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REVIEW OF POLLUTION IN THE CARIBBEAN REGION IN RELATION TO MARINE ARTISANAL FISHERIES

Summary

The most serious pollutant in the Caribbean region is oil, with 6.7 percent of the offshore production being spilled into the sea through blowouts, overflows, pipeline accidents and malfunctions. Next range domestic sewage, agricultural wastes and industrial effluents. The region has a high potential for coastal aquaculture, and artisanal fisheries are of great importance, both being closely linked to coral, algal, sea grass and mangrove habitats. It is these ecosystems that are mainly threatened by marine pollution and other human activities such as land reclamation. Studies should be undertaken to estimate the socio-economic impact of oil spills on artisanal fisheries and to ascertain the importance of coastal ecosystems such as mangrove swamps for the maintenance of coastal fish stocks.

W/M 1447

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1. INTRODUCTION

Since the 1954 International Convention for the Prevention of Pollution of the Sea by Oil several amendments, various other conventions and further measures have been taken to prevent and fight aquatic pollution as a result of increased public concern about the conservation and rational utilization of the environment. In December 1970 at the FAO Technical Conference on Marine Pollution and its Effects on Living Resources and Fishing, regional pollution problems were highlighted and major threats to the environment identified. Since then, additional emphasis has been put on joint efforts to tackle these problems on a national, as well as regional, basis.

The IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions, held in December 1976 in Port of Spain, Trinidad and Tobago, attempted to sketch the state of marine pollution in the area, identify the major problems and pave the way to embark on in-depth studies of various aspects of pollution. This should then lead to efficient control measures.

2. THE REGION AND ITS HYDROGRAPHY

For the purpose of this overview, the coastal and open waters of the Caribbean Sea proper, the Gulf of Mexico and the adjacent waters of the Atlantic Ocean lapping the Bahamas and the Antillan Archipelago, are considered as pertaining to the Wider Caribbean Region.

It is a semi-enclosed body of water encompassing various basins separated by major sills (Figure 1). The deepest point, 7 100 m, is in the Cayman Trench, its depth averaging approximately 2 200 m. The total sea surface of the area is 4.31×10^6 km^2; the total volume of the water is 9.37×10^6 km^3.

A brief outline of the hydrographic regime in the area has been given in the supplement of the report of the IOC/FAO/UNEP International Workshop on Marine Pollution in the Caribbean and Adjacent Regions (Unesco, 1977a) as follows:

"The most striking hydrographic feature in the region is the continuous flow of water through the area from east to west in the Caribbean Sea proper, followed by a movement from southeast to northeast in the Yucatan Basin and, finally, in the Gulf of Mexico, a strong flow to east again through the Straits of Florida, after an anticyclonic movement of most of this water in the western area of the Gulf.

"Approximately 3.0×10^7 m^3 of water per second [9.4×10^{17} l/year] pass through the various passages between the islands of the Lesser Antilles, transported to them by the combined equatorial currents. The general movement of this water, which is stable all the year round, although some seasonal changes can be found in the velocities, is shown schematically in Figure 3 (Figure 2), in which an area of continuous flow is indicated by a dotted line. The velocities given are mean velocities during the year. Seasonal changes can be expected however, and much higher velocities will be found, especially where the water is forced through narrow passages, such as the Yucatan Channel or the Straits of Florida; velocities up to 3.5 and 4.5 kn, respectively, are observed in the current core in these two areas.

"Outside the dotted line, currents are weaker and also unstable. During certain months largest vortices are formed off the coast of Costa Rica, Panama and Colombia and, similarly, in some parts of the Gulf of Mexico. The main circulation in the latter, as already pointed out, forms an anticyclonic movement flowing through the western part of the area and, eventually, combining its flow in the Straits of Florida with the water masses which turn after passing through the Yucatan Channel immediately to the east, the latter movement being more pronounced during the northern hemisphere winter months.

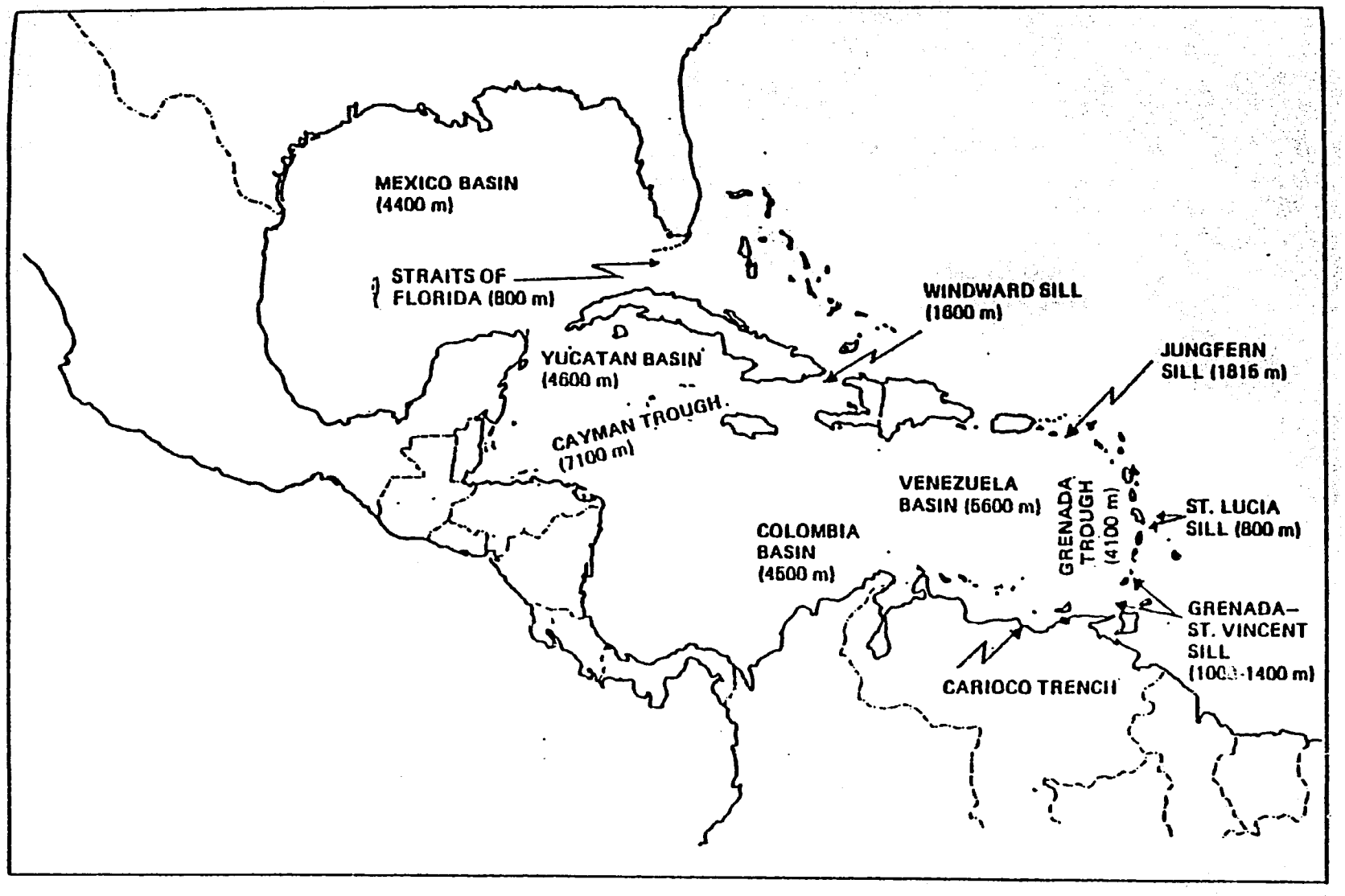

Figure 1 Major basins and sills of the Wider Caribbean

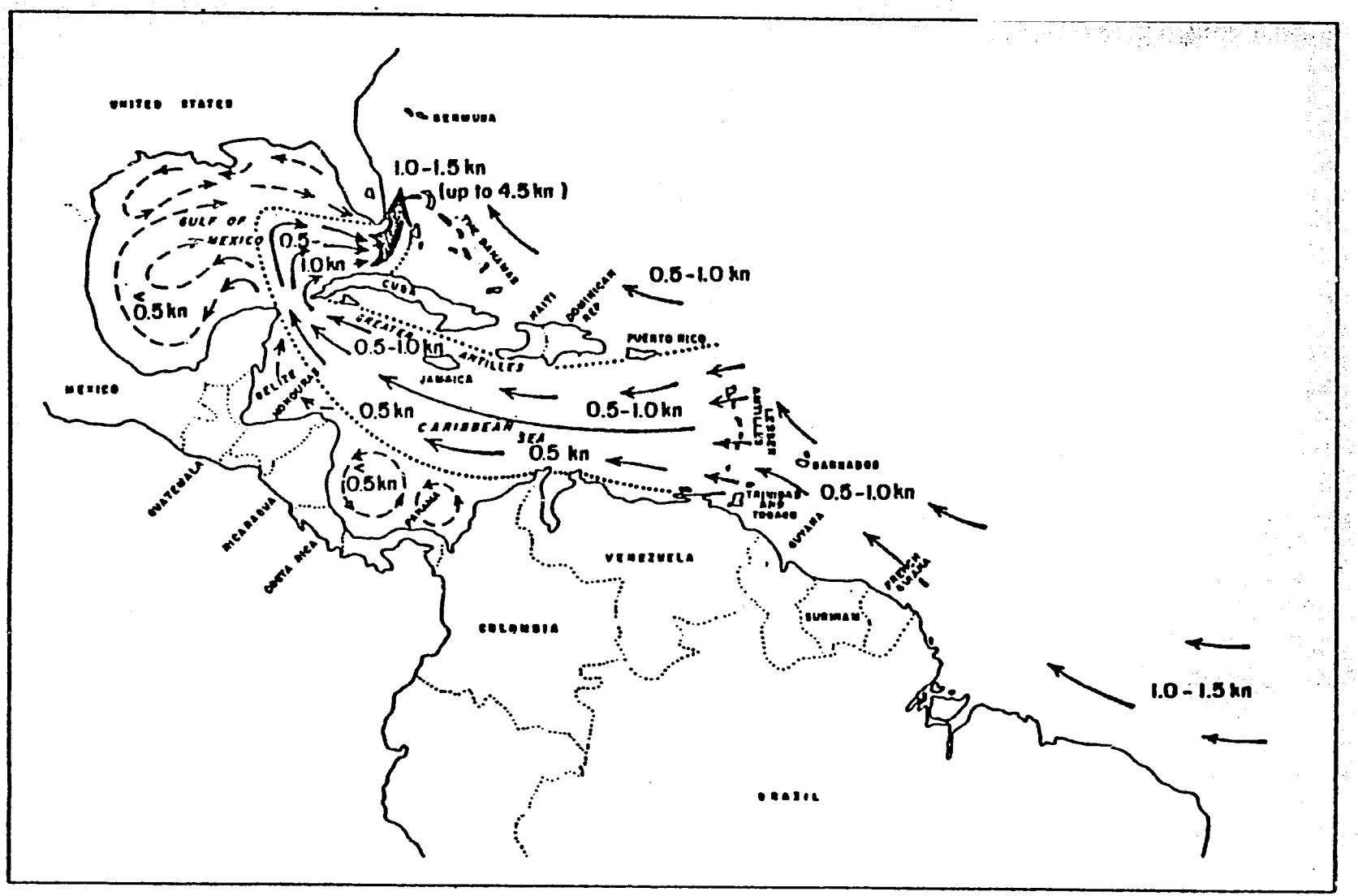

Figure 2 Prevailing currents of the Wider Caribbean (Unesco, 1977)

