# An Overview of the Fisheries of the Caribbean and Adjacent Seas

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ABSTRACT

The significance of fisheries of the Caribbean region is discussed in relation to environmental and geographical influence. Historical information provides insight into the importance of fisheries in relation to other industries.

Reasons for the lower fisheries productivity of the Caribbean relative to northerly regions are elaborated. Dominant fisheries and major species are ranked. Most current data on catch by country is tabulated.

Recent reports indicate a reduction in Cuban fishing fleet activity.

## HISTORY

Discovered and first explored by Christopher Columbus, the Caribbean Sea was named after Carib, a warlike tribe of cannibalistic Indians that inhabited some of the Lesser Antilles at the time of the European conquest.

The Spanish eventually settled the Greater Antilles and either killed or absorbed into their culture the Carib and Arawak Indians native to the islands. The Antilles held especial economic promise because of their proximity to gold deposits, supplies of Indian labor, easy access, fertile soil, and favorable climate. The region became known for its production of sugar, coffee, spices, and tropical fruits (Sakolowsky, 1981).

The importance of the Antilles changed as the Spanish advanced into the New World through México and Perú, and the islands mostly became strategic forts and supply bases. For centuries the Caribbean was a war zone fought over by European powers—England, France, Spain and Holland—as well as pirates.

Due to the growth and moderate costs of air transportation the islands in the Caribbean have become major tourist centers. The Windward Passage is a principal steamship route between the eastern United States and the Panamá Canal. An important oil industry has developed especially along the coast of Venezuela near Lake Maracaibo and southeastern Trinidad. Since about 1950, great efforts have been made to modernize and expand fishing, which has become a major industry; spiny lobster and shrimp are the two major species harvested. The other dominant species in the Caribbean are Venezuelan sardine, snapper, tuna, grouper, mullet, and anchovy. The major ports are San Juan, Puerto Rico; Havana and Santiago, Cuba; Port of Spain, Trinidad; and Santo Domingo, in the Dominican Republic.

## AREA AND COUNTRIES

The Caribbean Sea and the Gulf of México are considered together under the name of the American Mediterranean. This name has been employed particularly by German oceanographers (Sverdrup *et al.*, 1961). Both bodies of water are partially enclosed in the Western Hemisphere, an extension of the Atlantic Ocean. This area is bordered by South América (Venezuela, Colombia) on the south, Central América (Panamá, Costa Rica, Nicaragua, Honduras, Guatemala, Belize, México) on the west, and the U. S. and the islands of the West Indies on the north and east. The Yucatán Channel, between Cuba and Yucatán, connects the Caribbean Sea with the Gulf of México, numerous passages between the islands join it to the Atlantic, and the Panamá Canal furnishes access to the Pacific Ocean.

The total area of the American Mediterranean is about 4,023,500 $km^2$ (1,173,253 $mi^2$). Several ocean deeps extend to depths greater than 7,000 m (23,000 ft). The greatest measured depth is the Bartlett Deep (7,239 m/23,744 ft) in the Cayman Trench, between Cuba and Jamaica, in the Caribbean Sea.

The West Indies, which form the nucleus of the Caribbean Region, consist of two main groups: The Greater Antilles (Cuba, Jamaica, Hispaniola, and Puerto Rico) to the north and the Lesser Antilles, which again are subdivided into the Windward and Leeward islands, to the east. The major channels separating the islands are Windward Passage, between Cuba and Hispaniola; Mona Passage, between Hispaniola and Puerto Rico; and Anegada Passage, between British and U. S. Virgin Islands.

The Caribbean region is of major importance for international shipping to and from the Panamá Canal and for its natural resources, including oil. It is also a major tourist and recreation area of the Western Hemisphere.

Nevertheless, the fishing area considered for the purpose of this paper corresponds to the Western Central Atlantic fishing area 31 of FAO (Food and Agriculture Organization of the United Nations), which is better suited to state the catch and landings of fish and shellfish in the American Mediterranean region.

According to Villegas (1983), this region is called "Great Caribbean", and it is limited by latitudes 35°N (Cape Hatteras, U. S.), 10°S (N. Recife, Brazil) and longitude 40°W (Figure 1).

This geographical area is under WECAF (Western Central Atlantic Fisheries Commission of FAO). There are about 200 million inhabitants among the shores of 36 political units. They talk five languages and several dialects. The area of 42 % of the countries is equal to or smaller than 1,000 $km^2$; one of them is only 50 $km^2$ in area.

