



**A PRELIMINARY ASSESSMENT OF THE CONCH FISHERY  
ON THE SHELF AND BANKS OFF THE SOUTH COAST OF JAMAICA**

by

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**ABSTRACT**

There has been a recent rapid expansion in the fishery for conch on the south coast and banks south of Jamaica. This expansion appears to be primarily due to the entry into the fishery of several commercial scale vessels, in the 70 - 90 ft. size range with up to 20 divers using SCUBA and hooka gear. Preliminary estimates suggest that landings of conch meats in 1990 were somewhere in the vicinity of 2,100 metric tons. Export data indicate that about 800 and 1,200 metric tons of processed conch were exported in 1990 and 1991.

The landings appear to be coming primarily from Pedro Bank. Preliminary estimates of the potential sustainable yield of conch from Pedro Bank, based on estimate, from other areas of the Caribbean, are 600 - 800 metric tons per year. Therefore, it is likely that continued harvesting at current rates will rapidly lead to severe overexploitation. Rough estimates suggest that the fishery will reduce the resource past the levels required for MSY within the next 2 - 3 years. Experience elsewhere in the Caribbean indicates that conch stocks are easily reduced to such low levels that recruitment of young conch is diminished, and the fishery collapses with considerable loss in revenue.

(Abstract continued)

Various measures to reduce fishing effort have been employed in other Caribbean countries (shell size limits; meat weight limits; flared lip requirement (sign of maturity); closed seasons; closed areas; ban on SCUBA; catch quotas; limited entry by licensing; ban on fishing).

In the Jamaican context, meat weight limits and closed season could be applied. These measures might prevent the collapse of the resource. However, given the value of conch, they probably would not maintain the profitability of the fishery. Without limited entry by licensing, new entrants are likely to be attracted to the fishery until the stock has been depleted below its maximum sustainable yield, and well below its maximum economic yield.

This analysis is considered to be very preliminary, but is the best possible assessment given the information which is currently available. Efforts should be made to update information in this document, and to acquire more accurate information on which to base a revised management plan for this valuable resource.

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## **INTRODUCTION**

Conch have been exploited for decades on south shelf of Jamaica and the offshore banks to the south, by small-scale fishermen. In the early 1980s, production in the conch fishery appears to have increased due to the establishment or enhancement of collector systems on the cays and at landing sites, by exporters. In the late 1980s conch production appears to have increased substantially due to the introduction of commercial scale conch fishing, primarily on Pedro Bank, using vessels in the 60 - 80 ft. size range with 20 - 40 SCUBA and Hooka divers per vessel. This recent growth in fishing effort is reflected in what appears to be a dramatic increase in conch exports (see section below).

The apparent rapid increase in conch production from Pedro Bank resulted in the expression of concern by those involved in conch fishing and exporting, that the rate of exploitation of conch from the South Shelf and banks in general, and from Pedro Bank in particular, may exceed the potential yield of conch. Should this be the case, experiences in other parts of the Caribbean, indicate that overfishing would occur, and would result in the collapse of the fishery, or at best its persistence at marginally economical levels.

On the basis of these concerns, the Fisheries Division of Jamaica has asked the University of the West Indies, and the CARICOM Fishery Resource Assessment and Management Program for assistance in:

- A preliminary evaluation of the status of the fishery;
- Developing management options for consideration by the conch fishing industry and by the Minister of Agriculture, and;
- Developing a proposal for assessment of the conch resource in the area under consideration.

These three requirements for ongoing management of the conch fishery will be addressed in the current document which will provide the basis for further discussions.

## **THE CONCH FISHERY**

### **The primary sector**

Most of the conch currently exported from Jamaica appears to be harvested from Pedro Bank (*Figure 1*). However, conch are also occasionally taken from other banks such as Formigas Bank, and the Morant Bank, and from the South Shelf (*Figure 1*). The relative amounts of conch coming from these areas is not known. Formigas Bank, is considered to be relatively productive, Morant Bank is considered to be too deep for safe diving, and the South Shelf is considered to be either unproductive or overfished.

The conch fishery is pursued by three groups of fishermen, each of which is described below.

Small-scale fishermen resident on the Pedro Cays. These fishermen free-dive in the vicinity of the cays to depths of 15 m. They take their catch ashore to break and clean it. It is sold to collector boats.

Small-scale fishermen who go out from fishing beaches on Jamaica. These fishermen often dive with SCUBA, in the vicinity of the cays to depths of about 25 m. They may also dive on the South Shelf. They may sell their catch to collector boats, or bring it back to the fishing beach where it is sold to buyers for export.

Commercial-scale fishermen. These fishermen operate from vessels 20 - 30 m in length, with 20 - 40 divers using SCUBA and Hooka gear, operating all over the Pedro Bank, to depths of about 25 m. The conch are broken and cleaned on the bottom, then taken to the main vessel where they are either frozen or iced. The commercial vessels currently licensed to fish conch in Jamaica are described in Table 2. Details of many of these vessels remain to be acquired.

### **Processors / exporters**

There are about six companies currently processing / exporting conch from Jamaica.

B and D trawling (1 Port Royal St., Kingston, Mr. Bunny Francis, Proprietor): operates three commercial scale vessels, usually on Pedro Bank.

Grace Kennedy. Ltd. (Harbour St., Kingston) operates two commercial scale vessels.

Mr. Sydney Francis: Operates one commercial vessel (*Table 1*), and one collector boat which purchases conch from Pedro bank.

Mr. Percy Lambert (Rocky Point, Clarendon): Purchases from small-scale fishermen at Rocky Point and on Pedro Bank.

Miles Franklyn Commodities Ltd.: Whitehouse, Westmorland, operates three boats from Whitehouse, sometimes landing the catch in Montego Bay.

