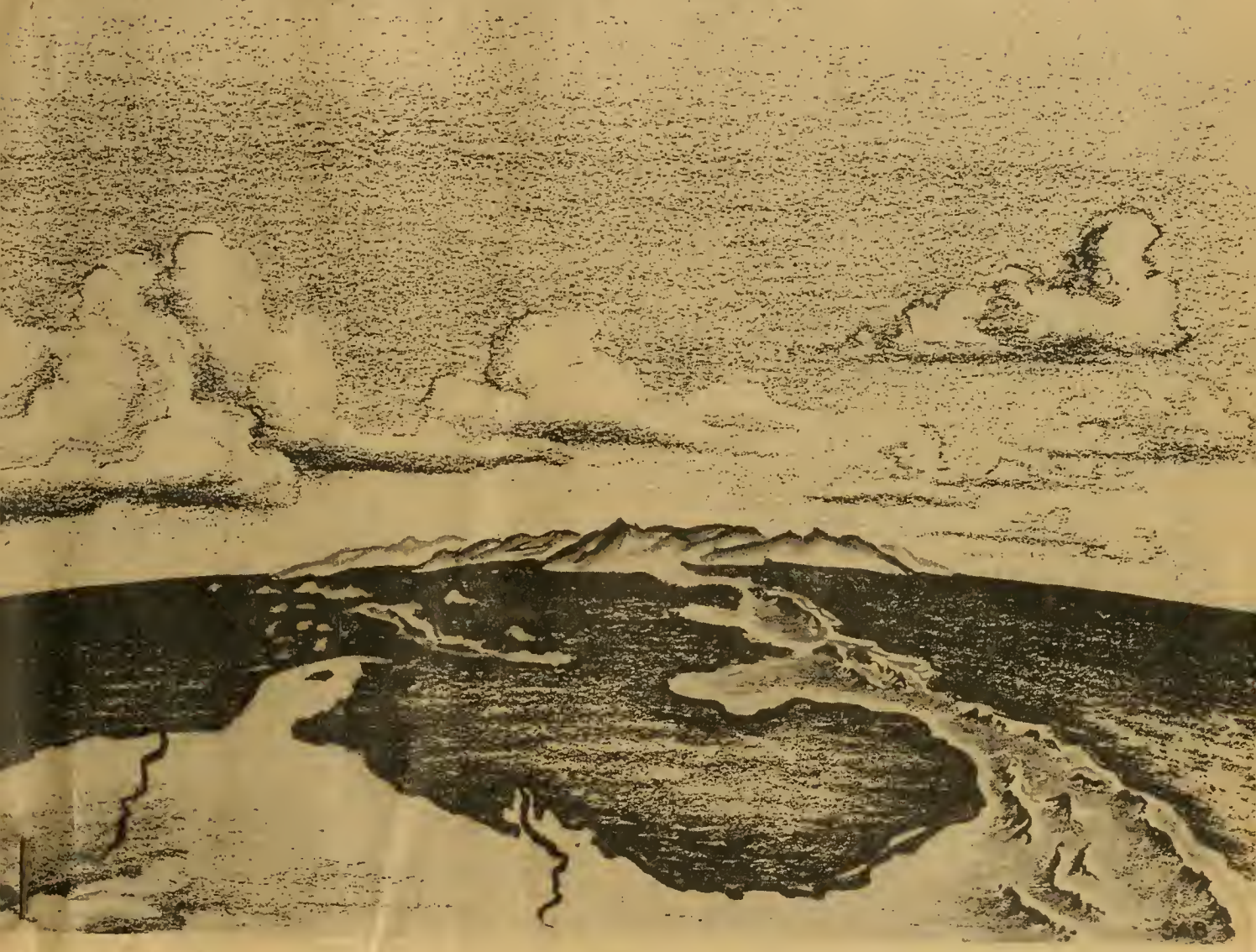
The Fisheries and Fishery Resources of the CARIBBEAN AREA



FISHERY LEAFLET 259
FISH AND WILDLIFE SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

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United States Department of the Interior, J. A. Krug, Secretary
Fish and Wildlife Service, A. M. Day, Director

Fishery Leaflet 259

Washington 25, D. C. September 1947

THE FISHERIES AND FISHERY RESOURCES OF THE CARIBBEAN AREA

(A Report of the Caribbean Fishery Mission of 1942) 1/

By

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Milton J. Lobell, Assistant Chief and Fishery Engineer

Clarence R. Lucas, Fishery Economist

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1/ The Caribbean Fishery Mission was conducted during the year 1942 by the Fish and Wildlife Service in cooperation with the Office of the Coordinator of Inter-American Affairs. This is a republication of the report which was issued in mimeographed form in August 1943 by the Office of the Coordinator of Inter-American Affairs.

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THE CARIBBEAN AREA

INTRODUCTION

A general inventory of the natural resources of the Americas is being made to further economic and social cooperation among the nations of the Western Hemisphere. Increasing interest in the utilization of the aquatic resources of the New World is manifested by many of our neighbors to the south. This interest has led, in many instances, to requests from these countries for technical assistance and advice in surveying and evaluating their fish resources, with the view toward expanding fishery industries on sound lines. In attempting to assist in this work, the Fish and Wildlife Service found that little factual information regarding the fisheries and fishery resources of Latin America was available.

With the coming of War, the acquisition of such data became more urgent, for it was soon evident that local production of foodstuffs was of great necessity--particularly in the Caribbean area. Thus, it was considered essential that a rapid, fact-finding survey of the Caribbean fisheries and fishery resources should be made to determine where possibilities for increased production of fishery products existed.

Funds for this purpose were transferred to the Fish and Wildlife Service of the United States Department of the Interior by the Office of the Coordinator of Inter-American Affairs in the early part of 1942. The Caribbean Governments were approached by the United States Department of State prior to the survey, and each expressed interest and offered cooperation in assisting the Mission to the fullest extent.

The Mission was headed by Reginald H. Fiedler, Chief of the Division of Fishery Industries of the Fish and Wildlife Service. He was assisted by Milton J. Lobell, Fishery Engineer, and Clarence R. Lucas, Fishery Economist.

The field survey was commenced on April 24, 1942 at St. Johns, Antigua, in the British West Indies and was terminated in Puerto Rico on October 28, 1942--a total period of about seven months. By far, the greatest distance, about 25,000 miles, was covered by air travel. The remainder, about 5,000 miles, was accomplished in schooners, sloops, trains, gas-cars, automobiles, dugout canoes, oxcarts, and on horseback. Every capital city was visited, and field surveys of the actual fishing areas were made in practically every country. Hundreds of government officials, storekeepers, fishermen, and other interested persons were interviewed. Files of the various Governments relating to fisheries and economic conditions were made available.

Originally, plans were made to survey only the Latin-American Republics in the Caribbean area. However, because of emergency war conditions and at the request of the Anglo-American Caribbean Commission, the British Colonies in the Caribbean were included.

No survey work was conducted by the Mission in Puerto Rico and the Virgin Islands since the Fish and Wildlife Service and the Insular Government of Puerto Rico maintain a research staff at Mayaguez, P. R. which is engaged in carrying on a long-range fisheries program. Information on the fisheries and fishery resources of these areas are contained in reports of the U. S. Bureau of Fisheries as indicated in the bibliography of this report.

The Fish and Wildlife Service in a cooperative program with the Government of Mexico is studying the fisheries of Mexico. Therefore, the Mission did not undertake to conduct a survey in this country, except that some consideration was given to the Yucatan Peninsula.

In Central America, it was found that the Pacific Coast was the most favorable for the establishment of fishery industries. For this reason, the Pacific coasts of the Central-American Republics were included, even though they did not fall strictly within the scope of the survey.

On account of transportation difficulties occasioned by the War, a number of smaller islands were not visited, although it would have been advisable to do so. Within this category are the Caymans, Providencia, Curacao, Barbuda, Saba, and others.

So far as can be determined, this is the first extensive fishery survey utilizing air travel as a basic means of transportation. The advantages were many. Days of valuable time were gained which otherwise would have been spent in awaiting transportation and traveling by slower means. Some areas, such as British Honduras and the Caribbean coasts of Nicaragua and Honduras, are practically isolated but can be reached by airplanes with ease. An excellent perspective is gained by aerial views of sea and land areas for fishing banks, fishing boats and ports, and even concentrations of birds and fish can be observed.

In each country, local Government officials and the Diplomatic Mission of the United States were contacted on arrival. With information gained from these associations, a working itinerary was set up and the necessary travel to fishing centers was made. Usually, basic information was compiled by Diplomatic Missions, by the Commission of Inter-American Development of the country, or by a Government agency of the country, and this was given to the Mission during its stay. In spite of war-time restrictions on travel, excellent cooperation resulted in little time lost in traveling, and practically every locality outlined in the original itinerary was visited. Customs and immigration formalities were usually perfunctory when the nature of the work was established, and no delays were caused.

Acknowledgments

Literally hundreds of individuals assisted the Mission. Officials of the countries visited were unfailingly interested and cooperative in furthering the work. The Commissions of Inter-American Development in the countries visited and the United States Diplomatic Missions collected basic data and arranged for travel and interviews with interested persons. Grateful acknowledgement must be made of the services extended by the Armed Forces of the United States at several points in the itinerary. Adherence to the fixed schedule was possible only through the assistance of the representatives of Pan-American Airways, the TACA Company, the Standard Oil Company of Venezuela, and the United Fruit and Standard Fruit companies. While it is impossible to list the individuals by name in this general section, this is done in the separate country reports. To all of these and many others not included, the Mission is indebted, for it would never have been possible to make this survey without their assistance.

Geography

For the purposes of this report, the Caribbean area is regarded as the land and water masses included roughly between 60 and 92 degrees west longitude and between 8 and 24 degrees north latitude. Strictly, however, it would include only the countries washed by the waters of the Caribbean Sea. This body of water is bounded on the north and east by a chain of islands forming an arc and known as the Antilles. The Greater Antilles occupy the northern position in the chain and include Cuba, Hispaniola, Jamaica, and Puerto Rico. The Lesser Antilles run along the eastern edge of the Caribbean and include the Virgin Islands, the Leeward Islands, the Windward Islands, and various French and Dutch possessions in this general area. On the south, the Caribbean is limited by the islands of Trinidad and Tobago, northern South America, including Venezuela and Colombia, and a part of Central America. On the west, it is bounded by Central America and a part of the Yucatan Peninsula. The greatest length, from east to west, is about 1,600 miles; and the width, from north to south varies between 400 and 800 miles. In total area, the Caribbean contains about 800,000 square nautical miles.

Access by sea is gained through a number of relatively narrow passages. The principal ones are the Yucatan Channel, the Windward Passage, Mona Passage, Anegada Passage, Jungfern Passage, and the various others in the Leeward and Windward Islands. The widest channel is the Yucatan Channel which stretches about 120 miles between Cuba and Yucatan. The rim of the Caribbean is about 8,500 nautical miles in extent and, of this distance, only about 600 miles represents water gaps between the land masses. The arc of the Antilles extends about 1,800 miles, and the remaining 6,700 miles is made up of the coasts of North, South, and Central America. Thus, the Caribbean Sea is practically landlocked. Because of its central position and its outlet to the Pacific through the Panama Canal, it has been and always will be the strategic key to the Americas.

THE CARIBBEAN AREA

The land topography of the Caribbean Rim countries varies greatly. The Antilles are relatively mountainous. A spur of the Andes parallels the north coast of South America in Colombia and Venezuela. In many places, it rises to great heights within short distances from the coastal belt of sweltering lowlands. For instance, in Colombia the perpetually snow-covered peaks of the Sierra Nevada de Santa Marta can be seen from the sea. In Venezuela, Caracas the capital, is only about 23 miles by road from its port, La Guaira. Yet it is located at an altitude of about 3,500 feet. The ranges between Caracas and La Guaira rise to an elevation of 9,000 feet. Through Central America runs a range of mountains which sinks to a low level in the Isthmus of Panama. The Caribbean Basin, thus is like an amphitheater until the Yucatan Peninsula is reached. Yucatan and Florida are flat, as is the Gulf coast of the United States.

The Caribbean coastline, too, is varied. Long stretches of white and dark sand beaches pounded by a foaming surf rising out of inky-blue depths are backed by quiet lagoons fringed by swamps chcked with shiny, metallic-green mangroves. Outside of the beaches, coral reefs thrive. Often where sand beaches are found, coconut palms rear their plumed heads. At other places, dry desert extends to the ocean edge, with only a few ragged sea-grape bushes to give relief from the head-splitting glare of the sun. In the Windward Islands, there are, in some cases, no beaches at all--the steep slopes of the islands slanting directly into the water. In other places, there are rocky surf-swept stretches. Many areas of the Caribbean are strewn with scattered cays and coral reefs. These are flat and barren wastes of sand and coral. At times, heavy seas and hurricanes sweep over them. On some, coconut palms are able to maintain themselves. Fishermen from nearby islands or from the mainland come to capture turtles, spiny lobsters, and fish. Often, they live on these sun-scorched sands for weeks, fishing in the nearby waters and drying their catches on shore. Sometimes, fresh water may be procured by digging shallow wells--most often the water secured is brackish.

Much of the land in the Caribbean area is of volcanic origin. Volcanic activity is still widespread and there are many volcanoes scattered throughout Central America and on some of the Antilles. Earthquakes and eruptions have always been a prominent feature in Caribbean history. The fertility of the volcanic soils, however, is great, and small farms can be found on the slopes of volcanoes and, in some cases even within the craters of extinct ones.

Because of the topography of the Caribbean countries, transportation by land always has been difficult. The sea itself and the rivers and lagoons have had to serve as highways for travel and commerce. For this reason, the customs, industries, and other characteristics of the peoples of the Rim are surprisingly homogeneous. In Central American countries, such as Costa Rica, Nicaragua, and Honduras, the Caribbean coast is definitely West Indian in atmosphere while the interior and Pacific coast is just as definitely Latin American.

THE FISHERY RESOURCES

The characteristics of the sea itself determine whether or not man can successfully establish extractive industries utilizing marine plants, animals, and chemicals. The sciences of oceanography and, to a lesser extent, meteorology are concerned with the physical, chemical, and biological factors affecting the aquatic world. Investigators in these sciences have succeeded in obtaining many basic facts which have enabled them to isolate and describe the factors influencing the productivity 1/ of water areas. Since the fishery industries, in the final analysis, are dependent on the productivity of the sea, men familiar with this knowledge and trained in commercial fishery practices are able to perform valuable services in developing new fishery industries.

Several expeditions have studied the oceanography of the Caribbean Sea and the information thus gained can be utilized in determining the probable productivity of this area as well as for the purpose of comparing this with other sea areas. It is quite impossible to gauge productivity by direct comparisons of production by fishery industries since the methods used, the fishing intensity, and the species themselves vary greatly from place to place. It is possible, however, to state in general terms what the productivity might be and, also, to indicate certain areas where the indicated productivity is higher than others. While a thorough discussion of the oceanography of the Caribbean would be very useful, it is impossible in the scope of this report. A review of the salient factors influencing the productivity, however, is presented below.

1/ Productivity here means the capacity of the sea for organic production of which fish is but a part. It should not be directly correlated with the present or possible yield in fishery products even though it has a great influence on this.

