), and the southern part of the island is credited with having the greatest concentrations.

In Saint Lucia spring lobsters are, by far, the most important of these sea dwellers. They appear between August and February in all coastal areas; however, the only worthwhile commerical concentrations are to be found in the south from Micoud to Vieux Fort.

Discussion

There exists more specific data on the fish resources in Martinique than on those in Saint Lucia. This situation arises out of Martinique's special status as a French Overseas Department. Whenever French research vessels ply the Caribbean, greater attention is focussed on the "home" waters of Martinique, Guadeloupe, French Guiana and other French Territories.

Saint Lucia is too small a Territorial unit to maintain elaborate research facilities. It relies, therefore, on general oceanographic surveys of the Caribbean to obtain data on its fisheries resources. However, its geographical proximity to Martinique allows it to share research data gathered by French agencies which often includes specific details on Saint Lucian resources.

Both islands are endowed with the same basic fish resources. Nevertheless, as a result of variations in the marine environment, and of the movement and life cycle characteristics of the individual fish species, differences exist in the day to day and seasonal composition of the catch between points on each island and between the islands.

A case in point is demonstrated by the migration habits of dolphins. They appear in Martinique from June to December, and in Saint Lucia from February to June. Therefore, although geographical proximity results in similar fish resources, these are not available to the islands on a uniform basis.

CHAPTER 3

TOOLS OF THE TRADE

Presently, there are six boats equipped for deep-sea fishing operating from Martinique, and one being constructed in Saint Lucia. All other fishing operations conducted in these islands are considered as traditional fisheries.

Traditional fishing was first practised by the islands' original Indian inhabitants. However, this group was slowly eradicated by the settlers and replaced by descendants of African labourers (see plates 1 and 2 for examples of today's traditional fishermen) who were brought to the islands as plantation slaves. These people, now forming the majority of the island's populations, are commonly known as Creoles or natives. The term Creole serves especially to identify the language used in both islands by the coloured and mixed-blood inhabitants.

Native fishermen operate from dug-out canoes or small planked boats. They prefer traditional boats and implements and, therefore, operators of deep-sea vessels must rely on South American crews to staff their boats.

There are two groups of traditional fishermen: the hired crew who have no equipment of their own, and the canoe owners who, having invested most of their resources in fishing equipment, form the backbone of the islands' traditional fleets.

1 - Fishermen at Grand-Rivière, Martinique.
Typical fishermen found in Martinique and Saint Lucia.

2 - Fishermen at Cap Chevalier, Martinique.
The shed contains all the equipment needed for traditional fishing.

Most fishermen engage in other occupations for varying lengths of time; however, the boat owners tend to devote most of their energies to fisheries activities, and can be considered as true fishermen. Each individual conducts his own small business enterprise, hiring crews as they are needed. However, two owners occasionally team up to fish for a day.

Most owners live very close to the sites where the canoes are beached, and, as they generally possess the necessary skills, they spend a great deal of time mending their equipment and fabricating new implements to be used during the course of fishing operations.

For the most part, identical fishing equipment is used in Martinique and Saint Lucia. However, a few specific items are exclusive to each island. It is possible to conduct fishing operations with a minimum of equipment; for example, Martinique's fishermen have been known to work with nothing more than a dug-out canoe, fish pots fashioned from bamboo, and ropes made from lianas (12). Most of the island's fishermen still use this locally produced basic equipment which they supplement with assorted hooks, nets and synthetic ropes.

Many fishermen have slowly added pieces of modern equipment to their traditional gear, and in several cases outboard motors have been purchased to power the canoes. The introduction of modern implements, especially imported motors, has taxed the

average fishermen's meagre financial resources. Because of this, the islands' governments, eager to develop their fisheries, have provided loan schemes to help the fishermen acquire modern tools. Nevertheless, many fishermen continue to function with little or no modern equipment.

The Canoe

The canoe is the most popular fishing craft in Martinique and Saint Lucia. Known as the "gommier" for the white gum-tree (Dacryodes hexandra - Griseb) from which it is dug out, the canoe has been in use ever since the arrival of the Europeans (50:392). Canoes are constructed on both islands; however, the art has been steadily declining in Martinique as more and more canoes are imported from Dominica and Saint Lucia where more raw material is to be found.

When an order for a canoe is received, the Saint Lucian boat builder sets an age old process into motion. Several hired men accompany the craftsman into the woods where a suitable tree is selected, cut and trimmed. The log is then dragged to the edge of the woods where the builder transforms it into a dug-out hull (plate 3). Trucked to the builder's yard, the dug-out hull is filled with water and stones for one or two weeks (plate 4). The water softens the wood while the stones open and stretch the hull. Often, a fire is set near the hull to accelerate the stretching process.

3 - Dug-out tree trunk. The first stage in building a traditional canoe.

4 - Stretching the Hull. The second stage in building a traditional canoe.

5 - A typical traditional canoe.

After drying, the dug-out is transformed into a canoe by the addition of planks (about one foot high) which build up the sides. Ribs are inserted at three foot intervals after which benches and oarlocks are added. The canoe is then delivered to the fisherman who paints and launches it (plate 5). However, some fishermen ask that the canoe be delivered at an earlier stage of process so that they can do the bulk of the work themselves.

The dimensions of canoes vary considerably; lengths range between 15 and 25 feet, and widths are between three and four feet at the broadest point. The overall depth averages $2\frac{1}{2}$ to $3\frac{1}{2}$ feet. The canoe seats a normal complement of one to three fishermen, but it can accommodate up to five people for "beach seine" fishing. However, this type of activity is limited to a very short distance off the coast and is generally conducted with canoes, slightly bigger than the average, which are built specifically for this purpose.

The Yole

The yole is a fishing boat native to Martinique, and it is used exclusively in that island. This craft, considered to be much more seaworthy than the canoe, is rapidly gaining in popularity. It is very similar in appearance to the canoe (plate 6), but it has an entirely different construction. Made

6 - A typical yole.

7 - The transom boat.

entirely of wooden boards, it is built by carpenters in all but seven of the coastal communes.

In general the yole is a bigger craft than the canoe. It averages 24 feet in length, four feet in width, and it has a depth of approximately three feet. Three men form the normal crew, but it can safely carry a fourth. Generally powered by an outboard motor, it has a slightly greater cruising range than the canoe.

Transoms and Whalers

The transom boat (plate 7) and the whaler are the biggest and sturdiest of the assorted planked boats found in Saint Lucia. They are built in Castries by carpenters who specialize in marine construction. Having the same general appearance, transoms and whalers have very similar specifications which are summarized in table 2.

Manned by Creole fishermen, whalers and transoms never venture out of sight of land, and lacking cold storage facilities, the boats are not kept at sea any longer than traditional canoes. The only real advantages offered by these boats are greater stability and larger fish-carrying capacity.

Deep-Sea Fishing Vessels

In addition to its native fishing fleet of canoes and yoles, Martinique has six deep-sea boats operating from Fort-de-

TABLE 2

AVERAGE SPECIFICATIONS OF TRANSOM BOATS AND WHALERS

Specifications	Transom	Whaler
Length	26 - 30 feet	26 - 30 feet
Width	9 - 10 feet	6 - 8 feet
Depth	$3\frac{1}{2}$ - $4\frac{1}{2}$ feet	$2\frac{1}{2}$ - 3 feet
Power source	Inboard motor Auxiliary sail	Inboard motor Auxiliary sail
Motor size	$8\frac{1}{2}$ - 15 H.P.	7 - 15 H.P.
Crew	3 - 4 men	3 - 4 men
Catch capacity	up to 4 tons	up to 4 tons
Shelter	small mid-section covering (wood)	Nil

France (plate 8). The boats range in weight from ten to ninety tons, and measure up to 51 feet in length. They have cold storage facilities and sleeping quarters for the crews.

The smallest of the boats, built in Martinique, roams the Caribbean in search of red fish. The other five vessels, constructed abroad, fish for tuna off the coast of South America. Three to five man crews, mostly Venezuelans, staff these vessels.

Saint Lucia has no deep-sea fleet. However, one vessel presently being built in Castries is intended for deep-sea exploitation. Designed to sleep a crew of six, this vessel is expected to stay at sea for two weeks at a time. The boat is 42 feet long, has

a 12 foot 6 inch beam, stands 4 feet 6 inches from bottom to deck, and weighs 20 tons. It is powered by a 100 h.p. inboard engine capable of generating 10 to 12 knots per hour. It has a cabin that provides 288 cubic feet of space, and is equipped with an icebox capable of storing seven tons of fresh fish (plate 9).

The Motors

In Martinique and Saint Lucia native fishermen rely on sails to propel their fishing crafts. However, within the last decade, many fishermen have turned to imported outboard motors as either a substitute or alternative energy source to power their boats. Bulky and costly, inboard motors are restricted to Saint Lucia's transoms and whalers. These inboards, properly maintained, have proven to be valuable and efficient additions to the fishermen's stock of equipment.

Approximately 40% of Martinique's fishermen have acquired outboard motors (13) while the corresponding figure for Saint Lucia stands at 20% (69). The introduction of outboard motors has not resulted in more efficient and profitable fishing operations. To the contrary, outboard motors have meant near economic disaster for many fishermen. These motors may have their place on planked boats, but canoes and yoles were not designed to be mechanically powered (4:55).

Furthermore, salt water, rough usage, and poor maintenance

8 - Deep-Sea fishing boat docking at Fort-de-France, Martinique.

9 - Deep-Sea vessel under construction in Saint Lucia.

contribute to shortening the average life span of a motor to approximately two years. Often, a fisherman has purchased a second motor before liquidating the debt on the first one. The blending of modern and traditional equipment has produced few encouraging results, and has increased the burden of an already difficult profession.

Fishing Apparatus

In both islands the fishermen use a diverse assortment of equipment which they adopt to a variety of fishing techniques. Two items, fish pots and beach seines, stand out as major pieces of equipment.

Fish pots or "naces" are in use in both islands. In Saint Lucia they are made of bamboo by skilled men employing techniques of long standing (plate 10). In Martinique bamboo has given way to wire netting, creating a sturdier and longer lasting implement. Oddly constructed (plate 11), fish pots are built to suit different fishing needs. The pots are all sizes and shapes, and have no standard dimensions. However, average dimensions may be listed as follows: small (8 inches high, 1 foot long, ½ foot wide), medium (2 feet high, 4 feet long, 1½ foot wide) and large (4-5 feet high, 6-7 feet long, 2 feet wide).

The beach seine (plate 12) is the biggest and most costly piece of fishing apparatus in use in Martinique and Saint

10 - Making a fish pot in Saint Lucia.

11 - Typical fish pot in use in Martinique.

12 - Beach Seine.

Lucia. Three hundred to one thousand feet long and sixteen to fifty feet high, the beach seine is made up of a series of nylon or cotton panels, of varying mesh size, sewn together so that the coarser sections occupy the extremities.

The balance of the equipment in use in the islands is made up of a variety of nets, lines and hooks. Individual fishermen differ widely in the amount and type of gear that they utilize. The final composition of any one fisherman's equipment is a function of both cost and the man's personal craftsmanship in fabricating part of what is needed. For many items there is a choice between traditional or imported material, and the ultimate selection is as much a question of preference as cost. Table 3 summarizes the principal items.

Discussion

The many similarities and differences that exist between the fishing implements used in the two islands may have arisen from history, culture, geography and governmental intervention.

The development of many of the tools in use today stems from the early histories of the islands. They both came under European dominance at about the same time, the French occupying Martinique in 1635, and the English settling Saint Lucia in 1638 (46). Researchers agree that European occupancy had an influence on early fishing implements, but the degree and extent of this influence remains a mystery.

TABLE 3

PRINCIPAL FISHING APPARATUS

Type	Used in	Description
Bottom line	Martinique Saint Lucia	Single, weighed down, nylon line. Set of hooks at the bottom end which are set 18 inches apart.
Bottom net	Martinique	Single net small enough to be thrown from the back of a canoe. Pulled in by a nylon cord.
Floating line	Martinique Saint Lucia	Long nylon line with one or more hooks. This line is trailed behind moving boats.
Floating net	Martinique Saint Lucia	Rectangular net which is supported by floats. It is weighed at the bottom end so that it stands vertically in the water. When fish enter the net, it can be pulled together like a purse.
Gillnet	Saint Lucia	Floating net that is specifically designed to catch flying fish.
Hand line	Martinique Saint Lucia	Simple piece of cord with a hook on the end.
Hand net	Martinique Saint Lucia	Marine version of a butterfly net.
Trammel net	Martinique	A three panel net. A fine mesh middle panel separates two coarser panels.

Prior to colonial settlements, the Spanish had come into contact with the islands' original Indian inhabitants. If the Spanish had left accurate documentation, it would have clarified the effect of European-Carib contact. For instance, the canoes in use today date back to the settlement era; but, according to McKusick (40), the paucity of existing literature prevents establishing whether or not the addition of planks to the canoes was aboriginal in origin or simply a local Carib adaptation of European technology. The same type of enigma surrounds other Carib implements that have filtered down to present day. However, documentation dealing with the influence of Caribs on their Creole successors is much more revealing.

Labatt (33) clearly states that the Creoles in Martinique acquired most of their fishing skills from the Caribs. This statement cannot actually be correlated for the Saint Lucian situation. However, findings by Jesse (29) indicate that Carib craftsmanship was identical in the two islands, and the Saint Lucian Caribs seem to have been responsible for "training" Creole fishermen.

Assuming that identical skills were inherited, the maintenance of similar types of equipment could be attributed to common cultural traits coupled with frequent inter-island contacts, to historical inertia that left common tools to exploit a common resource base, and to the past indifference of local governments which retarded the introduction of modern implements.

There is very strong evidence that a very similar, if not identical, Creole culture exists on the two islands (6). Consequently, similar cultures and a common language should have fostered good communications and understanding during the numerous meetings of fishermen at sea (especially in the Saint Lucia Channel), and should have encouraged the interchange of skills and knowledge. In turn, as no village existed in isolation, information was probably passed on by word of mouth from village to village both by land and sea, and in this way new techniques could have been spread throughout the islands.

However, Linton as quoted by Pierce offers the following explanation for the similarities that exist in the implements used by different groups of people:

> Techniques and their material products are the cultural elements most easily transmitted from one society to another, because they are the most readily and completely expressed for an alien observer. Thus, techniques may be imitated without necessarily being verbally transmitted, and the actual produced object may be acquired suddenly without the necessity of having to learn the process employed in its manufacture. An artifact may be first used and appreciated and later studied and analyzed at leisure in order to develop the technique to reproduce it. (47:218)

Although avenues were open for the diffusion of technology, many differences arose in the type of fishing implements used in the two islands. A partial explanation of these differences was given by Benoit (5) who has shown that fishermen in Martinique (and in Saint Lucia) are very individualistic, and tend to use their own

intuition in adapting implements and skills to local variations within the island.

In addition to the fishermens' individualistic character, three factors - a declining resource base, entrepreneurs, and recent gradual governmental intervention - appear to be responsible for the striking differences that exist among the equipment being used in the islands.

Martinique's supply of gum-trees has steadily declined through the years, to a point where the fishermen have either to import canoes or seek alternative means of transportation. Therefore, the adoption of the yole offers a natural solution to this problem, and allows fishermen to use a craft similar to their canoes without incurring the expense of importation.

Although most Saint Lucian fishermen utilize canoes, some have changed, out of preference, to small wooden boats. However, these are in a minority since the fishermen continue to exploit gum-trees as the prime resource for the construction of their fishing craft.

The bigger transom and whaler boats, in use in Saint Lucia, stem from the entrepreneurial activities of a few Saint Lucian retail merchants who have invested in these boats to assure themselves a steady supply of fish for their own retail outlets.

In the last fifteen years, the islands' governments

have gradually attempted to develop the traditional sectors of their fisheries industries. Official agencies have promoted various aid schemes, and have offered advice and financial assistance to the fishermen.

Excepting the motors, government intervention has brought very little change in the equipment used in Saint Lucia, whereas in Martinique more and steadier help has resulted in several changes in traditional equipment. In Martinique, fishermen have begun, very slowly, to progress into a more modern stage of equipment evolution. They have replaced bamboo with wire netting, they use an assortment of imported fishing apparatus, and have adopted items which are unknown in Saint Lucia, such as rain gear.

Government intervention has been, and will be, one of the greatest factors in creating differences in the equipment being used in the islands. There is no doubt that Martinique is ahead of Saint Lucia, and, as discussed later, the gap will widen considerably in the next few years.

CHAPTER 4

FISHING OPERATIONS

Native fishermen conduct three types of fishing operations: coastal, inshore, and beach seine. In addition deep-sea vessels operate from, or visit, the islands furnishing a substantial proportion of the total fresh fish consumed.

Fishing operations coincide with the wet and dry seasons of the area. The latter extends from January to July, and is considered as the bountiful season. It is a period during which canoes are sailed an average ten miles off the coast, and during which many canoes even venture out twenty to thirty miles.

The wet season, July to December, is known as the lean season. During this period, fishing activities tend to be restricted to the coast or to the inshore waters. Paradoxically, the wet season moderates the swells on the windward coasts, thus allowing canoes to be put to sea with greater ease.

This seasonal distribution is somewhat misleading, for although inshore fishing dominates in one period and coastal fishing in the other, both are carried out, to some extent, all year round. Furthermore, the greatest catches of some fish species are brought in during the lean season. In addition, beach seine fishing is conducted throughout the year.

There are more or less standard procedures employed during the course of these fishing operations. The principal methods in use, in the two islands, are outlined below.

Bottom Lining

Stationary bottom lines, baited with sardines or other small fish, are set into position at nightfall. The lines are left in position throughout the night, and pulled up the next morning. Red snappers, groupers and oldwives are the principal fish caught by this method.

Bottom Netting

Bottom nets are thrown from either a moving or a stationary canoe. This method requires good muscle power and a great deal of patience. The nets are pulled in, emptied, and heaved out again until a sufficient catch is obtained. A variety of smaller fish is harvested in this way.

Fish Potting

This is a type of fishing activity that can be carried out all year round on a continuous basis. The pots are taken to a projected fishing spot where they are left in position for a few days. They are baited with vegetable matter and lowered to considerable depths. Smaller fish are trapped in the pots, and the occasional lobster is often included in the day's catch.

Floating Lining

This activity, also called longlining is conducted on the move. One or two long lines are dragged behind the boats as they make their way back and forth between the shore and the fishing grounds. Live fish or metallic lures are used as bait. This method is designed to capture large fish such as dolphin, shark, bonito and tuna.

Floating Netting

A floating net forms a barrier that snares fish swimming in shoals. When sufficient numbers are trapped, the two ends of the net are pulled together into a circle and the catch is lifted into the boat.

Flying Fish Exploitation

The particular nature of these fish has resulted in the adoption of techniques devoted exclusively to their capture. Some fishermen still employ the basic method of one line and hook per man. However, this method has generally been replaced by the hand net or "butterfly net" which allows the fishermen to sit in the middle of a shoal of flying fish and scoop them into the boats.

A larger net - the gillnet - is slowly being introduced in Saint Lucia. Designed in Barbados, the mesh size of this net is the exact size needed to trap flying fish, and should result in an increase in production.

Beach Seine Fishing

Two canoes carrying up to five men apiece are used during the course of the operation. The net is placed in the first canoe with one end held by the crew of the second canoe. As the boats separate, the net is played out in a semi-circle and is submerged to an appreciative depth.

When the net is fully extended, the boats converge on each other as they move toward the shore dragging the captured fish with them. At this point, long ropes are grasped by shore crews (twenty to thirty men) who pull the seine up on the beach. For their efforts, the land based assistants are given a share of the catch, which includes a variety of species.

Fleet Operations

Martinique's deep-sea vessels fish primarily for tuna. They employ what is known as the Japanese long line technique. These lines, long enough to carry at least 1,000 hooks, are baited with sardines and drawn behind the moving fishing vessels. These fishing vessels are very flexible in their ability to conduct fishing operations. Whenever tuna resources are scarce, they utilize additional equipment to exploit other species of fish. Also, they have the advantage of staying at sea for as long a period as is needed to ensure a large catch.

The deep-sea vessel being constructed in Saint Lucia has been equipped to perform a variety of fishing operations: longlining

for tuna, net fishing for flying fish, pot fishing for lobster, and bottom line fishing for varied species. In addition, the boat will carry a harpoon gun, designed by the owner, which will be used on large fish such as dolphins and sharks.

Complicating Factors

Complications in the fishing operations arise out of the nature of the equipment in use, and out of harmful, illegal actions performed by a minority of fishermen.

The traditional nature of the equipment hampers the efficiency of fishing operations. Being very fragile, there are many and frequent breakages and losses which force the fishermen to curtail operations for periods of time.

Maintenance is costly and time consuming, and as a rule is performed by the fishermen. Consequently, the overall production of fish suffers a great deal.

In addition to natural hazards, human nature complicates the day-to-day fishing operations. Some fishermen pilfer their neighbour's pots and by doing so cause bad feelings and jealousies. These emotions are often translated into vengeance which results in many breakages and losses that cannot be attributed to nature.

A few fishermen show complete disregard for the resource base by employing dynamite to kill the fish so they can be plucked from the surface of the water. Although this practice is very restricted, it creates irreparable damage by destroying most of the living organisms within range of the blast.

Anti-dynamite laws have been in existence for many years in Martinique where government control is very strict due to policing by French gendarmes. On the other hand, the practice is less controlled in Saint Lucia where sanctions were first imposed in 1957 (72:399).

Discussion

The utilization of the fishing techniques is a function of the individual's stock of equipment, the season, and of the actual location of the different fishery sites.

For instance, beach seine fishing can only be carried on in locations where the coasts offer suitable beaching facilities. Therefore, most of this activity takes place on the islands' Caribbean coasts with but a few seines being operated from four beaching sites on Martinique's Atlantic shore.

During the dry season, fishing operations are curtailed on Martinique's Atlantic coast, and cease completely on this shore in Saint Lucia. On the other hand, during the wet season, this area provides some of the highest catches recorded in Martinique, but permits very little fishing activity in Saint Lucia.

Fishing activities originating from the islands' Caribbean coasts, and from their northern and southern shores, are carried on practically all year round. The types of techniques employed are tailored to the exploitation of the different species of fish that become available, during the course of their movements, throughout the year.

CHAPTER 5

THE DISTRIBUTION OF TRADITIONAL FISHING ACTIVITY

In order to arrive at an understanding of the spatial variations in the distribution of fishing activity, any analysis should include all available data that appear to have some relationship to the areal differences that exist in the intensity of fishing operations (39).

Of paramount importance is the distribution of fish resources which have been shown to occur in undetermined quantities on an areal and seasonal basis. However, according to production estimates[2], it would appear that more resources are available in places where the continental shelf is relatively large. Nevertheless, in some locations where the shelf is narrow, pelagic species may substantially improve the production capacity of the various sites. Therefore, there is no straightforward relationship between a feature such as the continental shelf and the degree of fishing activity.

The potential number of fishing sites is determined by the physical characteristics of the islands' coastlines which may be divided into three broad categories. The first type includes long broad beaches that stretch for a few uninterrupted miles along various sections of the coasts (plate 13), therefore providing potential

2. A full discussion of production is given in the following chapter. However, in order to place the distribution of fishing activity into the best possible perspective, reference to production estimates is made throughout this chapter.