Letts: This exporter purchases conch from small scale fishermen on various beaches.

Marine Products Ltd.: purchases conch from small scale fishermen on various beaches.

Annual exports (kg) in the category 'other crustaceans and molluscs', believed to be primarily conch appear to have increased dramatically between 1986 and 1990 (*Figure 2*, Table 3). These data were acquired from the External Trade reports published annually by the Statistical Planning Unit. Figure 2 also shows lobster exports, which have declined steadily since 1986. This suggests that there may be a relationship between the declining lobster exports and increased conch exportation.

Details of the exact composition of the exports in the above category, and of the destinations of the conch are not provided in the reports but can be accessed through the Statistical Unit.

### **Estimated landings**

There are no firm estimates of the landings of conch from the areas discussed above. Two approaches were taken to estimating the landings. The first approach was to ask major participants to provide information on the landings which their enterprise accounted for in 1990, and 1991 (*Table 2*). These estimates were discussed at a meeting with the conch industry in August 1992. The total estimated landings at this point are in the vicinity of 2,100 mt / yr.

The second approach was to work backwards from the export figures. At the conch meeting participants noted that there were various levels of product loss due to processing for export, and agreed that on average there would be about 25% loss in processing. It was also observed that about 70% of conch landed in Jamaica was exported. On the basis of the recorded values of 800 and 1,200 mt of conch exported in 1990 and 1991 respectively, and the above percentages, the estimated total landing for 1990 and 1991 respectively would be about 1,500 and 2,300 mt of cleaned meats.

The two estimates of landings are very close for 1991 but the 50% increase in exports in 1991 is not reflected in the fishing industry's estimates of its own production. However, the figures indicate that 1,500 mt would be a minimum estimate of conch landings in Jamaica.

### **POTENTIAL YIELD OF CONCH FROM PEDRO BANK**

The potential yield of conch from the fishing grounds described above is unknown. In this paper, the focus will be on the potential yield from Pedro Bank. There are several approaches to estimating potential yield of a fishery resource. All of these require data which do not exist for the Pedro Bank fishery, and which could not easily be acquired in an appropriate time frame. The application of these approaches will be discussed below under assessment requirements, with a view to determining the best approach for longer-term assessment of the conch resource. For the purposes of acquiring a rough estimate of potential yield, this document will use estimates of potential yield from other areas in the Caribbean (*Table 4*). These are quite variable, ranging from 0.033-0.263 mt/km<sup>2</sup>. The upper value is considerably higher than all the rest, and subsequent work indicates that the mortality rate which was used in the estimate was probably too high. *Table 4* suggests that a value of about 0.100 mt/km<sup>2</sup>, would be about average for the Caribbean.

The extent to which these estimates can be extrapolated to Pedro Bank will depend of the similarity between Pedro Bank and these areas as regards the amount and quality of conch habitat; namely, the relative amounts of sand, seagrass, reef, etc., in the various areas shown above, as compared to the amounts on Pedro Bank. The best available information on the distribution of habitats on Pedro Bank (*Figure 3*) is provided by Dolan (1972). Unfortunately, there is no documentation on which to base a rapid comparison of habitats between the various areas.

The average depth of Pedro Bank (about 25 meters, Munro, 1983) is probably greater than that in the areas used for comparison. The major effect of this may be to limit suitable nursery / juvenile habitats, which tend to be in shallow areas. If nursery / juvenile habitat is limiting, recruitment to the Pedro Bank stock may be lower than to the other areas, and MSY may be lower than in those areas. In this case, the fishery may be harvesting biomass which have accumulated over many years, but which does not replenish itself as rapidly as other areas with higher rates of recruitment.

The total area of Pedro Bank is 8,040 km<sup>2</sup>, with the distribution of depths as follows (Munro, 1983):

Depth range (m)	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
Area (km <sup>2</sup> )	171	2219	3700	1742	206
Percent of total	2.1	27.6	46.1	21.7	2.6

If we consider the entire bank to be harvestable, and apply the estimated yield of 0.100 mt/km<sup>2</sup>/yr to this area we arrive at an estimate of about 800 mt / yr. However, if the bank is harvestable only down to depths of 30 m, the estimated yield becomes about 600 mt / yr. Note that it is common fishery management practice to target yields at about two-thirds MSY, to provide a safety margin, and to increase economic efficiency of the fishery.

## STATUS OF THE RESOURCE

The estimated landings exceed the estimated potential yield by a factor of two to three. In considering the implications of this observation, several points must be born in mind.

- All sources of landings have not been accounted for, therefore, landings may be higher than shown in Table 3.
- Further to the above point, foreign fishing, and sales to foreign vessels are reported to occur, but to an unknown extent. These have not been included in the estimates of landings.
- All the conch landed does not come from Pedro Bank, and the proportion coming from other areas is unknown. Maximum sustainable yield from these other areas has not been estimated. However, indications are that most of the landings are from Pedro Bank.

Despite the uncertainty associated with the estimates presented above, it appears likely that if the current level of fishing effort is sustained, the conch resource on Pedro Bank will be overexploited. The scenario which is usually associated with the overexploitation of a fishery resource is that catch rates (catch per diver per day) decline steadily as the resource is depleted until they reach a point where fishing is no longer profitable, or until the resource fails to reproduce successfully, and becomes 'commercially extinct'.