There are large and suitable continental shelves for trawling fisheries in the Gulf of México and along South América. In the WECAF area there are 160 river systems; among them there are some of the world's most important, such

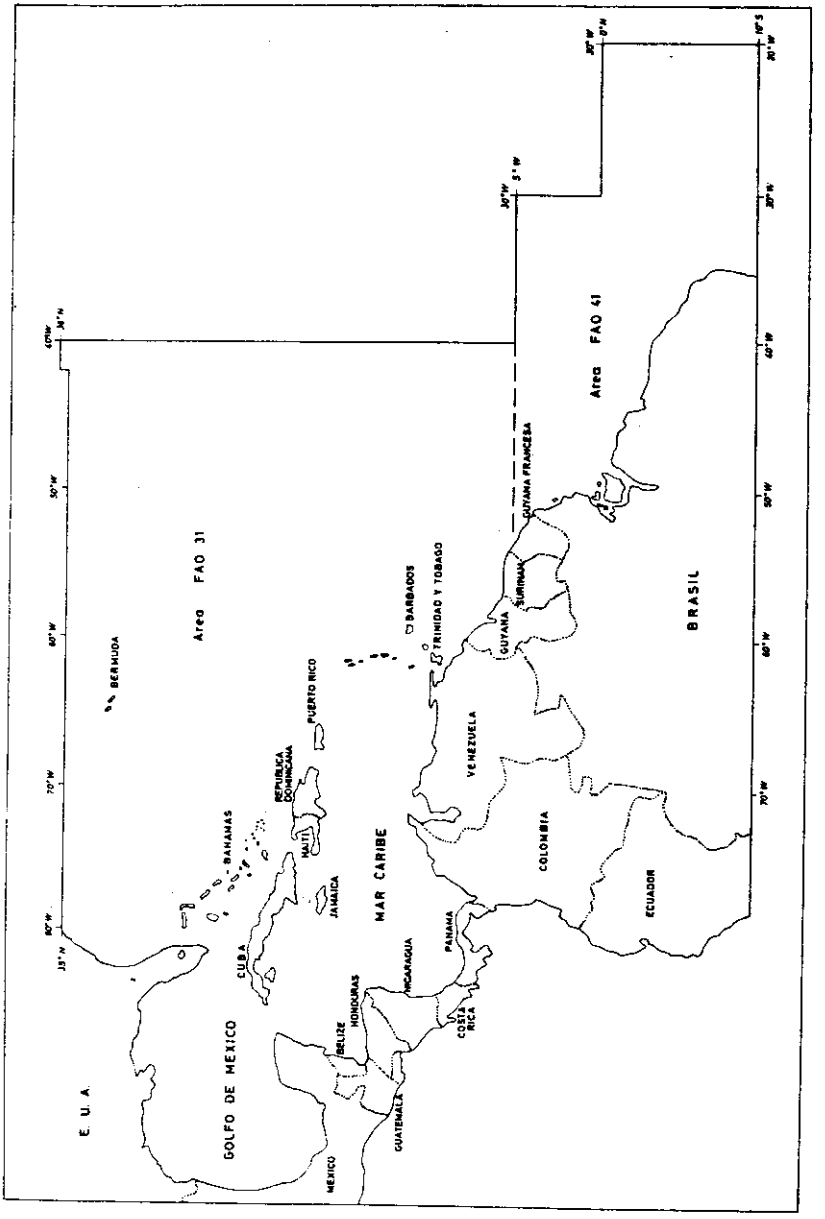


**Figure 1.** Area of the Great Caribbean Region according to Villegas (1983).

as the Amazon, Mississippi, Orinoco, and Magdalena. They pour great quantities of fresh water into the sea and develop huge estuarine areas in some of the fringes of the American Mediterranean.