13 - Beach at Vieux Fort, Saint Lucia.

14 - Inlet at Choiseul, Saint Lucia.

beaching sites at any point along the way.

The next category consists of inlets and bays, of the types shown in plates 14 and 15, which provide beaching sites for areas constricted between highlands. Finally, there are relatively long stretches of coastline where the presence of cliffs prevent the local residents from having immediate access to the adjacent seas (plate 16).

Excepting two villages in Martinique, all coastal villages in both islands have shorelines with physical conditions falling within the first two broad categories, and along which boats are beached. However, the presence of fishing boats does not necessarily mean that any community is strictly a fishing village. For example, in Vauclin there are no less than 115 boats (table 5) within the town limits, but the village is primarily a service centre for peasants living and working in the surrounding countryside (45:99). The analysis of village functions is beyond the scope of this work, therefore coastal towns are not referred to as fishing villages, but simply considered as fishing sites.

The actual number of fishing sites is influenced by several factors: the distribution of population in relation to the coasts, the landward accessibility of the sites, the presence or absence of seaward barriers, and the competition from other activities such as resorts which may occupy prime landing sites.

Ideally, the biological and physical variables out-

15 - Grand'Rivière, Martinique. A typical village nested in a small bay that is constricted between highlands. These sites are common in both islands.

16 - Section of Martinique's coastline. The physical features are typical of areas, in both islands, where fishing is not possible.

lined above should have been incorporated with all measurable cultural factors to formulate the research design used in the study of the distribution of fishing activity (17). This could have lead to a choice of a different dependent variable (possibly production estimates or the number of fishermen) than the one actually used. Also, the ideal analysis would include some estimates of the regional importance of alternative employment opportunities, notably agriculture, and behavioural parameters such as the individual's perception of a "good landing site".

Operational Research Design

The actual research design is a considerable modification of the ideal one presented above. No measures are available of the quantities of fish landed at the different sites, therefore production figures could not be included in the analysis. Also, excepting shelf widths, no physical parameters appear in the study as field work was used to grasp an understanding of the regional importance of fisheries, thus leaving no time for physical measurements.

In addition, the difficulties involved in assessing cultural factors, and the magnitude of the task required to appraise the regional significance of agriculture, prevented the inclusion of specific areal data on these very important factors.

Consequently, the analysis is restricted to the few general measurements made in the field, and to the body of data

available from official census records. The latter force the use of administrative divisions as areal units, rather than the preferable individual fishing sites.

In Martinique, there are 34 administrative divisions (103:9). Known as communes, each has a major agglomerated settlement[3] which serves as the district capital and gives the area its name (figure 7). Twenty-seven communes border the sea, and fishing activities are carried on in all but two, the exceptions being Le Lorrain and Macouba (figure 8).

Saint Lucia is officially divided into 11 areas known as quarters. However, for census purposes, the island comprises enumeration districts which are centred on its main villages or agglomerated settlements (89). Consequently, for this analysis, three boundaries have been modified[4] to coincide with census figures, and to mark the limits of fishing activity associated with each major village, reducing the number of quarters to ten (figure 9). Each quarter bears the name of its main village, is bordered by the sea, and has a certain degree of fishing activity (figure 10).

---

3. Name given to areas where the houses are contiguous, or grouped together having facilities such as parks, gardens, work places and other facilities. When a commune has several agglomerated settlements, census figures list only the district capital in this category. All other settlements are included in the second general census category which is called the dispersed population (84:32).

4. One adjustment places the town of Canaries within the limits of a new border isolating it from its original location in the quarter of Anse La Raye. Another modification involves the removal of the boundaries of the quarters of Dauphin and Praslin, thus creating an enlarged quarter of Dennery stretching from the limits of Micoud quarter to those of Gros Islet.

Figure 7

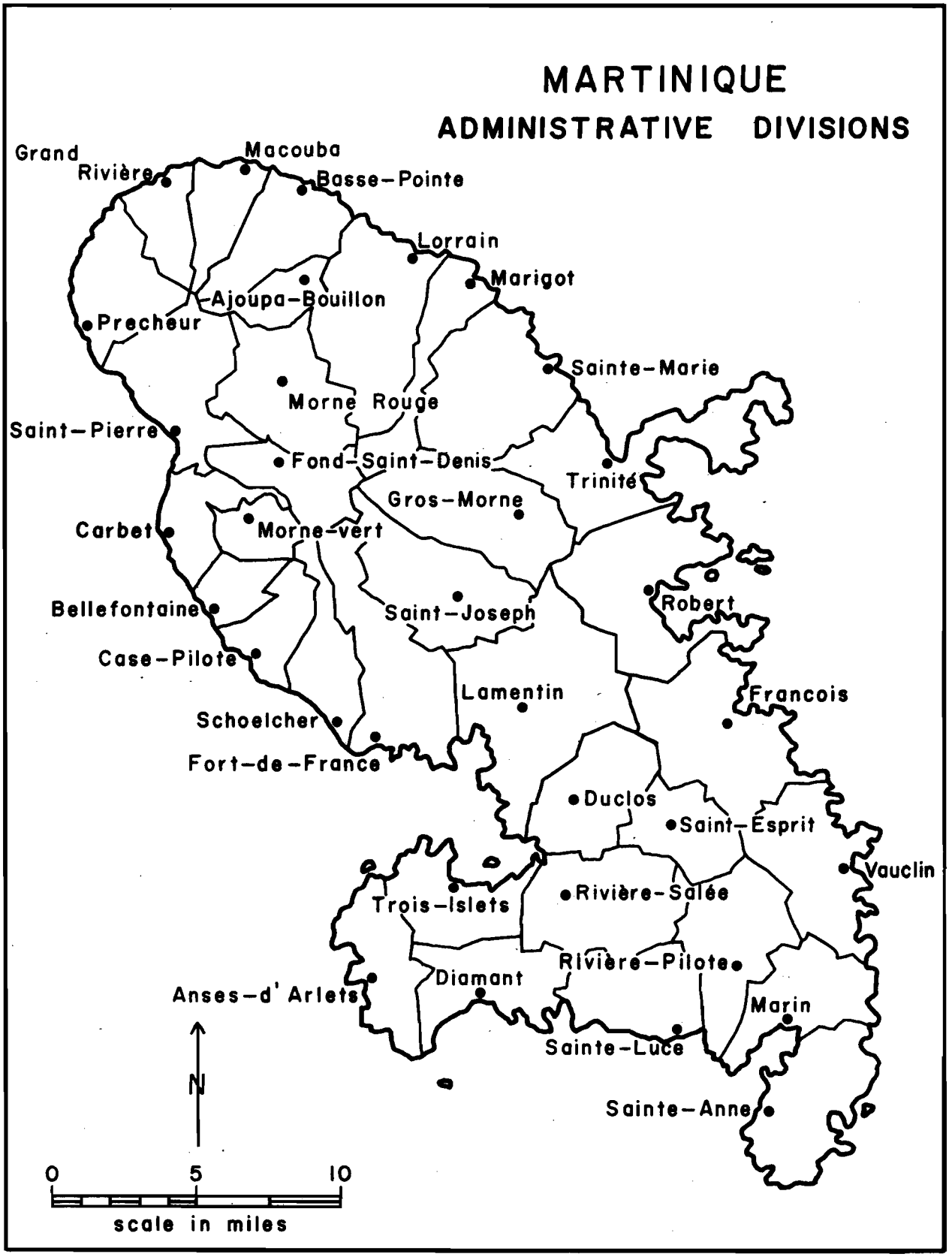

MARTINIQUE
ADMINISTRATIVE DIVISIONS
Grand Rivière
Macouba
Basse-Pointe
Lorrain
Marigot
Ajoupa-Bouillon
Prêcheur
Sainte-Marie
Morne Rouge
Saint-Pierre
Fond-Saint-Denis
Trinité
Gros-Morne
Carbet
Morne-vert
Robert
Bellefontaine
Saint-Joseph
Case-Pilote
Lamentin
Francois
Schoelcher
Fort-de-France
Duclos
Saint-Esprit
Vauclin
Trois-Islets
Rivière-Salée
Rivière-Pilote
Diamant
Anses-d'Arlets
Marin
Sainte-Luce
Sainte-Anne
N
0
5
10
scale in miles

Figure 8

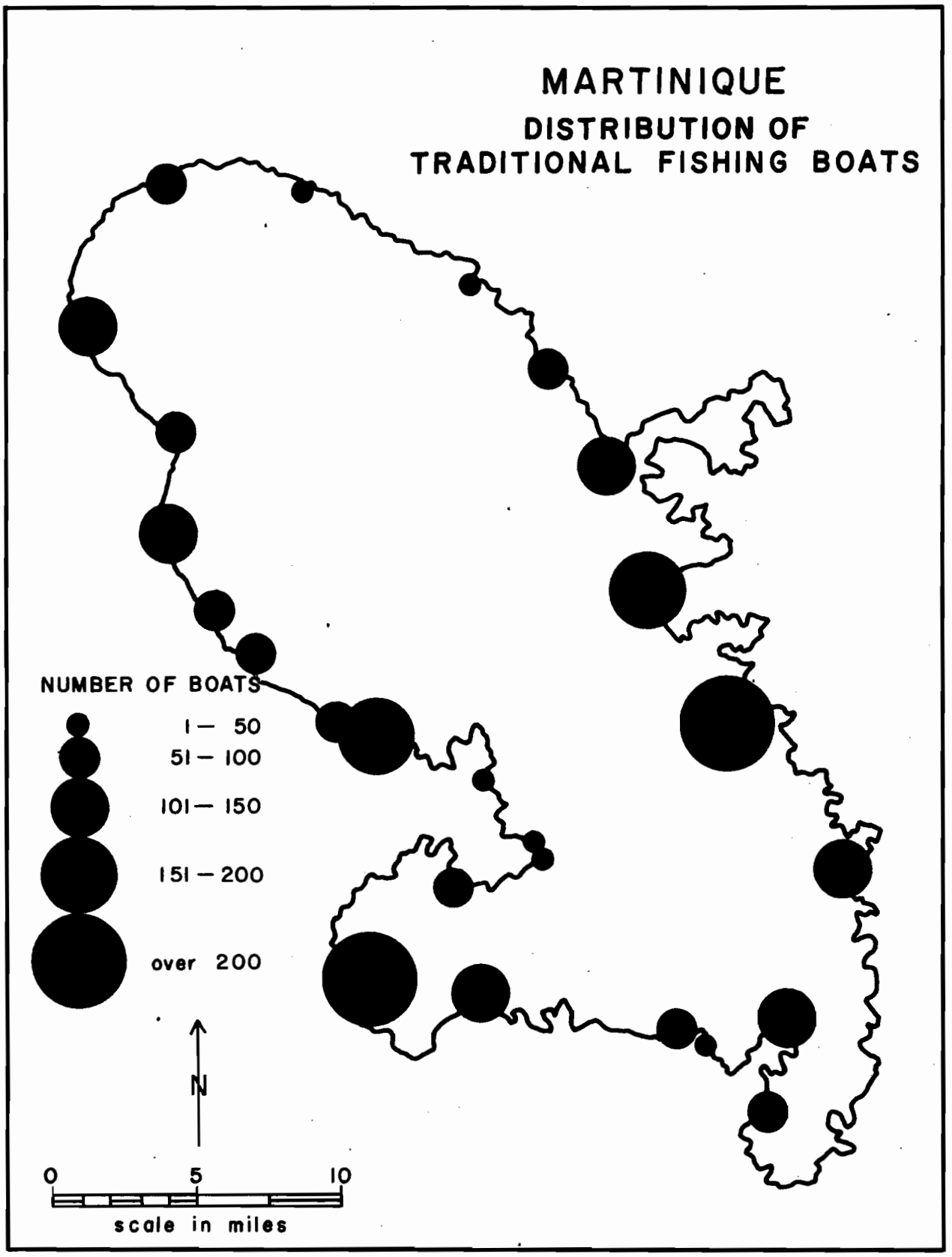

MARTINIQUE
DISTRIBUTION OF
TRADITIONAL FISHING BOATS
NUMBER OF BOATS
1 — 50
51 — 100
101 — 150
151 — 200
over 200
N
0
5
10
scale in miles

Figure 9

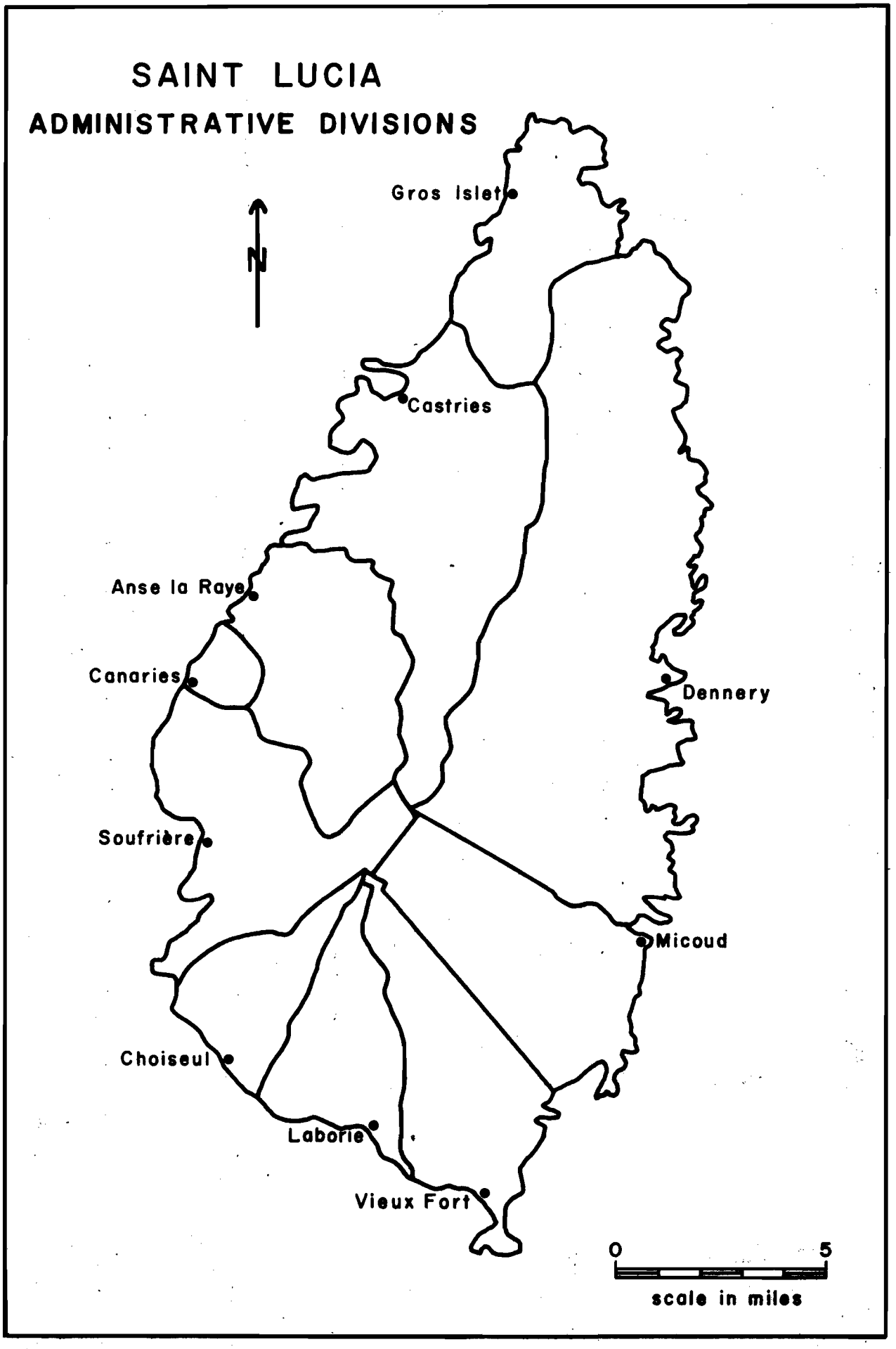
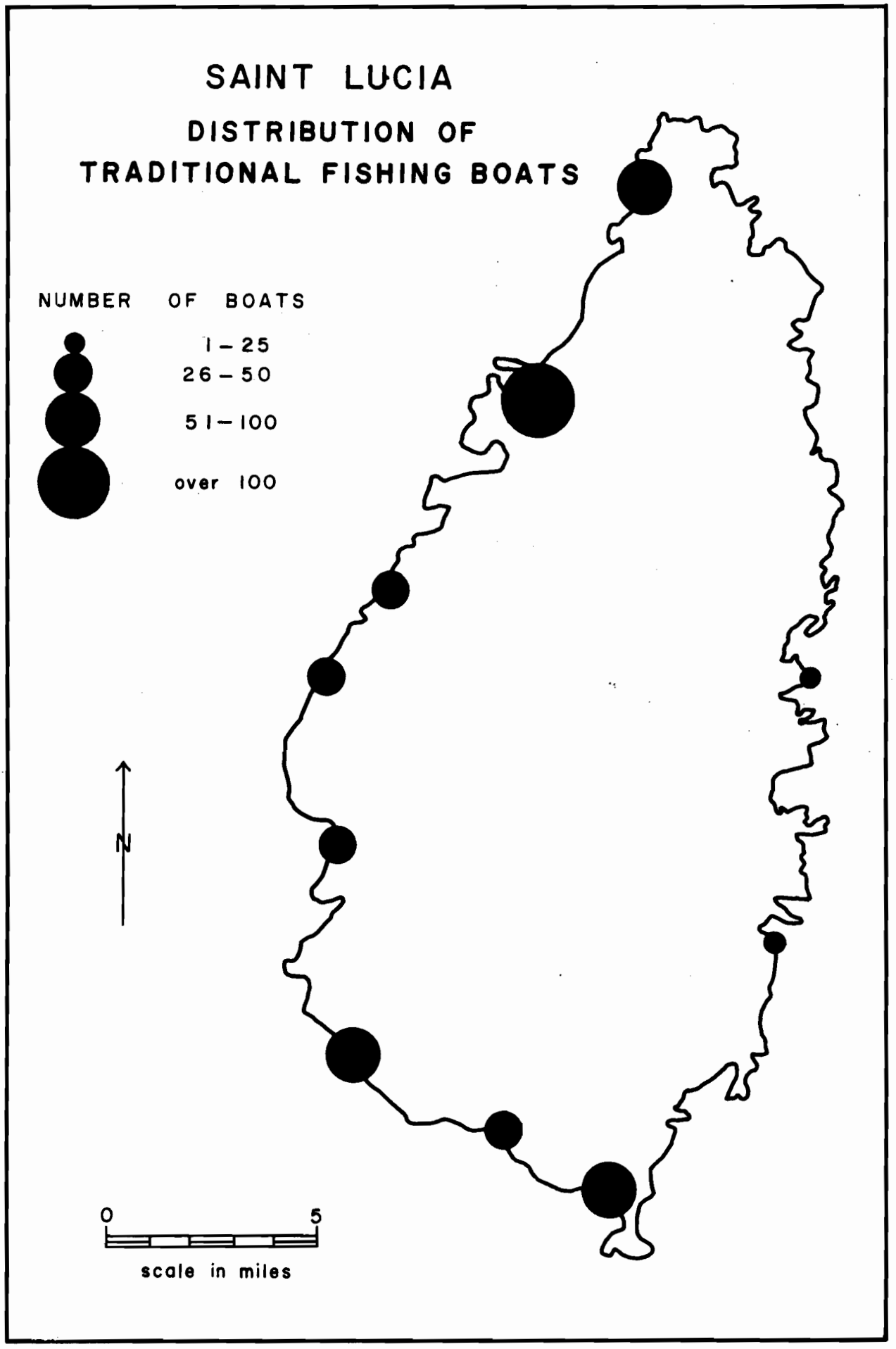

SAINT LUCIA
ADMINISTRATIVE DIVISIONS
N
Gros Islet
Castries
Anse la Raye
Canaries
Dennery
Soufrière
Micoud
Choiseul
Laborie
Vieux Fort
0
5
scale in miles

Figure 10


SAINT LUCIA
DISTRIBUTION OF
TRADITIONAL FISHING BOATS
NUMBER OF BOATS
1 – 25
26 – 50
51 – 100
over 100
N
0
5
scale in miles

Operational Definition of the Variables

The number of boats located at each fishing site are totalled by commune and by quarter to establish the dependent variable (Y), representing the distribution of fishing activity. In Martinique, the latest boat census was taken by de Roux in 1964 (13). In Saint Lucia, records taken from police stations (85) and the harbour master's office (87) were verified and modified in the field in August, 1964.

An explanation of the spatial variations of the dependent variable was attempted with the use of the 12 independent variables listed in table 4.

Hydrographic charts (107)(109) were used to determine the first independent variable, average shelf width. A perpendicular was drawn from each fishing site to the edge of the continental shelf. Then all measurements for each administrative division were totalled and divided by the number of sites to give the average shelf width for each area.

Figures used in denoting the percentages of Martinique's labour force engaged in agriculture, and those used for the category of people listed as workers[5] were taken from the island's 1954

5. This category includes all unskilled workers engaged in occupations other than fishing or agriculture, and who could very easily participate in fishing activities.

population census[6] (84).

Equivalent data was available for Saint Lucia from that island's 1960 population census (89). However, one complication arose from the grouping together of workers employed in agriculture, fisheries and forestry. This difficulty was overcome by using an independent field census of fishermen to adjust the category to show the percentage of people in agriculture (including forestry which is negligible).

The number of fishermen for Martinique was taken from a 1964 census conducted by de Roux (13); for Saint Lucia, the numbers were established by the writer from the 1964 field survey. The totals of fishermen for each administrative division were then weighed against figures for the active populations taken from the 1961 census (Martinique) (79) and the 1960 census (Saint Lucia) (89), thus determining the percentages of the labour forces engaged in fishing.

---

6. In order to arrive at a better understanding of the relative position of fishing activity in the islands' economies, census returns originating from several sources had to be employed. In Martinique, the 1954 census shows the percentages of people engaged in agriculture and in other occupations. However, the the 1961 census only gives the total active population. Furthermore, the census on the number of boats and fishermen was conducted in 1964. Consequently, although the numerical values of the percentages of people engaged in various occupations must have changed in seven years, the 1954 figures were retained to place agriculture and other work categories into perspective, but the percentage of fishermen was based on the more recent active population figures given for 1961.
In Saint Lucia, the boat and fishermen census was conducted in 1964, and incorporated into the 1960 general census. Comparisons between the islands were made as though all the data existed for the same year.

TABLE 4

INDEPENDENT VARIABLES

Variable	Name	Type
X_1	Average shelf width	Physical
X_2	% labour force in agriculture	Economic
X_3	% labour force listed as 'workers'	Economic
X_4	Number of fishermen	Economic
X_5	% of labour force in fishing	Economic
X_6	Boats in agglomerated areas	Economic
X_7	Boats dispersed	Economic
X_8	Agglomerated population	Demographic
X_9	Total population	Demographic
X_{10}	Active population	Demographic
X_{11}	Distance to prime market	Spatial
X_{12}	Distance to capital market	Spatial

The number of boats located in dispersed and agglomerated areas was determined from the total number of boats used as the dependent variable. This locational division was made in order to assess the significance of fishing activity in relation to the distribution of population. The accompanying demographic data was taken from the 1961 census in Martinique (79), and from the 1960 census in Saint Lucia (89).