"The surface temperature in the tropical parts of the region has an average value of about 27° C and does not vary considerably during the year. The seasonal fluctuations do not exceed 3° C. The same holds true for the southernmost part of the Gulf of Mexico. However its northern part shows extreme seasonal changes in temperature, from about 16° C in winter to 28° C in summer, so that during the winter months there is a strong latitudinal temperature gradient.

"The cooling of surface waters in the northern and central part of the Gulf of Mexico during winter months also affects the vertical temperature distribution. Whereas in the whole Caribbean area and adjacent seas the temperature decreses by 10°-15° C during the first 200 m, beyond which depth there is only very slow further decrease, a thermocline layer is formed during winter in parts of the Gulf of Mexico at depths that may sometimes reach 100 m.

"Although this will have some influence on the mixture of any potential pollutant in the area, more important in this connexion seems to be the development of upwelling which takes place, particularly along the north coast of the Yucatan Peninsula from May to October, with a peak in June, and off the northeastern Venezuelan coast, where upwelling is strongest between December and April."

Since the deepest of the sills (Windward sill, 1 600 m) are shallower than the shallowest basin, most of the water in the Caribbean is below sill depth; thus, the topography plays a decisive role in reducing any exchange process. Atwood (1977) therefore concludes after having analysed data on oxygen, temperature and silicates that "pollutants that find their way into this water will not be flushed out". Thus, organic pollution, for instance, may result in oxygen depletion and eventually anoxic conditions.

3. THE MAJOR CONTAMINANTS IN THE REGION

Oil pollution, due to extended production, conversion and transport of petroleum and petroleum products, is definitely the most serious marine pollution problem.

For the entire region a high percentage of total production (Table 1) was from offshore, and expansion is expected; 38 offshore platforms were scheduled for installation within the next 18 months (Ocean Industry, 1979). The high risk zones for offshore production accidents in the region are displayed in Figures 3a and 3b.

As stated in the report on the state of marine pollution in the Wider Caribbean Region (UNEP/CEPAL, 1979):

"Based on past experience, an estimated 6.7 percent of the total offshore production spills into the marine environment as a consequence of pipeline accidents, blowouts, platform fires, overflows and malfunctions and other minor occurrences. These sources accounted for the release into the Wider Caribbean waters of an estimated 76.6 million barrels of oil during 1978 (IMCO, 1979)".

Further threat is related to transport activities (Figures 3a and 3b), namely:

"1. The pathway for the transportation of Middle Eastern, West African, and North African crude oil to the United States usually by supertanker with a stop for refining, transshipping or lightering and subsequent transport by smaller vessels to the US coast.

2. The pathway for shipping either crude or refined products from Venezuela and/or Aruba, Curaçao and others to various world markets.

3. The shipping of Alaskan crude oil through the Panama Canal to the US Gulf coast, the Virgin Islands or US east coast refineries (UNEP/CEPAL, 1979)".

Table 1

Production of crude petroleum, trade and refinery capacity
(quantities in million metric tons)
in the Wider Caribbean Region in 1978

(Source: UN, 1979, World Energy Supplies, 1973-1978, Table 10)

Country	Crude petroleum production		Refinery capacity	Imports
	Total	Offshore		
Bahamas			26 750	9 300
Barbados	35		175	140
Colombia	6 800		8 670	1 300
Costa Rica			470	341
Cuba	50		6 350	6 400
Dominican Republic			2 300	1 400
Guatemala	30		750	720
Honduras			700	560
Jamaica			1 850	1 210
Martinique			580	550
Mexico	56 500	2 350	48 650	
Netherlands Antilles			40 100	28 500
Nicaragua			750	695
Panama			10 000	3 070
Puerto Rico			18 525	12 100
Trinidad and Tobago	12 000	9 700	23 050	9 100
USA	425 000	55 000	875 000	295 000
US Virgin Islands			39 100	30 700
Venezuela	109 352	80 000	80 220	

Additional petroleum-related sources of pollution may encompass port activities, tank, washing, etc. A list of zones of high risk from oil spills and likely points of impact has been compiled by IMCO (1979) (Table 2).

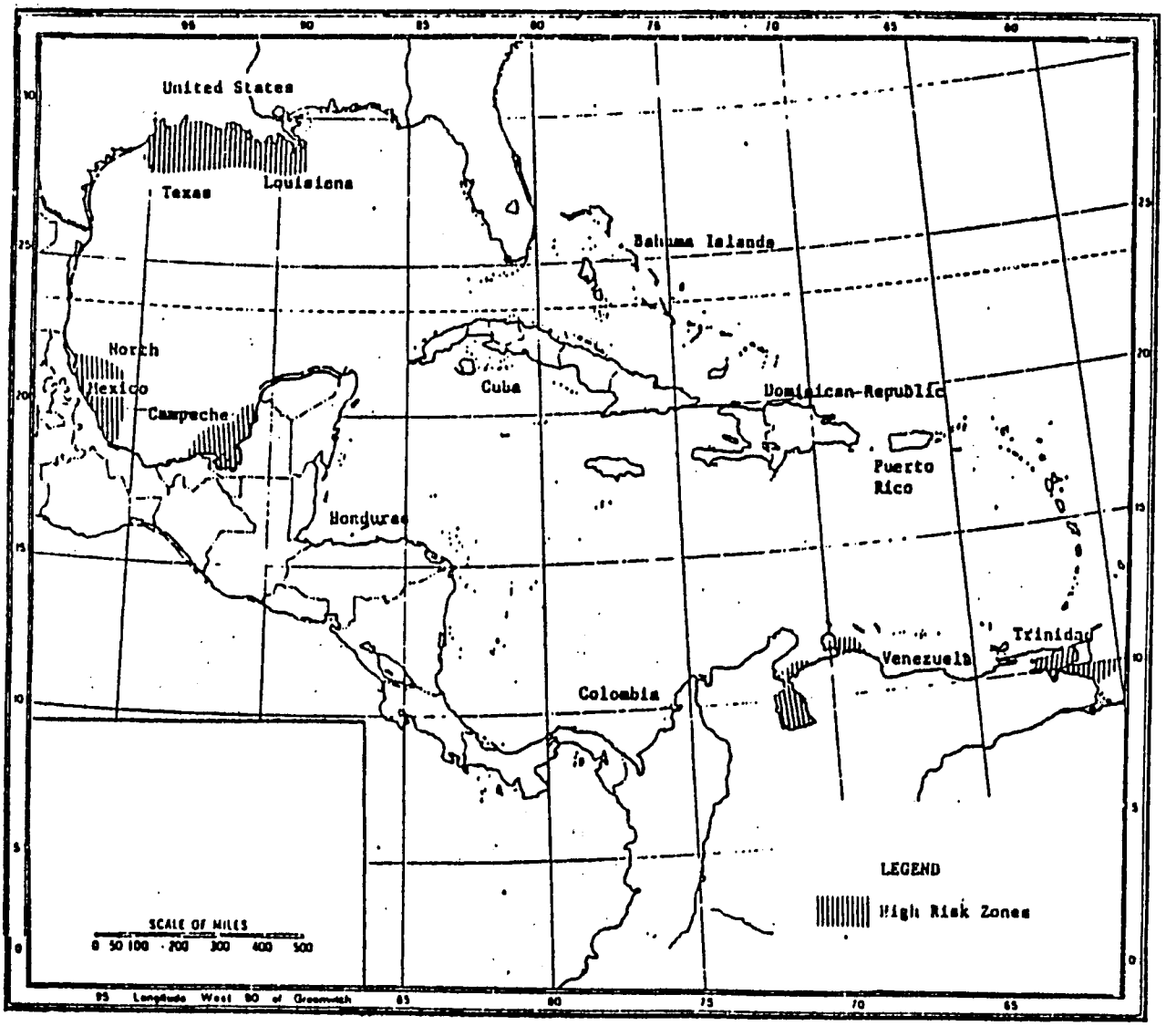

Figure 3a Wider Caribbean offshore production - Accidents: High risk zones (Source: UNEP/CEPAL, 1979)

Figure 3b High risk shipping zones - Wider Caribbean area
(Source: UNEP/CEPAL, 1979)

