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Formulation of a Management Scheme for the Swordfish Fishery of the Eastern Caribbean

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FORMULATION OF A MANAGEMENT SCHEME
FOR THE SWORDFISH FISHERY OF
THE EASTERN CARIBBEAN

BY
HAROLD F. UPTON

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
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OF
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ABSTRACT

During the 1983 season, two U.S. longline vessels initiated the first attempts at the commercial exploitation of swordfish in the Eastern Caribbean. In 1986, the number of U.S. vessels participating in the fishery surpassed 40 with landings of nearly two million pounds per season.

The sudden influx of participants and technology to the region has resulted in a variety of user conflicts and associated policy issues. Major areas of concern involve the conservation of a heavily exploited resource and the distribution of benefits which accrue from resource exploitation among the resource-adjacent island states and U.S. fishing operations.

This study examines principles of fisheries management, the international legal framework for highly migratory species, and regional responses to highly migratory species management. These experiences are then applied to the Eastern Caribbean situation. Management alternatives which are discussed for the Eastern Caribbean include: regional management; fees and conditions of foreign vessel access; compliance and enforcement; local development; and related issues such as stock conservation, recreational species and

by-catch landings. The study indicates that government fisheries treaties may involve issues far removed from fisheries such as strategic interests of the super powers.

The island nations of the Eastern Caribbean have the right to the benefits associated with the fisheries resources which occur in their zones of ocean jurisdiction. However, the realization of this goal will depend on regional cooperation, the wise use of scarce resources and long-term commitment.

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TABLE OF CONTENTS

INTRODUCTION.....	1
The Problem.....	1
Objectives of the Study.....	4
Methods.....	5
Chapter	
I. THE EASTERN CARIBBEAN.....	9
The Region Defined.....	9
History.....	13
The Contemporary Eastern Caribbean.....	14
II. EASTERN CARIBBEAN FISHERIES AND MANAGEMENT ORGANIZATIONS.....	23
Eastern Caribbean Fisheries.....	23
Physical and Biological Constraints.....	23
The Fishing Industry.....	26
Nearshore Demersal Fishery.....	27
The Deepwater Demersal Fishery.....	28
The Pelagic Fishery.....	29
Fishing Gear.....	30
Status and Development of the Industry.....	31
Regional Organizations.....	34
CARICOM.....	36
WECAF and FAO.....	40
ICCAT.....	41
OECS.....	42
Other Organizations.....	44
III. SWORDFISH FISHERY BACKGROUND.....	46
Swordfish Biology.....	46
History of the Fishery.....	49
Fishing Methods.....	51
Status of the Swordfish Resource and Fishery.....	57
United States Swordfish Management.....	59
IV. THE SWORDFISH FISHERY IN THE EASTERN CARIBBEAN.....	63
Issues in the USVI and Puerto Rico.....	67
Local Marketing of Incidental By-catch.....	68
Recreational Concerns.....	75
Conclusion.....	79
Illegal Swordfish Longlining in Eastern Caribbean States' Waters.....	81
The Case of the British Virgin Islands.....	81
Illegal Fishing in Other Parts of the Region.....	84

Local Development of a Pelagic Longline Fishery...	86
Other Considerations.....	88
V. MANAGEMENT OF HIGHLY MIGRATORY SPECIES.....	92
General Principles of HMS Management.....	92
Management Objectives.....	92
Stock Management.....	94
Economic Efficiency.....	97
Distribution of Benefits.....	100
Resource Adjacent Nation Fishery	
Development.....	102
Incidental Impacts on Related Stocks.....	104
The Legal Regime for Highly Migratory Species..	105
VI. HIGHLY MIGRATORY SPECIES MANAGEMENT EFFORTS.....	117
Management Alternatives.....	117
Management in the Pacific Islands Region.....	120
The Region.....	121
Fisheries of the Region.....	123
Tuna Management in the Region.....	127
Fisheries Forum Agency.....	127
The Nauru Group.....	133
Individual Coastal State Approaches.....	138
The United States Case.....	146
Regional Comparisons.....	153
VII. SWORDFISH MANAGEMENT ALTERNATIVES IN THE EASTERN	
CARIBBEAN.....	158
Maintenance of Swordfish Stocks.....	159
Benefit Distribution.....	168
International Legal Aspects.....	169
The Role of OECS.....	170
Access Agreements.....	178
Regional Registry.....	178
Access Fees.....	179
Other Benefits.....	189
Conditions of Access.....	193
Compliance.....	197
The U.S. Factor.....	203
Local Development of a Swordfish Fishery.....	207
Economic Efficiency.....	210
Multi-species Character of the Fishery.....	212
Further Considerations.....	213
VII. CONCLUSION AND RECOMMENDATIONS.....	214
Background.....	214
The Eastern Caribbean Situation.....	214

Problem Investigation Findings and Constraints.....	217
Swordfish Stocks.....	217
Management Institutions.....	218
International Legal Aspects.....	219
Management in the Pacific Islands Region.....	219
Recommendations.....	221
Conservation of Stocks.....	221
Benefit Distribution.....	222
Other Areas of Concern.....	227
Summary.....	229
Applicability Beyond the Caribbean Swordfish Fishery.....	231
BIBLIOGRAPHY.....	234

LIST OF TABLES

1. Political Status of Islands of the Eastern Caribbean.....	11
2. General Characteristics of Eastern Caribbean Islands.....	12
3. Economic Indicators of the Eastern Caribbean Region.....	16
4. Economic Indicators of Selected Eastern Caribbean Nations.....	20
5. The Eastern Caribbean: Imports as a Percentage of Gross National Product; Exports as a Percentage of Imports.....	22
6. Nominal Catch by Country in the Eastern Caribbean.....	33
7. Fisheries Statistics for Eastern Caribbean Nations.....	35
8. Participation of Eastern Caribbean States in Regions Organizations.....	37
9. Caribbean 1985 Swordfish Landings and Size Composition.....	64
10. Caribbean 1986 Swordfish Landings and Size Composition.....	65
11. 1986 U.S. Longline Landings and Value of Swordfish, Tuna and Billfish.....	70
12. Longline Catch Composition, USVI Development Project.....	71
13. Basic Data of the South Pacific Region.....	124
14. FFA and Nauru Group Membership in South Pacific Organizations.....	135
15. Eastern Caribbean Jurisdictional Claims.....	172

LIST OF FIGURES

1.	Map of the Eastern Caribbean.....	24
2.	Swordfish Longline Effort Distribution.....	52
3.	Longline Gear Types of Swordfish.....	54
4.	Species Composition from Longline Fisheries in the Western North Atlantic.....	78
5.	Surplus Yield Model.....	96
6.	Bioeconomic Model.....	99
7.	Map of the South Pacific Region.....	122
8.	EEZs of the Nauru Group.....	134
9.	200 nm Zones of Jurisdiction in the Eastern Caribbean.....	155
10.	Swordfish Exploitation in the Caribbean and Adjacent Areas.....	164
11.	FAO Statistical Areas.....	165

INTRODUCTION

The Problem

The swordfish longline fishery is one of the most recently developed and controversial fisheries of the Eastern Caribbean. The Eastern Caribbean Region, as used in this paper, will include the island nations of the Lesser Antilles, including their respective zones of ocean jurisdiction, extending from Puerto Rico to Venezuela. In the winter months of 1983 the commercial fishery was initiated by two U.S. mainland vessels (Campos et al, 1985). In 1986 the number of U.S. vessels operating in the region had grown to at least 40 with landings approaching two million pounds of swordfish annually (Rolon per. com. 1987, SAFMC 1987). The sudden influx of foreign participants and technology have resulted in a number of disputes and associated policy issues (Martin and Woods 1986a).

The swordfish resource of the North and Western Central Atlantic is highly migratory with a range extending from Canada to South America. Stocks pass through the high seas and at least 15 zones of national jurisdiction. There are six major participants in the fishery, the largest of which are the United States and Canada. Management of the

resource is further complicated by incomplete knowledge of its biology and population dynamics (Hoey per. com. 1987). Meanwhile average age at first capture has been dropping throughout the species range during the 1980s (Conser et al, 1985a). It has been determined that the stock exhibits growth overfishing, a drop in the average size of individuals which make up the stock. However, recruitment overfishing, the decrease of spawning stock biomass below levels which can sustain the level of recruitment required to maintain stock levels, has not yet occurred (Conser et al, 1985a). Of particular importance is the increased effort which has taken place throughout its range, especially in the Eastern Caribbean. It has also been determined that the Eastern Caribbean is one of the major spawning grounds for swordfish (Grall et al, 1981). The effects of increased fishing effort in the Eastern Caribbean on the Western Atlantic swordfish stock are currently unknown although concern over the health of the resource is growing. Currently the fishery is not regulated within its range either by international agreement or within respective zones of jurisdiction.

The central problem hinges on two interrelated matters involving international cooperation. Immediate concerns focus on the distribution of benefits derived from resource

exploitation among foreign participants and resource adjacent island states. Meanwhile, the absence of a regulatory strategy directed toward stock management throughout the range of the swordfish resource is a concern of all interested parties for conservation and maximization of benefits in the future. Therefore, there is a common need among all concerned parties to work in concert while attempting to reach individual goals.

Most small island states of the Eastern Caribbean lack the resources required to exploit the highly migratory resources which pass through their Fisheries or Exclusive Economic Zones. Distant water fleets of larger and relatively developed nations are more likely to target these species because they possess a comparative advantage in respect to capital, expertise and experience. Permitting and entry of foreign vessels to resource adjacent nations' waters is becoming more common, yet many distant water vessels continue to fish without permission or in a manner which is inconsistent with entry requirements (San Juan Star 1986). The island nations of the region lack the resources required to adequately enforce fisheries law within their respective 200-mile zones.

Objectives of the Study

The objective of this study is the development of a set of potential management options for the swordfish fishery with emphasis on the Eastern Caribbean Region. The recommended alternatives are directed toward a distribution of benefits accruing from resource exploitation, which is acceptable to concerned parties, while promoting conservation of the resource throughout its range.

The eventual management measures taken will depend on the concerned island states, fishing participants and other coastal states within the range of the species. Although most concerned parties would agree that benefit maximization and conservation are their goals, the definition of each, and the means by which these goals can be attained, are usually perceived differently by each interest group. The intent of this study is to indicate the alternatives concerned parties have at their disposal and the implications of each option in relation to the general goals stated above.

Another principal goal of this study is to indicate where gaps in information related to management of swordfish exist. Research and management institutions will have to be utilized and strengthened to allow the management process to move forward. Yet it must be determined which research

areas have priority, which institutions should be utilized and how they should be strengthened and whether potential gains outweigh the costs of undertaking these activities.

It should be recognized that the management options suggested in this study are only the starting point of the management process. In the future new information will become available, society and its social and economic institutions will change and fish populations will vary. Therefore one of the most important goals of this study is acknowledgment that flexibility is required in any management scheme so that questions concerning its institutions, makeup and direction continue to be asked.

Methods

The principal problems of this study revolve around factors which include a growing foreign fishery, resource adjacent developing states and a highly migratory resource. In other parts of the world where similar circumstances exist, management initiatives have evolved which deal with many of the same factors. Management principles in areas such as regional arrangements, permitting, enforcement, regulation and development have been proposed or initiated in the South Pacific, Eastern Pacific and the United States. The experiences gained in resource management and allocation in these regions offer valuable lessons which can be drawn upon

during the development of potential management options. These experiences can be studied within their regional context for relevance and transferability to the pelagic long-line fishery which is developing in the Eastern Caribbean.

The study is initiated with an investigation of elements and issues associated with the swordfish fishery. Areas of concentration include: the Eastern Caribbean Region, its geography, political entities and traditional fisheries; international and regional organizations involved in management of fisheries resources; the biology of the resource, including stock assessment, range and life history; issues such as illegal fishing, impacts on recreational stocks, impacts on the local industry, local development and impacts on swordfish stocks.

The investigation then centers on principles and practices of fisheries management which have been adopted or proposed in other regions or EEZs such as the South Pacific, Eastern Pacific and the United States. Major areas of concentration will include: the international legal framework such as The Law of the Sea Treaty and customary international law; permitting of foreign fishing vessels; enforcement of national and regional fisheries law; regional and international management arrangements; local development of the fishing industry; and resource conservation, involving data collection, assessment and regulation.

These experiences and principles are analyzed with respect to their possible transferability and adaptation to the Eastern Caribbean Region. The case of the South Pacific Fisheries Form Agency (SPFFA) is especially relevant due to similarities such as the foreign fishing participants involved, its general makeup of dependent and newly independent small island states, and the target species which is a highly migratory pelagic resource. Management options will also be considered according to the following general criteria: they have been arrived at through the use of the best available information; can be implemented with available resources cost effectively; are reasonable to the concerned user groups; they are flexible enough to be modified and built upon in the future. From these criteria and investigations and comparisons of other region's approaches directed toward highly migratory species management, potential management, options which are directed toward the resolution of issues surfacing in the Lesser Antilles are developed.

Resolution of the issues associated with the swordfish fishery cannot take place overnight. Many of the answers do not exist because we have failed or have not had the chance to ask the right questions. The management options recommended in this study are a starting point from which new initiatives and questions must evolve. Principal elements

of management such as conditions of foreign vessel entry, enforcement, conservation and local development will vary in significance according to particular points in time. Managers must recognize the importance of a management process which allows for flexibility and reevaluation.

Ultimately this depends on the building and utilization of management institutions for the collection of information, assessment of data and adoption of new or revision of measures as the process moves forward.

CHAPTER I

THE EASTERN CARIBBEAN

The Region Defined

In this study the Eastern Caribbean Region will be defined as the Islands of the Lesser Antilles stretching from Puerto Rico to Venezuela. A region as defined by L.M. Alexander is:

"an intellectual concept, created by the selection of certain features that are relevant to an areal interest or problem. It is a geographic generalization whose distinguishing criteria are chosen by the compiler of the region in order to serve a stated objective" (cited in Edeson and Pulvenis 1983).

The Eastern Caribbean Region was chosen because its geography corresponds to a part of the range of swordfish where foreign fishing effort has increased dramatically within the last five years. The islands of this area also possess a number of common features such as geographic proximity, colonial past and small size. The majority of islands in the region perceive foreign fishing and the issues associated with it as a common problem as they strive toward management of their Fishing or Exclusive Economic Zones.

The Eastern Caribbean is sometimes defined as the member nations of the Organization of Eastern Caribbean States

(OECS) (Palmer 1984, Goodwin 1985). It consists of independent island states which were former British Colonies of the Windward and Leeward Islands of the Lesser Antilles, formerly called The West Indies Associated States Council of Ministers (Edeson and Pulvenis 1983). Yet the picture is complicated by: the remaining British dependencies of the region; relatively large island states such as Barbados and Trinidad and Tobago; French possessions or departments; Dutch possessions or newly independent states; and Venezuela. In addition, the U.S. territories of the U.S. Virgin Islands and Puerto Rico exert a strong influence on the region. The region's ocean geography consists of a puzzle of adjacent zones involving all of the political entities cited above. Tables 1 and 2 illustrate the region's diversity in respect to colonial past and size.

This investigation concentrates on the former British possessions which include both dependent and independent states. Within the Eastern Caribbean these states have the greatest potential to act as an independent entity within a regional context while they exhibit the greatest degree of political and economic integration within the region. However, the other countries and possessions noted above are also important elements due to: their geographic proximity; sometimes larger size both in respect to population and economies; and fishing operations within the region.

TABLE 1

Political Status of Islands of the Eastern Caribbean

<u>Country</u>	<u>Former or Current Colonial Influence</u>	<u>Status</u>	<u>Year*</u>
Puerto Rico	United States	Commonwealth	1952
United States Virgin Islands	United States	U.S. External Territory	1954
British Virgin Islands	Great Britain	British Dependent Territory	1969
Anguilla	Great Britain	British Dependent Territory	1980
Netherlands Antilles	Holland	Self-governing Colony	1954
St. Christopher and Nevis	Great Britain	Independent	1983
Antigua and Barbuda	Great Britain	Independent	1981
Montserrat	Great Britain	British Dependent Territory	1960
Guadeloupe	France	French Overseas Department	1946
Dominica	Great Britain	Independent	1978
Martinique	France	French Overseas Department	1946
St. Lucia	Great Britain	Independent	1979
St. Vincent and the Grenadines	Great Britain	Independent	1979
Barbados	Great Britain	Independent	1966
Grenada	Great Britain	Independent	1974
Trinidad and Tobago	Great Britain	Independent	1962

*-year current status was attained, Source (Barry et al, 1984)

TABLE 2

General Characteristics of Eastern Caribbean Islands*

<u>Country</u>	<u>Population</u>	<u>Population growth rate</u>	<u>Density per sq km</u>	<u>Area sq km</u>
Puerto Rico	3,196,520	1.5%	370	8,860
United States Virgin Islands	103,000	1.3%	291	354
British Virgin Islands	13,000	1.6%	87	150
Anguilla	7,019	0.5%	73	96
Windward Neth. Antilles	15,479	-	228	68
St. Christopher and Nevis	45,800	0.7%	175	262
Antigua and Barbuda	80,300	1.3%	182	442
Montserrat	11,900	0.6%	117	102
Guadeloupe and Leeward Fr. Is.	385,000	-	216	1,780
Dominica	77,900	1.4%	104	750
Martinique	330,000	-	300	1,100
St. Lucia	136,800	2.0%	222	616
St. Vincent and the Grenadines	111,000	1.4%	285	389
Barbados	253,500	0.2%	590	430
Grenada	92,700	0.8%	269	344
Trinidad and Tobago	1,199,000	1.5%	234	5,128

*Figures are as close to 1985 and 1986 as possible

Sources: The 1986 Caribbean Development Bank Report and
the U.S. Dept. of Commerce International Marketing
Information Series

European domination began nearly 500 years ago with the "discovery" by the Spanish. The Dutch, English and French entered the region in the 17th century as Spanish power declined (Lewis 1985). On most islands the colonial powers established a sugar plantation economy based on European capital and imported African slave labor (Palmer 1985). The raw product was then exported for refinement and sale in European markets. During this period, capitalism in the Caribbean was totally exploitative since its only goal was to increase the colonial nations' power and wealth (Palmer 1985). In social terms colonial powers put into place the black-white-brown triangle with the white planter on top, the black slaves on the bottom and the brown mulatto groups in between (Lewis 1985). Indigenous peoples such as the Caribs were forced off the land and driven to near extinction in many cases (Barry et al, 1984).

Emancipation followed in the mid-nineteenth century during which economic control was retained by the European planter. Generally most of the choice land remained in the European hands. Many former slaves had little choice but to continue working for low wages or on their small plots (Lewis 1985). As the twentieth century approached, agriculture remained the economic mainstay of the islands. Although each island is unique in respect to the historical progression of events, the preceding summary gives a general view of the events leading up to the twentieth century.

The Contemporary Eastern Caribbean

The character of the contemporary Eastern Caribbean continues to be dependent on both its history and outside powers. Although most of the region's political entities have gained independence, trade, economic systems, and political and social institutions are subject to outside influence. This is in part due to the character of small island states and the general continental perception of them. The attributes of insularity and small size relate to the idea that islands are satellite appendages, frontier outposts or recreational sites (Towle 1985). The island states of the Eastern Caribbean also face constraints in areas such as skilled labor, the natural resource base and diversification of industrial and agricultural sectors.

The drive for independence gained momentum in the 1960s as aspirations for sovereignty and economic development spread among colonies which were also among the least developed states of the world. As European influence waned in the 1960s North American influence grew in the Caribbean, especially that of the United States. Although most colonies have achieved independence, it can be argued that dependence on the former colonial powers and the United States have continued to be a major constraint to self-sufficiency and development (Barry et al, 1985).

Most of the Eastern Caribbean island nations, particularly the small or micro-states, are still considered the least developed of the Caribbean Community (CARICOM) and the world (Palmer 1984). Per capita GDP for the LDCs of the region averaged only 1,110 in 1985 (CDB Report 1986) (see Table 3). Again history has played a role in dictating the current status of the region's economy. The early immigrants of the Caribbean were colonizers, not settlers. Settlers tend to build institutions which promote long-term development for the future of their children in areas such as education, transportation and indigenous industries. Colonizers build institutions to exploit the region for profits which could be returned to the metropolitan power (Palmer 1985).

Today foreign capital seeks cheap labor to produce for export, the function slave labor previously supplied (Palmer 1985). This takes place through Trans National Corporations (TNCs) and a world economic order which allows for the practice termed neocolonialism. The Caribbean is considered as one of the most penetrated by TNCs in the world (Barry et al, 1984). It has been argued that foreign capital is essential because the region's local economies cannot generate the capital required for public and private investment (Palmer 1985). It is also seen as strategy for technology transfer, diversification and employment (Palmer 1985). Yet industries which have located factories in the

TABLE 3
Economic Indicators of the Eastern Caribbean Region

<u>Country</u>	<u>GDP</u> ((\$m)	<u>Per Cap.</u> <u>GDP</u>	<u>Growth</u> <u>rate (GDP)</u>	<u>Largest Exports</u> (#1, #2, #3)
Puerto Rico	18,671	5,800	1.4%	chem/petro prod/pharm
U.S. Virgin Islands	(802)	(7,700)	-	petro products
British Virgin Islands	84.5	7,101	0.6%	fresh fish/sand & gravel/fruit & veg
Anguilla	(20)	(2,800)	-	lobster/livestock
St. Christopher and Nevis	67.3	1,469	1.0%	sugar
Antigua and Barbuda	180.2	2,244	6.7%	manufac goods/ machinery/chem
Montserrat	37.1	3,118	4.6%	poly bags/trop plant/elec parts
Guadeloupe	(1,200)	(3,500)	(14%)	bananas/sugar rum
Dominica	88.2	1,132	3.0%	bananas/laundry and toilet soap
Martinique	(1,300)	(3,800)	(13%)	petro prod/ bananas/rum
St. Lucia	170.3	1,245	5.8%	bananas/coconut oil/cocoa
St. Vincent and the Grenadines	102	933	3.1%	bananas/coconut arrowroot
Barbados	1,237	4,894	0.3%	sugar/elect comp clothing
Grenada	96	961	3.7%	cocoa/bananas nutmeg
Trinidad and Tobago	7,723	6,538	3.0%	petro prod/crude petroleum

Sources: Caribbean Development Bank Report 1986, U.S.
Department of Commerce International Marketing Information
Series and Barry et al, 1984.

() Indicates estimation, all data is taken as close to 1985 as possible.

Caribbean are subject to the strength of the industrialized economies, while a large portion of the profits are often funneled off by their parent TNCs. The region still suffers from chronic unemployment and few locally based firms, resulting in continued dependence on the industrialized economies.

The agricultural sector of the Caribbean has continued to be linked to the export of commodities to developed nations (Barry et al, 1984). Meanwhile, world prices for commodities such as sugar declined relative to essential imports of manufactured goods (Barry et al, 1984). There has been a decline in the prices of the 15 leading agricultural commodities over the last two decades according to the U.N. Food and Agriculture Organization (Barry et al, 1984). Bananas, of special importance to nations of the Eastern Caribbean, sold for prices 20 to 40 percent lower in 1980 than in 1960 (Barry et al, 1984). Although there has been a recent surge in banana prices, price volatility is another characteristic of commodities which frustrates planning and economic development.

Food production for local consumption is also in decline. This is in part due to the colonial legacy associated with it, a historical dependence on imports and better access to retail and wholesale markets of imported foods than for

local products (Barry et al, 1984). The majority of Caribbean nations import over 50% of their food while Trinidad, Barbados and Antigua import over 80% (Barry et al, 1984). In the Commonwealth Caribbean, food per capita production has dropped in the last 15 years as the region's population have moved away from farming (Axline 1984). The stagnation of agriculture and continued low production has led to dependence on imports of food to feed the local population (Barry et al, 1984). Although it is arguable whether the Eastern Caribbean can feed itself, the region can certainly improve its present performance in domestic food production.

Tourism has become one of the major strategies for decreasing unemployment and trade imbalances. Yet TNCs have generally controlled development of the sector and the industry's profits (Barry et al, 1984). The tourist industry is heavily dependent on imports, taxes already overburdened infrastructure, and produces impacts on the physical environment while the employment opportunities it produces are generally for low-pay and unskilled labor (Barry 1984).

In addition to economic dependence, the industrialized nations, especially the United States, have a direct political influence within the region. This is evidenced by the

remaining territories within the region, foreign aid programs and direct military intervention. The most explicit illustrations of this control involve multilateral lending institutions such as the World Bank, the Caribbean Basin Initiative and the recent invasion of Grenada. The treatment of the Bishop regime and the subsequent invasion of Grenada in 1983 illustrate the willingness of the United States to project power when it perceives its interests are at stake.

Unfortunately the declaration of political independence and actual economic and political independence are not synonymous in the Eastern Caribbean. The factors which were previously cited illustrate that the region's current state is a product of outside influences. The strength of these influences is made more acute because of limited natural resources in the region. Due to the sudden rise in oil prices and the economic slow down in industrial nations, most of the region's nations showed negative growth rates in real per capita GNP during the 1970s (Palmer 1984). Table 4 illustrates the growth in percentage distribution imports of food and fuels during this period. As economic health returned to the industrialized nations during 1985, GDP growth approached 5% in many of the nations in question (CDB Report 1986). The region's economic fortunes are not only tied to the industrial powers, but are subject to much

TABLE 4

Economic Indicators of Selected Eastern Caribbean Nations

<u>Country</u>	<u>Growth Rate of real GNP per capita 1970-1978</u>	<u>Percentage Distribution of Imports</u>			
		<u>Food 1960-69</u>	<u>Food 74-76</u>	<u>Mineral Fuels 1960-69</u>	<u>Mineral Fuels 74-76</u>
Barbados	2.1%	24.3%	21.3%	8.0%	15.0%
St. Lucia	2.3%	23.7%	24.5%	2.6%	7.7%
Grenada	-1.8%	27.6%	*40.6%	4.8%	*8.5%
St. Vincent	-1.8%	27.5%	31.3%	3.2%	6.2%
Dominica	-3.4%	27.5%	32.3%	2.8%	6.5%
Antigua	-3.1%	19.0%	17.7%	17.7%	44.2%

*1974 only

Sources: Problems of Development (Palmer 1984)

greater variance due to their peripheral status. Table 5 illustrates that imports have continued to be high relative to GNP and exports in the 1980s. The region's external resource dependence has resulted in a chronic balance of payments crisis because each of the nations in question imports more than it exports (Palmer 1985). The persistent gap in relative economic wealth between the United States and the region is in part the result of external dependence and the peripheral economic status of the Eastern Caribbean nations (Palmer 1985).

Foreign fishing is a specific example of continued exploitation and dominance by outside influences in the region. One of the major reasons for generally unobstructed foreign fishing and the lack of a local swordfish fishery is the economic status of the region. The management skills, infrastructure and institutions required for the development and management of the islands' fishing zones are only now being developed. The situation has resulted in a United States perspective, ranging from neglect on the part of the U.S. government to open exploitation by U.S. fishery participants.

TABLE 5

The Eastern Caribbean: Imports as a Percentage of Gross
National Product; Exports as a Percentage of Imports

<u>Country</u>	<u>Imports (CIF) GDP at Market Prices</u>				<u>Exports of Goods Imports of Goods</u>			
	<u>Year</u>	<u>Year</u>	<u>Year</u>	<u>Year</u>	<u>Year</u>	<u>Year</u>	<u>Year</u>	<u>Year</u>
Barbados	1977-79	62%	1986	52%	1977-79	33%	1986	41%
St. Lucia	1975-76	93%	1985	71%	1975-76	37%	1985	43%
Grenada	1974-76	68%	1986	80%	1974-76	51%	1986	34%
St. Vincent	1975-76	87%	1986	92%	1975-76	32%	1986	73%
Dominica	1975-76	69%	1980	135%	1975-76	56%	1980	20%
Antigua	1975-76	108%	1982	77%	1975-76	39%	1982	19%

Sources: Problems of Development (Palmer 1984, pp. 50-54),
Foreign Economic Trends and Their Implications for
the United States U.S. Department of Commerce,
Fisheries Development in Dominica (Mitchell and
Gold 1983)

CHAPTER II

EASTERN CARIBBEAN FISHERIES AND MANAGEMENT ORGANIZATIONS

Eastern Caribbean Fisheries

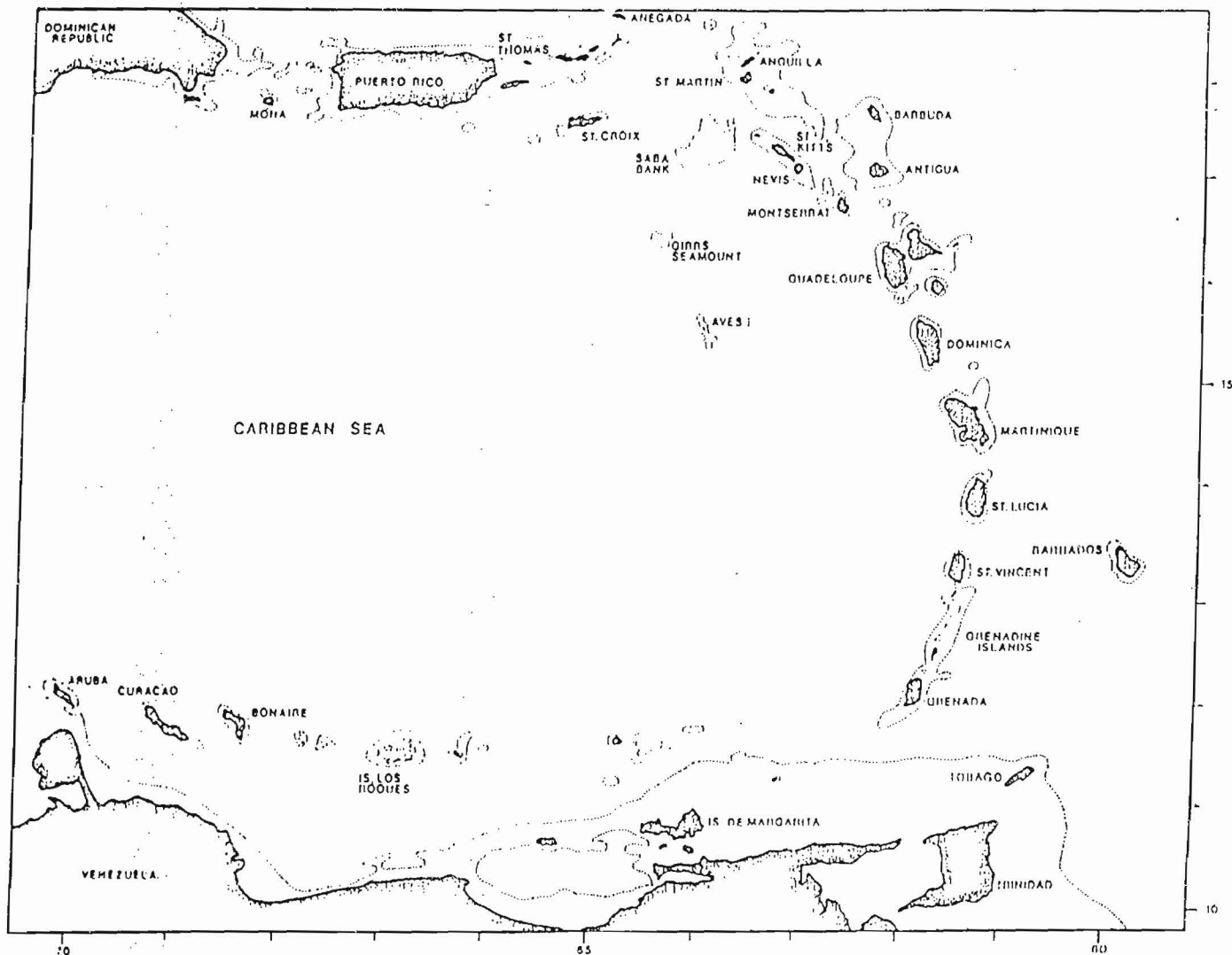
Physical and Biological Constraints

The geography of the Eastern Caribbean region is characterized by a large ocean area and the Lesser Antillean island chain. The relatively small and primarily volcanic islands stretch 450 miles from the U.S. Virgin Islands to Venezuela. These islands form the semi-enclosed eastern boundary between the Caribbean Sea to the west and curve out into the Atlantic Ocean to the east (Figure 1). These characteristics might lead one to conclude that the magnitude of the region's fisheries resources is considerable. Unfortunately this is not true due to a variety of physical factors.

The physical factors which account for the high productivity of the world's major fishing grounds are largely absent from the Eastern Caribbean region. Extensive shelf areas where nutrients may accumulate and where light can penetrate to the ocean floor to support primary productivity are not a common feature of tropical island chains (Idyll 1971, Gold et al, 1984). The islands of the region are characterized by narrow shelf areas that give way to ocean depths greater

Figure 1 Map of the Eastern Caribbean

Source (Appeldoorn 1986)



than 1,800 meters (Gold et al, 1984). Another factor involves the small degree of temperature fluctuation of the region's tropical climate. This enables the thermocline, which separates warm nutrient poor surface water from lower nutrient rich layers, to persist throughout the year (Idyll 1983). Therefore seasonal mixing which triggers the blooming of plant life in temperate regions is absent resulting in relatively unproductive waters (Idyll 1983). The Eastern Caribbean also lacks zones of upwelling of deep nutrient rich waters which is required for plant growth.