## ENVIRONMENT

The borders of the Caribbean Sea (Figure 2) are characterized by many small volcanic islands, coral reefs, and irregular shorelines. The floor consists of a complex structure of ocean ridges, trenches and basins (Rand McNally, 1979). The Jamaica Ridge, one of the major oceans ridges, runs from Honduras through Jamaica to Hispaniola and divides the sea into two major basins, western and eastern. The former is, in turn, divided by Cayman Ridge into the Yucatán Basin, more than 4,000 m (13,120 ft) deep, and the Cayman Trough, the deepest part of the sea, more than 7,000 m (22,960 ft). The Beata Ridge divides the eastern basin into the Colombia and Venezuela basins, which are about 4,000 m (13,120 ft) and 5,000 m (16,400 ft) deep, respectively. The Aves Ridge separates the easternmost part of the sea, the Granada Trough (3,000 m / 9,840 ft), from the Venezuela Basin. Other minor depressions include the Tobago Basin, the Virgin Islands Basin, the Dominican Trench, and the Cariaco Trench. The average depth of the basin floors is about 4,400 m (14,430 ft).

The bottom is composed of sedimentary rocks overlaid with carbonate marine sediments that consist mostly of tan to brown muds containing varying amounts of coarse organic particles. The sediments average about 1,500 m (4,920 ft) in thickness, reaching a maximum of 12,000 m (39,370 ft) in the area of the Curacao Ridge.

Water in the top few hundred feet of the Caribbean behaves as an extension of the North Atlantic Ocean. The Guiana Current and part of the North Equatorial Current flow past St. Lucia almost unimpeded into the Caribbean and continue westward at a speed of nearly 20 miles (37 km) a day (Figure 3). In the western Caribbean, the trade winds cause a surface flow of water northward, away from the coast of South America. This is replaced by nutrient-rich water upwelling from a depth of about 650 feet (198 m), and these extra nutrients support an important fishing industry.

Farther west, the main current turns north, through the Yucatán strait into the Gulf of México, where the "Loop Current" channels the water toward the Florida Straits and back into the Atlantic to join the Gulf Stream. The turn that the Loop Current tries to make is sharp, and it often becomes unstable, forming a large meander which may itself be cut off, leaving an eddy of warm surface water drifting westward across the Gulf of México.

According to Molinari *et al.* (1980), the distribution of surface currents in the Caribbean Sea is one of several variables required to determine the trajectories of floatable materials which have been injected into the area. For instance, the surface distribution of plankton, fish larvae, and pollutants, as well