The local market was defined as the original beaching

site. The prime market was defined as the main village within an administrative division, and the capital market was the term used for the markets found in each of the islands' capital city.

The distance to the prime market was obtained by taking the average measurement of the distances by sea between all the beaching sites within an administrative division to that area's main village. The distance to the capital market was crudely measured as the shortest landward distance over the best routes between a prime market site and the islands' capital cities (see figures 14 and 15 in chapter 7).

Analysis

The original data used in the analysis is given in table 5.

In attempting to account for the distribution of fishing activity, the analysis established the number of boats (Y) as a variable dependent on several factors (X_i) with which it may have a degree of association. In order to test these relationships, a regression correlation analysis was carried out. The latter analysis required that the input variables be normally distributed in order to test the significance of the relationships. Therefore, tests of normality (53) were made[7], the results of which appear in table 6.

7. By deriving measures of skewness and kurtosis.

TABLE 5

DATA USED IN THE ORIGINAL RESEARCH DESIGN[9]

	No.	Administrative division	Y	X_1	X_2	X_3	X_4	X_5	X_6
SAINT LUCIA	1	Castries	161	1.6	28.5	24.3	400	3.4	73
	2	Gros Islet	60	4.5	65.9	16.0	190	9.3	48
	3	Anse La Raye	45	1.3	70.4	18.6	60	2.9	38
	4	Canaries	40	1.2	65.4	6.5	110	18.0	40
	5	Soufrière	50	0.3	51.8	17.4	135	6.3	37
	6	Choiseul	77	0.7	69.0	33.6	165	9.7	37
	7	La Borie	38	2.4	60.1	14.3	105	8.9	20
	8	Vieux Fort	58	5.1	50.9	14.8	160	8.9	31
	9	Micoud	11	3.0	70.4	18.2	30	1.3	8
	10	Dennery	22	3.7	72.9	16.1	55	1.7	17
MARTINIQUE	11	Basse-Pointe	15	0.7	57.0	2.4	19	1.3	15
	12	Marigot	12	1.3	57.0	2.5	16	1.6	12
	13	Sainte-Marie	53	2.4	61.0	2.4	49	0.8	32
	14	Trinité	131	6.2	46.0	2.2	186	5.0	0
	15	Robert	196	9.4	64.0	1.6	168	3.6	48
	16	François	233	7.3	55.0	2.0	228	4.7	98
	17	Vauclin	142	2.9	62.0	1.4	115	5.9	115
	18	Sainte-Anne	81	2.2	52.0	1.6	108	13.8	25
	19	Marin	107	3.7	43.0	2.1	92	5.7	36
	20	Rivière-Pilote	33	1.3	68.0	1.2	38	1.0	12
	21	Sainte-Luce	75	0.8	62.0	1.5	101	10.6	63
	22	Diamant	101	1.4	44.0	1.7	126	19.3	29
	23	Anses-d'Arlets	250	0.8	27.0	1.6	375	37.5	61
	24	Trois-Islets	88	4.2	53.0	1.6	134	11.0	30
	25	Rivière-Salée	3	7.8	60.0	1.6	8	0.0	3
	26	Ducos	20	7.3	61.0	2.1	22	1.0	20
	27	Fort-de-France	184	5.7	5.0	3.3	281	1.0	0
	28	Schoelcher	97	0.7	18.0	3.6	63	2.0	26
	29	Grand-Rivière	70	0.7	28.0	1.7	101	24.7	70
	30	Case-Pilote	82	0.5	43.0	1.2	82	12.5	79
	31	Bellefontaine	70	0.4	54.0	0.7	107	21.5	50
	32	Carbet	145	0.7	44.0	1.2	148	15.0	30
	33	Saint-Pierre	90	0.4	36.0	2.2	98	5.0	45
	34	Prêcheur	118	0.2	58.0	1.2	129	14.8	44
	35	Lamentin	35	5.4	56.0	2.2	48	0.9	35

Continued .....

9 Where Y is the dependent variable (total number of boats). See Table 4 for a list of the independent variables.

TABLE 5

Continued

	No.	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
SAINT LUCIA	1	88	15,291	29,824	11,616	2.5	2.5
	2	20	1,016	5,428	2,043	1.4	5.5
	3	7	2,053	4,953	2,055	1.6	9.8
	4	0	1,676	2,157	611	0.0	17.2
	5	13	2,692	7,325	2,139	1.4	24.4
	6	40	970	5,925	1,697	1.1	32.5
	7	18	1,591	5,059	1,171	1.0	38.1
	8	27	3,228	6,981	1,902	2.1	42.2
	9	3	2,040	8,136	2,218	1.1	20.9
	10	5	2,252	7,810	3,092	1.2	10.2
MARTINIQUE	11	0	2,022	4,360	1,406	0.0	24.8
	12	0	608	3,548	969	0.0	25.3
	13	21	2,436	17,630	5,841	1.3	20.5
	14	131	3,571	8,058	2,656	3.5	15.7
	15	148	2,131	13,652	4,593	3.8	14.4
	16	135	2,849	13,435	4,785	2.0	14.2
	17	27	2,657	7,587	1,925	1.8	21.7
	18	56	964	2,816	782	3.4	33.0
	19	71	2,004	5,697	1,593	0.6	28.0
	20	21	1,691	11,334	3,465	1.0	21.5
	21	12	907	3,653	951	1.1	23.8
	22	72	760	2,225	652	2.2	21.9
	23	189	1,172	3,375	1,005	2.4	28.3
	24	58	1,132	3,170	1,218	2.9	25.5
	25	0	1,535	7,515	2,445	0.0	15.5
	26	0	874	6,496	2,152	0.0	10.7
	27	184	74,673	85,501	27,634	0.7	0.7
	28	71	3,879	9,879	2,925	0.6	2.1
	29	0	1,386	1,483	408	0.0	29.5
	30	3	1,432	1,712	653	0.8	6.3
	31	20	1,047	1,547	491	0.9	9.8
	32	115	2,447	3,530	183	0.5	14.0
	33	45	5,434	6,345	1,983	1.6	16.1
	34	74	1,495	2,500	867	1.2	21.2
	35	35	4,625	1,621	5,035	1.9	7.2

TABLE 6

TRANSFORMATIONS

Variable	No Transformation	X^2	Log_{10}	Square Root
Y				x
X_1			x	
X_2		x		
X_3			x	
X_4				x
X_5			x	
X_6				x
X_7				x
X_8[10]				
X_9[10]				
X_{10}			x	
X_{11}	x			
X_{12}	x			

10. The very skewed nature of variables X_8 and X_9 force their exclusion from the analysis. However, they are taken into account in the consideration of maps derived from the analysis.

The transformed X scores were subjected to a series of simple regression analyses, with each of the X_i variables regressed on Y, excepting the original X_8 and X_9. Then the same procedure was repeated for eight of the remaining ten variables (excluding X_6 and X_7)[8]. The results of these analyses are given in table 7.

Table 7 shows that four independent variables do not have significant relationships with the number of boats. These are: shelf width, percentage of the labour force listed as workers, active population and distance to the main market.

In the case of shelf width, the lack of relationship may be due to the technique used in measuring the variable. It is possible that the linear measurements used are inadequate, and that volumetric measures may have shown different relationships. However, crude production estimates have shown that fewer fishermen produce higher quantities of fish in the areas of wider shelf. Therefore, the results of this analysis seem realistic, within the limits of the measuring techniques used.

The lack of associations between the number of boats and the percentage of the labour force engaged as workers, and the active population, may be due to similar causes. Fishing is restricted to the coastal regions, and, excepting agglomerated

8. Because their sum makes up the dependent variable with which they are highly correlated.

TABLE 7

REGRESSION RELATIONSHIPS

A) SIMPLE[11]

Y vs.	a value	Regression coefficient (b)	Standard error of estimate	r	r^2	Significance level
X_1	8.6	-0.15	3.50	-0.02	0.04	-
X_2	12.50	-0.00	2.95	-0.54	28.89	.01
X_3	9.53	-1.77	3.39	-0.24	5.96	-
X_4	1.07	0.73	1.86	0.85	71.59	.001
X_5	6.44	3.21	3.06	0.48	23.48	.01
X_6	5.42	0.58	3.15	0.43	18.62	.01
X_7	4.44	0.73	1.68	0.88	77.04	.001
X_{10}	5.41	0.98	3.47	0.12	1.44	-
X_{11}	6.17	1.79	2.96	0.53	28.57	.001
X_{12}	9.43	-0.04	3.47	-0.13	1.71	-

Continued .....

11. The general form of the relationship is $y = a + bx$.

TABLE 7

Continued

B) MULTIPLE[12]

Y vs.	a value	Regression coefficient (b)	Standard error of estimate	r	r^2	Significance level	Proportion of the explained variance
	-1.23		1.42	0.93	87.07	.001	
X_1		-0.28					0.04
X_2		-1.48					29.64
X_3		-2.78					0.84
X_4		0.66					55.20
X_5		0.69					0.36
X_{10}		1.29					0.53
X_{11}		0.28					0.30
X_{12}		-0.02					0.16

12. The form of the multiple regression equation is: $y = a + b_1x_1 + b_2x_2 + \ldots\ldots\ldots + b_8x_8$.

areas, this industry must rely on the few people living near the sites to fulfil its employment needs. The bulk of the labour force, then, is found in areas with economic activities other than fishing. Furthermore, the workers segment of the labour force might be termed a spatial constant (about 20%), which is oriented to agricultural and urban occupations in their respective areas.

Finally, the lack of association between fishing activity and the distance to the capital market could be explained in terms of the marketing patterns. Although fishermen are engaged in supplying the capital markets, the land transportation of the product is in the hands of middlemen. Therefore, the traditional producer, free from this responsibility, need only be concerned with the distance from his original beaching area to a prime market site which serves as a gathering point for fish being shipped to the islands' capitals.

The distribution of boats is most significantly related to the number of fishermen, the number of dispersed boats and the distance to the prime market. The relationship between the number of fishermen and the number of boats is to be expected, for as the number of fishermen increases, the number of boats should increase. However, this relationship presents some fundamental analytical problems.

To begin with the fishermen generate fishing activity on a "one owner-one or more boat" basis. Then, as the number of boats increases, more employment opportunities become available and more people engage in fishing. Therefore, the dependent and in-

dependent variables are reversed. This raises the question of whether the number of fishermen would have provided a more significant dependent variable for the measurement of fishing activity. However, census figures on the number of fishermen can be misleading as these people can have more than one occupation, whereas the number of boats is a direct visual indicator of the degree of fishing activity at any one point.

The significance, as a predictor variable, of the number of boats located outside the agglomerated areas, seems to be due to the importance of fisheries as a major occupation offering alternative employment to agriculture in coastal rural areas. It shows that fishing is primarily a rural[13] activity, since 77% of the spatial variation in the total number of boats is "explained" by this variable. Note that if the correlation coefficient was $r = 1.00$, then the fishing industry would be entirely outside the limits of agglomerated settlements; i.e., it would be completely dispersed. Conversely an r value of -1.00 would reflect a completely concentrated industry.

The distance of the beaching sites from the prime market is of great importance to the fishermen wishing to operate with a margin of profit. They must have access to these better markets to dispose of larger catches. Fortunately, distances are

13. However, the difference between rural and urban in these islands, especially in Saint Lucia, is largely a question of terminology. For most of the main villages outside the capitals are small service centres which often have both agricultural and fishing activities within their town limits.

short in the islands, and most beaching points are generally no more than three miles away from a prime market site (see figures 14 and 15 in chapter 7). This relationship is expected from the discussion above concerning distance to capital markets, although the level of explained variation (28.57%) is still quite low.

The number of boats in town and the percentage of the labour force in fishing have a lower degree of significance in their relationships to the dependent variable. In the case of boats in the villages, this is probably due to competition from other employment opportunities available in these centres. The percentage of the labour force in fishing is related to the overall labour force structure and competition from other activities in the islands: the strength of the relationships will therefore be most affected by those areas with alternative opportunities for employment in agriculture and urban-based occupations.

There is a negative regression between the percentage of people in agriculture and the distribution of fishing boats. Notwithstanding the areal differences in types of agricultural activity and the seasonal nature of employment in certain facets of this sector, it appears that as employment in agriculture decreases, the level of fishing activity increases. However, only 29.64% of the spatial variations in the number of boats is "explained" by the agricultural sector of the labour force. Areal differences will arise with spatial covariations of physical conditions for agriculture.

Finally, the multiple regression between the number of boats and the eight variables in table 7B indicates that in terms of all the elements, the relationships hold for the relative significance of the predictor variables and in the direction of their relationships[14]. The high level of explained variation (87%) is very significant within the constraints set at the beginning of the chapter. However, the final column of the table indicates that two variables are responsible for most of the explained variation - number of fishermen (55%) and percentage of the labour force engaged in agriculture (30%).

Mapping Residuals from Regression

A more meaningfull geographical interpretation of these results is made possible by mapping the residuals from regression (58).

In order to investigate the difference between the two islands, the residuals from the regression line, in each analysis, were computed. An example of this is given in figure 11 which shows that the overall relationship between the number of boats and the number of fishermen is highly differentiated between Martinique and Saint Lucia.

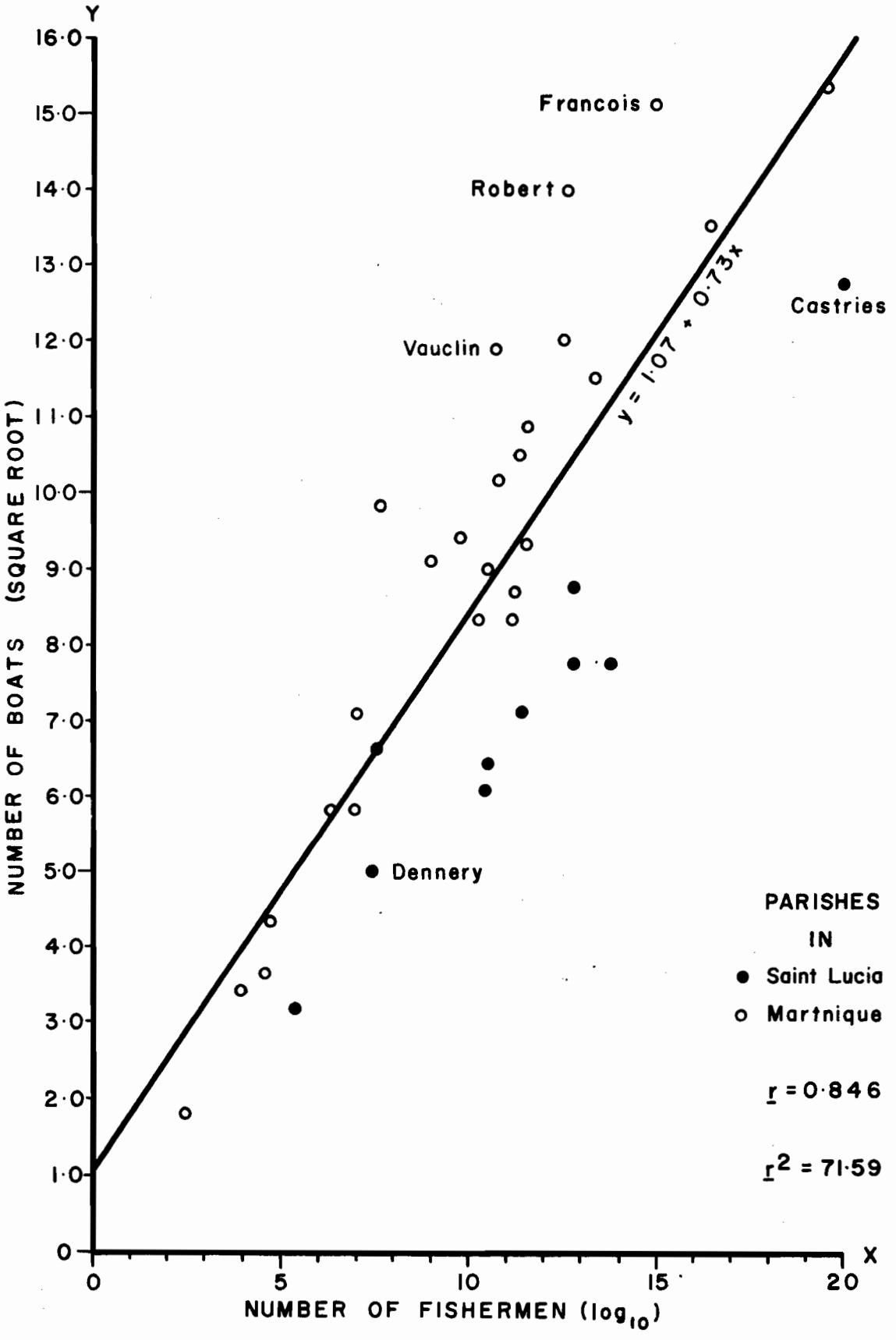
The residuals are derived by placing each administrative division's actual value on the independent variable into the

14. The regression coefficients for X_1, X_2, X_3 and X_{10} in both sets of analyses are negative; the remainder are positive in both cases.

Figure 11

REGRESSION RELATIONSHIP

Number of Boats vs. Number of Fishermen



regression equation ($y = a+bx$). The resulting $\underline{y}$ value is the estimated or expected value, and this is compared to the actual $\underline{y}$ value. Differences can therefore be positive or negative, and these residual values are used in further analysis.

For the significant regression relationships maps were drawn to investigate the spatial patterns of the residuals. The procedure for deriving the classes in mapping these data was as follows:

1. The 35 administrative divisions were placed in rank order, from high positive to high negative residual values.

2. The administrative divisions were then placed into quintiles; i.e., class 1 is made up of administrative divisions ranking first to seventh at the high positive end of the scale, administrative divisions ranking eighth to fourteenth placed in the second class, and so on through to the fifth class, composed of the divisions ranking 29th to 35th at the high negative end of the scale.

3. Class boundaries were then referred back to the residual values for mapping purposes.

Seven maps were produced in this fashion. Two of these (figures 12, 13), dealing with the main variables responsible for the explained variation, were retained for individual analysis.

Figure 12 relates the number of fishermen to the number of boats in the administrative divisions in each island. The spatial variations reveal that all areas having a number of

boats greater than the expected value (i.e., positive residuals) are to be found in Martinique. On the other hand, excepting Anse La Raye, all quarters in Saint Lucia have less than the expected number of boats (i.e., negative residuals) along with five communes in Martinique.

Consequently, in general it would appear that there is a better than average balance between the equipment in use and fisheries manpower in Martinique. On the other hand, in Saint Lucia, the imbalance seems to suggest that many of the people registered as fishermen only engage in this occupation on a part-time basis.

In addition, the areas ranked highest in Martinique coincide with the two general areas known to produce the highest quantities of fish; the Atlantic coast (Trinité to Vauclin) and the Caribbean coast (Diamant, Anses-d'Arlets, Schoelcher, Case-Pilote, and Carbet to Prêcheur).

Furthermore, four of the five communes ranked in the fourth quintile are situated in poorer fishing areas (Basse-Pointe and Marigot) or are primarily inland communes (Rivière-Salée and Lamentin); with Belle-Fontaine being an exception to the above.

Figure 13 establishes the relationships between the percentage of the labour force in agriculture and the number of boats found within the islands' administrative divisions. Areas having