Table 2

Zones of high risk from oil spills and likely points of impact

High Risk Zone	Likely Zone of Impact
Offshore Production Accidents	
Texas	Texas coastline
Louisiana	Louisiana and Texas coastline
Mexico (North)	Northern Mexico and Texas
Mexico (Campeche)	Southern Gulf Coast, Northern Mexico or Texas
Trinidad and Tobago	Trinidad and Tobago, Grenada, Venezuela
Venezuela	Venezuela, Colombia
Through Shipping	
Anageda Passage	Virgin Islands, Puerto Rico, Hispaniola
Bahama Island Passages	Bahamas, Florida, Cuba, Haiti
Cayman Island Lightering	Cayman Islands
Florida Straits	Florida, north Cuban shore, Bahamas
Jamaica Channel	Haiti, Cuba, Jamaica
Lake Maracaibo	Venezuela
Mona Passage	Hispaniola
Netherlands Antilles	Aruba, Curaçao, Bonaire, Venezuela
Panama Canal Approach	Costa Rica, Nicaragua
St. Lucia (north and south)	St. Lucia, St. Vincent, Martinique, West Indies
Texas	Texas
Louisiana Gulf Coast Lightering	Texas, Louisiana
Tobago-Trinidad Channels	Trinidad, Tobago, Grenada, Venezuela
Windward, Passage	Cuba, Jamaica, Caymans
Yucatan (east)	Yucatan Peninsula, Florida, Cuba
Yucatan (west)	Yucatan Peninsula, Mexican Gulf, Texas, Louisiana
Port Approaches	
Bahamas	
Freeport	Bahamas, Florida
Nassau	Bahamas, Florida
South Riding Point	Bahamas, Florida
Barbados	Barbados, Martinique, St. Vincent
Cuba	
Caibarien	Cuba, Mexico, Yucatan Peninsula
Havana	Cuba, Florida, Dominican Republic, Haiti
Santiago de Cuba	Cuba, Dominican Republic, Haiti
Dominican Republic	
Bani	Cuba, Dominican Republic, Puerto Rico, Haiti
Santo Dominigo	-

Table 2 (continued)

High Risk Zone	Likely Zone of Impact
Jamaica	
Kingston	Haiti, Cayman Islands, Cuba
Mexico	
Coatzacoalcos, Tampico, Tuxpan, Veracruz	Southern and western Gulf of Mexico
Netherlands Antilles	
Aruba	Aruba, Venezuela
Bonaire	Aruba, Bonaire, Curaçao, Venezuela
Curaçao	Aruba, Curaçao, Venezuela
Panama	
Colon	Colombia, Costa Rica, Nicaragua
Puerto Rico	
Guayanilla, Los Mareas, Port Yacuboa, San Juan	Dominican Republic, Puerto Rico, Virgin Islands
St. Lucia	Martinique, St. Lucia, St. Vincent
Trinidad and Tobago	
Brighton, Galeota Point, Point Fortin, Point-à-Pierre	Trinidad, Tobago, Venezuela
USA	
Corpus Christi, Texas	Texas
Port Aransas	
New Orleans, Louisiana	Louisiana
Venezuela	
Altagracia, Amuay, Bachequero, Bajo Grande	Venezuela, Colombia
Capure, Carpito	Trinidad, Venezuela
Virgin Islands	
St. Croix	Antigua, Dominican Republic, Puerto Rico
Tank Washings, Oily Ballast Discharge	
Tank washings from US destination tankers, offshore lightering and harbours	Texas, Louisiana
Tank washings from tankers returning from Caribbean offshore lightering and harbours	Venezuela, Texas, Louisiana, Mexico
Tank washings from tankers returning from the US east coast and from Europe	West Indies, Venezuela, Trinidad, Tobago, Netherlands Antilles

Other industrial waste does not pose widespread pollution problems. Localized effects are mainly confined to the vicinity of major urban areas and industrial plants. Along the US coasts of Texas and Louisiana chemical wastes have been disposed of. A number of contaminants known to be highly toxic have already found their way into the environment and, consequently, into marine organisms; i.e., chlorinated biphenyls (PCBs) and various residues from the pesticide and other chemical and pharmaceutical industries, pulp and paper industry, tanneries and textile industry, food and sugar industry.

Mining of minerals, i.e., bauxite, and subsequent disposal of the red mud tailings as practised in several countries, add to potential dangers towards sensitive ecosystems. Other minerals exploited are, for instance, lead, nickel, zinc and iron.

Domestic sewage and other forms of mainly organic pollution are common all over the region. Organic load creates high biochemical oxygen demand (usually determined as BOD_5 = demand in 5 days). Tentatively, the biochemical oxygen demand may be assumed to be 20 kg per person per year (same figures as used in the Mediterranean (GFCM, 1972).

For primary treatment, a BOD reduction of 30% is assumed, whereas secondary and tertiary treatment may reduce BOD by as much as 80%. However, it has been estimated that less than 10% of the sewage systems of the region, mainly associated with urban areas and big hotel compounds (Figure 4) have treatment facilities, the majority of which is primary. Consequently, this gives rise to about 570 000 t BOD_5/year for the roughly 30 million people living in the region, and it is likely that installation of any new purification plants cannot keep pace with increasing organic pollution.

Since warmer waters generally contain less dissolved oxygen, organisms inhabiting them, however, tend to have higher respiratory rates; it may be concluded, therefore, that tropical marine organisms live, on the average, at oxygen levels closer to their lethal levels than do the biota of cooler waters.

Adverse effects of organic discharge and subsequently deteriorating oxygen conditions on fish and shrimp nursery grounds have been established, for example, in an extensive study on Kingston Harbour, Jamaica (Wade, 1972).

Agricultural waste usually comprises also a high amount of organic load - not the least from industries such as the sugar refineries and rum distilleries, sugar cane production constituting as much as 30 to 50% of total arable land in several islands. Apart from this, agricultural run-off introduces inorganic fertilizers, pesticides which are increasingly utilized and high silt content due to the poor soil management. Consequently, analyses on various reef fish species in the region have produced evidence of - so far low - pesticide contamination (Giam *et al.*, 1974).

Finally, pollutants carried by rivers, mainly through the Orinoco and the Mississippi, may affect adjacent estuarine, lagoon, mangrove and coral ecosystems which play an important role as primary source of biological productivity in the region, i.e., as nursery grounds for commercial species.

4. THE ARTISANAL FISHERIES

4.1 Definition

Artisanal fisheries, small-scale fisheries, inshore fisheries and similar terms have often been used as equivalents or as opposed to commercial or industrial fisheries, without clearcut definition of the terms. In the present paper, following Smith's (1979) categorization, artisanal and subsistence fisheries are summarized as traditional fisheries, distinguishing them from industrial fisheries by means of scale and management as well as income levels rather than indiscriminately in relation to market orientation. The author elaborates the following distinctive measures for the traditional sector:

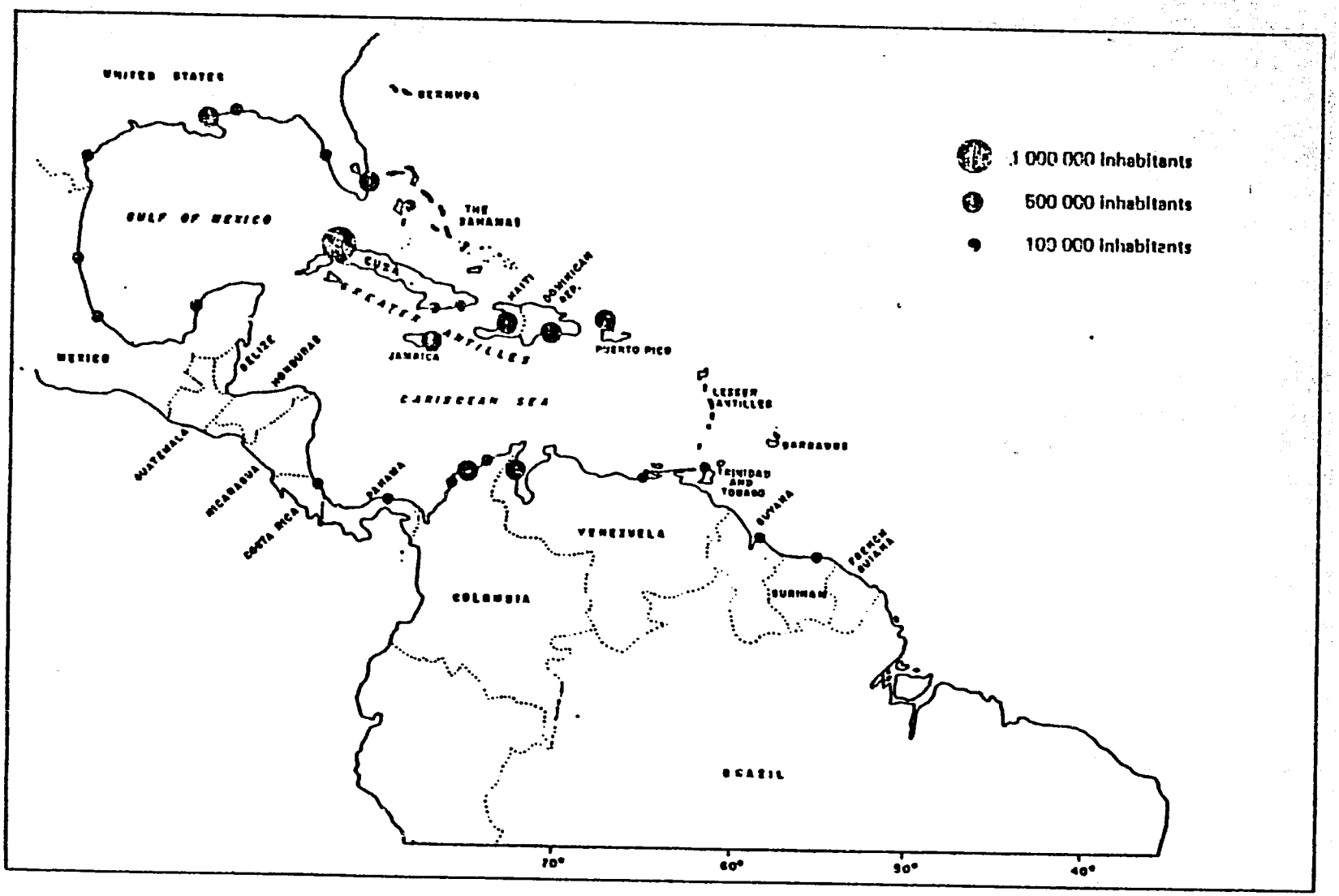

Figure 4 Major urban areas in the Wider Caribbean Region

"Traditional fisheries are carried out by small-scale fishing units, often consisting of kin groups using small, occasionally powered boats or none at all. The fishing activity is often part-time, and household income may be supplemented by other non-fishing activities of the fisherman. Payment of fishermen is on a share basis and vessels and gear are usually owner-operated, as distinct from industrial fishing where there is more distance between owners and fishermen. Gear, which may be machine-made such as nylon netting, is usually operator-assembled and requires minimal or no machine assistance to operate. Investment levels are low, with capital often borrowed from those who market the catch. Catch per fishing unit and productivity per fisherman range from medium to very low. Catch most often does not enter large organized markets, but is sold at dispersed points of landing or even at sea. Part or all of the catch is operator- and family-consumed. Traditional fishing communities are frequently isolated, both geographically and socially, and the standard of living of traditional fishing households is low to minimal."