Finally, except on its southern perimeter, the region lacks runoff of major rivers from major land masses which contain the sediments and nutrients required for higher levels of productivity (Kenny 1983). Primary productivity studies yielded levels of 50 to 100 grams of carbon per meter per year in the Caribbean Sea as compared to levels of 500 gm/m in the major fishing grounds of the Atlantic (Kenny 1983). These levels are comparable to the world's oceans most barren areas while it has been reported by Margalef that the mean off-shore levels in the region may be lower (Kenny 1983). The United Nations Development Programme, with the Food Agriculture Organization, undertook a major exploratory fishing program from 1965 through 1971. The fisheries resources of the Eastern Caribbean were reported to be inadequate for the development of large scale commercial operations (Goodwin 1987).

The physical environment further limits fishing due to the strong northeast trade winds which affect the activity of smaller fishing vessels during much of the year (Idyll 1971). Hurricanes which occur from June to October also restrict fishing activities (Idyll 1971).

Ciguatera or tropical fish poisoning is yet another constraint of Eastern Caribbean fisheries development.

According to Olsen and Wood, ciguatera has been implicated in 50% of fish species and 56% of landings by weight in the U.S. Virgin Islands (Goodwin 1985). The problem is particularly acute in the northern part of the region in large reef fishes caught in areas less than 30 fathoms (Goodwin 1985). The neurotoxin which causes the poisoning is synthesized by a dinoflagellate which colonizes damaged coral surfaces (Caddy 1981). The toxin is then transferred through the food chain by herbivorous fish that feed on the reef (Caddy 1981). The potentially life-threatening symptoms constitute a major obstacle to marketing of these species due to the risk of poisoning (Goodwin 1985). Currently there is no field method which can detect the toxin in marine organisms.

The Fishing Industry

Although these factors illustrate the limitations associated with the resource base, the fisheries resources which are present can have significant impact on the small island

scale (Goodwin 1985). A general breakdown of the resource and associated environment include the nearshore demersal reef fishes, the deepwater demersal fishes, pelagic fishes and benthic bottom-dwelling invertebrates such as conch and spiny lobster (Goodwin 1985).

Nearshore demersal fishery

The nearshore demersal fishery targets on bottom-dwelling species which are concentrated in shallow reef areas. Species diversity is very high in reef areas. The habitat is among the most complex ecosystems in the world with a rich web of interrelationships among its inhabitants. Over 300 species are associated with these areas, of which 180 species are utilized in the fishery (Goodwin 1985). Some of the most common fishes found in reef and inshore areas include: wrasses, triggerfish, snapper, grouper, angelfish, jacks, mullet, grunts, croakers and many more. Although coral reefs are some of the most productive marine areas in the world, fishery production is limited by the usable biomass present and the limited shelf areas of the islands.

The inshore fishery is difficult to assess in respect to sustainable yields due to its multispecies character and the lack of landings data from the region. Yet there is general agreement that most of the region's inshore stocks are beyond maximum exploitation levels (Goodwin 1985; Wilson 1987, Caribbean Fishery Management Council 1985).

The conch fishery is second only to lobster in pound-for-pound value and only second to fin fish as a component of local diets (Goodwin 1985). Conch are seldom found in depths below 30 meters. Its vulnerability to capture, high economic value and the recent introduction of SCUBA as a fishing method have contributed to its over-exploitation in most parts of the region (Goodwin 1985).

The highest valued fishery species in the region is spiny lobster (Goodwin 1985). It is heavily exploited throughout the region necessitating management measures such as minimum carapace size, restriction of berried lobsters and possibly reductions in effort before over-exploitation becomes more acute. Regional cooperation may become an important factor in spiny lobster management due to its larval stages which may last up to six months (Goodwin 1985). The dispersion of larvae while they inhabit the water column means that recruitment of one island may be dependent on adult populations of another locale (Goodwin 1985).

The deepwater demersal fishery

Deepwater demersal species are found at depths of 60 meters to 27 meters on the edge of shelf areas (Goodwin 1985). The distinction between the inshore and deepwater stocks is made by the fishing gear utilized in this zone and a general transition in the occurrence of species. The inshore

artisanal trap fishery generally changes to handline or vertical longline techniques in deepwater areas (Goodwin 1985). The dominant target species in this area are snapper and grouper. Although these areas are considered to be under-exploited at present, they are thought to be sensitive to fishing pressure and present limited potential (Goodwin 1985).

The pelagic fishery

On most Eastern Caribbean islands pelagic species make up the largest component of total landings. The seasonal flying fish fishery of Barbados and the dolphin associated with it is the one largest fisheries of the region. Fishermen also capture small tunas, yellowfin tuna, albacore, billfish and, to a lesser degree, sharks with handlines and by trolling lines. Although greater potential landings are possible, the lack of more precise estimates of abundance and sustainable yields are constraints to further development (Goodwin 1985). One estimate states that in the Lesser Antilles only 5,000 of a potential 25,000 tons of tuna species are taken (Marcille and Caddy 1985). Martinique, Guadeloupe, Barbados, St. Lucia and St. Vincent participate in an artisanal fishery for these species, and are responsible for most of the landings. Venezuela is the only regional nation which has developed an industrial tuna fishery with landings estimated at 5,000 tons of yellowfin

and skipjack in the Caribbean Sea alone (Marcille and Caddy 1985). Highly migratory tuna and billfish stocks are also taken by foreign fishing operations. However, the wide-ranging nature of the Asiatic fleets of Japan, Korea, and Taiwan results in annual variations in effort and landings within a given area. Catches of longline tuna and marlin by Asiatic fleets in the Caribbean and Lesser Antilles Zone were quite low at approximately 500-1000 tons (Marcille and Caddy 1985). These figures are highly speculative in respect to amount and location, but they are illustrative of a probable range of resource limitations.

Fishing gear

Most fishing operations of the Eastern Caribbean can be characterized as artisanal. Vessels are generally either traditional canoes, which are shaped and hollowed from logs ranging in length from 12 to 15 feet, or double-ended "whalers" with a length of 20 to 30 feet (Goodwin 1985). Outboard motors are used for propulsion except in southern parts of the region where dinghies may be powered by sails (Goodwin 1985). In inshore areas Antillean fish traps are used to target on reef species. Bottom handlines made up of monofilament line and baited hooks are also used on shelf areas (Goodwin 1985). Trammel nets are nonselective entanglement gear which is set in shallow reef areas. Since a wide variety of fish including juveniles and undesirable

fish are caught, its effects on resource health are potentially serious (Goodwin 1985). Beach seines are a traditional gear type used in near shore areas to capture pelagics passing nearby (Goodwin 1985). Trolling lines are used for pelagic species from a running or drifting boat. Gillnets are also used for pelagic species especially flying fish (Goodwin 1985). Vessels generally operate without haulers for traps or longlines and without depth sounders. There are very few larger modern vessels which could be considered industrial operating from OECS states. In the French Islands, U.S. territories, Trinidad and the Barbados flying fish fishery, many of the operations have developed beyond basic artisanal capabilities, yet are not on the scale of industrial operations in respect to capital and equipment.

Status and Development of the Industry

The fisheries of the Eastern Caribbean can be generally classified as labor intensive as opposed to highly capitalized operations. Therefore employment is a major consideration for the industry. Small-scale fishing activities of the region tend to be marginal operations resulting in less disposable income than in other occupations (Goodwin 1985). For these reasons fishing may not be considered a prestigious job. The recent development of light manufacturing and service industries such as tourism have produced employment

opportunities which might be considered more respectable. These factors contribute to the large percentage of part-time fishermen working in the industry (Goodwin 1985 [see Table 7]).

The lack of available capital for greater investment in the industry and the introduction of new fishing technologies are often stressed in development efforts. Yet the basic artisanal methods, combined with some modern adaptations such as outboard motors, have been ample to over-exploit most inshore stocks (Goodwin 1985). It also should be noted that traditional fishing methods are well adapted to local conditions, constraints and culture. In the case of currently under-exploited resources, care should be taken in the increase of fishing effort and the transfer of technology foreign to the region. First the resource base may be limited and easily over-exploited, resulting in the same problem currently being faced with most inshore resources. Second, the technology or methods may not be appropriate in respect to the local economy, culture and conditions. Many fishermen currently operating marginal enterprises cannot afford to risk limited resources on technology which is unproven within their range of experiences (Goodwin 1985).

Many of the fishery resources of the Eastern Caribbean are limited and at or beyond maximum levels of exploitation. Although the accuracy of the fishery statistics in Table 6

TABLE 6

Nominal Catch by Country in the Eastern Caribbean
(All landings given in metric tons)

Country	Years								
	1978	1979	1980	1981	1982	1983	1984	1985	1986
Puerto Rico	3197	3597	2537 2802a	1784	2202	2655	2354	1496	1327
USVI	557	547	669 1667a	634	883	611	680	600	640F
BVI	318R 607b	318R	318R 680c	318R	318R 667b	318R	318R	318R	318R
Anguilla	-	-	-	-	-	-	- 740d	-	-
St Kits & Nevis	1700	1700	1850	1880	1880 1500e	1100 973f	1300F	1500	1500F
Antg Barbuda	3313	2469	2444 2000f	2439 1700f	2004 1400f	2246 1100f	2246R 800f	2246R	2246R
Montserant	100 55f	102	109	104	111	111R	111R	111R	111R
Guad	9000F	8500F	8000F	8300F	8240	8826	8940	8390F	8500F
Domnica	1070 1070h	642	1445	1514	1545	1000F 950i	500F 625f	446	450F
Martn	4375	4664	4891F	4700F	5500F	5107F	5147F	4604F	5000F
St Lucia	2600 2700k	1024	969	891	921	910 1772f 2600j	946	1052	840
St Vincent	698	547	547R	547R	547R	547R 1600m	547R 1700f	547R	547R
Barbados	3884	4516	3808	3528	3579	6648 6600l	5913	3915	4223
Grenada	2063 2908f	1464 4085f	1387	718	960	1473	1501 1500n	1584	2328
Trind Tobag	4823	3840	4461	3804	4574	4240	3593	2862	3000
Total	37698		33162		33264		34096		31030

Sources: FAO, Yearbook of Fishery Statistics, 1986, FAO Rome, (All first line entries adjacent to country name), R-Repetition of data previously reported by country or area. F-FAO estimate from available sources of information. Other references given after Table 7.

are questionable, it illustrates that total landings may have peaked and may actually be dropping. Nearly half of the fish consumed in the Lesser Antilles is imported (Idyll 1981) as shown in Table 7. The region must now examine methods of better management of its resources through the identification of priorities and goals and the building of management institutions to carry them out. Improvements are also required in areas such as infrastructure and marketing, field staff and training, regulation, monitoring programs and enforcement (Goodwin 1985). The development of under-utilized resources should be undertaken with caution in respect to technology and potential impacts on stocks. Although the resource base of the Eastern Caribbean region is limited, its fishery resources have the potential to make a greater contribution to local development in respect to balance of payments, employment and nutrition (Goodwin 1985). Industry constraints and potential benefits must be considered as the region's island nations attempt to manage adjacent pelagic resources.

Regional Organizations

There are several regional and subregional organizations which are active in the economy and fisheries of the Eastern Caribbean. The island states of the region have characteristics such as small size, dependence on external influences and a limited resource base. These factors may encourage a

TABLE 7

Fisheries Statistics for Eastern Caribbean Nations

<u>Country</u>	<u>No.</u> <u>Fishermen</u>	<u>Vessels</u>	<u>Landings</u> <u>(mt)</u>	<u>Imports</u> <u>(mt)</u>	<u>Exports</u> <u>(mt)</u>	<u>Per Cap.</u> <u>kg/yr</u>
P.R. /a	1872	1449	2802	24454	-	9
USVI /a	578	237	1667	2590	-	26
BVI /b	91ft75pt	123	667	416	520	32
Anguilla /d,e	150ft100pt	122	980	-	740	24
St Kitts Nevis /f	267ft283pt	283	974	850	-	39
Antigua Barbuda /f,g	1100	350	800	500	350	31.5
Montserrat /f	20ft180pt	80	55	221	-	-
Dominica /f,i	1300	640	625	260	0	15.1
St. Lucia /f,j	1000ft1000pt	600	1772	500	0	26.4
Barbados /l	1600	618	6600	3600	30	40.4
St Vincent /f,m	2750ft2750ot	537	1700	200	550	11
Grenada /f,n	560ft840pt	700	1500	920	750	14.9

ft-full-time fishermen, pt-part-time fishermen, - no data

a CFMC, 1985

b Gold et al., 1985

c Caddy, 1981

d Olsen and Ogden, 1984

e Gold et al., 1984

f Goodwin, 1985

g FAO. Antigua Country Profile 1986

h Mitchell, 1983

i FAO, Dominica Country Profile 1984

j FAO, St Lucia Country Profile 1985

k Mitchell et al., 1982

l FAO, Barbados Country Profile 1984

m FAO, St Vincent Country Profile 1986

n FAO, Grenada Country Profile 1987

regional unified approach toward common problems involving trade and management. Although common characteristics, especially geography, promote such action, the states of the Caribbean as a whole and those of the Eastern Caribbean in particular are not homogenous. Factors related to history, current trading partners, individual island state site-specific conditions and goals underscore the diversity present in the region. The French islands of Guadeloupe and Martinique provide an example of the limitations of regional action based on geography. Although they are located in the middle of the region, due to strong ties with France, they have remained outside the regional institutions formed by the former British colonies of the Caribbean. Regional groupings and action are often cited as one of the few alternatives of small developing states although the results of such programs are mixed at best. The following is a review of the regional organizations which are especially relevant to the fishing industry of the Eastern Caribbean. Table 8 indicates participation of political entities in the region.

CARICOM

For the wider Caribbean, The Caribbean Community (CARICOM) is the main economic regional organization. CARICOM evolved from The Caribbean Free Trade Association (CARIFTA) which eliminated most tariff barriers between most nations and

TABLE 8

Participation of Eastern Caribbean States in Regional
Organizations

<u>Country</u>	<u>OECS</u>	<u>CARICOM</u>	<u>Other</u>
Puerto Rico	-	-	CFMC
United States Virgin Island	-	-	CFMC
British Virgin Islands	associate member	-	U.K. terr
Anguilla	-	-	U.K. terr
St Kitts and Nevis	X	X	-
Netherlands Antilles	-	-	-
Antigua and Barbuda	X	X	-
Montserrat	X	X	-
Guadeloupe	-	-	Fr dep.
Dominica	X	X	-
Martinique	-	-	Fr dep.
St Lucia	X	X	-
Barbados	-	X	-
St Vincent	X	X	-
Grenada	X	X	-
Trinidad and Tobago	-	X	-

CFMC - Caribbean Fisheries Management Council

X - Member

territories of the Commonwealth Caribbean (Payne 1984). To advance regional integration, the Treaty of Chaguaramas was signed in July of 1973 (Payne 1984). According to Payne the goals of CARICOM involve three basic areas:

"The first is the furtherance of regional economic integration by the establishment of a common market; the second is the expansion of functional co-operation in such fields as health, education transport and meteorology; and the third is the co-ordination of foreign policy among the fully independent states of the Community" (Payne 1984, 128).

The international economic crisis of the 1970s deeply affected the economies of the region. This led to tension within the association caused by bilateral economic arrangements between relatively wealthy Latin American countries and impoverished member states, and import restrictions even among member states (Payne 1984). Integration has continued to be plagued by political forces such as the balance of power between member states, the ideological question concerned with the meaning of economic development, and rivalries and conflicts between heads of government in the region (Payne 1984).

Intra-CARICOM trade is low relative to both the total trade of Member States and intra-regional trade among other regional groupings of developing nations. In 1980 intra-regional trade accounted for 8% of the total trade of CARICOM members (McIntyre 1984). The weak production

structure, limited resource base, and the resulting lack of complementary production contribute to the low levels of intra-regional trade (McIntyre 1984). However, the region has potential to utilize CARICOM as a mechanism to reduce imports, especially in the case of food and consumer goods through the coordination and integration of commodity production (Payne 1984).

In the case of fisheries CARICOM members can trade in fish free of customs duties (Edeson and Pulvenis 1983). The role of CARICOM in regional fisheries development was highlighted by its third Technical Fisheries Conference in March of 1985. Topics of intended involvement which were discussed included: insurance; training, aquaculture research center; research, development and promotion of fishery products; safety measures; resource assessment; intra-regional cooperation; inter-agency coordination; and protection and development of Exclusive Economic Zones (Goodwin 1985). CARICOM intends to collaborate with OECS and FAO in the areas cited above. The organization's role in the region's fisheries has been questioned due to the differing goals, needs and potentials of CARICO, member states, especially between the smaller Eastern Caribbean states and other members (Goodwin 1985).

WECAFC and FAO

In 1973 the Western Central Fisheries Commission (WECAFC) was established as a regional commission of the Food and Agriculture Organization of the United Nations (Edeson and Pulvenis 1983). The Statutes of WECAFC state that its objectives include the following:

"promoting and assisting in the collection of national statistics relating to fisheries, and the compilation and dissemination of statistical data on a regional basis; facilitating the co-ordination of national research programmes and standardization of research methods; promoting the exchange of information relating to fisheries in the region; promoting and co-ordinating studies on environment protection and fisheries; promoting and assisting the development of aquaculture and stock improvement; encouraging education and training; assisting member countries in establishing national policies for the development and utilization of fishery resources and promoting and co-ordinating international aid to achieve these objectives. (Cited in Gold et al, 1984, 82.)

The region includes the Caribbean, Northern South America to five degrees north, Central America north of the Panama Canal Entry, the coast of North America including the Gulf of Mexico and southeastern United States to 35 degrees north (Edeson and Pulvenis 1983). WECAFC and The United Nations Food Agriculture Organization (FAO) have been involved in a wide variety of fisheries development projects in the Caribbean focused in areas such as development of under-exploited stocks, training, utilization of existing catches, management of heavily exploited stocks and promoting harmonization of fisheries legislation in the region (Gold

1984). The large size of the WECAFC region necessitates action in conjunction with UNDP/FAO and other United Nations agencies on a sub-regional level. Other United Nations agencies involved in Caribbean ocean management include the United Nations Educational, Scientific, and Cultural Organization/International Oceanographic Commission (UNESCO/IOC) and The United Nations Environmental Program (UNEP) with its Regional Seas Program (Goodwin 1985).

ICCAT

During the period following the second world war there was rapid expansion of tuna fisheries throughout the world. Concern over potential production and continued viability of tuna stocks prompted nations and related industries to establish international organizations for research and management of highly migratory species (Joseph 1983). The International Commission for the Conservation of Atlantic Tuna (ICCAT) entered into force in 1969 under the International Convention of the same name (Edeson and Pulvenis 1983). According to Article IV,

"The principal objective of the Convention is to study populations of tuna and tuna-like fishes (including billfish), and such other fishes exploited in tuna fishing in the Convention area not under investigation by another international fishery organization" (Edeson and Pulvenis 1983, 7).

The main aim of the convention is conservation of these species throughout the Atlantic Ocean and adjacent seas

(Edeson and Pulvenis 1983). ICCAT is constrained by the lack of funding for a permanent staff, data acquisition and the timely formulation of management advice (Joseph and Greenough 1979). It does not conduct its own research, but depends on member nations to analyze data. The Caribbean is included within this area although none of the nations of or bordering the Eastern Caribbean, other than the United States and Venezuela, have signed or deposited instruments of ratification or adherence (Edeson and Pulvenis 1983).

OECS

The Organization of Eastern Caribbean States (OECS) was established by formal treaty in 1981. The OECS evolved from the West Indies Associated States Council as most members achieved independence and perceived a need for a new mechanism to promote cooperation (Edeson and Pulvenis 1983). The main goal of OECS is political and economic integration of the region's member states. A regional strategy for the Eastern Caribbean is a rational answer to constraints such as the small size of its island nations, limited resource base and external dependence on capital, trade and security (Palmer 1984). Therefore member states have made an effort aimed toward the pooling of resources through the harmonization and coordination of economic and foreign policies where their interests converge (Palmer 1984). The general areas of proposed cooperation are: international, economic and

political relations; domestic economic and financial relations, including matters relating to the sea and its resources; the judiciary; mutual defense and security; and education, training and cultural relations (Emmanuel 1984). To date, the areas of greatest integration are the judiciary and currency systems while there has been little progress in the areas of diplomatic representation and defense and security (Emmanuel 1984). The OECS countries suffer from many of the same problems which plague CARICOM such as the lack of trained managers, a limited resource base, dependence on imports and the lack of indigenous capital.

In November of 1988, the Windward Islands of OECS, including Dominica, Grenada, St. Lucia and St. Vincent, agreed to move forward on plans for a political union (The Daily News 1988). The Leeward Islands of the OECS - St. Kitts, Montserrat and Antigua - have not joined in the initiative although they may join in the future if they wish (The Daily News 1988). The four windward islands are closely grouped geographically and have been the most active of the OECS in formulation of the political union. Further integration of this type has the potential to be a positive development in coordination of fisheries policies.

OECS is active in development of the Eastern Caribbean's fisheries resources. OECS plans to work closely with

CARICOM in the development of its programs (Goodwin 1985). OECS has also been a participant in FAO workshops involving the harmonization of fisheries legislation and fisheries development in the Lesser Antilles (Goodwin 1985). An OECS fisheries desk has also been established in St. Vincent for the provision of technical services to member states and the collection of fisheries statistics in the Eastern Caribbean. The OECS fisheries desk is currently working on a regional approach to foreign fishing within member states' zones of national jurisdiction (Blok per. com. 1988).

Other Organizations

In the field of oceanography, The International Oceanographic Commission promotes cooperative international marine research. Its projects include the support of research for projects involving snappers and groupers, lobster migration and turtle stocks (Idyll 1981).

The Caribbean Fisheries Management Council (CFMA) based in Puerto Rico is the principal agency involved with United States fisheries management in the U.S. territories of Puerto Rico and the U.S. Virgin Islands. Their work has involved management of reef fisheries, lobster and input concerning U.S. swordfish management.

Finally the Gulf and Caribbean Fisheries Institute has met for 40 years, bringing together U.S. and Caribbean scientists, administrators and industrialists (Idyll 1981). Papers and sessions include a wide range of topics concerned with fisheries of the region. The special topic at last year's meeting involved the swordfish fishery which has been recently developed in the region.

Although the OECS is the principal institution involved in the management of the swordfish fishery of the region, all of the organizations mentioned are required for management both within and outside the region. Stock management and benefit distribution are dependent on the coordination of these agencies in data collection, evaluation, information dissemination and regulation. These organizations must be utilized to match the wide biological range of highly migratory pelagics to the political range of fishery participants and resource adjacent states involved in the fishery.

CHAPTER III

SWORDFISH FISHERY BACKGROUND

During the early 1980s, the swordfish fishery of the Northwest Atlantic was undergoing rapid expansion due to the relaxing of U.S. mercury regulations in 1978 and growing consumer demand for the product. These factors encouraged the expansion of effort and range of U.S. swordfish operations. A perceived trend toward declining stocks and issues associated with fishing outside traditionally fished areas have made the swordfish fishery one of the most controversial fisheries in the Northwest Atlantic.

This chapter will examine the characteristics which make the management of the swordfish fishery inherently difficult as the geographic range of U.S. operations has expanded.

Swordfish Biology

Swordfish, Xiphias gladius, range throughout most of the temperate and tropical waters of the world between roughly 45 degrees north to 45 degrees south latitude (Conser et al, 1985b). In the Atlantic, swordfish generally occur throughout this zone with concentrations in the Northwest Atlantic along the east coast of the United States and Canada, in the South Atlantic along the South American

coast, and in the Eastern Atlantic off the west coast of Spain and in the Mediterranean Sea (Beardsley 1979). Although their distribution is considered to be continuous with no clear-cut dividing line between these areas of concentration, no movement among the areas in question has been documented with the limited number of tag recaptures which have been recorded up to 1985. This suggests the possibility of separate stocks in the three areas although it is more likely that at least limited interchange occurs between these groups (Conser et al, 1985b).

In the Northwest Atlantic, swordfish inhabit waters from Newfoundland to Northern South America. Seasonal shifts of different age groups have shown central movements which are dominantly south-north (Hoey and Casey 1983b). Larger size groups generally move further north and east than those fish of smaller age groups. All groups show a tendency toward northern movement in the summer and southern movement in the winter (SAFMC 1985). Swordfish can be highly migratory in nature as indicated by tag and recapture of individuals which have travelled several thousand miles. This does not mean that the entire population migrates long distances. Some elements of the population occur year-round in specific areas, and different age groups may migrate to different degrees as mentioned above (SAFMC 1985). Distribution and seasonal migration are dependent on temperature, feed

availability and spawning (SAFMC 1985). Swordfish are opportunistic feeders which favor cephalopods (squids) and a variety of fish species including juvenile swordfish. Swordfish are often found in greater concentrations where favorable conditions exist although they are generally classified as a solitary fish. Areas which sustain the greatest fishing effort are the edge of continental shelves and along ocean frontal zones where swordfish forage is most abundant, such as the edge of the Gulf Stream off the eastern United States. This is probably a reflection of the swordfish's somewhat narrow horizontal distribution (SAFMC 1985).

Larval studies have shown concentrations of occurrences in the east-central Gulf of Mexico, Straits of Florida and the Eastern Caribbean. Swordfish larvae have been collected throughout the year in the Northwest Atlantic with the greatest concentrations during the fall and winter (Grall et al, 1981). In the Caribbean Sea the greatest number of larval swordfish have been collected from November to February (Berkeley and Houde 1980). Swordfish are continuous pulse spawners with most spawning activity occurring during March and April. The estimated fecundity of swordfish ranges from 1×10^6 to 2.6×10^7 eggs which are released into the water column (SAFMC 1985).

Swordfish exhibit growth differentiation according to sex. Females grow faster than males after age two and attain a larger size. In Florida the largest aged female weighed over 300 kg compared to the largest males which weighed less than 140 kg (Berkeley and Houde 1985). Males reach reproductive maturity at approximately three years of age with a lower jaw fork length (LJFL) equal to 126 cm and a dressed weight of 17 kg, while females reach reproductive maturity at five years of age with a LJFL of 151 cm and a dressed weight near 28.8 kg (SAFMC 1985).

History of the Fishery

In 1962 the dominant gear strategy utilized in the Northwest Atlantic swordfish fishery changed from harpoon to longline gear. This change was associated with a dramatic increase in swordfish landings from 2,500 MT to a high of over 8,000 MT round weight in 1963 (SAFMC 1985). This figure dropped off and stabilized around 5,000 MT on an annual basis until 1970 (Caddy 1976). During this period, the fishery was dominated by Canadian participants who accounted for 80-95% of landings in the Northwest Atlantic. The size composition of the catch was marked by a trend toward smaller fish from an average dressed weight of 90.7 kg in 1963 to 45.4 kg in 1971 (Beckett 1971). This decline has been attributed to the change in gear strategy from harpoons, which take larger fish to longlines, which are less selective, and the

expansion of fishing grounds to southern areas where smaller fish make up a greater percentage of the population (Caddy 1976). Harpoon effort generally decreased during this period, while longlining effort increased from under six million hooks when landings were at their peak to six to seven million in 1970 (Caddy 1976). Landings which were maintained around 5,000 MT in the later 1960's depended on increased fishing effort and expansion into new fishing grounds. The fishery subsequently collapsed after the imposition of mercury regulations in 1971 (Beckett 1971).

Since 1956, the Japanese have carried out a pelagic longline fishery in the Atlantic targeting on tuna (Fox 1971). Swordfish landings from this fishery were incidental because sets were usually made during the daytime when swordfish are least likely to feed. According to ICCAT, annual landings of incidental by-catch were around 1,800 MT during the late 1960s.

In 1971, the FDA issued guidelines which limited the concentrations of mercury in swordfish to 0.5 ppm. A positive correlation between mercury concentration and swordfish body weight was found to exist; generally the larger the fish, the larger the concentration of mercury. Since few fish could meet the standards, the 1970s were characterized by clandestine fishing operations. Fishermen were afraid of

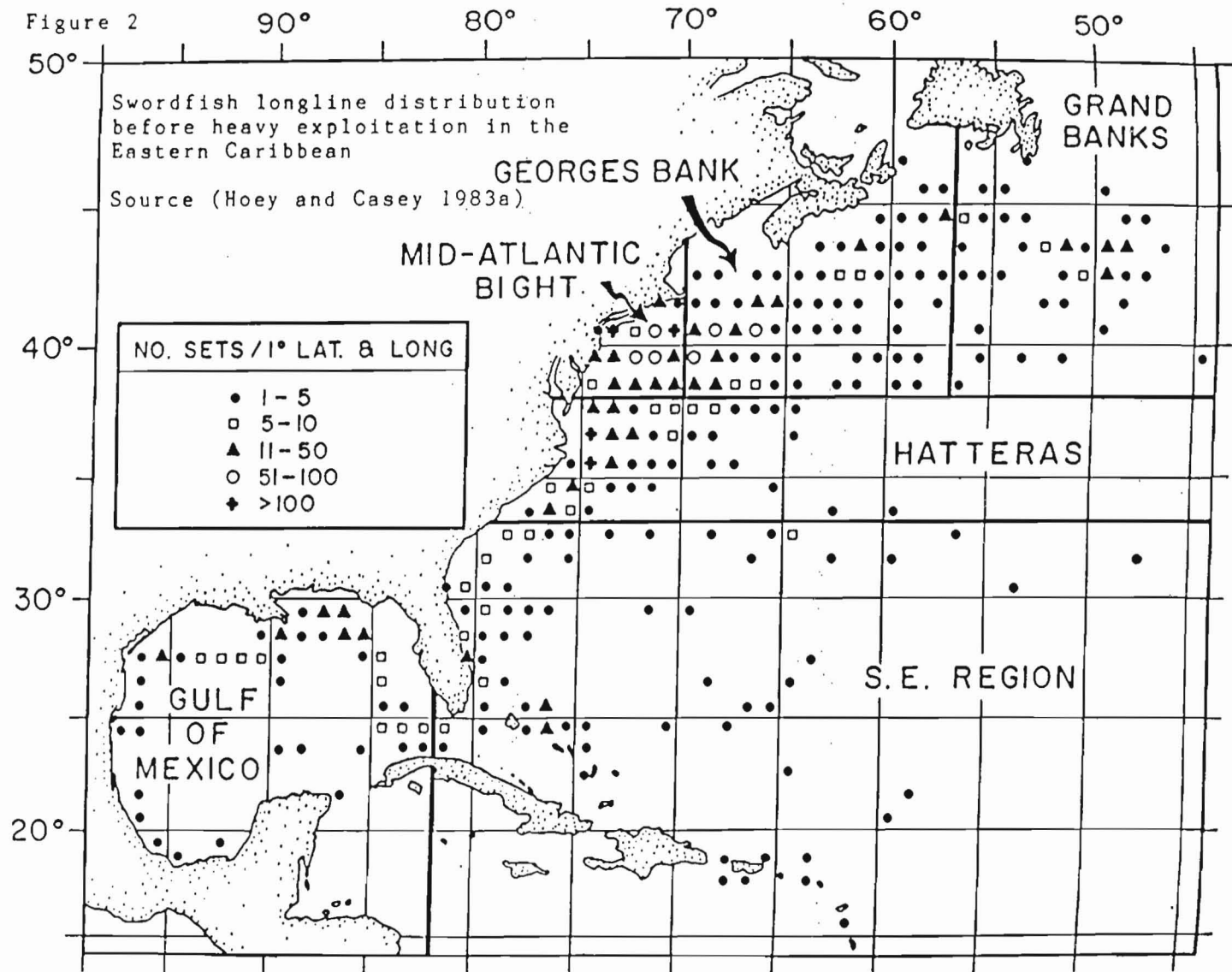
losses to impoundment if the FDA sampled their fish (SAFMC 1985). Therefore, little is known about the fishery during this time period although average size and CPUE were reported to increase as expected after 1970 (Caddy 1976). In 1978 the FDA restrictions were challenged and raised to 1.0 ppm. This action encouraged a dramatic growth in fishing effort and expansion to new areas in the fishery. In 1982 Canadian landings were calculated to be approximately 2,500 MT while U.S. landings had reached approximately 4,100 MT (SAFMC 1985). Figure 2 illustrates the areas of longline effort concentration during this period.

Fishing Methods

Swordfish are taken by harpoon, entanglement gear, handlines, rod and reel, and longline. Longlines take the majority of the U.S. commercial catch and are the primary gear strategy which is employed in the Eastern Caribbean. Swordfish exploitation began as a commercial longline fishery in the U.S. in the early 1960s off the Northeast coast, although it has been practiced by both the Cubans and Japanese since the 1950s.