Figure 12

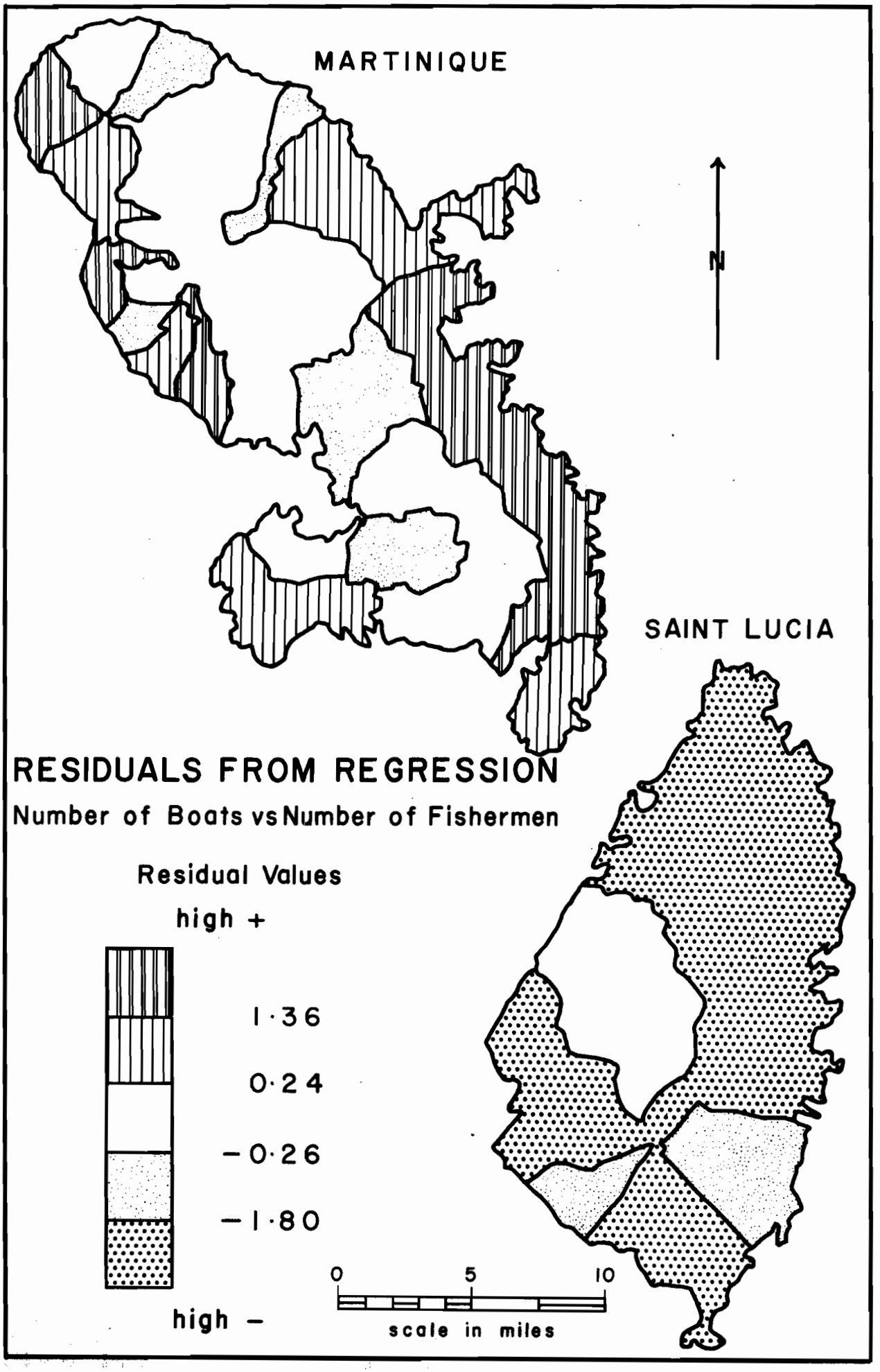
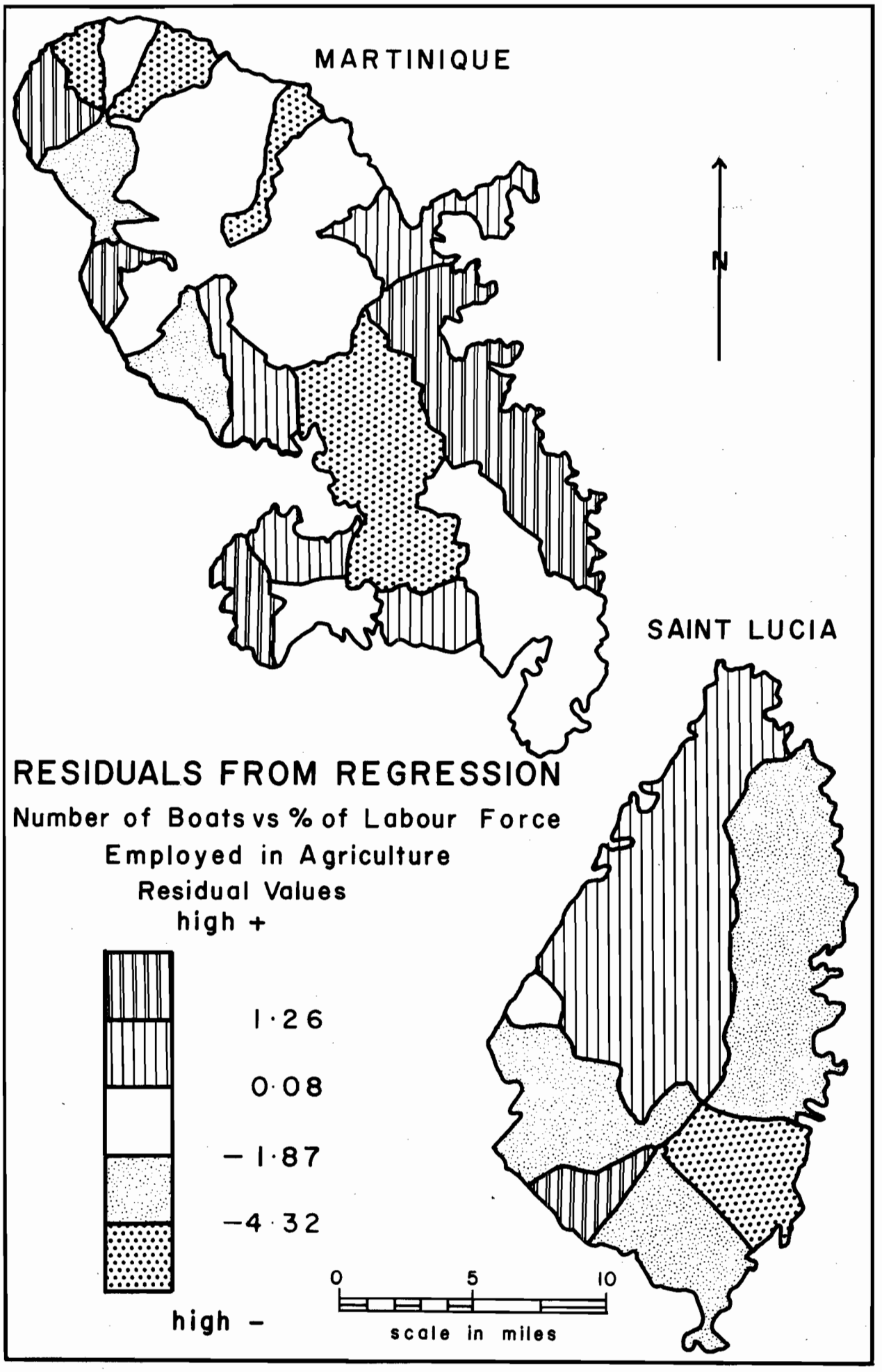

MARTINIQUE
N
SAINT LUCIA
RESIDUALS FROM REGRESSION
Number of Boats vs Number of Fishermen
Residual Values
high +
1·36
0·24
−0·26
−1·80
high −
0
5
10
scale in miles

Figure 13


MARTINIQUE
N
SAINT LUCIA
RESIDUALS FROM REGRESSION
Number of Boats vs % of Labour Force Employed in Agriculture
Residual Values
high +
1·26
0·08
−1·87
−4·32
high −
0
5
10
scale in miles

more boats than the number that could be expected from the percentage in agriculture are primarily found in Martinique.

This is especially true for the administrative divisions ranked in the first quintile where six of the seven are found in Martinique. Of these, five are directly correlated with the first quintile in figure 12 (Robert, Francois, Vauclin, Carbet and Prêcheur) possibly indicating that these regions are both good for employment opportunities in fishing and agriculture.

The sixth commune, Anses-d'Arlets, appears in the first quintile in figure 13 and in the second in figure 12. Therefore, implying that fishing is the most important activity in the commune. This was actually stated by de Roux (14) who lists fishing as the main economic activity in his 1964 study of this commune.

The locations ranked in the second quintile are regions tending towards having more boats than the percentage of the labour force engaged in agriculture would suggest. Therefore, these locations (Trinité, Sainte-Luce, Trois-Islets, Fort-de-France, Castries, Gros Islet and Anse La Raye) would appear to be good agricultural areas where fishing activity, although not as important as in the areas ranked in the first quintile, would be quite significant.

All regions ranked in the fourth and fifth quintiles would appear to be areas where agriculture is a more important activity than fishing. This would include all the quarters in Saint Lucia except Castries and the predominantly inland communes

of Rivière-Salée, Ducos and Lamentin in Martinique along with the following coastal communes: Basse-Pointe, Macouba, Schoelcher, Grand-Rivière, Case-Pilote and Saint-Pierre.

All regions ranked in the first (highest positive) and last (highest negative) quintiles in figures 12 and 13 were placed into table 8, along with all the administrative divisions that fell within these categories in the five other maps prepared but not reproduced here. The table indicates extremes in fishing activity relationships.

Table 8 gives an indication of the overall importance of fishing areas based on the results of the six final variables used in the simple analysis and the multiple case.

The table indicates that all the best fishing areas are to be found in Martinique. Moreover, the most important is François followed closely by Robert and Vauclin and to a lesser degree by Trinité and Marin. All these communes are located side by side on the Atlantic coast. Therefore, there is a direct correlation between the results of this analysis and the production estimates to be discussed in the next chapter, which rank the Atlantic coast as the island's prime area for fish production. Furthermore, the results in table 8 lend full support to the discussion of figures 12 and 13 presented above.

Anses-d'Arlets also shows up as an area of high fishing activity which is to be expected in the light of the importance

TABLE 8

EXTREME RESIDUALS

	Administrative division	8 variables	X_2	X_4	X_5	X_6	X_7	X_{11}
SAINT LUCIA	Castries	-		-	+	+	+	
	Gros Islet	-		-				
	Anse La Raye	+						-
	Canaries			-	-	-	+	
	Soufriere			-				
	Choiseul		+					
	La Borie			-	-		-	
	Vieux Fort			-				
	Micoud		-		-	-	-	-
	Dennery			-		-	-	-
MARTINIQUE	Basse-Pointe		-		-	-		
	Marigot		-		-	-		-
	Sainte-Marie							
	Trinité				+	+		
	Robert	+	+	+	+	+		
	François	+	+	+	+	+	+	+
	Vauclin	+	+	+	+		+	
	Sainte-Anne							-
	Marin	+		+				+
	Rivière-Pilote	-					-	
	Sainte-Luce						+	
	Diamant						-	
	Anses-d'Arlets		+		+	+		+
	Trois-Islets	-						
	Rivière-Salée	-	-		-	-	-	-
	Ducos		-			-		
	Fort-de-France				+	+		+
	Schoelcher	+		+				+
	Grand-Rivière		-		-		+	
	Case-Pilote						+	
	Bellefontaine	-						
	Carbet	+	+	+		+		+
	Saint-Pierre							
	Prêcheur		+	+				+
	Lamentin	-	-				-	-

\+ = 1st quintile (highest positive residuals)

\- = 5th quintile (highest negative residuals)

already attributed to this activity in this commune. The remaining important fishing communes are all located on the north-east Caribbean coast (Fort-de-France, Schoelcher, Carbet and Prêcheur) where fishing activity is known to be carried out on an intensive basis.

Data from the table establish that in Saint Lucia Micoud and Dennery, occupying 9/10 of the Atlantic coastal area, are quarters where fishing is least important as an economic activity: a fact which is sustained by field observations which reveal that physical conditions along this coast are very detrimental to the performance of fishing operations.

Martinique has five communes where fishing activity is not very important. Two of these, Basse-Pointe and Marigot, are the northernmost fishing areas on the Atlantic coast where, unlike the central and southern sections, high cliffs allow a very limited number of beaching sites. The other three (Rivière-Salée, Ducos and Lamentin) have limited coastal areas, and extend more inland where agricultural activities and urban employment predominate.

The importance of fishing activity in the remaining administrative divisions lies somewhere between the extremes discussed above. However, comments are reserved on these areas as the data in table 8 are not sufficient to allow a full analysis.

Discussion

By incorporating all of the islands' 35 administrative

divisions into a single study, the analysis ranks all areal characteristics as though both islands formed an integral territorial unit.

If there were more basic areal units in Saint Lucia[15], the analysis could have been conducted on an individual island basis[16]. The results could then have been ranked independently by quarter and by commune. Therefore, such a study could have revealed a higher degree of spatial differentiation within each island.

Nevertheless, by using an overall analysis, the study has indicated that Martinique is in a better position as regards fishing activity than Saint Lucia. Nearly all the extreme positive residuals occur in Martinique, whereas practically all the extreme negative ones are found in Saint Lucia.

The scope of the present analysis is too limited to explain the reasons behind these differences[17]. At best, the extent of fishing activity is placed into perspective by the few

15. In general at least 30 units are needed in order to derive significant results from a correlation and regression analysis.

16. This would have enabled a better appraisal of the relative areal importance of fishing in each island which is masked, especially in Saint Lucia, by the general analysis.

17. For example, between 1954 and 1961 the number of fishermen in Schoelcher declined from 170 to 63 (15). This is the type of data that is useful for the analysis of fishing activity, but that had to be omitted as it was not available for all areas.

variables used in the study. A meaningful interpretation of the geography of this industry can only be attempted after all factors (physical, biological, economic, cultural, demographic and historical) have been assessed and measured, and ideally these measures would be related to each fishing site.

Therefore, this study must be viewed as a preliminary analysis which introduces the problems involved in assessing the areal variations in levels of fishing activity. It should serve as the foundation for future work, and as a basic design for a more complete research programme that would lead to a better understanding of the distribution of fishing activity in under-developed countries.

CHAPTER 6

PRODUCTION

As these insular populations have relatively easy access to the sea, and as production of other animal protein is low, West Indians are large fish eaters consuming almost four times the quantities eaten by Europeans and North Americans (25). This big demand is supplied by the islands' traditional fishermen, by locally based deep-sea boats, and by imported fresh and processed fish.

Domestic and foreign deep-sea vessels can be relied upon to land consistantly steady supplies of fresh fish in Martinique's and Saint Lucia's capitals. For these boats, manned by competent professional fishermen, are capable of long range cruising that enables them to search for large shoals of pelagic fish, and to exploit the rich fishing grounds located off the northeast coast of South America.

On the other hand, traditional fishermen restricted to limited and seasonal resource bases, bring in widely varying quantities of fish at sites along the islands' entire coastline.

In addition to fluctuations in resources, several factors contribute to an uncertain and erratic production from this sector. Fishing operations are hampered by the individualistic character of the fishermen, the type and quality of the tools

and techniques in use, the lack of cold storage facilities, and the buying habits of the native inhabitants.

Production in Martinique

The only reliable records of fresh fish production are kept at the main market in Fort-de-France; therefore, all fresh fish produced by the traditional sector which is not retailed through this outlet goes unrecorded officially.

The annual totals of fresh fish recorded for the period 1961-1965 are given in table 9. These figures give an indication of the relative importance of the different species consumed in the capital. However, as these quantities represent only 10 to 15% of the yearly catch, and as at least 80% of this fish is brought in by deep-sea vessels, they do not reveal which species are the most important in traditional fishing.

Based on work by de Roux (13) a summary, of the production by sector for 1963, is given in table 10, and the estimated production by area for the traditional sector is given in table 11.

Although the figures in table 10 deal with only one year's production, they indicate that Martinique's traditional fishermen are capable of producing between 85 and 90% of the island's fresh fish supply. The regional breakdown of this production, as shown in table 11, shows a strong correlation with the availability of continental shelf depicted in figure 5, and

TABLE 9

FRESH FISH PRODUCTION IN LBS.
RECORDED AT FORT-DE-FRANCE MARKET BETWEEN 1961-1965[18]

Species	1961	1962	1963	1964	1965
Tuna	282,780	447,440	477,000	305,980	326,960
Red Fish	433,720	314,600	267,280	260,180	338,580
Dolphin	174,220	185,040	108,820	270,420	287,400
Jackfish	193,440	279,840	155,300	162,080	75,380
Flying Fish	127,960	134,860	165,920	128,280	230,760
Spanish Mackerel	140,880	82,680	53,580	147,300	121,820
Shark	89,700	124,720	110,780	81,460	87,340
Mackerel	48,440	188,620	99,040	50,160	64,040
Halfbeak Garfish	43,760	50,120	54,580	62,840	80,780
Bonito	18,160	26,580	39,580	71,680	46,200
Sardines Herrings	15,960	18,780	23,500	48,720	38,460
Varey	14,180	20,520	22,940	21,740	24,240
Turtle	15,300	12,640	7,940	15,420	18,720
Lobster	20,060	12,620	6,220	13,880	12,280
Couvalli	5,220	4,660	20,020	11,860	12,220
Pisquette Titiri	7,420	16,820	7,860	12,460	9,500
Mullet Snook	7,660	5,720	9,860	5,520	13,160
Raies	2,500	9,840	7,480	1,180	12,160
Sennet	1,700	4,360	4,920	3,780	6,160
Conches	580	1,420	900	3,160	2,540
TOTALS	1,644,380	1,941,880	1,643,520	1,688,760	1,806,240

18. Statistics translated from the French, and converted to pounds from kilos. Extracted from Etat Des Quantités de Poissons Entrées à la Poissonnerie de Fort de France. Mairie de Fort de France, 1966.

TABLE 10

FRESH FISH PRODUCTION IN MARTINIQUE IN 1963
WEIGHTS IN POUNDS LANDED BY THE DIFFERENT SECTORS

Estimated yearly totals	12,100,000
Landings by foreign deep-sea vessels	880,000
Landings by domestic fishermen	11,220,000
Landings by domestic deep-sea vessels	564,740
Landings by the traditional sector	10,655,260
Number of traditional fishermen	2,849
Landings per year per traditional fishermen	3,740
Landings per day per traditional fishermen	102

TABLE 11

REGIONAL LANDINGS BY TRADITIONAL FISHERMEN IN MARTINIQUE

AREA	LIMITS	% FISHERMEN	% LANDING
Atlantic Coast	Grand Rivière to Ste-Anne	35.4	45
South Caribbean Coast	Les Anses-D'Arlets to Schoelcher	32.6	22
Saint Lucia Canal	Marin to Diamant	12.5	20
North Caribbean Coast	Case Pilote to Prêcheur	19.5	13

also indicate that areal production is not necessarily a direct function of the number of fishermen, as substantiated by the analysis presented in chapter 5.

Production in Saint Lucia

The only available records on fish production in Saint Lucia are those kept at the main market in Castries. A summary of the total weights of fresh fish recorded for the period 1961-1964 is given in table 12.

TABLE 12

FRESH FISH PRODUCTION IN LBS.
RECORDED AT CASTRIES MARKET BETWEEN 1961 - 1964[19]

Month	1961	1962	1963	1964
January	44,101	28,501	18,880	20,472
February	21,163	22,301	27,595	32,007
March	39,682	25,255	31,177	37,306
April	33,237	27,922	27,449	33,795
May	32,460	42,113	35,299	35,678
June	21,651	47,982	32,032	49,642
July	28,261	27,290	27,175	46,491
August	26,044	37,682	30,520	22,651
September	13,404	32,092	44,685	23,307
October	9,997	28,694	22,255	17,250
November	14,305	24,353	62,067	13,541
December	31,523	25,128	25,998	12,743
TOTALS	315,828	369,313	385,182	344,883

19. Statistics were extracted from the Official Record of Market Superintendent, Castries Market, 1964.

The figures in table 12 give no indication of the relative amounts of the species entering the market. However, they do reveal that monthly and yearly fluctuations exist which are comparable to those that occur in Martinique.

An estimation of the relative yearly composition of the island's production was given by the fisheries officer. He reported that tuna, bonito and dolphin made up 40% of the catch, flying fish account for another 30%, jackfish constitute some 20%, and the remaining 10% includes all other species.

Among fisheries authorities in Saint Lucia, it is generally recognized that if the annual total of fresh fish, registered at the Castries market, were multiplied by $2\frac{1}{2}$ or 3, the resulting figure would represent the island's annual catch.

This method of estimation was used by Hees (25) in his assessment of fish consumption in the West Indies. He stated that Saint Lucia authorities had furnished the Food and Agricultural Organization with an "official" figure of 882,000 pounds for an estimate that indeed represents between $2\frac{1}{2}$ to 3 times the amount shown in any year in table 12.

For 1964, the year during which the boat census was taken, the Castries market figure stands at 344,883 pounds. If this total is multiplied by 3, a rough estimate of the island's total fresh fish production would be 1,034,649 pounds.

As Venezuelan deep-sea boats (74) delivered 190,230[20]

20. Extracted from the files of the sole agents for Venezuelan fish passing through the Castries market. Malings Compton Commission and Fishing Agent. Castries, August 1965.

pounds of fish to the market in 1964, the figure is adjusted to 844,419 pounds to represent the amount of fresh fish produced by the traditional sector. This total divided by 1,410 fishermen shows an individual production of 600 pounds per year per boat or 1.6 pounds per day.

Traditional fishermen supply a little less than half of the capital's requirement. This production occurs throughout the islands at different locations where it assumes varying degrees of importance. Although no official surveys exist that show the regional shares of the catch, field studies have established the relationship shown in table 13.

Assessments made in table 13 indicate a close relationship between producing areas and the extent of the island's continental shelf (figure 6). As in Martinique, the most productive areas are correlated with the greatest shelf widths, and appear to be independent of the actual number of fishermen. Therefore, presenting further evidence that the distribution of fishing activity is not necessarily a function of the available resources.

Complicating Factors

The Islands lack cold storage facilities. Consequently, during the bountiful months, individuals will often limit their catches out of fear of having surpluses sold at inferior prices or wasted altogether.

Also, the buying habits of the peasants contribute to

TABLE 13

REGIONAL IMPORTANCE OF TRADITIONAL FISHERIES IN SAINT LUCIA

AREA	LIMITS	% FISHERMEN	IMPORTANCE
Saint Vincent Channel	Vieux Fort Parish	11.3	primary producing area
North Caribbean Coast	Gros Islet Parish	13.4	secondary producing area
Remainder of Caribbean Coast	Castries to Laborie	69.3	orientated primarily to local consumption
Atlantic Coast	Entire Coast	6.0	negligible production

curtailing production. People congregate on the beach in search of fresh fish, and fishermen anxious to capture this prime market hurry back with very small catches in the hope of securing quick profits.

Discussion

As Hess explains:

> It is apparent that the productivity of the West Indies fishing industry is relatively low when expressed in terms of average annual landings per fisherman (25:5) ... (however) Although it may sound paradox(ical), the production of fish per caput of population, on the other hand, is quite high in several Units, even when compared with countries with highly developed fisheries, and (despite) ... the high population densities in many West Indian islands (ibid.: 6).

By employing figures from the most recent F.A.O. Yearbook of Fishery Statistics (68), and United Nations Demographic

TABLE 14

COMPARATIVE PRODUCTION DATA FOR TRADITIONAL FISHERMEN

	MARTINIQUE	SAINT LUCIA
Share of Total Production	85 - 90%	80%
Traditional Production	10,655,260 lbs.	844,419 lbs.
Number of Fishermen	2,849	1,410
Yearly Production per Fisherman	3,740 lbs.	600 lbs.
Total Population	292,062	86,108
Yearly Production per Resident	37 lbs.	10 lbs.

Yearbook (67), it is possible to place Martinique and Saint Lucia's productions into perspective with other countries.

In that year, Martinique was the highest West Indian producer with 34 pounds of fish per island resident. On the other hand, Saint Lucia was the lowest producer with 10 pounds. In comparison, totals for other countries stood as follows: Barbados (34 lbs.), Antigua (25 lbs.), France (36 lbs.), Indonesia (21 lbs.), and Japan (149 lbs.).

A comparative summary of the production from Martinique and Saint Lucia's traditional sectors is given in table 14.

Table 14 indicates that more than 80% of the islands' fresh fish is produced by the traditional sector. However, twice the number of fishermen in Martinique produce over twelve times more

fish than their counterparts in Saint Lucia. Consequently, the population in Martinique which is $3\frac{1}{2}$ times greater than Saint Lucia's receives $3\frac{1}{2}$ times more fish per person per year.

The very wide difference in production is related to the number of fishermen, and appears highly correlated with the extent of the continental shelves. In Martinique 68% of the fishermen (1937) operate in the two prime fishing regions which have the larger shelf widths. In Saint Lucia, a comparative figure for the two best shelf areas stands at 24.7% (352). This means that in terms of actual numbers, there is an 11 to 1 ratio of fishermen, in favour of Martinique, available to exploit what appears to be the island's best resource areas. Thus giving Martinique a clear advantage in production.

In addition, Martinique has a much longer coastline which allows fishing activity to be spread throughout the island, whereas operations are practically restricted to Saint Lucia's short Caribbean coast. Also, more than 80 beach seines, each capable of large landings, are in use in Martinique, whereas no more than 11 are employed in Saint Lucia.

Finally, many fishermen divide their time between fishing and other kind of work. Therefore, the regional availability of outside work is an influential factor on production from site to site and from island to island. This is especially true in areas where there is a high percentage of people engaged in agriculture.

CHAPTER 7

MARKETING THE PRODUCT

Upon beaching their boats, most fishermen surrender their fish to waiting market women who take charge of trading activities. The first sales are made on the beaches to people looking for the choicest and freshest products. Once these customers have been satisfied, the balance of the catch is marketed in the inland areas near the coasts.

In both islands, the capitals are only a few hours' drive from the most outlying points. Consequently, the main city markets cater to all the islands' residents, and it is not unusual for people living in areas where fish is landed to obtain their supplies in the capital cities.