4.2 Geographical Distribution and Contribution to Total Fishery

In the absence of a comprehensive study of the traditional sector in the region, information is scant, incomplete, unequal in format and distribution and mostly only qualitative. Sources of information thus comprise, among official publications as the FAO Yearbook of Fishery Statistics (1978), the UN Statistical Yearbook, etc., draft documents, working papers, FAO Fishery Country Profiles and other less accessible papers not allowing for anything but a tentative estimate.

In general, population density, fish consumption and demand tend to be higher in the islands as compared with the Central American countries, though their shelf area is narrow. A considerable proportion of the fishing fleets in the islands seems to be artisanal (Table 3). This may be partly due to the extended coral reefs and other hard bottom substrate impeding trawling operations (Figure 5).

The few industrial vessels are usually engaged in shrimping or tuna fishing, since this is the most valuable resource throughout the Region and the major fishery contribution to earn foreign exchange (except for Cuba, which has a well developed industrial fishery, including long-distance activities), and the US menhaden fishery. The artisanal sector comprises a varying number of small vessels, often of the canoe type, with or without outboard engine, sometimes even sailing sloops (i.e., Bahamas). They operate from beaches scattered around the islands, utilizing mainly traditional gear, i.e., traps, pots and handlines for spiny lobster, blue crab, snappers, groupers, grunts, etc., and trolling lines, gillnets and seines for pelagic species, i.e., sharks, dolphins, flying fish. Turtles may be caught with seines, tangle nets and harpoons. Conchs are mainly hand-caught. Due to pressing unemployment problems and present need for fish imports to matche the protein requirements of the population, most insular countries direct some effort in fishery extension and improvement of the artisanal and industrial fisheries, as well as the onshore facilities.

In most Central and South American countries, the artisanal fisheries play a less important role in terms of employment as well as in terms of seafood production; in Mexico, for instance, 60% of the population does not consume fish (Table 4). In general, the industrial fisheries is much better developed. However, since production of the latter aims to a substantial part at the foreign exchange earnings, it remains to the artisanal fishery to supply fish and other seafood for local human consumption. In some countries, it contributes as much as 10% of the total protein supply.

In view of extended national economic zones and reduced numbers of foreign vessels operating in coastal waters, increased support and development of the traditional as well as the industrial sector are being planned or are already underway.

High potentials for coastal aquaculture, i.e., cultivation of mangrove oyster (Crassostrea rhizophorae) has been estimated as viable (Flores, 1978; Nikolic and Mendellez, 1968; Bacon, 1971), besides sustained yield of the American cupped oyster (C. virginica).

Table 3

Total population, fishing population in the artisanal sector, catch and properties of artisanal fishing fleet in some islands in the Wider Caribbean Region
(Source: FAO Fisheries Country Profiles)

Country	Total population 1977 1/	Total catch 1978 2/ in metric tons (trade not considered)	Per caput supply (kg/y)	Estimated employment in the artisanal sector	Estimated number of artisanal fishing vessels	Equipment	Gear	Items caught
Bahamas	220 000	3 741 F	9.8	ca 1 000 3/	83 4/ unknown	Small sailing sloops with outboard engine 3-5 m dinghies used by part-time fishermen	Traps hand lines simple seines	Spiny lobsters groupers snappers grunts conch turtles
Barbados	254 000	4 000 F	29.9	1 450 5/ (not all full time)	560	Canoes 6-10 m long, engines up to 80 hp, no navigational aid nor mechanical fishing equipment	Gill nets trolling lines hand lines trap nets	Flying fish pelagic species demersal fish " " *dolphin, shark, billfish and kingfish
Cuba	9 596 000	213 170	17.7	9 000 6/	2 300	Various types of traditional boats in the Gulf of Guantanamo		Spiny lobsters shrimps finfish 32% of national catch
Dominican Republic	4 978 000	5 171	6.9	4 500 7/ (70% full time)	2 319 1 159 991 169	Inshore fleet: yolas (3-6 m long, 72% motorized) cayucos (dug-out canoes, 2-4 m long, 13% motorized) botes (wooden GRP vessels and larger clinker-built wooden sailing vessels, 6-7 m long, with outboard engine)	Hand lines traps Less common: trolling lines bottom-set long lines harpoon fishing gill nets beach seines cast nets	Mainly south coast, ca 80% of total catch artisanal snappers groupers mackerels jacks grunts Crustaceans and molluscs each 3-7% of total catch turtle meat 1%

1/ UN 1978 Statistical Yearbook
2/ FAO 1978 Yearbook of Fishery Statistics (F = FAO estimate)
3/ Estimated 1976
* Estimates referring to 1970
4/ Registered in Nassau
5/ Estimated 1975
6/ " 1974
7/ " 1979

Table 3 - (continued)

Country	Total population 1977[1/]	Total catch 1978[2/] in metric tons (trade not considered)	Per caput supply (kg/y)	Estimated employment in the artisanal sector	Estimated number of artisanal fishing vessels	Equipment	Gear	Items caught
Jamaica	2 085 000	9 645	22.6	9 000[8/]	ca 3 500	Canoe-type boats, 1/3 motorized	Pots seines gill nets hand lines	Snappers goatfish Jacks Parrotfish groupers lobsters
Saint Lucia	112 000	2 500 F	26.5	1 700[9/] (ca 2/3 part time)	530	Dug-out canoes, 5-8 m long, ca 85% with outboard engines 6-60 hp	Hand lines traps gill nets beach seines	Demersal species " " flying fish
Trinidad and Tobago	1 027 000*	4 823	17.5	<3 500[10/] (ca 2 500 full time)	ca 1 400	Pirogues (up to 5 m long) in Trinidad; "bum" boats (100% with out-board engines 30-60 hp)	Pots seines troll lines beach seines	Perciforms jacks mackerels sharks shrimps

8/ Estimated 1973
9/ " 1978
10/ " 1970

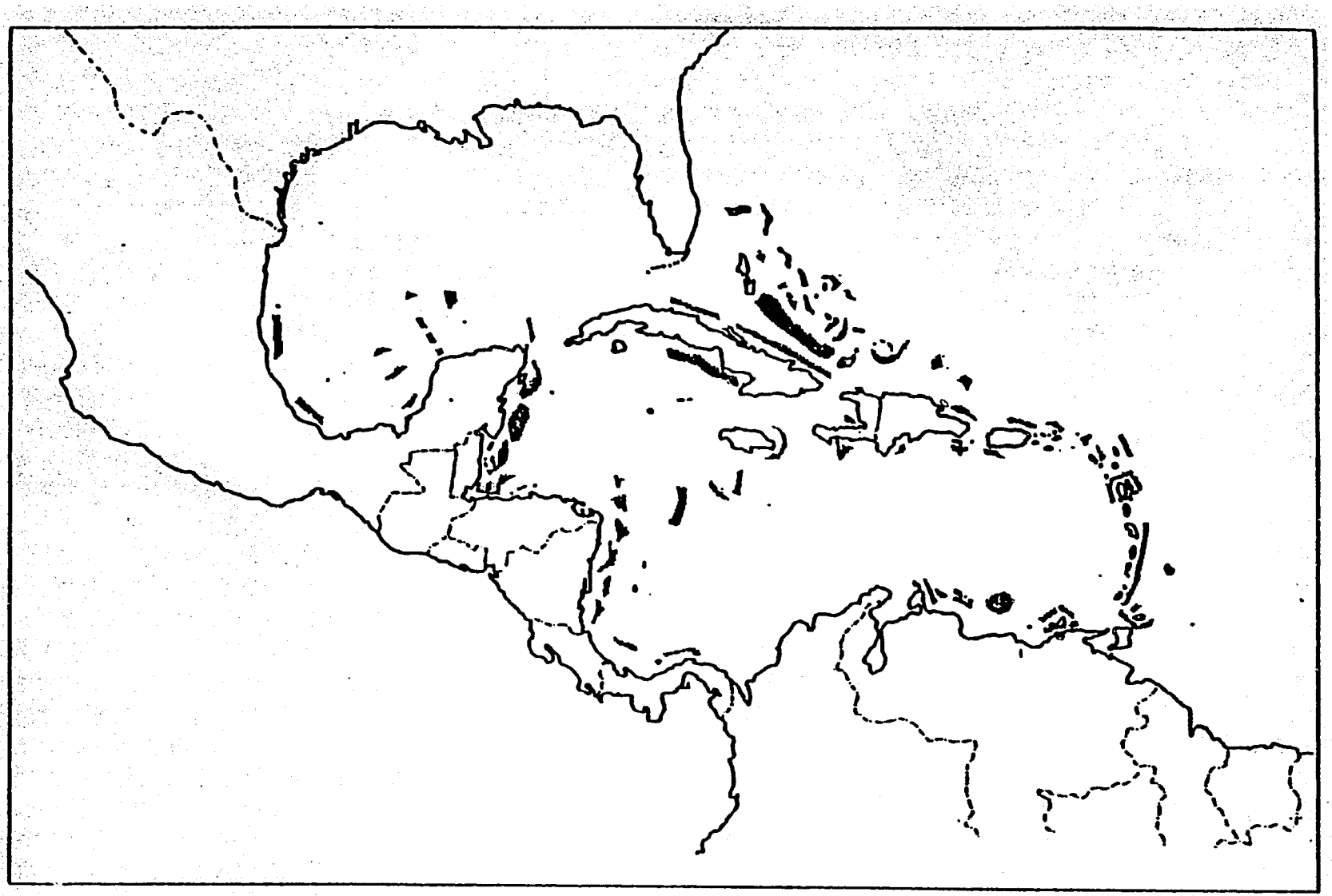

Figure 5 Areas where living coral reefs exist
(Source: UNEP/CEPAL, 1979)