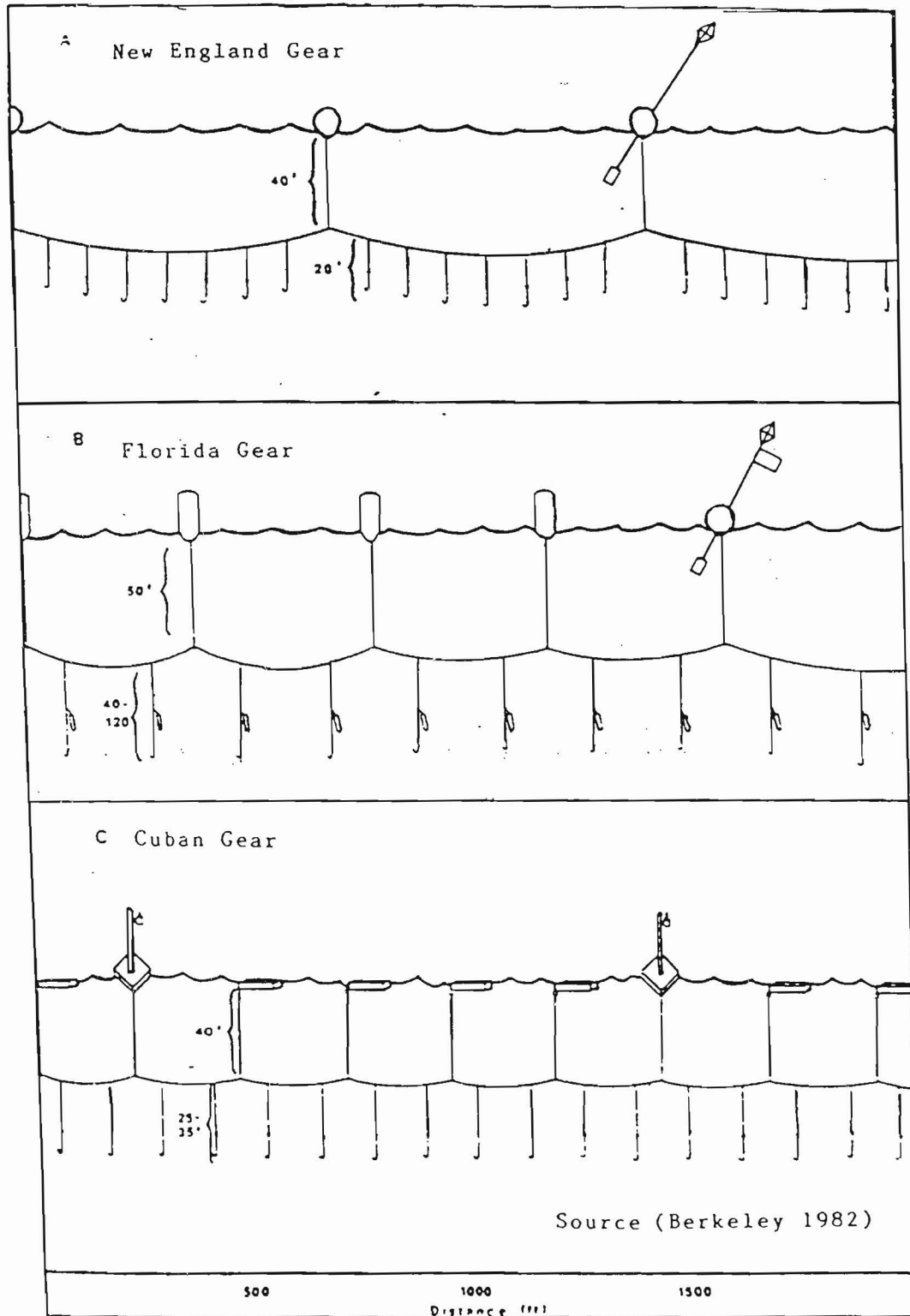
The three principal types of longline strategies are the New England, Florida and Cuban methods although the artisanal Cuban method is rarely used today (Berkeley et al, 1981). The general fishing method can be characterized by the

Figure 2



following description. Longlines of up to 40 miles are set in the evening and retrieved the next morning by vessels which usually range from 50-85 feet in length (Berkeley et al, 1981). The preferred area for sets are ocean frontal areas which are the border areas between zones of different physical characteristics such as the edge of the Gulf Stream. In the Caribbean, sets are commonly made in areas adjacent to shelf areas where the depth may be 1,000 feet or more. Swordfish longlining takes place at night due to the nocturnal feeding habits of the species. Hooks are baited with squid or mackerel and spaced along the main line every 200 to 300 feet (Berkeley et al, 1981). The main line is suspended below the surface with floats which may be made up of inflatable polyethylene balls at a predetermined depth which varies around 10 to 20 meters (Campos et al, 1985), although adjustments are frequently made according to conditions. The gangions which are suspended from the mainline vary in length from 10 to 40 meters also depending on conditions. Strobe lights and radar reflectors or high flyers are attached to the main line every one to one-and one-half miles (See Figure 3). The gangions, floats, and high flyers are all attached to the mainline with stainless steel "snap-on" connectors (Berkeley et al, 1981). The mainline is made up of 700-pound test monofilament while the gangion line has 400-pound test monofilament line (McLain per. com. August 1986). Cyalume chemical lights are suspended 10 to 15 feet

Figure 3 Longline gear types for swordfish



above the bait with elastic or rubber bands for swordfish attraction (Berkeley et al, 1981). These lights are thought to resemble glowing squid. The hooks are big game fish hooks ranging in size from 8/0 to 12/0 (Campos et al, 1985).

Haulback is usually accomplished hydraulically with a longline hauler or reel on which the main line is wound (Berkeley et al, 1981). Gear clipped to the mainline is then detached and fish are taken aboard as the mainline is retrieved. Swordfish are dressed immediately and stored on ice which is made from salt water. Dressing is accomplished by removal of the head, fins, entrails and tail. This routine is repeated daily until the boat has the catch required to fill the hold or to make the venture economically viable. This means that a trip may last up to three weeks with catches ranging from 10,000 to 30,000 pounds per trip. There are variations to the preceding description in gangion spacing, depths, bait, floats and catches which depend primarily on vessel size and local conditions, but most methods and gear are similar to what has been described above.

Most of the operations in the Caribbean are characterized by a hybrid of New England and Florida methods. New England boats, especially those fishing in the Caribbean, are larger allowing them to travel greater distances, make longer sets

and spend greater periods of time away from port. Many of the Florida vessels are smaller in size because they usually fish areas where the Gulf Stream comes within 15 miles of shore, or in the Gulf, and make shorter trips of two to three days. The utilization of longer sets and larger vessels characteristic of New England and of Florida gear sets which utilize monofilament line, deeper fishing depths and greater spacing of gangions have been the predominate gear strategy operating in the Eastern Caribbean.

The Cuban method is rarely used today although it may be useful for adaptation by Eastern Caribbean artisanal fishermen, especially in areas where the shelf edge is near shore. Unlike the former methods, the sets were approximately four miles, which is relatively short, and done from smaller vessels of around 30 feet. These vessels were not equipped with the electronic instrumentation which is common to most longline vessels currently operating. Lanterns were utilized instead of cyalume lights for swordfish attraction and for indication of when a fish is hooked. The set was checked for fish throughout the night so that fish were taken soon after becoming hooked, resulting in less loss due to sharks. Retrieval was accomplished by hand instead of hydraulically. Fish were then preserved on ice or by covering with a wet tarp. Trips were usually limited to one

night, thereby limiting the effective range of the operation in comparison to the other two methods (Berkeley 1982).

The utilization of larger New England boats and Florida methods and gear has been a successful combination in the Eastern Caribbean, as evidenced by the growing number of vessels which visit the area each year. The fishery can be described as lucrative for the longliner in supplying swordfish dockside for prices approaching four to five dollars per pound (Rolon per. com. August 1986) while sold in the U.S. for prices approaching \$12.00 per pound depending on location and season. Commercially viable concentrations are present in the Eastern Caribbean from November through May although swordfish are present in the region throughout the year.

Status of the Swordfish Resource and Fishery

Perhaps the subject which is researched and discussed the most, but the least understood or agreed on, is that of swordfish stock health and management. The swordfish fishery has been subject to virtually no regulation throughout its range. Management measures are complicated by: the wide distribution of the species; limited understanding of swordfish stock differentiation, biology and population dynamics; and the number of countries which participate in the fishery, either directly or indirectly.

Since over one-half of U.S. landings originate outside the U.S. EEZ, regulation is further complicated by jurisdictional questions (Pollack 1988).

In 1983 swordfish landings in the Northwest Atlantic peaked at over 9.3 million pounds (SAFMC 1985). Recently the number of small fish (dressed weight < 40 pounds) taken has risen significantly, and average size has dropped in most U.S. management regions indicating growth overfishing (SAFMC 1985). Mean dressed weight has dropped from 83 pounds in 1980 to 60 pounds in 1986 (Pollack 1988). According to analytical assessment of Northwest Atlantic stocks, fishing mortality has increased since 1978 resulting in a 40% drop in spawning stock biomass of swordfish aged five years or greater by 1984, then increased to within 75% of 1978 levels by 1986 (Southeast Fisheries Center 1986). Meanwhile the number of juveniles of ages 0-2 years remained stable until 1982, then increased thereafter (SEFC 1986). A 30% reduction in total stock biomass took place from 1978 through 1982, then stock biomass increased to the 1978 level by 1985. Catches exceeded stock growth from 1979 through 1980, became approximately equal to growth in 1981, and increased from 1982 to 1985 (SEFC 1986). Total landings have generally remained stable during the period. In 1980 U.S. landings were 8.0 million pounds, while in 1986 landings were 7.6 million pounds (Pollack 1988).

Although studies indicate that growth overfishing has taken place resulting in a smaller average size, recruitment overfishing has not occurred (ICCAT report 1985). Steve Berkeley of the South Atlantic Fishery Management Council states that "longliners are working longer and harder and with more sophisticated gear to catch about the same number of fish" (Pollack 1988). The fishery has experienced substantial increases in the fishing mortality rate since 1978 and has approached the fully exploited level (Conser et al, 1985b). It should be noted that there are inherent uncertainties associated with the analysis of fish populations due to the effects of natural fluctuations in the environment, imperfect or incomplete data and models which cannot fully explain the complexity for fish stocks (Pollack 1988).

United States Swordfish Management

The actual health of swordfish stocks is debatable, but most studies agree that exploitation is at or near peak production levels, while total effort within their probable range in the Northwest Atlantic is steadily increasing. This question has prompted the five U.S. Fishery Councils (New England, Mid-Atlantic, South Atlantic, Gulf and Caribbean), whose regions lie within the range of swordfish stocks, to initiate a cooperative effort to control the resource through the establishment of a Fisheries Management Plan

(FMP). Although this action was initiated over six years ago, the effort has resulted in very little in the form of regulation to date. The last FMP was rejected by the Secretary of Commerce in 1985. Management was further complicated by disagreement among participants, scientists and managers involved in the Northwest Atlantic longline fishery whose arguments were as politically motivated as economic or biological.

The major goal of the FMP currently under consideration is to reverse the current trend of growth overfishing by the increase of average weight. According to Brad Brown of the Southeast Center, it can be argued that the increase in fishing mortality due to longline effort has resulted in a more intensive fishery on the entire resource and that the fishery appears to be functioning at or near an optimum level (Pollack 1988). However, since price is positively correlated with swordfish carcass size, pound for pound, larger fish are more desirable. The increase in average size exploited will also raise the time of first capture which will prevent the future possibility of recruitment overfishing.

The principal components of the FMP that were under consideration include Variable Season Closures (VSC), mandatory log requirements, restriction of entanglement gear and on-

board observers. Log requirements went into effect in May of 1986 while the possibility of on-board observers has been dropped. VSCs were passed by the Councils, but never enacted by the National Marine Fisheries Service. According to the South Atlantic Council, "the VSC was designed to reduce the catch of small swordfish by selectively closing the fishing grounds during periods when small swordfish are most concentrated there" (Pollack 1988E, 4). It was questioned whether the measure would produce the desired goal due to the possibility of increased effort during openings and the difficulty in making the VSC coincide with the presence of small fish.

According to Craig O'Conner (NMFS acting Southeast Regional Director), because a large proportion of U.S. landings originates outside the U.S. EEZ, "the VSC would deny American fishermen access to U.S. ports thereby impairing their ability to compete with foreign vessels fishing the same waters" (Pollack 1988, 72). The proposed ban on imports during closures could help to alleviate the problem, but it has been blocked by controversy (Pollack 1988). Meanwhile, adverse effects on U.S. tuna longliners due to the prohibition of nighttime longlining during closures was another negative factor associated with the VSC measure (Pollack 1988). Finally, the Japanese fishing industry filed suit against the Department of Commerce because the

proposed measure would limit their longline operations in the U.S. EEZ (Pollack 1988). The Japanese contend that VSCs would "deprive them of a significant part of their tuna catch" in the U.S. EEZ in which the U.S. has not declared jurisdiction over tunas (Pollack 1988, 72). These factors have combined in killing the proposed VSC regulation. Size limits have been proposed for fish under 25 pounds dressed weight. This proposal was rejected by the South Atlantic Council because longline gear is nonselective, and small fish will be hooked and killed anyway (Pollack 1988).

Although no regulatory actions have been taken other than reporting requirements, the U.S. Atlantic Fisheries Management Councils are planning to amend the swordfish management plan in the coming year (Stevens 1988). There is no definitive plan of action at present; however, there is general agreement among the councils that management measures are required. According to Gail Johnson, swordfish committee chairperson, "fishing mortality is too high across all age groups and something needs to be done" (Stevens 1988, 20). The one certainty which remains is that swordfish management will remain controversial and the enactment of a regulatory regime is uncertain in the near future.

CHAPTER IV

THE EASTERN CARIBBEAN SWORDFISH FISHERY

During the 1983 season, two U.S. mainland longline vessels initiated the first attempts at the commercial exploitation of swordfish stocks in the Eastern Caribbean. In 1986 the number of vessels operating in the region increased to at least 50 with some reports that the total may range as high as 70 (Rolon per. com. 1987). In 1985 U.S. landings in the Caribbean Region reached 652,635 pounds. Landings increased by nearly 300% to 1,902,750 in 1986, accounting for over a quarter of the U.S. Atlantic catch of 7,607,909 pounds (SAFMC 1987a) (See Tables 9 and 10). In addition to the target species, the incidental by-catch of marlin, tuna, wahoo, dolphin fish and a number of shark species has been reported.

The majority of the commercial fishing vessels which exploit large pelagics such as swordfish or tuna in the Eastern Caribbean are of foreign origin. Most swordfish vessels originate in the continental United States while the majority of far-ranging tuna vessels come from Asiatic nations such as Japan, Taiwan and Korea. The Japanese have carried out pelagic longlining in the Atlantic since mid-1956 (Fox 1971). From 1956 through the 1960s they targeted

TABLE 9

Caribbean
 1985 Swordfish Landings and Size Composition

<u>Month</u>	<u>Landings Dressed Wt.</u>	<u>Mean Wt.</u>	<u>Total No.</u>	<u>% < 50 Lb.</u>	<u>No. < 50 Lb.</u>
January	138,170	107.0	1,291	15.1	195
February	143,546	105.5	1,361	10.9	148
March	172,138	101.3	1,699	18.4	313
April	59,971	91.8	653	24.8	162
May	24,474	101.0	242	21.7	53
June	0	0.0	0	0.0	0
July	0	0.0	0	0.0	0
August	0	0.0	0	0.0	0
September	0	0.0	0	0.0	0
October	7,901	76.2	104	27.9	29
November	18,630	71.0	262	33.8	89
December	87,805	78.7	1,116	22.0	246
Total	652,635	97.0	6,728	18.4	1,235

Source (SAFMC 1987)

TABLE 10

Caribbean
1986 Swordfish Landings and Size Composition

<u>Month</u>	<u>Landings Dressed Wt.</u>	<u>Mean Wt.</u>	<u>Total No.</u>	<u>% < 50 Lb.</u>	<u>No. < 50 Lb.</u>
January	275,250	80.6	3,192	32.0	1,021
February	369,000	83.1	4,440	31.6	1,403
March	297,750	83.7	3,557	32.0	1,138
April	270,750	79.9	3,389	31.6	1,071
May	121,500	71.3	1,704	34.5	588
June	57,750	64.7	893	38.1	340
July	28,500	54.8	520	49.9	259
August	15,750	60.5	260	37.1	96
September	105,750	79.0	1,339	25.7	344
October	90,750	72.8	1,247	31.0	387
November	122,250	74.0	1,652	32.0	529
December	165,750	81.5	2,034	25.2	513
Total	1,902,750	78.6	24,227	31.7	7,689

Source (SAFMC 1987)

on yellowfin tuna in areas adjacent to the Eastern Caribbean (Fox 1971). Taiwanese and Korean operations are currently more active in the region and transship landings through St. Martin, Curaco and Trinidad and Tobago (Rolon, per. com. 1986).

United States operators who formerly fished in areas adjacent to the mainland originally expanded to U.S. waters adjacent to Puerto Rico and the U.S. Virgin Islands. The only requirement for U.S. fishermen who fish in U.S. waters is a federal swordfish permit which is free of charge. Although swordfish were known to inhabit Caribbean waters, stock concentrations and commercial viability were unknown until these initial attempts were made. In 1984 the U.S. Virgin Island Pelagic Fisheries Development Project, funded through the Saltonstall-Kennedy Act, illustrated the potential viability of the fishery as the number of U.S. vessels visiting the area increased annually (Wood 1986).

The sudden influx of nonindigenous participants and the introduction of gear technology uncommon in the Lesser Antilles have resulted in a variety of user conflicts and policy issues. Problems began to surface in Puerto Rico and the U.S. Virgin Islands in 1985. The landing of longliner by-catch, including recreational billfish species, put longliners in conflict with local commercial and

recreational fishermen. Meanwhile it became apparent that a substantial proportion of swordfish landed in Puerto Rico originated outside U.S. waters. Issues involving access of foreign fishing vessels became a pressing policy consideration for island states of the Lesser Antilles because longliners have operated in their fishing zones without permission, or in a manner which was inconsistent with prior agreements. Embedded within these policy issues is the realization that development of a local longline fishery is impeded by the lack of expertise, experience and capital. These issues appear before a background riddled with controversy concerning stock health, management and regulation of the far-ranging species.

Issues in the U.S. Virgin Islands
and Puerto Rico

The effect of longliner by-catch sales on local markets is the major source of conflict between local fishermen and stateside longliners. Recreational fishermen fear that the health of several billfish species which they target on is threatened due to longliner landing. Foreign tuna vessels from the Far East have carried out longline operations in the region for nearly three decades with little or no problem. The lack of associated conflicts is due to their lack

of visibility to local fishermen. Tuna vessels fish farther from shore and over greater ranges than U.S. swordfish vessels, while local markets are not utilized for their operations' by-catch.

Local Marketing of Incidental By-catch

The question of incidental by-catch and its impact on local markets and billfish stock health are related to the actual volume resulting from swordfish operations. Swordfish longline gear is only as selective in the capture of other pelagic species (which also inhabit Eastern Caribbean waters) as the strategy with which it is fished and deployed. This means that the depth and time of deployment are instrumental in the determination of catch composition. Japanese longline statistics, NMFS exploratory fishing and New England Swordfish operations illustrated temporal segregation between tuna and billfish which are more vulnerable to daytime sets, while swordfish are more vulnerable to nighttime effort (SAFMC 1985) (see Figure 4). The strategy of nocturnal gear deployment is selective for swordfish with a predominate incidental by-catch of sharks (Hoey and Casey 1983a). Longline operations which target on tuna are generally set during the day and yield a by-catch of sharks and a greater percentage of billfish species and other teleosts than nocturnal sets (Casey et al, 1983).

In 1986 the Caribbean Region reported landings of 110,077 pounds of billfish and 287,863 pounds of tuna (SAFMC 1987a) (see Table 11). The incidental catch of fish actually hooked is lacking except for 78 sets made by the U.S. Virgin Islands Pelagic Fisheries Development Project. This is a relatively small sample size from which to draw conclusions, but it reported the expected predominance of swordfish at nearly 50% and sharks at 32%. Other telosts including tuna, marlin, dolphin and others totalled approximately 16% of total landings (Wood 1984) (see Table 12). Although these figures should be treated cautiously, in association with the studies cited earlier, they indicate that by-catch rate of sharks is substantial, probably as high as 50%, while the by-catch of teleosts such as tuna, wahoo and dolphin are likely to be between 10% and 20%.

It seems reasonable to expect that a great deal of variation in amount and composition of landed by-catch exists, depending on each vessel's objectives and fishing strategy. Although swordfish longline retrieval is usually started before first light, it may take over six hours, thereby extending into daylight hours due to the length of sets which may approach 40 miles (Rolon per. com. 1986). The result is the capture of a greater percentage of species that are commonly caught during daylight hours such as tuna, marlin, sailfish, dolphin, and wahoo (McLain per. com.

TABLE 11

<u>Area</u>	<u>Swordfish</u>		<u>Tuna</u>		<u>Billfish</u>	
	<u>Dressed Wt.</u>	<u>Value</u>	<u>Whole Wt.</u>	<u>Value</u>	<u>Whole Wt.</u>	<u>Value</u>
NE & MA	3,720,750	\$ 9,332,214	1,818,370	\$ 5,358,043	14,000	\$ 8,400
South Atlantic	1,385,909	3,869,183	672,913	1,061,819	36,218	20,685
Gulf Of Mexico	598,500	1,617,855	6,734,981	9,637,893	141,400	89,082
Caribbean	1,902,750	5,258,335	287,863	541,811	110,077	16,394
Total	7,607,909	20,077,587	9,514,127	16,599,566	301,277	134,282
% of Total	43.67%	54.54%	54.61%	45.09%	1.73%	0.37%

1986 U.S. longline landings and value of swordfish, tuna and billfish according to U.S. management region.

Source (South Atlantic Fisheries Management Council 1987)

TABLE 12
Longline Catch Composition

<u>Species</u>	<u>Number Caught</u>	<u>Relative Abundance</u>
swordfish (<u>xiphias gladius</u>)	133	.496
blue shark (<u>Prionace glauca</u>)	20	.074
blacktip shark (<u>Carcharhinus limbatus</u>)	13	.048
whitetip sharks (<u>Eulamia longimanus</u>)	10	.037
hammerhead shark (<u>Sphyrna mokarran</u>)	6	.022
bull shark (<u>Eulamina leucas</u>)	4	.015
tiger shark (<u>Galeocerdo cavieri</u>)	4	.015
unidentified sharks	29	.107
blackfin tuna (<u>Thunnus atlanticus</u>)	12	.044
yellowfin tuna (<u>Thunnus albacarus</u>)	3	.011
escolar (<u>Lepidocybium flavorbrunneum</u>)	12	.044
blue marlin (<u>Makaira nigricans</u>)	14	.051
Wahoo (<u>Acanthocybium solandri</u>)	3	.011
dolphin fish (<u>Coryphaena hippurus</u>)	2	.007
sailfish (<u>Istiophorus platypterus</u>)	2	.007
white marlin (<u>Tetrapturus albidus</u>)	1	.004
snake mackerel (<u>Gempylus serpens</u>)	1	.004
Totals	272	.997
Source (Wood 1986)		

1986). Recent increases in the price of fresh tuna are making them a valuable component of landings. Sharks have been reported as a nuisance due to the damage they cause to hooked swordfish. Most shark species have a low dockside value and are prone to spoilage without special treatment. Therefore, they are usually cut from the mainline to save time and money. It has been reported that marlin may also be cut away or released due to their low dockside value.

The press reports a difference between the major companies' vessels which seem to have a set of ethical rules and renegade vessels which have little regard for the preservation of gamefish or local conditions (Martin and Woods 1986d). Hypothetically, the behavior of fishermen will be dictated by their self-interest, in this case most likely being financial returns due to the transitory nature of their operations. If there are low marginal costs associated with the use of available space and the extra effort involved with incidental catch retention, or daytime effort, then by-catch will be retained. Combine low costs of retention with ready dockside markets, and incidental by-catch becomes an attractive commercial proposition for the longliner. If it is not cost effective to send these species to the U.S. by airfreight from Puerto Rico, then it will be sold locally. Mainland longliners who wish to sell fish locally must obtain a Virgin Islands commercial fishing license for five

dollars (Christian per. com. 1986). Sales may be carried out by the company which is involved in the enterprise or as "shack" (the sale of incidental catch), the profits of which are immediately split by the crew (Rolon per. com. 1986). A major factor contributing to disruption of local markets is the relatively low price of by-catch in relation to the prices normally obtained by local fishermen for the same pelagic species such as dolphin fish. Local fishermen cite examples where they have been undersold for species such as dolphin fish for prices of \$2 or less per pound (Hildebrant 1986). Swordfish vessels are not constrained by the same costs and conditions which affect local fishermen. The outcome appears to result in the dumping of fish which creates temporary market gluts and prices which may be below the local cost of local production (CFMC 1986).

In both the U.S. Virgin Islands and Puerto Rico the lack of infrastructural facilities for product storage and marketing may leave the fisherman without an alternative on a given day. An example reported in Puerto Rico involves middlemen who normally deal with local fishermen. They cite greater profits, regular supply and a high quality product as factors which attract them to longliner by-catch marketing (Rolon per. com. 1986). Tourist hotels find large pelagics such as fresh dolphin fish or tuna desirable for their menus for the reasons cited above (CFMC 1986). Local catches

which are generally composed of pot fish are also in direct competition with longliner by-catch. The actual or perceived threat of ciguatera in reef fish is not present in the pelagics landed by longliners, presenting another possible reason for preference of the latter.

Total imports of fish and fish products amounted to 2.2 million pounds in the U.S. Virgin Islands and 53.8 million pounds for Puerto Rico in 1980, as compared to 1.5 and 7.2 million pounds which were landed in the same year (CFMC 1985). Although salt cod and luxury tourist products are included in these import statistics, the figures illustrate a large short fall in the supply of fishery products. From the consumer's side, locally produced fishery products are considered somewhat scarce and expensive at prices approaching or surpassing \$3 per pound for mixed reef fish. It seems reasonable to expect that the general population and restaurants of the USVI and Puerto Rico stand to benefit from an increase in fish supplies in the form of lower prices, better quality and greater choice.

In the long term, or on an annual basis, it is apparent that short falls of supply in relation to demand occur in most of the Eastern Caribbean. The problem occurs in particular markets at certain times of year in an area which has a poorly developed fisheries marketing infrastructure. The

established marketing system, although imperfect, has evolved over a long period of time and has more or less met the fishermen's needs until the advent of longlining by-catch. When a new element was introduced to an already somewhat stressed and delicate system, it caused disruption to fishermen who were already operating what is in many cases a marginal enterprise. Most fishermen believe that the local fishing industry has stagnated or is in decline while most inshore stocks are at or beyond maximum levels of exploitation (Taylor 1986). The income of fishermen averages below \$300 per month in this region (CFMC 1985). Swordfish fishing is not a traditional activity among local fishermen. They do not "seem particularly worried about the impact of the longliners on stocks of swordfish" (CFMC 1986-8). However, local fishermen believe that the longliners are in part responsible for a perceived decline in pelagics which they also target such as dolphin fish, wahoo and occasional tuna and marlin (CFMC 1986).

Recreational Concerns

Another area of concern is the possible detrimental effect of swordfish longlining on recreational species such as marlin and sailfish. Recreational fishermen perceive longlining as a threat to populations of the large highly migratory pelagic species which they target (CFMC 1986). In 1986, longline landings of billfish in the Caribbean

Management Region totalled 110,077 pounds as compared to 1,902,750 pounds of swordfish (SAFMC 1987a) (see Table 11). This figure may have been low relative to the number of fish actually hooked because marlin were sometimes cut off dead or alive due to their relatively low dockside value (Rolon per. com. 1986). Also a portion of the billfish landed may not have been included in these figures because it was reported that fish were landed illegally without a local commercial fishing license. Dockside prices were reported to be \$.60 to \$1.20 per pound, although during the last two years the price has been rising (Rolon per com. 1986). Recreational and small commercial fishermen also reported 11,000 pounds landed in 1985 for an ex-vessel value of \$1.50 per pound (SAFMC 1987b).

As noted previously, incidence of billfish by-catch is greater for daytime as opposed to nocturnal longline sets. In the USVI Pelagic Fisheries Development Project, sailfish and marlin constituted approximately 6% of the total catch (Wood 1986). NMFS exploratory fishing and commercial swordfish data off the east coast of the United States resulted in a composition of less than 1% billfish for night sets (SAFMC 1985). The tuna longliners operating throughout much of their range utilize daytime sets which may account for higher rates of hooked fish per unit effort. Species

composition data indicates percentage catch of 4% billfish as the result of Japanese tuna effort (Casey and Hoey 1983) (see Figure 4). An accurate mortality rate for marlin released from longlines may vary markedly although 47% for blue marlin and 71% for white marlin have been cited in observer reports from Japanese longline operations (SAFMC 1987b).

Stock assessment analysis is plagued by deficiencies in basic data and biological parameters (ICCAT report 1985). Sailfish appear to be only moderately exploited, but a better picture could be achieved if data concerning sailfish and spearfish species were separated and with better overall data collection (ICCAT Report 1985). Stock condition of white and blue marlin is also unclear although "a declining trend in CPUE for both species is seen as a cause for concern" (SAFMC 1987b, 10). Bill Vissner, an organizer of Caribbean billfish tournaments, feels that "the billfish population has declined dramatically over the past few years and that longliners are responsible for an 85% reduction in billfish landings" (Stimpson 1988, 50). It should be emphasized that, although this is a common view among recreational fishermen, scientific analysis cannot support this assertion.

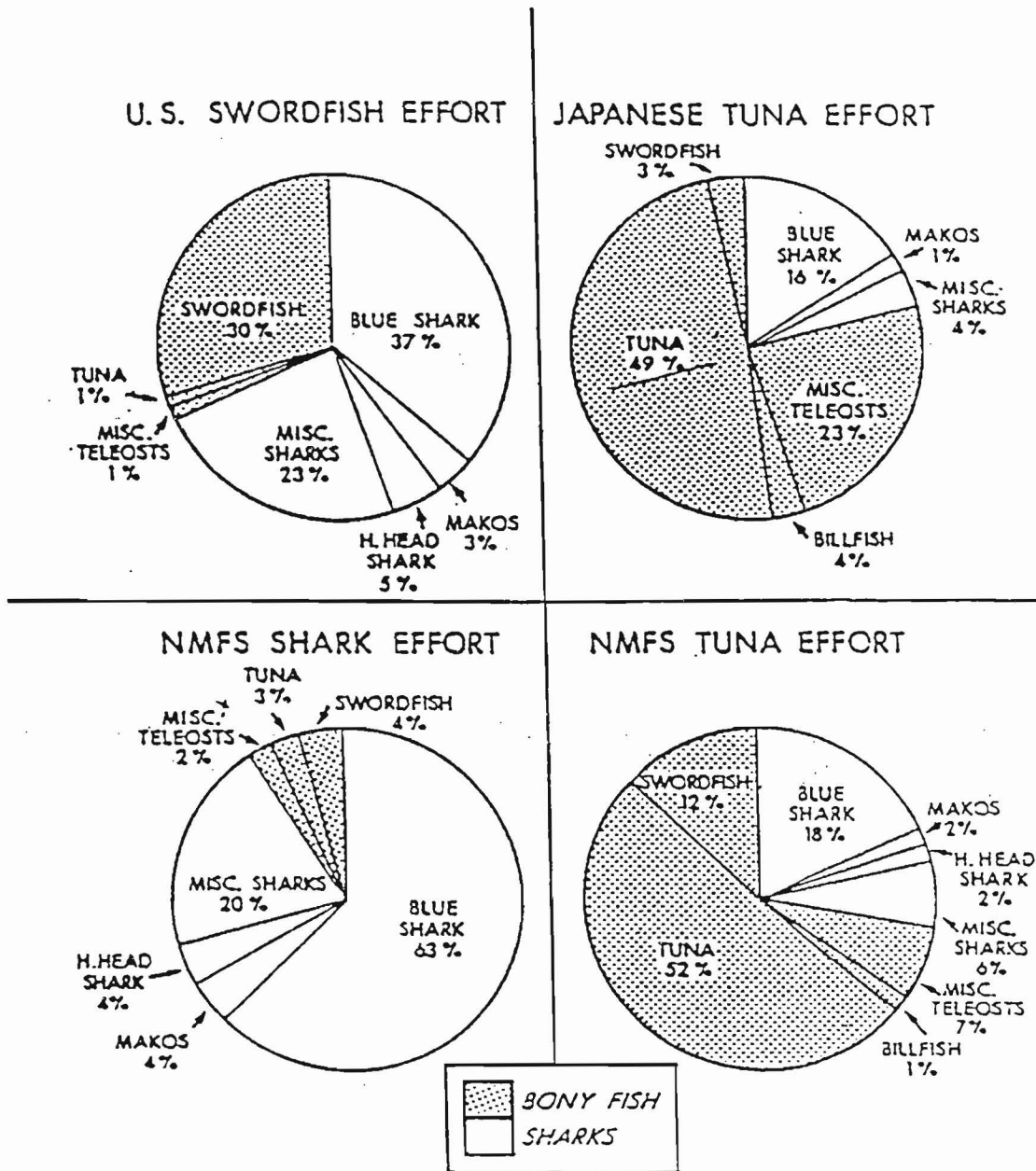


Figure 4 - Species Composition from Longline Fisheries in the Western North Atlantic (Hoey et al 1983)

Sport fishing brings tourist dollars into the local economy for charter boats, equipment and indirect revenues to various service sectors of the economy (Campos et al, 1986). Expenditures by participants in the U.S. recreational billfish fishery were estimated at approximately \$100 million in 1977-78 (SAFMC 1987b). The actual figure may be larger due "to inflation, growth in the activity and indirect expenditures which were not accounted for in the study" (SAFMC 1987b, 27). Fishing tournaments are annual attractions in both Puerto Rico and USVI. A National Marine Fisheries study done by the Clapp and Mayne Consulting Firm stated that the marine recreational fleet of Puerto Rico was composed of 8,200 vessels with an investment of \$85.3 million in 1979 (Puerto Rico Sea Grant, per. com. 1987). Caution should be exercised with these figures because they do not represent the actual economic value of the resource. They are also crude estimates if projected to 1988, yet these figures illustrate that the recreational billfish fishery is an important component of the region's economy.