The Oceanography of the Caribbean

Topography:--The Caribbean Sea, together with the Gulf of Mexico, is often called the American Mediterranean Sea. It is shaped like a wide and irregular channel with the mouth facing the North Atlantic. The Caribbean is generally deep. About half of it is 2,000 fathoms or deeper and about four-fifths deeper than 1,000 fathoms. It has been proposed by Parr (1936) that the Caribbean Sea area be broken down into the Cayman Sea and the Caribbean Sea proper. He regards the former as the region lying between the Yucatan Channel on the northwest and the ridge extending fron Honduras via Jamaica to Haiti. This area is quite complex from a topographic standpoint. Cayman Brac, Grand Cayman, and Misteriosa Bank emerge from a submarine ridge extending westerly from the southwest point of Cuba (Cape Cruz). Between Misteriosa Bank and Honduras is the tiny Swan Island. Immediately south of the ridge from Cuba is a long, deep, and narrow trough known as Bartlett Deep or the Cayman Trough. This trough has recorded depths of more than 3,400 fathoms. The Cayman Sea connects with the open Atlantic, by way of Bahaman waters, through the Windward Passage, a channel about 45 miles wide. It is separated from the Caribbean proper by banks and passages on the submarine ridge between Honduras and Jamaica and by a continuation of this ridge, about 105 miles long, between Jamaica and the southeast point of Haiti.

The Caribbean proper is of comparatively simple topography except in the Honduras-Jamaica Ridge section. Here there are several deep gullies and a number of islands and banks. Further eastward there is a slight elevation of the bottom which slopes southwesterly from southern Haiti. Still further eastward, an elevation extends directly south from the eastern bank of Anegada Passage emerging at Aves Island and continuing to the coast of Venezuela. Just west of the Lesser Antilles is another depression, the Grenada Trough, with recorded depths up to about 2,200 fathoms. This terminates at the southern end in about the latitude of Grenada. The Grenada Trough is separated by the Lesser Antilles from the open Atlantic and the depths of the passages are less than those in the Trough. Outside of limited areas of relatively shallow waters around the coasts and a few small banks, the Caribbean proper has depths of 2,000 to 2,800 fathoms. Almost half is occupied by the inter-connected Venezuelan Basin and Colombian Basin each with depths of over 2,000 fathoms. More than half of the remaining area is more than 1,000 fathoms in depth.

The bottom of the deepest areas is composed of globigerina ooze with about 50 percent of calcium carbonate. In the eastern portion, there are areas of red clay. The remainder of the Caribbean bottom is of terrigenous origin. The globigerina oozes are composed chiefly of the calcarious remains of foraminifera which through the ages have sunk from the upper water layers to the bottom. Terrigenous deposits are formed by the disintegration and decomposition of rock. In shallower depths, the bottom is usually more varied. Sand, mud, coral, gravel, and shells may occur in separate bodies or combined depending upon the type of locality.

Composition of the Water Masses:--In order to determine the origin and characteristics of the bottom waters of the Caribbean, it is necessary to examine the topography of the area from a slightly different angle than above. Essentially, the Caribbean has depths much greater than the passages leading from the outside into the Caribbean; and, for this reason, there are sills or thresholds over which water from the outside must pass.

Thus, the Yucatan Channel has a sill depth of about 1,100 fathoms, the Windward Passage about 900 fathoms, Mona Passage about 300 fathoms, Anegada about 1,100 fathoms, St. Lucia about 600 fathoms, and Martinique Channel about 550 fathoms. Moreover, there are sills between the basins in the Caribbean. The Cayman Ridge is about 1,500 fathoms deep, Rosaline-Pedro Channel about 650 fathoms, Navassa-Jamaica Channel about 1,000 fathoms, and Aves Swell about 870 fathoms. These barriers to deep circulation might have the effect of rendering the waters below threshold depths in the basins stagnant. Actually, however, this is not the case. Parr (1937) has reported that the bottom waters of the Caribbean and Cayman Seas are virtually identical by temperature and salinity characteristics, but must be entirely distinct bodies having separate external origins and being separated at least below about 1,000 fathoms. The bottom waters have proved to be rich in oxygen and not stagnant as once supposed. It is indicated that these bottom waters are of the most recent origin. By means of involved physical and chemical calculations, Parr has determined that there is an actual constant renewal of the bottom waters over the thresholds and that the displaced bottom waters rise and are finally swept away by the friction of the currents in the upper water levels.

The Caribbean receives its water masses mainly at the eastern end through the various passages between the Antilles from the Virgin Islands to Trinidad. Some further contributions may also be received through the Mona Passage and through the Windward Passage. The origin of these water masses has been determined by studies of salinity and temperature relationships. In general, there are relatively low salinities at the surface (36.0°/oo to 36.2°/oo) which increase sharply to a high maximum (36.5°/oo to 36.7°/oo) around 150 to 200 meters. They drop again to a minimum (about 34.78°/oo to 34.92°/oo) around 800 meters depth and finally rise slightly to about 34.96°/oo to 35.00°/oo in the bottom waters. The vertical distribution curves of salinity in the Caribbean are quite similar to those of the North Equatorial region, and the characteristics of the upper water masses are similar to those of adjacent North Atlantic waters. There is a relatively shallow homogeneous top layer and below this a nearly discontinuous decrease in temperature indicating a more or less perpetual thermocline. 1/ In most localities, a maximum salinity is found within the discontinuity layer. Water masses entering through the Lesser Antilles passages show a streaky distribution of salinity with narrow bands of highly saline water alternating with bands of low salinity water. These differences are rapidly smoothed out by intense surface mixing, and on arrival at the Yucatan Channel the waters are of almost uniform character.

The upper surface waters flowing into the Caribbean are mainly of North Atlantic origin but they contain considerable admixtures of water of the South Atlantic type. The proportional composition has been determined by comparison of temperature-salinity relations from the South Atlantic, the Sargasso Sea, and the Yucatan Channel. At the higher temperatures, the current passing through the Yucatan Channel carries about 1 part of South Atlantic water to about 3 1/2 parts of North Atlantic. The total transport is about 26 million cubic meters per second with about 6 million cubic meters per second representing South Atlantic contributions.

Below the upper layers, there is a considerable amount of Antarctic Intermediate water. The water at the intermediate salinity minimum (about 34.78°/oo to 34.92°/oo at 800 meters) is thus mainly of South Atlantic origin (Nicken, 1925) (Parr, 1937). The intermediate salinity minimums decrease in intensity with the flow direction so that in the Eastern Caribbean (about longitude 68 degrees W.), the average minimum salinity is about 34.73°/oo whereas in the Yucatan Channel it is 34.88°/oo. This shift is due mainly to vertical mixing within the moving water mass. (Seiwell, 1938).

Temperatures:—Surface temperatures in the Caribbean are, in general, high, with an overall annual average of about 27 degrees C. The average minimum is reached in February when the sea surface over the entire area is about 25.5 degrees C. From February to September, the trend is upward, so that in the latter month, sea-surface temperatures average about 28.2 degrees C. There is a slight rise of temperatures from north to south. At the extreme northwest corner, including the Yucatan Channel and southwest Cuba, the average is about 26.3 degrees C. while in the offshore Gulf of Darien area, it is about 1 degree C. higher. There is very little fluctuation in the average annual sea-surface temperatures from east to west, although the central area between eastern Cuba and the Gulf of Darien appears to be slightly warmer than the areas to each side of it. The greatest monthly variations in temperature of the sea surface are found in the western part of the Caribbean. Off southwest Cuba the variation is from 23.7° to 28.8° C.— a difference of 5.1°C. In the Yucatan Channel area, the difference is between 24.4° and 28.4° C. or 4°. The monthly temperature variation to the eastward becomes less and just inside the Lesser Antilles it is only 1.6°C.

The greatest differences between areas are found in January and these become less until September, when they again rise. It is not possible to give a definite explanation for these temperature variations since more data would be required to do so. They may be caused by the heating of the sun, by cooling effects of winds, by vertical upwelling or mixing, by inflows of cool water from other areas, or by other factors. There is some possibility that upwelling might occur in the Yucatan Channel—Southwest Cuba area. If so, this is probably seasonal and would influence the productivity of the area to a great extent.

1/ The thermocline is a discontinuity layer found in series taken vertically in serial water temperatures. It is usually regarded as the area where there is the greatest change in temperature within the narrowest limits.

Chemistry:—The concentration and distribution of certain salts, principally phosphates and nitrates, in sea waters have a great effect on the productivity.

The vertical distribution of phosphates and nitrates in the Caribbean, in general, is about the same as found in the deep water of the Atlantic and elsewhere. The zone of maximum phosphate and nitrate concentration falls between 300 and 500 fathoms, usually at about 400. It is associated with the most extreme part of the thermocline and in the Caribbean with the isotherm of 7 degrees C. This region is, also, the level of minimum salinity and of the maximum vertical stability of the water. From 400 to 750 fathoms, the phosphates and nitrates diminish and below this the water is almost completely homogeneous.

At the surface, there is a central area of very low phosphate concentration (less than .10 milligram atoms per liter--Rakestraw and Smith, 1937) and this suggests an inflow of water from the Sargasso Sea to the northeast. Higher surface concentrations occur to the south and west and east (from .10 to .50 milligram atoms per liter).

At 200 fathoms, the entire northern half of the Caribbean (north of a line from Cape Gracias a Dios to Martinique) has a phosphate concentration of from .50 to 1.25 milligram atoms per liter, and this is also true in an intrusion from the eastward between St. Vincent and Trinidad and reaching a point off central Venezuela. Off central and wertern Venezuela and eastern Colombia is an extensive area where phosphates run over 2.00 milligram atoms per liter. In general, the Caribbean area at all levels is rather richer by the active regeneration of the phosphates by organic development in the Caribbean and in the Cayman Seas.

Nitrate values at the surface are very low throughout the Caribbean but the Cayman area seems to have a slightly higher concentration than the Caribbean proper. The northwestern third runs more than 15 milligram atoms of nitrate per liter. The central third runs from 10 to 15 milligram atoms, and the southern third less than 10 milligram atoms of nitrate per liter.

The maximum nitrate concentration occurs at 400 fathoms and this extends all over the southern and western parts of the area.

As is the case of the phosphates, the nitrates are higher in the Caribbean than just outside. It is evident that nitrate regeneration occurs in the Caribbean.

There is a close relation between the hydrogen-ion concentration (pH) and nitrate and phosphate, since the generation of the latter substances results from the oxidation of organic matter. This is accompanied by the formation of carbon dioxide and an increase in acidity (lowering of pH is the result). The surface waters of the Caribbean range from 8.10 to 8.2 except for the southeastern quarter where they are higher than 8.2.

The lowest pH values occur at 400 fathoms and this might be expected since phosphate and nitrate are both at maximum value at this point.

The oxygen content of the surface waters is about 4.50 milligrams per liter throughout the Caribbean. This drops to around 3.00 at 250 fathoms depth and then increases to 5.50 in the deep-water basins.

Productivity:—As a general rule, resident fish populations in tropical seas are not large enough to justify intensive commercial fisheries. There are, however, certain exceptions to this generalization, and these are caused by certain well-known factors.

The primary food supply of the sea is produced by the living microscopic plant life (phytoplankton) and the abundance and distribution of phytoplankton is affected by the chemistry, physics, and biology of its environment. Phytoplankton includes all the passively-floating sea plants and is composed chiefly of diatoms and secondarily of dinoflagellates. Two broad general groupings of the phytoplankton are the coastal or neritic species and the oceanic species. Many of the neritic forms are able to form spores, by which means they are able to survive during unfavorable periods and to germinate new crops when conditions become favorable.

Phytoplankton production is dependent upon radiant energy for reproduction and growth. With carbon dioxide and water, plants are able, by virtue of the chlorophyll or other contained pigments, to utilize the radiant energy of the sun to manufacture organic compounds. This process furnishes a store of energy in the plant which becomes a source of chemical energy for life processes, not only for the plant itself, but indirectly for other links in the food chain. An important by-product is oxygen and this has great importance in the respiration of organisms and in the oxidation of inorganic and organic substances in the sea. Since oxygen is always used in the respiration of the algae, the free supply dissolved in the water is drawn upon for metabolic processes during periods of low-light intensity or when the plants have sunk to a depth at which the light intensity is below the minimum required for oxygen production by photosynthesis to balance oxygen consumption by respiration. The depth at which light intensity is just sufficient to bring about this balance is known as the compensation depth.

The factors of food supply for phytoplanktonic organisms are dependent on the dissolved gasses and salts.

Carbon dioxide is used directly in photosynthesis and, although it is of tremendous importance, it cannot be considered a limiting factor since there are practically always ample stocks available in the sea.

Dissolved nutrient salts, particularly those of nitrogen and phosphorus, have a great limiting or controlling effect on phytoplankton production. Iron, magnesium, and other elements may also have some influence. Nitrates (also nitrites and ammonia) and phosphates are usually regarded as indicators of the probable productive capacity. When concentrations of these salts are found in sufficient amounts above the compensation depth, the phytoplankton flourishes; otherwise, it does not. Since phytoplankton is the basis of life in the sea, it is an essential in fish production.

Silicates which are important in the formation of siliceous shells of diatoms and certain other organisms appear to be important but not controlling items.

There are also certain other accessory growth factors, the nature of which is little understood but which appear to be necessary to diatom growth. These factors seem to be both seasonal and regional in occurrence.

The metabolism of the phytoplankton is influenced by three important factors and these are temperature, salinity, and hydrogen-ion concentration. Temperature is important because the metabolic rate is accelerated by rises in temperature. According to van't Hoff's law, this increase is two to three times for each 10-degree rise in temperature within favorable limits. Increases in metabolism include greater reproductive action and shorter life spans but a greater number of generations. Salinity affects the osmotic relationship between the organism and its surroundings. Coastal forms are usually quite tolerant of salinity shifts and are known as euryhaline forms while oceanic forms, known as stenohaline types, are not. Salinity variations seem to affect the types of species found rather than the fertility in the area.

Hydrogen-ion concentration is generally quite stabilized and, therefore, its range of variations is so small that it has only a very moderate influence, if any, as a limiting factor for phytoplankton.

The population density of phytoplankton is controlled by the factors affecting the reproduction of the organisms. Since these animals increase by simple cell divisions, under optimal nutritional and metabolic conditions, the populations would build up a geometric progression unless disturbed by limiting factors.

Since phytoplankton is the main pasturage of the sea, it is drawn upon by herbivorous animals, usually planktonic, which live within or periodically invade the photosynthetic zone. Copepods are probably the chief diatom users but other forms also utilize diatoms as food. With consumption at certain levels, it is possible that the actual production might

be greater in areas only moderately rich in plants at any given time than in others much richer but not utilized. The fluctuations in plankton distribution may be a reflection of the relative intensity of grazing rather than control through nutrients or physical conditions of the waters.

When diatoms sink below the level of the photosynthetic zone, they must be considered as lost to the reproducing population. Although diatoms are especially adapted to a floating existence by means of suspensory organs and oil globules, these only serve to retard sinking and cannot always overcome the constant pull of gravity. In connection with the velocity of sinking, temperature is very important since the viscosity of the water is inversely proportional to the temperature and the rate of sinking inversely proportional to the viscosity. When, due to transportation or water masses vertically in the water column, portions of the phytoplankton population are included, a direct loss of reproductive capacity is caused if the organisms are taken out of the photosynthetic zone.

Indirect factors involving productivity are many and have complicated relationships. Temperature, for instance, modifies the rate of metabolism while at the same time it regulates the viscosity. The vertical temperature gradient tends to reduce active turbulence. On the other hand, turbulence, upwelling, or convection currents are essential to the return of nutrients to the photosynthetic layer. Other indirect factors are water movements of various kinds, stability of waters in the photosynthetic zone, discharge of rivers, meteorological conditions, bathymetric conditions, and geographic positions.

Hydrogen-ion concentration, salinity, water temperature, available radiant energy, oxygen and carbon dioxide concentration, and suitable phytoplankton species are available in almost optimal conditions in the Caribbean area. These then are not the limiting factors of the productivity level. It appears that the distribution and concentration of the nutrient salts--phosphates and nitrates-- in the water column holds the key to the problem.