The rate at which the resource will be depleted when the rate of exploitation exceeds the rate of production depends on the initial abundance (standing stock) of the resource. There are no surveys of abundance of conch in Jamaican waters which can be used to estimate initial abundance. However, there is information on the density of conch from other areas in the Caribbean. The available data indicate that conch density is considerably higher in lightly fished areas -- the Great and Little Bahama Banks - than in heavily fished areas (Table 5). If we consider Pedro Bank to have been lightly fished prior to 1990, and apply an average density for the Bahama Banks (2,465 individuals / km<sup>2</sup>) to the area of Pedro Bank shallower than 40 meters, the estimated standing stock is about 20 million individuals. Conch processors report that there are, on average, 3 cleaned conch meats / lb, in the catch from Pedro Bank. Therefore, the estimated total weight of meats on Pedro Bank before 1990 would be about 3,000 mt.

Clearly, at the current rate of fishing (1,500 mt / yr) it would take only 1 - 2 years to remove most of the standing biomass. It is also necessary to consider the rate of production of the resource. This has already been estimated in the vicinity of 600 - 800 mt / year. Such production levels would be expected at intermediate levels of stock biomass. Therefore, even considering both standing stock and production together, it is unlikely that the resource could sustain the current fishery for more than a few years.

Given that there have already been almost three years of fishing, one would expect that the industry would already have noted significant depletion in some areas and reduced catch rates. There are several reasons why the rough estimates of standing stock and production above could be in error, but given the information from other areas of the Caribbean, it is unlikely that they would be in error by more than a factor of two. Even if both these values were double our estimates, the resource could not sustain the current levels of harvest for more than 2 - 3 years longer, and would currently be in the vicinity of the level of abundance at which MSY would be expected (i.e. half the original biomass).

It must also be born in mind that as the abundance of conch goes down, the catch rates will also decline. This will slow the depletion process, and will reduce profitability.

## **MANAGEMENT OPTIONS**

### **Management measures**

A variety of management measures have been used in various areas of the Caribbean in attempts to prevent overexploitation of conch, These are summarised in Table 6 and discussed below. A more general discussion of management options for conch can be found in Mahon (1990).

#### Shell size limits, meat weight limits and flared lip requirement

The measures are all aimed at reducing or eliminating the harvesting of immature individuals. Shell size and flared lip regulations are only useful when conch are landed in the shell. This is never the case for the commercial fishery in Jamaica, but does occur in the small-scale fishery is unknown. Therefore, although meat weight limits would be most useful measure for Jamaica, the

flared lip indicator might be useful in certain situations. The former could be spot checked on the dock and in processing plants.

The appropriate limit should be determined by a study of size at maturity for the stock in question. However, an interim limit could be established on the basis of information from other areas. The OECS have adopted a limit of 8 oz. (224 g.) for unprocessed meats.

Although the flared lip, taken as an indicator of maturity, is not useful as a regulatory measure, fishermen could still use it as an indicator, and avoid harvesting individuals without a flared lip.

### Closed season

Closed seasons have been used to protect conch during the period of reproduction. The appropriate period should be based on a study of the reproductive season for the stock in question. However, other studies indicate that the conch reproductive season is more or less the same throughout the Caribbean (Appeldoorn, et al 1987, Stoner, et al. 1992):

Venezuela	early July – mid November
St. John, USVI	late April – late November
Turks and Caicos	February / March – November / December
Puerto Rico	mid March – mid November
St. Kitts & Nevis	mid May – mid November
Florida	late May – September
Jamaica	pre-July – late November

A closed season somewhere during the period from April to November could be considered for conch in Jamaica. A closed season would be relatively easy to enforce if it were island wide. However, foreign fishing and sales to foreign vessels would have to be strictly controlled.

### Closed areas

Closed areas are generally used to eliminate fishing in areas where there are abundant small individuals; that is know nursery areas. Two individuals interviewed indicated that there were specific areas on Pedro Bank where extremely high densities of juvenile conch had been seen. Closing such areas to fishing might be appropriate if large numbers of juvenile conch were being landed. This is not currently the case, but might become so as stocks of adults become depleted. Enforcement of closed areas on Pedro Bank would be difficult.

### Ban on SCUBA

In view of the depths at which the fishery is being conducted, any ban on SCUBA or Hooka would essentially eliminate the commercial fishery.

### Catch or export quotas

Catch or export quotas can be either for the entire fishery, or for specific vessels/enterprises. To enforce a single quota for the fishery, it must be possible to monitor landings, and close the fishery when the quota has been met. In the absence of individual vessel licenses, this approach usually results in a race for the quota. This requires investment in vessels and gear, which may then sit idle after the quota has been taken. The closure of the fishery also results in unemployment.

Individual vessel or company quotas imply that there will be licensing of vessels and/or exporters. How many vessels should be licensed, and how quotas will be allocated should be decided in consultation with the industry. First it will be necessary to determine the overall allocations for commercial and small-scale fisheries.

### Limited entry by licensing

As indicated above, this is a prerequisite for vessel quotas. However, it may be used alone as a means of controlling exploitation. Usually, the number of vessels which can be licensed is determined on the basis of the harvesting capacity of the vessels, and the potential yield.

### **Special considerations**

#### Conflicts between commercial and small-scale fishing

There is a potential for conflicts between the newly established commercial fleet and the small-scale fishermen. The latter fish primarily by free-diving in areas shallower than 20 m, and near to the Pedro Cays. There have been some observations by small-scale fishermen relating to depletion of conch in these areas. Spatial separation of the two fleets could be achieved by zoning. For example a zone in the general areas shown as 'Pedro Cays Area' and 'Eastern Pedro' for small-scale fishermen might be appropriate.

If zoning is considered to be an appropriate approach, then potential yield can be estimated separately for the two zones and the management measures used in each zone can be geared to the type of fishery.

#### Consultation with the fishing industry

There should be ongoing consultation with the fishing industry in developing an approach to managing the conch fishery. The commercial component of this fishery requires considerable investment, and their owners / operators usually have a significant stake in the future of the fishery.