Conclusion

The investigation of by-catch landing composition and volume is essential to gain a better understanding of the problem. In addition, the voluntary stationing of on board observers could supply valuable data on the composition of fish actually hooked and fishing operations. Since longliner

landings are seasonal and have localized effects, a better understanding of local marketing infrastructure could assist in the formulation of policies which could minimize effects on the local industry.

CODREMAR, the agency in Puerto Rico which classifies and inventories catches of small boat fishermen, is doing surveys on landings of longliners in Puerto Rico (Kimmel per. com. 1987). In 1986, a contract was awarded to the University of Puerto Rico to begin the Caribbean Observer Project (NMFS 1987). ICCAT is also intensifying efforts in the research of Atlantic billfish. The fisheries councils of the Atlantic U.S. recently proposed a Billfish Management Plan which will prohibit the commercial sale of billfish and require size limits on fish retained by recreational operations (SAFMC 1987b). This plan illustrates current concerns regarding recreational billfish stock health.

Local market interactions and impacts on recreational stocks are issues which have no easy answers, but they illustrate valuable lessons in dealing with the swordfish fishery. These issues have the potential to be instructive and to contribute to future policies of Eastern Caribbean states throughout the region as the U.S. longline presence expands.

Illegal Swordfish Longlining in Eastern
Caribbean States' Waters

The illegal operation of U.S. longline vessels in Lesser Antillean nations' waters, either due to unauthorized entry or by operating in a manner inconsistent with prior agreements, has become a major issue in the Eastern Caribbean region. A significant percentage of the 1,902,750 pounds of swordfish reported for the U.S. Caribbean Region originates beyond the U.S. zone. During the Caribbean Pelagic Resources session of the 40th Annual Gulf and Caribbean Fisheries Institute, U.S. industry participants openly admitted to fishing in other island nations' waters (Merritt 1987). Al Merritt also stated that, "And I can't say we never poached. We're not lily white" (Stimpson 1988, 51). Bob McAuliffe, a representative on the Caribbean Management Council illustrates the attitude which may be common among a large segment of longliners when he stated that, "the major problem this year is that the smaller independent Caribbean states view the ocean as their private property" (Stimpson 1988, 51). The question remains as to the frequency of longliner intrusions and the amount of fish caught in the fishing zones of the Eastern Caribbean island states.

The Case of the British Virgin Islands

The most immediate problem and best documented case involves the British Virgin Islands. The "Reciprocal Fisheries

Agreement Between the Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland" states that commercial fishing by vessels of the United States may continue in the territorial waters of the British Virgin Islands (BVI) in accordance with existing patterns and at existing levels. In 1977, when this agreement was drafted, there was no swordfish fishery with only a small number of USVI pot fishermen utilizing stocks in BVI waters. Longlining initiated by U.S. vessels in 1983 prompted the British Virgin Islands to draft new requirements for entry of U.S. longline vessels. The 1985 amendment required a higher fee, from \$150 to a \$7000 permit for each vessel, required reporting of swordfish catch and the landing of all by-catch at the British Virgin Islands fisheries terminal (Walters per com. 1986).

In the 1985-86 season, 13 of the 14 vessels permitted to fish reported the taking of 400,000 pounds of swordfish and 10,615 pounds of by-catch which was landed in the BVI (Walters per com. 1986). In addition to late reporting of swordfish catch, only eight of the 13 vessels operating in BVI waters complied with by-catch landing requirements (Walters per. com. 1986, CFMC 1986). The price offered in the BVI by the government cooperative handling by-catch landings was only \$.30-\$.50 per pound although according to

Mr. Blok, the acting BVI Fisheries Officer, this was never actually paid (Blok per. com. 1987, Walters per. com. 1986). It was suspected that a large percentage of the by-catch actually went to the USVI or Puerto Rico where \$2 to \$3 per pound could be obtained (Rolon per. com. 1986). These factors dismayed BVI officials who issued permits for four vessels during the 1986-87 season with a reported catch of 71,278 pounds of swordfish and 5,350 pounds of by-catch (Blok per. com. 1987). In the 1987-88 season the number of vessels permitted to work in the British Virgin Islands Zone dropped to two with a swordfish catch of approximately 100,000 pounds and landed by-catch of nearly 5,000 pounds (Blok per. com. 1988). By-catch was made up of predominately tuna and marlin species (Blok per. com. 1988). The reasons given for increased swordfish landings in 1987-88 were better reporting at the Puerto Rico terminal and better all-round fishing than during the previous season (Blok per. com. 1988). The reason for limiting entry of vessels related to poor cooperation in previous years, but the two vessels currently permitted have been very cooperative (Blok per. com. 1988).

In respect to enforcement, the BVI has a police boat which is frequently unavailable for fisheries work or inoperative (Walters per. com. 1986). It is responsible for the entire 200-mile zone of 84,000 square miles which is under BVI

jurisdiction (Gold et al, 1985). It is suspected that other U.S. swordfish vessels operate illegally within the BVI Fisheries Zone. The BVI also requires that foreign vessels take domestic observers for compliance monitoring, data collection and familiarization with the fishery.

Illegal Fishing in Other Parts of the Region

Another activity which is unconfirmed in many cases, but likely in light of the longline fishermen's attitudes previously cited, is the operation of U.S. longliners in other Eastern Caribbean nations' waters. A confirmed report involved three Florida-based fishing vessels which were detained by St. Vincent officials (San Juan Star 1986). One vessel allegedly had engine trouble, and when the two other vessels entered within 12 miles of St. Vincent waters all three were seized (San Juan Star 1986). The boat which had been fishing had a sizable quantity of swordfish on board, \$75,000 worth according to the captain (San Juan Star 1986). The captain of the "Miller Time" claimed the \$200,000 fine demanded for release of the vessel was "extortion, ransom - whatever" (San Juan Star 1986). Sightings of U.S. longliners have been reported by an Anguillan fisherman in 1986 (Carty per. com. 1986). Meanwhile, amid controversy Merritt boats attempted operations in Venezuelan waters (Stimpson 1988). Al Merritt, owner of Merritt's Seafood, stated that he has approached several island nations for fishing permits

(Merritt per. com. 1987). These reports indicate that U.S. longline activity extends beyond the U.S. zone along the entire Lesser Antillean island chain. Therefore, a substantial proportion of the reported BVI and USVI catch may actually come from areas beyond their respective fisheries zones.

Without exception, the neighboring island nations of the region lack the enforcement capabilities required to deal with foreign fishing vessels. In addition, although extended jurisdiction had become a widely recognized component of international law, Eastern Caribbean states are only now in the process of developing necessary legal and technical institutions to deal with the problem.

The U.S. Department of Commerce could be of some assistance by the enforcement of the Lacey Act. This law gives the U.S. government the right to prosecute U.S. nationals who are importing fishery or wildlife products which were obtained in violation of foreign law recognized by the United States (Christian per. com. 1986). For U.S. enforcement followup, the country in question must report the vessel's description, location and whether fishing gear was deployed at the time of the sighting (Christian per. com. 1986). Therefore, a U.S. vessel which is fishing illegally in other nations' waters is subject to U.S. prosecution although this

has not happened during the short history of the swordfish fishery in the Eastern Caribbean. It might be suspected that fisheries enforcement of this type is not a priority in the region given U.S. preoccupation with drug enforcement.

Local Development of a Pelagic Longline Fishery

Another issue relates to the revenues which are not kept in the local economy because most longliners are based in the mainland United States. It might be concluded that the local fishermen and population of both the U.S. territories and Eastern Caribbean states could derive greater benefits from direct participation in the swordfish fishery. The potential feasibility of a local fishery was one of the main objectives of the U.S. Virgin Islands Pelagic Fisheries Development Project (Wood 1986). The inshore reef fisheries of most of the region's islands are already at or beyond maximum sustainable levels of exploitation. Local exploitation of pelagic resources on islands such as Barbados, Grenada, Dominica and St. Lucia is substantial for flying fish, dolphin fish, kingfish and tunas in some cases (Goodwin 1985). Yet, the local development of a pelagic longline fishery is practically nonexistent.

One reason might be the capital requirements for what might be considered a risky venture. There is little room for error if operating and finance costs are to be covered

during the initial year of operation. In 1979 an investment of \$80,000 was required for a 36-foot vessel and gear, with variable and fixed costs for the first year totalling nearly \$85,000 (Cato and Lawlor 1981). In Florida, gross revenues of nearly \$150,000 were expected assuming a catch of 70,000 pounds (Cato and Lawlor 1981). During the past seven years, these costs have surely increased, pushing initial investment requirements beyond the capabilities of the majority of local fishermen. The U.S. Virgin Islands Development Project utilized a vessel of similar size and indicated that sets longer than the six miles they used were required for a profitable operation (Wood 1986). Most vessels currently operating in the region are of larger size allowing them to utilize longer 40-mile sets and to spend longer periods at sea. It is questionable whether smaller vessels could be competitive given the current structure of the fishery.

Local fisherman may also have problems in adapting to new fishing methods and strategies. Most fishermen have worked in a less capital intensive pot fishery. A local pelagic longline fishery will require a jump in vessel size, required equipment, fishing skills and recordkeeping and accounting skills to compete with the boats arriving from the mainland. A coordinated extension program oriented toward the adaptation of islands technology to the swordfish fishery, a long-term monitoring system and provision of

startup costs are required if the activity is to have a chance at becoming a viable alternative for local fishermen. Even if the required skills and capital can be transferred, cultural and social factors may prohibit development. Local fishermen are not accustomed to spending long periods at sea which they may find unacceptable. They may also be risk adverse when presented with new methods with which they are not personally familiar.

Two vessels were operated by British Virgin Islands fishermen during the 1987-88 season. One of them failed because they simply could not find fish (Blok per. com. 1988). At least one vessel is now being operated out of the U.S. Virgin Islands although the owner is from the U.S. mainland (Stimpson 1988). In Grenada local longlining for Atlantic sailfish was recently reported (Bryant 1988). Generally longlining remains an activity undertaken by foreign participants. Local development may be possible, but it will require consideration of many of the factors cited above, including time.

Other Considerations

The stock management problems of the Eastern Caribbean are magnified by the newness of the fishery and the lack of associated data. Evidence related to local swordfish population origin and migratory patterns are less certain than

those of other regions to the north. Preliminary landing statistics show a greater average size than landings of the Southeast and Gulf regions of the United States (SAFMC 1987a). There is evidence that a segment of the swordfish population remains in the eastern Caribbean throughout the year. Therefore, various segments of population may have different migration patterns dependent on age. It has also been speculated that swordfish landed in the region may originate from southern areas adjacent to South America (Rolon per. com. 1986). The Caribbean is also probably a major spawning area for swordfish as evidenced by larval studies. All these possibilities illustrate the underlying uncertainties related to the dynamics of the Caribbean region's swordfish stock dynamics.

Another factor relates to the growing demand for fishery products in the continental United States, especially for highly valued species such as swordfish. Consumption of swordfish reached record levels in 1986 at approximately 21 million pounds including imports (Lipton 1986). Assuming no changes in real prices due to the dollar exchange rate with exporting countries and consumer preferences, consumption would exceed 30 million pounds in 1995 (Lipton 1986).

Meanwhile, recent increases in tuna prices, due to U.S. fresh and sushi markets and a growing Japanese export

market, have increased the value of species such as bigeye beyond prices for swordfish in some cases. In the Gulf, yellowfin tuna landings increased from 148 thousand pounds in 1983 to 3 million pounds in 1985 (Pollack 1987). It was reported during the 1987 Caribbean season that tuna became an important segment of longliner landings for many fishermen due to rising prices (Rolon per. com. 1987). It was also indicated that some daytime sets were made to target exclusively on tuna.

Sharks are an under-utilized species which are currently considered a nuisance to swordfish operations due to the damage they cause to hooked swordfish and the time and effort wasted when they are hooked (McLain per. com. 1986). Although they make up a high percentage of total fish hooked, only certain species are taken due to their relatively low value. Unlike other large pelagics, fecundity is low for shark species, making their populations more susceptible to fishing pressure. In the future, under-utilized shark species could become a valuable resource while impacts on those species of present commercial value could become serious.

Increases in longline effort of U.S. vessels seem probable due to the factors cited above. In addition, longline

efforts of other nations such as Korea, Spain and Venezuela are reported in areas within or adjacent to the region (Campos and Munoz-Roure 1986).

The central problem in the Eastern Caribbean region relates the sharing of benefits accruing from the exploitation of highly migratory species among resource adjacent island states and the nations which possess the capital and expertise to exploit the resource. Yet side issues exist concerning the best possible use of pelagic resources affected by the swordfish fishery such as recreational species. Meanwhile, all fishery participants are intricately related to the complex issues associated with the goal of stock conservation due to the wide ranges of large pelagic species. Only through international cooperation will it become possible to implement sound management measures. Fisheries management principles, international ocean law and regional management strategies are currently evolving as responses are formulated to many of these issues. The next two chapters will examine these factors for their potential application to the Eastern Caribbean.

CHAPTER V

MANAGEMENT OF HIGHLY MIGRATORY SPECIES

The objective of this chapter is to present a general overview of HMS management. This is initiated through an examination of management objectives, basic principles of fisheries management and international legal aspects of highly migratory species management. These factors are the basis from which management regimes can be organized, built and evolved. However, the application of these principles must also be modified due to constraints such as site specific factors, imperfect information and the differences between simplified models and complex real world situations.

General Principles of HMS Management

Management Objectives

Highly migratory species are among the most complex and controversial stocks to manage. They are the most extreme example of transboundary stocks because their wide-ranging oceanic migrations repeatedly cross boundaries between zones of national jurisdiction and the high seas. Tuna and billfish species are the two major groupings of highly migratory fish which are treated in this chapter. These species have exceptionally wide ranges, and their conservation is dependent on international cooperation (Joseph and Greenough

1979). According to the Law of the Sea Treaty, Dolphin fish, Cetaceans, oceanic sharks and sauries also fit within the highly migratory category, but are not dealt with in this report (United Nations 1983). Tunas and billfish are among the highest valued fishes, due to their demand as food fish and the recreational excitement they provide at the end of a fishing line. Due to their high demand, fishing effort has increased dramatically within the last three decades. Some commercial stocks, such as Atlantic swordfish, southern and northern bluefin tuna and Eastern Pacific yellowfin tuna, are now considered to be at or beyond maximum levels of exploitation (Saila and Norton 1974, Hilborn and Sibert 1988).

The identification of management objectives is the first step in devising potential HMS management arrangements. A 1971 FAO publication cited the following tuna management objectives which were identified in a joint meeting of the Indo-Pacific Fisheries Council and the Indian Ocean Fishery Commission (Saila and Norton 1974). These objectives are still appropriate 15 years later and apply to most HMS. The five main objectives include:

- "(1) Maintenance of tuna (HMS) stocks at levels that provide high sustained yields;
- (2) Improved economic efficiency;
- (3) Appropriate distribution of benefits;
- (4) Measures which afford the opportunity for countries not yet participating in tuna (HMS) fishing to build up their fishing industries;

- (5) Conservation measures that do not interfere with development of unexploited stocks" (Saila and Norton 1974, 37).

Objective 5 may also be stated as: Conservation measures which can protect stocks caught incidentally while creating as little disruption as possible to the primary fishing operation.

It should be recognized that the strong interrelationships which exist between objectives mean that achievement of one objective may conflict with another (Saila and Norton 1974). The following section examines these objectives in terms of basic fisheries management principles. These principles are initially presented under ideal conditions; then they are related to realities of HMS management.

Stock management

Objective (1), the maintenance of high sustained yields, is of interest to all concerned parties. From a biological perspective, "conservation of a stock depends on the balance between losses due to natural and fishing mortality and gains in stock growth" (Copes 1987, 5). A stock is made up of individual fish of fishable size. The stock increases in biomass through recruitment, juvenile fish which reach fishable size, or by the growth of fish which are already part of the stock (Copes 1987). The relationship between

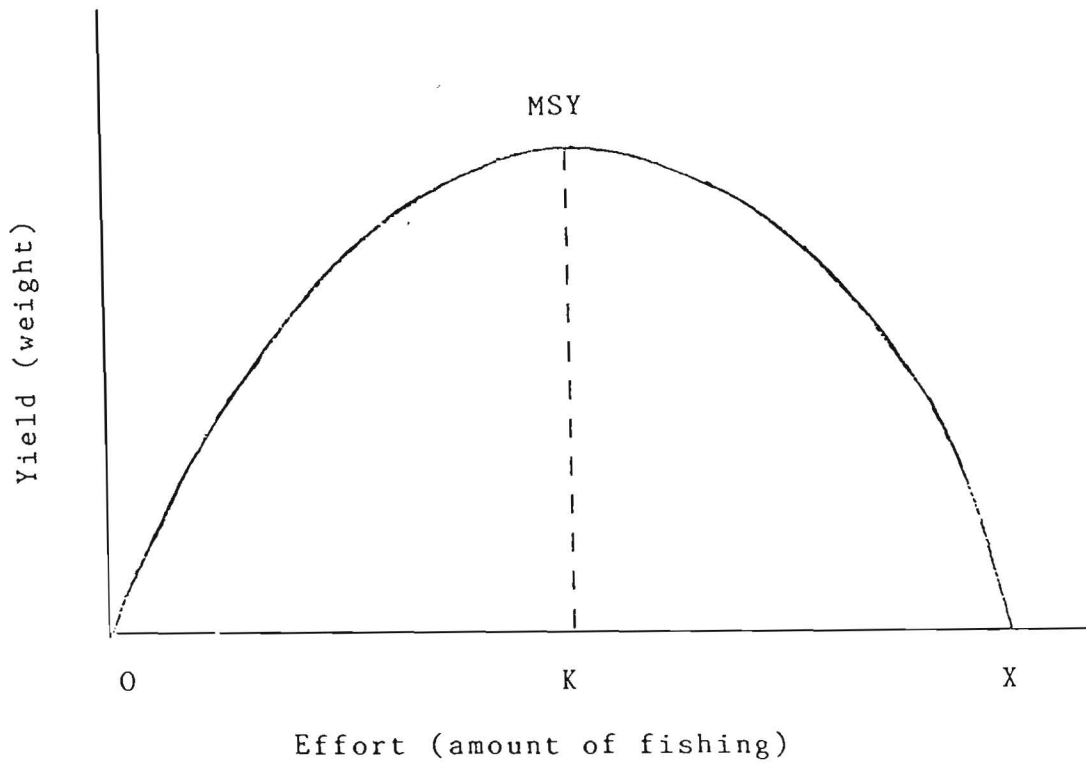
stock gains and losses due to fishing effort is explained by an analysis of "effects of fishing effort on fish catches over time" (Copes 1987, 5). The relationship between yield and effort shows "the yields that can be sustained at various levels of long-term effort" (Copes 1987, 7). This is called a surplus yield model because it represents the surplus which can be harvested on a sustained basis at a given level of effort (Copes 1987). Maximum Sustainable Yield (MSY) is the level of effort which will result in the largest possible sustained yield. Figure 5 illustrates that increases in effort beyond MSY will in the long run decrease landings due to the decline in the standing stock of fish.

Surplus yield models are utilized for most of the world's tuna stocks because: they are relatively simple; they require catch and effort statistics which are available and they are "reasonably well suited for long-lived species such as tuna" (Copes 1987, 8). Therefore, to satisfy objective (1), Total Allowable Catch (TAC) could be set at MSY. This would provide the highest possible sustained yields without the risk of over-exploitation while producing the greatest amount of protein possible for the world population (Copes 1987) (See Figure 5).

Unfortunately, maximum sustained yield is an ambiguous term due to an incomplete scientific understanding of stock

Figure 5

Surplus Yield Model



This curve illustrates a yield-effort relationship. The curve represents the yields that can be sustained at various levels of long-run effort. Long-run means that equilibrium will be reached among the stock and catch levels at a given level of effort over a period of time depending on stock dynamics. MSY is the maximum yield of fish which can be harvested from a stock on a sustained basis.

Source (Copes 1987)

populations and imperfect information. The importance of the preceding explanation is that, like most renewable resources, a biological limit to production on a sustainable basis exists for HMS (Saila and Norton 1974).

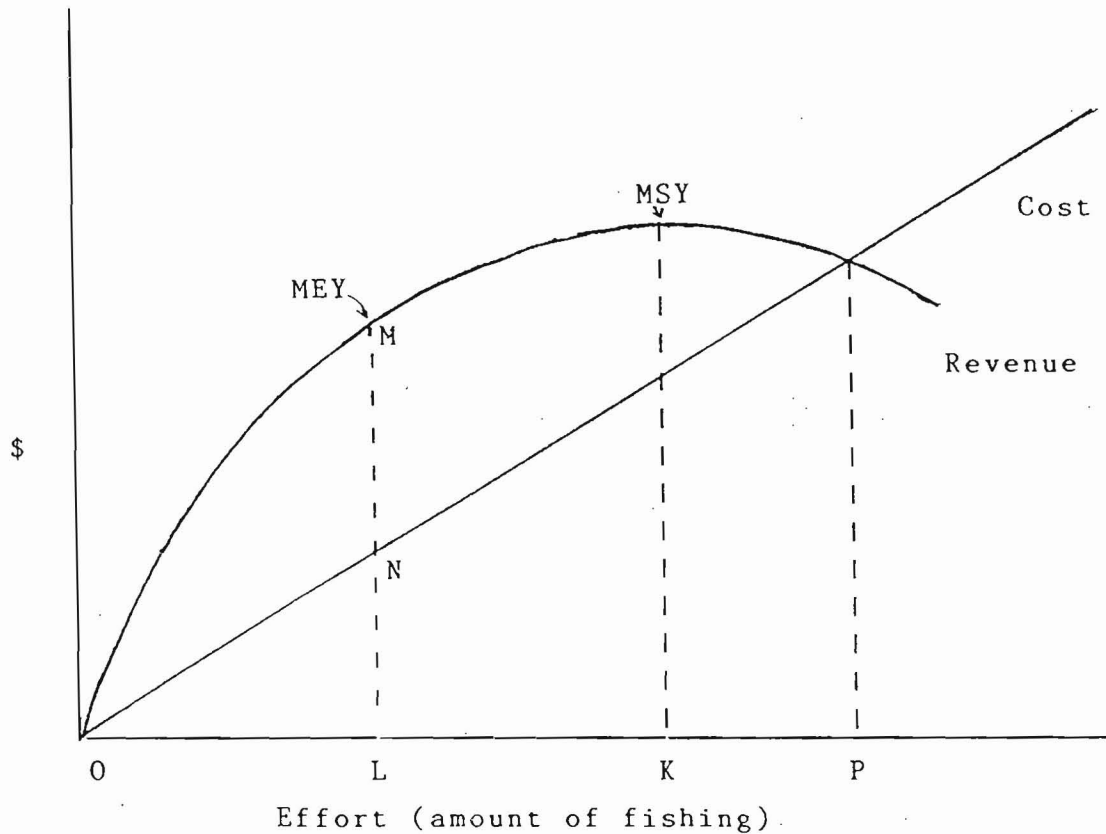
Economic efficiency

The presence of strong interrelationships between objectives means that an action in one area such as objective (1), high sustained yields if set at MSY, will affect another such as objective (2), economic efficiency (Saila and Norton 1974). Economists would argue that MSY is only a measure of gross benefits without accounting for the cost of production (Copes 1987). From a standpoint of economic efficiency, benefits should be measured by the difference between "the value of the catch over the costs of production" (Copes 1987, 9). Figure 6 illustrates the maximum economic yield (MEY), the point at which "the maximum net benefit or resource rent can be generated" (Copes 1987, 9). MEY will be lower than MSY in respect to effort and total landings, but it will yield the greatest resource rent without threatening over-exploitation. Like MSY, MEY is difficult to attain due to modeling and information constraints while the political goals of user groups make agreement on a set level of effort difficult to attain.

The common property character of most fisheries resources is usually a major factor which contributes to their economic and biologic waste. Under open access, all fishermen have access to a given stock, but they neither control nor own the stock. An individual fisherman has no incentive to limit harvests for the maintenance of productivity because other fishermen fishing the same stock will capture these benefits (Copes 1987). Fishermen will continue to enter the fishery with corresponding increases in effort until economic benefits are equal to economic costs (See Figure 6). At this point, the economic rent has been dissipated and overcapitalization has occurred. Therefore, the high opportunity cost of labor and capital utilized in the fishery indicates that resources could be better utilized in another economic sector.

The use of overall catch quotas to satisfy objective (1) will lead to overcapitalization. Individual fishing nations will generate over capacity in the race to catch as much as possible before the quota is reached (Saila and Norton 1974). The limitation of effort through limited entry is one strategy which could satisfy objective (2). Improved economic efficiency will also result if those nations with a comparative advantage are allowed to operate. For highly migratory species, this could be accomplished through the establishment of transferable national quotas. If fishing

Figure 6 Bioeconomic Model



In this diagram the yield curve is transformed into a revenue curve by multiplying the yield at different effort levels by a constant price. Total costs are proportional to the level of effort, and they are represented by a linear cost curve. The maximum net benefit or resource rent that can be generated is MN which occurs at an effort level of OL. This is the maximum economic yield (MEY). At MSY the resource rent is smaller while at effort level OP, which corresponds to an open access situation, there are no net benefits in the fishery. Therefore at the effort level OL the government of the coastal state in question can collect the greatest amount of revenue illustrated by MN while at effort level OP the economic rent has been dissipated and there is no room to generate revenues through access fees.

Source (Copes 1987)

rights are transferable or marketable among nations, then shifts to those operations with lower labor and capital costs could take place (Saila and Norton 1974). Unfortunately, a system of this type would require a large degree of political compromise for the distribution of the resource among concerned parties. This is not presently realistic on an international level in most cases.

Distribution of benefits

The question of benefit distribution involves the coastal state or resource adjacent nations (RANs) and the distant water fishing nations (DWFNs). The increased mobility of foreign fishing fleets during the 1960s, the development of excess harvesting capacity and high resource demand have resulted in the expansion of DWFNs to new fishing grounds and increased effort worldwide (Saila and Norton 1974). Since the near universal acceptance of exclusive economic or fishing zones, governments have claimed ownership or management authority over stocks within their respective zones of jurisdiction.

Ideally, objective (3), the distribution of benefits, could be satisfied through the charging of entry or license fees from those DWFNs which wish to operate within RAN fishing zones (Copes 1987). The greater the rent (the amount above normal levels of return for labor and capital, or economic

costs), the greater the license fees which can be charged without discouraging the vessels from operating in the given nation's fishing zones (Copes 1987). If an open access situation exists, then boats will enter the fishery until they break even. In the case of open access or if excess effort is allowed to enter a RAN's zone, the rent is dissipated to the point where license fees will make the boats leave the fishery. This will leave no room for revenue generation by the government of the coastal state in question (Copes 1987). Joint venture arrangements can involve cooperation beyond the charging of license fees. Assistance in the development of domestic fishing and processing sectors are other ways in which benefits can be realized by the RAN.

In the case of HMS, their wide-ranging nature makes management difficult on a national basis because the highly migratory resource retains its common property character on the high seas. In addition, stocks also move from one zone of national jurisdiction to another. Stock management can then be complicated by different management approaches depending on individual national policies. Entry can be limited on the national level, but usually not on the international level. Therefore in most cases no one RAN has control over objectives (1), maintenance of stocks at high levels, and (2), increasing economic efficiency, because of neighboring

nations' policies and high seas fishing by DWFNs. An additional complicating factor involves enforcement. Many RANs which have excess stocks adjacent to their shores are developing nations which lack the enforcement capabilities required to effectively police their zones. Therefore, in reality, open access still exists within many zones of national jurisdiction as well as the high seas.

Resource adjacent nation fishery development

Objective (4), the building of RAN fishing industries, is related to objective (3), the appropriate distribution of benefits. The generation of employment, export earnings and a domestic supply of protein are potential benefits which could be obtained by the RAN. However, these benefits must be weighed against the required foreign exchange, fishing skills and infrastructure of more capital intensive fishing operations. In addition, competition with existing fleets and overcapacity in many HMS fisheries will make the achievement of this objective difficult. If the country in question decides to develop a local fishery, then objective (2), increased economic efficiency, might be relaxed in favor of the social benefits produced within the RAN.

Another problem involves the relationship between domestic and foreign fishing operations fishing within a national fishing zone. The fishery resource might be envisioned as a

pie which represents the total allowable catch. The pie is then divided among the coastal state according to the domestic harvesting capacity and the foreign participants which are granted the surplus (Garcia et al, 1986). Unfortunately, the picture is complicated by the nature of the resource because the total pie is "not fixed in size, its size is not easy to determine and its components, domestic harvesting and the surplus are not independent of each other" (Garcia et al, 1986, 192). The sustainable yield from a given stock of fish is illustrated by a plot of effort against catch. As more fishing effort, in this case foreign fishing, is introduced to the fishery, catch per unit effort will drop. Therefore, the domestic fishery will have to increase fishing effort to maintain catch levels. This will result in greater costs incurred per unit of catch due to the decrease in CPUE. Therefore, the concept of surplus has little meaning for the coastal state which has the objective of catching the most fish with the least amount of effort.

The coastal state which is allowing the entry of foreign vessels while attempting to develop a domestic fishery must recognize that this relationship exists. In reality, the loss of domestic fishery revenues attributable to foreign fishing must be weighed against gains associated with the entry of foreign vessels. Under cooperative agreements, the

domestic fishery could obtain benefits such as technology and skill transfers, and fees which could mitigate the effects of lower CPUE levels attributable to the foreign fishery. The nature of highly migratory resources further complicates the situation because fishing in adjacent fishing zones and the high seas could affect stock abundance within the given national zone. Therefore, objectives (1) through (4) are all interdependent. Management decisions depend on resource makeup, the makeup of the fishing fleet which targets on the resource, both foreign and domestic, and interaction between user groups. The relationships cited in the biological and economic principles given above are important; however, in the case of highly migratory species, already inherent uncertainties are increased by the international management requirements of the resource.

Incidental impacts on stocks

Objective (5) involves the effects of the fishery on other stocks besides the principal target species. Longlining, one of the major gear strategies utilized in HMS exploitation, is usually a multispecies fishery. Therefore, fishing operations could produce negative effects on species caught as incidental by-catch. Although some pelagics may have relatively low commercial values, their value for recreational fisheries may be quite high. Ideally, a balance should be sought between commercial and recreational

fisheries through an examination of whether or not impacts on stocks caught incidentally in the commercial fishery are significant and the benefits attributable to each fishery. In reality, there is a great amount of uncertainty associated with economic values for competing user groups and fishery stock populations, especially highly migratory recreational stocks.

The preceding objectives and discussion of related management principles are the foundation from which management objectives can be evaluated, reality can be injected and interrelationships between objectives can be examined. It becomes clear that tradeoffs and compromise among objectives and participants are required for management on the international level. The next section involves the foundation of international cooperation, international ocean law and The United Nations Conference on the Law of the Sea.

The Legal Regime for Highly Migratory Species

Highly migratory species are treated with a special article in the Convention on the Law of the Sea, but their management is also subject to other articles concerned with the management of the living resources within the EEZ and beyond. This section explores the international legal background of fisheries management with emphasis on highly migratory species and realities concerning state practices.

The negotiation of The Third United Nations Convention on the Law of the Sea (UNCLOS III) guided the evolution of the international ocean law during the 1970s. These negotiations produced a codified set of standards for national conduct, especially for the utilization of the world's ocean resources. Actual state practice is dictated by international norms which are defined by the concurrent evolution of accepted state practices or customary law, and codified treaties such as the Law of the Sea Treaty (Belsky 1985). Although UNCLOS III has not been ratified by the 60 nations required for it to go into force, many of its components reflect existing practice in the international community. Distant water fishing fleets grew at a tremendous rate during the 1960s into the 1970s. Rapid progress in fisheries technology and the world's growing demand for protein contributed to the expansion of fishing fleet ranges and capacities. During this period, it became apparent that fishing fleets had the potential to over-exploit many of the world's major fishing grounds. This prompted coastal state concern with exploitation of stocks occurring adjacent to their shores by foreign fishing fleets. The benefits resulting from stock exploitation were being obtained by foreign operations. Meanwhile, the common property nature of the resource, coupled with a general lack of international cooperation, resulted in declining stocks and over-exploitation. The question became: What rights do

coastal states have over fishery resources by virtue of their geographic proximity to these resources?

The question of coastal state rights in the determination of fishery management and utilization is one of the major factors which contributed to the extension of coastal state jurisdiction. During negotiations at the Conference of the Law of the Sea, nine coastal states presented a working paper concerned with the EEZ stressing the following point.

"The coastal [nation] should have the right to utilize and preserve resources adjacent to its coasts, since the survival or development of its people depends on those resources and because it [is] in the best position to regulate their rational exploitation" (Cited in Bowen and Hennessy 1984, 42).

Unilateral jurisdictional claims have become a common feature of state practice, while in most cases it has been acquiesced to by the world community (Ross and Landry 1987). The Law of the Sea Conference set down a comprehensive set of guidelines to add conformity to nation states' zones as jurisdictional claims spread during the 1970s (Ross and Landry 1987).