Nutrient Salts:--Dissimilarities in productivity between known sea areas do not appear to be caused so much by differences in the absolute amounts of nutrient salts but rather in their distribution within the water column. In arctic and temperate seas, the upper surface layers are replenished periodically by annual overturns of the water layers brought about by complicated physical changes. In the tropical seas, however, while there are great stores of these nutrients to be found in the lower and middle water layers, there are no annual overturns to make them available to life in the photosynthetic zone. 1/ They are relatively useless unless in the zone of light penetration. Tropical waters are characteristically stable, and there is usually little interchanges of waters from layer to layer.

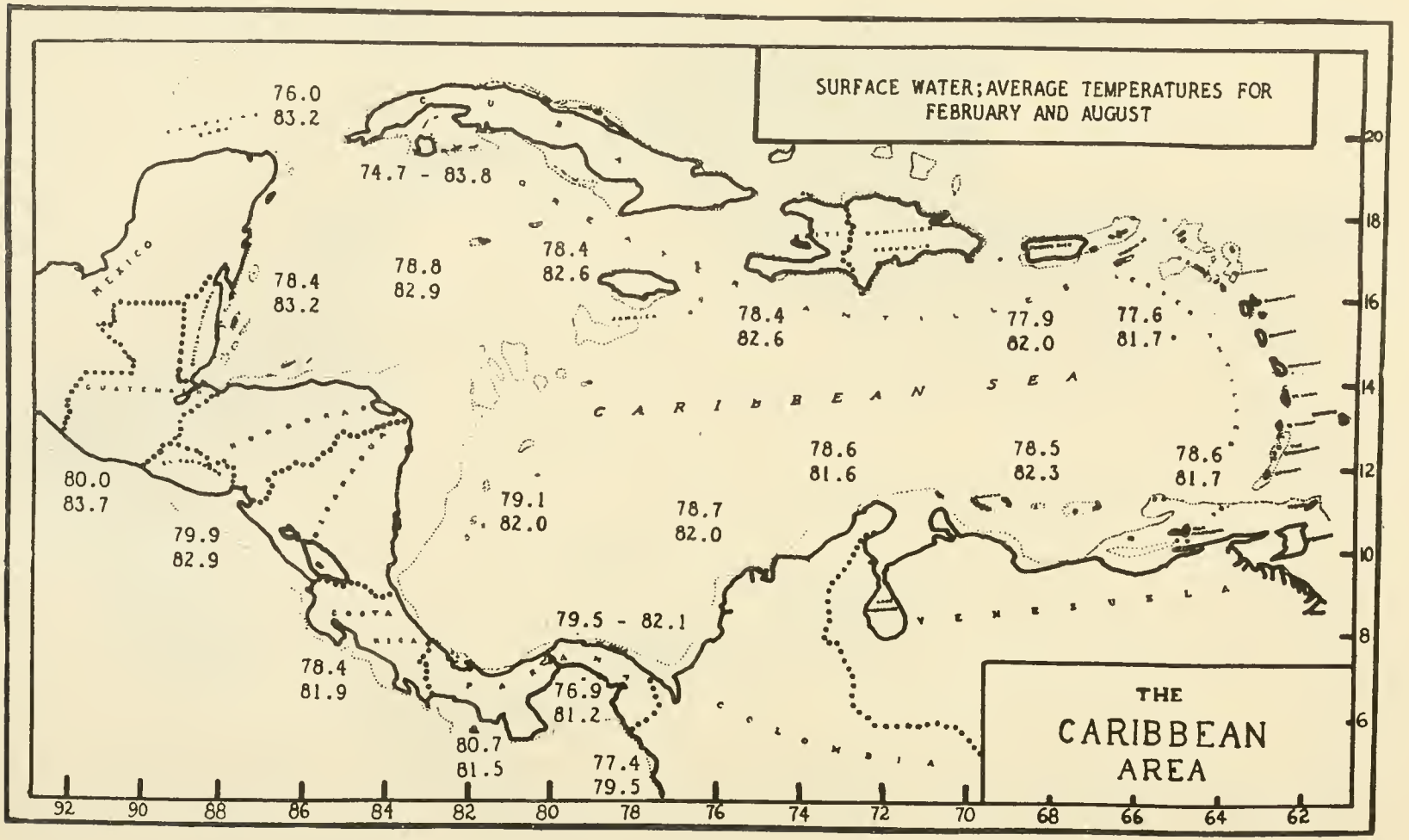
Under certain conditions, masses of nutrient rich waters may be brought to the surface and affect the productivity of an area tremendously. These conditions are summarized as follows:

Oceanic currents: These water movements may carry nutrient salts, depending on the origin of the movement, the regions traversed by the flow, the distance covered, character of the stream, and other factors.

Upwelling: Movements of intermediate or bottom waters rich in nutrients to the surface occur under certain conditions of wind, shelf contour and currents, and this has a tremendous effect on plankton production since it provides constant replacement of nutrients in the photosynthetic zone.

Rivers and land outwash: Great quantities of dissolved salts, in addition to silt are added by these means. They become available to increase the productivity sometimes at considerable distances from the area of discharge. Since sunlight penetration is necessary for photosynthesis, the river mouths are not necessarily plankton rich, for there is often great turbidity.

1/ The upper surface zones extending to depths of about 30 fathoms in which there is sufficient sunlight for photosynthetic reactions.


SURFACE WATER; AVERAGE TEMPERATURES FOR FEBRUARY AND AUGUST
76.0
83.2
74.7 - 83.8
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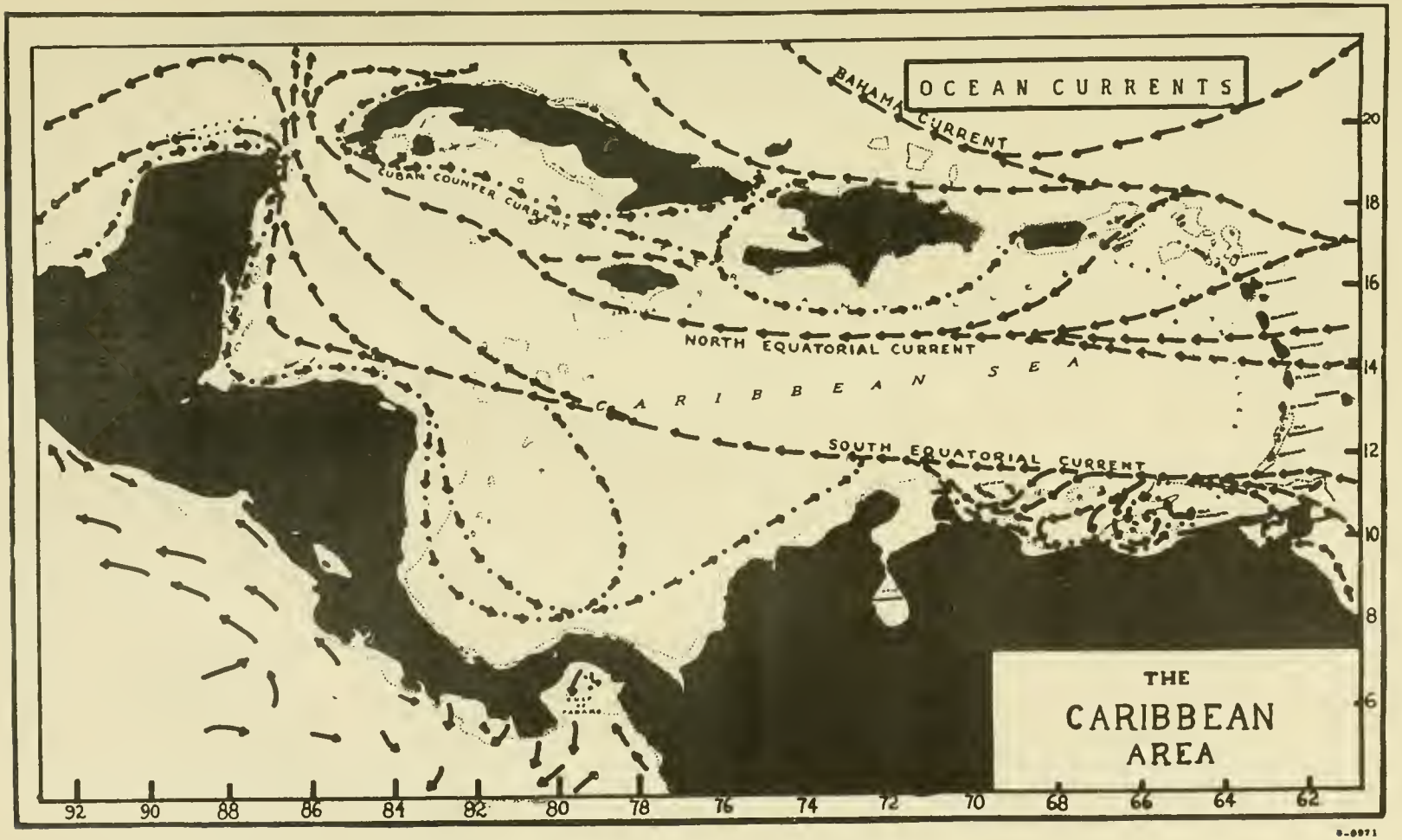
OCEAN CURRENTS
BAHAMA CURRENT
CUBAN COUNTER CURRENT
NORTH EQUATORIAL CURRENT
CARIBBEAN SEA
SOUTH EQUATORIAL CURRENT
THE
CARIBBEAN
AREA
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Overturns and vertical mixing: The presence or absence of a perpetual thermocline indicates the possibility of overturns of water layers. A perpetual thermocline indicates great stability in the water masses and that there is practically no mixing. Consequently, there is no periodic replenishments of nutrients. The lack of a perpetual thermocline indicates that such mixing does occur and indicates a better chance for productivity.

Oceanic Currents:—The waters of the Caribbean are derived mainly from the North Equatorial Current (Drift), the Sargasso Region, and from the South Equatorial Current. The effect of the northeast and southeast trade winds is to form two great drift currents, setting in a westerly direction across the Atlantic from Africa toward the American continent. At times, their combined width covers upward of 50 degrees of latitude. These are known as the North and South Equatorial Currents or Drifts, according as they arise from the trade winds of the northern or southern hemisphere. The South Equatorial Current is the more extensive, originating off Africa south of the Guinea coast. It begins its flow with an average velocity of .6 knot and maintains a general westward set. The portion near the Equator later acquires a northward flowing component. The rate of drift steadily increases until, on arriving off the South American coast, a rate of 2.5 knots is not uncommon. At Cape San Roque (Brazil) the current splits, the Main or Equatorial branch flowing along the Guiana coast, while the other portion is deflected to the southward.

The North Equatorial Current originates to the northward of the Cape Verde Islands and sets across the ocean in a due west direction in about latitude 15 degrees north and with a velocity of about 0.7 knot. An Equatorial Counter Current is found between the North and South Equatorial Currents. It sets to the eastward, being propelled by the southwest monsoon. This wind prevails in an area of varying extent north of the Equator and extending some distance westward from the western tip of Africa. The extent and force of the counter current varies. In July and August its effect is apparent from longitude 50 degrees W. to the Gulf of Guinea while in November and December its influence is slight and prevails for only a limited distance from the African coast. The North and South Equatorial Currents unite in about mid-Atlantic to the westward of the region of the counter current and a large part of the combined stream flows into the Caribbean Sea through the passages between the Windward Islands, between Trinidad and Tobago, between Trinidad and Grenada, and to a lesser extent through the Gulf of Paria. After passing into the Caribbean, the currents pass westward and then northwestward, finally reaching the Yucatan Channel. A massive eddy is formed in the Costa Rica-Panama-Colombia bight and another round the island of Jamaica.

A complicated system of eddies and counter currents occurs between Cuba and the Cayman Islands, and the Cuban Counter Current runs eastward along the south coast of Cuba and Hispaniola, ending at Mona Passage. Another counter current passes southward along the Yucatan, British Honduras, Miskito Coast, swings eastward along the coast of Panama and Colombia, and joins the eddy movement. Increments of water are, also, observed from the northward through the Windward and Mona Passages.

During the long journey of the currents from the Eastern Atlantic across the equatorial regions to the South American coast, the nutrients in the surface layers become exhausted. Dead animal and plant tissues drop out of the warmer surface zone, but no replacement of nutrient salts from below is possible because of the stability of the water layers as indicated by the perpetual thermocline. Phosphates run about .3 mg. of P_2O_5 per cubic meter, and there are practically no nutrients present. The only significant amounts of salt are in the organic form in the living tissues of animals, and in the very meager phytoplankton. When these are liberated through the death of an organism, they are reutilized almost immediately and, thus, have a very transient existence.

As the current sweeps along the Brazilian and Guiana coasts, it picks up and transports vast quantities of nutrient salts from the effluents of the great rivers of this region--the Amazon, Maroni, Courantine, Essequibo, and Orinoco. With the increased amounts of available nutrients, the water becomes murky and oftentimes pea-green in color with phytoplankton. Great schools of pelagic fish feed along the margins of the current. A small part of the current sweeps through the serpent's Mouth into the Gulf of Paria and picks up additional nutrients from the streams emptying into the Gulf. The main current flows into the Caribbean through the channel between Trinidad and Tobago and other branches may enter through other passages in the Windwards. The effects of the increased fertility is sometimes noticeable as

far as Barbados or beyond. The current then continues off the coast of Venezuela and almost the entire Venezuelan sea area is productive, particularly around the offshore islands.

By the time the current has reached the central and western Caribbean, its nutrients have become dissipated and, lacking further renewal, its productivity is low. None of the other Caribbean currents is of the type which can carry nutrient salts in appreciable quantities since they originate and flow through relatively barren areas.

There is, as yet, no findings to indicate the presence of other means in the Caribbean of supplying nutrients to the surface waters. It is doubtful that upwelling of any extent will be found, for the wind conditions, the bottom configuration, and the direction of the currents are all more or less unfavorable. As far as has been determined, there is a permanent thermocline, and this militates against annual overturns of water layers tending to supply available nutrients. Regeneration of nitrates and phosphates does occur and has been suggested as a reason for the higher concentration of these salts in the Caribbean as compared to adjacent waters elsewhere. It is indeed unfortunate that the oceanographic expeditions studying the Caribbean have never included the extreme southeast corner, for this is the area that holds the key to the productivity of much of the southern Caribbean.

Shallow-water Areas:--Most of the great fisheries of the world and almost all of the fisheries of the Caribbean area are conducted at depths of less than 100 fathoms. The area within the 100-fathom curve is usually considered the most productive in fish and organisms on which fish feed. The Caribbean is notably deficient in extensive areas of less than 100-fathoms depth. From eastern Cuba around to Trinidad, such areas are practically confined to narrow coastal belts and to small bank areas--the largest of these being the Virgin Island Bank, with the Anguilla Bank, Saba Bank, and the Barbuda and Antigua Bank areas being smaller. These banks are all steep-to and of coral formation, usually with reefs and coral heads.

From Trinidad and Tobago westward almost to La Guaira, Venezuela, the 100-fathom curve is found at a considerable distance off. At the latter point, however, it comes close inshore, until the Peninsula of Paraguana is reached. The area between the Paraguana and Goajira Peninsulas and including the Gulf of Venezuela is all within the 100-fathom line. Passing westward along the coasts of Colombia, Panama, and Costa Rica, the 100-fathom line is found rather close inshore--usually about 10 to 15 miles off. These are no offshore banks.

From Nicaragua northward, there is a great, shallow-water area about 300 miles long and 80 to 85 miles wide. It abounds with reefs, cays, and small islands--all of coral origin. Lying to the eastward are a number of more or less separate bank areas. Included are Roncador, Serrana, Quita Sueno, Rosalind, Serranilla, and a few others of much smaller size. The coasts of Honduras and British Honduras are lined with reefs, cays, and islands, with some extensive banks in British Honduras, but the 100-fathom curve is not more than 15 to 20 miles off. A few small isles, banks, and knolls are found far offshore. Cuba has a large area of shallow water on the southwest and southcentral coasts. Jamaica has a fair amount on the south coast plus the extensive Pedro Bank to the southward, and the much smaller Morant, Albatross, and Formigas Banks on the east side. While the central part of the Caribbean Sea is all deep water, it is calculated that 10 to 12 percent of the entire area or 80,000 to 96,000 square nautical miles is within the 100-fathom curve.