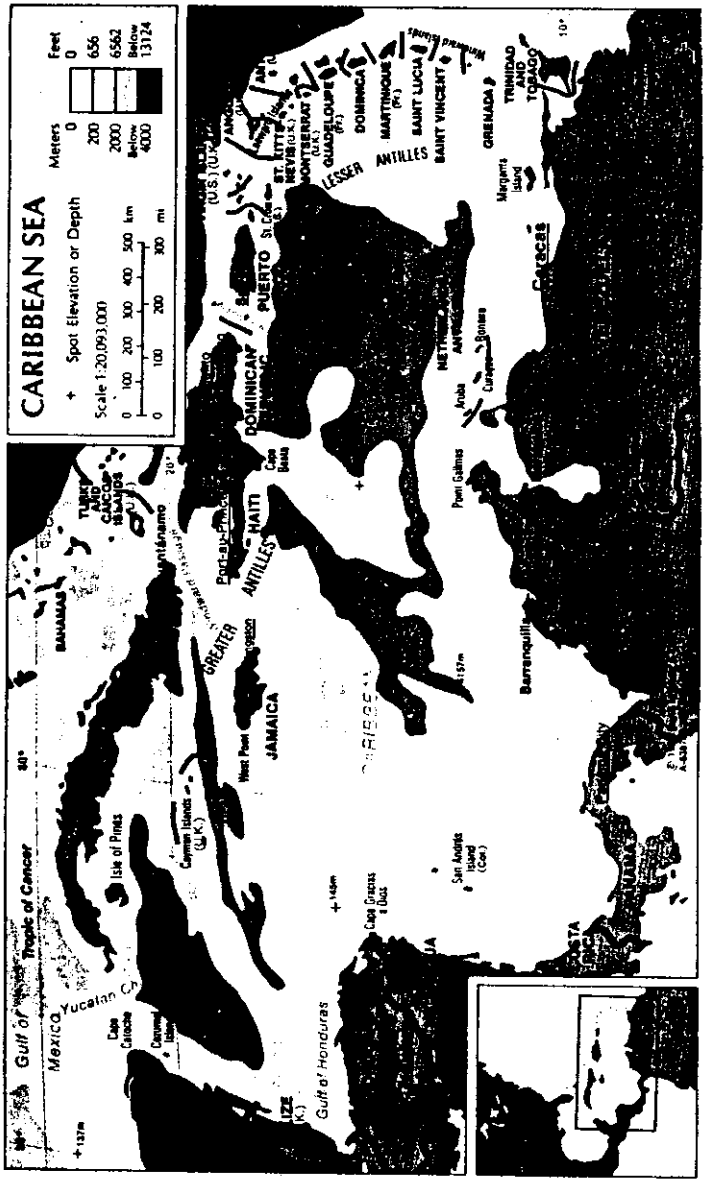


**Figure 2.** Caribbean Sea (Sakalowsky, 1981).

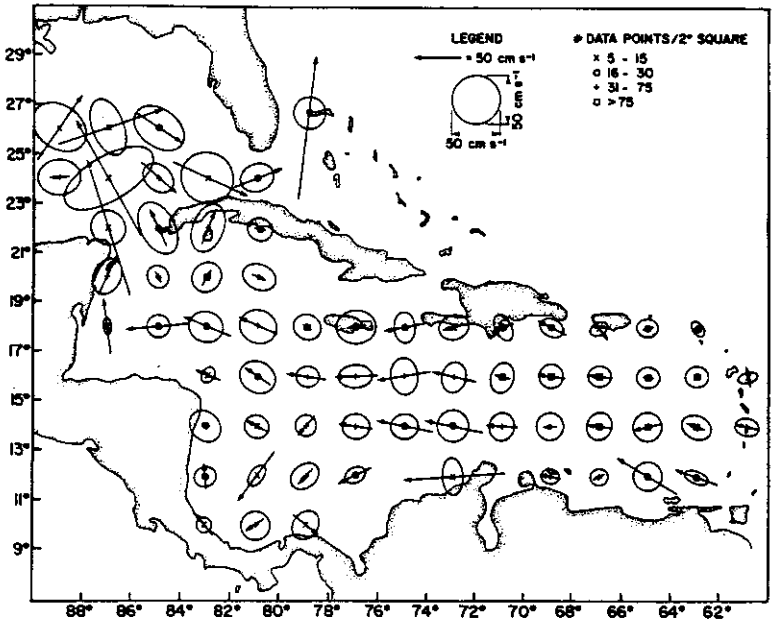


**Figure 3.** Average currents in the Caribbean Sea and Gulf of México for the period October 1975 to June 1976 (Molinari *et al.*, 1980).

as their residence time in the Caribbean, are affected by the horizontal structure of the current field. Older current charts, as presented by Wust (1964) for instance, depict a surface drift over most of the Caribbean of between 50 cm/sec and 75 cm/sec to the west. This flow pattern would suggest a residence time in the Caribbean Sea of approximately 75 days for surface water flowing from the passages of the Lesser Antilles to the Yucatán Channel.

In accord with the above mentioned authors, an experiment was conducted in the Caribbean Sea from October 1975 through June 1976 to map the distribution of surface currents. Lagrangian drifters tracked by satellite were deployed in the passages of the Lesser Antilles and within the Caribbean Sea. The buoy trajectories were considerably more complex than merely a westward drift, with several scales of meanders and eddies observed. The residence time in the Caribbean Sea for some of these buoys was over 5 months.

Figure 3 shows average currents in the Caribbean Sea and Gulf of México for the period October 1975 to June 1976 determined by averaging surface currents onto 2° x 2° grid. The axes of the ellipses centered on the grid points

represent the standard deviation of speed components normal to and along the mean flow (Molinari *et al.*, 1980).

The surface temperature of the seawater ranges from 23°C (73°F) to 29°C (84°F); the air temperature above it is always similar. Warm, moist air masses (maritime tropical) develop over these waters, and the climate is subject to an additional moderating influence from the northeasterly Trade Winds.

Winter air temperatures over the Caribbean average about 27°C (81°F) during the day and range from 21°C to 24°C (70°F to 75°F) at night. During July and August, the hottest months, temperatures approach 32°C (90°F). The windward side of the islands and coasts receive 2,000 to 3,000 mm (78 to 117 in) of precipitation annually. Torrential rains fall during June, July, and August; February and March are usually the driest months. The interior valleys and the leeward sides of mountains receive only 500 – 1,000 mm (20 – 39 in) of precipitation. The Caribbean is known for its long periods of fair weather; during the warmer months, however, the moist tropical air becomes unstable and produces a variety of tropical disturbances. Afternoon thunderstorms, which are sometimes intense, are common over both land and sea. From late July through October, hurricanes also develop, and frequently cause great damage to adjacent land areas.