The main component of extended jurisdiction is the Exclusive Economic Zone (EEZ). According to Article 56 of the UNCLOS III text:

"In the exclusive economic zone, the coastal state has: sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the water superjacent to the sea-bed..." (United Nations 1983, 258).

Article 56 indicates that the coastal state has complete control of fisheries within its EEZ. The EEZ is comprised of a 200-nautical-mile zone extending seaward from the coastal state's baselines (United Nations 1983). Under the convention, the coastal state also has jurisdiction over fisheries resources within its: territorial sea, an area not greater than the width of 12 nm measured from the baselines; internal waters, waters on the landward side of the baseline; and archipelagic waters, water enclosed by archipelagic baselines in the case of countries comprised of closely grouped islands (Slatyer 1987).

Article 64 of the UNCLOS III text refers explicitly to highly migratory species and states the following:

"The coastal state and other States whose nationals fish in the region for the highly migratory species listed in Annex I shall co-operate directly or through appropriate international organizations with a view of ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone. In regions for which no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region shall co-operate to establish such an organization and participate in its work" (United Nations 1983, 261).

Annex I identifies highly migratory species as tunas, frigate mackerel, pomfrets, marlins, sail-fishes, swordfish, sauries, dolphin, oceanic sharks and Cetaceans (United Nations 1983).

Viewed by itself, Article 64(1) would appear to indicate that HMS are an exception to coastal state competence over the living resources of the EEZ referred to in Article 56. Article 64(1) indicates that it is the joint responsibility of the coastal state and other participating nations to ensure conservation and optimal utilization, both within and outside the EEZ. Cooperation and the formation or strengthening of international management institutions are stressed in this paragraph. Article 64(2) clarifies the context of Article 64(1) by stating: "The provisions of paragraph 1 apply in addition to the other provisions of this part" (United Nations 1983). Therefore, the term "sovereign rights" referred to in Article 56 indicates that HMS are subject to coastal state authority within the EEZ just as all other living resources (Burke 1984).

In the case of high seas fishing, Article 116 states that:

- "All States have the right for their nationals to engage in fishing on the high seas subject to:
- (a) their treaty obligations;
 - (b) the rights and duties as well as the interests of coastal States provided for, inter alia, in article 63, paragraph 2, and articles 64 and 67; and
 - (c) the provisions of this section" (United Nations 1983, 273).

Article 116 indicates that fishing states must cooperate with the coastal state regarding questions of conservation and allocation of HMS stocks occurring both on the high seas and within the coastal state EEZ (Burke 1984). It appears to give "priority to the coastal states' rights and interests affecting high seas fishing states" (Burke 1984, 276).

In both the case of coastal state rights over HMS in the EEZ and fishing nation's high seas fishing rights, the convention indicates that both parties should seek cooperation. In reality, if cooperation does not exist, it is doubtful whether the coastal state will limit effort in its EEZ or that coastal state regulations will be followed by fishing nations on the high seas. In most real world situations, except in the cases of international agreement, coastal states have taken full control over HMS management within their EEZs while fishing nations continue to fish the high seas without coastal state input. HMS are found both within adjacent EEZs and high seas areas with varying stock abundances in each area due to their great mobility (Burke 1984). Although cooperation has been poor or nonexistent in many instances, Articles 64 and 116 are constructive approaches which are essential for the control of fishing effort and stock conservation.

HMS are also subject to UNCLOS provisions dealing with conservation and utilization of fisheries resources in the EEZ. Although the coastal state has sovereign rights over the fisheries resources within its EEZ as specified in Article 56, Articles 61, 62 and 63 are meant to imply that it also has certain duties. In reality, the language of the text and the characteristics of fish stocks have contributed to ambiguities in this area and generally left the balance of control in favor of the coastal state within its EEZ.

Article 61 states that the coastal state "shall determine the allowable catch," and the coastal state "shall ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive Economic Zone is not endangered by over exploitation" (United Nations 1983, 260). Article 61(3) refers to MSY as the level to which stocks should be restored or maintained, but it goes on to state "as qualified by relevant environmental and economic factors including the economic needs of coastal fishing communities and the special requirements of developing states" (United Nations 1983, 260). Therefore, the coastal state is authorized to set levels above or below MSY, a concept which is theoretical and difficult, if not impossible, to equate with a value (Burke 1984). In reality, the coastal state has total control in setting total allowable catch at any level it considers appropriate

with respect to specific circumstances. Again, due to the mobility of HMS, it is impossible to set total allowable catch for a given EEZ.

Article 61(4) refers to effects on other species associated with harvested species. It states that the coastal state should take into account, "Maintaining or restoring populations of such associated or dependent species above levels at which their reproduction may become seriously threatened" (United Nations 1983, 260). This paragraph does not indicate that the coastal state is required to take action or give a definition of "seriously threatened." Although this paragraph is important in relation to multispecies fisheries, it is unclear whether constructive measures will evolve in this management area.

Article 61(5) refers to the free flow of information among all participating states and competent international organizations (United Nations 1983). Although most of the world's nation states exchange such information, it should be recognized that individual states will act in their own self-interest if this information will reflect negatively on their operations or sacrifice competitive advantages.

Article 62 refers to coastal state duty in promotion of "the objective of optimum utilization of the living resources in

the exclusive economic zone" (United Nations 1983). If the coastal state lacks the capacity to harvest the allowable catch, then access to the surplus should be given to other states (United Nations 1983, 260). The terms "optimum utilization," "allowable catch" and "surplus" are all ambiguous and left to the discretion of the coastal state. Optimum utilization does not require "full utilization" while allowable catch can be set at any level considered appropriate to the coastal state (Burke 1984). The concept of surplus is also difficult to define when referring to fisheries stocks, especially HMS. HMS require management throughout their range, negating the importance of concepts such as "surplus" and "total allowable catch" within an individual EEZ.

As indicated in the previous section, levels of additional effort will affect levels of catch per unit effort. Although a biological surplus may exist, a surplus may not exist in respect to the optimization of coastal state operations within its EEZ. In reality, many coastal states allow the entry of foreign fishing nations' to their EEZs, but entry is given due to factors involving coastal state self-interest, not due to international obligation cited in UNCLOS III. If international cooperation fails, the coastal state is in the position to allow entry of vessels at

whatever effort level it considers appropriate. This defeats the purpose of Article 64(1) and the special management requirement of HMS.

Article 63 refers to cooperation between coastal states in the cases of shared stocks, which is frequently the case with HMS. It indicates that coastal states should seek to cooperate through appropriate subregional and regional organizations for the objective of stock conservation and development (United Nations 1983). This has happened in many parts of the world where information is exchanged and attempts at quota allocations have been made. However, it has been difficult to impose effort or quota limitations within individual coastal state EEZs through regional arrangements.

The UNCLOS III text is both ambiguous and incomplete for two main reasons. First, it enabled the negotiating nations to reach a consensus in areas where disagreement was acute. It also gave room for individual states, subregions and regions to address site specific problems. Although many of the Convention's provisions are not spelled out in detail or enforceable, it does present a set of norms, standards and a spirit for members of the world community. Ratification of UNCLOS III will not solve the problems of HMS management,

but it will provide a foundation from which the international legal regime can continue to evolve.

International law is made up of compromises between individual state self-interest and the need for order in the international community. Rules are established by state practice or custom and through multilateral treaties instead of legislatures or political executives as in the case with domestic law (Belsky 1985). Although each state might benefit through international agreement, compromises may entail, or be perceived by individual states as entailing, a loss of potential benefits. Because cooperation and enforcement is the responsibility of each individual state or group of states, individual states can disregard the system or remain outside it (Belsky 1985). Only when the costs of remaining outside the system outweigh the benefits will individual states cooperate.

The case of HMS highlights these perceptions. It is in coastal states' interest to claim HMS within their EEZ, and take as much as possible before stocks move on to an adjacent EEZ, in the short run. It is in the fishing nations' interest to take as much of the resource as possible both within EEZs and on the high seas, also in the short run. It is in everyone's interest to conserve and utilize the species through international cooperation in the long run, but

this means that certain states may sacrifice a proportion of their harvest through compromise. Unlike less migratory stocks, highly migratory species are common property at an international level throughout much of their range. Initially there is no motivation to sacrifice individual goals in the interest of the majority. On the high seas, and in many zones of jurisdiction, this is the case where a first-come, first-served mentality generally applies.

The interdependence between coastal states and fishing nations for the conservation and maintenance of stocks at high levels, and the benefits both sides can gain through mutual cooperation, are the basis from which international cooperation can originate. The next chapter examines management of HMS in the South Pacific region where compromise has resulted in greater benefits to island states while allowing continued access to foreign fishing fleets.

CHAPTER VI

HIGHLY MIGRATORY SPECIES MANAGEMENT EFFORTS

The declaration of sovereign rights over the living resources occurring within national zones of jurisdiction has become accepted practice in the international community. In most cases, highly migratory species have also been claimed within 200 nm EEZs or Fishing Zones. However, no one nation can manage this resource unilaterally due to the unique characteristics of HMS (King 1979). International cooperation is hampered by differing resource endowments and national priorities. The need for common action has encouraged national and regional entities to formulate a variety of management proposals and regimes where their interests converge. This section will explore evolving responses to HMS management, especially in the South Pacific.

Management Alternatives

Coastal state extended jurisdiction and the regional approach to HMS management in the South Pacific should be put in the proper international context as it evolves as a management institution. The Eastern Pacific is an example of regional management where attempts were made at limiting catch while allowing for a greater distribution of benefits

among developing resource adjacent states (RANs). The Inter-American Tropical Tuna Commission (IATTC) was established by treaty in 1949 and began operating actively in the Eastern Pacific in 1951 (Saila and Norton 1974). It was a regional body whose purpose involved the development of programs for the management of tuna stocks (Saila and Norton 1974). The IATTC set annual catch quotas for yellowfin tuna in the eastern tropical Pacific as a conservation measure aimed at the maintenance of yields of the resource (Saila and Norton 1974). This measure did not fully address the objectives of economic efficiency and benefit distribution among participants. From 1966 to 1973, the fleet operating in the region increased by nearly three times, the open season for yellowfin fishing decreased from 10 months to three months, and competition among participants increased (Joseph and Greenough 1979). This suggests that overcapitalization and economic waste resulted (Saila and Norton 1974). It also did not solve the problem of benefit distribution among participants.

As zones of extended jurisdiction gained acceptance in the world community, resource adjacent nations demanded a greater proportion of the benefits accrued through resource exploitation. Meanwhile, U.S. tuna interests remained intransigent to coastal state demands. In 1979, the IATTC management system broke down, partly due to disagreements

over allocations and fees between the foreign participants, especially the United States, and the resource adjacent Latin American nations (Joseph 1983). Since 1979, there has been no set quota on landings, and yellowfin stocks have been overfished (Copes 1987).

Overall catch quotas may be effective in the short term to prevent over-exploitation, but, as indicated above, they contribute to overcapitalization as participants compete for as much as possible before the quota is reached (Saila and Norton 1974). National quotas have been recommended as an alternative which would divide the permissible yield among concerned nations (Saila and Norton 1974). National quotas would allow each nation to harvest its quota where ever and in whatever way it chooses. National quotas should be marketable so that nations without the capacity to harvest their share of the resource would be able to market it to obtain benefits from the resource. This would make the resource available to the lowest cost or the most efficient harvesters and contribute to greater economic efficiency (Saila and Norton 1974). Although this would prevent overcapitalization due to competition between states, it would not prevent competition within the state and overcapitalization (Saila and Norton 1974). Under this system, benefits could be distributed, yet criteria in determining quotas must be acceptable to all participants if the system

is to survive. Criteria may include historical catch and proximity to the resource among other political aspects considered appropriate to participating nations. Effort limitation and license fees and taxation are other management tools which can be utilized in serving the objectives of conservation and economic efficiency. The main question remains as to how effort and benefits can be divided among concerned nations (Saila and Norton 1974).

Unfortunately, HMS management has not attained the level of cooperation on the international level which is required for the effective implementation of many of these proposals. The next section will concentrate on the management regime which is evolving in the South Pacific.

Management in the Pacific Islands Region

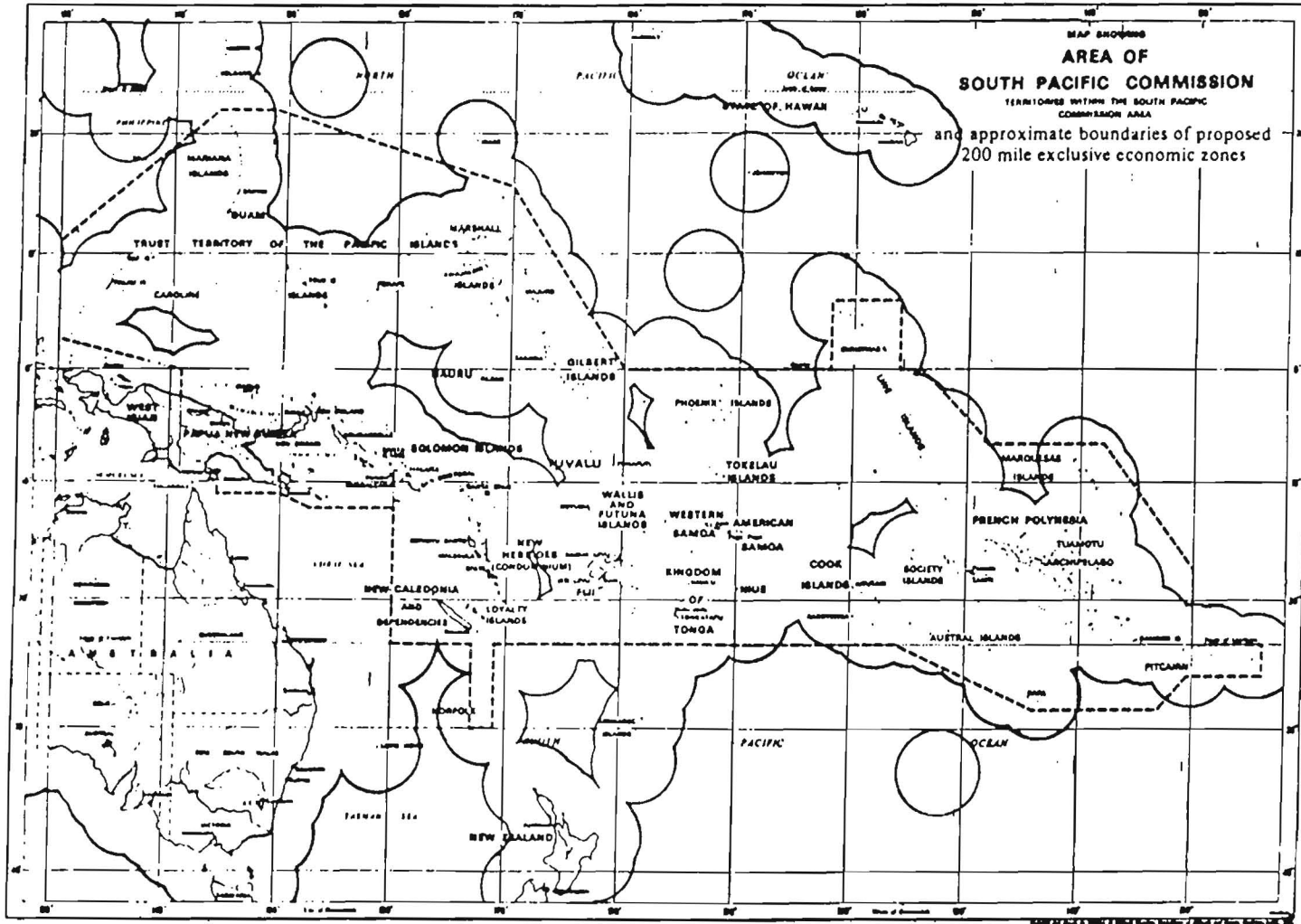
The island nations of the Central and South Pacific are currently struggling with the issues of benefit distribution with foreign fleets. Some of the largest tuna stocks in the world range throughout the vast expanses of ocean waters which separate the generally small, newly independent nations of the region. Extended jurisdiction has given the region's island nations new hope for greater control over their destinies. It also offers the tremendous challenge of formulating a management regime that is based on the cooperation required to obtain benefits from the resource.

The Region

The Pacific Islands Region stretches from the Republic of Palau in the west to the Pitcairn Islands in the east (Doulman 1987a). A wide definition of the region includes the more developed and larger nations of the region such as Australia and New Zealand, but for the purposes of this report, concentration will focus on the small, lesser developed island states of the region (see Figure 7). Except for Tonga, all of these states were colonies of metropolitan powers; 14 are now independent and eight remain territories of the United States, France, United Kingdom and New Zealand (Doulman 1987a). Therefore, the region as a whole is diverse, widely spread and huge (approximately 30 million square kilometers). It stretches across over half of the tropical and temperate southern Pacific as indicated by Figure 7.

The small, newly independent island nations of the region are subject to political influence and economic dominance of outside developed nations. According to Doulman, two of the major factors which may cause the situation to worsen are the islands' "narrow economic bases and limited agricultural resources and land-based activities" (Doulman 1987a). As with many developing countries, the region's island nations face low per capita incomes, rising imports relative to exports, high unemployment, high rates of

Figure 7



122

Source (Kent 1980)

emigration by youth, and high reliance on external aid (Kent 1980). Table 13 illustrates the generally low per capita GNP of the region's island nations and their relatively small land area, as compared to the large ocean area which has come under island nation jurisdiction. Due to these factors, marine resources are central to economic development, self-reliance and the general well-being of the people of the region (Kent 1980, Doulman 1987a).

Fisheries of the Region

Tuna is the most abundant and valuable fishery resource of the region (Doulman 1987a). In 1984, landings harvested by both domestic and foreign vessels were estimated at 650,000 tons, with an ex-vessel value of \$700 million (Doulman 1987a). This accounts for approximately 30% of the world catch of tuna (Copes 1987). The tuna landings of the region are comprised mainly of yellowfin and skipjack tuna with several other minor tuna species (Copes 1987).

The three principal gear types utilized in their capture are longline, purse seine and pole and line (Sibert 1987). Yellowfin are generally caught with longlines, although they are taken by all three methods (Sibert 1987). Skipjack are caught with purse seines and pole and line (Sibert 1987). Longlines and pole and line fisheries took most of the catch until 1980. In the 1980s, the introduction of the purse

TABLE 13
Basic Data of the South Pacific Region

<u>Nation or Territory</u>	<u>Population (1977)</u>	<u>1974 GNP/ Capita</u>	<u>Land Area</u>	<u>EEZ Area (000 sq km)</u>
American Samoa	30,500	1,100	197	410
Cook Islands	18,500		240	2,200
Fiji	592,000	840	18,200	1,370
French Polynesia	137,000	2,530	4,000	5,380
Gilbert Islands	53,500	730	684	4,430
Guam	102,000	4,420	-	-
Nauru	7,300	6,500	30	290
New Caledonia	134,000	4,170	19,100	1,540
New Hebrides	99,500	480	11,880	670
Niue	3,800	-	260	350
Norfolk Island	1,900	-	35	570
Papua New Guinea	2,908,000	470	461,693	2,300
Pitcairn Island	65	-	4	970
Solomon Islands	206,000	310	28,500	1,520
Tokelau	1,600	-	10	330
Tonga	90,000	300	697	720
Trust Terr.	120,000	500	1,800	7,460*
Tuvalu	7,500	-	25	760
Wallis and Futuna	9,700	-	16	280
Western Samoa	152,000	300	2,934	160

*-includes the EEZ of Guam
Source (Kent 1980)

seine led to a decline in the pole and line fishery. In 1982, purse seining surpassed the other two major gear types (Sibert 1987). Purse seining is the most capital intensive and efficient method of catching tuna (Doulman 1987b). It accounts for over half of total landings in the Pacific Islands Region, but ranks behind longlining in value (Doulman 1987b). Purse seines target on surface-dwelling species such as skipjack and small yellowfin. These species are of lower value than those species occurring deeper in the water column such as larger yellowfin, bigeye and albacore which are vulnerable to longline sets (Doulman 1987b).

Foreign fishing nations take the vast majority of the tuna commercially harvested in the region. Locally-based or registered fleets take 140,000 to 160,000 tons of the 650,000 tons landed (Doulman 1987a). The Japanese entered the region in the early 1950s and steadily expanded longline and pole and line fisheries in subsequent years (Fujinami (1987). Korea and Taiwan expanded into the region during the 1960s with longline and pole and line operations which have continued to grow up to the present. United States purse seiners began fishing in the region during the early 1970s (Felando 1987). Fleet overcapacity leading to shorter seasons in the Eastern Pacific encouraged a shift in effort to new tuna fishing grounds (Felando 1987). Currently,

Japan and the United States take the majority of landings in the region (Copes 1987). Many countries or companies operating in the region are vertically integrated. Shore-side processing and transshipment locations are an important component of the industry for the region's economy.

The condition of yellowfin and skipjack stocks is not certain due to inadequate statistical data (Van Dyke and Heftel 1981, Sibert 1987). However, it is generally agreed that skipjack stocks are well below maximum levels of exploitation. Kearney predicts that "a several-fold increase in harvest levels above the present one of 300,000 mt may be possible without depleting the resource" (Bardach and Ridings 1985, 53). Moderate increases above current yellowfin landings of approximately 250,000 mt may also be possible without serious effects by utilizing longline gear (Bardach and Ridings 1985). However, yellowfin stocks present greater concern to managers because they are more heavily targeted due to their greater value (Copes 1987). There are concerns with the recent growth in the surface purse seine fishery, because of potential effects on the mixed stocks of yellowfin and skipjack which it targets, and possible effects on the economics of the tuna fishery (Sibert 1987). There is general agreement that further expansion is possible, although better reporting of statistics and further analysis are essential (Sibert 1987).

Tuna Management in the Region

Subsistence fisheries of the Pacific Island Nations are estimated at approximately 10,000 mt compared to the 650,000 mt commercial harvest landed annually (Doulman 1987a).

Therefore, virtually all of the tuna harvested is consumed outside the region. DWFNs provide an important source of revenue totalling between \$15 to \$20 million annually for access fees. As indicated above, commercial operations are dominated by outside interests in both the harvesting and processing sector, but they also contribute to the region's economy.

Fisheries Forum Agency

In the mid-1970s, UNCLOS III negotiations and coastal state practice established the concept of extended jurisdiction as an accepted norm in the international community. During the South Pacific Forum meeting of 1976 in Nauru, the idea of establishing a South Pacific fisheries agency was presented (Gubon 1987). The meeting culminated in the Nauru Declaration which emphasized creation of 200-mile zones, conservation, regional cooperation and coordination of policies related to marine resources (Gubon 1987). Later in 1976 in Suva, governments of the region:

- "(1) declared their intention to establish 200-mile Exclusive Economic Zones after consulting with each other;
- (2) decided to harmonize fisheries policies in the region and to adopt a coordinated approach to their negotiations with distant-water fishing nations;

- (3) decided in principle to establish a South Pacific fisheries agency to promote conservation and the rational use of tuna stocks in the region" (Kearney 1978, 250).

The scope of cooperation was questioned because regional states indicated that: the sovereignty of the coastal states should remain inviolable" (South Pacific Forum 1977 cited in Gubon 1987, 246). During subsequent meetings, disagreement centered in two main areas: eligibility of membership in the agency, and whether or not tuna should be declared within the EEZ.

Actually, the two areas are interrelated. Two types of organization were proposed: "one aiming primarily at ensuring conservation and promoting optimum use of living resources in the region, the other at ensuring maximum benefits for the people of the coastal states of the region" (Gubon 1987, 247). The former proposal followed a more broad-based conservation approach as taken in Article 64 of UNCLOS III (Gubon 1987). The United States promoted this approach during meetings because this would allow participation of distant water fishing nations. The U.S. was one of the few nations in the world which had exempted tuna from jurisdiction within its fishing zone due to claims that tuna should be managed throughout their range. In reality, west

coast tuna interests, such as the American Tunaboat Association, were responsible for this policy in order to claim reciprocal rights to access in other nations' fishing zones (Wade 1984). This put U.S. policy in conflict with the Pacific island nations' goals. The Pacific island nations argued for coastal state jurisdiction over HMS because they are the only significant fisheries resources within their zones of jurisdiction (Van Dyke and Heftel 1981). The Pacific island nations wanted an organization which would unite them in negotiations with DWFNs (Gubon 1987).

The South Pacific Fisheries Forum Agency (SPFFA) agreement was signed in 1979. It recognizes that the coastal state has sovereign rights over the living resources within the EEZ including highly migratory species (Van Dyke and Heftel 1981). It also limited membership to Forum nations of the region, thereby excluding distant water fishing nations and nations with regional island dependencies (Van Dyke and Heftel 1981).

The objectives of the SPFFA as stated in its preamble are expressed by the following:

- "(1) their common interest in the conservation and optimum use of the living marine resources in the region, particularly highly migratory species;

- (2) their desire to promote regional cooperation and coordination in fisheries policies;
- (3) their concern for securing maximum benefits from the region's living resources for the national well being of SPF countries;
- (4) their desire to facilitate the collection, analysis, evaluation, and dissemination of information about the region's fisheries resources, especially highly migratory species" (Guben 1987, 248).

The SPFFA convention does not satisfy Article 64 requirements due to membership restrictions (Van Dyke and Heftel 1981). It reflects the common concerns of the region's nations which center on maximizing benefits to the region. The South Pacific nations realized that regional cooperation is required in areas such as enforcement, expertise, information collection and dissemination, and negotiation (Gubon 1987). As a group they stood a better chance at obtaining essential information such as:

- "(1) the quantity and quality of the fisheries resources;
- (2) how much fishing could be permitted while sustaining stocks;
- (3) who had traditionally fished their resources;
- (4) where their fish were sold, processed, and consumed;
- (5) and the market value of their fish" (Gubon 1987, 249).

Conventional wisdom concerning highly migratory species management expresses the proposition "that international cooperation is required for the effective utilization of the tuna resources of the world" (Hilborn and Sibert 1988, 31).

However, the term highly migratory species has been misused to the point where its biological meaning may have become irrelevant (Hilborn and Sibert 1988). The assumption that all tuna species have huge ranges encompassing entire ocean basins has been exaggerated in some cases. There are indications that the ranges of yellowfin and skipjack of the South Pacific region are smaller than previously believed (Hilborn and Sibert 1988). DWFN claims that widely-based international organizations necessary for HMS management are sometimes more self-serving than based on biological fact. Therefore, international cooperation may not have to satisfy Article 64 to be effective. It also indicates that international catch quotas may not be necessary if high seas fishing does not threaten species conservation. The degree of international cooperation should depend on actual species distribution and geographic considerations such as EEZ configurations and relative sizes (Hilborn and Sibert (1988). A high degree of regional cooperation may still be required, especially in the case of adjacent relatively small EEZs. This lends legitimacy to the South Pacific approach toward regional tuna management which excludes DWFNs from membership. However, cooperation in data collection and interpretation is still required of all participating nations.

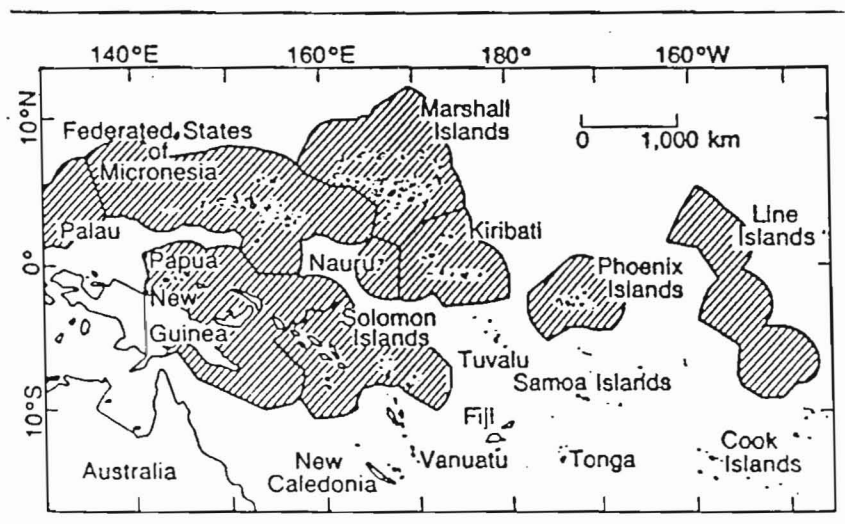
The SPFFA was not generally concerned with dictating management in areas such as quotas, setting of license fees or limitation of fishing effort. The decisions pertaining to the EEZ were left to the respective coastal state (Gubon 1987). The SPFFA functions as a forum for the exchange of ideas, information, technical advice, and communication of current state activities (Gubon 1987). Under the SPFFA system, individual states were left to negotiate individually with foreign fishing nations. This left the danger of encouraging competitive undercutting of fees required of foreign fishing nations because of competition between individual nations to sell fishing rights (Van Dyke and Heftel 1981). As a united group, the Forum nations would be in a better position to negotiate better terms (Van Dyke and Heftel 1981). Uniform entry would also be beneficial to foreign fishing nations because this would enable them to follow changing concentrations of fish without regard for EEZ boundaries and national licenses (Van Dyke and Heftel 1981). Surveillance and enforcement is another common problem of the region's coastal states due to the vast area of the region. Conventional methods of policing, such as surface patrols and air patrols, are inadequate in this situation (Van Dyke and Heftel 1981). A satellite system has been proposed although costs would be very high (Van Dyke and Heftel 1981). Enforcement activities can be

enhanced by regional cooperation in order to avoid duplication of efforts and to share costs among concerned coastal states (Van Dyke and Heftel 1981). These factors encourage greater cooperation in issues involving foreign vessel entry and management.

The Nauru Group

In 1982, the Nauru Agreement was signed by several countries of the region. The basis of the regional grouping was primarily economic (Doulman 1987c). The distribution of tuna within the Pacific Islands Region determines individual coastal state responses and distribution of domestic and foreign fishing (Doulman 1987c). Those countries with the greatest at stake in the region's tuna fisheries had the common concern of deriving the greatest possible benefits from their tuna resources (Doulman 1987c). The harmonizing of policies within the region for the maximization of financial returns is the major goal of the Nauru Agreement. The Nauru grouping is logical for the following reasons: most of the group's EEZs are contiguous as indicated in Figure 8; scientific research indicates that tuna stocks are shared among members; more than 75% of the tuna taken by DWFNs in EEZs of Pacific island nations is harvested in waters of the Nauru nations; over 70% of access fees paid by DWFNs go to Nauru nations (Doulman 1987c) (See Table 14 for organization

Figure 8 EEZs of the Nauru Group



Most of the Nauru Group EEZs are contiguous and are endowed with the richest tuna resources of the region.

Source (Doulman 1987)

TABLE 14

FFA and Nauru Group Membership in the South Pacific

<u>Country</u>	<u>FAA Membership</u>	<u>Nauru Group Member</u>
Australia	X	-
Cook Island	X	-
Federated States of Micronesia	X	X
Fiji	X	-
Kiribati	X	X
Marshall Islands	observer	X
Nauru	X	X
New Zealand	X	-
Niue	X	-
Palau	observer	X
Papua New Guinea	X	X
Solomon Islands	X	X
Tonga	X	-
Tuvalu	X	-
Vanuatu	X	-
Western Samoa	X	-

X indicates membership

Note - Nauru membership is not exclusive while members may join or leave. However, due to the contiguous nature of their zones and resource endowments, the two most likely additions would be Tuvalu and Vanuatu.

Source (Doulman 1987a)

membership). These factors all have significance to enforcement and access agreements with DWFNs.

"The Nauru Agreement is an international treaty that obligates members to adopt common courses of action with respect to their shared fisheries resources so long as the cooperation benefits them without derogating their sovereign rights" (Doulman 1987c, 261). The two areas of greatest importance involve a regional registry of foreign fishing vessels and minimum terms of fisheries access that member countries adopt in licensing foreign vessels (Doulman 1987c). All foreign fishing vessels must be listed on the FFA's register before being granted a license by the Nauru group nations (Doulman 1987c). If a vessel violates terms of entry in a given nation's EEZ, it may be removed from the register and eligibility to participate in the region's tuna fishery. The registry has aided enforcement in the region and in the collection of fines to prevent the deregistration of vessels for violations (Doulman 1987c). The adoption of minimum terms of fisheries access has allowed the Nauru group to stop DWFNs from playing one nation against another during the negotiations. It simplifies negotiation by leaving fewer variables to be determined while allowing the coastal state to concentrate on obtaining better financial terms (Doulman 1987c).

Two other areas which the Nauru group will likely address in the future are "preferential access for fishing vessels from Nauru group countries and the standardization of methods for determining access fee payments for DWFN fleets" (Doulman 1987c, 263). Preferential access is already taking place on an informal basis and will probably become more common as Nauru group members develop their own fleets (Doulman 1987c). The method of fee determination in using a per-trip formula is also nearly universally accepted within the Nauru group (Doulman 1987c). In the future, standardization in setting access fees according to the scope of the DWFN operation is expected (Doulman 1987c).

Foreign fishing nations were uneasy with the establishment of the SPFFA and Nauru Agreement. They expected that unreasonable access terms might be demanded, especially by the Nauru Group (Doulman 1987c). However, DWFNs encouraged cooperation among Nauru group members because of DWFNs' willingness to play one country off against another. The members of the Nauru Group realized the importance of the financial returns they receive from access fees. They understood that there was room for improvement in terms of access without making terms destructive to the operations of fleets they depend on for revenues.