Winds and Weather:--The dominant feature in the winds of the Caribbean area are the northeast trades. Northerly winds sometimes affect the westernmost part during the winter months. Tropical cyclones or storms visit all but the extreme southern part and are most frequent in September and October.

The equatorial belt of calms lies further northward in summer than in winter and interrupts the trade winds in the extreme southern part of the Caribbean during the months of June to October.

Along the coasts, there are local wind conditions usually appearing as land- and sea-breeze effects. During the rainy season, westerly winds are frequent from Colombia to Nicaragua. In general, the wind velocities are higher during the dry season than in the rainy season.

Air temperatures are affected to a considerable extent by the sea temperatures but the heat is usually tempered by the winds. The humidity usually is fairly high, but there is considerable variation from place to place and season to season.

Hurricanes occur from June to November. There are two types—one of which forms in the Caribbean and the other out in the Atlantic offshore. These usually travel from the south or west in a north or northeasterly direction—usually the path is curved. Hurricanes do not affect the southern coast of the Caribbean but may do great damage in the Antilles and on the northern part of the Central American coast.

Rainfall is, in general, quite heavy and it falls most frequently and in greatest amounts from May to December. The amount of rainfall, however, varies considerably due to local conditions. Thus, rainfall is heavy at all seasons in western Panama and Costa Rica but it is very light in the Goajira and Paraguana regions at all times.

Species and Distribution

The fishes of the Caribbean area are of the species found more or less from Florida to Brazil. Given like ecological conditions, there is practically the same species representation in all parts of the Caribbean.

Species distribution, however, varies greatly in the different types of environment found. Thus, fish which are to be found in estuarine, lagoon of brackish habitats are never found in the offshore "blue" waters of high salinity. This holds true for other types of habitat also, although there may be some overlap due to spawning migrations and schooling and to the wide tolerance of a few species as regards salinity and food.

It has been found that species distribution is relatively constant throughout the region. For instance, coral reef forms of identical species are found in widely-separated localities. The species on a coral reef around Barbuda will be the same as the ones found on reefs off British Honduras and elsewhere.

Species:—The fishes of some Caribbean localities have been studied by Meek and Hildebrand (1923) and by Beebe and Tee Van (1928) as well as by Metzelaar (1919) and others. There are, however, many gaps in the areas studied and new species, doubtless, will be found with more intensive field work and collecting methods.

The following list is not complete and possibly not accurate in all respects, but it should serve as an indication to the common species and to the common local names. Since these names vary greatly from place to place and include, in some cases, more than one species, they are not definitive.

Fishes of the Caribbean Sea

Scientific Name	English Common Name	Local Common Name
Ginglymostoma cirratum	Nurse shark	gata
Cynias canis	dogfish	cazon de playa
Galeorhinus sp.	"	cazon
Galeocerdo arcticus	tiger or leopard shark	alecrin
Carcharias commersonii	requin shark	requin
" obscurus	dusky "	tiburon
" milberti	brown "	cazon
Scoliodon terrae-novae	sharp-nose shark	cazon
Carcharhinus limbatus	spot-fin ground shark	bluefin shark, caconeta
" taurus	sand shark	cazon de playa
" falciformis	olive "	tintorero, scythe-shape shark
Sphyrna zygaena	hammerhead shark	pantoufflier, cornuda, cruz
Isurus tigris	mackerel "	tiburon
Pristis pectinatues	sawfish "	pez sierra
Urobatis sloani	round sting-ray	raya
Lasyatis spp.	stingaree	chucho
Aetobatus narinari	whip ray, eagle ray	raya, wacawa, obispo
Manta birostris	devilfish, manta	manta
Elops saurus	ten-pounder	big-eye herring, riverfish
Tarpon atlanticus	tarpon	grand ecaille, sabalo, cuffum
Albula vulpes	bonefish, ladyfish	bonefish, ladyfish
Sardinia anchovia	sardine	sardina, caille
Clupanodon pseudo-hispanicus	fake Spanish sardine	arenque
Harengula maculosa	pilchard	arenque
" macrophthalmus	red-ear pilchard	sardine d'or, sardine rouge, sardine
Sardinella sardina and spp.	sardine	sardina
Opisthonema oglinum	thread herring, sprat	machuelo
Chirocentrodon taeniatus	spiny-toothed herringlet	anchobeta
Jenkinsia lampartaenia	blue fry	anchobeta, manjue
Anchoviella choerostoma	white fry	" " hog-mouth-fry
" epsetus	Bonnaterre's anchovy	anchobeta
" hyolepis	spot-cheeked ghost-fish	-------
Gymnothorax spp.	moray eels, conger eels	morena, congrio, hamlet
Anguilla rostrata	common eel	anguilla
Synodus spp.	lizard fish	lagarto
Strongylura spp.	houndfish, gar, needlefish	z'orphie, aguja, agujon
Hemiramphus braziliensis and spp.	halfbeak	balaju, ballyhoo, balao
Hirundichthys speculiger	flying fish	pez volador
Cypselurus cyanopterus	flying fish	guineaman, pez volador
Bregmaceros atlanticus	unicorn fish	-------
Platophrys lunatus and spp.	flounder	platefish, lenguado
Citharichthys spp.	whiffs	lenguado
Anchirus achirus	sole, hogchoaker	lenguado
Symphurus plagusia	tongue fish	lenguado
Holocentrus spp.	squirrelfish	cook, welchman, marianne, cartinau, candil, frere, jacque
Aulostomus sp.	trumpet fishes	trompetero
Fistularia sp.	cornet fishes	-------
Atherinidae	silversides	peje-rey
Mugil braziliensis	mullet	queriman, lebranche
" cephalus	"	liza
" curema	white mullet	" blanco
Sphyraena barracuda	barracuda	picuda, bechine, barracouta
" guachancho	"	picudilla, guachancho, secoye

Fishes of the Caribbean Sea

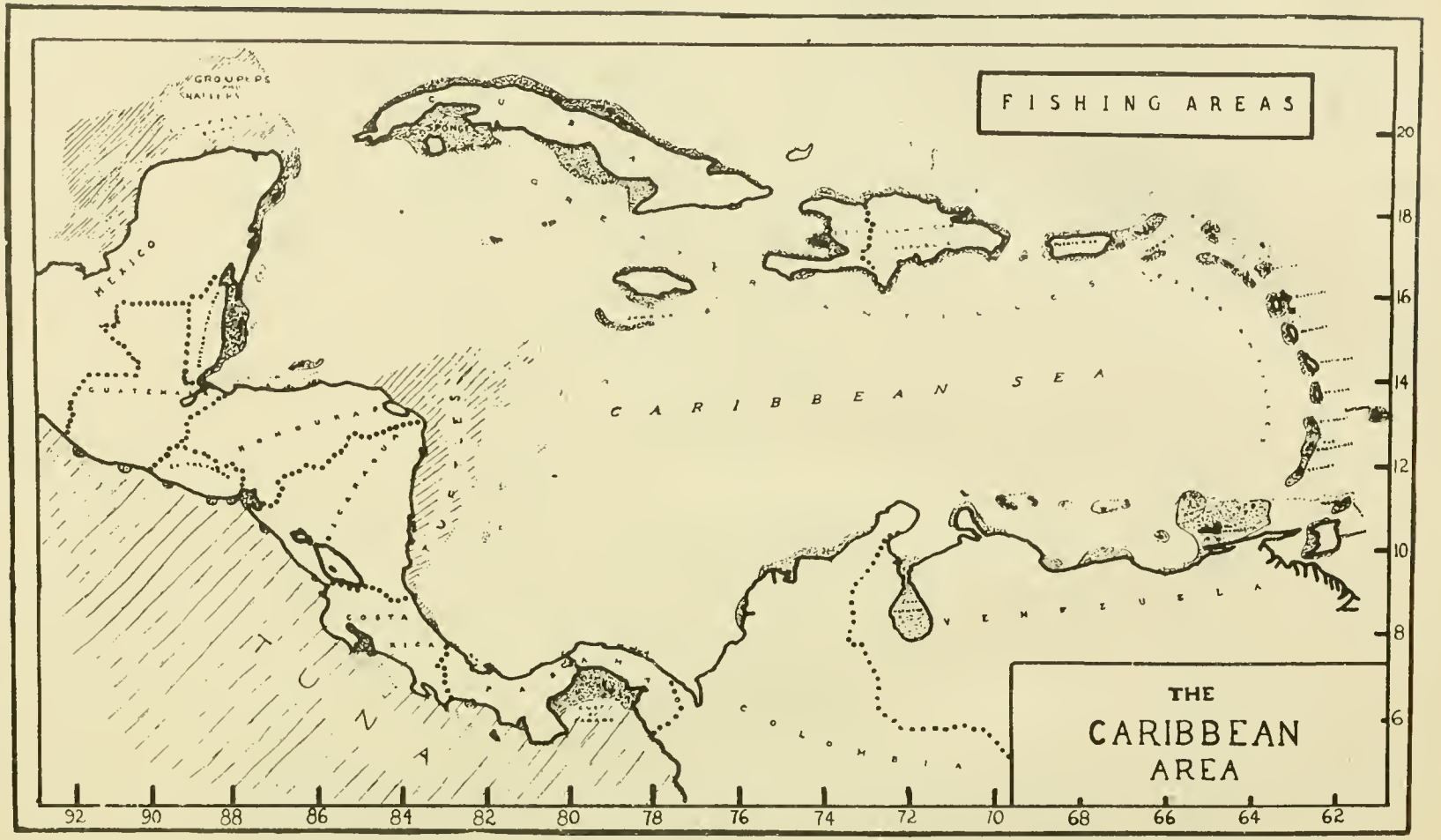
Scientific Name	English Common Name	Local Common Name
Sphyraena picudilla	barracuda	sennet, picudilla, bechine
Polynemus virginicus	threadfin	beardfish, barbudo, bobo
Acanthocybium solandri	wahoo	peto, kingfish, queenfish, sierra de canal
Sierra cavalla	kingfish	sierra, tassard
Scomberomorus maculatus	Spanish mackerel	carite, mackerel
" regalis	king "	kingfish mackerel, painted mackerel
Katsuwonus pelamis	oceanic bonito, skipjack	white bonito
Euthynnus alletteratus	Mediterranean tuna	atun, tunny
Auxis thazard	frigate mackerel	blowgoat
Sarda sarda	bonito	bonito
Parathynnus athlanticus	bonito	vaca
Thunnus thynnus	tuna, bluefin tuna	atun
Germo alalunga	albacore	bonito, albacora
Neothunnus albacora	yellow-fin tuna	albacore, atun, yellowwhip
" allisoni	Allison's tuna	atun, albacore, yellowwhip
Ruvettus pretiosus	oilfish	escolar
Trichiurus lepturus	cutlassfish	cuna, machete
Peprilus paru	harvest fish	------
Istiophorus americanus	sailfish	billfish, pez vela
Makaira ampla	blue marlin	billfish, pez aguja
" albida	white marlin	billfish, pez aguja
Xiphias gladius	swordfish	pez espada, emperador
Coryphaena hippurus	dolphin	dorade, dorado
Decapterus punctatus	scad	cha-cha, robin, cigarfish quia-quia
Selar crumenophthalma	goggle-eye scad	selar, chicharro
Caranx ruber	jack	cibi macho, carbonero, skipjack, passing jack, rainbow or green jack
" bartholomaei	yellow jack	crevalle, coolihoo, jurel, crevalle
" crysos	runner	carengue grasse, jurel, carang
" latus	horse-eye jack	night couvalli, jurel
" lugubris	black jack	jurel
" hippos	common jack	couvalli, carengue, camard
Argyreiosus vomer	moonfish	la lune, corcobado
Trachinotus palometa	pompano	oldwife, pompano, swallowtail
" falcatus	round pompano	palometa, carang-a-plume
" glaucus	gaff-topsail pompano	palometa
" goodei	pompano	permit, aileronde, pompano
" carolinus	"	carangue france, pompano
Oligoplites saurus	leather jack	sapate, zapatero, shoemaker, kal
Alectis ciliaris	threadfish	------
Elagatis bipinnulatus	rainbow runner	tabio
Seriola dumerlii	amberjack	amberfish, salmon, madrigal
Amiidae spp.	cardinal fish	------
Gobiesox spp.	clingfish	peje sapo
Zonichthys falcatus	amberjack	rock salmon, amberfish, madrigal
Nematistius pectoralis	reosterfish	carangue a plume, pluma
Pomotomus saltatrix	bluefish	anchoa, pez azul
Rachycentron canadus	sergeant fish	crabeater, bacalao
Centropomus undecimalis	common snook	brochet, robalo
" pectinatus	" "	" "
" parallelus	" "	salmon, robalo, saumon
" ensifirus	sword-spined snook	snook, robalo

Fishes of the Caribbean Sea

Scientific Name	English Common Name	Local Common Name
Petrometropon cruentatus	rock hind	coney, coon, ningring, ouitallibe
Cephalopholis fulvus	red (coney), guativere	negro fish, butterfish, velvet
Epinephelus mystacinus	black grouper	mero, guasa, aguaje
" adscensionis	rock hind	cabrilla, cabra mora
" flavolimbatus	white grouper	mero
" striatus	Nassau grouper	hamlet, mero, tienne, cherna
" guttatus	red hind	mero, cabrilla, koon, grandjele
" morio	red grouper	mero, mero pinto, cherna americana
Garrupa nigrita	black jewfish	judio, mero de la alto
Alphestes afer	guaseta	cherna
Promicrops itaiara	spotted jewfish	judio, mero
Trisotropis venenosus	yellow-fin rockfish	-------
" bonaci	marbled rockfish	Bonaci cardinal
Myctoperca falcata	broomtail grouper	scamp, salmon grouper
Paranthius furcifer	creole fish	pricklewood, rabirubio de la alto
Hyploplectrus unicolor	vaca	petit negre
Prionodes spp.	seabasses	tobacco fish, bout de tabac
Priacanthus cruentatus	glassy-eyed snapper	catalufa, tete ronde, toro
" arentus	big-eye	Johnny Liggens, juif
Lobotes surinamenais	tripletail	conkyleaf, marrocoto, flasher
Lutianus griseus	grey or mangrove snapper	green pargue, carde gris
" synagris	lane snapper	manchego, walliacke, argente
" jocu	dog snapper	pargue dent'chien, carde roulesse
" apodus	schoolmaster	pargo amarillo, yellow pargue
" buccanella	blackfin snapper	gunmouth snapper
" vivanus	yellow-eye snapper	silk snapper, vivanot, vive-en-eau
" campechanus	red snapper	pargo, vivanot, jolle-bleu, ronde
" blackfordii	" "	pargo real, chillo, pargo colorado
" analis	mutton snapper	sorb, muttonfish, sama, pargo criollo
Ocyurus chrysurus	yellowtail snapper	cola, rabirrubio, cola rubia
Rhomboplites aurorubens	chub snapper	plumphead
Tropidinius dentatus	black snapper	arnillo
Etelis oculatus	blear-eye snapper	brim, bream, cachucho
Conodon nobilis	grunt	bureteado
Haemulon album	grunt	margate fish, cro-cro blanc
" macrostotum	grey grunt	cro-cro, lite tete feuilles
" bonariense	black grunt	roncador, berraco, corocoro
" parra	sailor's choice	berraco, arrayado, ronco blanco
" carbonarium	Caesar grunt	cro-cro, greule rouge, roncador
" melanurum	black-tail grunt	roncador, corocoro, jeniguana
" sciurus	yellow grunt	boar grunt, roncador cachicato
" plumieri	common grunt	cro-cro, roncador, ronco ronco
" flavolineatum	French grunt	cro-cro d'or, corocoro, "condenado"
Pomadasys sp.	roughcheeks	ronco
Bathystoma rimator	tomtate	redmouth grunt, seize, roncador
Anisotremus surinamensis	porkfish	lippe, chita, pompon, margatefish
" virginicus	porkfish	palriot, chita
Orthopristis chrysopterus	pigfish	puerco
Calamus calamus	saucer-eye porgy	porgy gros yeux
" bajonado	jolthead porgy	pluma, diol pas blue
" spp.	porgies	littlehead, sheepshead, grass
Archosargus unimaculatus	sheepshead	medance
Kyphosus sectatrix	rudderfish	Bermuda chub, chopa, chopa blanca
Gerres cinereus and spp.	mojarra	broad shad, blanche
Clinidae	blennies	-------