In addition to the main markets the capital cities offer consumers other outlets from which fresh fish can be obtained. In both islands, private companies retail a great dealof fish mainly derived from deep-sea boats.

In Saint Lucia, smaller concerns equipped with home freezers and supplied by their own "fleets" of transoms and whalers offer additional retail outlets to the consuming public.

Marketing the catch from the traditional sector is largely a day-to-day affair. This sector lacks cold storage facilities; consequently, fish must be disposed of quickly to avoid

the rapid spoilage brought on by the tropical climate.

This lack of refrigeration contributes to the creation of certain patterns of distribution. For example, when large quantities of fish are caught, rather than beach at their permanent landing sites, fishermen often head for the nearest larger centre where they are likely to dispose of their entire catch, or to a prime site where land transportation is available to take surpluses to the capitals or the hinterlands.

The Role of Market Women

Market women, sometimes the wives of fishermen, are to be found at most landing sites where they begin marketing the produce right on the beaches from which the surplus is carried, in baskets and on foot, to nearby settlements where it is distributed until the supply is exhausted.

In some areas, notably in Martinique, they accompany light vehicles which periodically transport surpluses to the rugged hilly inland areas. Often, the market women take the fish by bus, or other conveyance, to the capital cities where they either vend the products in the streets (Martinique) or sell them to their counterparts at the main markets.

Market women monopolize the sale of fish produced by the traditional sector. They are the day-to-day arbiters of prices, and their profits and losses are reflected in the returns handed back to the fishermen.

Supply Patterns in Martinique

Although slightly more than half (157,454) of Martinique's 292,062 inhabitants are dispersed in rural areas, the supply patterns are primarily oriented to cater to the demands of the 134,608 people concentrated in the island's 32 main agglomerated settlements.

The capital city of Fort-de-France makes the greatest demands on the island's supply of fresh fish. For more people reside in the capital (74,673) than in all the agglomerated settlements combined (59,935) whose population range from 324 to 5,434 inhabitants.

In addition to absorbing all the supplies brought in by deep-sea vessels, the capital draws fresh fish from 20 main coastal villages whose beaches allow them to serve as gathering sites for fish destined for the capital. However, some sites only ship fish on rare occasions.

The day-to-day availability of fresh fish is a function of the following factors: the size of the fishermen's catch, the entrepreneurial activity of small vehicle operators, the nature of the road network, and the location of the agglomerated and rural markets.

Fish is distributed in well established patterns. Small catches are landed at the fisherman's original fishing site, and distributed on the beaches and along the roadways leading to his home.

Larger catches are brought to the nearest primary landing sites where part is sold locally, with the rest generally being shipped to the capital city by land or sea. The main road network, connecting the capital to the gathering sites, passes through all but four of the

remaining nucleated settlements. Consequently, these villages offer intervening opportunities for fish merchants to dispose of considerable quantities of fish en route to the capital (figure 14).

The other four main settlements offer secondary opportunities for entrepreneurs wishing to bring their fish directly to an agglomerated settlement from a nearby coast. During periods of exceptional production small vehicles will travel to these villages distributing the fish whenever an opportunity presents itself.

Supply Patterns in Saint Lucia

Saint Lucia has a rural population of 51,299 and an agglomerated population of 34,809. The rural population is dispersed in very rugged country served by very poor roads. Consequently, virtually no fish is brought directly to this segment of the population.

On the other hand, the island's 10 main agglomerated settlements are all located on the coasts. Therefore, as each serves as a primary landing site, supplies are generally available to satisfy the demands of these villagers and as these villages are all linked together by the island's only good road, they are all in a position to send fish to Castries (figure 15).

Castries has a population of 15,291 and the other main villages have populations which range in size between 970 and 3,228. Even though the island's communication system is poor, distances are short enough to allow commuting to Castries, and the town's

Figure 14

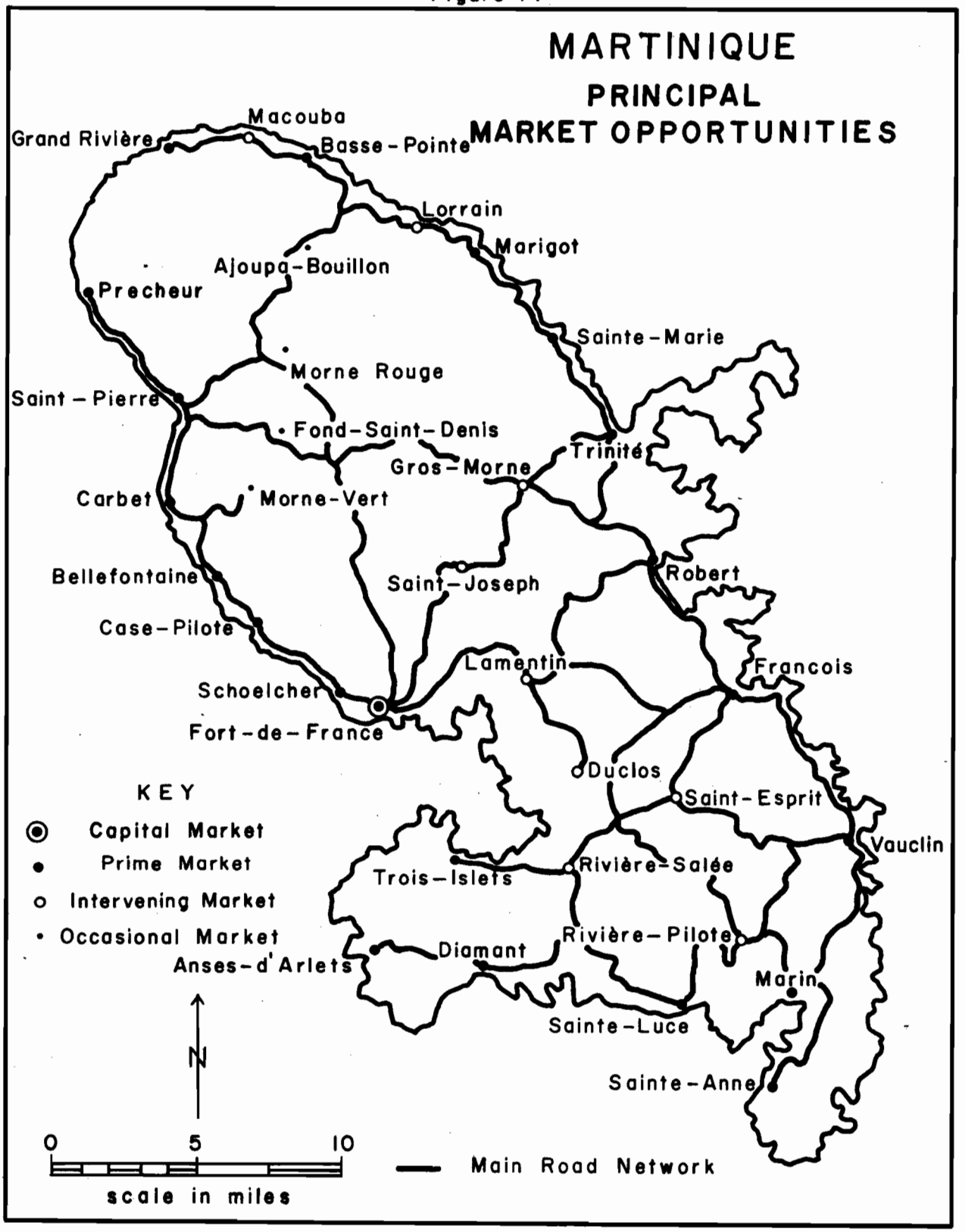
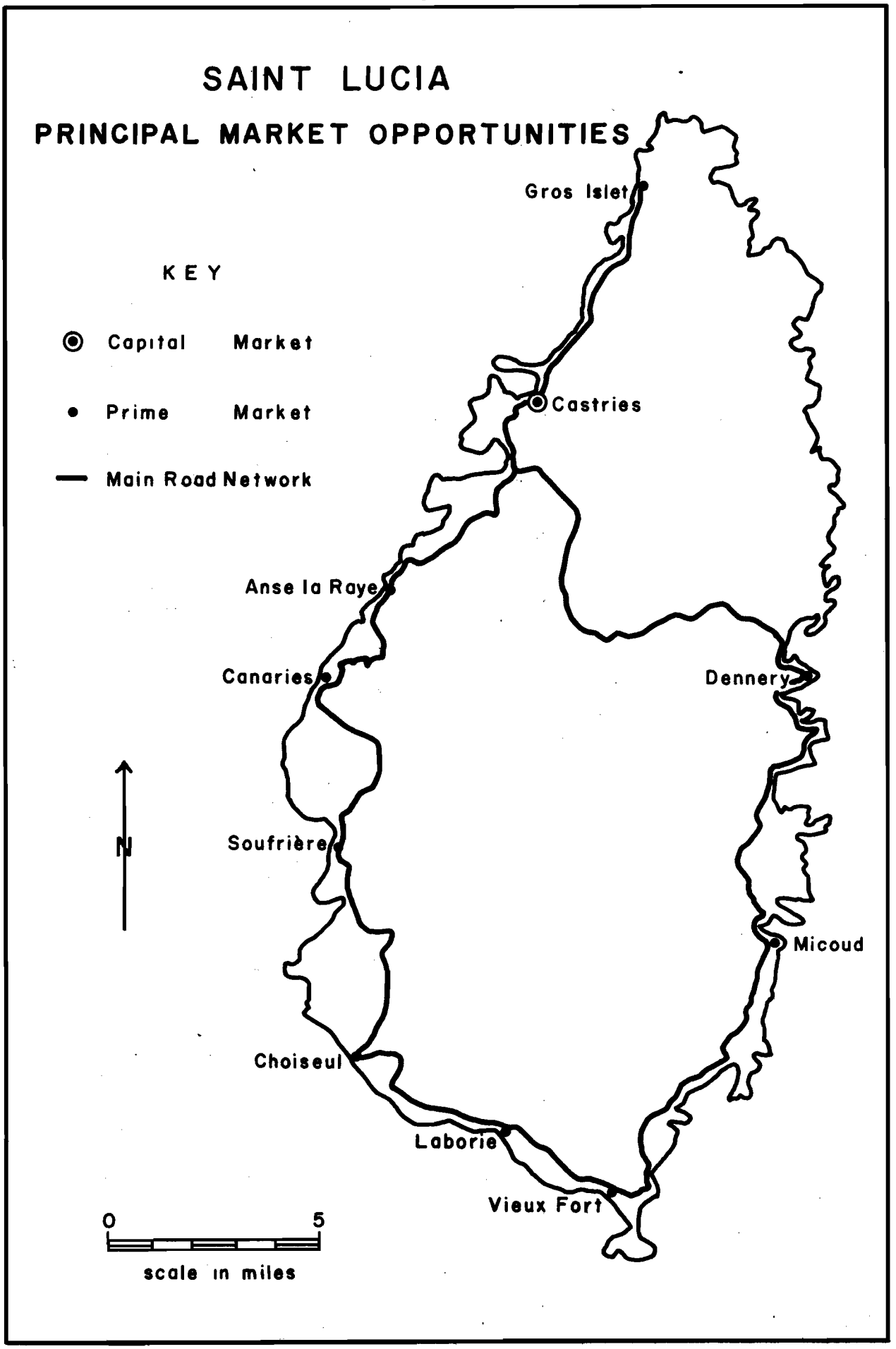

MARTINIQUE
PRINCIPAL
MARKET OPPORTUNITIES
Macouba
Grand Rivière
Basse-Pointe
Lorrain
Marigot
Ajoupa-Bouillon
Precheur
Sainte-Marie
Morne Rouge
Saint-Pierre
Fond-Saint-Denis
Trinité
Gros-Morne
Carbet
Morne-Vert
Bellefontaine
Saint-Joseph
Robert
Case-Pilote
Lamentin
Francois
Schoelcher
Fort-de-France
Duclos
KEY
Saint-Esprit
Capital Market
Vauclin
Prime Market
Rivière-Salée
Trois-Islets
Intervening Market
Occasional Market
Rivière-Pilote
Diamant
Anses-d'Arlets
Marin
Sainte-Luce
N
Sainte-Anne
0
5
10
Main Road Network
scale in miles

Figure 15


SAINT LUCIA
PRINCIPAL MARKET OPPORTUNITIES
KEY
Capital Market
Prime Market
Main Road Network
Gros Islet
Castries
Anse la Raye
Canaries
Dennery
Soufrière
Micoud
Choiseul
Laborie
Vieux Fort
N
0
5
scale in miles

normal population swells daily. Therefore, Castries places the biggest demand on the island's supply of fresh fish.

The capital's needs are supplied from foreign deep-sea craft and from the island's traditional sector. However, although fish is shipped to the capital from all major landing points, the only regular supplies of any importance from the traditional sector come by land and sea from the villages of Gros Islet and Vieux Fort.

The other primary sites cater primarily to local markets with the bulk of the production being sold on the beaches and along the roads leading to the fishermen's homes. Surpluses are shipped to the capital from these sites, but this type of movement tends to be rather exceptional.

Marketing Facilities

There is a main fish market in each of the islands' capital cities. A comparative list of specifications and characteristics is given in table 15.

The Castries market provides better facilities than the one in Fort-de-France. However, the building in the French capital has iceboxes for overnight storage. Nevertheless, both markets fulfil more or less the same function. Under present conditions, they are little more than transfer sheds where market women oversee the brief passage of fish from producer to consumer.

TABLE 15

COMPARISON OF THE ISLANDS' MAIN MARKETS

	Martinique	Saint Lucia
Location	Independent building, located near vegetable and meat markets.	Single building, occupying a separate wing of the capital's general market.
Appearance	Covered structure enclosed by a six foot cement wall topped by a four foot iron grill.	Covered structure enclosed by a six foot cement wall topped by slats and iron bars.
Floor space	5,600 square feet	1,200 square feet
No. of Vendors	50	28
Facilities	Tables, iceboxes, water.	Tables, water.
Organization	No floor plan, haphazard arrangement of tables. Customers mingle with the vendors. Water outlets poorly located at either end of the structure. Floor slimy and unclean. Difficulty of movement in the building.	Tables neatly arranged around the building four feet from the walls. Vendors separated from the customers. One water outlet per table. Floor clean and tidy. Ease of movement all through the structure.

In Martinique, Saint-Pierre and Trinité are the only other locations where fish is sold in a market solely designed to accommodate this product. In other areas, when the fish is vended through market facilities, it is sold alongside other types of goods in the towns' main market buildings.

The market at Saint-Pierre is a single enclosed and

covered structure containing 600 square feet of space. It is a fish market in name only, as it offers no psecial equipment for marketing. Six tables separate the customers from the market women who sell the product without benefit of refrigeration or cleaning facilities. At best, the only useful advantage offered by the market is to protect the market women from the hot sun on the beach.

The market at Trinité is the government's first attempt to provide a modern market exclusively designed for the fish trade. It consists of a single structure, made entirely of cement, enclosing 476 square feet of space which is divided into eight open air vending stalls covered by a protective roof (plate 17).

The market is designed for both efficiency and cleanliness. All the actual market space is occupied by the vendors with the customers milling around outside the structure. Each vendor is isolated from her neighbour, and the stalls are planned in such a manner that no more than two front on any side. Therefore, the consumers tend to disperse themselves proportionally around the market.

Each stall is equipped with the following facilities: water faucet, sink, vending table, cutting table, cupboard space, shelves and sufficient room for one or two assistants. Also, all the equipment is arranged in such a manner that different operations

can be performed separately, and maximum efficiency is assured.

The Saint Lucia government has erected fish markets in all the major coastal villages except Micoud. The markets are small single structures, cheaply built, and offer little more than a questionable degree of protection against the elements.

Markets of the type shown in plate 18 are to be found in Choiseul and Gros Islet. They are equipped with water, and for this reason attract a few users. However, the bulk of the marketing at these locations is carried out right on the beaches with the markets being by-passed.

The rest of the markets are similar to the type shown in plate 19. They resemble simple storage sheds and serve approximately the same purpose. Lacking water, they are ignored by traders to such a degree that most of the sheds are closed permanently or serve as shades for the local lads who gather in them to drink and gamble.

Spoilage Problems

High temperatures combine with frequent rough handlings and poor refrigeration to produce the most suitable conditions for the accelerated decomposition of fisheries products in tropical latitudes.

High tropical temperatures encourage the rapid growth of bacteria whose action is directly responsible for the decomposition of fresh fish. There are many and varied species of bacteria that

17 - Market at Trinité, Martinique.

18 - Market at Gros Islet, Saint Lucia.

19 - Market at Laborie, Saint Lucia.

exist under widely different growth conditions. However, most species follow a standard growth rate which decreases with refrigeration and accelerates proportionately to increasing temperatures (19).

Bacteria are already present on the external slimy surfaces of the fish, and they begin the decomposition process as soon as the fish die. Also, the decaying process is speeded up by the gastric juices and microorganisms found in the animal's digestive tracks (21).

In addition, spoilage is greatly accelerated during handling and transfer operations. Many fish are bruised and battered while being pulled into the boats. Consequently, the bacteria can penetrate directly into the body tissues thus infecting greater surfaces in a shorter time (9).

After the fish leave the sea, they are transferred to one contaminated surface after another, with each successive surface contributing its share of decay-causing organisms. Also, the fish handlers themselves present an additional, and often dangerous, source of contamination. Many have no concept of the rudiments of personal hygiene, and consequently expose the consumer to infection originating from human fecal sources.

Depending on the species of fish involved, the decomposition process can be arrested for varying lengths of time by the use of cold storage. One type is the electrically controlled cold room where the temperature can be kept constant, and

where the fish can be stored under dry conditions.

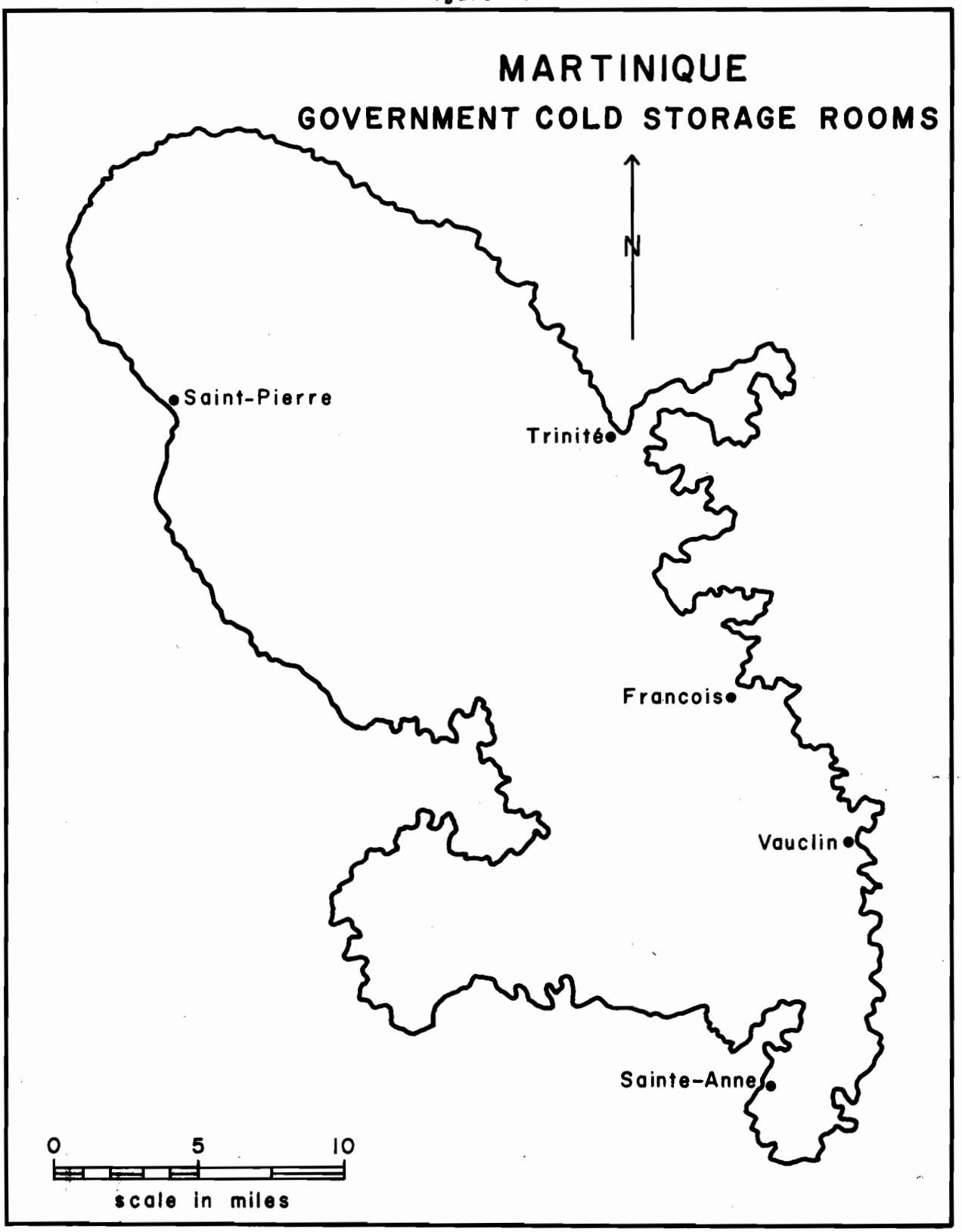
Authorities in Martinique have erected five electrical cold rooms in coastal communes (figure 16). These range in capacity from 648 to 826 cubic feet of storage space. Unfortunately, following a brief period of use, these rooms have been relegated to the role of storage sheds for equipment and goods, and no longer serve as refrigeration units.

The market at Fort-de-France is the only location in the two islands where ice is available to people using the public markets. However, as the fish is only iced late at night after lying on tables all day, this type of refrigeration does little to improve the quality of fish which is already in an advanced state of decay.

Deep-sea vessels utilize block ice which is chipped by hand, when needed, out at sea. This results, as a rule, in coarse, crushed ice of uneven size, and may account for the fact that, due to poor icing practice, even such fish occasionally are of inferior quality when landed, only 3-4 days old (21).

The lack of refrigeration during all phases of transport is a most serious problem facing the traditional producers, especially those who ship fish to the islands' capitals. Often, the fish will have spent several hours in boats before being transferred to trucks or buses for the final trip to the city. Consequently, a good deal of fish arrives in Fort-de-France and Castries in a state which makes it unfit for human consumption.

Figure 16


MARTINIQUE
GOVERNMENT COLD STORAGE ROOMS
N
Saint-Pierre
Trinité
Francois
Vauclin
Sainte-Anne
0
5
10
scale in miles

Authorities in Castries will tolerate spoiled products to a certain degree. However, the administrative officials of Fort-de-France follow to the letter the law which demands that all fish be inspected by a qualified veterinarian (49), and that all substandard fish be discarded.

The Veterinarian is present at the market when large shipments are brought in, and when fish arrives in his absence a well established grapevine informs his office from which an inspector is dispatched if the veterinarian is not available. These inspections result in large quantities of fish being sprayed with a denaturating chemical and subsequently being thrown into the sea, causing large production and revenue losses.