Tannehill (1938) believes Columbus first encountered a hurricane in the region of Santo Domingo (Hispaniola) in October 1495. Almost every year some part of the Great Caribbean region is struck by a hurricane with torrential rains and devastating winds which produce enormous damage to people and properties. Among them one of the most affected groups are the fishermen, their craft, and gear.

Many island countries of the Great Caribbean region, as Cuba, Jamaica, Hispaniola, Puerto Rico, and the Lesser Antilles, have been severely impacted by these tropical storms since the last century. Hurricane "Allen" hit the Caribbean Islands to the Texas Gulf Coast, with highest wind speed of 120 mph (193 kmh) and estimated damage of 300 million dollars, from August 3 - 10, 1980. Over 200 people were killed in the Caribbean Islands; the highest tides in 61 years; and extensive damage to fishing gear and craft occurred.

Other dangerous hurricanes as "Donna" (1960), "Carla" (1961), "Cleo" and "Dora" (1964), "Betsy" (1965), "Camille" (1969), "Eloise" (1975), "David" and "Frederic" (1979), and "Alicia" (1983), took place in the Great Caribbean Region during the last 40 years.

Surface-water temperatures show small seasonal variations. A well developed thermocline exists at a depth of about 300 m (1,000 ft), below which temperatures are relatively uniform. At depths of 1,500 m (5,000 ft) or more, the water temperature remains at about 4°C (39°F) year round.

The salinity of surface water varies from 34.93 parts per 1,000 to more than

36 parts per 1,000, depending on the amount of evaporation, precipitation, and surface runoff. It is generally lowest in the northern part of the sea and highest in the southern parts.

Caribbean waters are composed of four water masses: surface waters, subtropical subsurface water, subantarctic intermediate water, and North Atlantic deep water. Most of the channels between the sea and the open Atlantic are so shallow that only surface waters intermix. Thus the movement of water at depths greater than 1,200 m (3,900 ft) is sluggish. Because of the poor circulation, the waters at these depths contain little dissolved oxygen and, as a result, little marine life. Some of the deeper channels play a major role in the Caribbean circulation. The Guiana Current flows northwest along the South American coast and enters the Caribbean Sea through passages between the Windward Islands of the Lesser Antilles. The water follows the deepest path through the Caribbean and exits through the Yucatán Channel. Some oceanic upwelling also occurs along the coast of Colombia and Venezuela, where surface water is replaced by deeper water. The sea receives relatively little runoff water. Some of its largest tributary rivers are the Magdalena and Atrato of Colombia; the San Juan, Grande and Coco of Nicaragua; the Patuca of Honduras; the Montagua of Guatemala; and other large rivers from South América and United States, mentioned before.

## FISHERIES

The Great Caribbean Region is generally less productive than many areas of the world ocean, and with the exception of the northern part of the Gulf of México most of the fisheries are small enterprises at a low level of sophistication.

Because the Caribbean area has enormous expanses of water does not mean that it automatically has large stocks of exploitable fishes, large enough to support major commercial fisheries. Nonetheless, localized fisheries of economic importance can be supported, and this will supply local regions with additional quantities of food and income (Proudfoot, 1984).

Caribbean people are relatively large consumers of fish and spend an important part of their scarce foreign exchange to buy fish from other nations (Idyll, 1966).

The relatively poor productivity of the region is due to three main factors: the lack of any major upwellings; the relatively narrow continental shelf, much of which cannot be fished because of coral reefs; and the lack of nutrient inflow to the surface waters. Nevertheless, many of the island and coastal inhabitants are occupied with fishing activities, and thousands of fishermen work the reefs and banks for shrimp, lobster, tuna, shark, snappers, groupers, and a wide variety of tropical fishes. The artisanal fishery is, for the most part, conducted from small craft—canoes and rowboats—although in recent years many have

been improved by the addition of inboard or outboard engines.

By far the most important fisheries of the area are those conducted for shrimp and menhaden, mainly in the Gulf of México. In recent years shrimp fisheries have developed off Central América, Venezuela, and the Guianas, but the largest and most mechanized fishery in the Caribbean is that based on the menhaden stocks in the northwestern Gulf of México. Here, large carrier vessels up to 130 feet in length pump the catch taken by purse seines into their holds and transport them to shore stations, where the catch is processed into fish oil and meal.