Fishes of the Caribbean Sea

Scientific Name	English Common Name	Local Common Name
Lepophidium brevibarbe	cusk eel	———
Chloroscombrus chrysurus	bumper	casabe
Upeneus maculatus	red goatfish	queen mullet, barbaray, salmonete
" martinicus	yellow goatfish	queen mullet, barbaray, jaune salmonete
Micropogon sp.	drummers	berruigate
Stellifer sp.	croaker	corbina
Cynoscion regalis and sp.	weakfish or drummers	grey salmon, corbina, burro
Larimus sp.	cabezon	cabezon
Eriscion nebulosus	spotted weakfish	sea trout, corbinilla, burro
Malacanthus plumieri	blanquilla	blanquilla
Chaetodipterus faber	spadefish	white angelfish, paoua, paguala
Chaetodon spp.	butterfly fishes	four-eyed butterfly, parche
Pomacanthus arcuatus	black angel	Portugais, sabellick, mariposa
Holacanthus tricolor	rock beauty	yellow nanny, catalineta
Angelichthys ciliaris	angelfish	yellow angel, blue angel
Acanthurus spp.	tangs	surgeon, doctor, medico, sous ge
Scorpaena plumieri and spp.	scorpionfish	prickly hind, lionfish
Cephalacanthus volitans	gurnards	poule de la mer
Eupomacentrus leuco rostris	black pilot fish	Beau Gregory
Pomacentridae spp.	demoiselles	———
Lachnolaimus maximus	nog fish	capitan
Bodianus rufus	ladyfish, wrasse	Spanish hogfish
Iridio radiata	wrasse	pudding wife
" bivittata	wrasse	doncella, slippery Dick
Sparisoma abilgaardi	red parrot fish	red-bellied chub, red jacquot
" chrysopterum	blue " "	blue chub, loro azul, blue jacquot
" flavesens	mud " "	marbled chub, loro, green jacquot
Scarus taeniopterus	ribbon-finned parrotfish	blue chub, loro
" vetula	rainbow parrot	blue chub, loro
" caeruleus	blue parrotfish	blue jacquot, loro
Remora remora	pilot fish	piloto
Balistes capriscus	triggerfish	cochino, turbot, puerco
" vetula	"	oldwife, cochino, puerco, bouze
Melichthys piceus	"	black oldwife, niggerhead
Monacanthus hispidus	filefish	cuckold
Osbeckia scripta	filefish	cuckold
Acanthostracion quadricornis	cowfish	shellfish, chapin
Lactophrys spp.	trunkfish	chapin, toro
Spheroides spengleri	swellfish	swelltoad, puffer, chouf-chouf
Diodon hystrix	porcupine fish	hedgehog
Dormitator maculatus and others	goby	guavina


FISHING AREAS
CARIBBEAN SEA
MEXICO
GUATEMALA
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NICARAGUA
COSTA RICA
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VENEZUELA
CUBA
THE
CARIBBEAN
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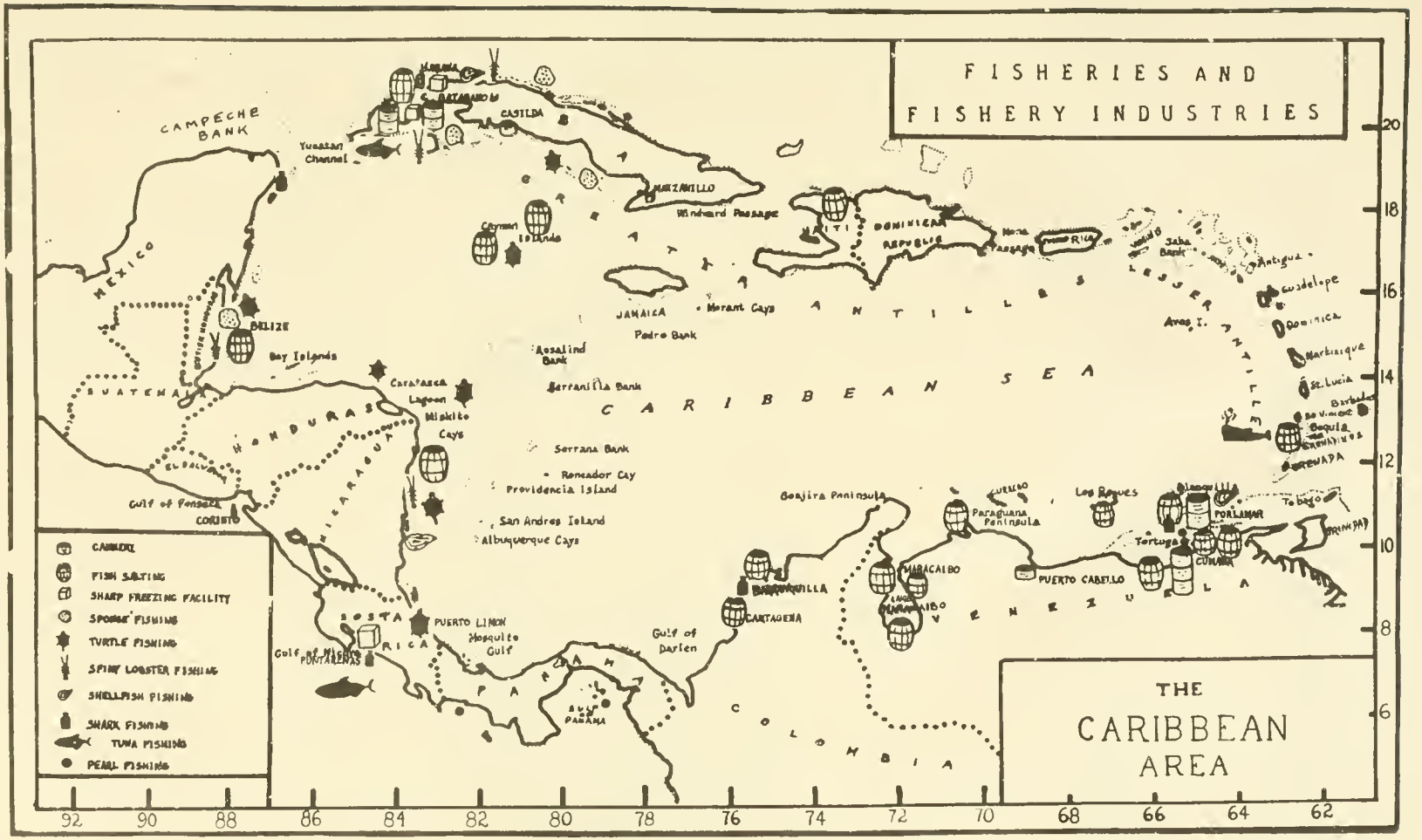
FISHERIES AND
FISHERY INDUSTRIES
THE
CARIBBEAN
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CAMPECHE BANK
MEXICO
BELIZE
Bay Islands
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
COSTA RICA
PANAMA
COLOMBIA
VENEZUELA
Yucatan Channel
CASTILLA
MANZANILLO
Windward Passage
HAITI
DOMINICAN REPUBLIC
Mona Passage
Saba Bank
Antigua
Guadelope
Dominica
Martinique
St. Lucia
Barbados
St. Vincent
Grenadines
GRENADA
Trinidad
Tobago
CARIBBEAN SEA
JAMAICA
Morant Cays
Pedro Bank
Rosalind Bank
Serranilla Bank
Serrana Bank
Roncador Cay
Providencia Island
San Andres Island
Albuquerque Cays
Caratasca Lagoon
Miskito Cays
Gulf of Fonseca
CORINTO
PUERTO LIMON
Mosquito Gulf
Gulf of Dulce
PUNTARENAS
Gulf of Darien
BUEN PANAMA
CARTAGENA
BARRANQUILLA
Goajira Peninsula
Paraguana Peninsula
MARACAIBO
PUERTO CABELLO
Los Roques
Tortuga
CURUMA
PORLAMAR
TRINIDAD
CARIBBEAN SEA
LESSER ANTILLES
Aves I.
CARIBBEAN
SHRIMP
FISH SALTING
SHARP FREEZING FACILITY
SPONGE FISHING
TURTLE FISHING
SPINY LOBSTER FISHING
SHELLFISH FISHING
SHARK FISHING
TUNA FISHING
PEARL FISHING
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Distribution:--The Caribbean area offers a number of distinct types of habitat for fishes. These may vary as to temperature and salinity of water, as to the type of bottom, depth of the water, and other factors.

The following habitat groupings are more or less artificial, and there is probably some overlap. There is included a partial list of the kind of fishes which may be encountered in each. Repetition in the lists is due to the fact that some groups have species living in several habitat types

Lagoons and estuaries:--

The salinities are fresh, brackish, hypersaline, but seldom normal. Temperatures have a wide variation. The turbidity varies widely, usually there is heavy sedimentation. The bottom is mud, sometimes sand. Food conditions are good (crustacea, small fish, and insects are available). Oxygen is usually deficient. The lagoons and estuaries are often surrounded by mangrove swamp areas. They may or may not have a permanent entrance to sea. Usually, there is fresh water entering as creeks or rivers.

Principal types

tarpon	snooks	sawfish	shrimp
mullet	mojarras	gars	oysters
grunts	groupers	sole	threadfins
anchovies	snappers	crabs	herrings
gobies			

These areas, in general, may be considered quite productive of fish. Nutriment for fishes is usually available in the form of aquatic vegetation and animals. These areas are often nursery grounds for young fish and they are admirable for this purpose. They are usually shallow and quite protected from heavy seas so fishing may be carried on easily at almost any time. In dryer regions, or where there is a very definite rainy and dry season, salinities vary greatly, from practically fresh to hypersaline. Thus, the lagoons and estuaries may have great stores of fish during some seasons when conditions are good, but they may be populated by relatively few species and individuals under extreme conditions. While some lagoon areas, such as the Unare in Venezuela, are fished quite heavily and produce large amounts of fish, others such as the Caratasca in Honduras, are practically unutilized. Since there are extensive lagoon and estuary areas in the Caribbean and since these are relatively good production areas, increased yields can be expected from them. With intelligent control, the yield can be sustained. Since many of the species occurring in these habitats are migratory in a limited sense, they may appear in catches from other habitats. Perhaps, the best example of this are in the cases of snook, mullet, and tarpons.

Open beaches to about five fathoms:--

Salinities are more regular than in the lagoons and estuaries but subject to changes due to rain and outwash from land. Also, temperatures are less variable than in the lagoons and estuaries. Turbidity may be more pronounced due to wave action. The bottom is usually sand, coral, rock, or possibly mud. Food conditions are not as good as in the lagoons and estuaries. Oxygen is usually in high concentrations due to wave action. Less shelter is found in these areas than in the lagoons and estuaries. There may be reefs, rocks, or sandy or muddy shoals in the foreshore.

Principal types

croakers	pompanos	silversides	flounders
bumpers	porgies	lizard fish	moonfish
seabass	grunts	anchovies	rays
sheepshead	gobies	herrings	butterfish
spadefish	snook	mullet	barracuda
blennies	tarpon	bonefish	clams
puffers	sharks	harvestfish	mussels
jacks	sardines	needlefish	

The dominant types of fish in this habitat are more or less wandering. Nutriment for fish is usually low from local production, but there may be considerable food organisms swept in from deeper water and from the land and lagoon areas. The beach areas are supplied with fish from both lagoon and estuary areas and from deeper waters, depending upon the conditions. Many species spawn on or near the surf. The fisheries in such regions are dependent upon the productivity of adjoining areas. Increased fishing is possible in many areas of the Caribbean, but the yield will fluctuate greatly from season to season depending upon the concentrations of the fish themselves.

Coral reefs and heads:—

Salinities are almost always normal and temperatures are quite constant. The water is usually clear except with unuaual surf conditions. The bottom is of coral, coral mud, coral sand, and usually overlaid with flocculent detritus in sheltered spots. The food conditions are better than in open areas but there is more competition for it. There is good shelter in cracks and crannies. The depths range to about 15 fathoms. Quiet areas are to be found to leeward and heavy surf on exposed faces.

Principal types

wrasses	holocentrids	barracuda	porkfish
moray eels	demoiselles	jacks	goatfish
groupers	angel fish	cardinal fish	croakers
hinds	trumpet fish	seabass	ribbon fish
tangs	comet fish	grunts	blennies
corvina (Odontoscion)	chaetodons	scorpionfish	threadfins
triggerfish	filefish	trunkfish	spiny lobsters

Coral reefs and heads occur widely in the inshore area to depths of about 15 fathoms, and offshore banks and reefs, also, support coral growths. These coral habitats form a very distinctive environment and there are many fish species which are found nowhere else. Popularly, the coral reefs are supposed to abound in fish, for casual observers can observe great numbers of highly-colored fish in reef areas. As a basis for commercial fisheries, however, coral-reef areas have considerable limitations. While there are many species present, the number of each species is small. Many do not grow to sizes usable as food for man. They are all dependent on the coral structure for existence. In spite of the fact that reef areas are more productive of food organisms, the actual amount available to commercially-fishable species is relatively low, for there are many competitors, unusable to man, taking their share of nutriments. The rate of growth and replacement is generally low due to the generally poor conditions as regards food. Even though good protection for small fish is present, predators are able to take considerable numbers. Coral-reef areas, available to fishermen, are, in many localities, depleted. This is evidenced by poor catches per unit of effort and by the small average size of the fish caught.

Since each of the isolated coral reefs may be regarded as almost a unit in itself, there is limited chance for increments from other coral-reef areas. Where there are extensive reef areas, such as off the coast of Nicaragua, there may be movements from one reef to another. In this area, localized fishing operations may draw on fish which have moved from other unfished reefs. The presence, therefore, of unfished reefs does not necessarily argue that catches can be greatly increased over a period of time by using these reefs. There may be a temporary enlargement of the catch, but as soon as the population is brought down to a certain level, the replacement rate will be the basic factor influencing catches. As has been stated above, the natural replacement rate by reproduction and growth is low and, therefore, the yield will drop or will include smaller and smaller fish until it is no longer economically feasible to continue fishing. In summation, then, it can be stated that increased yields may be obtained over a relatively short period of time but that the total possible yield is so limited that there is virtually no hope of establishing great fishery industries based on coral-reef populations. Even if there were large available populations of fish, the very nature of the coral makes mass-production of fish impossible, so that coral-reef fishing must remain an individual hook and line or pot fishery. Moreover, the

tremendous variation in size, quality, and species makes standardized, low-cost, fishery products from coral-reef areas impossible. While the coral areas will continue to supply some fish for local use, they cannot ever take care of the requirements of the area and can be expanded only to a limited extent.

Open bottom areas offshore (up to 100 fathoms):—

Salinities are always normal with little fluctuations. Temperatures usually show a constant variation in the water column but these may vary with upwelling or mixing. The turbidity is slight, if present at all. The bottom is mud, sand, shell, rocks, or pebbles. Food conditions are generally poor in the Caribbean Sea except with possible very-localized areas of collection. Oxygen is usually sufficient. Open-bank areas usually have no shelter except gorgonians and other structures. Limited bottom-dwelling life is found.