Private Retail Outlets

Private retail outlets play a vital role in supplying fresh fish to the islands' residents. Operated by companies and small entrepreneurs, these outlets draw their supplies from both foreign and domestic sources.

In Saint Lucia, there are two large commercial establishments, amply supplied with cold storage, that market fresh fish entirely derived from foreign deep-sea vessels. These vessels land their catches in Castries on a regular basis, assuring the merchants a steady supply of fish.

Both companies sell fresh fish in Castries only, and cater primarily to the middle and higher income groups. The fish

are fileted, packaged and displayed in refrigerated showcases of the type used in North American supermarkets.

In addition to patronizing the main market, the lower income groups obtain fish from small retail outlets owned by merchants who have acquired home freezers in which fish can be kept for long periods. They are supplied from the traditional sector, and in the two most important cases they maintain their own "fleets" of transoms and whalers which assure them a daily supply of fish. One such merchant has, in addition, a regular delivery service which supplies him daily from his boats at Vieux Fort.

In Martinique, home freezers help to create a few small retail outlets in the capital. Also, freezers are to be found in most communal capitals where they are occasionally used to store very small quantities of fish for later sale.

In the capital, two large private companies monopolize most of the retailing of fisheries products conducted outside the city's main market. Well endowed with cold storage, the companies obtain their supplies from their own, and from foreign, deep-sea vessels. In addition, these concerns often purchase the traditional sector's surpluses which they resell to the market women when supplies are short in the capital.

Discussion

Both islands face identical problems: the markets for

fresh fish consisting of dispersed rural populations, small agglomerated settlements, and the overhwlemingly large concentrations of people in the islands' capitals.

Present supply patterns could in theory be changed with the introduction of refrigeration which would allow the islands' periodic gluts to be stored. If the facilities were located in strategic geographical positions, their presence would insure a more regular distribution of fish fish to larger segments of the population.

However, the introduction of cold storage in Martinique has not yielded the expected results. Part of the reasons behind this can be found in the peasants' attitudes towards the fish products that they consume. They simply prefer to eat freshly caught fish or salt cod, and they have built up a dislike for any other type of product. But the presence of home freezers has resulted in the gradual introduction of the frozen product, and has contributed to breaking down the "resistance barrier".

Marketing facilities require a great deal of improvement especially from the sanitary viewpoint. Some order should be put into the establishment at Fort-de-France so that operations could be conducted under cleaner conditions. Also, the vastly superior market at Castries would be better equipped if cold storage facilities could be provided.

The outlying markets have not enjoyed widespread

popularity, notably because they are poorly equipped and they offer little advantage over direct selling on the beaches.

The market at Trinité is an exception. It has all the necessary facilities for clean and sanitary trading, and it could well serve as a model for the building of new units in the two islands.

CHAPTER 8

VIABILITY OF THE TRADITIONAL FISHING INDUSTRY

Traditional fishermen operate under widely varying conditions. Nevertheless, it is possible to arrive at some estimate of viability by examining the average yearly operational costs, and the total weight of fish needed to offset these costs and to go beyond to a margin of profit.

Costs must be examined in the light of the following variables: availability and location of resources, number and type of tools being utilized, and the nature and length of the fishing operations. Also, the assessment must include cost of fuel, maintenance, and depreciation.

Appraisal of revenues must be based on the number of fishing days, the length of stay at sea, and the average yearly catch of a traditional canoe. Also, revenue calculations must be based on the average sale price of fish, and on the catch sharing arrangements that exist in the islands.

Comparative Costs

Based on field data, a comparative summary of the minimum and maximum operational costs is given in table 16.

Variations in equipment costs stem from the availability of a wide range of specifications for the individual items, and price differences between the two islands depend on the material in use and on the availability of the various implements on a

TABLE 16

OPERATIONAL COSTS IN MARTINIQUE AND SAINT LUCIA[21]

	Martinique		Saint Lucia	
Item	Min.	Max.	Min.	Max.
Canoe	306	520	150	300
Motor	160	660	280	400
Maintenance	30	40	20	30
Paint	30	40	30	40
Fish Pot	10	20	4	6
Fish Net	4	5	2	5
Bottom Line	70	-	-	-
Box of Lines	90	100	60	70
Inscription Dues	-	160	-	-
Tax Free Gas/Gal.	-	0.24	-	0.37
Oil/Qt.	-	0.40	-	0.42

local basis.

In general, prices are higher in Martinique where fishermen employ sturdier and costlier material in the construction of their tools. Also, as canoes must be imported, the purchase price must include handling and transport costs. In addition, because of the tendency to overpower canoes, the maximum cost of motors is higher.

An extra expense is incurred by fishermen in Martinique. They must register with the government and pay an enrolment fee of $160.00 per annum which entitles them to social security benefits. To date, although registration is required by law, only 40% of the fishermen have complied with the regulation.

21. All values in U.S. dollars. This currency used throughout this analysis.

Comparative Revenues

Fishermen in both islands have similar revenue patterns. When the day's fishing is completed, the catch is shared among the members of the crew on the basis of one share for the boat and one share for each man in the boat. Therefore, when the owner is part of the fishing crew, he receives two shares of the catch.

The sale price of fish is controlled in both islands, but the regulations are seldom adhered to. Legislation in Martinique has divided edible fish into four categories (appendix II) priced respectively at 45, 41, 28 and 18 cents per pound (65). Saint Lucian authorities have established three categories for fisheries products (appendix III) priced at 23, 20 and 17 cents per pound, with a 3 cent additional charge for frozen fish, gutted and cleaned (88).

The estimation of revenues used in this analysis does not include income derived from sources other than fishing. This is a major problem in assessing the annual earnings of traditional fishermen, for with a few exceptions, they spend varying lengths of time as plantation labourers, road workers or employed in other capacities. Also, in many cases, they derive small profits from their own small subsistence farm plots.

Therefore, income gained from other sources may be used to purchase fishing equipment, and may indeed provide most of the initial capital to undertake fishing operations. However,

in this analysis, revenue estimates are based solely on fish production in order to establish whether or not the fishing industry is viable on its own.

Individual Viability in Martinique

A government subcommission on fisheries has prepared a cost-production summary for the yearly operation of a traditional canoe. Their evaluations, translated and converted to U.S. currency, are presented in table 17 (64).

The figures presented in table 17 give an indication of the annual catch needed to offset the costs postulated for the operation of a traditional canoe. However, valid as they are, these figures do not give a full picture of the extreme variations that exist within the industry.

Consequently, the balance sheet can be subjected to several modifications. In the cost column, the family allowance fees can be omitted as they are irrelevant to the operational costs. Also, the value of salaries paid in cash and fish can be left out, and an equivalent adjustment can be made in the production column.

The assessment of costs should include the minimum and maximum prices of the main pieces of equipment most frequently used, and the figures should represent the average number of items being utilized during the year.

The annual gas consumption figure must be calculated

TABLE 17

FISHERIES SUBCOMMISSION
YEARLY COST-PRODUCTION SUMMARY

Costs (dollars)		Production	
Fuel	320.00	Sale of Fish:	
Equipment Renewal	200.00	5,280 lbs. x 0.30 cents	
Enrollment Fees	160.00		$1,584.00
Payments, Boat-Motor	200.00		
Family Allowance Fees	40.00	Fish Taken Home:	
Maintenance	40.00	2,750 x 0.30 cents	
Salaries in Cash	624.00		$ 825.00
Salaries in Fish	825.00		
Totals	$2,409.00		$2,409.00

on the basis of the time spent at sea, and on the type of operation being undertaken. Therefore, as no two fishermen have exactly the same fishing habits, the estimate is at best arbitrary. Nevertheless, instead of rigidly fixing the cost at $320.00, a much truer estimate can be obtained by establishing probable minimum values based on field data average of 180 - 220 days at sea.

The subcommission overlooked the annual depreciation of the boat and motor. The Food and Agricultural Organization of the United Nations has set a standard scale of depreciation, for powered small craft, of $6\frac{2}{3}\%$ for the hull and the engine (44). Therefore, $6\frac{2}{3}\%$ of the basic purchase price of the boat and motor should be added to the cost column.

With the existing sharing arrangements, a boat owner will retain $\frac{1}{2}$ or $\frac{2}{3}\%$ of the catch depending on whether he is part of

a three or two man fishing crew. This works out to an average value of 56% which is comparable to the figure of 55% used by the fisheries subcommission in estimating the canoe owner's share of the annual production.

From the above, an owner's annual income from fishing operations is based on the retention of 56% of the canoe's yearly production, and the share allotted to the crew is included in the estimates of the total production needed to offset the operational costs.

The marketing structure creates complications in the calculation of revenue. In theory, fish is sold at four different market prices; in practice, the price is subject to the absolute control of the market women, and it fluctuates widely during periods of dearths and gluts. However, a sale price of 37 cents, as opposed to the commission's 30 cents, can be taken as an average.

Any estimate of production revenue must include the weight of fish needed to gain a profit after all expenditures have been offset. For Martinique, the per capita annual income in 1964 was set at $420.00 (71). Therefore, basic viability of canoe operations could be based on this amount.

A modified balance sheet incorporating the above changes is drawn up in table 18.

Field data fix the average daily catch between 20 and 80 lbs. Consequently, the daily amounts postulated in table 18

TABLE 18

ANNUAL COST-PRODUCTION
ESTIMATES FOR A TRADITIONAL CANOE IN MARTINIQUE

COSTS (dollars)

	Minimum	Maximum
Payments, boat and motor	200.00	250.00
Depreciation	25.00	70.00
Enrollment Fees	160.00	160.00
Fuel	300.00	370.00
Maintenance	20.00	40.00
Paint	10.00	40.00
Fish Pots	85.00	105.00
Bottom Lines	70.00	140.00
Box of Lines	90.00	100.00
Totals	960.00	1,275.00

PRODUCTION

To offset yearly minimum costs:	56% of 4,645 lbs.
To offset yearly maximum costs:	56% of 6,330 lbs.
To show a profit after costs:	56% of 2,031 additional lbs.
To offset minimum costs in 180 days:	26 lbs./day
To show a profit in 180 days:	37 lbs./day
To offset maximum costs in 220 days:	29 lbs./day
To show a profit in 220 days:	39 lbs./day
Total yearly weights for viability:	6,675 to 8,361 lbs.
Total daily weights for viability:	37 to 39 lbs.

can indeed be satisfied. Therefore, it would appear that, depending on the number of trips, daily catches averaging 37 to 39 lbs. would suffice to offset costs and allow a margin of profit that would be commensurate with the island's per capita income.

Working on this basis, the island's annual production should be shared according to table 19. Figures from the table infer that all the island's traditional fishing fleet can operate on a viable basis. However, in practice there are too many uncertainties attached to the operations of traditional canoes: boats remain beached for long periods of time; they often return with few, if any, fish: they use far more fuel than the figure in table 18 would suggest; and with the geographical variations in production, catch returns fluctuate widely.

Consequently, viability fluctuates widely throughout the islands, and remains a function of the individual equipment, work habits, and luck. Therefore, fishermen operate with a profit, some barely break even, and far too many operate at a loss.

Viability in Saint Lucia

Saint Lucian fishermen pay 13 cents more per gallon of gas, but as they tend to use smaller motors they utilize less fuel than their counterparts in Martinique. Also, equipment

TABLE 19

MARTINIQUE
ESTIMATED SHARING OF YEARLY CATCH AMONG THE TRADITIONAL SECTOR

Number of motorized craft:	440
Average weight per boat:	8,000 lbs.
Total weight for motorized canoes:	3,520,000 lbs.
Total annual production:	10,655,260 lbs.
Share of seine and non-motorized craft:	7,135,260 lbs.
Share of seine:	3,000,000 lbs.
Share of 650 non-motorized canoes:	4,135,260 lbs.
Share per non-motorized craft:	6,417 lbs.

is much less costly in Saint Lucia.

The sale of fish is subject to the same production fluctuations and market women controls that exist in Martinique. However, as the government fixes the price between 17 and 23 cents per pound, the average retail price is about 20 cents which is 17 cents less than the usual rate in Martinique.

The per capita income figure for Saint Lucia is much lower than the $420.00 quoted for Martinique. The most recent estimate showed that less than 2% of the population earned over $300.00 per annum (55). Therefore the present estimate of viability could be based on a figure of $300.00 per annum.

Using the same basic procedure as that employed in the study of viability in Martinique, a balance sheet showing cost estimates, and the production needed to affect the costs and earn a

profit, is drawn up in table 20.

Figures from the table reveal that a canoe must land 45 to 54 lbs. of fish per day to be viable after the outlined costs have been satisfied. Under present conditions, it is indeed possible to land such amounts as field data fix the daily catch between 20 and 80 lbs.

Viability would require that individual yearly catches be between 8,040 and 11,715 pounds. Therefore using an average of 10,000 lbs. per canoe, the island's 100 motorized canoes would have to bring in 1,000,000 pounds per annum.

With the production from the traditional sector fixed at 1,034,649 pounds, the production of 1,000,000 pounds by the motorized canoes would only leave 34,649 pounds as the total produced by the island's 462 non outboard boats (which includes inboard transoms and whalers) and the island's 11 seine nets.

The 11 seines may account for 100,000 pounds of the annual production. This would leave an annual production of approximately 1,895 pounds per craft not equipped with an outboard motor, and would represent a total yearly revenue of $379.00 per boat before deductions for operating costs. The calculations indicate that 100 motorized canoes would have to produce all but 34,639 pounds of the annual catch from the traditional sector. Clearly, this is not possible. Therefore, many motorized canoes must be operating outside the limits set in table 20.

TABLE 20

ANNUAL COST-PRODUCTION ESTIMATES
FOR A TRADITIONAL CANOE IN SAINT LUCIA

COSTS (dollars)

	Minimum	Maximum
Payments, boat-motor	100.00	150.00
Depreciation	25.00	42.00
Fuel	200.00	275.00
Maintenance	20.00	40.00
Paint	10.00	20.00
Fish Pots	60.00	100.00
Fish Nets	25.00	145.00
Bottom Lines	70.00	140.00
Box of Lines	90.00	100.00
Totals	600.00	1,012.00

PRODUCTION

To offset minimum costs:	56% of 5,360 lbs.
To offset maximum costs:	56% of 9,035 lbs.
To show a profit after costs:	56% of 2,680 additional lbs.
To offset minimum costs in 180 days:	29 lbs./day
To show a profit in 180 days:	45 lbs./day
To offset maximum costs in 220 days:	42 lbs./day
To show a profit in 220 days:	54 lbs./day
Total yearly weights needed for viability:	8,040 - 11,715 lbs.
Total daily weights for viability:	45 - 54 lbs./day

Although viability is possible, and indeed very probably, in individual cases, production figures seem to indicate that in general traditional operations are not very profitable.

Discussion

A viability range must, and can only, be established from a representative sample of daily income - expenditures, taken over a sufficient length of time. The data must reflect all the variables of the operation, and should be patterned on balance sheets such as those proposed by Hess (23) (see appendices IV and V for examples of these sheets).

Time prevented such an elaborate analysis during the present study. Nevertheless, the alternative method was to conduct field interviews, the results of which appear in tables 18 and 20.

Calculations for Martinique suggest that canoe operations can be viable. However, field checks indicate that viability varies widely in relation to production from region to region. Also, many canoes operate at a loss, and many fishermen would suffer greatly if they did not receive income from other endeavours.

Calculations for Saint Lucia clearly show that motorized canoes cannot produce enough fish to enable all of them to be viable; a fact substantiated by field checks which show that few canoes operate at a profit, and the owners must have alternative sources of income to survive.

CHAPTER 9

GOVERNMENTS AND TRADITIONAL FISHERIES

In the past decade, governments have shown a growing concern for the islands' traditional fisheries. Authorities have initiated aid schemes and have established schools to help train the fishermen. Government intervention has resulted in a relative margin of success in Martinique, but has failed completely in Saint Lucia.

In addition to aid schemes, the governments have participated in experiments designed to test the viability of heavier and sturdier craft which may eventually replace traditional canoes. Also, in Martinique, the government has actively supported fishermen's cooperatives and unions.

Aid Schemes in Martinique

Authorities in Martinique have initiated a number of schemes designed to increase the viability of the traditional sector of the island's fisheries. This aid has been given in the forms of loans, advice and participation in various experiments designed to improve techniques and equipment.

All aid schemes in Martinique originate from a government agency known as S.A.T.E.C. (Société d'Aide Technique) or Technical Aid Society, established in 1954.

One of S.A.T.E.C.'s most ambitious schemes was the

creation of an island wide cooperative for fishermen. This cooperative was founded in 1954 and was called S.I.C.O.M.A. (Société d'Intérêts Collectifs Maritimes) or The Society of Collective Maritime Interests (91).

S.I.C.O.M.A. lasted for ten years, ceasing its operations in 1964. During this time, S.A.T.E.C. contributed $32,000 to the project in one form or another, and the fishermen financed the rest of the costs by paying $40.00 a year in dues.

S.A.T.E.C. made its major contribution to S.I.C.O.M.A. by opening three cold rooms (Vauclin, Trinité, Saint-Pierre) in 1962, and two (Francois, Sainte-Anne) in 1963. Also, S.A.T.E.C. provided part of S.I.C.O.M.A.'s administrative staff with the balance originating from the ranks of the fishermen (64).

Membership in S.I.C.O.M.A. placed certain obligations on the fishermen. Notably, as soon as the cold rooms were installed, the fishermen were required to deposit a predetermined amount of fish for storage. This regulation created many conflicts which ultimately culminated in the liquidation of the cooperation (92).

Today the island wide S.I.C.O.M.A. has been replaced by local cooperatives that try to provide the lower cost gear formerly supplied by the larger organization.

In 1962, S.A.T.E.C. sponsored a mission to Barbados to study the use of gillnets for the exploitation of flying fish.

Several nets were brought back and put into use at Vauclin. The results were so disappointing that the project was dropped (64).

Also, in 1962 S.A.T.E.C. funds paid for the construction of a small experimental fishing boat. The boat was launched, but due to its poor design, it only operated for a few months before being scrapped. A second modified vessel was destroyed before launching in 1963 (ibid.).

Presently, S.A.T.E.C. is supporting the sea trials of experimental fishing crafts built by cooperatives at Carbet and Sainte-Luce. In addition, S.A.T.E.C. is providing loans to individual fishermen for the purchase of canoes and motors.

Fishermen receive additional aid in the form of social security. The enrollment fee of $160.00 insures compensation for the fisherman and his family in case of sickness or accident. Also, providing that the individual has spent sufficient time at sea, his annual payments will entitle him to a retirement pension.

Finally, the government provides coast guard service, a fisheries school and technical advice. Also, government inspectors tour the island examining canoes for their seaworthiness, and ensuring that they are all equipped with sufficient corking material that ensures buoyancy in case of upset at sea.

Aid Schemes in Saint Lucia

Authorities in Saint Lucia have not furnished as much

aid to fisheries as their counterparts in Martinique. Aid provided has been in the form of government intervention in the distribution of motors, and in the creation of a now defunct fisheries school.

In 1961, the government purchased 63 motors which were subsequently distributed to fishermen throughout the island. The motors were to be paid for in two years, on a monthly basis. Although this scheme was fairly successful, the government now either provides loans or arranges for motors to be imported duty free for firms who then make their own arrangements with the fishermen.

Also, in 1961 a Colonial Welfare and Development grant was approved to provide 20 medium sized (30 ft.) mechanized boats, to graduates of the Fishery Training School, on a hire-purchase plan (101). This scheme was implemented but failed completely.

Cooperatives and Syndicates

Cooperative and syndicated groups are to be found in Martinique only. After the liquidation of S.I.C.O.M.A. in 1964, three independent cooperatives were formed in Carbet, Sainte-Luce and Trinité.

The cooperative at Trinité is not very effective and is verging on extinction. However, each of the other two cooperatives is under the influence of parish priests whose interest

and devotion keep the cooperatives strong and active.

The government is subsidizing part of the financing of the cooperatives with the difference being derived from membership dues. The cooperatives' main activity is to obtain equipment in bulk, and then sell it at cost price to their members.

In addition, the priest at Carbet has built a radically new fishing craft which he is now testing, with a second one under construction. Also, experimental trials are scheduled to be conducted at Sainte-Luce with two new fishing boats to be provided and equipped by S.A.T.E.C.

Fishermen belong to one of two syndicates or unions. The first, La Compagnie Générale Transatlantique, accepts fishermen but is primarily a seafarers union. The second, Syndicat Indépendant des Marins Pêcheurs (S.I.M.P.) is composed solely of traditional fishermen.

This union accepts fishermen from all parts of the island. However, as it was only created in 1964 (63), and as it groups four, formerly independent unions from Fort-de-France, Sainte-Luce, Carbet and Trois-Islets, its main membership is found in these locations.

The union's chief aim is to better the lot of traditional fishermen (94), and to enlist as many members as possible to have the strongest bargaining power with the island's civil authorities. To date, the union has been slow in developing

and it is still in the stage of gathering members.

The union is asking for action on the following points: higher sale price for fish, the re-opening of the island's five cold rooms, the right to build canoe shelters on the beaches, and more and improved social security for the individual fisherman (62).

Fishing School in Martinique

Martinique's fishing school was opened by the government in 1957 and its administration was turned over to a private association in 1959. At its founding convention, the association outlined the following categories of membership: active members paying annual dues of $1.00, contributing members paying $25.00, and benefactors donating at least $10.00 (81).

Although the school is privately administered, the government continues to support the establishment. Also, interest and support is forthcoming from all associations and trade groups in the island which includes such organizations as harbour pilots and the association of seafaring pensioners (93). Furthermore, as the school accepts students from Guadeloupe and French Guiana, it also receives financing from these governments.

The school is administered by volunteers made up of active and retired seafaring personnel. As they accept little or no salary, the bulk of the school's funds are used for the purchase of equipment and for the salaries of the full time and part time instructors.

The school accepts pupils who are at least 14, but have not reached their 17th birthday. Prospective students must possess a primary school certificate, and must pass an entrance examination. Also, they are required to pay fees amounting to $6.00 per month (66).

Located in Fort-de-France in an unpretentious but adequately equipped building, and outfitted with two training boats and a smaller observation craft, the school offers courses which last nine months.

The boys receive the same training as their counterparts in Metropolitan France. Courses are divided into two parts, theoretical and practical. Some ten hours per week are used for instruction in academic subjects and in the theories of navigation, boating, mechanics and fishing techniques. The rest of the time, 20 - 25 hours per week, is devoted to practical training in the school's two boats (77).

After completion of the nine month course, a few selected students are sent to France for further training while the rest are released to seek employment in the island's fishing industry. Unfortunately, the supply is greater than the demand, and as trained personnel have little interest in working with traditional canoes, the only alternatives are the deep-sea fleet (six small boats) and the merchant marine.

Despite the lack of suitable job opportunities, the school continues to train young boys, and is now making a con-

centrated effort to finance youngsters from outlying communes that cannot afford to pay for their own training at Fort-de-France (82).

In the period 1959 to 1964, 125 students completed the course. Of these, only 7 filtered back into the island's traditional or deep-sea fishing sectors. Of the remainder, 52 have found employment with shipping concerns, 10 are in the army, 9 are in France for further training, 10 stayed in France after training, and 10 gave up fishing for land based jobs. The other 27 are unaccounted for (83).