Cooperation between the Nauru Group and the FFA have continued to be good although there was some initial apprehension on the part of the FFA. The Nauru Group has been a progressive influence on the FFA. This is illustrated by its adoption of Nauru Group cooperative policies in areas such as a vessel registry (Doulman 1987c).

Historically, there has been little cooperation between the Micronesian and Melanesian nations of the Nauru organization (Doulman 1987c). However, common resources and economic concerns made a compelling case for regional cooperation, because the benefits of cooperation outweighed the national concerns involving independence (Doulman 1987c). This regional grouping offers advantages in administration, enforcement, revenue maximization and data collection (Doulman 1987c).

Individual Coastal State Approaches

In the South Pacific, regional institutions such as the SPFFA and the Nauru Group are continuing to evolve especially in the areas of cooperation and coordination of policies. However, a balance under which rights have been retained within respective island state EEZs has been one of the bases from which the current system works. License fees are collected and used by each island state for its own development. In the case of the South Pacific, resource

distribution and beliefs in state sovereignty are two factors which are barriers to complete integration.

In the South Pacific, individual states have more flexibility because tuna resources are generally below maximum levels of exploitation. This is the case in Papua New Guinea where the results of stock assessment programs indicate that "the potential annual yield from its Declared Fisheries Zone (DFZ) significantly exceeds the quantity of tuna currently being harvested" (Doulman 1987e, 16). Papua New Guinea has the third largest EEZ in the Pacific Islands region covering 2.3 million square kilometers (Doulman 1987e). It also contains rich tuna resources with an annual harvest of 100,000 tons (Doulman 1987e). The domestic harvest averages approximately 28,000 tons, with the rest taken by foreign fishing operations (Doulman 1987e). The case of Papua New Guinea is a good example of the access arrangements which have been evolving in South Pacific states of the region.

The policy of granting foreign fleet access to the Papua New Guinea DFZ is encouraged because domestic harvesting capacity cannot fully exploit the tuna resources occurring in its zone, and because the payment of access fees generates government revenue (Doulman 1987a). The government will license any foreign fishing vessel as long as it is listed

on the Fisheries Forum Agency register, and it has not previously infringed on licensing conditions in Papua New Guinea (Doulman 1987e). All access agreements are based on the Papua New Guinea/Japan Fishing Agreement. The general conditions are "the payment of a prescribed fee and the observance of terms and conditions of access specified in the Papua New Guinea/Japan Fisheries Agreement" (Doulman 1987e, 18). Access fees are: "designed to extract the resource rent of the resource; foster operational efficiency in the use of the resource; and provide an instrument for the government to regulate, develop and conserve and generally manage the resource" (Doulman 1987e, 19). The Papua New Guinea Fisheries Act specifies that fees consist of a Fisherman's licensing fee and a Boat Licensing Fee, which are nominal, and an Operation Fee which is meant to extract a financial return for fisheries resources which are exploited (Doulman 1987e). In the Papua New Guinea case, foreign aid is not accepted as part of the payment for access, but must be fully independent of the provision of fisheries access. Papua New Guinea has taken the position that access must rely strictly on commercial terms (Doulman 1987e). Fees are related to a somewhat complicated formula which is dependent on the type and size of the vessel, duration of time of fishing trips and the type and market price of species targeted (Doulman 1987c).

In addition to the payment of access fees, foreign vessels have certain obligations "to minimize administrative costs, provide a basis for scientific monitoring and management and to promote the orderly exploitation of the fishery" (Doulman 1987e, 22). This is accomplished through the establishment of conditions of entry. Prohibited areas were established within the Papua New Guinea territorial sea to protect domestic pole and line fishing operations. Vessel owners must report entry and exit from the Papua New Guinea DFZ with the exact location, time and quantity of fish on board. Catch records must be maintained and forwarded to the director of fisheries after each trip. The radio call sign of the vessel must be displayed on the top of the vessel and recognizable from the air. Foreign fishing vessels are obligated to take on government-nominated observers who must have access to all facilities and equipment. Foreign fishing vessel owners must base an agent in the country to handle licensing and arrangements to reduce administrative costs. These conditions assist Papua New Guinea in enforcing and administering the program. These conditions are also terms which the Nauru group has adopted for the harmonization of terms of access throughout the region (Doulman 1987e).

Papua New Guinea received \$4.5 million in revenue from foreign fishing in 1985 (Doulman 1987e). In 1984, revenues

obtained by licensing foreign fleets exceeded the Fisheries Division's budget by 20% (Doulman 1987e). It might be inferred that these revenues have a significant impact on available funding for domestic development and management of the nation's fisheries (Doulman 1987e). However, this must be gauged against administrative, enforcement and surveillance costs to administer the program. In 1982, administration and enforcement costs incurred by the Fisheries Division were \$0.6 million (Doulman 1987e). Costs associated with Defense Department surveillance and the Department of Primary Industry would result in a significantly higher figure (Doulman 1987e). Costs of administration and enforcement illustrate that actual benefits accrued by the country in question are related to the behavior of foreign fishing operations within their zone. Compliance with the Japanese fleet has been good although patchy in the case of other flag states (Doulman 1987e). As voluntary compliance drops, the cost of surveillance and enforcement increases (Doulman 1987e). This will put upward pressure on access fees and selective limitation on entry (Doulman 1987e). This is an example where a mutual relationship with voluntary compliance is in the interest of both foreign and domestic parties.

Most of the Pacific Island states have made similar arrangements in respect to conditions and access fees required for

the entry of foreign fishing vessels. In addition, joint venture agreements and foreign aid are other benefits provided to island states to satisfy entry requirements.

For relatively small island states, access fees can be of considerable size relative to their domestic economies. In 1986, license receipts from foreign fishing operations accounted for 25% of Kiribati government revenue (Doulman 1987a). In the case of Kiribati, Japanese access fees were usually a combination of cash payments and goods and services for domestic fisheries development (Teiwaki 1987). The Kiribati government had reservations with this method of payment because it felt that access arrangements should be a purely commercial transaction (Teiwaki 1987). The Kiribati government felt that "the value of fish harvested should be measured and compensated for in cash and not confused with the aid inclinations of the foreign state" (Teiwaki 1987).

Development aid as a method of payment, especially in the case of a small island nation, is questionable in respect to the benefits it produces. Foreign aid, some in the form of subsidies, is a major segment of many of the economies of the region's island nations. The injection of excess aid can have negative effects in cases where the local economy does not have the capacity to absorb and utilize it (Teiwaki 1987). Nations such as Kiribati need development which they

can control at a pace with terms that are in their own interests (Teiwaki 1987). Members of the South Pacific Forum are in agreement that access should be based on commercial considerations and that aid and access should be delinked (Doulman 1987c). There have been instances where aid has benefited countries and others in which inappropriate and inadequate assistance were provided (Doulman 1987d). Development aid is not inherently evil, but the motivations behind it are often more self-serving on the part of the donor than helpful to the recipient.

Domestic development of tuna fisheries is the goal of most of the nations of the Pacific Region. However, most of the Pacific Island states also lack the capital, expertise, information, skills and infrastructure to develop fishery operations. Tuna prices have also stagnated in the 1980s resulting in stiffer competition among participants (King 1987). The region's tuna fisheries are capital intensive operations, especially purse seiners (King 1987). The industry is also vertically integrated so that processing and access to markets may be a necessary component depending on national development goals.

The answer in some cases is joint ventures, where foreign capital and expertise can be combined with domestic resource endowments and local labor. The Solomon Islands have

participated in this type of arrangement with Japanese businesses since 1972 (Hughes 1987). Problems involving skilled manpower needs, meeting time tables, depressed market prices for tuna and the United States embargo were setbacks encountered during this period (Hughes 1987). However, localization of the industry has continued while the Solomon Islands have benefited in the form of taxes, commissions and fees, and employment while building industry infrastructure (Hughes 1987). The Solomon Islands have also benefited from Japanese "industrial know-how, access to capital and to markets" (Hughes 1987, 221). The Japanese company, Taiyo, benefited from access to the Solomon Islands' Zone and a good working relationship with the government. The following statement made by Anthony Hughes expresses the positive side in the following: "It is unlikely that the industry could have been established so fast, on such a scale, and in such a permanent form by any method but a joint venture" (Hughes 1987, 220). Joint ventures can generate employment, foreign exchange and technology transfer, but they must be based on mutual benefits and careful planning by the participants. It must be recognized that the motives of the foreign partner and island government are often very different (Doulman 1987d).

Another area which may benefit the island nations involves trans-shipment of tuna from island nation ports (Doulman

1987d). Trans-shipment could benefit the concerned island state through development of infrastructure and greater integration with tuna operations.

The tuna industry is very competitive in all sectors such as harvesting, processing, distribution and marketing. The island nations must identify those areas where they possess the greatest comparative advantage and where value is added in the production system (King 1987). Dennis King stated the following: "This end is best achieved by collecting access fees or some other form of rent from foreign tuna producers and using the proceeds to develop local industries consistent with national goals" (King 1987, 295).

The United States Case

The presence of the United States tuna fleet in the South Pacific Region became one of the major sources of conflict and the impetus for greater cooperation and coordination of fisheries policy among the South Pacific States.

The U.S. position, from the inception of extended jurisdiction, was to exclude tuna from coastal state control. The Magnuson Fishery Conservation Act expresses the U.S. legal position in sections involving highly migratory species, international fishery agreements and import prohibitions

(Van Dyke and Nicol 1987). The United States does not recognize coastal state jurisdiction over tunas and requires coastal nations to join with DWFNs to manage HMS (tuna) through international fishery agreements (Van Dyke and Nicol 1987). If a coastal state seizes a U.S. tuna vessel "as a consequence of a claim of jurisdiction which is not recognized by the United States", then that nation's fishery products may be embargoed (MFCMA 1976, Van Dyke and Nicol 1987, 109). These policies are a reflection of U.S. West Coast tuna interests, the American Tunaboat Association (ATA) and the United States Tuna Foundation (USTF (Van dyke and Nicol 1987). The tuna industry wanted continued access to other nations' fisheries zones on their own terms. As extended jurisdiction with the inclusion of HMS became the international norm, the United States found itself out of step with the rest of the world. Increased conflict in the Eastern Pacific encouraged migration of U.S. operations to the South Pacific. However, they did not escape conflicts and the inevitable need for compromise with resource adjacent nations.

In 1985, the United States had 60 purse seiners registered with the South Pacific Forum member nations. This is more than any other country, and a significant portion of the total of 147 which were operating in the region (Doulman 1987b). In some cases the ATA gained access with Pacific

Nations under terms similar to those negotiated by the Japanese. This was the case in Papua New Guinea where U.S. purse seiners were licensed under the Papua New Guinea/Japan Fisheries Agreement (Doulman 1987e).

The U.S. fishing presence in the South Pacific was unpopular from its beginning in the mid-1970's. During negotiations leading to the formation of the Fisheries Forum agency, the U.S. promoted its national interests and those of the ATA instead of interests of the territories it represented (Gubon 1987). In respect to compliance, U.S. vessels had one of the worst records in the region. In Papua New Guinea a U.S. registered purse seiner, the "Danica" was arrested in 1982 for fishing without a license (Tsamenyi 1986). In 1984, another U.S. registered purse seiner, the "Jeannette Diana" was arrested for illegal fishing in the Solomon Islands (Tsamenya 1986). In both cases, the U.S. government invoked Magnuson Act provisions and embargoed fish products from the two nations (Tsamenyi 1986). The embargos were lifted in both cases after sanctions imposed by the concerned island nations were modified. The illegal fishing problem continued in 1985 and 1986 with the fishing vessels "Ocean Pearl" and "Priscilla M" in the EEZ of the Federated States of Micronesia (Van Dyke and Nicol 1987). In both cases, negotiated sanctions were paid by owners of the offending vessel and the U.S. did not proceed with an

embargo, possibly due to ongoing treaty negotiations (Van Dyke and Nicol 19876). These cases undermined the normally strong relationships between the South Pacific nations and the United States (Tsamenyi 1986).

As early as 1982, Congressman Paul McCloskey, Jr. advocated negotiation with the South Pacific states (Tsamenyi 1986). He stated that the U.S. needs to show the concerned South Pacific states that it is willing to deal justly with matters of stock management and conservation (Tsamenyi 1986). This could thwart Soviet penetration within a region which is of strategic value to the security interests of the United States (Tsamenyi 1986). The South Pacific nations also had both economic and political motivations for agreement on fisheries issues related to tuna (Tsamenyi 1986). The U.S. is both the largest consumer of tuna in the world and the largest market for tuna products of most South Pacific states (Tsamenyi 1986). U.S. policy, as stated in the Maguson Act, had negative effects on the region's economy in the form of embargos and difficulties in granting access (Tsamenyi 1986). The South Pacific states also have strong ties with the capitalist world and its financial institutions (Tsamenyi 1986). These reasons encouraged negotiation because agreement could be potentially beneficial to both sides.

Although both sides recognized the need for compromise, negotiations did not progress smoothly or at a fast pace. In initial talks, according to one Pacific commentator, the U.S. delegation displayed a good deal of "ignorance, insensitivity and more than a touch of arrogance concerning Forum Fisheries aspirations" (Islands Business 1985, 27; Cited in Van Dyke and Nicol 1987, 118). The one factor which changed the U.S. willingness to compromise and accelerated the pace of negotiations was the Kiribati-Soviet fisheries agreement. In August of 1985, 16 Soviet fishing vessels were allowed access to fish for 12 months in the Kiribati EEZ for access fees totaling \$1.5 million (Teiwaki 1987). The strategic considerations which arose prompted greater U.S. concern as illustrated by participation of the State Department and moderation of the U.S. negotiating position. After 10 rounds of negotiation, in October of 1986, the United States and Pacific Islands nations reached agreement on a regional fisheries treaty (Van Dyke and Nicol 1987).

The treaty gave the U.S. access to 10 million square miles of fishing grounds. Perhaps of greater importance, it served U.S. strategic interests by promoting a positive U.S. presence in the region. The Pacific Islands made economic gains of about \$60 million over a five-year period (Van Dyke and Nicol 1987). Payments are broken down in the following manner: \$9 million in cash annually to the FFA paid by the

U.S. government; \$1 million per year in development aid in addition to current programs for projects formulated by the FFA and administered by USAID; \$50,000 per vessel paid by the ATA with a minimum of 35 vessels totaling \$1.75 million per year; and \$250,000 per year paid by the USTF to provide in-kind technical assistance (Van Dyke and Nicol 1987). The FFA cash payments will be divided among the 16 concerned South Pacific nations. It will consist of a minimum guaranteed payment for each nation, with the other 85% paid according to fishing vessel catch locations (Van Dyke and Nicol 1987).

In addition to license fees, there are other terms of entry which generally reflect existing conditions that individual states require of all foreign vessels. In order to be eligible, a vessel must be in good standing on the Regional Register (Van Dyke and Nicol 1987). The island nations also wanted independent control over closed and limited areas within individual EEZs (Van Dyke and Nicol 1987). In the cases of Australia, Papua New Guinea and the Solomon Islands, closed areas within their EEZs were left to bilateral negotiations (Van Dyke and Nicol 1987). U.S. vessels are required to report catches under the South Pacific Commission standard reporting procedures (Van Dyke and Nicol 1987). This includes the completion of a catch report form and weekly reporting. In addition, vessels must

report at the time of entry or departure from waters under jurisdiction and at least 24 hours before entry into any port. Foreign vessel operators must also allow observers on board for scientific and compliance monitoring functions. The observer has the right to inspect any part of the vessel and ships' logs, and the right to gather information related to fisheries within the Licensing Area (U.S. State Dept. 1987).

One of the most important parts of the Treaty involves the responsibility of the U.S. government to enforce the provisions of the Treaty. The treaty states that the United States government will cooperate in the investigation of alleged violations, report to the concerned Pacific Island States and take steps in the sanctioning of offenders (U.S. State Dept. 1987). Government-to-government agreements are to the Island Nations' advantage because "diplomatic measures can be used to help ensure compliance" (Doulman 1987d, 302). This treaty spreads responsibility for vessel operators' actions directly to the United States government.

The Pacific Island States-United States Fisheries Treaty recognized coastal state jurisdiction over highly migratory species and the terms under which the entry of U.S. vessels is allowed. The departure from the former U.S. policy, reflected in U.S. law under the MFCMA, was in large part due

to the importance of political concerns outside the sphere of fisheries policy. In reality, the United States government paid for the strategic value of the region in addition to the value of fishing access. To accomplish this feat, the U.S. tuna industry was subsidized in part through U.S. government payments, and U.S. law under the MFCMA was ignored. It is questionable whether fee payments actually reflect the commercial value of fishing access, whether higher or lower, due to these factors.

The treaty is also an important step for cooperation and the coordination of fisheries policies among the region's island nations. The island nations gained economic benefits while retaining good relations with the United States. Therefore, the Treaty appears to be mutually beneficial in meeting the goal of benefit distribution among participants.

Regional Comparisons

There are many similarities and differences between the Eastern Caribbean and South Pacific situations. Perhaps the most important factor is the illustration that regional cooperation for the advancement of common goals is possible. However, there are many site specific factors which must be recognized before direct application to the swordfish management in the Eastern Caribbean.

The Eastern Caribbean and the South Pacific Islands regions are generally made up of small island states. However, differences in size and configuration of projected zones of jurisdiction are huge. The Pacific Islands Region is vast in respect to total area and the size of individual Fishing or Exclusive Economic Zones. Although many of the EEZs in the Pacific Islands Region are contiguous, they are widely spread and therefore huge relative to land area. The entire South Pacific Islands Region is approximately 30 million square kilometers in size. All of the states in the region have EEZs greater than 100,000 square kilometers in area with a range between 160,000 sq km for Western Samoa to 746,000 sq km for the U.S. trust territories (see Table 13).

The islands of the Eastern Caribbean Region are also surrounded by relatively large zones of extended jurisdiction, but these zones are characterized by the structure of the 450-mile arc of islands which extend out into the Atlantic. The islands occurring along this arc are much more closely packed, resulting in an interlocking puzzle of adjacent zones. All of the OECS countries except Antigua are cut off by adjacent states' potential zones well before the 200-mile limit (see Figure 9). The Greater Caribbean has an area of 1.5 million square kilometers while the area of the Eastern Caribbean is approximately one-third of this figure. Potential national zones of extended jurisdiction range between

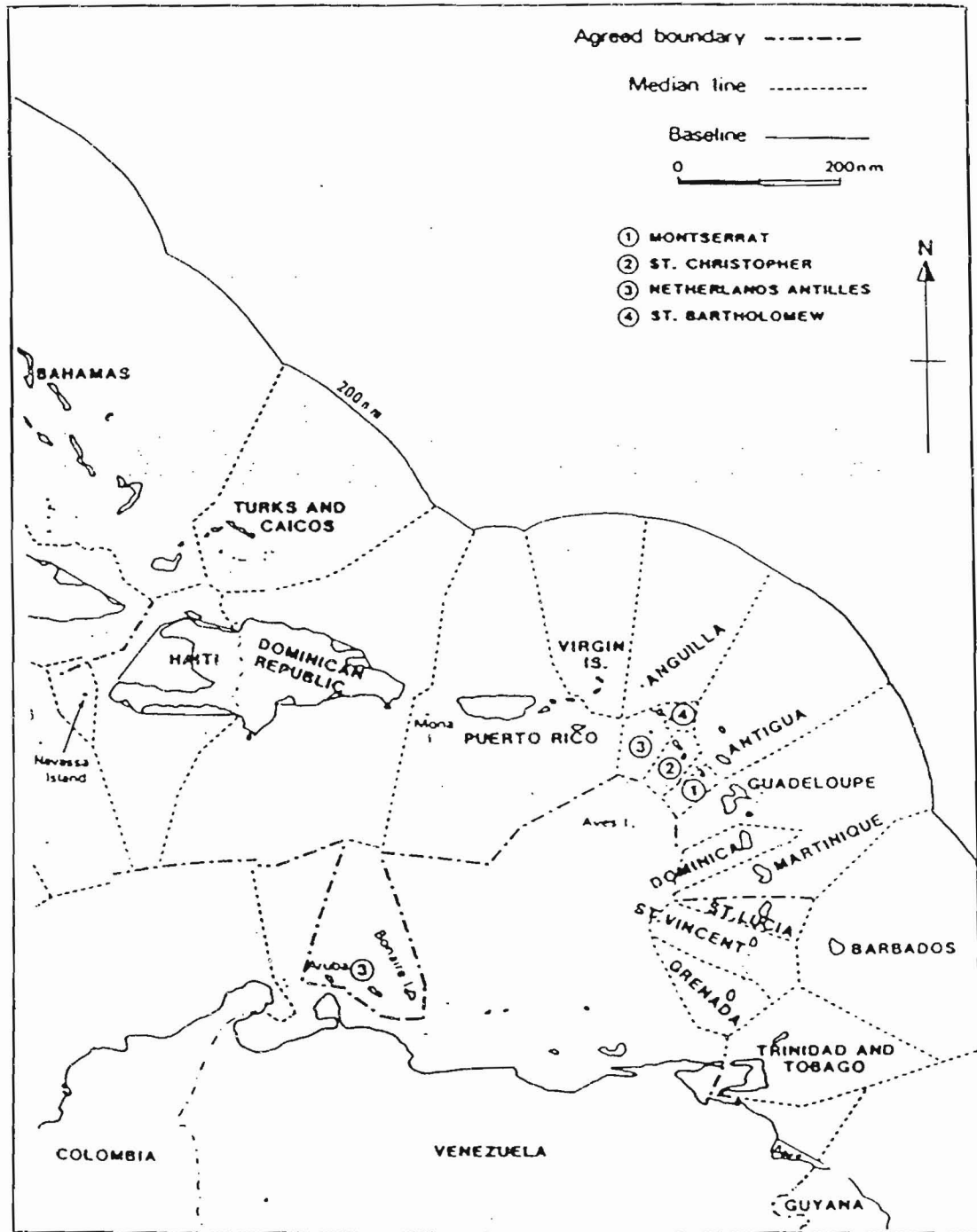


Figure 9 200 nm zones of jurisdiction in the Eastern Caribbean with the median line used for boundaries which have not been agreed on.

Source (Prescott 1985)

approximately 10,000 to 110,000 square kilometers in area. These geographic differences between zones have implications for fishing operations which target on wide-ranging pelagics such as swordfish. Forty-mile sets could easily span two national zones while movement during a given season could mean that operations will span several zones.

The resource endowments of the two regions are quite different both in respect to magnitude and composition. The tuna resources of the South Pacific Islands Region are among the richest in the world. An estimated 650,000 tons, with an ex-vessel value of \$700 million, was harvested in the region in 1984 (Doulman 1987a). This consisted primarily of skipjack and yellowfin tuna, the bulk of which is taken by purse seine. About 1,000 tons of swordfish with an ex-vessel value of approximately \$6 million was landed by U.S. vessels operating in the proximity of the Eastern Caribbean region during the 1987 season (SAFMC 1987). An additional 1,000 tons of tuna species may have also been taken in the proximity of the Lesser Antilles region by other foreign longline vessels (Marcille and Caddy 1985). However, this figure is highly speculative. The swordfish longline operations of the Caribbean produce a high-valued product which is sold fresh in U.S. markets. Purse seined tuna is of lower value and is usually used for a canned product. The United States is the largest single consumer of both Pacific tuna and Caribbean swordfish.

Politically, the regions share a history of foreign influence and dominance. Both the Eastern Caribbean and the South Pacific Island nations are generally made up of newly independent states. The South Pacific generally escaped the legacy of slavery, possibly due to its distance from metropolitan powers and small land areas. The states of both regions are generally made up of developing nations with characteristics such as: relatively low per capita income; limited resource and industrial bases; reliance on imports; foreign aid recipients; and close economic and political ties with the western capitalist world. The nations of both regions view economic development and self-reliance as two of their major goals as independent states. The United States has major interests in both regions including economic and strategic concerns.

Although there are major differences between the two regions, experiences in the South Pacific tuna fishery have the capacity to be instructive as the Caribbean attempts to manage the highly migratory species occurring within their zones of extended jurisdiction. Issues concerning regional groupings, access negotiations, conditions of entry and political concerns have relevance to the Eastern Caribbean. The next chapter attempts to outline the management alternatives which might be applied to the Eastern Caribbean swordfish fishery.

CHAPTER VII

SWORDFISH MANAGEMENT ALTERNATIVES IN THE CARIBBEAN

The extension of coastal state jurisdiction in the form of 200 nm Fishing or Exclusive Economic Zones has become an accepted practice of international ocean law. Under this regime, the coastal state has gained "sovereign rights" over the living resources occurring adjacent to it by virtue of its location. International practice has also dictated that highly migratory species are not exempt from coastal state jurisdiction. Therefore, according to international customary law and UNCLOS III, the island nations of the Eastern Caribbean have the right to claim jurisdiction over the highly migratory species, including swordfish, within their 200 nm jurisdictional zones. However, the right to declare jurisdiction over the resource, and the realization of resource management goals such as a more favorable distribution of benefits to the coastal state, are not synonymous.

Practices in the South Pacific and fisheries management principles are drawn upon in this chapter to formulate management alternatives for the Eastern Caribbean. The five basic management objectives examined in Chapter V are used

to organize principal areas of concern. It should be recognized that all of the objectives are interrelated.

These objectives in order of presentation include:

- (1) Maintenance of swordfish stocks at levels that provide high sustained yields;
- (2) Appropriate distribution of benefits;
- (3) Measures which afford the opportunity for countries not yet participating in HMS fishing to build up their fishing industries;
- (4) Improved economic efficiency;
- (5) Conservation measures which can protect stocks caught incidentally (recreational stocks) while creating as little disruption as possible to the primary fishing operation (swordfish longlining).

Benefit distribution is treated in the greatest depth because this is currently the area of greatest concern to the Eastern Caribbean, although other areas deserve attention because of their potential future impact.

Maintenance of Swordfish Stocks

All participants would agree with the objective of maintaining swordfish stocks at high levels. However, the definition of what level is best, how this level can be maintained and the current status of stocks are all disputed. With the information currently available and our present understanding of swordfish stocks, it is nearly impossible to answer these questions. It is possible to examine what we do know and how management might be improved.

The question of stock conservation is more complicated in the Eastern Caribbean than in the South Pacific Islands Region. It is generally agreed that stocks in the South Pacific are below maximum sustainable levels of exploitation. Although South Pacific tuna stocks are highly mobile, their range generally encompasses the South Pacific Islands Region. In the case of swordfish in the Western Atlantic, the only real agreement is that stock status is uncertain. The range of swordfish extends far beyond the Eastern Caribbean to the Grand Banks and perhaps beyond. Therefore, it is probable that the principles concerned with maintenance of stock abundance must be applied well beyond the Eastern Caribbean Region.

As noted in Chapter III, the current status of stocks is a very controversial subject. It is known that fishing pressure has resulted in growth overfishing, or smaller average carcass size, in the Atlantic management areas of the United States. It has been argued that this has not affected productivity of the Northern or Western Atlantic swordfish population. There is general agreement that the current rate of exploitation is near maximum sustainable yields.

Given that the range of swordfish includes most of the Atlantic Ocean, the question of interest to the Eastern

Caribbean becomes: Will effort levels and exploitation patterns in other regions of the Atlantic, especially the Northwest Atlantic, affect production in the Eastern Caribbean? If swordfish are as highly migratory as reported, the answer is affirmative. However, swordfish migration is not a simple matter of fish leaving for northern areas in the summer and returning in the winter. There appears to be a residential population, or at least a year-round presence, of the species in the Eastern Caribbean. The Caribbean may also be a spawning area for swordfish. Ray Hilborn and John Sibert indicate that the highly migratory label has been overused and poorly defined in many instances (Hilborn and Sibert 1988). Questions concerning the relationship of South Atlantic stocks to Caribbean stocks and the actual range of swordfish appearing in the Caribbean remain to be answered.

As seen in cases such as Atlantic Bluefin tuna, the Eastern Pacific and Southern Bluefin Tuna, it is likely that swordfish management is dependent on cooperation and coordination of policies throughout the stock's range. The argument that HMS are not always as migratory as they seem may be more true than previously thought, but current evidence points toward wide movement and ranges for swordfish.

Effort levels in the Western Atlantic are increasing while

the condition of the resource is in doubt. All biologically driven systems have limits in respect to potential yields. Although the available information is far from perfect, there are basic principles concerning effort and catch and population age structure which indicate that, regardless of the present status of the resource, exploitation limits exist. Although fishery systems are biologically driven, our only control over potential yields is dependent on the management of human activities. Therefore, the starting point is not necessarily biological, but a better understanding of human activity associated with it. Without cooperation among the concerned participants, it is extremely difficult to collect the data required to understand the biological system involved. The question then becomes: What management process can be initiated to gain the required data, trust of participants, and understanding of the fishery which will result in a strategy aimed at the protection of the resource from a potential decline in yields?

This question is difficult to answer on a national, much less international, level. For over six years, the United States Atlantic Fisheries Councils and Regional Centers have struggled with this problem. They have succeeded in collecting valuable information but, like most fishery investigations, definitive answers have not been agreed upon.

During the intervening years, U.S. fishing operations have spread beyond traditional fishing grounds to the Grand Banks and the Caribbean. The fishery has become more international in nature as U.S. boats ranged beyond the United States EEZ. It has been reported that 50% of current East Coast U.S. landings originate outside the U.S. EEZ (Pollack 1988). Spanish vessels are now ranging further west while their presence is anticipated in the Caribbean. Therefore, management requirements such as information collection, scientific research and regulation are becoming more important on the international level (see Figures 10 and 11).

The relevant international organization for HMS, as referred to in Article 64, is the International Commission for the Conservation of Atlantic Tunas (ICCAT). The U.S. supports the ICCAT Convention through the reporting of U.S. fishery statistics and research carried out at the Southeast Fisheries Center. The recommendations of the ICCAT biennial report for 1986-87 expressed the need for statistics and research, but no management recommendations were presented. Statistics recommendations included: national reporting of catch and effort; adequate levels of size and sex sampling; and standardization of statistics (ICCAT 1987). Research recommendations included: intensification of tagging efforts; standardization of CPUE; identification of stocks;

Figure 10

Swordfish Exploitation in the Caribbean and Adjacent Areas

Resource Adjacent Nations	FAO Reporting Area	Foreign Fishing Nations
United States (1562 mt)* Canada (585 mt)	Area 21 (Northwest Atlantic)	Japan (245 mt)
Cuba (148 mt) United States (1922 mt)* Venezuela (51 mt) OECS nations CARICOM nations Others Central America Mexico	Area 31 (West Central Atlantic) WECAFC	United States (1922 mt)* Japan (86 mt) Korea (84 mt)
Barbados and Trinidad OECS nations Venezuela French Islands Territories, Br. Neth. U.S. territories	Eastern Caribbean Swordfish Stocks	United States (900 mt)* Korea Taiwan
Argentina (404 mt) Brazil (375 mt) Uruguay (1685 mt)	Area 41 (Southwest Atlantic)	Japan (695 mt) Korea (134 mt)
Spain (7440 mt)* Portugal (15 mt) France (4 mt)	Area 27 (Northeast Atlantic)	Spain Japan (33 mt)

* - Indicates that it is likely that a large percentage of reported landings were taken outside the given nation's fishing zone.

Source (FAO 1986 Yearbook) (landings given for 1985)

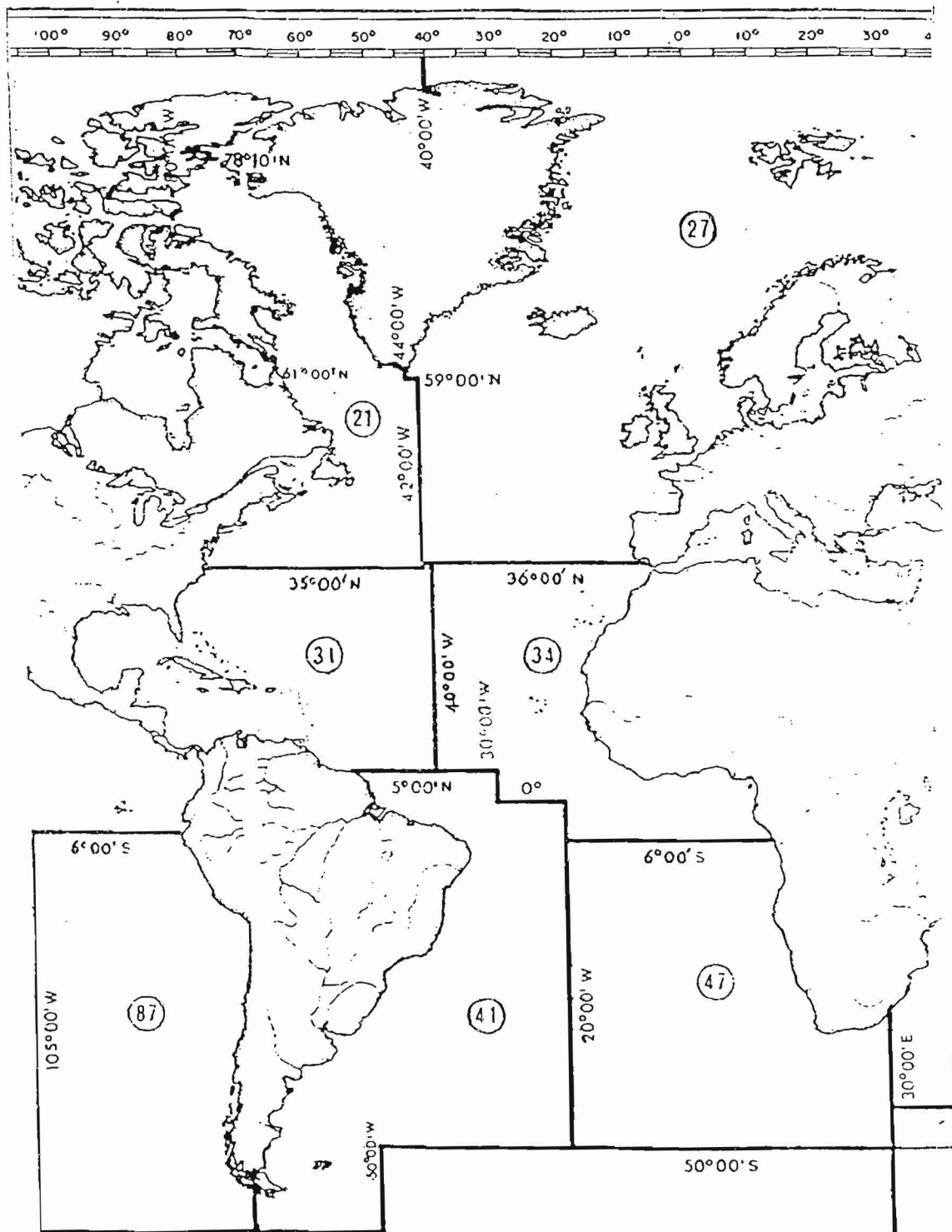


Figure 11 FAO Statistical Areas used in Figure 10
(FAO 1986 Yearbook)

better growth estimates and analysis of fishing effort effectiveness to improve indices of abundance (ICCAT 1987).