In particular, the commercial subsector should be involved in setting management objectives for the fishery. For example, they should be consulted with regard to the level of risk of overexploitation they would consider acceptable. This would play a role in determining what safety margin (e.g.  $\frac{2}{3}$  MSY) should be employed. As indicated above, these decisions are also

related to the decision as to whether the fishery should be managed with a view to gross revenue, or profitability.

### Foreign fishing

It will be very difficult to gain the cooperation of the Jamaican participants in managing the conch fishery on Pedro Bank until they are confident that there is no significant amount of foreign fishing or sales to foreign vessels.

## **ASSESSMENT REQUIREMENTS**

The approach to resource assessment which will adequately address the long-term management needs for conch in Jamaica will depend on the management measures which are considered feasible. In any case, there will be the need for accurate data on catch, catch location, and fishing effort. Further assessment activities are medium to long-term undertakings which are described in the revised version of the preliminary assessment (Mahon et al. 1992).

### Catch and effort monitoring

Data on catch and fishing effort are essential for an assessment of the resource, and for monitoring the status of resource and its response to fishery management. A trip reporting form is essential for commercial vessels. It will be necessary to conduct random spot checks on vessels as they land to ensure that the forms are being completed accurately.

In order to acquire information on landings by the small-scale fishermen, processors should be required to report their purchases monthly.

### Stock abundance survey

The abundance of juvenile and harvestable conch on Pedro Bank should be determined by a diving transect survey, such as has been carried out in other areas (Wood and Olsen, 1983; Smith and van Neiroop, 1984; Berg et al. 1992a; Berg et al. 1992b). This survey should take the seasonal variation in availability of conch into account.

### Breeding season

The breeding season of conch on Pedro Bank should be determined in order to define the most appropriate closed season. This could be done by sampling on commercial vessels, and would require the cooperation of the operators in bringing uncleaned meats on board.

### Growth and maturity

Growth and size of maturity of conch on Pedro Bank should be determined in order to set the appropriate minimum size for maintenance of spawning stock biomass, and to provide advice on

optimisation of yield per recruit. This study could also be carried out from commercial vessels, but would require additional sampling of small conch.

The above analyses will also require information on the size distribution of conch in the commercial catch. This information can be gathered at landing points by a sampler.

## CONCLUDING REMARKS

In conclusion, it appears that extreme overfishing could be expected in less than three years. Conch fisheries throughout the Caribbean have experienced extreme overexploitation (Brownell and Stevelly, 1981; Berg and Olsen, 1991). This has usually manifested itself as a dramatic reduction in catch, and has sometimes required closure of the fishery (Munoz et al. 1987; Hunt, 1987; Moore, 1992). If management is aiming at  $\frac{2}{3}$  MSY or even MSY it is clear that urgent action will be required. It is well known to fisheries managers that once fishing effort has developed past the target levels, it is very difficult to reduce it.

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**Table 1: Vessels licensed to fish conch in Jamaica**

Vessel	Length (m)	Description	Company	Base	Notes
El Indio	23		B & D Trawling Ltd.	B & D Trawling Ltd., Kingston	
Cachita	23		B & D Trawling Ltd.	B & D Trawling Ltd., Kingston	
La Coca	?		B & D Trawling Ltd.	Nicaragua	
Mefal Adventure	25	Leased from Capt. Andy Goll. Two 20,000 lb freezers, 30 – 40 divers, SCUBA & hooka	Sydney Francis	Kingston Fisheries Complex	
Iquazi	26	Freezers	Miles Franklin Comm. Ltd.	Whitehouse, Westmoreland	Relocated to Miami in 1992
Hope	23	Freezers	Miles Franklin Comm. Ltd.	Whitehouse, Westmoreland	Relocated to Miami in 1992
Dream Girl	23	Freezers	Miles Franklin Comm. Ltd.	Whitehouse, Westmoreland	
Water Spirit			Grace Kennedy Co. Ltd.	Kingston Fisheries Complex	
Kalpha			Grace Kennedy Co. Ltd.	Kingston Fisheries Complex	

**Table 2: Estimated landings of conch in Jamaica** accounted for by the fishing or processing operations of various participants in the conch fishing industry

Participant	Type	Landings (mt)		Notes
		1990	1991	
Grace Kennedy Ltd.	Commercial	600	600	Estimated at industry meeting, relative to landings by B & D Trawling
B & D Trawling Co. Ltd.	Commercial	800	800	Based on 3 boats landing about 80,000 lbs / month each for 7 – 8 months / year.
Sydney Francis	Commercial Small-scale	0	250 ?	Based on 1 boat landing about 80,000 lbs / month for 7 – 8 months / year. Figures for collector boat to be provided.
Miles Franklin Commodities Ltd.	Commercial	500	?	Based on 2 boats landing about 80,000 lbs / month each 7 – 8 months / year.
Percy Lambert	Small-scale	110	110	Based on an estimate of about 20,000 lbs / month
Lett	Small-scale	?	?	No contact with participant
Marine Products	Small-scale	?	?	No contact with participant
Total		2,010	2,260	

**Table 3: Exports (kg) of lobster and other crustaceans and molluscs (crus / moll) assumed to be primarily conch, from Jamaica, 1979 - 1990.**

Year	Lobster			Crus / Moll		
	Frozen	Other	Total	Frozen	Not frozen	Total
1979	11,285	1,251	12,536	1,355	0	1,355
1980	7,025	2,202	9,227	0	0	0
1981	21,421	7,099	28,520	0	0	0
1982	18,921	3,578	22,499	0	0	0
1983	30,594	795	31,389	317	0	317
1984	38,519	613	39,132	5,658	0	5,658
1985	130,814	14,499	145,313	4,914	0	4,914
1986	115,567	929	116,496	22,124	0	22,124
1987	94,455	129	94,584	35,107	11,773	46,880
1988	69,838	4,590	74,428	91,992	9,453	101,445
1989	83,270	454	83,724	119,969	250	120,219
1990	75,565	218	75,783	649,752	171,632	821,384
1991	112,448	-	112,448	1,246,717	-	1,246,717