## CONTINENTAL SHELF RESOURCES

The continental shelf resources of the Great Caribbean Region lie in the waters of Northern South América, Central América, México and the United States (Figures 4 and 6, Table 1). The countries enclosed in this region are French Guiana, Suriname, Guyana, Venezuela, Colombia, Panamá, Costa Rica, Nicaragua, Honduras, Guatemala, Belize, México, and United States. The total nominal catches of these countries reached about 7.9 million tons of fish and shellfish in 1988; 22% was taken in the Great Caribbean region. The highest figures were from Venezuela (293,947 MT), México (1,362,952 MT), and U.S. (5,965,598 MT) producing the lion's share.

The distribution of marine fisheries in the Great Caribbean Region is shown in Figure 5.

According to Juhl (1971) the most productive areas are located in the Guianas to Panamá region, owing mostly to outflow from large rivers, fairly wide shelf, and partially limited upwelling. This latter occurs in the Margarita Island area, Venezuela, and off Barranquilla, Colombia.

The most common commercial species in the Guiana–Trinidad area are Sciaenidae (weakfish and croakers), Scombridae (mackerels), Clupeidae (sardines), Pomadasydae (grunts), Ariidae (catfishes), Ephippididae (spade fish), and Gerridae (mojarras). From Trinidad to Panamá region, the species listed above and to a lesser degree Characins (freshwater fish), Lutjanidae (snappers), Centropomidae (snooks), Carangidae (jacks), Mugilidae (mullets), Megalopidae (tarpon), and Engraulidae (anchovies) are important. From Nicaragua (and in part Costa Rica) to Yucatán the composition of the commercially important species is similar to that of the island arc. From the Guiana east to the Colombia region four species of penaeid shrimp are a significant resource (Figure 6). Fisheries for these are centered in the Gulf of Venezuela—Lake Maracaibo and off the Guianas. Spiny lobster is taken off the Central América shelf from Yucatán south to Panamá.

Fisheries resources in the Caribbean–Gulf of México continental shelves and the United States are significant, especially penaeid shrimp, spiny lobster, and menhaden (Atlantic and Gulf).