Table 4

Total population, fishing population in the Artisanal sector, catch and properties of artisanal fishing fleet in some Central and South American countries in the Wider Caribbean Region
(Source: FAO Fishery Contry Profiles)

Country	Total population 1977[1]	Total marine catch, 1978[2], in metric tons (trade not considered)	Total per caput supply (kg/y)	Estimated employment in the artisanal sector	Estimated number of artisanal fishing vessels	Equipment	Gear	Items caught
Belize	149 000	1 899 F	4.6	2 200[3] (800 part time)	517	14-17 ft open boats, usually powered with out-board engine 22-33 ft sailing boats with outboard engine	Drop lines traps free diving	Lobsters reef fish conchs
Colombia	25 048 000	21 791 F >50% C	4.8	11 300[4]		Pirogues		Finfish shrimps spiny lobsters
Costa Rica	2 071 000	14 430 ≤25% C	4.7	500 C	ca 100 C[5]	Dug-out canoes, some equipped with outboard engines	Hand lines gill nets throw nets harpooning	Spiny lobsters turtles
Guyana	827	17 690	15.2	11 500[3] (4 000 part time)	1 870	Simple flat-bottomed or V-shaped craft (17-45 ft long)	Chinese seines cadell lines pin seines gill nets	Finfish shrimps

[1] UN Statistical Yearbook, 1978
[2] FAO, Yearbook of Fishery Statistics (F = FAO estimate) (C = Wider Caribbean)
[3] Estimated 1978
[4] Source: Colombia, Ministerio de Agricultura et al., 1978, Table V-3, p. 217: the following percentages of the total artisanal fishing population have been assumed (in relation to the coastline and in comparison with provinces with only or predominantly marine artisanal sector) as reasonable to estimate the share of the Caribbean marine artisanal sector; total for 1972 in brackets:

Atlántico,	50%	(2 355)
Antioquia,	50%	(7 990)
Bolívar,	10%	(13 282)
Chocó,	25%	(818)
Córdoba,	50%	(3 856)
Guajira,	100%	(1 178)
Magdalena,	10%	(12 051)
San Andrés,	100%	(598)

[5] Marshall, N., 1975, Artisanal fisheries: characteristics, problems, needs and relationships to aquaculture. Int.Center Mar.Res.Development, Univ.Rhode Island, 57 p.

Table 4 (continued)

Country	Total population 1977[1]	Total marine catch, 1978[2], in metric tons (trade not considered)	Total per caput supply (kg/y)	Estimated employment in the artisanal sector	Estimated number of artisanal fishing vessels	Equipment	Gear	Items caught
Mexico	64 594 000	737 014 30%	4.3	65 500[6]	18 700 3 t (5 600 C)[7]			Spiny lobsters shrimps ponyfish grunts groupers conchs marine turtles
Nicaragua	2 312 000	20 414	4.4	5 300[8] (unknown number part time)	1 260 >50 C	Canoes; other small boats, 15% mechanized	Hand lines long lines drag nets cast nets	Juvenile white shrimps spiny lobsters turtles demersal fish
Panama	1 771 000	113 768 only 16% artisanal ≪50% C	9.7	2 500[9]	several hundred	Canoes		Snappers croakers groupers soles
Venezuela [10]	12 737 000	159 560	12	20 000	46 000 operating from about 250 landing places along the coast	Open 6-10 m long boats; almost no mechanization of gear handling; poor catch preservation on board	Beach seines hand lines castlifts trap nets	Sardinella snappers groupers clams shrimps 80-90% of total marine catch artisanal

6/ Estimated 1976
7/ Figures in brackets derived by assuming 30% of total on the Atlantic side
8/ Estimated 1975
9/ " 1973
10/ Task force report on the Fisheries Development Prospects of Venezuela, November 1975, Department of Fisheries/Investment Center and FAO Fisheries Travel Report by C. Nédélec, FIIT/TRAM/1588, November 1978

Consequently, assistance to improve a sound management of the fishery resources has been allocated to countries cooperating in the Caribbean Regional Fisheries Development Project, as well as through national FAO/UNDP projects. Further assistance, and financial aid is provided by CIDA (Canada), the World Bank and the International Development Bank.

5. RESOURCES FOR ARTISANAL FISHERIES

Due to its limited equipment, artisanal fisheries (and subsistence fisheries, that is the whole traditional sector) is generally confined to coastal waters and lagoons.

Coastal, shallow waters, particularly the well illuminated 0-20 m depth zone, can reasonably be assumed to have the highest benthic production. Smith and Ray (1979) estimate this area as 4.8×10^5 km^2 or some 10% of the total sea surface of the Wider Caribbean Region. They further assume that roughly 20% of the total area may be made up by the above four. Eventually, after a review of available literature on the region, the authors assume that the gross primary productivity of the four habitats within the 0-20 m zone is, on the average, about 50 times greater than that of phytoplankton communities in surface waters of the Wider Caribbean.

Based on these assumptions, they conclude that the relative contribution of the 4 communities to productivity of the area are equal to that of the combined surface waters of the region. Without disputing these admittedly rough estimates too much, it may be suggested that coral, algal, sea grass and mangrove habitats play a decisive role in supporting biological systems throughout the region (see Figures 6 and 7).

Major resources exploited by the artisanal fisheries are, for instance, various groups of reef and small demersal fish throughout the region, different life stages of shrimps and prawns, spiny lobster, bivalve molluscs, conchs and sea turtles. Their common feature is that, in at least some life stages, they are directly dependent on one of the abovementioned habitats. Larvae and juveniles of shrimps are found in the sheltered lagoons and estuarine areas. Nesting of turtles is confined to beaches, while adults often are associated with shallow coastal waters, including vegetated bottoms and mangrove zones. Conchs are common in beds of turtle grass and manatee grass. Consequently, the distribution of the fishery resources is closely associated with that of the critical habits, as depicted in Figures 8-12.

As for the commercial catch, Klima (1976a) estimated the total landings from Campeche Bank alone as making up for some 60 000 t in the second half of the 1960s up to 1971. Assuming they were stable in the following years (apart from the exceptionally high catch of 122 796 t in 1972), they account for about 3-5% of the total commercial catch in the region, presently acknowledged as 1 852 942 t (1978) (FAO, 1979). However, the last figure does not include shrimp fishery discards, estimated in 1974 at some 700 000 t in the Gulf of Mexico, and the considerable recreational fishery of the USA which was set at about 400 000 t already in 1970 (Klima, 1976, and references therein). It does also not account for an unknown part of the artisanal catch landed on beaches and/or consumed without being channelled through market systems.

From this and other sources, particularly on the basis of exploratory fishing, Klima (1976) estimated the standing stock of fish in the Gulf of Mexico and the Caribbean proper. Crude estimates for snapper and grouper in the total area amount to 160 000 and 110 000 t respectively. The standing stock of other ground fishes in the Gulf of Mexico, encompassing some 175 species, was estimated at about 2 680 000 t excluding the area of Mexico. Sciaenids, croaker, stop, drums, sea trout and grunt contribute the major portion. The assessment of the actual yield of these demersal resources in the Gulf amounts to some 970 000 t. In the absence of knowledge on single stock parameters, however, it is difficult to estimate the potential of the area, since the simple Schaefer model does not match the predator-prey interrelationships and indiscriminately applied to tropical multispecies stocks, results in severe overestimates of sustainable yield (Pauly, 1979).

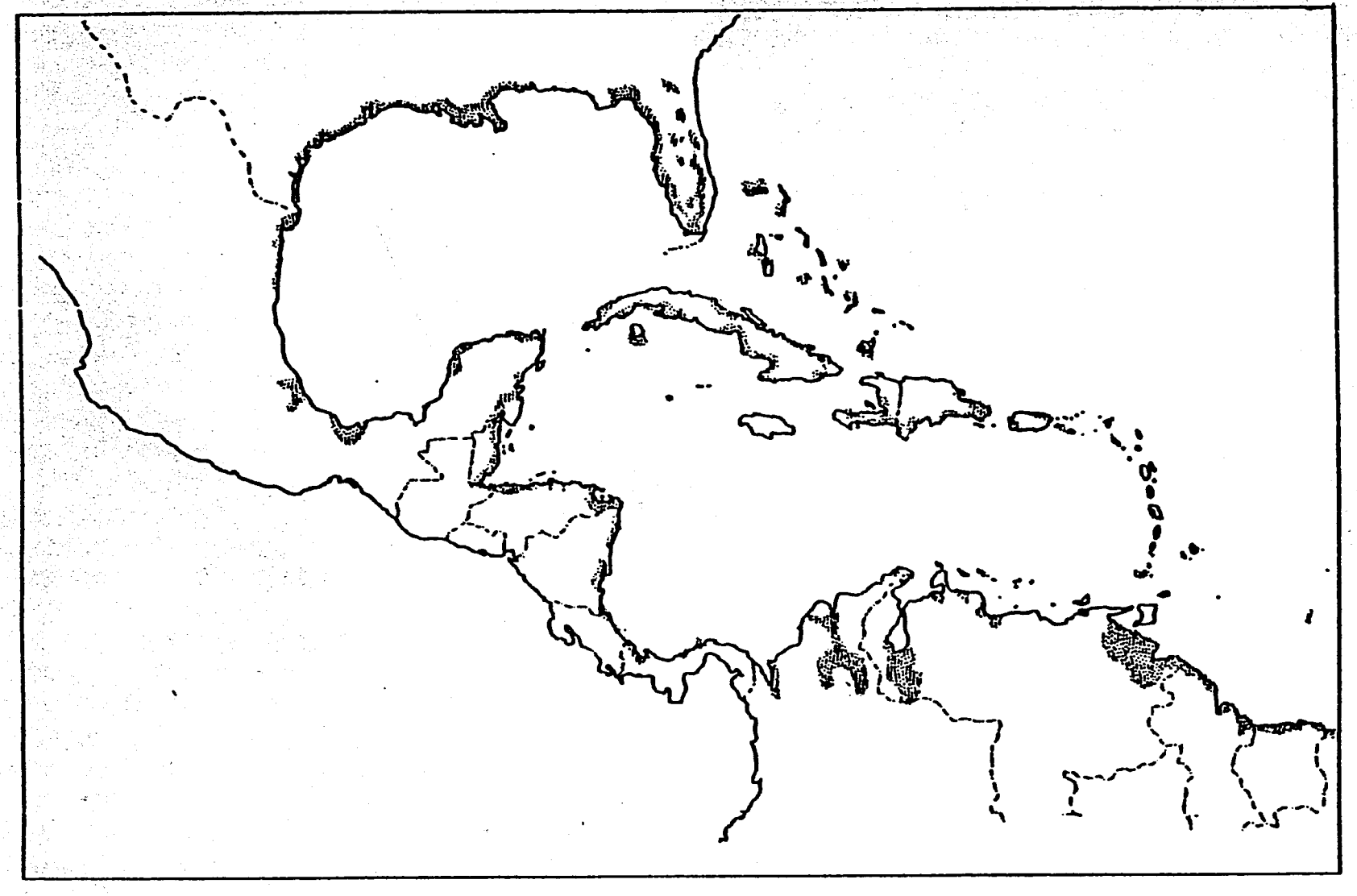

Figure 6 Areas where mangrove exist
(Source: Ray, 1979; from
UNEP/CEPAL, 1979)