**Table 4: Estimates of maximum sustainable yield of queen conch (MSY ml/km<sup>2</sup>) from various areas in the Caribbean.**

Location	MSY	Method	Reference
Great Bahama Bank	0.054- 0.093 0.033	Biomass survey and Cadima's formula Revised above estimate to correct for bias	Smith & van Neiroop (1984) Appledoorn (1992)
Little Bahama Bank	0.152- 0.263	Biomass survey and Cadima's formula Revised above estimate to correct for bias	Smith & van Neiroop (1984) Appledoorn (1992)
Caicos Bank	0.101	Biomass survey and Cadima's formula Revised above estimate to correct for bias	Berg & Olsen (1989)
St. Thomas / St. John, USVI	0.116	Surplus production model	Wood & Olsen (1983) Appledoorn (1992)
St. Croix, USVI	0.101 0.057	Yield / recruit and recruitment Revision of above estimate	Wood & Olsen (1983) Appledoorn (1992)
Puerto Rico, West Coast	0.079 0.057	Yield / recruit and recruitment Revision of above estimate	Appledoorn (1992)
	0.057	Gulland-Fox surplus production model	



**Table 5: Estimates of density of queen conch in various areas of the Caribbean**

<b>Location</b>	<b>No. / km<sup>2</sup></b>	<b>Exploitation</b>	<b>Reference</b>
Great Bahama Bank	2,850	Low	Smith & van Neiroop (1984)
Little Bahama Bank	2,079	Low	Smith & van Neiroop (1984)
St. Thomas, USVI	970 1,225	High	Wood & Olsen (1983) Friedlander <i>et. al.</i> (1983)
St. Croix, USVI	760	High	Wood & Olsen (1983)
St. John, USVI	1,264	High	Friedlander <i>et. al.</i> (1983)
Puerto Rico, S. Coast	811	High	Torres (1987)
Florida Keys	1,157 -14	High	Berg. <i>et. al.</i> 1992a
Bermuda	52	Low <sup>1</sup>	Berg. <i>et. al.</i> 1992b

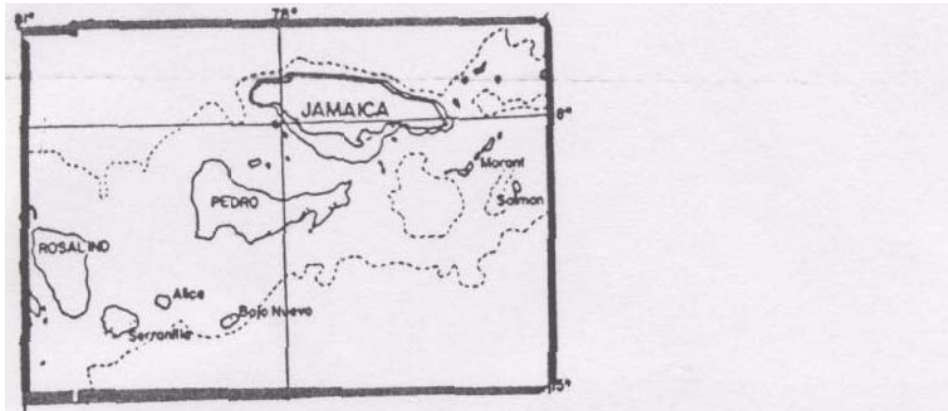
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<sup>1</sup> Previously very high

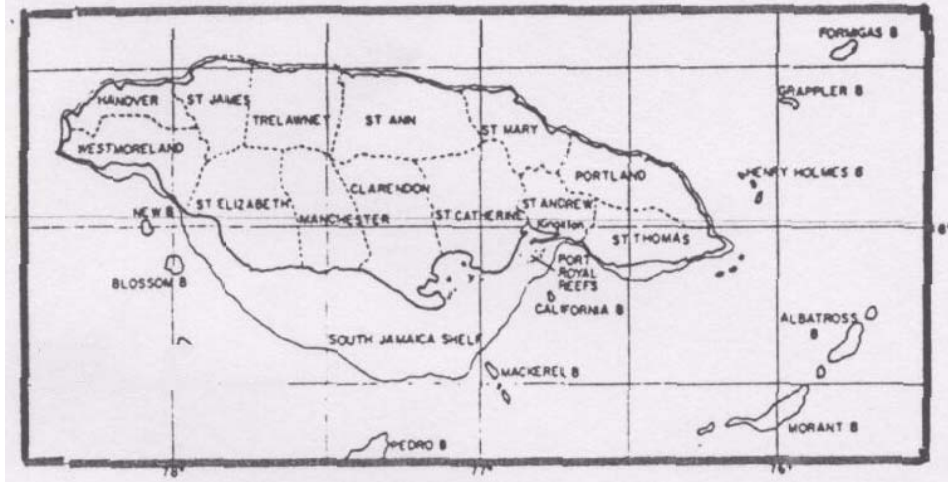
**Table 6: Summary of management measures which have been used for queen conch in various Caribbean countries.**