The effectiveness of ICCAT has been questioned because each member state conducts research, interprets recommendations and enforces management on its own (Devnew 1981). Therefore, there are wide differences in opinion concerning the need for management, difficulties in standardizing information and differing levels of compliance in accordance with management recommendations. The self-regulating character of the convention is not sufficient for the difficult management and conservation issues which must be dealt with in the future. The utilization of ICCAT as a scientific institution concerned with research and data collection may be the feasible limit of its role in the management process. The separation of ICCAT scientific functions from the political realities of nation state self-interests is a possible alternative. Management in the areas of regulation and enforcement might be carried out by negotiation of multilateral treaties. This might help to minimize the impact of political bias on scientific investigations. It is not realistic to expect a timely and effective international regulatory strategy for swordfish management under the current ICCAT convention. The U.S. experience in swordfish management highlights the proposition that, until the situation worsens, there is little political will to move forward.

The examination of principles in Chapter V concerning stock abundances are important, yet their actualization will require cooperation which does not exist. However, the following management tools may be utilized in the future. The use of national quotas is a possible alternative, although management within the U.S. context alone makes this alternative seem unlikely. In addition, the international compromises required for allotment of national quotas are beyond the level of cooperation which can be reasonably expected at the present time. Variable season closures, size limits, effort restrictions, or a tax on small fish to cut profitability in their targeting are other management measures which could be helpful. Presently, there is no swordfish regulation for the Atlantic on the international level. On the national level, only Canada has limitations of effort and landings.

The states of the Eastern Caribbean can do very little if stocks begin to decline due to fishing outside their waters. Articles 63 and 64 of UNCLOS III indicate that international cooperation is required among participants under these circumstances, but this seems unlikely when confronted with the current state of cooperation of participants within the swordfish range. However, the Eastern Caribbean states should be aware of ICCAT proceedings and participate through OECS to the greatest degree possible. The information

obtained from vessels operating in the Eastern Caribbean waters could be valuable in gaining a better understanding of the resource, while the Eastern Caribbean Nations could benefit from current research taking place outside their immediate region.

Previous discussion of this objective illustrates the inherent uncertainty which is implicit in the investigation of fisheries population dynamics. The goals in this area must include cooperation in information collection and coordination of regulatory policies on an international scale. Although these goals may not be met in the foreseeable future it is important for the Eastern Caribbean Nations to be recognized as concerned parties which have a stake in the conservation of the resource. This includes their inclusion in the management process which has the potential to be in everyone's interest. Without progress in international cooperation and coordination of policies, the eventual decline in swordfish production of the Western Atlantic is likely within the next decade.

Benefit Distribution

The appropriate distribution of benefits is the most important economic and political issue related to the Eastern Caribbean swordfish fishery. The recent emergence

of a longline swordfish fishery has proven that commercially viable concentrations of swordfish are present in the region. However, the fishery is dominated by foreign operations, and the economic value of the resource does not benefit the region. This section explores some alternatives directed toward a distribution of benefits which are potentially acceptable and mutually beneficial to both U.S. fishing interests and the Eastern Caribbean Nations.

International Legal Aspects

Under Article 56 of UNCLOS III and customary international law, the Island Nations of the Eastern Caribbean have the right to claim "sovereign rights" over the living resources within their EEZ. Swordfish is considered a highly migratory species by definition in the UNCLOS III text; therefore, Article 64 applies. In the Atlantic, the relevant international organization referred to in Article 64 is ICCAT. Since ICCAT has not proposed any management recommendations for swordfish, coastal states within its range are free to adopt any management measures they consider appropriate under the "sovereign rights" granted in Article 56. Even if management recommendations are adopted by ICCAT, none of the independent Eastern Caribbean States are party to the convention. It is also reasonable to believe that without the region's input there would be little incentive to abide by recommendations concluded in part by the

United States, the largest participant in the Eastern Caribbean swordfish fishery.

Article 62 of UNCLOS III is concerned with access to coastal state waters for the harvest of underutilized stocks. Swordfish occurring in the EEZs of the Eastern Caribbean would fit this description because they are presently underutilized by the region's fishermen. Article 62 allows the coastal state to: license foreign vessels; establish fees and other forms of remuneration; and determine conditions of entry. Article 62 also states that coastal state must promote "optimum utilization" by determining its harvesting capacity and granting the surplus of the total allowable catch to other nations (United Nations 1983). Since the local harvest of swordfish is near zero, it is the duty of Eastern Caribbean states to grant access to foreign harvesters. The Caribbean nations have the right to control access of foreign fishing operations within their zones of jurisdiction under both customary international law and the provisions of UNCLOS III. However, it is also the duty of the Eastern Caribbean states to grant access under the objective of "optimum utilization" as stated in the UNCLOS III treaty.

The Role of the OECS

The Organization of Eastern Caribbean States (OECS) is presently taking action on the issue of illegal fishing

within the waters of the OECS nations. All of the OECS nations have declared 200 nm zones of jurisdiction in which they declare rights over the management of living resources, including swordfish (see Table 15). They have also initiated attempts at the harmonization of the legal regime governing foreign fishing access in the region. The relative size and resources of each nation make such a step imperative for management of transboundary stocks such as swordfish. A unified political voice may also have greater impact on negotiations with foreign fishery participants, especially the United States. Negotiation of fishing access terms may also be enhanced because island nations will not be played off against each other. Harmonization of regional fishery law will set a standard which could also work to the advantage of the foreign fishing operation. In this way, laws will be consistent as operations move from zone to zone.

There are definite advantages to a regional approach, but also many questions concerning the degree of management integration and membership in the organization. The OECS membership has geographic limits in relation to the probable range of the swordfish resource in the Eastern Caribbean. The configuration of potential 200-mile jurisdictional zones leads to potential limitations in effectiveness of management. The OECS zones are not contiguous while all zones

TABLE 15

Eastern Caribbean Jurisdictional Claims

<u>Country</u>	<u>Territorial Sea</u>	<u>200 nm zone and year declared</u>	<u>Maritime Boundaries</u>
Anguilla	3 mile	Fishing (1981)	-
Antigua	12 mile	Fishing and EEZ (1982)	undetermined
Barbados	12 mile	EEZ (1978)	undetermined
British Virgin Islands	3 mile	Fishing (1977)	-
Dominica	12 mile	Fishing and EEZ (1981)	undetermined
French Islands	12 mile	EEZ (1977)	-
Grenada	12 mile	EEZ (1978)	undetermined
Montserrat	3 mile	-	-
St. Kitts	12 mile	EEZ	undetermined
St. Lucia	3 mile	EEZ	w/Martinique
St. Vincent	3 mile	EEZ	undetermined
Trinidad and Tobago	12 mile	EEZ	w/Venezuela
U.S.A. terr.	3 mile	EEZ (1976)	w/Venezuela
Venezuela	12 mile	EEZ (1978)	w/U.S./Trin.

- indicates unknown, undetermined maritime boundaries
 indicates that delimitation of EEZs has not taken place

Sources (Edeson and Pulvenis 1983, Ross and Landry 1987)

except Antigua are cut off by other nations' zones before they extend 200 miles in any direction (see Figure 10). The subregional Nauru group of the South Pacific was formed due to common fisheries concerns such as contiguous geographic factors and resource endowments. The origins of the OECS are rooted in economic and political factors related to common characteristics such as to geographic location, colonial past, relatively small size and similar political and development goals. OECS, unlike the Nauru group, was already in existence when the common concern with the swordfish issue surfaced. For this reason, geography and resource endowment played a smaller role, in relation to the current formulation of responses to the problem, than in the case of the Nauru group.

Although there are geographic disadvantages to Caribbean swordfish management carried out through only the OECS states, it must be seen as a positive development. The Nauru group has had a progressive influence on the FFA. Measures such as a regional registry were quickly adopted by the FFA after the Nauru group initiated the practice (Doulman 1987c). Consensus at the subregional level is more easily reached and could be spread on a wider scale as other nations recognize the benefits of such an association. A wider association would give the region greater political leverage with the distant water fishing nations and simplify

management through the standardization of policy over a greater and more contiguous geographic area. However, it would also require a willingness to compromise in areas involving individual state sovereignty, the degree of management integration and the makeup of the management organization. Beyond the OECS, the remaining British territories (the British Virgin Islands and Anguilla) are the most immediate possibilities for expansion. They have common concerns because illegal swordfish longlining is currently suspected in their waters, and permitting of U.S. vessels has been carried out in the BVI fishing zone for the last three seasons. Their fishing zones are relatively large due to their projection into the Atlantic Ocean and contiguous with other OECS states. Their common colonial past and the BVI association with the OECS associate member make this a practical possibility.

Cooperation and coordination of politics with CARICOM could add bargaining power to regional swordfish management. Barbados and Trinidad have contiguous and relatively large zones in the Southern part of the region. Their inclusion would be a significant addition to the potential management area.

The French Islands lie in the middle of the region, separating the Northern OECS nations from those in the south and

isolating Dominica in the middle. Although there are inherent difficulties with their integration due to their association with France, some degree of cooperation would be beneficial due to their location. Their participation during the 1985 WECAFC meeting was positive in relation to views expressed concerning enforcement and regional data collection (WECAFC 1985). Venezuela is another important factor in a regional response due to both the EEZ it projects into the Caribbean Sea, and its developing longline fishery. Venezuelan Aves Island claims cut off the extension of several OECS states' EEZs within the Caribbean Sea. Therefore, negotiation concerning boundary delimitation and fishing rights with Venezuela is an important consideration for the region.

A regional association has the potential of providing greater benefits at less cost than the development of independent institutions. Duplication in the areas of administration, surveillance and enforcement and data collection could be avoided through the development of one regional agency. This would be a great advantage to the Eastern Caribbean states which lack resources and skilled personnel. However, the management organization will rely on the sharing of costs and benefits of resource management in a manner which is acceptable to all parties. Initial problems might involve the strengthening of the organization

as the vehicle through which political compromise can be accomplished for the division of tasks as the region attempts to maximize benefits.

The OECS is fortunate because a regional fisheries unit was recently established on St. Vincent. This OECS institution is acting as an administrative and support center for information collection and dissemination, and a focal point from which policy can be formulated. Subsequent steps in the areas of enforcement, training, and development are either in the planning stage or near implementation. The Canadian government has provided \$250,000 in the first year for the establishment of an enforcement unit (Joseph per. com. 1988). The program will consist of a regional information unit to facilitate communication between member states concerning foreign fishing. Funding will also be utilized for renting light aircraft and vessels from the coast guards of member states for air and sea patrols (Joseph per. com. 1988).

The OECS has several alternatives in respect to: the entry of foreign vessels; the expansion of programs beyond the immediate OECS nations; and the direction of possible local development. The degree of integration, expansion of regional cooperation and eventual success will depend on the mutual gains in benefits among those nations or territories

included. If these gains outweigh the benefits of initiating individual management strategies, then regional cooperation has a chance at success. However, if the region's political entities perceive infringement on sovereignty, high administrative costs or an inequitable division of costs and benefits, then the purpose of the association is lost. One of the greatest potential strengths is the united political stand which could be taken against the outside presence of both foreign fishing operations and their governments. Recent developments indicate that the OECS nations are moving in this direction. The planned political union of the Leeward Islands will almost certainly result in a common program among the OECS members in the southern part of the region (The Daily News 1988). The consolidation of a common fishing zone for the purpose of foreign entry has not been achieved for the coming season, but a harmonized fee structure will go into effect (Joseph per. com. 1988). Although further integration will be required in the future in the areas of enforcement, the common fee structure and political ties, positive steps have been taken.

Further integration of nations outside the OECS is merely speculative at present, but it is an alternative which could be to the region's benefit. The OECS still has a long way to go; however, it is probably the best starting point from which wider regional cooperation and coordination can evolve.

Access Agreements

One of the most promising immediate alternatives is the licensing of foreign vessels wishing to fish in the zones of Eastern Caribbean Nations. The development of a domestic longline fishery would demand capital, skills and access to markets which are beyond the present capabilities of the island states of the region. Therefore, the granting of entry to foreign vessels in exchange for access fees is a strategy by which revenues could be gained by the region's island states. However, there are many factors related to foreign fishing entry which must be examined, such as the best way to maximize revenues, conditions of entry, and enforcement and surveillance.

Regional registry

A regional response is preferable to individual state actions in carrying out a program of this type. It has the advantage of presenting a united front to the distant water fishing nations. A useful regional management practice in the South Pacific has been the establishment of a regional registry. The Eastern Caribbean Nations could utilize this system by requiring that all foreign vessels operating in the region appear on the register. If a vessel is found to be operating illegally, it could be removed from the registry. This would make the vessel ineligible for access to any nation's zone in the region. A vessel could be

returned to the registry only after paying required fines and illustrating that it will comply with conditions of entry in the future. The register would act as a self-regulating strategy for those vessels which value continued access to the fishery.

Access fees

The coastal state can obtain benefits from the resource without extensive domestic development of the fishery through the charging of entry fees. Ideally, these revenues can be utilized to provide an instrument for government to regulate, develop, conserve and generally manage the fishery (Doulman 1987a). The coastal state wants to capture as much of the resource rent as possible, "the return beyond the profits and wages necessary to keep capital and labor employed at normal levels of remuneration" (Copes 1987 ,10). Therefore, the resource rent can be captured through license fees or taxes without endangering the viability of fishing operations (Copes 1987). Fees should be set at levels which capture the vessel operator's willingness to pay which will be determined by his next best alternative, but not so high as to discourage entry into the fishery. Therefore, vessel entry is a mutualistic arrangement under which an optimal number of vessels can maintain adequate returns on capital and labor while the coastal state collects the resource rent.

Fees can be linked to the prevailing prices of swordfish, species composition of landings, type and size of the vessels and the length or number of trips, or all of these factors. The method of fee collection will depend on the amount of information available, the costs of implementing the particular program and the related surveillance and enforcement requirements of the program. Therefore, choosing a method of fee determination and collection will depend on constraints of the Eastern Caribbean nations and the nature of fishing operations.

In 1984, the market value of landings taken by distant water fishing fleets in the South Pacific was \$662.7 million, with total access fees paid to South Pacific countries of \$15 million which is 3% of the total value of landings (Kotobalavu 1987). In Papua New Guinea the operational fee, which makes up the bulk of fee payments, is based on 5% of the fishing ground value of catch (Doulman 1987e). This percentage is equal to the domestic export tax on tuna and designed to extract a financial return to the resource owner (Doulman 1987e).

Under the U.S. government Pacific Islands Treaty, the fee/aid package will represent approximately 9% of the total landed value of tuna taken by U.S. vessels in the region (Kotobalavu 1987). However, these U.S. fees at least in

part reflect the strategic value of the resource or the U.S. government's, as opposed to the tuna fisherman's, willingness to pay. In the case of the Japanese, access fees equal about 4% of total landed value although, if direct fisheries grants are added, this figure is somewhat higher (Kotobalavu 1987).

South Pacific examples are not directly transferable to the Caribbean because of different fishing methods, species composition, and the complex processing and marketing systems present in global tuna markets. However, it illustrates the potential variability of access fees, from 3% to 9% of landed value. The determination of fees is not always based on the economic rent of the resource, but according to convenience, former practices, negotiations or political agreements. This is because the information and skills required to obtain a figure based on economic values are not always available or relevant to the issues surrounding the fishery. However, a foreign vessel or fleet will not normally operate in a fishery if fees are set at levels which result in greater costs than revenues.

The British Virgin Islands is the only case in which entry has been granted for access fees of \$7,000 per vessel annually. In 1986, 13 vessels reported swordfish landings of approximately 400,000 pounds with a 1986 landed value of

approximately \$1.1 million. The \$91,000 paid in access fees was about 8% of landed value. In 1987, two vessels were permitted with landings of nearly 100,000 pounds of swordfish with a 1986 value of approximately \$276,000 (Blok per. com. 1988). The \$14,000 paid in access fees was approximately 5% of landed value. The possible reasons for increased landings in 1987 were better reporting and a good fishing year (Blok per. com. 1988). The value of total benefits also includes the landing of by-catch in the British Virgin Islands free of charge. Its value is difficult to calculate, but the estimated value of over 5,000 pounds of billfish, tuna and sharks landed by two vessels in 1986 was approximately \$7,500. Therefore, the total benefits obtained by the BVI in 1987 may have approached 8% of the total value of swordfish harvested.

The BVI case highlights two questions: By what method and how much do you charge; and how many vessels do you allow to enter the fisheries zone? The BVI case illustrates that by charging a flat fee for entry, the island government is assured of known returns regardless of fishing conditions. However, without a link to the value of swordfish landed, as fishing vessel success increases, the island government will gain a lower percentage in returns in relation to the total value of the harvest. In a bad year the foreign fishermen will be the losers since they pay a corresponding high

percentage for access in relation to the total value of their catch. Therefore, for greater stability and sharing of benefits, it may be in the interest of both parties to relate access fees to the quantity and value of swordfish taken in a season. This might be accomplished through charging a percentage of total landed value.

Cato and Lawlor studied the economics of a 36-foot Florida longline vessel which earned \$142,327 (Cato and Lawlor 1981). After accounting for fixed costs, variable costs and the captain's share, \$16,255 remained - or approximately 12% of the total revenues earned by the boat through swordfish landings. The application of this percentage to the Eastern Caribbean could be deceptive due to a variety of factors. The vessels operating in the Eastern Caribbean are generally larger and make longer trips than a Florida vessel of this type. Therefore, they probably take advantage of greater economies of scale with potentially higher revenues in relation to costs. Swordfish stock characteristics are also different in the Caribbean with different catch rates and greater average carcass sizes. There are also additional or higher costs associated with operation in a foreign region such as repair costs, transport, resupply and fuel. Therefore, it is highly speculative to associate a percentage value with access fees, but given the BVI case and the margin given above, it is likely that 10% of landed value is probably a reasonable starting point.

There are problems in linking access payments to the value of swordfish harvested. Administrative costs might be increased due to information and reporting requirements. The information required to formulate fee structures is complicated by differing resource endowments, stock fluctuations, price volatility and the required economic expertise to carry out the program. Foreign vessel reporting must be truthful and timely. This will put greater demands on personnel and enforcement capabilities to ensure compliance.

In the British Virgin Islands, problems concerned with compliance in the areas of reporting and by-catch landings contributed to their decision to lower the number of vessels licensed to operate in their fishing zone. An improvement in cooperation was illustrated by an increase in by-catch landings per vessel from 10,000 pounds landed by 13 vessels in 1986 to 5,000 pounds landed by two vessels in 1988 (Blok per. com. 1988). Therefore, the number of vessels permitted is in part dependent on practical limits of island state administration and enforcement. It is important to note that the illegal fishing of unlicensed vessels is suspected in BVI waters.

To maximize revenues, it would seem that a given state should allow the entry of as many vessels as possible. The

question then becomes: Assuming development of sufficient enforcement and administrative capabilities, what is the limit on the number of vessels that a given state or region can license? Conventional wisdom would link this question to stock abundance and maximum economic yield. Fishing effort, or the number of vessels, should be set at MEY where the greatest economic rent could be obtained from the foreign fishing vessels. This could be accomplished by setting fees at the difference between costs and revenues at MEY (see Figure 6). At effort levels higher than MEY, the combined costs of access fees and of fishing operations will be greater than total revenues. This will result in vessels leaving the fishery until equilibrium is reached (Copes 1987). This economic approach would: limit the number of vessels in the fishery; maximize coastal state revenues; maintain economic efficiency; and keep rates of exploitation below levels which might contribute to a decline in stocks.

Unfortunately, the use of this model is hampered by the characteristics of fisheries resources. Initial problems involve the large and costly information requirements of this model. The use of already imperfect information is further complicated by constant variations in stock abundances and economic data. Of greatest importance is the character of the highly migratory swordfish resource. Due

to its large range and natural variations in stock abundance, it is unlikely that effort levels in the Eastern Caribbean Nations Region can be fine-tuned to the MEY level. Excessive exploitation levels in any region within swordfish range have the potential to impact stock abundances.

The Eastern Caribbean states have an interest in limiting effort below those levels which would contribute to over-exploitation of the species. However, considering the current lack of cooperation and regulation, one alternative is to permit as many vessels as possible to maximize revenues in the short run. There are also limits to the number of vessels which can operate in a given zone due to the area required to make 40-mile sets and potential gear conflicts. To some degree, the vessel owner's willingness to pay becomes lower as the number of vessels permitted to fish in a given zone increases (Merritt per. com. 1987). Until greater international cooperation can be reached, the setting of the optimal level of fishing effort throughout the species range, including the Caribbean, will not become a factor in its management. This relies on the assumption that it is possible to arrive at an optimal figure, given the difficulties in understanding fish populations and the human activities associated with them. The current management constraints, and potential negative effects, dictate that the best alternative may be to continue to allow entry

near current levels of effort until there is a better understanding of swordfish stocks in the Eastern Caribbean region and throughout the Atlantic range of the species.

The OECS nations recently implemented a uniform fee structure as a first step in attempting to answer these questions. Fees consist of three basic components: a \$25,000 payment for vessel entry for eight months and landings of up to 100,000 pounds of swordfish; payment of 10 cents per pound for landed swordfish; and payment of \$14,000 per vessel for an observer program (Joseph per. com. 1988). Each OECS member is limited to permit only two vessels to operate within its zone. Agreement on the application of uniform fees in the region is a positive development. However, it does not recognize the unique characteristics of individual zones such as size, configuration and resource endowments. Therefore, the value of entry to each zone will be different. This may result in a lack of applications for fishing in those zones which offer less attractive fishing opportunities, or the wandering of vessels into other zones where fishing is more favorable. In addition, the fees may be unrealistically high regardless of the national zone being considered or for the region as a whole. The OECS fisheries unit is still attempting to formulate a strategy, based on a common fisheries zone, which could resolve some of these problems.

In 1986, the value of the U.S. longline landings in the Caribbean was \$5,259,335 for swordfish, \$541,811 for tuna and \$16,394 for billfish, totalling \$5,816,540 (SAFMC 1987). The percentage of landings taken outside the U.S. EEZ is unknown, although it could be substantial in light of BVI landings which were approximately 400,000 pounds in 1986 and the reported interest of longliners in entry to waters adjacent to Grenada (Blok per. com. 1988, Joseph per. com. 1988). If it is assumed that half of U.S. swordfish landings were caught inside other Caribbean Nations' fishing zones, and 10% of the landed value could be paid to the Caribbean nations in access fees, then nearly \$300,000 could be gained in revenues. This figure is only a gross approximation which is given to indicate the order of magnitude of possible revenues, not an actual figure. Total benefits could be higher if by-catch is landed in the island states and other conditions are required of foreign vessels. However, given the configuration and sizes of the OECS 200-mile fishing zones, some vessel owners may reason that OECS entry is not in their interest. Without a doubt, a more wide-spread regional fishing area will be of greater value to the foreign fisherman. Without knowledge of resource concentrations, it is impossible to state where fishing is concentrated and access is most valued.

It is important to realize that in the South Pacific situation revenues are in the tens of millions, whereas in the Eastern Caribbean benefits from the swordfish fishery are not likely to be greater than in the hundreds of thousands of dollars. Potential revenues are important for understanding the relative costs of program implementation. The costs of administration, enforcement, data collection and general management activities could easily outweigh the benefits accrued through fees. Care must be taken to operate within the limits of the fishery and resource.

If a regional strategy is adopted, the allocation of benefits among member states is another important factor. In the case of the United States-South Pacific Islands Treaty, a minimum payment is guaranteed to each FFA member with the rest divided among members according to harvest locations. This is a possible method of dividing revenues among members of the OECS which have different resource endowments and EEZ sizes and configurations. This assumes that an excess will be available after management activities have been undertaken.

Other benefits

The requirement of landing foreign longline by-catch in island nations is another potential benefit for Eastern Caribbean Nations. It produces benefits by providing an

additional source of protein for domestic consumption or, in the case of tuna, a high-valued product for tourist hotels. Initially, longliners cooperated by some degree in local landing of by-catch in the BVI, except in the case of "shack" landed in the USVI and Puerto Rico. Recently the increase in tuna prices, due to fresh U.S. markets and bigeye demand in Japanese markets, has encouraged retention of tuna species. In these cases, island nations must decide which is in their best interest: to obtain greater revenues through linking tuna landings with access fees, or to require the landing of tuna and other species, including perhaps a portion of the swordfish catch.

It may be in their best interest to retain a portion of longliner catch for domestic consumption although, as is the case with access fees, it cannot be so large as to discourage longliner entry. Another problem relates to the case of the U.S. Virgin Islands and Puerto Rico, where by-catch has competed with local fishermen's landings. According to the Fisheries Officer in the British Virgin Islands, by-catch landings had no negative side effects (Blok per. com. 1987). Care must be taken to assimilate the added fishery supply without disruption of traditional markets. Most of the Eastern Caribbean Island Nations are net importers of fisheries products. Therefore, the landing of longliner catch could have potential beneficial effects if planning

and markets are identified in advance. Ultimately, it is up to the specific island nation whether or not longliner landings could have a beneficial effect under site specific conditions. On a wider level, perhaps a portion of longliner catch could be distributed, on a regional basis, to those areas of greatest need through a regional agency such as the OECS or wholesalers. As in the case of the individual island states, careful planning and consideration of the local fishery and markets must be recognized. The OECS plan for the coming season will require the landing of by-catch subject to certain conditions.

Transshipment of longliner catch through Eastern Caribbean Nations is another possibility which could provide employment and improve infrastructure for other fishery exports as the local fishing industry develops. Doulman identified this as one area of potential benefits to the island states of the South Pacific for these reasons. Presently, most swordfish are transshipped through the U.S. territories of Puerto Rico and the U.S. Virgin Islands. "The Law of the Sea Convention (Article 62) permits a coastal state to require DWFN fleets to offload or to transship their catches made in its EEZ at domestic ports" (Doulman 1987d, 304). The landing of catches in domestic ports could also facilitate data collection and enforcement activities. One problem involves U.S. Mercury restrictions of 1.0 ppm.

Swordfish landed in the United States are seldom checked, but imports can be held up in customs or held for a period of time for testing (Kramer 1984). Transshipment to the United States has been reported from Grenada and Curacao (Joseph per. com. 1988), but communication and agreement with Federal Food and Drug Administration procedures should be made before further plans are made in this area.

Another potential benefit which is sometimes linked to or considered as a part of access payments is the provision of development aid by the distant water fishing nation. The general view of South Pacific Nations stressed that access agreements should be a purely financial transaction based on the commercial value of the resource (Doulman 1987e). In many cases, development aid does not produce the desired result because of failure to understand development within the proper environmental, economic, political and cultural context. Development projects initiated by outside interests are sometimes rapidly implemented and inappropriately scaled (Towle 1985). The introduction of inappropriate technologies or development models can result in projects which cannot sustain themselves after the aid is stopped, degrade the environment, break down traditional systems and create a greater dependence on imports. These factors can be magnified by the unique characteristics of small tropical island states such as dependence, insularity and a fragile

environment (Towle 1985). In addition, the motivations and perceptions of the donor nation may be very different than those of the island nation. It should also be noted that a large percentage of total aid budgets are usually spent in the donor nation for personnel, equipment and institutional support. This is not meant to indicate that development aid is inherently evil, but that extreme care should be taken if actual benefits are to accrue from this alternative. The host country needs to carefully study and identify those areas in which development aid can result in benefits that will contribute to the goals of economic development and self-sufficiency.

Conditions of Access

The purpose of setting terms and conditions of foreign fishing vessel access to the Eastern Caribbean Nations fishing zones are similar to those of the South Pacific States. It is meant to: "promote the orderly exploitation of the fishery; minimize administration costs associated with licensing FFVs; and provide a basis for scientific monitoring and management of the fishery" (Doulman 1987e, 22). The main conditions include, but are not limited to: establishment of prohibited areas; license application procedures; reporting requirements; maintenance of catch records; vessel identification; domestic observers; and agents to handle administrative matters (Doulman 1987e).

The island nations may require closed areas to prevent conflicts with domestic fisheries and to protect local fishermen from competition with longliners. In areas where local fishermen target large pelagics in nearshore areas, longliners may have potentially negative impacts. However, closed areas cannot be so extensive as to needlessly complicate or significantly reduce the profitability of fishing operations because this will lower the value of access fees. One possibility is to require additional conditions for foreign fishing within the 12-mile territorial sea where conflicts are most likely to occur. Additional information regarding swordfish concentrations and local fishing patterns are required if the option of closing areas is carried out.

Licensing procedures should be kept as simple as possible to reduce administrative costs and potential conflicts while supplying required information and facilitating communication between parties. One option is to require the assignment of a FFV agent, or agents, in the region to handle licensing arrangements (Doulman 1987e). This could expedite administrative requirements for the FFV owners while reducing administrative costs for the Eastern Caribbean Nations.

If, when a vessel enters the management area, it reports information such as time, position and the amount of fish on

board, this will assist compliance monitoring for the region. Weekly radio reports, which include position and catch, are other possible requirements for vessels operating within the Region's fishing zones. In addition, the maintenance of fishing logs which record time, fishing location, catch and cumulative catch should be required. The completion and timely delivery of logs to regional and national authorities at the conclusion of fishing activities could be a condition for future access. Domestic observers and agents could be used to facilitate this process.

Fishing vessels may also be required to display their radio call signs or international signal letters on the vessel so that they are visible from the air. This could assist identification of vessels by air patrols.

Another condition of entry could include the obligation for foreign fishing vessels to take on observers for compliance monitoring, biological data collection, and possibly training. An onboard observer would be in the unique position of observing fishing operations in areas where the greatest concentration of fishing activity is taking place. This would have the additional benefit of documenting operations of other vessels which may not be registered for operation within the area. The observer could collect data concerned with catch rates, species composition of landings,

and biological data such as sex and size. This information could be helpful for subsequent local development, as well as a valuable contribution to regional and international scientific agencies. The observer could also acquaint himself with technical aspects of the operations such as electronics, hydraulics and strategies used for gear sets. First-hand examination of these operations and supplemental training programs could allow the observer to gain the expertise required for extension programs or to establish his own fishing operation. The first-hand knowledge gained by observers has potential benefits which could range beyond the function of compliance monitoring. The BVI requires observer coverage as a condition of entry to its fishing zone. It has been considered as helpful in gaining a better understanding of the swordfish fishery in the area (Blok per. com. 1987). The new OECS program includes observers as a condition of entry.

The conditions and terms of foreign fishing vessel access will be instrumental in gaining potential benefits from the resource. Administrative requirements should be tailored to minimize costs for the Eastern Caribbean Nations while maximizing benefits. However, requirements should be reasonable to foreign fishing operations in respect to cost and compliability to foster a mutualistic relationship.

Compliance

Foreign fishing vessel compliance through the payment of access fees and observance of access terms and conditions is a necessary ingredient for success in obtaining the benefits associated with resource exploitation. Adequate surveillance and enforcement will be necessary as a deterrent to the violation of regulations or laws (Lepiz and Sutinen 1985).

"The four main modes of fishing surveillance and enforcement include: air patrols; sea patrols; special observers on fishing vessels; and inspection in harbors... . The proper mode of enforcement depends on the available resources, the type of regulations or terms of access and the characteristics of the fishery" (Lepiz and Sutinen 1985, 313).

The behavior and eventual decisions made by fishermen are motivated by their interests in the fishery. Their reaction to a set of regulations will depend on the probability of violating without being detected; the benefits associated with such undetected activities; the probability of being detected, but avoiding sanctions and the benefits associated with it; and the probability of being detected and sanctioned" (Becker 1968).