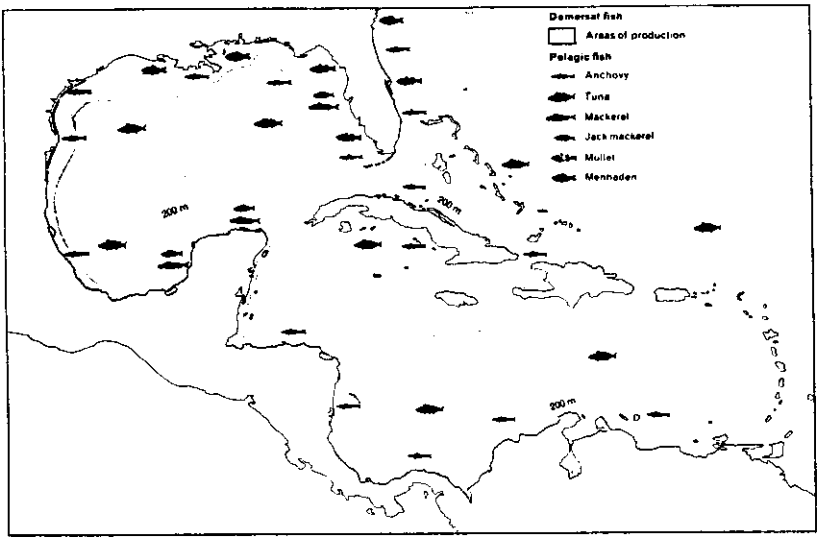


**Figure 4.** Distribution of demersal and pelagic fish in the Great Caribbean Region (Rand McNally, 1979).

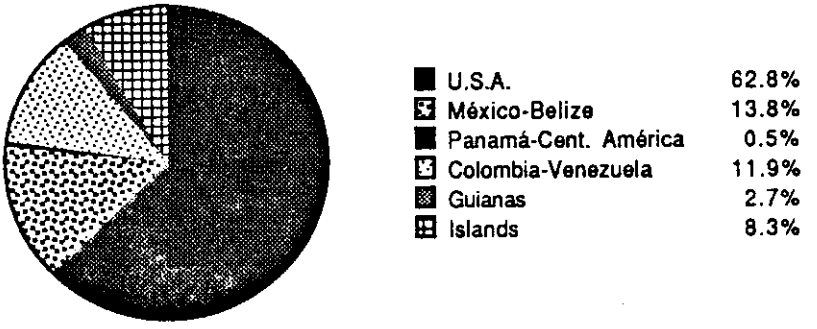


**Figure 5.** Distribution of fisheries in the Great Caribbean Region in 1988 (FAO, 1989).

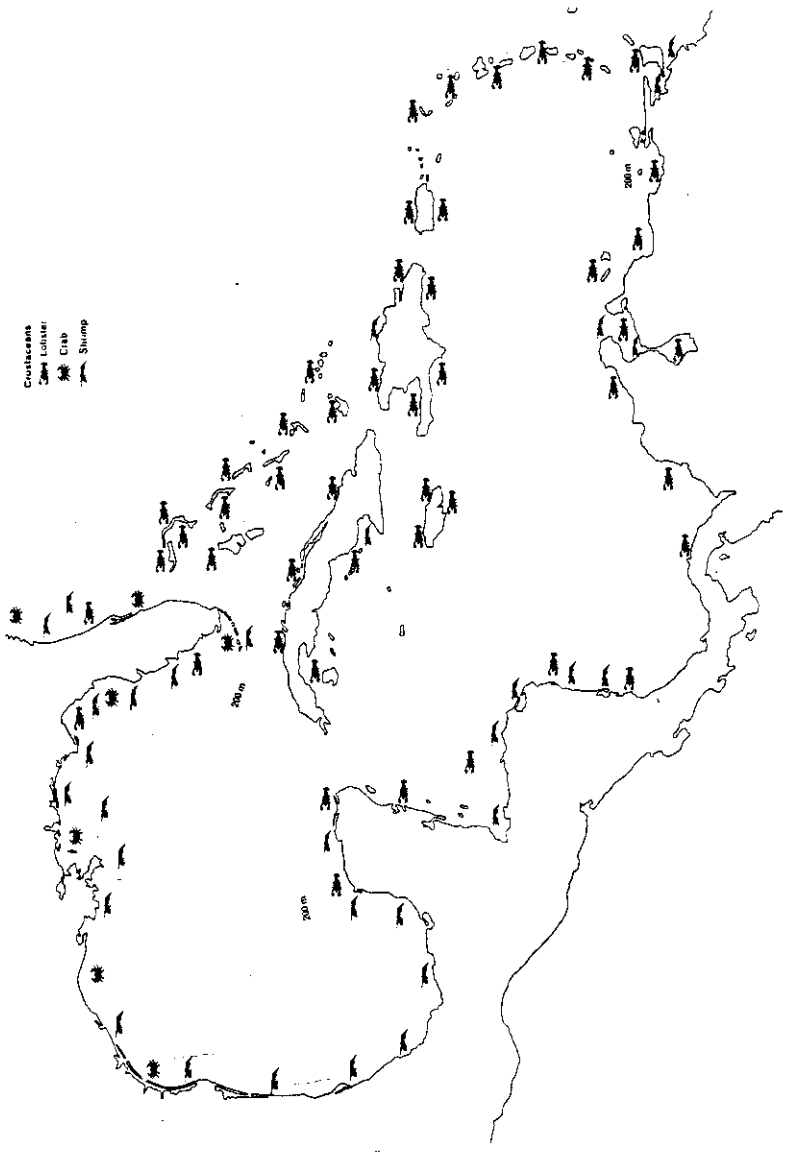


**Figure 6.** Distribution of lobster, crab, and shrimp in the Great Caribbean Region (Rand McNally, 1979).

**Table 1.** Islands and continental fishing countries of the Great Caribbean Region, 1988 (Nominal Catches in 1,000 metric tons (MT))(FAO, 1989).