Location	Shell size limit	Meat wt limit	Flared lip	Closed season	Closed area	Ban on SCUBA	Catch quotas	Limited entry	Ban on fishing
Bahamas	X		X						
Belize	>18 cm	>84g process	X	July - Sept.		X	X	X	
Bermuda									X
Bonaire	>20 cm			X	X				
Cuba				X			780 mt		1978-1982
Florida									X
French Antilles						X			
Turks & Caicos	>18 cm		X			X			
Venezuela				Dec. - April				X	
Puerto Rico									
OECS islands		224 g cleaned	X	Mar. / April - Sept.		X			
St. Thomas / John, USVI									5yr. 1988-
St. Croix. USVI									5yr. 1988-

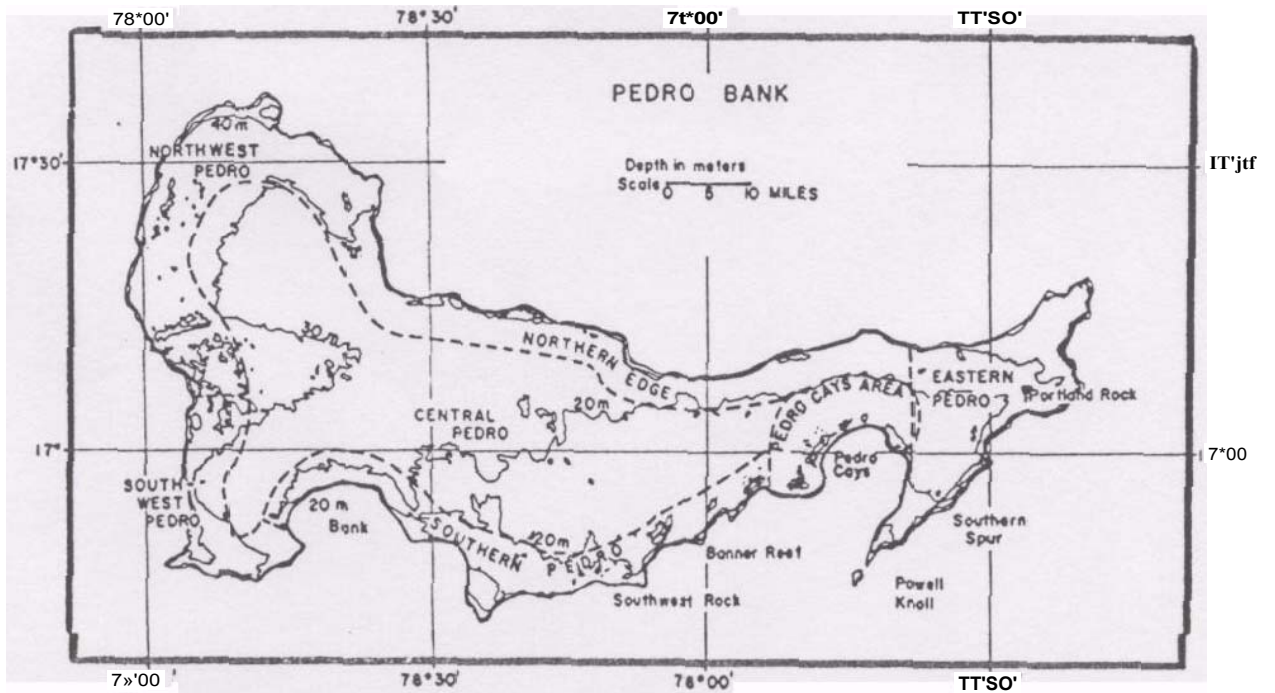
(a)



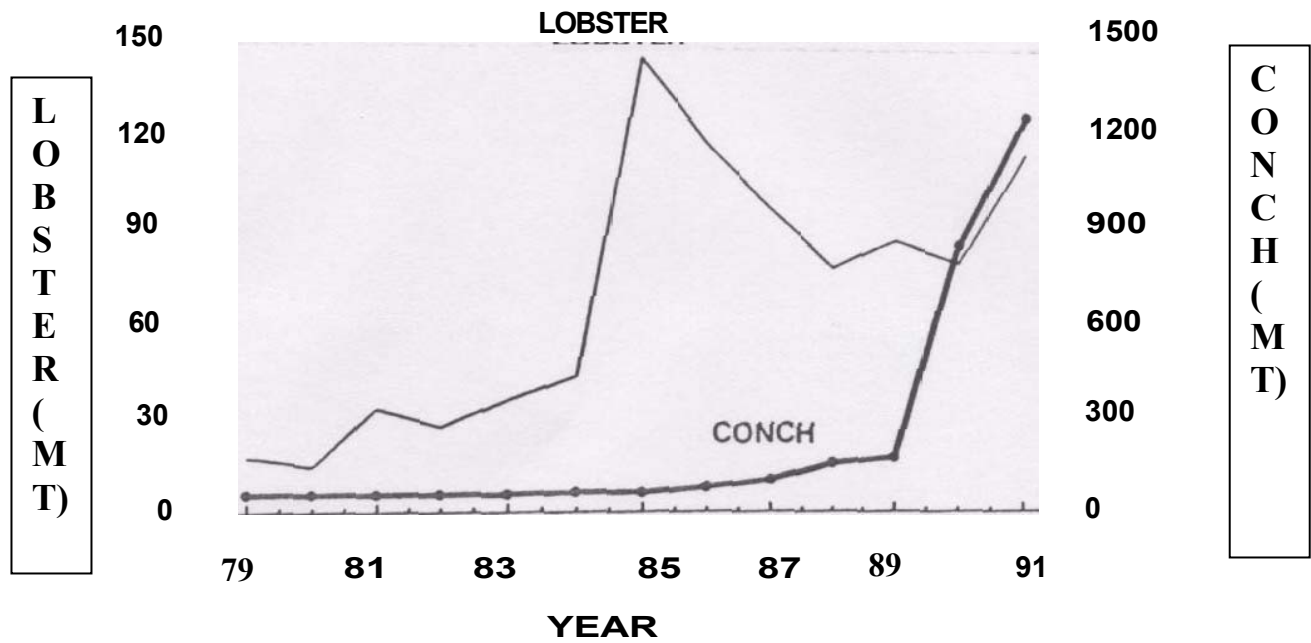
(b)