As only 5.6% of the students are employed in fishing, the school authorities have considered discontinuing the school. However, even though the youths are lost to fishing, their training allows them to make valuable contributions in other sectors of the economy, and therefore the school will remain.

Also, authorities are watching the fishing experiments, being conducted in the island, with great anticipation. They hope to find the right type of craft to replace the canoes, and consequently provide school graduates with many challenging job opportunities.

Fishing School in Saint Lucia

The Saint Lucia Fisheries School opened in 1959 and ceased operation in 1962. Located at Vieux Fort, the school was housed in a building, formerly belonging to the United States

Air Base, converted to provide classrooms, workshops, dormitories, and all other facilities for a self-contained unit (10).

Throughout its existence, the school came under the control of the government who appointed a Canadian principal and two Saint Lucian instructors. The school also had a permanent domestic staff of three (98).

Eight of the original ten students in the first course completed their training in December 1959. These students took theoretical and practical training in all aspects of motorized fishing, and built the school's first two boats (99).

By the Summer of 1960, the first two classes were being recalled for further practical training, and an experimental fisheries boat, the "Caranx", was being outfitted in Castries for use by the school (100).

By February 1962, the school had provided instruction for two classes totalling some 25 men. This total fell short of the expected 65 candidates, and for a variety of reasons the school closed its door during this month (102).

The twenty-five graduates from the school were given an equivalent number of boats and inboard motors, on a hire-purchase plan, to carry out fishing with the techniques learned at the school. This scheme failed. The boats are now rotting on a beach in Castries, and the motors are rusting in a government storage shed.

Today, other than the decaying material, there is

little indication of a school ever existing in Saint Lucia. The graduates have either abandoned fishing or turned to traditional ways. The building at Vieux Fort is abandoned, and the research boat "Caranx" has sunk.

In 1965, a group of fisheries authorities from Martinique undertook a study trip to Saint Lucia. Their mission was to assess the feasibility of salvaging and buying one or two of the school's boats for experimental trials in Martinique.

From their findings, they postulated that the school failed because it provided poor sailing craft and poor training for the fishermen taking the courses. It was their opinion that the boats were too large for coastal fishing, too small for deep-sea fishing, and in general too under-powered (97).

Fisheries Experimentation in Martinique

Among the many small boats tested to replace the canoes and yoles in Martinique, two are viewed as possible contenders. The first, a radically new design known as the "Catamaran", has yet to be fully tested, but promises to be very efficient for coastal fishing.

The second, called a "Pointu" (Plate 20) has been used experimentally in Martinique and Guadeloupe. This type of craft is a little over 18 feet long and 4 feet wide, and is equipped with an inboard motor and a large storage space for iced fish.

20 - The experimental "Pointu" boat.

In Martinique, trials with the "Pointu" were conducted at Trinité during a nine month period extending from July 1964 to March 1965. During this time, the boat made 67 trips which resulted in the landing of 12,507 pounds of fish or an average of 187 pounds a trip (80).

The fish was sold at an average price of 28 cents per pound. Therefore, total revenue was $3,612.00. Operation costs amounted to $272.00 leaving a profit of $3,340.00. The profit was divided into two equal parts. One half ($1,670.00) went to the crew. The other half ($1,670.00) was used to liquidate overhead and sundry costs, and to pay part of the boat's original all inclusive cost of $7,045.00 (ibid.).

The "Pointu" has also undergone several trials in Guadeloupe. In a 12 month period extending from May 1963 to April 1964 such a craft undertook 96 fishing trips in Guadeloupe's water.

A total of 35,770 pounds of fish were landed to give an average per trip of 367.9 pounds. The catch was sold for $7,583.00 of which only $284.00 was needed to offset operational costs. This left $7,299.00 part of which ($3,778.00) was shared among the crew, and the remainder ($3,521.00) was used to offset overhead costs and as partial payment for the original cost of the boat (48).

Authorities in both islands are extremely pleased with the results obtained with the "Pointu" type craft. Clearly,

fishing operations conducted under these conditions are very viable. However, as authorities feel that many improvements can be made in the specifications of the boat, the outcome of further experiments, will be awaited before final recommendations are made to the fishermen to help them choose new boats.

Fishery Experimentation in Saint Lucia

Practically the only legacy of value left by the Saint Lucia Fisheries School has been the results of a fisheries experiment conducted in 1961. Two boats, constructed at the school, were manned on a cooperative basis by graduates of the two courses given in 1959-1960 (57).

Boat number 1 was active for two months only. However, boat number 2 operated for four months from December 1960 to March 1961. During the time, boat number 2 made 62 trips landing 5,725 pounds of fish or an average of 92 pounds per trip.

All fishing activity was conducted on the banks located off Vieux Fort (figure 6) by four man crews who cleaned and gutted all fish at sea prior to landing. Unfortunately, no account was kept of the economics of the operations.

Nevertheless, it was concluded that the experiments revealed that the individual income of a crew member could be increased by 50 to 100%. However, overall viability would require some 200 days of fishing per year, and the assurance of a well organized and consistent distribution system (ibid.).

Discussion

The calculations for Martinique infer that canoe operations can be viable. However, the figures can be misleading as field checks indicate that many canoes operate at a loss, and many fishermen would suffer greatly if they did not receive income from other endeavours.

Calculations for Saint Lucia clearly show that motorized canoes cannot produce enough fish to enable all of them to be viable: a fact substantiated by field checks which show that few canoes operate at a profit, and the owners must have alternative sources of income to survive.

Authorities, in both islands, are faced with the problem of changing a traditional non viable industry into a profitable modern commercial operation. This is a task which can be accomplished by the introduction of new methods and equipment. However, the governments cannot force new techniques and equipment on the people (3), thus new developments must be fitted wherever possible into the organizational principles of the traditional fishermen (28). Therefore, authorities can only propose new ways, and wait for the fishermen's approval.

Neglect of these facts may have caused the closing of the school in Saint Lucia, and the subsequent reclaimation of the equipment that had been leased out. Following these failures, the fishermen reverted back to their original methods which they

will continue to use until internal or external aid is once again put at their disposal.

On the other hand, authorities in Martinique proceeded with caution and the industry is slowly moving towards re-organization. The unions and cooperatives are fighting for a better marketing system, and a more equitable price structure. Also, experiments with new boats have proven to be viable, and as soon as the fishermen accept the new boats, a well organized efficient school is waiting to train them.

CHAPTER 10

PRESENT POSITION AND FUTURE PLANS

According to gross domestic production estimates, the fishing industry is ranked fifth in Martinique (70) and fourth in Saint Lucia (96).

Economic activities associated with the islands' fisheries are all carried on at a very small scale. They include boat building, motor repairs, equipment suppliers and very small export industries.

Neither island is self sufficient in fish production. Consequently, there are substantial imports of fisheries products which could be reduced if the traditional fishermen were better trained and equipped.

Authorities in Martinique are working towards this goal by participating in the aid schemes discussed in the previous chapter, and by formulating long range plans for a period extending to 1970. On the other hand, Saint Lucian officials have no immediate or future projects in view, but they are willing to participate in a Caribbean wide training scheme initiated by the United Nations.

Activities Associated with Fisheries

There are no industries or services in these islands whose success depends entirely on the needs of the fishing

industries. On the contrary, the fishing industries make irregular demands on the resources of the boat builders, repair shops and retail outlets.

Most builders of traditional boats are craftsmen who spend the greater part of their time at other occupations, building the occasional boat when a contract is received. Also, as a traditional craft can last beyond twenty years, and as fewer new boats are required every year, the trade is declining and its adherents are turning to other professions.

Saint Lucia has one boat building shop in Castries that specializes in the building of larger planked boats. Some of its trade is derived from the fishing industry, but most of it is involved with construction and maintenance of the island's coastal commercial vessels.

Private concerns, located within the limits of the port of Martinique's capital, are equipped with all the modern apparatus needed to build and service small deep-sea vessels. A fraction of their trade is derived from fisheries with the greater part of their activities catering to the deep-sea commercial and pleasure craft trade.

The demand for outboard motors and imported fisheries equipment is not large enough to support commercial outlets dealing exclusively in these products. Therefore, dealers who sell these items normally handle large quantities of other goods.

By the same token, there are no service establishments

wholly devoted to the maintenance of traditional fishing gear. Motors are generally overhauled in local service stations, and the boats and fishing equipment are repaired on the beach generally by the fishermen themselves.

The presence of substantial lobster resources on Martinique's Atlantic Coast has generated a small export industry. Ships from metropolitan France first exploited these resources in the 1950's (11). Later, in the 1960's local business groups began exporting live lobsters to France.

S.I.C.O.M.A. participated in the lobster export trade for one year from 1963-1964. During this time, it sent several shipments abroad bringing substantial profits to the fishermen in the Vauclin and Trinité areas (90).

From time to time, the possibility of using Martinique as a base for foreign fisheries operations has been set forth. One scheme, requiring financial cooperation from Martinique, was proposed by a California tuna canning firm. This company wanted to construct storage facilities in Fort-de-France to receive African tuna, that would have been brought in by French fishing vessels, to be stored until shipped to the United States (101). No action was taken on this proposal.

Recently, a Japanese organization has approached the government of Martinique seeking permission to establish a giant tuna canning factory at Trinité. The tuna would be supplied by Japanese vessels operating from Trinité, and a good deal of the

labour required in the plant would come from the local populace.

This proposal, still being debated, has been received with mixed feelings. On the one hand there are dangerous political overtones to the project as the plant could flood the European Common Market with cheap Japanese tuna. Also, the presence of a large group of foreigners operating a commercial establishment in Martinique is viewed with some alarm.

On the other hand, such an operation would create many badly needed employment opportunities for the residents of the Trinité area. Consequently, final decisions have not yet been taken on the matter.

The fishing industry offers very few full time employment opportunities. For, of the 10,000 new jobs envisaged by the island's fourth five year plan, none was to originate from the fisheries sector of the economy (16).

Fisheries Imports

As discussed in Chapter 4, fish is an extremely important part of the stable diet of the large majority of the populations of these islands. Although fisheries products are more readily available than meat products, the islands cannot supply their own fisheries needs, and must import both fresh and processed fish.

In the period 1960 to 1963, Martinique imported an average of 6,677,000 pounds of processed fish per annum, mainly

in the form of salt cod (73). This amounted to slightly more than one pound of imported processed fish for every two pounds of fish produced by the traditional sector.

During the same period, Saint Lucia imported a yearly average of 513,615 pounds of processed fish, also consisting mainly of salt cod (86). By coincidence, the imports represented the same approximate ratio of processed to fresh fish as found in Martinique.

More than 90% of the imported processed fish is salt cod. Therefore, due to the nature of this product, it is necessary to convert processed weight back to landed weight to obtain an indication of the local production necessary to affect the imports. This can amount to 3.7 pounds of fresh cod for every pound of processed cod (25).

Consequently, as the islands import nearly 1½ pounds of fish for every two they produce and as 3.7 pounds of fish are needed to replace one pound of salt cod, the local fisheries industries would practically have to increase their catch fourfold to eliminate fish imports.

Even if local production could completely supply demands, the islands would continue to import fresh and processed fish. The fresh fish would be needed in times of scarcity; and the processed fish would include speciality products not available in the islands, and salt cod which has become a national West Indian dish.

Nevertheless, increased local production is needed to replace the supplies landed by foreign vessels, to furnish more fresh fish to the people on a local basis, to conserve valuable foreign exchange, and to increase the viability of the traditional sector of the islands' fisheries.

Government Plans in Martinique

The French government formulates five year plans for the development of the nation's economy. Consequently, as Martinique is a department of France, five year plans are also drawn up for the island, by local officials.

During the island's fourth plan, which covered the period up to 1965, the governments had hoped to increase production and employment within the fisheries sector of the economy. To do this, the government participated in the aid schemes discussed in the previous chapter (64).

The fifth plan, for the period 1966-1970, calls for increased government participation in the testing of fisheries equipment and method. Also, the plan proposes that a fisheries research laboratory be established in Martinique to serve all the French dependencies in the Caribbean (ibid).

In addition, as soon as suitable boats are available to replace the canoes, the government might build several new ports equipped with modern docking facilities, which would facilitate the handling of produce and general cargo.

The United Nations in the Caribbean

In 1962, a United Nations special mission was sent to the Caribbean to examine the possibility of "Special Fund" support in assisting in the development of the area's fisheries. The commission recommended that the United Nations support a regional fishery project encompassing all the islands located in the Caribbean (32).

The United Nations accepted the commission's recommendations, and decided to implement a three part project including: a first phase of exploratory fishing, a second phase of market research, and a third phase of fishermen training (ibid.).

Presently, headquarters for the project have been set up in Bridgetown, Barbados.[22] The director has spent the period from 1964 to 1965 contacting the governments of the various islands and signing them up for the project. So far all except Haiti and the Dominican Republic have agreed to the scheme.

The project will be jointly financed by the United Nations and the governments of the islands involved. The governments are required to assist the United Nations with legislation, shore based facilities, the selection of candidates for training, and the contribution of part of the funds.

For its part the United Nations is now engaged in a

22. The following information stems from an interview with H.C. Winsor, Director of F.A.O. in the Caribbean.

preparatory year (1965-1966) during which plans were to be finalized for the purchase of four training boats to be built in northern countries not yet selected.

The United Nations will provide trained personnel from such countries as Japan, Norway and Canada, to staff its facilities and train the fisheries candidates. Plans also call for the training of shore based marketing and fisheries officers.

The project should be implemented during a three year period from 1966-1969. The Caribbean will be divided into two geographically independent units: one extending from the waters adjacent to South America to Puerto Rico, and the other including all islands located north and west of Puerto Rico.

Phase one will last approximately one year and will primarily be involved with the training of a few fishermen. Phase two and three will then be combined with phase one for the two remaining years. These last two years will be devoted to training fishermen, marketing personnel and fisheries officers.

Throughout the project, the United Nations will provide courses in Jamaica, and will conduct full fledged fishing operations during the practical side of the training programme.

The production from the sea trials will be marketed by the United Nations throughout the Caribbean, and part of the proceeds from the sales will be surrendered, on a proportional basis, to the participating governments to help them offset the costs of their contributions.

Discussion

It is generally recognized that the waters of the Caribbean are not overfished, and that it is possible to expand present Caribbean fisheries (22). Moreover, there are several fishing grounds which are relatively unused (51).

Consequently, if the islands are equipped with suitable fishing crafts capable of undertaking extended fishing trips, the annual fish production for any island should increase. However, a quantitative assessment of all local fisheries resources should be undertaken before plans are made to radically change the fishing fleets of the individual islands.

Resource appraisal is a vital prerequisite to the developing of fisheries industries. For the presence or absence of sufficient fish in "home" waters will determine whether the fleet should operate locally or at considerable distances from their home ports.

For example, the island of Jamaica is already exploiting to their limits the fisheries resources on its narrow continental shelf. Therefore, development for the island should hinge on the creation of a fleet of boats capable of sustained deep-sea fishing (61).

Although little is known of the actual quantities of the resources available to Martinique and Saint Lucia, it is believed that the waters around, and within 200 miles east of, these islands can support the operations of fleets of small inboard

powered fishing crafts. Therefore, all present plans are devoted to the creation of such fleets.

Although the government of Martinique is participating in the United Nations' scheme, authorities on the island are relying on their own abilities to develop their fisheries. However, cooperation with the United Nations can only strengthen the projects now under way in the island.

On the other hand, an island such as Saint Lucia, having failed in its own attempts to improve fisheries, is a territory which is ripe for the project to be implemented by the United Nations.

In the smaller islands, the United Nations faces a very difficult task in the years ahead. Any attempt to re-organize the marketing system will conflict with long established patterns, and may also face a degree of obstruction from the monopolies that control the sale of imported fish (20).

Another problem will arise from the people who are to be trained as fishermen. At first, younger candidates will be chosen. However, they may be difficult to recruit as few youths are enthusiastic over a career in fishing. Also, if the project is to have any margin of success, there will have to be exact coordination between the training of fishermen and the creation of jobs to absorb the trainees.

If the training of older fishermen is undertaken,

both the government in Martinique and the United Nations elsewhere will encounter a lot of resistance and apprehension brought about by a lack of education and by the very individualistic character of the fishermen (35).

The fishermen's attachment to their traditional ways is held to be largely responsible for the failure of improvement schemes in the past (76). Consequently, the fishermen will have to be educated to understand the importance of new techniques which will have to be accepted on the recommendations of the fishermen themselves.

The experience of the fishing industry in Barbados has shown that a traditional industry can be converted into a modern viable enterprise (2) (26). Therefore, it should be possible for official agencies to bring about considerable changes in Martinique and Saint Lucia providing that they proceed with caution and patience in their undertakings.

CONCLUSION

Studies to date indicate that the islands have basically the same marine environment which yields a multiplicity of species regionally and seasonally. Therefore, fishermen have evolved parallel equipment and techniques to exploit similar bases, and they have maintained their traditions mainly because of historical inertia and, until very recently, of the indifference of local governments.

Fishermen come from the ranks of the peasants who have alternative employment opportunities especially in agriculture, and in other unskilled work categories. Therefore, the fishing industry must compete with other segments of the economy to obtain its labour. This is evident by the fact that where work opportunities increase in agriculture, employment decreases in fisheries. However, in areas where fishing returns are very good, the industry succeeds in attracting sufficient labour despite the opportunities in agriculture.

Martinique with only double the fishermen produces eleven times the weight of fish landed in Saint Lucia. This is due primarily to the availability of more landing sites in the wide shelf areas, and to a concentration of fishermen in these regions that amounts to 11 times the number fishing in Saint Lucia's most productive waters.

Both islands face identical marketing problems. The supply is highly oriented to satisfying the demands of the residents of prime landing sites, and more important to fill the needs of the inhabitants of the islands' capitals. Consequently, there is an irrational distribution of fish which results in the islands' residents having unequal opportunity to obtain this product.

Traditional fishing is not a viable undertaking. It is sustained by an uncertain resource base, it employs inefficient tools and techniques, and it produces erratic quantities of fish that must supply a traditionally acceptable but outdated market system. Consequently, government officials, especially in Martinique are increasing their efforts to institute many needed changes.

After many failures, Martinique's authorities hope to introduce the "pointu" as a substitute for the canoe, and Saint Lucia's officials have decided to wait for aid from the United Nations. However, before any large scale changes are made, an appraisal of the location of fishing industry is warranted.

The present analysis of the distribution of fishing activity reveals several associations between the location of boats and a number of different variables. However, due to the lack of measurements for many fundamental parameters, a full explanation cannot be given for the areal differences in fisheries activity. In fact, the fullest possible understanding of the distribution of fishing activity will never be achieved until an

assessment is made at the individual fisherman's level where human perception and behaviour matter a great deal, and where geographic assessments generally stop (7).

In a sense, the government in Martinique is already accounting for human behaviour by its support of unions and cooperatives. For as these organizations grow stronger, it is hoped that they will generate a dedicated interest for fishing operations. Slowly, the government is encouraging the co-operatives to test new fishing vessels. These experiments are proving successful, and if the fishermen decide to adopt these economically viable boats, these crafts should provide the back-bone of a new traditional fleet.

The decision to change must be made by the fishermen, but once it is taken it will pose many serious problems. For in as much as the combination of certain variables account for the present distribution of canoes, the introduction of swifter, larger vessels will create a whole new set of location parameters. Therefore, it is most probable that in many areas, the introduction of new boats will force many fishermen to cease operations, sign on another boat as crewmen or continue to operate at a subsistence level.

Consequently, as the governments will administer the subsidies needed to launch the new fleets, they should exercise their control by careful planning in the selection of areas for the location of the new boats, and should arrange for proper

education and training to accompany the change over. Finally, as the new fleets increase, the islands marketing structures and facilities will have to be reorganized in order to obtain maximum sanitary distribution of the expected higher productions.

BIBLIOGRAPHY

I. Books and Articles

(1) Augier, F.R., et al. : The Making of the West Indies. Longmans, 1961, 310 pp.

(2) Bair, R.A. : The Barbados Fishing Industry. Unpublished M.A. thesis, Dept. Geog., McGill University, 1962, 83 pp.

(3) Beaglehole, E. : "Cultural Factors in Economic and Social Change". International Labour Review, Vol. 69, January - June, 1954, 415-432.

(4) Beaugé, L. : Océanographie Technique de la Pêche. Paris Editions Maritimes et Coloniales, 1957.

(5) Benoit, J. : "Individualisme et Traditions Techniques Chez Les Pêcheurs Martiniquais". Les Cahiers d'Outre-Mer, Tome XII, 1959, 265-285.

(6) Breen, H.H. : St. Lucia Historical, Statistical and Descriptive. Longman, Brown, Green, and Longmans, 1844, 423 pp.

(7) Brookfield, H.C. : "Questions on the Human Frontiers of Geography". Economic Geography, Vol. 40, No. 4, October, 1964, 283-303.

(8) Brown, H.H. : The Fisheries of the Windward and Leeward Islands - A Report - Advocate Co. Ltd., Bridgetown, 1945.

(9) Burdon, K.J. and Williams, R.P. : Microbiology, Fifth edition. Macmillan, New York, 1964, 772 pp.

(10) Calvert, R. : "Training Fishermen in the Windwards". The Windwards Annual 1962, Letchworth Publishing Agency Ltd., Hertfordshire, 46-48.

(11) Delaunay-Belleville, A. : Choses et Gens de la Martinique, Deuxième édition. Nouvelles Editions Debresse, Paris, 1960, 350 pp.

(12) Delawarde, J.B. : Le Prêcheur. R. Buffault Imprimeur, Paris, 1936, 102 pp.

(13) de Roux, A. : La Pêche en Martinique. Atelier d'Urbanisme Antilles Guyane, Fort-de-France, 1964, 61 pp.

(14) de Roux, A. : Les Anses D'Arlets, Plan d'Urbanisme Directeur, Rapport Documentaire. Atelier d'Urbanisme Antilles Guyane, Fort-de-France, 1964, 52 pp.

(15) de Roux, A. : Schoelcher, Projet d'Urbanisme Directeur, Rapport Documentaire. Atelier d'Urbanisme Antilles Guyane, Fort-de-France, 1965, 70 pp.

(16) Desportes, G. : "L'Economie Martiniquaise Devant La Poussée Démographique". Les Cahiers de la Société D'Etudes Démographiques et Sociales de la Martinique, Première Série, février, 1963, 19-27.

(17) Foote, D.C. and Greer-Wootten, B. : An Approach to Systems Analysis in Cultural Geography. Unpublished paper prepared for the General Session in Cultural Geography, Annual Meeting of the Association of American Geographers, Toronto, August, 1966, 11 pp.

(18) Fosberg, F.R., Garnier, B.J. and Küchler, A.W. : "Delimitation of the Humid Tropics". The Geographical Review, Volume 51, No. 3, July, 1961, 334-347.

(19) Frobisher, M. : Fundamentals of Microbiology, Seventh Edition. W.E. Saunders Company, London, 1963, 610 pp.