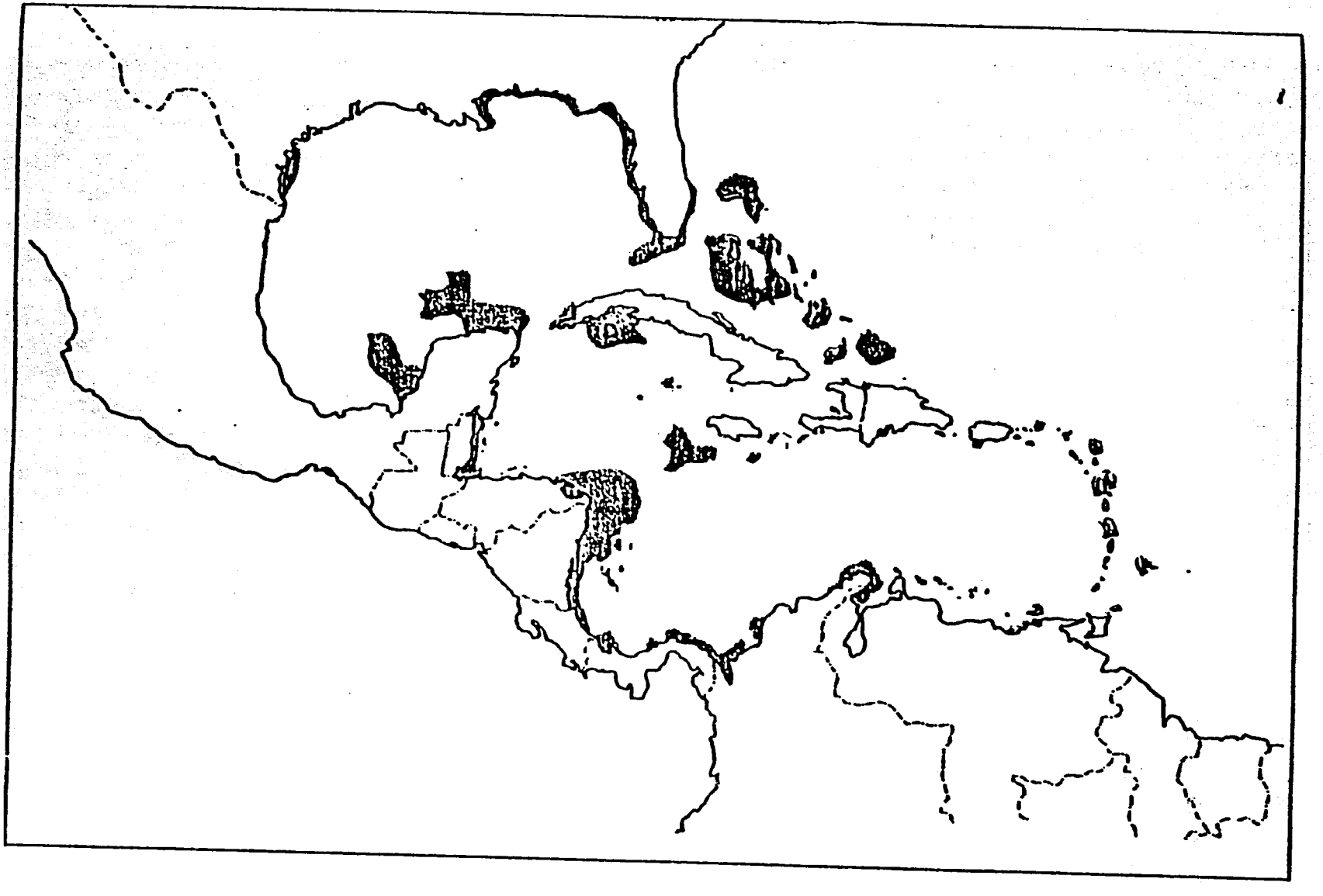

Figure 7 Areas where seagrass exists
(Source: Ray, 1979; from
UNEP/CEPAL, 1979)

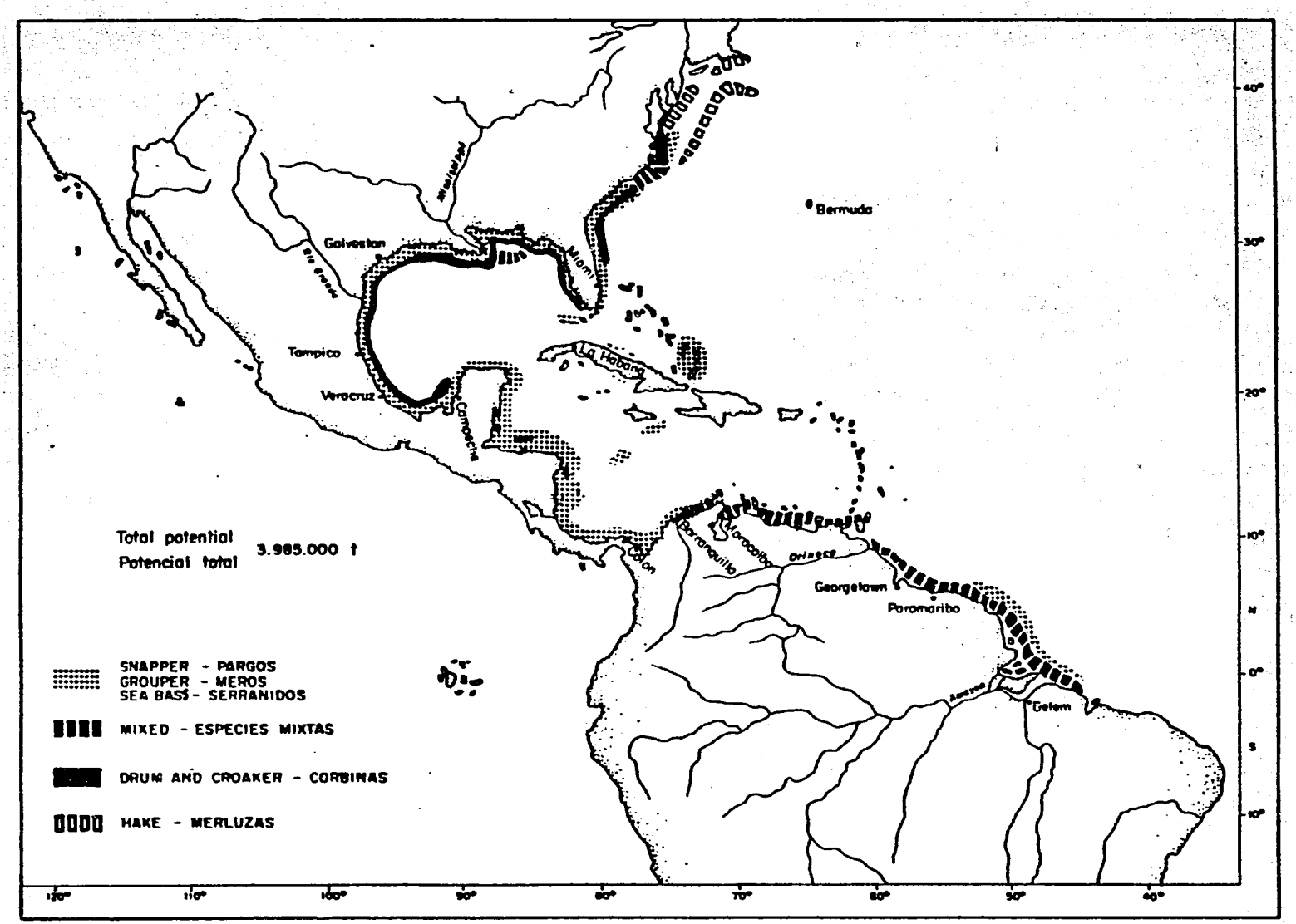

Figure 8 West Central Atlantic demersal resources
(Source: FAO, Atlas of the Living
Resources of the Sea, 1972)