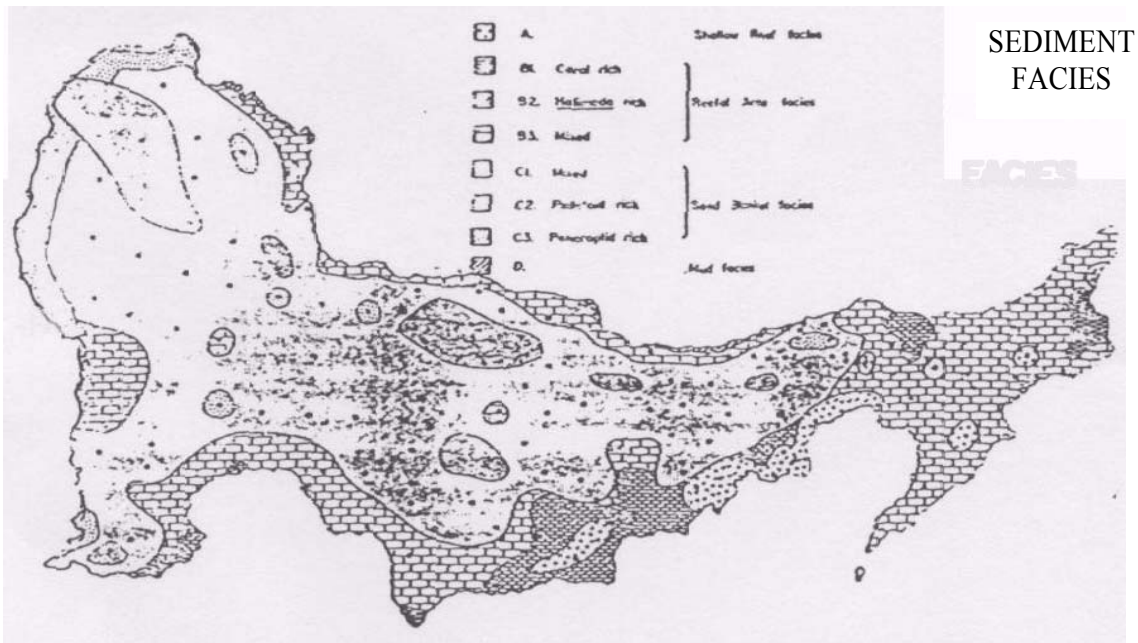
(c)



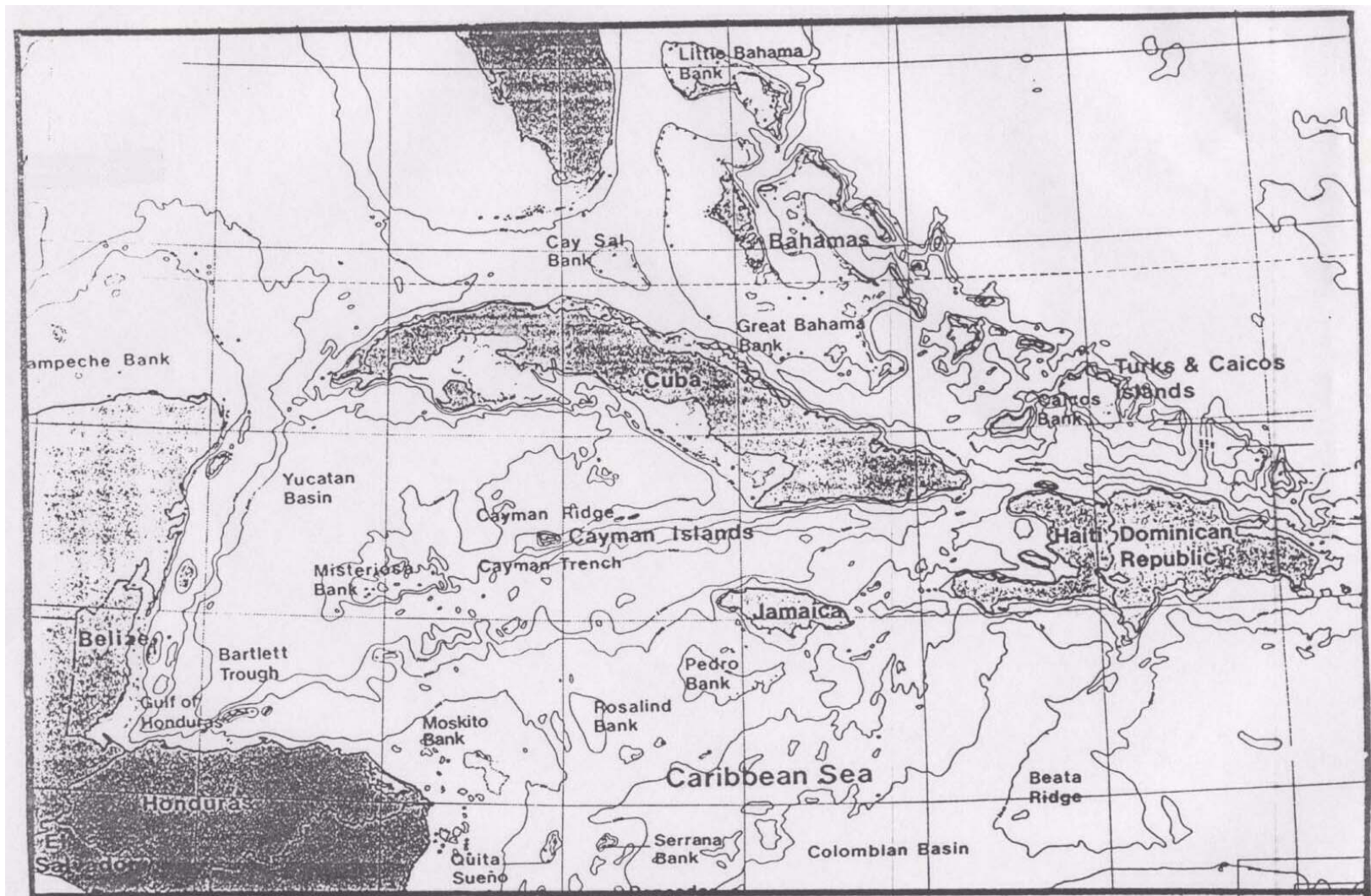
**Figure 1: (a) Offshore banks in the area of Jamaica; (b) The south shelf; (c) Pedro Bank (Munro, 1983).**