(20) Guérin, D. : The West Indies and their Future. Dennis Dobson, London, 1961, 192 pp.

(21) Hess, E. : "Fresh Fish Handling and Distribution Problems". West Indies Fisheries Bulletin, No. 5, Sept./Oct., 1959, 1-16.

(22) Hess, E. : "Fisheries Problems in the West Indies". West Indies Fisheries Bulletin, No. 2, March/April, 1960, 1-10.

(23) Hess, E. : "Operating Costs of Small Mechanized Boats". West Indies Fisheries Bulletin, No. 2, March/April, 1961, 1-8.

(24) Hess, E. : "The Fisheries of the Caribbean Sea". Atlantic Ocean Fisheries, ed. G. Borgstrom and A.J. Heighway, Fishing New (Books) Ltd., Ludgate House, London, 1961, 213-222.

(25) Hess, E. : "Fish Consumption in the West Indies in Relation to Production and External Fish Trade". West Indies Fisheries Bulletin, No. 2, March/April, 1962, 1-16.

(26) Hess, E. : Barbados Fisheries Development Programme 1961-1965. Barbados Government Printing Office, Bridgetown, 1965, 42 pp.

(27) Horowitz, M.M. : "Metropolitan Influences in the Caribbean: The French Antilles". (Social and Cultural Pluralism in the Caribbean, ed. O.V. St. Whitelock et al) Annals of the New York Academy of Sciences, Vol. 83, Art. 5, 1960, 802-808.

(28) Hoselitz, B.F. : "Problems of Adapting and Communicating Modern Techniques to Less Developed Areas". Economic Development and Cultural Change, Vol. 2, 1954, 249-268.

(29) Jesse, C. : The Amerindians in St. Lucia. St. Lucia Archaeological and Historical Society, Castries, 1960, 17 pp.

(30) Jesse, C. : Outlines of St. Lucia's History. St. Lucia Archaeological and Historical Society, Castries, 1960, 74 pp.

(31) Jourdain, E. : Le Vocabulaire du Parler Créole de la Martinique. Librairie C. Klincksiek, Paris, 1956.

(32) Kasahara, H. and Idyll, C.P. : United Nations Special Fund Caribbean Fishery Mission, Report for the Managing Director. United Nations, New York, 1962.

(33) Labat, J.B. : Nouveau Voyage aux Isles de l'Amérique. J.B. Delespine, Imp. Lib., Paris, Huit Volumes, 1742.

(34) Laevastu, T. : "Natural Bases of Fisheries in the Atlantic Ocean: Their Past and Present Characteristics and Possibilities for Future Expansion". Atlantic Ocean Fisheries, ed. G. Borgstrom and A.J. Heighway, Fishing New (Books) Ltd., Ludgate House, London, 1961, 18-39.

(35) Laserre, G. : La Guadeloupe. Union Française d'Impression, Bordeaux, 1961, Deux Volumes, 1135 pp.

(36) Lee, D.H.K. : Climate and Economic Development in the Tropics. Harper, 1957, 182 pp.

(37) Lewis, J.B. : "Tagging Experiments on the Flying Fish Herundichthys Affinus (Gunther)". Bulletin of Marine Science of the Gulf and Caribbean, No. 14, 1964, 381-386.

(38) Lowenthal, D. : "The Range and Variation of Caribbean Societies". (Social and Cultural Pluralism in the Caribbean, ed. O.V. St. Whitelock et al) Annals of the New York Academy of Sciences, Vol. 83, Art. 5, 1960, 786-795.

(39) McCarty, H.H., Hook, J.C. and Knos, D.S. : The Measurement of Association in Industrial Geography. Department of Geography, State University of Iowa, Iowa City, 1956, 143 pp.

(40) McKusick, M.B. : "Aboriginal Canoes in the West Indies". (Papers in Caribbean Anthropology, compiled by S.W. Mintz, Nos. 57-64) Yale University Publication in Anthropology, No. 63, Dept. of Anthropology, Yale University, 1960, Section 64: 1-11.

(41) Morgan, R. : World Sea Fisheries. Metheun and Co. Ltd., London, 1956, 307 pp.

(42) Morice, J. and Cadenat, J. : Fisheries in the Caribbean, Report of the Fisheries Conference Held at Kent House, Trinidad, March 24-28, 1952. Caribbean Commission Central Secretariat, Kent House, Port-of-Spain, 1952, 102-121.

(43) Morice, J. : "Thons et Bonites des Antilles". Science et Pêche, No. 6, 1953, 1-6.

(44) Ovenden, A.E. : Costs and Earnings Investigations of Primary Fishing Enterprises, F.A.O. Fisheries Study No. 10. Food and Agricultural Organization of the United Nations, Rome, 1961, 60 pp.

(45) Paquette, R. : An Analysis of Concentration and Dispersal of Settlements in Martinique and Saint Lucia. Unpublished M.A. thesis, Dept. Geog., McGill University, 1965, 181 pp.

(46) Parry, J.H. and Sherlock, P.M. : A Short History of the West Indies. Macmillan and Co. Ltd., London, 1956, 316 pp.

(47) Pierce, B.F. : "The Ethnic Factor in Biotechnology". Economic Development and Cultural Change, Vol. 14, No. 2, January, 1966, 217-229.

(48) Pioch, F. : L'Expérience des Canots de Types "Pointu". Service de Pêche, Satec Guadeloupe, Pointe-à-Pitre, Le 11 mai, 1964, 5 pp.

(49) Prudhomme, M. : Inspection Sanitaire des Poissons, Mollusques et Crustacés Comestible de l'Eau Douce et de la Mer. Vigot frêres, Editeurs, Paris, 1957.

(50) Revert, E. : La Martinique. Nouvelles Editions Latines, Paris, 1949, 588 pp.

(51) Salmon, G.C. : F.A.O. Report No. 781, Report on the Fisheries Industry in the Countries Served by the Caribbean Commission. Translated from French and printed by the Central Secretariat Caribbean Commission, Port-of-Spain, Trinidad. (Originally F.A.O. 58/3/22781) Rome, March 781, 1958, 86 pp.

(52) Seité, A. : "La Pêche dans les Départements d'Outre-Mer". Marchés Coloniaux du Monde, No. 557, 14 juillet, 1956, 1925-6.

(53) Snedecor, G.W. : Statistical Methods. Iowa State College Press, Ames, 1956.

(54) Springer, S. : "Tuna Resources of the Tropical and Sub-Tropical Western Atlantic". Transactions of the American Fisheries Society, Eighty-Fifth Annual Meeting, Georgia, Sept. 14, 15, 16, Vol. 85, 1955, 13-17.

(55) Starkey, O.P. : Commercial Geography of Saint Lucia. Office of Naval Research, Technical Report No. 8, Indiana University, Feb., 1961, 15 pp.

(56) Sylvestre, E. and Lotaut, E. : Annuaire de la Vie Martiniquaise. Imprimerie Officielle, Fort-de-France, 1947, 311 pp.

(57) Taylor, G.T. : "An Experiment in Fisheries Cooperatives". West Indies Fisheries Bulletin, No. 6, Nov./Dec., 1961, 1-9.

(58) Thomas, E.N. : Maps of Residuals from Regression : Their Characteristics and Uses in Geographic Research. Department of Geography, State University of Iowa, Iowa City, (No. 2), 1960, 60 pp.

(59) Walford, L.A. : Living Resources of the Sea. The Ronald Press Company. New York, 1958, 321 pp.

(60) Whiteleather, R.T. and Brown, H.H. : An Experimental Fisheries Survey in Trinidad, Tobago and British Guiana. Anglo-American Caribbean Commission, United States Government Printing Office, Washington, 1945, 130 pp.

II Bulletins, General Reference Works, Reports

(61) A Brief Historical Review of the Fishing Industry in Jamaica. Ministry of Agriculture and Lands, Division of Economics and Statistics, Hope, Jamaica, 1963, 27 pp.

(62) Bulletin de Liason No. 1, De l'Union des Syndicats Indépendants des Marins-Pêcheurs de la Martinique. Mai, Fort-de-France, 1964, 2 pp.

(63) Bulletin d'Information de l'Union Départementale des Syndicats Indépendants des Marins-Pêcheurs de la Martinique. No. 3, novembre, Fort-de-France, 1964, 4 pp.

(64) Cinquième Plan 1966-1970. 1) Sous-Commission Agriculture, Pêche et Forets, 1) Groupe de travail : Produits, g) Pêche, Fort-de-France, 1965.

(65) Classification et Prix des Poissons. Annexe à l'Arrêté Préfectoral, No. 64-1759 du 3/12/64, 2 pp.

(66) Conditions d'Admission, Ecole de Pêche et d'Apprentisage Maritime de Fort-de-France. Ecole de Pêche, Fort-de-France, 1959, 1 page.

(67) Demographic Yearbook 1964, Sixteenth Issue. Statistical Office of the United Nations, United Nations, New York, 1965.

(68) F.A.O., Yearbook of Fishery Statistics, Catches and Landings. Food and Agriculture Organization of the United Nations, Volume 18, 1964.

(69) Fishery Office Official File : Number of Outboard Motors Used by Fishing Canoes. Dept. of Agriculture and Fisheries, Castries, 1964.

(70) La Martinique 1964. Préfecture de la Martinique, Fort-de-France, 1964, 128 pp.

(71) La Martinique 1964 : Quelques Chiffres. Préfecture de la Martinique, Fort-de-France, 1964, 1 page.

(72) Laws of Saint Lucia: Vol. I Titles I-X: Saint Lucia Revised Ordinances 1957. The Voice Publishing Co. (1953) Ltd., Castries, 1959.

(73) Le Commerce Extérieur de la Martinique de 1960 a 1963. Imprimerie des Editions Berger, Fort-de-France, 1964, 20 pp.

(74) Malings Compton Commission and Shipping Agent : Records of Venezuelan Fish Passing Through the Market at Castries in 1964. Castries, 1965.

(75) Mairie de Fort-de-France : Etat des Quantités de Poissons Entrées à la Poissonnerie de Fort-de-France. Fort-de-France, 1965.

(76) Notes et Etudes Documentaire : La Martinique. Département Français d'Outre-Mer, Secrétariat Générale du Governement, Direction de la Documentation, No. 2744, janvier, Paris, 1961, 76 pp.

(77) Notice de Renseignements Concernant les Ecoles d'apprentisage Maritimes. Publié par l'A.G.E.A.M., Paris, 1959, 6 pp.

(78) Official Record of Market Superintendent: Castries Market. Castries, 1965.

(79) Population des Départements d'Outre-Mer : Recensement de 1961. République Française, Institut National de la Statistique et des Etudes Economiques, Imprimerie des Journaux Officiels, Paris, 1962, 12 pp.

(80) Procès Verbal de la Réunion du Mercredi 14 avril 1965 sur les Problèmes de la Pêche. Ecole de Pêche, Fort-de-France, 1965, 5 pp.

(81) Procès Verbal de l'Assemblé Constitutive de l'Association de Gérance de l'Ecole de Pêche et d'Apprentisage Maritime de la Martinique. Ecole de Pêche, Fort-de-France, février, 1959, 3pp.

(82) Procès Verbal de la Troisième Assemble Générale de l'Association de l'Ecole de Pêche et d'Apprentisage Maritime de la Martinique. Fort-de-France, 24 mai, 1964, 5 pp.

(83) Rapport Moral de la Troisième Assemble Générale de l'Association de l'Ecole de Pêche et d'Apprentisage Maritimes de la Martinique. Fort-de-France, 24 mai, 1964, 4 pp.

(84) Résultats Statistiques du Recensement Général de la Population des Départements d'Outre-Mer: Effectué le premier juillet 1954. Antilles Française, République Française, Ministère des Affaires Economiques et Financières, Institut National de la Statistique et des Etudes Economiques et Financières, Presse Universitaire de France, Imprimerie national, Paris, 1956, 300 pp.

(85) Saint Lucia : Boat Registration Records. District Police Stations, 1964.

(86) Saint Lucia : Imports and Exports of Certain Commodities. Statistical Office, Castries, 1965.

(87) Saint Lucia : Official Boat Registration for the Castries Area in 1964. Office of the Harbourmaster, Castries, 1964.

(88) Saint Lucia : Statutory Rules and Orders, No. 3, 1965, Trade (Prices Control) (Amendment) Regulations. Government of St. Lucia, 15 Feb., Castries, 1965.

(89) Saint Lucia, Windward Islands, Population Census 1960, Volume II, Summary Tables. Central Statistical Office, Trinidad and Tobago, 1963.

(90) S.A.T.E.C. : Bulletin d'information des Cadres et Administrateurs. Imp. des Editions Berger, Fort-de-France, 1963, 60 pp.

(91) S.I.C.O.M.A. : Formation-Dénomination-Object-Durée-Siège Social. Ecole de Pêche, Fort-de-France, 1954, 18 pp.

(92) S.I.C.O.M.A. : Règlements Intérieurs. Ecole de Pêche, Fort-de-France, 1954, 5 pp.

(93) Statuts de l'Ecole de Pêche et d'Apprentisage Maritime de la Martinique. Ecole de Pêche, Fort-de-France, 1959, 5 pp.

(94) Statuts du Syndicat Indépendant des Marins-Pêcheurs. Fort-de-France, 1964, 8 pp.

(95) Third Caribbean Fisheries Seminar : Document No. 1, Caribbean Fisheries Development 1955-1959. Prepared for the Third Caribbean Fisheries Seminar, St. Marteen, Netherland Antilles, July 3-9, 1959, Caribbean Commission, Kent House, Port-of-Spain, 1959, 43 pp.

(96) University of the West Indies : An Abstract of Statistics of the Leeward and Windward Islands, and Barbados. June, 1964.

(97) Voyages d'Etudes de Marins-Pêcheurs Martiniquais à Sainte-Lucie. Syndicat des Marins-Pêcheurs, Sainte-Luce, juin, 1965, 5 pp.

(98) West Indies Fisheries Bulletin, (News from Federal Unit Territories) No. 5, Sept./Oct., 1959, 18.

(99) West Indies Fisheries Bulletin, (News from Federal Unit Territories) No. 1, Jan./Feb., 1960, 18-19.

(100) West Indies Fisheries Bulletin, (News from Federal Unit Territories) No. 4, Jul./Aug., 1960, 13-14.

(101) West Indies Fisheries Bulletin, (News from Federal Unit Territories) No. 1, Jan./Feb., 1961, 17-19.

(102) West Indies Fisheries Bulletin, (News from Federal Unit Territories) No. 1, Jan./Feb., 1962, 13.

III Base Maps

(103) Béringuer, C. : "Les Communes en Martinique". L'Espace Régionale Martiniquais, Les Cahiers du Centre d'Etudes Régionales, Antilles Guyane, Cerag, Cahier No. 3, Tome 1, 192 pp.

(104) Martinique : Carte Routière et Touristique 1:100,000. Ministère des Travaux Publics et des Transports, Institut Géographique National, Paris, 1957.

(105) Martinique : Hydrographic Chart No. 371, 1:79,700. British Admiralty, London, 1965.

(106) Martinique : World Aeronautical Chart, 1:1,000,000. The Aeronautical Chart and Information Center, St. Louis, 1962.

(107) Saint Lucia : Hydrographic Chart No. 1273, 1:72,000. British Admiralty, London, 1963.

(108) Saint Lucia : Topographic Map, 1:50,000. Directorate of Overseas Surveys, 1964.

(109) Sombrero to Dominica : Hydrographic Chart No. 955, 1:475,000. British Admiralty, London, 1962.

(110) The World, 1:39,283,000. Compiled and Drawn in the Cartographic Division of the National Geographic Society, Washington, 1965.

(111) Wust, G. : "Basins and Ridges of the Caribbean-Antillean Regions, One inch equals 150 miles". Stratification and Circulation in the Antillean-Caribbean Basins, Part One. Columbia University Press, New York, 1964, 201 pp.

APPENDIX I[23]

COMPARATIVE NOMENCLATURE

A PARTIAL LIST OF THE MOST COMMON SPECIES OF FISH FOUND IN THE WATERS SURROUNDING MARTINIQUE AND SAINT LUCIA

Creole Name	English Name	Systematic Name
Balaou	Halfbeak	Hemiramphus species
Banane	Bonefish	Albula vulpes Elops saurus
Barbue argenté	Red goatfish	Upeneus maculatus Polydactyla virginieus
Bayol	Red goatfish	Theutis hepatus
Bécune	Sennet	Sphyraema species
Blanche	Broad Slack	Gerres cinereus
Bonite	Bontio	Euthynnus alletteratus Auxis thazard
Brochet	Snook	Centropomus undecimalis
Carangue	Couvalli	Caranx species
Carite	Spanish Mackerel	Scomberomorus maculatus
Chirurgien	Doctor or Sword-fish	Acanthurus species
Coulirou	Goggle-eyed jack	Trachurops crumenophthalma
Couronné	Red Hind	Epinephelus species
Coutelas	Oldwife	Balistis vetula Chaetodon capistratus

Continued

23. This appendix combines the nomenclature used by Brown (8) for Saint Lucia, and by Jourdain (31) for Martinique. In all cases, the Creole name is commonly used in both islands and the English name is derived from Brown's work. However, the two authors often differ in their use of the species systematic name. Therefore, where this occurs, the first species name is that proposed by Brown and the second by Jourdain.

APPENDIX I

Continued

Creole Name	English Name	Systematic Name
Demoiselle	Oldwife	Balistis vetula Chaetodon capistratus
Grand écaille	Tarpon	Tarpon atlanticus
Lune	Moonfish	Argyreiosus vomer
Mullet	Mullet	Mugil species
Poule	Guineaman	Cypselurus cyanopterus Prionotus tribulus
Raies	Dolphin	Dasyastis sabina
Requin	Shark	Eulamia longimanus Isurus oxyrinelus
Sarde	Yellowtail snapper	Ocyuras chrysurus Lutzanus chrysurus
Savon	Gar fish	Tylosurus species Hysticus saponicus
Souris rouge	Red goatfish	Upeneus maculatus
Tassard	Kingfish	Sierra cavalla
Thon	Albacore Yellowfinned tuna	Nedthunnus albacora
Thon	Blackfinned bonito Blackfinned tuna	Parathynnus atlantis
Vieille	Oldwife	Balistis vetula Epinnephelus mystacinus
Volant	Flying fish	Hirundichthys speculiger Exococtus rufipinsus
Z'orphie	Gar fish	Tylosurus species

APPENDIX II[24]

MARTINIQUE
MAXIMUM ALLOWABLE PRICES FOR THE MARKETING OF FRESH FISH

Class 1 (45 cents per pound)

In order to obtain 45 cents per pound for fresh fish, the vendor must be able to make up one kilogram (2.2 pounds) with no more than 8 individual fish.

This class includes: Argenté - Barbarin - Bariolé - Carangue - grasse ou noire - Carmeau - Cordonnier (ou carangue à plume) coulirou - Couronné - Grands yeux (ou gros yeux) Portugaise blanche - Romantar (Bracon ou Bondieu) - Minyié - Rélé - Rodboy Saumon - Sardes et Sorbes (ou sobre) thon - maquereaux - Thazards - Vermeil Vierges - Vivanot - Souris - Roitalibi - Carangue grasse ou noire.

Class 2 (41 cents per pounds)

In this case, the vendor can use between 9 and 15 fish to make up the kilogram.

This category includes: Balarou blanc - Balarou bleu - Barbu argenté - Bayol - Bonites - Bourse - Bronchet de mer - carangues (autres que grasses ou noires) carpes - Congrès (longeur 60 cms.) - Coulirous - Espadons - Mère balarou - Grande bécune (longueur 80 cms.) - Juifs - Vieiles - Père Abbé Mulets - Goret - Marignan - Orphies - Poissons rouges (divers) Portugaise colorée - carte et lune.

Class 3 (27 cents per pound)

In this category, the kilogram can consist of 16 to 25 fish.

This class includes: Balarou queue noire - Blanche plate - Anguilles - Cabri - Chirurgien - Coffre - Congre (longueur 60 cms.) - Dervin - Daurade - Langue Monsieur l'Abbé - Moubin - Petites bécunes et changelles - Poissons rouges (divers) - Rachalons - Raies - Requin - Roicaroi - Vareys Sapaters - Tarpon (ou Grande Ecaille) Vache - Scie Soles - Vive - Volants (ou poissons volants).

Continued

24. Extracted from Classification et Prix des Poissons (65) and partially translated from French.

APPENDIX II

Continued

Class 4 (18 cents per pound)

This division is used when more than 25 fish are needed to form a kilogram. However, excepting sardines, no fish measuring less than 10 centimeters (3.9 inches) is acceptable.

This category includes: Anchois - Banane - Blanche longue - Brisure - Coutelas - Crapaud - Demoiselles et Papillons - Gros ventre - Harengs - Maquereaux - Murennes (ou Moringues) - Pisquettes - Poissons armés - Poissons rouges (divers) - Pompano-Poule - Quaqui à sardines - Trompette and in general all other fresh fish.

APPENDIX III[25]

SAINT LUCIA
MAXIMUM ALLOWABLE PRICES FOR THE MARKETING OF FRESH FISH

Group 1 (23 cents per pound)

Albacore, Amber, Barracuda, Bill, Bonito, Cavalli, Dolphin, Grouper, King, Mackerel, Salmon, Snapper, Jacks.

Group 2 (20 cents per pound)

Black, Butter, Chub, Gar, Lion, Marian Porpoise, Round Robin (large) 4 or less to the pound, Shark, Jacks (small) more than 4 to the pound, Whiting and Flying per pound.

Group 3 (17 cents per pound)

Anchovy, Ballahoo, Barber, Conger Eel, Cupboard, Doctor, Shell (excluding Lobster and Shrimps), Sprats, and all other fish per pound.

Fish: Frozen, gutted and cleaned - 3 cents per pound more than the prices for fresh fish falling under the respective groups above.

25. Extract from Saint Lucia Statutory Rules and Orders (88).

APPENDIX IV[26]

DAILY VOYAGE REPORT

Boat number .....

Set out: time ..... date .....
Returned: time ..... date .....

EXPENDITURES

	Quantity	Amount
Fuel		
Lubricating oil		
Rations		
Bait		
Ice		
Other items		
OTHER COSTS		
Commissions		
Market fees		
Crew's fish		
Others		
TOTAL		

REVENUES

	Weight	Value	Boat's share
DEEP SEA FISH			
List by species			
PELAGIC FISH			
List by species			
POT FISH			
List by species			
TOTAL			

26. After Hess (23).

APPENDIX V[27]

OWNER'S WEEKLY REPORT

Report for week ending: .....

REVENUE

TOTAL .....

EXPENDITURES

	Quantity	Amount
PAINTING		
Paint bought		
Other supplies		
Labour		
CRANE HIRE		
ENGINE OVERHAUL		
Parts purchased		
Labour		
Fees		
HULL REPAIRS		
Materials		
Labour		
Days laid up		
REPAIRS TO SAILS AND RIGGINGS		
Materials		
Labour		
GEAR PURCHASED		
Rope		
Lines		
Nobbing		
Hooks		
Other items		
REPAYMENT OF LOAN		
INSURANCE PREMIUM		
ALL OTHERS		
TOTAL		

27. Ibid.