| COUNTRY | GRT.CARIB. REG. | OTHER AREAS | TOTAL | %GR.CARIB. REG. |
|---|---|---|---|---|
| Aruba | 0.78 | 0. | 0.78 | 100. |
| Netherland Antilles | 1.2 | 0. | 1.2 | 100. |
| Trinidad Tobago | 3.2 | 0. | 3.2 | 100. |
| Grenada | 2. | 0. | 2. | 100. |
| St.Vincent -Granadines | 0.712 | 0. | 0.712 | 100. |
| Saint Lucia | 0. | 0. | 0. | 0. |
| Barbados | 9.097 | 0. | 9.097 | 100. |
| Martinique | 3. | 0.06 | 3.06 | 100. |
| Dominica | 0.65 | 0. | 0.65 | 100. |
| Guadaloupe | 8.17 | 0.063 | 8.233 | 0.77 |
| Monserrat | 0.111 | 0. | 0.111 | 100. |
| St. Kitts-Nevis | 1.5 | 0. | 1.5 | 100. |
| Antigua Barbuda | 2.4 | 0. | 2.4 | 100. |
| Anguilla | 0. | 0. | 0. | 0. |
| Virgin Is. Br. | 0.318 | 0. | 0.318 | 100. |
| Virgin Is. USA | 0.55 | 0. | 0.55 | 100. |
| Turks Caicos | 1.358 | 0. | 1.358 | 100. |
| Bahamas | 7.2 | 0.036 | 7.236 | 0.5 |
| Cayman Is. | 0. | 0.4 | 0.4 | 0. |
| Bermuda | 0.78 | 0. | 0.78 | 100. |
| Cuba | 78.153 | 153.148 | 231.301 | 33.8 |
| Haití | 7.75 | 0.3 | 8.05 | 3.9 |
| Dominican Rp. | 16.8 | 2. | 18.8 | 89.4 |
| Jamaica | 8.5 | 1.5 | 10. | 1.5 |
| Puerto Rico | 1.611 | 0. | 1.611 | 100. |
| SUBTOTAL ISLANDS | 155.84 | 157.507 | 313.347 | |
| French Guiana | 4.785 | 0.063 | 4.848 | 99. |
| Suriname | 5.08 | 0.107 | 5.187 | 98. |
| Guyana | 40.869 | 0.8 | 41.669 | 98. |
| Venezuela | 213.254 | 80.693 | 293.947 | 72. |
| Colombia | 10.591 | 74.257 | 84.848 | 12. |
| Panamá | 1.789 | 110.062 | 111.851 | 2. |
| Costa Rica | 0.3 | 20.089 | 20.389 | 1. |
| Nicaragua | 1.45 | 3.204 | 4.654 | 31. |
| Honduras | 6.529 | 18.947 | 25.476 | 26. |
| Guatemala | 0.082 | 2.718 | 2.8 | 3. |
| Belize | 1.491 | 0.001 | 1.492 | 100. |
| México | 260.17 | 1102.782 | 1362.952 | 19. |
| U.S.A. | 1186.599 | 4778.999 | 5965.598 | 20. |
| SUBTOTAL (CONT. SHELF) | 1732.989 | 6192.722 | 7925.711 | |
| TOTAL | 1888.829 | 6350.229 | 8239.058 | |

Fishing methods vary widely, but the most common methods used in commercial harvest of these and other species include trawling, beach seining, gillnetting, pound netting, cast netting, handlining, longlining, and pot fishing. México and United States have the largest modern trawling fleets working in the continental shelf.

## ISLANDS AND REEF RESOURCES

In 1988 the Great Caribbean island countries caught only 8% of the total regional production (Table 1). Cuba produced 50% of those landings. It is noteworthy that they own a modern, large industrial fishing fleet. Its operations are not profitable on account of the conditions of the Caribbean Sea islands—narrow shelves and abundant areas of coral reef—which are not proper for trawling.

Most fishing fleets of countries in this area are coastal fishing craft of simple design and construction ranging in size and type from 14-foot row boats to 40-foot sloops. According to Juhl (1971), over 2/3 of these are motorized, largely by outboard motors, and many of them lack mechanical labor saving equipment and electro-acoustical aids.

The most important fishing gear is the fish pot. However, a variety of other gear is also used, including the bottom trawl, haul (beach) seine, gill net, turtle net, cast net, set line and bottom, and trolling lines. The overall production as well as the catch per unit of effort was low (Juhl, 1971), probably one-fifth to one-tenth of the average taken by more developed fishing nations. Today, it is my opinion that Cuba is the only Caribbean island country which could surpass that average. Nevertheless, it is reported that the Cuban fleet fishing in the Gulf of México has been relieved of their operations, and their boats have been added to other Cuban fleets (Suárez-Caabro, 1988). It is important to mention also the lack of availability of fuel for fishing craft on account of the situation arisen in some countries of the Middle East.

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