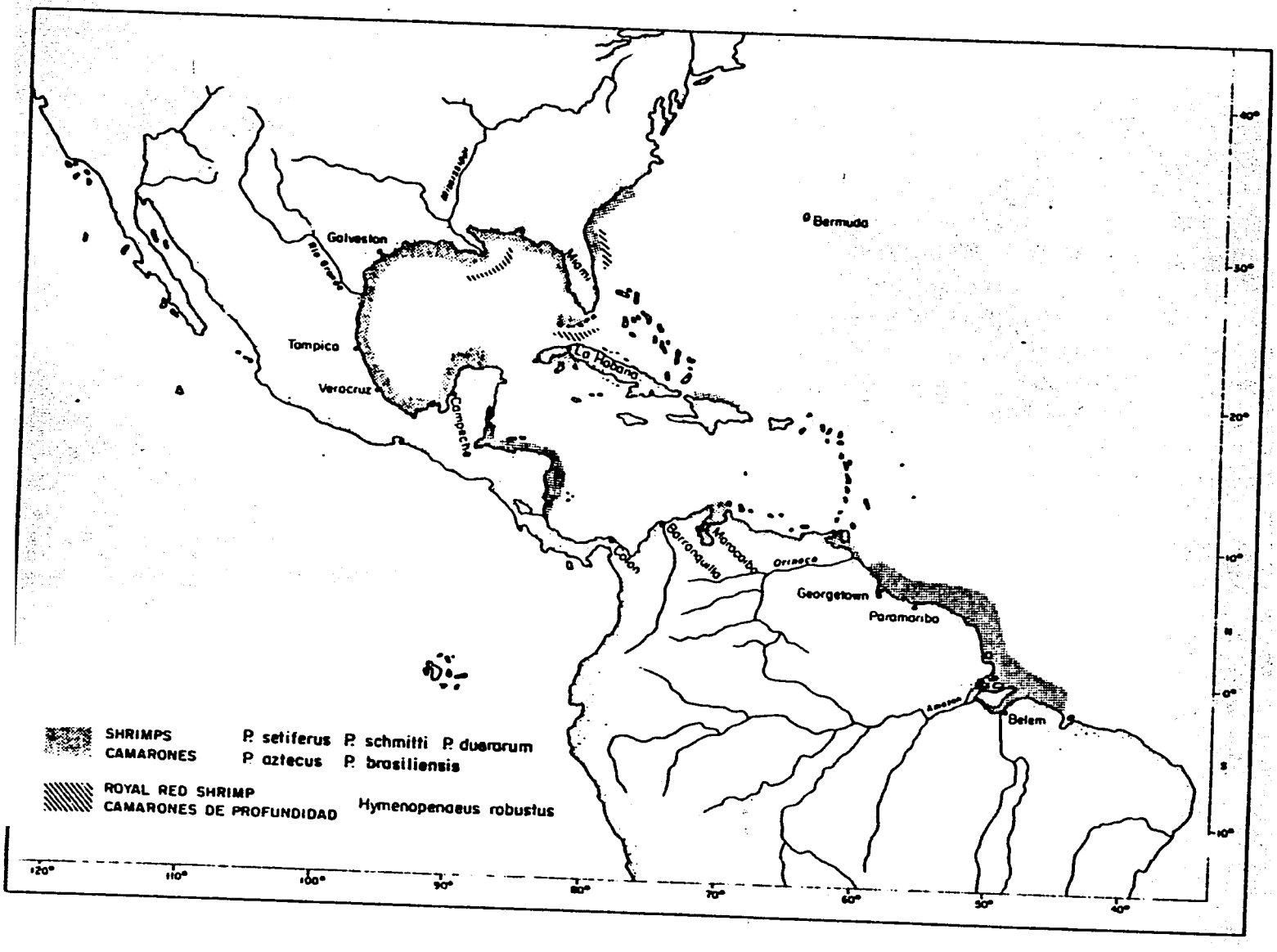

Figure 9 West Central Atlantic crustacean resources (Source: FAO, Atlas of the Living Resources of the Sea, 1972)

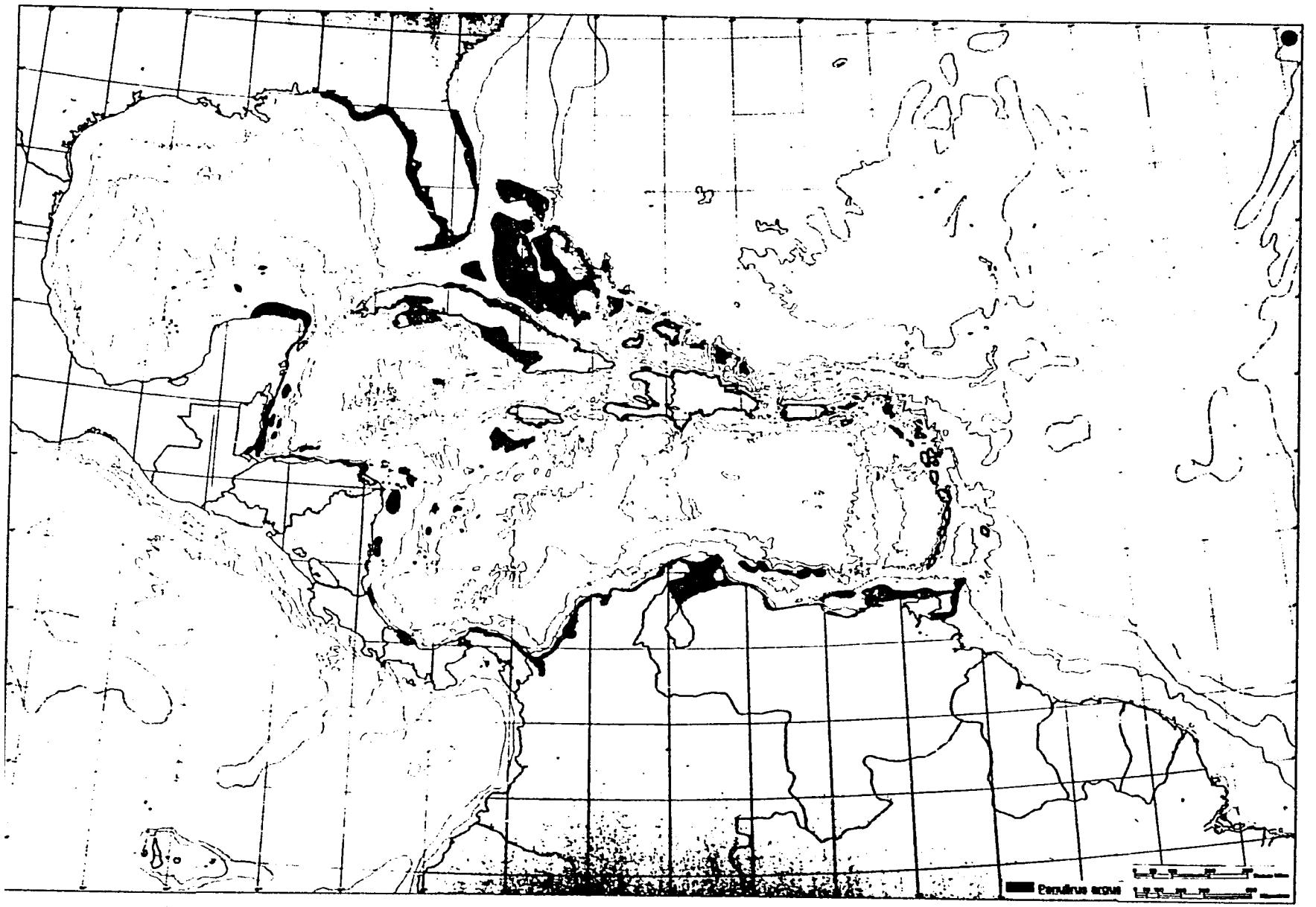

Figure 10 Lobster resources of the Wider Caribbean Region
(Source: IUCN, Caribbean Data Atlas, 1980)

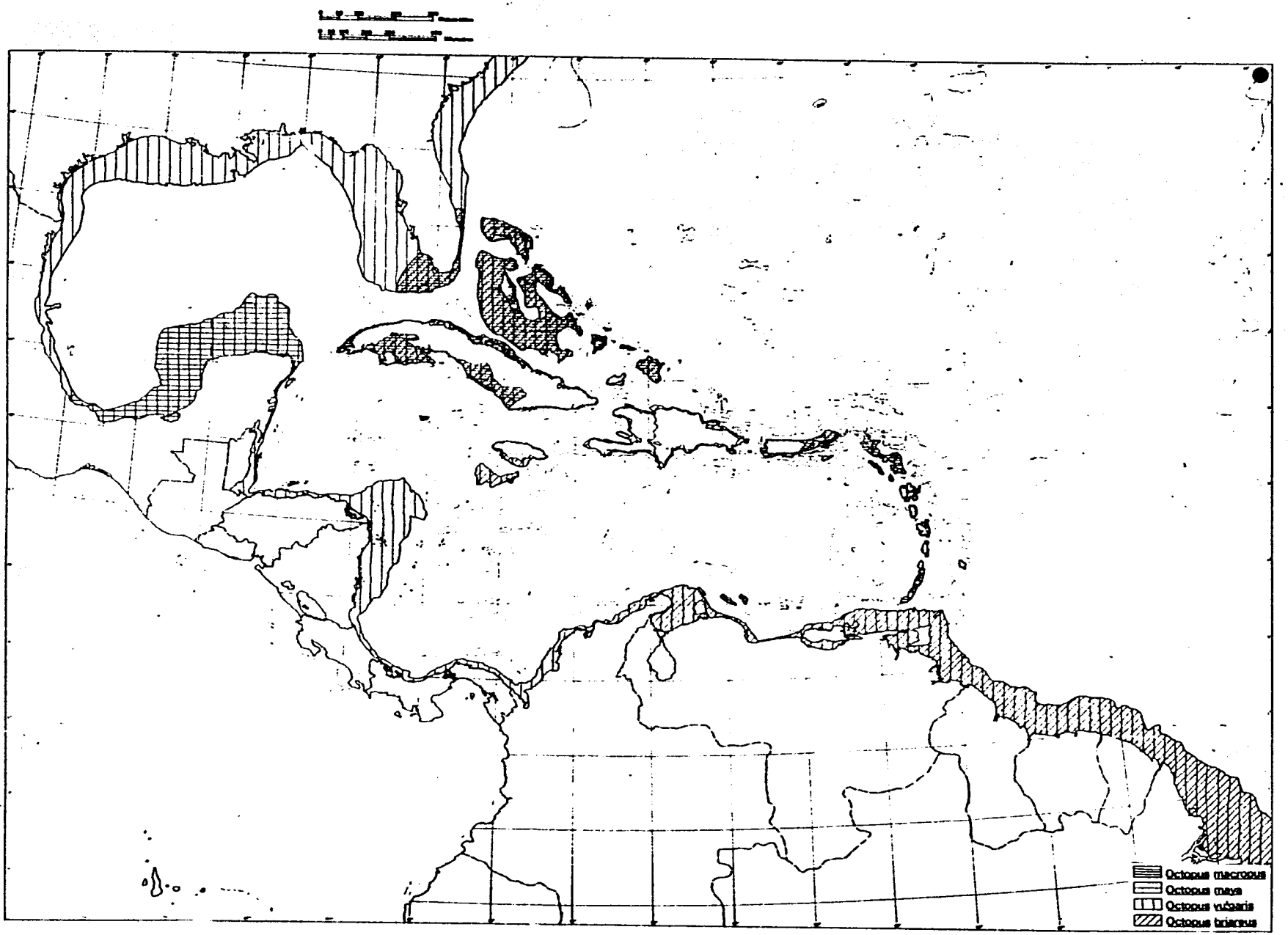

Figure 11 Octopuses in the Wider Caribbean Region
(Source: IUCN, Caribbean Data Atlas, 1980)