Principal types

groupers	sharks	seabass	wrasses
snappers	rays	porkfish	filefish
grunts	holocentrids	croakers	frogfish
eels	cutlass fish	scorpionfish	batfish
flounders			

Offshore, bottom areas with depths up to 100 fathoms are usually considered relatively unproductive in tropical waters. Clear, sandy, or muddy areas have few resident species, but some groupers and snappers may be taken at certain times of the year. Where the bottom is varied with ridges, ledges, and rocks, the fish population is usually greater. Jarvis (1935) found in the Campeche Bank red-snapper and grouper fishery that the fish were found most usually in depressions in the bottom. These are probably areas where food organisms collected. The amount of this type of bottom is relatively limited in the Caribbean and such areas as do occur cannot be regarded as highly productive. Again, as in the case of the coral-reef areas, the fishing activity must be more or less individual. Where trawling areas exist, fish are not abundant. Otherwise, the bottom is too rough for such nets. In any event, after examining the facts and analyzing results of attempts made previously by certain fishing companies to conduct trawling operations, it is concluded that the future of the Caribbean fisheries cannot depend upon this source of fish.

Open-surface areas offshore:—

Salinities and temperatures are normal for the Caribbean conditions. Turbidity is usually slight. Food conditions are usually very poor because of limited plankton production. There is true oceanic circulation, and the waters are of oceanic type.

Principal types

Spanish mackerel	frigate mackerel	flying fish
kingfish	albacore	dolphins
tuna	scads	rudderfish
jacks	sardines	myctophids
barracuda	rays	swordfish
sharks	anchovies	marlins
bonito	halfbeaks	sailfish

Open-surface areas offshore are the least known of the Caribbean habitats, and they form the major part of the region. The offshore-oceanic region is perhaps the least productive of food organisms, for the supply of nutrient salts is low. Yet all available evidence points to considerable supplies of fish in the "blue" waters. The fish in this habitat may be divided into two groups — the long-range migratory such as tunas, swordfish, marlins, and sailfish, and the limited migratory such as Spanish mackerel, kingfish, flying fish, and dolphins. The first group occurs seasonally, passing through the Caribbean along fairly definite channels,

the second group has been available to shore fishermen only at certain times of the year, but may be taken, possibly, in quantity offshore at other times. Hardly anything is known of the distribution, abundance, migration routes, or seasonal occurrence of the pelagic fishes. Reports, however, indicate that they appear in the Windward Island passages and around Tobago, off the coast of Venezuela, off the south coast of Cuba, and in the Bahamas. Since the abundance of these migratory fishes is not directly affected by the low productivity of the Caribbean Sea, there is some reason to believe that considerable amounts might be taken with proper methods. Limited migratory species seem most abundant in the Venezuela-Trinidad-Tobago region but they do occur in considerable numbers elsewhere as well. They are not now being utilized to the extent possible, and this is due chiefly to the limited radius of the present fishing methods.

From all evidence available and after consideration of the other habitat types, it is suggested that the fisheries for the pelagic species—both inshore and offshore—offer the greatest possibilities for fishing expansion in the Caribbean area.

Other Fishery Resources:—To the fish species may be added the spiny lobsters, shrimp, turtles, shark, and whales.

Spiny lobsters (Panulirus spp.) occur practically throughout the Caribbean. Their abundance varies according to the degree of fishing and on the amount of coral-reef area available. Considerable quantities are taken, particularly in Cuban waters, but several enterprises based on canning these crustacea have failed. This has been due, usually, to the irregularity and dimunition of supply. There are possibilities for local, small-scale industries based on lobsters if the grounds to be fished are extensive enough so almost immediate depletion does not occur. Continuous, successful operation of a lobster fishery depends upon systematic regulation of fishing intensity.

Shrimp are found in greater or lesser amounts in the Caribbean area, most usually in the neighborhood of lagoons, river mouths, and estuaries. There is reason to believe that fairly extensive shrimp fisheries can be developed in localized areas.

Turtles in the Caribbean area have been fished quite extensively, particularly by the Cayman Islanders on the Nicaraguan coast. Turtles are also taken on the Costa Rican coast and elsewhere in considerable numbers. A fishery at a fairly-high level could be maintained with adequate control measures if the depleted areas could be rehabilitated to some semblance of the original abundance.

Sharks of various species are found in all waters in the Caribbean. There has been, for years, some attention paid to shark fishing—formerly for the hides and fins, but more recently for the vitamin A content in the livers. Experience has shown that stocks of sharks in a given area are soon depleted below the point of successful commercial operations. With a stoppage of fishing, however, the sharks gradually return. As with the other species mentioned above, it would appear that the fishing area should be fairly large in order to spread the fishing strain to conform with the rate of replacement.

Whales are found from time to time, especially in the Windward Islands area. At one time, whaling was carried on as a commercial enterprise, but this activity has almost entirely disappeared. The low ebb of abundance makes organized commercial whaling quite impossible at this time.

Conclusions

1. The Caribbean Sea is not a greatly productive area.

2. The most productive areas within this Sea are the lagoons and estuaries.

3. Most of the habitat types will stand further fishing, but to a limited extent, and this added strain must be controlled.

4. The pelagic fish offer the greatest opportunities for fishery development.

5. Other fishery resources such as lobsters, shrimp, turtles, and whales are available, but in limited amounts.

THE FISHERY INDUSTRIES

Since before the discovery of America, the fisherman of the Caribbean Area has strained its waters through his nets and lowered his lines and fish pots to the floor of the sea. He has chosen fishing because of the life it gives him—simple, carefree, and vigorous—and he has little aspiration to fame and fortune. From the day's toil he hopes to obtain enough to keep himself and his family alive with a scanty roof over their heads, and to buy replacements for his boat and fishing gear.

Fishermen throughout the Caribbean and on the Pacific side of Central America are much the same in type, though they may vary in color and language. With very few exceptions, they are poor, living from day to day on the sales of the catch of the day before. Their homes are usually huts of thatched grasses, sun-baked clay, or unpainted wood. Their food is the cheapest and the most simple that nature and world trade can deliver to their doors.

All coastal communities seem to have developed or accumulated a few fishermen. These men furnish the communities a fairly regular supply of fresh fish, selling them from their boats to street or market vendors. In almost all coastal communities fish are sold in the public markets. Most of the large inland communities are also supplied with small quantities of fish. In places where fish are exceptionally abundant, comparatively large communities of fishermen have been formed.

PRODUCTION OF FISH AND SHELLFISH IN THE CARIBBEAN AREA
(Estimated and from Various Sources)
Normal Annual Catch prior to the War

Country or Colony	Pounds
British West Indies (Eastern Group)	11,100,000
Venezuela	100,000,000
Colombia	3,500,000
Panama	2,000,000
Costa Rica	1,000,000
Nicaragua	300,000
Honduras	300,000
British Honduras	500,000
El Savador	700,000
Guatemala	100,000
Cuba	15,000,000
Jamaica and the Cayman Islands	10,000,000
Haiti	2,000,000
Dominican Republic	1,000,000
Puerto Rico	3,000,000
American Virgins	600,000
Dutch West Indies	1,000,000
French West Indies	9,000,000
Total	161,100,000

In general, fish are handled without refrigeration and are sold and consumed within a few hours after being caught. In many places, however, preservation of fish permits their sale in localities off the coast or at a considerable distance from the fishing grounds. Under such circumstances, ice is used or crude salting or smoking is employed.

Only one canned Caribbean fishery product, spiny lobster, appears in international trade. Several species of fish are canned in Venezuela for consumption in that country and a few cases of tuna are produced in Costa Rica and Cuba. Canned fish is very acceptable in

trade in the countries in which it is packed. Venezuelan canned products are sold to the exclusion of imported canned fish in many retail outlets throughout Venezuela. Some of that country's canned fish has been shipped to Trinidad in recent years.

Dry-salted or smoked fish is used within the limits permitted by the cure of the products. Usually the cure is mild and the product suitable only for quick sale and limited transportation. Almost without exception the salted products seen were quite moist, with a brown coloration evidencing oxidation of fat in the tissues. These products serve local trade in an acceptable manner, but their enlarged use would be difficult without improvement of the curing process.

Transportation facilities are undeveloped. Fishermen undoubtedly suffer considerable loss of fish from decomposition after the catches have been made. The great majority of the fish is carried from fishing ground to landing points by sailboat, and when the wind fails, even iced fish may become spoiled. This factor of loss does not appear very important, however, as prevailing winds are fairly reliable in the Caribbean Sea. Fishermen soon learn the keeping capabilities of the fish they catch and limit their fishing operations to grounds from which they can transport the fish safely. For fishing at greater distances from port, ice is used, gasoline or diesel engines employed, or live-well vessels constructed. The latter devices are employed only by a rather restricted group of more ambitious fishermen, where the rewards in large catches or exceptional marketing opportunities justify the extra expense and effort.

Landing facilities are no more elaborate than the fishing operations demand. In many places fishermen may moor their small boats alongside the public markets. In most others the boats are run ashore and the fish unloaded into baskets to be transported to the market place. A few ports have docking facilities for unloading vessels. At Havana fish from live-well vessels are transferred into floating crates or live cars that hold them alive until market demands are favorable for their sale. At other points, turtles and spiny lobsters are collected and held in similar manner.

Virtually all communities in the Caribbean region have public markets at which goods may be displayed and sold for no charge or for a small fee. In the communities founded by Spaniards these market places are much more elaborate than those in the areas settled by peoples of other original nationalities. These markets usually are located on or near the waterfront as marketing in the area has always relied on water-bourne commerce for most of its goods. Fish are usually displayed at general produce markets, although in many places where fishing is important, special fish markets have been provided adjacent to other market facilities. While running water has been piped to most markets, some are entirely lacking in these facilities, and fish must be cleaned along the water's edge or in water carried in buckets to the market place. Concrete display benches are usually provided. These are occasionally tile topped and may be equipped individually with sinks with running water.

In several communities, special market stalls have been provided for use by a few fish vendors. One of these in Ciudad Trujillo in the Dominican Republic, contained refrigerators. Most of the others seen had facilities for icing fish.

Most public markets are covered with galvanized sheet-iron roofing, tile, or concrete, and are open on all four sides. All have concrete floors. Virtually all are operated under strict sanitary regulations and are washed by hose after each day's business. Inspection of products is often provided. In some markets insulated storage boxes are provided for holding fish in ice overnight. Such facilities are not widely used, however, as it is common experience that fish displayed one day deteriorates in quality too much to be appealing to buyers on the next day. Most of the fish handled fresh in the entire area are sold in the market on the same day they are caught.

There are only a few private fish markets. Some of these appear to have been established because of inadequacies in the public markets. These markets are built with much better facilities for handling fish than are the public markets. Most of them use ice and cold-storage facilities. They are under less strict sanitary control than the public markets.

Ice is usually available in some quantity. It varies in price from 50¢ to $1.00 per 100 lbs. It is not used, however, if fish can be delivered in good condition without it. Cold-storage space can be secured for holding fish in most ice plants, but only in Cuba and Costa Rica has space been constructed especially for fish. Freezing and storage facilities have been built in Cuba for engaging in trade in frozen spiny lobsters, and on the Pacific side of Costa Rica a large cold-storage plant has been operating for several years, freezing and holding tuna for the California tuna-canning industry.

A few fish trucks are used, some of which are insulated. No railway cars have been especially equipped for fish transportation. Transport vessels are virtually unknown. Boxes holding ice and 100 to 200 pounds of fish are universally used for shipping. These are carried in any manner possible--by truck, rail, and boat. Fish is carried to market by airplane from Barranquilla to Bogota in Colombia and from Amapala to Tegucigalpa in Honduras. In the British West Indies it is carried in baskets on the heads of Negro women, as they peddle it on foot through the countryside or carry the day's purchases home from market. Street vendors may carry their fish stocks on their heads, on muleback, in small insulated pushcarts, or strung from a pole balanced on one shoulder.

Prices vary from place to place, being influenced particularly by the abundance of fish, condition of the market, and prices of other food products. Prices are almost invariably lower than those for meats. As fishing operations usually take only a few fish a day, the prices are fairly high, however, usually yielding the fisherman 6 to 10 cents per pound. Retail prices are normally too high to enable the common laborer to purchase any but the cheapest varieties of fresh fish.

Emergency conditions in the Caribbean area some time ago forced many governments to establish maximum retail prices for fish. Today, almost without exception such prices have been established throughout the Caribbean. Generally products are divided into classes entitled to various differences in price. In Jamaica, a government purchasing agency buys fish at the landing ports at established minimum prices, transporting them to Kingstown, where they are sold at or below the established maximum prices. Private buyers purchase fish in competition with the local government, but the system guarantees the fishermen as large a return for their labor as is possible under existing prices to the consumer.

Earnings of the fisherman have increased in most of the Caribbean area since the beginning of the War. In most localities the established prices have been higher than those of normal times. Prices of supplies and gear have increased, however, and it has been increasingly impossible to obtain gear replacements. Many fishermen have discontinued fishing when their gear has worn out. Others have left their usual fishing to take jobs in other lines of work. Construction projects connected with the War have offered very enticing wages to the low-income fisherman. At many points, dislocation of normal industry has made many men available for fishing, but lack of gear and boats have prevented much of an increase in catch from this cause. Continued decline in catch appears inevitable if gear replacements are not made available.

Normally there are about 160 million pounds of fish caught per year in the Caribbean Sea. One hundred million of these are taken in Venezuelan waters and 15 million in Cuba. The population of the area also consumes about 150 million pounds of imported fishery products a year. These food supplies provide much of the flesh-building proteins used by the 35 to 40 million people of the Caribbean. The average per-capita consumption of fish (on the basis of whole, round fish) is about 20 pounds. While many of the people in the area consume little or no fish, others rely on this food for almost their complete supply of flesh proteins. Yearly consumption varied from less than one pound per person in parts of Central America to 180 pounds per person in the French West Indies.

The high consumption of imported fishery products is explained by the comparative cheapness and high food value of dry-salt codfish, the predominant import item. This product has for years been the world's cheapest source of flesh proteins. The grade of salt-cod usually sent to the Caribbean contains about 2 1/2 times the protein content of fresh beef round, pound for pound, and it sells normally for a much lower unit price. It is also adaptable to transportation, sale, and use without refrigeration to the extent made necessary by conditions of merchandising in the Caribbean.

IMPORTS OF FISHERY PRODUCTS INTO THE CARIBBEAN AREA

(From Customs and Other Reports)

Normal Imports prior to the War

Country or Colony	Pounds
British West Indies (Eastern Group)	14,500,000
Venezuela	7,800,000
Colombia	3,000,000
Panama	2,500,000
Costa Rica	700,000
Nicaragua	100,000
Honduras	200,000
British Honduras	100,000
El Salvador	500,000
Guatemala	1,000,000
Cuba	17,000,000
Jamaica and the Cayman Islands	23,600,000
Haiti	9,000,000
Dominican Republic	10,000,000
Puerto Rico	36,000,000
American Virgins	500,000
Dutch West Indies	1,200,000
French West Indies	24,800,000
Total	152,500,000

PER CAPITA CONSUMPTION OF FISH IN THE CARIBBEAN AREA

Based on Normal Production and Trade,
converted to equivalents in whole, fresh fish

Country or Colony	Population	Average Annual Consumption In Pounds
British West Indies	1,018,000	66.2
Venezuela	3,840,000	30.3
Colombia	9,242,000	1.0
Panama	632,000	15.0
Costa Rica	656,000	4.3
Nicaragua	1,380,000	0.4
Honduras	1,160,000	0.7
British Honduras	65,000	11.3
El Salvador	1,790,000	1.0
Guatemala	3,320,000	0.7
Cuba	4,300,000	17.7
Jamaica and the Cayman Islands	1,195,000	84.9
Haiti	2,700,000	14.0
Dominican Republic	1,650,000	24.7
Puerto Rico	2,000,000	69.9
American Virgin Islands	22,000	104.5
Dutch West Indies	66,000	65.5
French West Indies	600,000	180.1
West Indies, Entire	13,551,000	42.7
Caribbean Area, Entire	35,646,000	20.2

The use of salt codfish (called "bacalao" in the Spanish-speaking areas), has become firmly implanted in the customary diet of much of the Caribbean area. Many esteemed dishes are prepared with bacalao, the use of which has become intimately associated with rice and beans, two other important staples of the diet.