Each individual considers the probability of being caught and sanctioned against the potential returns which are associated with the illegal activity. It is expected that the fishermen will then compare the value of returns

associated with illegal activity against the value of returns associated with compliance to regulations (Hennessey and Kaiser 1986). If the chances of being caught and sanctioned are very small and the potential benefits are relatively large, fishermen will operate illegally. This has been the case in the Eastern Caribbean where fishermen have operated illegally because there has been a very small probability of being caught. In many Eastern Caribbean zones there was no mechanism in place to permit access although it has been reported that local governments were approached by U.S. fishermen. Given the choice of operating illegally or being excluded entirely, foreign fishermen have generally chosen the latter.

One important factor beyond the cost-benefit approach mentioned above involves whether foreign swordfish fishermen are risk takers or risk adverse. If they are generally risk adverse, some fishermen may follow entry requirements even when the chances of being caught and sanctioned are very small. Goodwill fostered by communication, explanation of island nation policy, attitudes which voice mutual concerns instead of differences and reasonable terms of entry, could help to create a mutualistic, instead of adversary, relationship. Some fishermen have indicated that they would be willing to participate in an entry program if one existed. However, on the other hand, most fishermen may be risk

takers. In this case, greater surveillance and enforcement activities will be necessary to produce an adequate deterrent.

An access program is currently being considered in the Eastern Caribbean. The question now becomes: How can fishermen's behavior be modified to obtain the compliance necessary for program success? According to Stigler, government authorities have the following means to improve compliance: minimize the chances that violations will go undetected; maximize the probability that sanctions will follow the detection of violations; speed up the process from the time of detection to assignment of sanction; make the sanction large (Stigler 1970).

The Eastern Caribbean nations will use some combination of these alternatives to achieve the greatest amount of compliance for the least cost. The high cost associated with the detection of violations through sea and air patrols indicates that concentration on measures 2 through 4 may be more cost effective. Therefore, one alternative is to increase the probability that sanctions will follow violations, sanctions are processed quickly and sanctions will consist of large fines. It should be noted that a very high level of compliance is not necessarily the goal of a cost effective enforcement program (Sutinen and Anderson 1985).

The cost of detecting all or most violations could be greater than the value of the resource.

The following factors will determine the approach Eastern Caribbean nations might take in making detection of violations more likely:

- 1) the available enforcement modes;
- 2) the relative costs of each enforcement mode;
- 3) and the relative effectiveness of each enforcement mode.

The principle which must be recognized by Eastern Caribbean Island Nations is that the marginal benefits must exceed the marginal costs of added units of enforcement capability.

The most important and likely violations are foreign vessel entry to the region without payment of access fees and under-reporting of catch if fees are linked to the value of landings.

A combination of all four enforcement modes can be effective in curtailing this type of activity. Air patrols are effective in locating concentrations of fishing vessels and tracking their movements (Lepiz and Sutinen 1985). This can be valuable information for surface patrols which can follow up on air patrol reports. The use of a large aircraft for

this purpose was too costly according to French experiences in the region (WECAFC 1985). Small commercial aircraft or commercial flights might be a more cost effective alternative, although it is likely that the benefits from present swordfish fishery alone are insufficient for regular operations. Sea surface patrols are necessary as an actual deterrent to violations on the fishing grounds. This is accomplished through actions such as boarding and inspection of vessel holds, logs and radio reports (Lepiz and Sutinen 1985). Although this mode of enforcement is effective, it is also potentially expensive. Additional capital outlay for more vessels is probably inappropriate considering the limited resources of the region's island states. Therefore, the complementary use of existing air and sea patrols through cooperation with coast guards and police may be the best alternative until a more reasonable estimate of the fishery's value can be calculated. The recent Canadian funding for the establishment of an enforcement unit will be used for this purpose.

The placement of observers on at least a percentage of vessels operating in fishing zones or the management area could be an important deterrent to underlogging. An observer program can be an expensive alternative when administration, salaries and training are included. There is also some apprehension on the part of the Eastern

Caribbean Nations concerning observer treatment and onboard conditions. The use of a combination of air patrols, sea patrols and observers could reduce the cost of any one enforcement component. If concentrations of fishing effort can be followed by observer reports and occasional air patrols, then sea surface patrols could be used with the greatest potential impact. Instead of spending long periods of time on the fishing grounds, sea surface patrols could be used only in the case of strongly suspected violations. Sanctions will be another benefit which could then be used to help finance operations.

Harbor inspection is probably the mode of the least cost although it will usually be effective for those vessels complying with conditions of entry. It could still be useful for calculating landings and biological data, especially if vessels are required to land catches to be transshipped from eastern Caribbean terminals.

Probably the two most important factors concerned with enforcement relate to keeping costs down while using all available resources in the most effective manner through regional cooperation. Air patrols, sea patrols and observers will work best if they are used on a regional basis where costs are spread out among member states. Another important area which must accompany this cooperation

involves the harmonization of legal requirements concerned with conditions of entry. Perhaps the best alternative to improve compliance is the development of a regional registry.

The U.S. Factor

The Eastern Caribbean swordfish fishery is dominated by the United States both in respect to landings and markets. Access agreements in the near future will depend primarily on negotiations with U.S. entities. The Eastern Caribbean Island Nations can negotiate directly with the U.S. government, the private sector or some combination. The South Pacific Island States-United States Fisheries Treaty indicates that U.S. government cooperation can be a valuable asset for the maximization of benefits.

In the South Pacific case, a major complicating factor involved the U.S. legal stance concerning tuna jurisdiction. The U.S. claimed that the coastal state should not have authority over tuna resources because their highly migratory character required an international management strategy. Although this principle of HMS management is widely accepted, the U.S. legal view was actually related to the political pressure of west coast tuna interests. The ATA wanted continued access to tuna stocks within other nations' EEZs. Swordfish are also considered a HMS, but the U.S.

legal definition does not include them in this category (Wade 1986). Unlike the case of tuna, the bulk of U.S. swordfish landings originated within the U.S. EEZ when the MFCMA was drafted. United States law recognizes the right of the coastal state to carry out management authority over swordfish. Recent developments in the South Pacific indicate that the United States can also recognize coastal state authority over tuna within the coastal state EEZ when it is in the interest of U.S. policy, even when it is in conflict with U.S. law. Therefore, Eastern Caribbean jurisdiction over the region's swordfish fishery and growing tuna fishery can be recognized by the United States, and U.S. access to it is negotiable because of the precedent established in the South Pacific.

A United States-Eastern Caribbean Nations Treaty, modeled to some degree after the South Pacific Treaty, has the potential to be mutually beneficial. The potential benefits to be gained through government negotiations were realized in the South Pacific where U.S. access fees rose from 4% of landed value to 9% after the treaty. It is likely that when strategic concerns are recognized by the United States, higher returns can be obtained through government negotiation than through dealing with individual companies and fishermen. A treaty could also shift a portion of compliance and enforcement responsibility to the United States.

The enforcement of the Lacey Act could assist in the sanctioning of violators who have returned to U.S. waters. Guaranteed U.S. cooperation in following up suspected and documented violations would also be a less costly method of improving compliance in the waters of the Eastern Caribbean Nations.

The United States would benefit in several areas if a treaty could be drafted. It would guarantee access for U.S. fishermen to fishing grounds during a period in which expansion of swordfish operations is essential for continued industry health. Continued access provides the benefits of employment and a greater supply of swordfish destined for U.S. markets. Because the bulk of swordfish consumed in the United States is imported, the maintenance and growth of U.S. production in the Caribbean should be seen as a positive development. Other national fleets from Venezuela and Spain, which may be lower cost producers, may be able to outbid the U.S. for access in the future. Therefore, it could benefit U.S. fishermen to deal fairly for protection of their future interests in access.

Perhaps the most important benefit which could result from U.S. cooperation is not directly related to fisheries. The Caribbean is often viewed as strategic to U.S. security interests. The U.S. projection of power in the case of

Grenada and development assistance and terms of trade associated with the Caribbean Basin Initiative are two examples which illustrate the willingness of the United States to act according to its perceived strategic concerns. In 1982 on the floor of the House while discussing the Pacific Islands situation, Congressman Paul McCoskey indicated that the Pacific Islands Region is just as important as the waters of the Caribbean (Tsamenyi 1986). It is unfortunate that these concerns have not translated into greater understanding and respect for the Eastern Caribbean States as independent national entities instead of satellite appendages.

The recent intrusion of U.S. draggers into the Canadian portion of George's Bank has become a problem area. A recent incident involving the New Bedford-based "Donna Lynn" has resulted in a NOAA General Council's Office review of the evidence for possible civil violations under the Lacey Act (Dennison 1988). Unlike the Caribbean, there is greater respect for Canada due to its greater enforcement capabilities and relative importance to U.S. relations. This incident indicates that prosecution under the Lacey Act is possible in the Eastern Caribbean, if communication and cooperation exist between the relevant government officials. Illegal U.S. swordfish fishing is not a problem in Canadian waters, although many U.S. longline vessels operate adjacent to them.

The problem of illegal swordfish fishing is a situation in which the U.S. is in the position to promote goodwill by respecting the rights of the region's nations under the norms of international ocean law. Therefore, a fisheries treaty would have the value of strengthening positive relationships with the Eastern Caribbean. Both sides could benefit from the understanding that mutual respect is the key to the proper management and exploitation of the fishery, and better international relations. This serves the strategic interests of the United States government better than a fisheries policy currently based on neglect.

Local Development of a Swordfish Fishery

The Eastern Caribbean Nations currently exist under constraints which make development of a swordfish longline fishery difficult at best. As King noted in the South Pacific case, "A nation's proximity to major fishing grounds is only one of the factors influencing its competitive position in the industry" (King 1987, 280). The major problem areas include the lack of capital, expertise, trained fishermen and marketing infrastructure.

The swordfish fishery is a potentially risky and expensive commercial proposition, especially in the case of developing countries with scarce resources. Fishing operations require vessels, equipment and fuel which must be imported. There

is a danger that the greater import and capital requirements of development in this sector could lead to greater dependency rather than self-sufficiency (King 1987). Swordfish longlining is not a traditional activity of local fishermen. New skills associated with the use of longline equipment and finding fish mean that initial operations will work at a disadvantage. Local fishermen may also object to extended periods at sea which they do not encounter in the inshore fishery.

There are positive aspects associated with local development such as employment, local supplies of fish products, and potential foreign exchange earned from exports. Although these factors make local development attractive, they should be weighed carefully against the cost of undertaking this type of program.

In reality, development is not an all or nothing proposition. It is the type of program which must take place over years, or perhaps decades. The time to start is the present - by recognizing constraints, identifying achievable goals, carrying out cost-benefit analyses and perhaps initiating pilot projects. Effective extension targeted on progressive local fishermen with the adaptation of small-scale techniques could be the first step. Methods and equipment which are available locally may minimize import and foreign

exchange requirements. Since the shelf edge is relatively close when compared to fishing grounds such as the Grand Banks, smaller vessels might be employed. Local development must be a steady and methodical process. In this way, mistakes can be turned into learning experiences without catastrophic results related to expending too much capital and resources too rapidly. The local sector can also learn valuable information from the current foreign fishery such as location, size and economic value of the resource.

Local development is an attractive alternative although, given the current constraints of the region's fisheries operations, it is difficult if not impossible in the short run. However, in the long run, it has the potential to provide greater benefits and control over the region's destiny. A long-term program with this objective might include characteristics such as: relatively small but steady annual expenditure; extension concerned with cooperation and coordination with progressive local fishermen; and the steady development of a data base concerned with resource characteristics. International development agencies could have a role to play in this development by recognizing that it requires a long-term commitment of decades rather than years and small but steady revenue requirements.

Joint ventures are often mentioned as a vehicle by which foreign expertise, technology and capital can be employed to stimulate development, while profits are shared by the resource adjacent and distant water fishing nation. Joint ventures can work, but the proper balance must be met on both sides. This is a difficult proposition given that each side's motivations for joint venture establishment are usually different. A joint venture agreement is only as good as the planning and communication between the two parties. Possibilities under joint venture agreements include transshipment facilities, by-catch or a portion of swordfish landed in the island nations, and access fee payments. Further cooperation in profit-sharing and local development are possible, but careful future study and negotiation will be required.

Economic Efficiency

Economic efficiency is of concern to the Eastern Caribbean Island Nations because greater economic rents mean that greater access fees may be charged without endangering the viability of foreign operations. However, a great amount of information and expertise is required to fine-tune a fishery to an optimal stock abundance level. This assumes that it is possible to gain a high degree of understanding of stocks and that cooperation between participants for the required effort limitations can be achieved. The utilization of a

strategy based on transferable national quotas could satisfy the goal of economic efficiency. However, the cooperation required for implementation of this type of program is most likely impossible given the present lack of international management of swordfish in the Western Atlantic.

One factor within the control of the Eastern Caribbean Nations involves the entry of lower, or lowest, cost producers. In the future, it is possible that nations such as Venezuela and Spain could enter the region's swordfish fishery. If their costs of production are lower than those of the U.S. producers, then potentially higher access fees might be obtained by the Eastern Caribbean Island Nations. In the future, the region could attempt to gain the highest possible market value of its resource, perhaps through competitive bidding between fishing nations.

Local development may also be a factor in relation to the level of economic efficiency. As a local fleet develops, other factors such as employment and local consumption may become more important than profit maximization. This is a difficult trade-off with potential dangers such as eventual over-capitalization and state subsidies which become a permanent fixture within the local industry. Nations of the region may also grant preferential treatment for access throughout the region to those regional nations which are

developing swordfish fishing operations. This would increase the chances of success of local operations as they follow swordfish concentrations regardless of national boundaries.

Multi-species Character of the Fishery

As mentioned in the case of Puerto Rico and the U.S. Virgin Islands, there is concern over impacts of longlining on species caught incidentally, especially other billfish species such as marlin. The growth of the recreational fishing industry and its possible benefits to the Eastern Caribbean Nations could be an important consideration for future regional policies. In the British Virgin Islands, billfish tournaments have already become a segment of the tourist industry. The Eastern Caribbean Nations must decide whether the resource is of greater value as food or as a recreational species in the future. It is beyond the scope of this report to speculate on the potential benefits and costs of recreational and commercial utilization of the resource. However, it should be recognized that, unlike commercial fisheries, the actual value of the recreational resource cannot be measured by market values. Although expenditures of recreational fishermen can indicate its importance, the actual willingness of the recreational fisherman to pay should be measured by non-market values. Various techniques of economic measurement and actions taken

by the United States might be an indicator of the potential importance of recreational fisheries. The U.S. Billfish Management Plan will prohibit the commercial sale of billfish and implement size restrictions (SAFMC 1987). The Eastern Caribbean Nations will have to consider the implications of billfish exploitation in the region and the future importance of the species.

Further Considerations

It is apparent that the five major categories treated above are interrelated. For example, benefit distribution through foreign fishing access and local development or joint ventures have direct effects on each other and future developments. Stock abundance will affect the level of access fees and benefits associated with local development. These interactions must be recognized as the Eastern Caribbean develops policies to manage the swordfish fishery.

This chapter examined some of the alternatives which are available to the Eastern Caribbean states. The Eastern Caribbean swordfish fishery is still filled with uncertainty in respect to biological, economic and social characteristics. All of these areas deserve greater attention as the management process moves forward. Hopefully this chapter has highlighted some of the important questions which must be answered as the management process evolves.

CHAPTER VIII

CONCLUSION AND RECOMMENDATIONS

Background

The Caribbean Situation

The swordfish fishery is one of the newest and most controversial fisheries of the Eastern Caribbean Region. The Eastern Caribbean Region, as referred to in this paper, includes the island nations of the Lesser Antilles including their respective zones of ocean jurisdiction, extending from Puerto Rico to Venezuela.

During the early 1980s, the Eastern Caribbean swordfish fishery was initiated by longline vessels owned by U.S. companies or individuals. Rising U.S. demand encouraged longliners to expand fishing operations beyond traditional fishing grounds near the United States mainland. Swordfish landings reported for the United States Caribbean Management Region in 1986 were nearly two million pounds, with a landed value of approximately \$5.5 million (South Atlantic Fisheries Council 1987). This was approximately one-quarter of U.S. domestic swordfish landings in 1986. The sudden influx of foreign participants and technology have resulted in a number of disputes and associated policy issues.

The central problem hinges on two interrelated matters involving international cooperation. Immediate concerns focus on the distribution of benefits derived from resource exploitation between foreign participants and resource adjacent island states. Meanwhile, the absence of a regulatory strategy directed toward stock management through the range of the swordfish resource is a concern of all interested parties for conservation and maximization of benefits in the future.

The island nations of the Eastern Caribbean are characterized by: small size; developing economies; limited resource bases; negative trade balances; and a history of external dominance and influences. The United Nations Convention on the Law of the Sea and accepted nation state practice under customary international law resulted in the expansion of their zones of ocean jurisdiction. The region's island nations believe that the utilization of the resources of this zone is one strategy by which they can further their goal of economic development and self-sufficiency. Although fisheries resources are limited in the region due to physical and biological factors, they have the potential to contribute to this goal. However, development of the swordfish fishery depends on technology, expertise and capital which are beyond the present capabilities of Eastern

Caribbean Island Nations. Fisheries operations of the region are characterized by artisanal fishermen who employ traditional fishing strategies.

Swordfish is a high valued product with growing demand in the United States. The bulk of Western Atlantic swordfish is landed by U.S. longliners operating from the Grand Banks to the Caribbean. Although swordfish were known to exist in the Caribbean, the first fishing efforts which indicated that they occur in commercially viable concentrations in the Caribbean were made by U.S. longliners. In the mid-1980s, U.S. longliners expanded beyond the EEZs which surround the territories of Puerto Rico and the U.S. Virgin Islands to the fishing zones of the region's island nations. This expansion of fishing operations beyond the U.S. EEZ is illegal. However, due to the lack of resources to carry out enforcement and the absence of a unified regional management plan, fishing has continued with little opposition. The OECS is initiating action based on a regional enforcement unit and uniform access fees. However, this is only the first step which is required for the region to gain a greater share of the benefits associated with exploitation of the swordfish resource.

Problem Investigation Findings and Constraints

Swordfish stocks

The status of swordfish stocks in the Western Atlantic is a very controversial subject among both fisheries managers and resource users. There is general agreement that growth over fishing is indicated by smaller average carcass size; but recruitment overfishing, evidenced by poor recruitment due to a decline in spawning stock biomass, has not yet occurred. The controversy centers around whether recruitment overfishing will occur in the near future if at all. Over-exploitation and a decline in stocks are possible due to the expansion of fishing operations and increased effort. However, in the U.S. case, no agreement can be reached on how conservation could be achieved through regulation. The inherent uncertainties associated with understanding the biology and population dynamics of swordfish leaves no definitive answers in respect to stock condition.

In both the Eastern Caribbean and the Western Atlantic in general, management is further complicated by the huge range of the species which includes nearly all of the national zones of jurisdiction of the Western Atlantic and adjacent high seas areas. The use of basic fisheries management principles involving stock and bioeconomic models are confounded by the transboundary character of the highly migratory swordfish resource. The stock cannot be managed

without cooperation and coordination of national policies of all concerned states. In order to initiate the management process based on our current knowledge of fish stock behavior and exploitation patterns, agreement must be reached on a legal regime which can foster international cooperation.

Management institutions

In the Atlantic, the International Convention for the Conservation of Atlantic Tunas is the relevant scientific institution for the international management of stocks such as swordfish. ICCAT is an important organization for the collection of scientific data, but its effectiveness in the management of stocks is questionable. It is constrained by funding and the capability to gain concensus and enforcement for management recommendations.

The Organization of Eastern Caribbean States is a sub-regional organization made up of the Lesser Antilles Island States which were former British possessions. The use of this association as a united front in dealing with foreign fishing operations is a positive development in gaining an acceptable distribution of benefits from resource exploitation. However, the size and configuration of their zones of ocean jurisdiction limit their potential effectiveness as a regional management agency.

International legal aspects

Under the United Nations Convention on the Law of the Sea and customary international ocean law, the coastal state has gained the right to manage and conserve the living resources adjacent to it. These rights were established by state practice in the 1970s through the declaration of 200-mile zones of extended ocean jurisdiction. Although the LOS Treaty included several articles concerned with the management of the living resources, including a special provision related to highly migratory species, it was not explicit in relation to specific management requirements. Especially in the case of highly migratory species, this has left the subject of international cooperation and stock management open to evolving international norms defined by state practices and international treaties.

Management in the Pacific Islands Region

In the South Pacific, a regional approach has been taken for the management of the Region's tuna fisheries. The South Pacific case is important in illustrating the gains which can be made through regional cooperation and coordination of policies. This has been accomplished through access agreements with foreign fishing nations culminating in the Pacific Island Nations-United States Treaty. Regional entities such as the Fisheries Forum Agency and the Nauru Group are the first step toward building the institutions

which will be instrumental for future management challenges. The underlying ingredients of a highly migratory resource, developing resource adjacent island nations without sufficient harvesting capacity and foreign fishing nations are common to both the South Pacific and Eastern Caribbean Regions. Although differences in resource type and endowments, jurisdictional zone sizes and configuration, and history and culture are apparent, the South Pacific Region has relevance to the Eastern Caribbean situation. Areas of particular applicability to the Eastern Caribbean include: Conditions of access such as reporting, observers, agents and vessel identification requirements; the charging of operational or access fees; compliance and enforcement especially in the establishment of a vessel registry; regional unity in dealing with distant water fishing fleets; and the Pacific Islands Nations-United States Treaty. Perhaps the factor of greatest importance involves the major participant in both regions, the United States. In both the Eastern Caribbean and South Pacific Islands Regions, the United States has strategic interests which may be of greater national concern than fisheries issues.

Principles of fisheries management related to biology, economics and international law are integrated with experiences in the South Pacific to formulate management alternatives for the Eastern Caribbean Region embodied in the recommendations given below.

Recommendations

The following recommendations are a set of alternatives which the region's states may use as the management process moves forward. This list is not all inclusive, but should be seen as a starting point or reference material from which more detailed work can evolve. As more information becomes available and a regional unit takes a more definitive shape, these recommendations may be incorporated or discarded. Hopefully, they will at least encourage discussion as the Eastern Caribbean Island Nations decide the direction management of highly migratory pelagics should take.

Conservation of Stocks

The nations of the Eastern Caribbean Region probably have little control over swordfish stock abundance due to the species' wide range. However, the Eastern Caribbean Region can respond to conservation concerns through ICCAT and WECAFC as a united entity. This could be a step toward the international cooperation which is required for future conservation efforts. Exploitation levels in the region and biological information are important pieces of the puzzle as scientists try to gain a better understanding of swordfish stocks. The Eastern Caribbean Region could demonstrate that it is an essential component of any future international management strategy.

Specific areas where research could be carried out include: the reporting of effort and landing levels in the region; a tagging program carried out by local observers in cooperation with ICCAT; standardization of data reporting; the reporting of other biological data such as length, sex and by-catch data. Funding for adequate training of personnel, administration and salaries will be a problem especially in light of ICCAT funding limitations. One potential source is the United States due to the importance of the fishery in that country. Another possibility which could cut costs involves reporting requirements for foreign vessel entry. Unlike the U.S. domestic fishery, some of the basic effort and landings data could be maintained on a stricter basis as a condition of entry.

The future conservation of stocks will require more data, international cooperation and the eventual coordination of national policies throughout the swordfish species range. The Eastern Caribbean Region should work as a united entity in order to gain a larger voice in the eventual direction of swordfish and other commercially important highly migratory species management in the Atlantic.

Benefit Distribution

In order to gain a share of the benefits which accrue from swordfish exploitation, the nations of the Eastern Caribbean

may grant access to foreign fishing vessels. Access can be granted under certain conditions including the payment of fees.

In the future, cooperation between Eastern Caribbean States should stretch beyond the current OECS membership. This would provide greater leverage in dealing with foreign fishing nations and greater benefits. I would allow for a larger contiguous zone of ocean jurisdiction in which legal aspects of fishing could be harmonized to some degree. However, there is also a danger of over-extending too fast, especially in the case of the smaller island states of the OECS. The larger island nations of CARICOM and the French possessions could overshadow the collective voices of OECS in negotiations with distant water fishing nations. The key may be gradual integration on the subregional level in key areas such as a regional registry. The future goal of legal harmonization on a regional level will evolve as individual island states recognize the benefits of greater and equitable cooperation. The OECS nation's first goal must be a greater degree of integration related to a common fishing zone and harmonization of legal aspects of the foreign fishery.

Foreign vessels wishing to fish in Eastern Caribbean waters should be charged access fees. Fees may be based on a

variety of factors such as vessel size, amount and value of landings, time periods of operation or a combination of all of the above. The payment method which is chosen should be cost effective, relatively simple to enforce and fair to both the island states and fishing concerns. Perhaps the fairest method is to link access fees to the value of landings if reasonable levels of compliance in reporting can be attained.

To control vessels which have been granted access to island nation jurisdictional zones, certain terms and conditions should be required of the foreign fishing operations. These conditions should aid in administration, enforcement and information collection, but not become so cumbersome that they unreasonably restrict fishing operations. Terms and conditions involve the following: the use of observers; reporting requirements; vessel identification requirements; agents; and administrative procedures.

Surveillance and enforcement will be required to achieve an acceptable level of compliance among vessels given access. The four main enforcement modes include: surface patrols; air patrols; observers; and dock inspections. Another important technique which may be both inexpensive and effective is the maintenance of a regional registry of vessels allowed to operate in the region. If a vessel

violates agreements related to access, it could be withdrawn from the registry. This could be effective for those vessels which value continued access to the region's resources. The four modes of enforcement are generally complimentary to each other. Therefore, the Eastern Caribbean nations will want to use the combination which will result in the greatest compliance at the least cost. Enforcement modes such as air and surface patrols will be of greatest importance in respect to illegal entry of unregistered vessels. However, these modes of enforcement are also the most expensive and the development of greater potential in these areas must be balanced against potential benefits. Observers and dock inspections will be important for the accurate reporting of total landings.

In addition to the use of enforcement to improve compliance, other factors can influence a fisherman's behavior. The level or size of sanctions, time between apprehension and sanctioning and the probability of actually applying sanctions in addition to the probability of being caught will affect fishermen's attitudes toward breaking the law. The Eastern Caribbean Nations may want to set strict standards in these areas, such as high fines, to influence fishermen to act within the law.

As the Eastern Caribbean nations endeavor to derive benefits from their pelagic resources through access agreements, it must be stressed that a basic goal must be the minimization of costs. The value of the swordfish fishery alone is not sufficient for capital investments in equipment and significant additions in personnel. The challenge will be to create as much revenue as possible with the resources currently available.

Direct government negotiation of a treaty between the U.S. and the Eastern Caribbean Nations is one type of agreement alternative. The treaty could define terms and conditions of access, set access fees, and define responsibilities of participating governments. This could result in benefits for the island nations such as higher fees and a U.S. government role in assuring compliance of U.S. vessels. The U.S. would gain guarantees of access for its growing long-line fleet. Perhaps of greatest interest to the United States, a treaty perceived as fair by the region's nations would result in political goodwill and potential cooperation and communication involving other sectors. This would indirectly, yet effectively, benefit U.S. strategic interests in the region.

Both the Eastern Caribbean Island States and U.S. fishing interests can gain benefits through access agreements.

However, the proper balance must be attained to allow both sides adequate returns to continue participation in the program. Common concerns and needs must be stressed to create a mutually beneficial rather than adversary relationship.

Other Areas of Concern

Local development of a swordfish longline fishery is not currently feasible in the Eastern Caribbean due to technical, economic and institutional constraints. It is debatable whether development in this sector will result in tangible benefits due to import, infrastructural and skill requirements of swordfish fishery development. However, a local longline fishery could provide foreign exchange from exports, fish for local consumption and employment. The author feels that the region should begin to work in this direction through information collection, planning and research of strategies by which development can proceed. Although progress may be slow, possibly better measured in decades instead of years, it is questionable whether the region can further the goals of self-sufficiency and economic development unless local development is attempted.

Joint ventures are a commercial strategy or agreement made between the resource adjacent state and foreign fishing nation. Although a joint venture can promote local

development, the history of this type of agreement is patchy. The motivations of each partner may be quite different resulting in different expectations regarding the agreement. Joint ventures are potential vehicles of local development, yet their value to both partners is only as good as the communication between them and the agreement on which the operation is based.

The incidental by-catch of other pelagic stocks can have impacts on local markets and recreational fisheries. If an agreement specifies that incidental by-catch should be marketed locally, care should be taken to avoid potential detrimental effects on the markets of local fishermen. The recreational fishery for large pelagics may have greater future value than utilization through commercial landings. These species, such as marlins and other billfish, may deserve special regulations such as size limits or prohibitions on commercial sales.

Further information will be required in all areas on an ongoing basis. Current emphasis is required in: biological studies such as tagging and better effort and landings data to gain a better understanding of species distribution in both the Atlantic and Caribbean; economic studies to achieve greater efficiency in determination of access fees, enforcement levels and modes and overall access program

costs; and the continued study of a regional legal regime which is both reasonable to all resource users and flexible for adjustment to changing conditions. Studies and data collection are limited by funding constraints yet any progress toward the building of a data base is important to subsequent development.

Summary

The two major management goals of the Eastern Caribbean island nations involve resource conservation and the distribution of benefits accruing from resource exploitation.

The Eastern Caribbean will be an important component of any international management regime for swordfish due to its geographic placement and resource endowments. The conservation of highly migratory species such as swordfish is a difficult proposition because it requires a large degree of international cooperation and political compromise. The region's nations will need to participate in international organizations such as ICCAT. They must present a unified voice for the region during these discussions in order to gain some degree of balance with larger and more powerful participants such as the United States. International management of the species is a continuous long-term process in which the Eastern Caribbean nations must become participants.

The issues concerning benefit distribution can be dealt with in both the short and long term. The region's island nations do not have the resources to exploit the swordfish resource themselves. However, they can allow the entry of foreign vessels to their zones of national jurisdiction in exchange for fees. Foreign vessel entry could be allowed under conditions or terms which help to guarantee compliance and program administration for the least cost. There is an inherent danger of program cost escalation which could easily outweigh revenues gained through fees. It should be recognized that perfect compliance, large data collection requirements and large increases in fisheries personnel are not necessarily the goals of the program. The program should maximize revenues which can be used to manage the marine environment. Finally, the island nations must work together to achieve these management and development goals. Common regional conditions of foreign vessel entry are essential to maximize economic returns from the fishery. A unified regional response will also give the Eastern Caribbean Island States greater leverage in negotiations with other nations, especially the United States. Perhaps of greatest importance, political aspects of the relationship far removed from fisheries can have important consequences which are directly related to the terms of fishery agreements.

Applicability Beyond the Swordfish Fishery

Technical advances in the fisheries harvesting sector have outpaced the development of the social and political cooperation required to manage world fisheries stocks. The extension of coastal state jurisdiction embodied in the Law of the Sea Treaty has been a step toward greater management control on a national level. However, many fishery stocks range beyond and between national zones of jurisdiction requiring cooperation and coordination of management policies on an international level. These requirements are especially important in the case of highly migratory stocks.

In addition to swordfish, other highly migratory stocks such as tunas and billfish pass through the waters of the Eastern Caribbean. These species are exploited by wide-ranging fleets of Korea and Taiwan. It is suspected that these fleets also operate at times within the jurisdictional zones of the Eastern Caribbean Nations. The institutions and regional cooperation developed to control the swordfish fishery may be utilized to obtain benefits from these fisheries. As in the case of swordfish, greater cooperation is required between the resource adjacent and distant water fishing nations to ensure that conservation and appropriate benefit distribution can be achieved.

Regional cooperation has been strengthened by the perceived threat of U.S. operations within the region. This cooperation can be built on for management of the region's transboundary pelagic stocks such as flying fish and dolphin fish. The OECS fisheries unit has great potential in developing a data base for regional fisheries. In the future, its demonstrated value might be built upon for the greater Caribbean region through integration with CARICOM and the French islands. The collection and dissemination of information and management initiatives will have great value for the future development of the region's fisheries.

The potential demonstrated benefits of regional responses to fisheries management problems have relevance to regions in other parts of the world. Transboundary stocks are a common feature of most of the world's fisheries. As effort levels increase beyond the carrying capacity of stocks, participating nations will continue to learn that objectives such as the maintenance of stocks at high levels are dependent on international cooperation. The appropriate distribution of benefits between the resource adjacent nations and foreign fishing fleets is an objective which is being worked toward throughout the world. Many developing coastal states which lack the capacity to exploit the stocks of their EEZs allow distance water fishing fleets to enter their zones to harvest the resource surplus. Strategies concerned with

access fees, conditions of entry, compliance and bilateral and multilateral treaties will continue to evolve.

Therefore, management responses in each region have the capacity to be instructive through the evaluation of successes and failures.

It is also important to recognize that cooperation in fisheries can involve issues and result in benefits which involve areas far removed from the sector. As in the case of the South Pacific and potentially the Eastern Caribbean, common concerns must be built upon to achieve mutually beneficial relationships which are in the interest of all concerned nations. Martin Belsky stated that "constraints on total ecosystem management are not legal, but rather political" (Belsky 1985, 763). It might be added that constraints are also not strictly biological or economic. They are dependent on the ability of the world's nation states to understand that political solutions must be sought as man's technical ability to affect not only fisheries resources, but the entire planet, continues to increase.

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