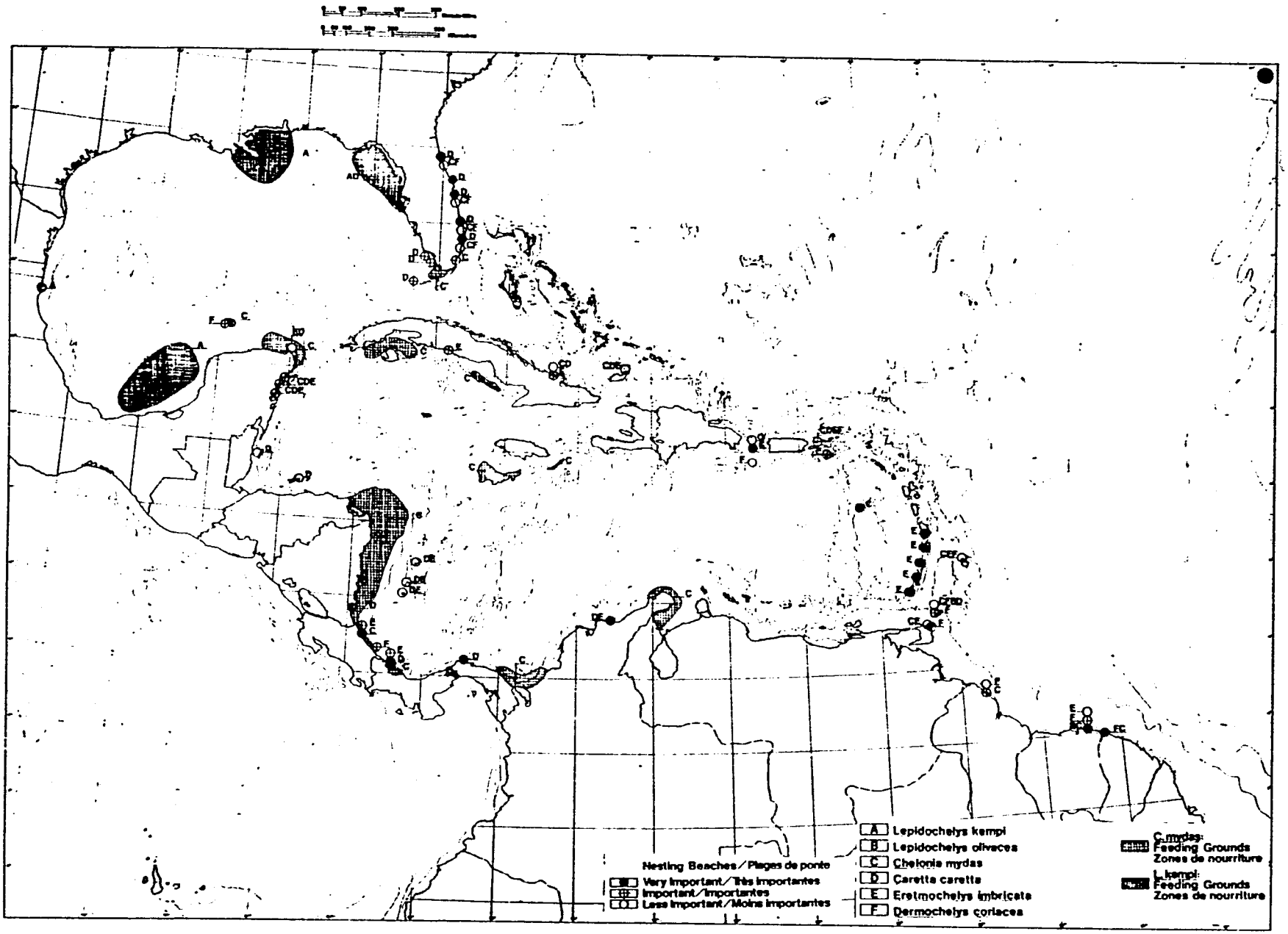

Figure 12 Turtles in the Wider Caribbean Region
(Source: IUCN, Caribbean Data Atlas, 1980)

Guesstimates for potential yield per unit shelf area around Jamaica have been deduced by Munro and Thompson (1973, cited in Klima, 1976) by plotting the catch per canoe per year against the number of canoes per square nautical mile of shelf. The findings are thought to pertain also to other shelf areas of the Caribbean proper. The maximum sustainable yield of all exploited species other than oceanic pelagic fish (which are out of the range of the artisanal fisheries) was derived as at about 40 kg/ha. This figure includes a variety of pelagic and demersal fish, crustaceans and even turtles. Only a fraction of this total yield, circa 1-2 kg/ha, would consist of snappers and groupers.

Adjusting for different productivity in certain areas and extrapolating for the total area, Klima (1976) produces figures of about 335 000 t for the mainland shelf areas, 150 000 t for the insular shelf areas and about 95 000 t of demersal species in the Bahamas (Tables 5-7).

No reliable estimates on the potential yield of coastal pelagic species have yet become available. In 1978 production of the commercial menhaden fishery was about 820 000 t for Gulf menhaden and 90 000 for Atlantic menhaden, respectively. Data in relation to artisanal fishery are lacking.

As for shrimps, the most important of which are the northern brown shrimp (Penaeus aztecus), white shrimp (P. setiferus) and northern pink shrimp (P. duorarum), catch statistics of the commercial fishery are available (1978, roughly 120 000 t in the region), data on artisanal activities as juvenile fishing, etc., however, are scarce.

For molluscs again only total production as reflected in fishery statistics can be given; in 1978, about 176 000 t for the American cupped oyster (Crassostrea virginica), about 3 000 t for the mangrove cupped oyster (C. rhizophorae), and about 5 000 t for conchs (Strombus).

Table 5

Potential yield of snappers and groupers (0.2 t/km^2) and of all demersal species 1 t/km^2) on mainland shelf areas of the Caribbean

Place	Area (km^2)	Potential yield (t)	
		Snapper-grouper	All demersals
Belize	10 000	2 000	10 000
Honduras	48 700	9 740	48 700
Nicaragua	75 000	15 000	75 000
Costa Rica	13 200	2 640	13 200
Panama	48 950	9 790	48 950
Colombia	48 365	9 673	48 365
Venezuela	90 650	18 130	90 650

Table 6

Potential yield of snappers and groupers (0.2 t/km^2) and of all demersal species (1 t/km^2) on insular shelf areas and banks of the Caribbean

Place	Area (km^2)	Potential yield (t)	
		Snapper-grouper	All demersals
Cuba shelf	70 000	14 000	70 000
Jamaica shelf	3 425	685	3 425
Pedro Bank	8 020	1 604	8 020
Rosalind Bank	4 930	986	4 930
Other banks near Jamaica	3 155	631	3 155
Hispaniola	5 000	1 000	5 000
Monte Cristi Bank	1 060	212	1 060
Silver Bank	2 970	594	2 970
Other banks near Hispaniola	765	153	765
Puerto Rico to Virgin Islands	11 800	2 360	11 800
Barbados to Antigua	3 340	668	3 340
St. Kitts to Dominica	3 600	720	3 600
Anguilla Bank	4 480	896	4 480
Saba Bank	2 200	440	2 200
Other banks near Leeward Islands	625	125	625
Martinique to Barbados	5 785	1 157	5 785
Trinidad and Tobago	20 400	4 080	20 400
Total	151 555	30 311	151 555

Table 7

Potential yield of snappers and groupers (0.1 t/km^2) and of all demersal species (0.5 t/km^2) in the Bahamas

Place	Area (km^2)	Potential yield (t)	
		Snapper-grouper	All demersals
Bahamas Bank	183 475	18 348	91 738
Other banks	11 470	1 147	4 735
Total	194 945	19 495	97 473

6. RESOURCES AT RISK

With the presently accessible information, it seems impossible to quantify damages to which living aquatic resources and thus artisanal fisheries might be subjected as a result of oil spills, chronic oil pollution, heavy organic discharge or land reclamation in swamps and estuaries.

In a case study on the impact of mangrove/estuarine areas on commercial fishery, Robas (1970) estimated that one acre (0.405 ha) of undisturbed estuarine area would have an annual value of US$ 380 and, capitalized at a modest of 5% over a period of 20 years, yields US$ 7 980 worth of commercial fish products. She estimated further that for every acre lost as result of land reclamation filling or other perturbation, two additional ones are lost. Thus, the capitalized losses of seafood production potential in the same period sum up to about US$ 24 000.

Rapid deterioration of conditions in the Kingston Harbour area since the mid-1960s resulting from heavy eutrophication and oil contamination though not spelled out in monetary terms by Wade (1976) threatens to destroy the fishery and recreational resources. The author concludes that urgent steps need to be taken to protect the fish and nursery grounds in Kingston Harbour and the Port Royal mangrove swamps.

As far as artisanal fishery alone is concerned, impact of oil pollution (see Table 2) and organic overload (see Figure 4) are likely to be most severe on the islands (see Table 3) and on some of the continental countries with a great number of people in the traditional sector (see Table 4). The reasons for this are threefold:

(1) Artisanal fisheries are carried out close to the shore, and coastal waters tend to be subjected to various kinds of pollution more often than offshore waters;

(2) artisanal fisheries mostly rely directly on susceptible habitats as mangroves and coral reefs, exploiting living demersal resources which also are more likely to be affected by pollution than oceanic pelagic species;

(3) artisanal fisheries and subsistence fisheries retain high economic importance in view of growing unemployment pressure and increasing local protein demand.

Thus, it is required to investigate more thoroughly in this matter to come up with more 'hard facts' as to the effects of pollution on artisanal fisheries to improve preventive, as well as recuperational measures against pollution and direct more effort toward the development of the traditional sector of fisheries.

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