Fishery exports from the Caribbean area are limited thus far to canned and frozen spiny lobster from Cuba; turtles and tortoise shell from Central American republics, the Cayman Islands, and Cuba; sponges from Cuba and Central America; pearls and canned fish from Venezuela; and shark livers, liver oil, fins, teeth and hides from scattered points throughout the region. This trade now has been reduced by the War to a fraction of its normal size. Other exported products associated with fisheries are frozen frog legs from Cuba and alligator hides from Central America. The collective value of all these exports is estimated at about $1,000,000 per year during normal times.

Most of the exports shipped are destined for the United States. Some previously went to Germany and France. Natural pearls at one time were very important in export trade with France and it was reported that some thirty years ago large quantities of live spiny lobsters were collected for the French market off various Caribbean islands by live-well vessels coming from ports in France. A sizeable export trade in live spiny lobsters was also established in Cuba several years ago, the shipments going to nearby Florida ports.

Fishermen

The best estimates available place the number of commercial fishermen in the Caribbean at about 95,000. To this number must be added the very considerable numbers of persons who fish for their own use, others who fish only irregularly, and perhaps a relatively few sport fishermen.

Cuba leads the area with 40,000 fishermen or about 42 percent of the total number for the entire Caribbean area. Fishermen represent about 0.9 percent of the population of Cuba and about 0.3 percent of the total Caribbean population. Estimates of the number of fishermen in the remainder of the area are given in an accompanying table.

The economic level of the fishermen is low. Some of the more progressive individuals have succeeded in bettering themselves by accumulating two or three fishing outfits which they hire out to other fishermen for a share of the catch. It is doubtful, however, that the average income of Caribbean fishermen is more than about $150.00 per year.

Fishermen in most of the Caribbean region live in communities of their own--usually on the shore and away from the larger towns. In these communities practically everyone is a fisherman or belongs to a fisherman's family. Almost everyone helps with the fishing in some way. Houses and furnishings are of the simplest types and the food of the community runs to fresh and dried fish with additions of various vegetables and cereals. In general, people of the fishing villages are healthier than those of other communities and those of the same economic level in other occupations.

Contrary to ideas frequently expressed as to the diligence of these people, it was found that the average fisherman works just as hard, if not harder, than agricultural labor, and it goes without argument that his work is much more hazardous. It also requires more initiative and perseverance than is usually characteristic of other types of labor. In spite of this, however, fishermen have been little encouraged by the various governments to better their lot.

That fishermen are highly individualistic is true. But in their village life they often show a distinct leaning toward cooperative efforts. They do not, as a rule, wish to work for an outsider but will work for another fisherman or for someone whom they like and respect.

In the West Indies, most fishermen are of Negro stock. In the Republics of Venezuela and, to a lesser extent, Colombia, they are almost all pure Spanish or mixed Spanish and Indian types. Along the Caribbean coast of Central America, fishermen are either Indians or Negroes or mixtures of these races. Few persons of white blood fish on this coast. In Cuba,

FISHERMEN IN THE CARIBBEAN AREA

(Estimated and from Various Sources)

Country or Colony	Number of Fishermen
British West Indies (Eastern Group)	7,000
Venezuela	20,000 1/
Colombia	2,100
Panama	600
Costa Rica	150
Nicaragua	100
Honduras	200
British Honduras	400 2/
El Salvador	130
Guatemala	200
Cuba	40,000 3/
Jamaica	6,000
Cayman Islands	650
Haiti	3,000
Dominican Republic	1,500
Puerto Rico	3,000
American Virgins	400
All Others	10,000 4/
Total	95,430

1/ 6,500 operating in boats of more than 1 ton gross

2/ full-time fishermen

3/ including all fishermen

4/ includes French and Dutch possessions

the fishermen are predominantly of white blood and there is also some Negro blood represented. All of the Haitian fishermen are of Negro stock and the fishermen of the Dominican Republic are mixed Negro and white stock.

Political refugees from Spain and elsewhere have gone into fishing and fishery industries in a number of Caribbean countries. With them they have brought new techniques, new enthusiasm, and new methods. Their activities will probably have a beneficial effect.

As a general rule the fishermen of the Caribbean are excellent seamen and very good fishermen. They make most of their equipment by hand and exhibit considerable ingenuity in using local materials in their work. Very few, if any, of these men will sell the fish in the market since they feel that this is a woman's duty. Usually fishermen limit their catches to the amount they know can be sold at a good price. Often they agree amongst themselves not to exceed a certain quota. If one transgresses he is likely to be roughly handled by the others. In the Latin-American countries, fishermen have sometimes organized into "gremios". These are in the nature of a guild organization but are not true cooperatives. They represent the fishermen in religious, political, and in other ways. In Cuba and Venezuela, gremios are relatively widespread and have accomplished, to a certain extent, the task of unifying the fishermen for their material benefit.

In many regions the fishermen or their families till a piece of ground as a supplement to their fishing activities. In the Gulf of Cariaco region in Venezuela, however, and in other like regions, the inhabitants subsist entirely from the sea and are truly peasants of the sea. Many of the fishermen in the more isolated regions are migratory. They follow the runs of fish from place to place and salt and dry their catches.

Among the best fishermen of the Caribbean are those living on the Cayman Islands. They have a long history of boat-building and fishing activity. In normal times they fish almost throughout the western Caribbean and land their catches in Jamaica, the United States, or in the Canal Zone. The fishermen of Saba Island are quite akin to the Cayman Islanders in their ability.

As a result of the work of the Mission, it has been found that the fishermen of the Caribbean can assimilate new techniques easily and that they, as a group, would be worthy of increased attention from the various governments.

Boats

Estimates from various sources indicate that a total of some 30,000 craft make up the fishing fleet in the Caribbean. The greatest number, 12,000 or 40 percent of the total is found in Cuba.

The most common form of fishing boat is the dugout canoe (cayuco or dori boat). These are found practically throughout the area and are much used for fishing. Most frequently they are used in sheltered waters but they are also used in open waters to a considerable extent. The length ranges up to about 35 feet. Usually the beam is relatively narrow--not more than 3 or 4 feet. The depth may be 2 to 3 feet and there is sometimes a shallow keel extending for practically the entire length of the bottom. Dugout canoes vary greatly in details of design. Some are pointed at both ends--others at only one end. Some have an outboard tiller--others are steered by a wide-bladed oar. Actual construction varies considerably. In most of Central America, the finished craft is made of one piece of wood. There may be a few thwarts added. In the West Indies, strengthening ribs are often fitted inside of the shell and the depth of the craft increased by adding strakes all around the gunwale.

In Trinidad, the only dugout portions are the keel and garboards. The remainder of the hull is built up of hardwood stem, stern, and frames of local hardwoods with planking of broad lengths of imported white pine fastened in clinker fashion. These boats are known as "lambias" or "shellboats". They range from 15 to 22 feet in length and they are designed primarily for lightness in hauling up on beaches and for ease in rowing. Sails are seldom

FISHING CRAFT IN THE CARIBBEAN AREA - ALL TYPES

(Estimated and from Various Sources)

Country or Colony	Fishing Craft
British West Indies (Eastern Group)	2,300
Venezuela	3,000 1/
Colombia	1,200
Panama	200
Costa Rica	100
Nicaragua	75
Honduras	100
British Honduras	400
El Salvador	100
Guatemala	100
Cuba	12,000
Jamaica	1,800
Cayman Islands	200
Haiti	1,450
Dominican Republic	600
Puerto Rico	1,200
American Virgins	200
All Others	5,000 2/
Total	30,025

1/ 1,300 larger than 1 ton gross

2/ Estimated - includes French and Dutch possessions

used since the slender lines and low freeboard render these quite unsuitable, except with the wind abaft the beam. If they do use sails, these are made of very light cotton. The shellboats are most usually rowed by two men each handling a pair of oars with a third man watching the lines.

Few, if any, dugouts are found in Puerto Rico, the Virgin Islands, or Antigua. They first appear at Dominica and southward. At St. Lucia the bottom section is formed from a single log of "gommier" wood. The upper bulwarks are made of planking in one broad strake which is lapped over the dugout section and strapped to it. The dug-out solid section has a long projecting, square-shaped bow resembling an ice-breaker or ram and this is shod with strap iron. The upper strakes terminate in a pointed bow some distance aft of the projecting "ram". An average size dugout would be from 20 to 27 feet in length, about 3 feet wide, and about 2 1/2 feet in total depth. Ribs of local wood are placed to strengthen the shell and to hold the top strakes. The stern almost approaches a point but in reality has a square transom about 6 inches wide. The rudder is outboard and slung on pintles and gudgeons. One or two, usually two, mast steps are provided, the forward one being smaller than the after one. The sail is almost always a spritsail and the only spar is a sprit pole running from the peak of the sail to the foot of the mast. The size of the larger sail is about 8 by 10 feet and the smaller, 6 by 4 feet. These are usually made of flour-sacking material. These craft are very fast with favorable breezes but since they have round bottoms and carry no ballast they are cranky and require expert handling.

Dugouts have almost been replaced by other types in Venezuela but some small ones are used as tenders and for lagoon and sheltered-bay fishing, especially around Maracaibo. Large dugouts are used in Colombia and these are employed in the lagoons or "cienagas". They are usually poled or paddled. In Cartagena, these craft are double-ended and have rounded sections throughout. Each end is raised considerably and the general form is that of an American Indian birchbark canoe. They are 15 to 18 feet in length and 4 to 5 feet wide. A mast is stepped forward and the sail is of sprit type. Thwarts are arranged for seating. The immediate region of both ends is decked over. These boats are used almost entirely in inside waters.

At Las Palmas, Panama, small dugouts ranging from 12 to 25 feet are used. The smaller ones are double-ended with considerable rake. Larger ones have square sterns and are equipped with outboard tillers. Paddles are used for the small ones and sails with the larger ones. Each has a keel at the stern and aft sections but the remaining sections are rounded.

On the Central American Caribbean coast, dugout canoes are about the only kind of local boat used for fishing. Two types appear—both made by the Indians. The "dori" or keeled canoe is used to navigate the sea and lagoons, while the "pitpan", or flat-bottomed canoe is employed on the rivers. The sea canoes are fast sailers, but somewhat cranky. Both types are hollowed out by means of the adze; the largest, cut out of the solid tree, without any additions, may reach a size of 5 feet beam and 40 feet length. Pitpans are long and narrow and have flat bottoms, and they are particularly adaptable for use in the shallow creeks of the interior. They glide noiselessly over the water and are easily handled but they are cranky and easily upset. Pitpans have a square projecting bow and stern, like a small pulpit, large enough for one person to stand on. A hole is made in the bow through which a pole is thrust perpendicularly into the ground, to moor at river banks or at shoals. They are thick-bottomed and can sustain rough treatment.

The dori boats are keeled, double-enders and are not built up as described previously in other sections. The Indians on this coast were acquainted with the manner of cutting trees and hollowing them out long before the arrival of the Spaniards. They made a ring with a stone axe through the bark and base of the tree, thus causing it to dry. Then fire was applied, and the wood was cut away as it charred. This was continued until finally the tree was felled. The hollowing-out process was effected by alternately applying fire and the stone axe. The width of the dugout was enlarged after it had been filled with water for a number of days by stretching and widening by inserting sticks.

The trees used in cance making are several. Most commonly used is the mahogany (*Swietenia macrophylla*). Canoes made of this wood are very durable but rather heavy and they are susceptible to attacks from boring worms. Cedar (*Cedrela* sp.) is not subject to

worm attacks but is easily split. Canoes of cedar, however, are very light and comparatively durable. The guanacaste tree (Enterolobium cyclocarpum) is a favored material. It is allowed to season for several months on the ground before being hollowed out. It is as light as cedar. From the silk cotton tree or ceiba (Ceiba pentranda) very large dugouts may be made, but the light, whitish-colored wood is not durable. Emery (Vochysia hondurensis) is occasionally used and its wood resembles that of the Ceiba but is more lasting. It soon, however, waterlogs and also rots immediately where nails are driven into it. Saba (Carapa guianensis or Guarea saoba), Santa Maria (Calophyllum brasiliense var.), and banek or cebo (Virola merendonis) are used occasionally.

The canoes are propelled by long poles or paddles. A captain sits in the stern and steers with a paddle. Paddles are broad-bladed and made of mahogany or cedar. They measure 4 to 5 feet in length and are often polished. At the upper extremity the paddle terminates into an enlargement or "ear" which serves as a hand grip while the other hand grasps the paddle about 2 feet further down. Sails are used to some extent and are made of canvas or other imported cloth.

Some of the larger dugouts have been powered with outboard motors. In Cuba, a few dugouts are equipped with small inboard motors. In Colombia they have a fair-sized ice box built-in amidships.

It was learned that the fisherman desiring to build a dugout canoe goes into the interior and selects and purchases a suitable tree. The tree is cut down and hollowed out on the spot by a boat maker and then later brought to the coast—often at considerable labor. The finishing touches are made when it has been delivered to the fisherman.

While dugout canoes are slowly being replaced for fishing, they still represent the cheapest and most easily-procured craft, and, for this reason, dugout canoes will probably be used for years to come, both for fishing and for transportation and freighting.

Sailboats of built-up types are found throughout the Caribbean area. They are a diverse size and design and they show the influences of many foreign fishing-boat types. They range in size from small, crude, sailing skiffs to ocean-going schooners. Most usually they are locally-built of native hardwoods for the keel and ribs and of imported woods for the planking.

The fishing craft of Antigua are all powered by sail. They are built locally with hardwood frames of native origin and planked with imported yellow pine. Lengths are up to 30 feet and depths 4 to 5 feet. Their beam varies from 6 to 8 feet. They are equipped with outboard tillers hung on pintles and gudgeons. The craft are well built and admirably well-designed for fishing. Live wells or "tanks" have been used in the past but are not now regarded as necessary. The masts are 20 to 25 feet in height and made of solid wood. Shrouds are of rope. A mainsail of triangular shape equipped with a boom and a jib with a loose foot is employed. The boats are decked forward and aft and also along the gunwales with a working space retained amidships. Considerable amounts of ballast (heavy rocks and scrap iron) are used. The planking is fastened in carvel style. The stern is straight with no counter. The keel is fairly deep and of deep-sea type. The hull sections are clean with easy lines and the freeboard is about 18 inches. The construction throughout is good and the craft are stoutly built.

At Castries, St. Lucia, whaleboat-type boats were observed. There were only a few on the island—all built locally by one builder at Castries. These craft are around 30 feet in length, have a 5 to 6 foot beam and are about 3 feet deep. They are equipped with centerboards which are used to avoid making leeway. There are 3 to 4 thwarts and 400 to 500 pounds of ballast composed of rocks and scrap iron. Construction is of pitch pine with white cedar frames, and the planking is carvel laid.

The whaleboats are double-ended and are partially decked forward. There is considerable sheer and the lines are clean and fast. A low keel extends most of the length of the boat. The centerboards are dagger-shaped and made of hardwood. The cost of such a boat without sails or rigging would be around $200. With materials available, boats of this type could be built in about 5 weeks. Two sails are carried—a mainsail and jib—both made of canvas. There is a short mast built of local wood and rigidly stayed. The mainsail is long and gunther-rigged. The gaff is of bamboo and it is much longer than the mast. When in use, it

is hauled in vertically and very close to the mast. The boom is of local wood and the sail has a very long reach. The jib, also, is equipped with a light boom. The rudder is shipped outboard on pintles. These boats are used in offshore fishing with trolling lines and harpoons.