**Figure 2: Exports (kg) of lobster and other crustaceans and molluscs (crus / moll) assumed to be primarily conch, from Jamaica, 1979 - 1990**



**Figure 3: Sediment Facies.** The shallow reefs facies is restricted to the southeastern side of the Bank, while the allied Reefal Areas facies is present as a discontinuous peripheral zone around the entire Bank. The Sand Blanket facies occupies a central position, while the mud facies is restricted to the marginal upper slopes (from Dolan, 1983).



*Figure 4a: Reference map for areas in the western Caribbean referred to in the text and Tables.*

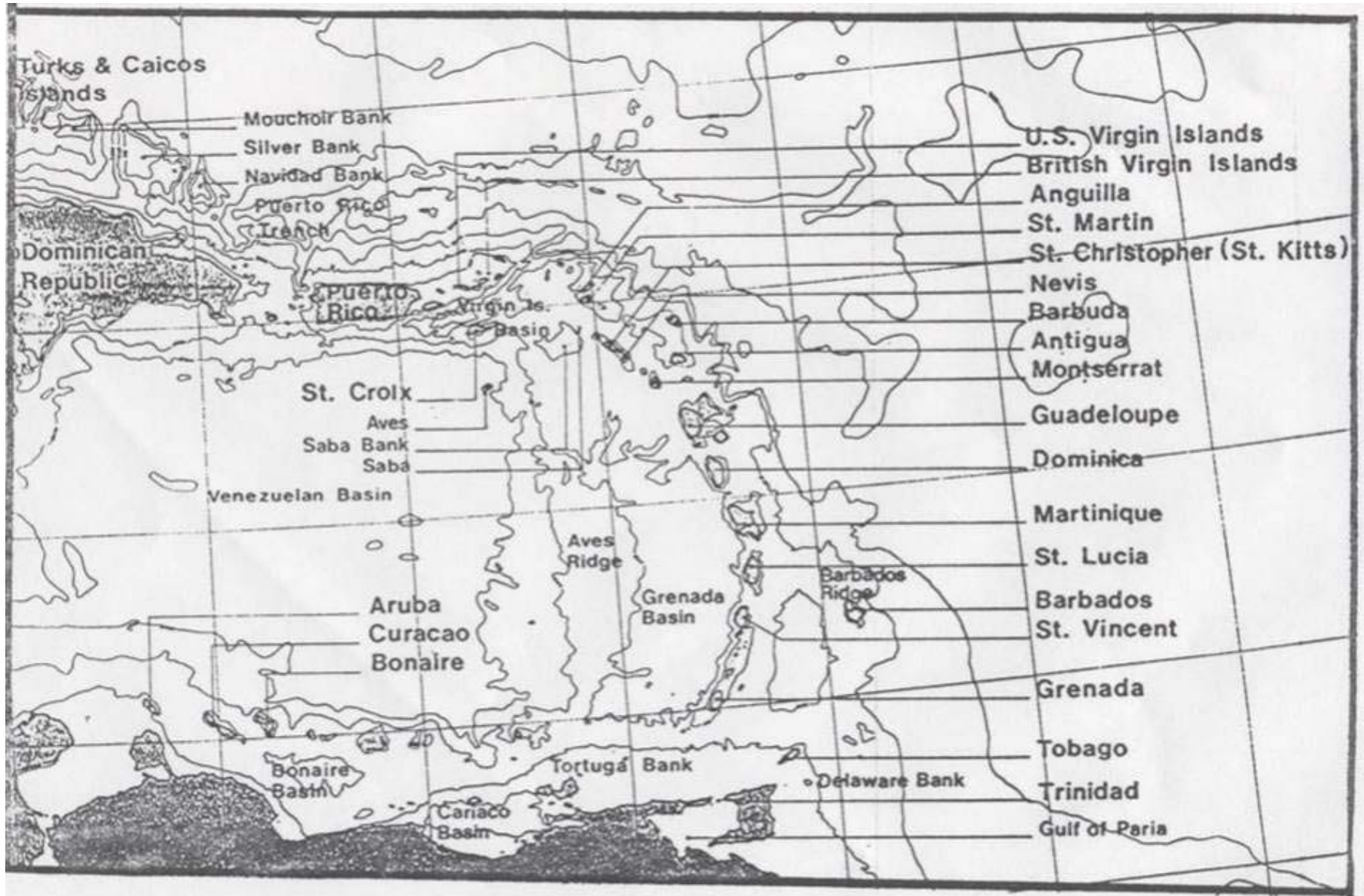


Figure 4b. Reference map for areas in the eastern Caribbean referred to in the text and Tables