Fishing craft observed on the island of St. Vincent fall into two types but there are no dugout canoes in use. All exhibit strong influences of the old Yankee whaleboat. In the old whaling days, the area around the Grenadines and St. Vincent was a whale-hunting ground and, doubtless, whaleboats were repaired and possibly built in this region, even in those times. The whaleboats now built at Bequia for fishing are excellent. They have a 19-foot keel and are 25 feet in length overall. The beam is about 6 feet. They are strongly constructed of local woods in the ribs, keel, and frames, and are planked with pitch pine imported from the United States. They are carvel built and equipped with outboard rudders and a deep centerboard. These whaleboats are rigged with a spritsail and jib--the luff of the mainsail being lashed to the mast. The jib is loose-footed and reaches to the head of the mainmast. Most, if not all, these boats are built at Friendship Bay, Bequia. A smaller type of boat, built on the same general lines but with a greater relative beam is the second type observed. These are double-ended and are well built. They are planked in carvel style. Ones over 16 feet in length are equipped with centerboards. A spritsail and jib is used. The bottom is a shallow vee with a sharp turn to the bilge. The beam is more than one-third of the length. Sections fore and aft are very full and this makes for solidity and stability. They lack the fine lines of the whaleboats but they must be heavily constructed since they are usually drawn up on the beach.

At Trinidad the trend has been away from sailboats, and here the boats are designed particularly for lightness and for rowing qualities. The seine boat or large pirogue is double-ended and has a raking bow and stern. The fine lines fore and aft swell into fairly full sections amidships. Up to 7 men are carried, usually pulling 5 oars in whaler fashion. These craft are often powered with outboard motors and one has an inboard engine. At two places, heavy, clinker-built dinghy-type boats are used. These may be called bumboats and are the standard type boat in Tobago. A few are used on the east coast of Trinidad.

The standard fishing boat of Barbados is the flying-fish boat. These are strongly-built open vessels of 18 to 25 feet. The profile has no overhangs and a straight stem with a firmly-rounded forefoot running down to a straight keel. The keel slopes gently down to the heel of the rudder post where the draft is deepest; about 5 feet. The rudder post is nearly vertical and supports a transom stern. Sections are very full forward and to the level of the mast, then they taper off to a clean run. Below, there is a fair amount of dead wood. No outside ballast is carried, but about a ton of scrap iron is carried inside. The flying-fish boats are propelled by two sails--a good-sized, gunther-rigged, leg-o-mutton mainsail and a powerful jib set on the end of a short stout bowsprit. These boats may be regarded as excellent for the type of fishing in which they engage.

Fishing boats in Venezuela are specialized for the various kinds of fishing. For seine and shore fishing "piraguas" are the most used. These have widely-flaring bows, a great deal of sheer and square skiff-like sterns. Propulsion is chiefly by paddle and they carry 5 to 10 men as well as a haul seine. At times they are fitted with a short mast and a long "entena" for a lateen type sail. Piraguas are used for bringing in catches as well as in fishing. The bow sections are flat and shallow in order that the boat may be more easily pulled up on the beach. The length varies from 25 to 35 feet, the width from 7 to 8 feet, and the total depth from 2 to 3 feet. The seine is piled in the after part of the boat and is set over the gunwale on one side. Piraguas are locally built, usually of imported woods. In the Lake Maracaibo region a type of boat somewhat similar to the piragua is called a "canoa". These are locally-built of both imported and locally-produced woods. The length is about 35 feet and the width 5 to 6 feet. Two masts are stepped and they carry lateen-type sails. There is a centerboard and rudder as well as considerable deadwood aft. The keel area is limited and shallow. Center sections are vee shaped and the bottom is flat. Bow sections are more or less vee shaped and there is a sharp turn to the bilge. Larger vessels, called "chalanas" range up to 5 gross tons. These are powered by sails and are decked fore and aft. These have flat bottoms and are double-ended. They are equipped with one or two masts. Another type of boat uses a square sail which is fore-and aft-rigged. There is a yardarm lashed to the mast and the sail is loose-footed.

The largest fishing boats in Venezuela are known as "goletas" and these are locally-built of imported and domestic woods. The size ranges up to 60 or 70 feet and a number of them are equipped with auxiliary motors. These vessels are used for offshore handline fishing but more usually for fish transport. At Porlamar, Isla Margarita, there are many medium-sized sailboats used in pearling during normal times and for fishing at the present time. These vessels average about 50 feet in length, are schooner-rigged and are excellent sea boats. They have good characteristics, being built with flared bows, a good deal of sheer and rounded sterns. Some have auxiliary engines while others utilize outboard motors fastened to a rail on the stern. A specialized type of sailing boat is used for trolling aroung Isla Margarita. These are about 35 feet in length. They are generally of the piragua-type hull but usually are made more seaworthy by the addition of splash guards of canvas fastened along the rail. An outboard rudder us used. Propulsion is by means of a powerful lateen sail and jib. Another type, also used for trolling, is about the same length but has a blunt bow and carries a stubby bowsprit. Both types are equipped with outrigger trolling poles, and in this way a number of trolling lines can be fished simultaneously.

In Panama, on the Pacific side, there are a number of small sailing craft of fishing type which are evidently an adaptation of the Mediterranean felucca. These are locally called "chalupas". They range from 27 to 30 feet in length and are completely decked over, except for a small cockpit. Hold space with hatch covers is provided for nets and iced fish. The boats are double-ended, have considerable sheer and low keels. The rudder is slung outboard and these little craft are reputedly good sailers. The sail is of lateen type and jibs are sometimes used.

In British Honduras the most commonly used boat is called the "dorey". These range from 16 to 40 feet in length and usually are equipped with live wells. They carry a gunther-rigged sail and jib. Doreys are locally-built and are of good design. They are double-enders and employ outboard rudders. Many are decked over in the forward part and there is usually a cockpit. The well is situated amidships and is covered with a hatch. Larger sailing vessels, called smacks, also are used for fishing. These range from 2 1/2 to 6 1/2 gross tons and require a crew of from 3 to 5 men. They are equipped with live wells and are used for offshore fishing. They carry a good spread of sail and are capable sea boats.

Cuban fishing craft range in size from 150-ton schooners down to small 15 or 20-foot sailboats. Most Cuban boats are of schooner- or sloop-type, and are equipped with sails. Many of the larger vessels have auxiliary engines. Most of the large schooners and practically all of the smaller ones are built locally. A few of the large offshore fishing schooners were introduced from New England or Nova Scotia. A particularly handy type of vessel is found at Batabano, the headquarters for extensive sponge fisheries. These vessels range from 50 to 75 feet in length, are schooner- or sloop-rigged, and are excellent sea boats. Many are equipped with live wells and some with auxiliary engines. There is probably a greater number of large sailing craft used for fishing in Cuba than anywhere else in the Caribbean. Most of the smaller sailing craft are rigged with sails--either gaff-rigged or spritsail-rigged. Numerous variants of design were noted in Cuban sailing craft, but in general they are well built and quite suited to the type of fishing in which they are engaged.

Fishing boats in Haiti are, in general, not as well-built or well-designed as elsewhere. They range from 14 to 40 feet in length and many are open types with little or no decking. Most are gaff-rigged or spritsail-rigged. They usually have square or round sterns with either inboard or outboard rudders. Most are constructed locally, employing some local wood but mostly imported planking.

Both rowboats and sailboats are used in Puerto Rico and the Virgin Islands. The rowboats are usually flat-bottomed skiffs from 15 to 20 feet in length and 3 to 4 feet beam. They are generally built on the lines of a dory although some are little more than floating boxes. Few, if any, have keels. Some carry sails. The construction is invariably rough. Sailboats are of two general types. One is small--2 tons gross or less--and is not decked over or fitted with live wells. The other type ranges from 3 to 5 tons gross, is decked and equipped with live wells. All sailboats are locally constructed. Ribs, knees, and other frames are of native wood but imported pine is used for planking. They are roughly but strongly built, being fitted with a single mast and bowsprit with the sails triangular

and quite powerful. They are built with considerable sheer and have a fair amount of keel surface and deadwood aft. The bow is flared and clipper-styled. The stern is square with a small transom and a good deal of overhang. Freeboard is generally low. They are completely decked over and there are a number of hatches on deck leading to the live well, storage spaces, and a small cockpit. The rudder is hung outboard.

Fishing vessels of the Cayman Islands are well-constructed locally and are excellent sea boats. They are usually 50 to 75 feet in length and often equipped with live wells. They are fitted with schooner-type rigging and are capable of making long trips to sea.

Motor vessels are comparatively little used for fishing in the Caribbean. Most motorized boats are conversions from sailing types. This is accomplished through the installation of auxiliary motors or outboard motors. Very few have been built especially as motor fishing boats. One or two small motorized craft are found at Trinidad and these are open boats. In Venezuela, a number of craft have been motorized and at least one, a motorized experimental fishing vessel of European type has been constructed. In Cuba, a special type of bait-fishing boat for tuna has been built and is operating successfully. In Puerto Rico, a shrimp trawler-type boat is being used in exploratory fishing. In general, however, there has been little incentive for adding motors and practically none for designing more modern types of motorized fishing vessels.

It was found that while good vessels and boats could be built in the Caribbean area, the success of this was dependent on importations of wood, particularly planking, and fittings, hardware, and sails. With these materials freely available, good boats of any type can be built, for native craftmen are quite skilled in ship carpentry.

Fishing Gear

The types of fishing apparatus used in the Caribbean fisheries are strikingly similar throughout the area. While native ingenuity has supplied substitutes for some materials essential to fishing, the entire area is dependent to a large entent on imported materials. Caribbean fishermen usually knit their own nets—usually from imported twine. They also assemble their own hook and line gear and make their pots by hand. Fishing apparatus in use usually stresses individual effort rather than mass effort, and, for this reason, there are practically no modern, mass-production types of gear used.

The basic types of apparatus may be listed as follows:

1. Pots or traps
2. Weirs
3. Nets—gillnets, trammel nets, haulseines, dipnets, Italian seines, castnets
4. Hood and line--troll lines, hand lines, line trawls, "palangres"
5. Spears, harpoons, bow and arrow, hooks
6. Illegal forms—dynamite, toxic substances

Pots and Traps:—These are generally known as "nasas" in the Spanish-speaking parts of the Caribbean and as fish pots in the English-speaking sections. Pots are used throughout the area and number many tens of thousands. The design, dimensions, and materials used vary with the locality as does the method of fishing.

One type of pot is built in the shape of a broad arrowhead. The tunnel, or opening into the pot, is located at the center of the base of the arrowhead. It is shapped like an elbow funnel, running first upward toward the top of the pot and then sharply downward toward the floor. The funnel tapers from the outside opening to the inside end. The latter is oval and about 10 inches long and 5 inches wide. Overall, the pots may vary from 3 feet to 12 feet in

length and from 1 1/2 to 3 feet in width or depth. The framework is made of locally-procured wood, with mangrove wood favored. Usually the framework members are lashed with wire or native fibers and sufficient cross members and uprights are used to make the frame rigid. The covering of the pots varies. Formerly, and now with the lack of other materials, woven mats of wild cane or bamboo are used. These were made usually by the fisherman or his family. The weave gives a hexagonal mesh with a width of about one inch. The covering and frames are fastened together with native fibers or with wire. As far back as 1931, many fishermen were using galvanized chicken wire as the covering for their pots. The mesh used is hexagonal and varies from 1 to 2 inches. In a few areas, drawn wire, usually discarded cable wire, is used in making the pots.

A variant of the type described above is used to a considerable extent in the British West Indies. This has a shape of a figure "S". A tunnel is placed at each concavity giving entrance to the pot from two opposite sides. The construction and materials are otherwise the same as the single-tunnel trap. Occasionally, rectangular pots are used. Usually these are considerably smaller than the arrowhead type and many have a single-tunnel entrance or one tunnel at each end. It is reported that the weaving and construction of a bamboo pot requires about one week, while a wire pot requires considerably less time to build. About 100 square feet of chicken wire is needed for an average-size pot (21 feet of material 5 feet in width).

Fish pots are set on the bottom in depths up to 50 or 60 fathoms. In some areas they are buoyed and in others they are not. In the latter case, the pots must be retrieved by grappling. When buoys are used, they are made of bamboo or light wood (bois flot) and they are attached to the pot by means of a line made of vines or local fibers. Wooden pots usually must be weighted down and rocks are used for this purpose. In some localities, the pots are baited while in others they are not. When bait is used, it consists of any one of a number of things. The white pulp of the cactus plant, a broken piece of white chinaware, and other like objects are often used as decoys. Scrap fish allowed to become stale or crushed spiny lobster may also be used. The reasons for not using bait are that it tends to attract sharks or that crabs and other animals rob the traps. The smaller traps are used in shallow water and take the smaller-sized fish, while the larger traps are set at greater depths and catch larger fish. In some areas the traps are lifted each day; in other places they may be fished on alternate days or even less frequently.

Pots are allowed to remain in the water, without being dried out or repaired, until they are no longer usable. Wooden pots are reported to last from 4 to 6 months and chicken-wire pots up to 18 months, while drawn-wire ones last even longer. Even under normal conditions, however, many pots are lost and some are destroyed by large sharks or by other means. Pots are not always fished the year around but some pot fishing is probably always carried on for personal use. The catch per pot varies considerably, but catches of from 20 to 30 pounds of fish per day are a good average. The fish taken are of the bank and reef types--groupers, snappers, grunts, surgeon fish, squirrel fish, etc. The gear is not selective and many small and immature individuals are taken. Pots are perhaps the most efficient type of gear devised for reef-fishing and they are used by many of the poorer fishermen since they are relatively inexpensive to construct and keep up.

One fishing boat may fish as many as 12 to 30 pots per day but usually handles less. Some fishermen have two sets or ranges of pots which are hauled on alternate days. The pots are placed by the fishermen on spots which they can recognize by experience as good. Small pots are sometimes strung in a line but the large pots are usually placed singly.

Some complaints regarding the use of fish pots were heard. These were usually to the effect that pots were depleting the stock of fish to the extent that hook and line gear could not catch any fish. While no detailed study on the question has been made, it can be stated that the coral reef areas are not very productive in any case and that any considerable fishing strain would cause depletion. Too, many useful species cannot be taken by any other means. On the other hand, fish pots take small and immature fish which most often are not returned to the water.

Perhaps the greatest specialization in fish pots is to be found in Jamaica. Here there have been developed a number of types, each designed for fishing in a specific location and taking specific kinds of fish. The largest traps found in the Caribbean are

fished in Jamaica waters. Recently, a cooperative scheme was set up whereby pots are made from wild cane. It is intended to secure idle labor to cut and weave the canes and build the pots according to the fishermen's specifications. In this way, unused labor would be benefitted and the fishermen would be able to spend more time fishing. Previously the individual fisherman was forced to procure the materials in the interior and then construct the pots himself.

Weirs or Corrals:—These are not used extensively in the Caribbean area because of the generally low tidal range. There are, however, a few in Puerto Rico. These are placed to form a barrier across an estuary or stream. They are constructed of bamboo like a fence from one bank to the other. At points along the barrier, small semicircular enclosures are built on both sides. Fish attempting to pass either upstream or downstream are stopped by the barrier and follow along until they reach the entrance to one of the enclosures. They enter and swim around and around until removed with a dipnet by the watchman on the weir. On the Pacific side of Central America, weirs are made of netting and they are set with each tide in a channel or estuary. When the tide goes out, the fish are retained and are then collected by the fishermen.

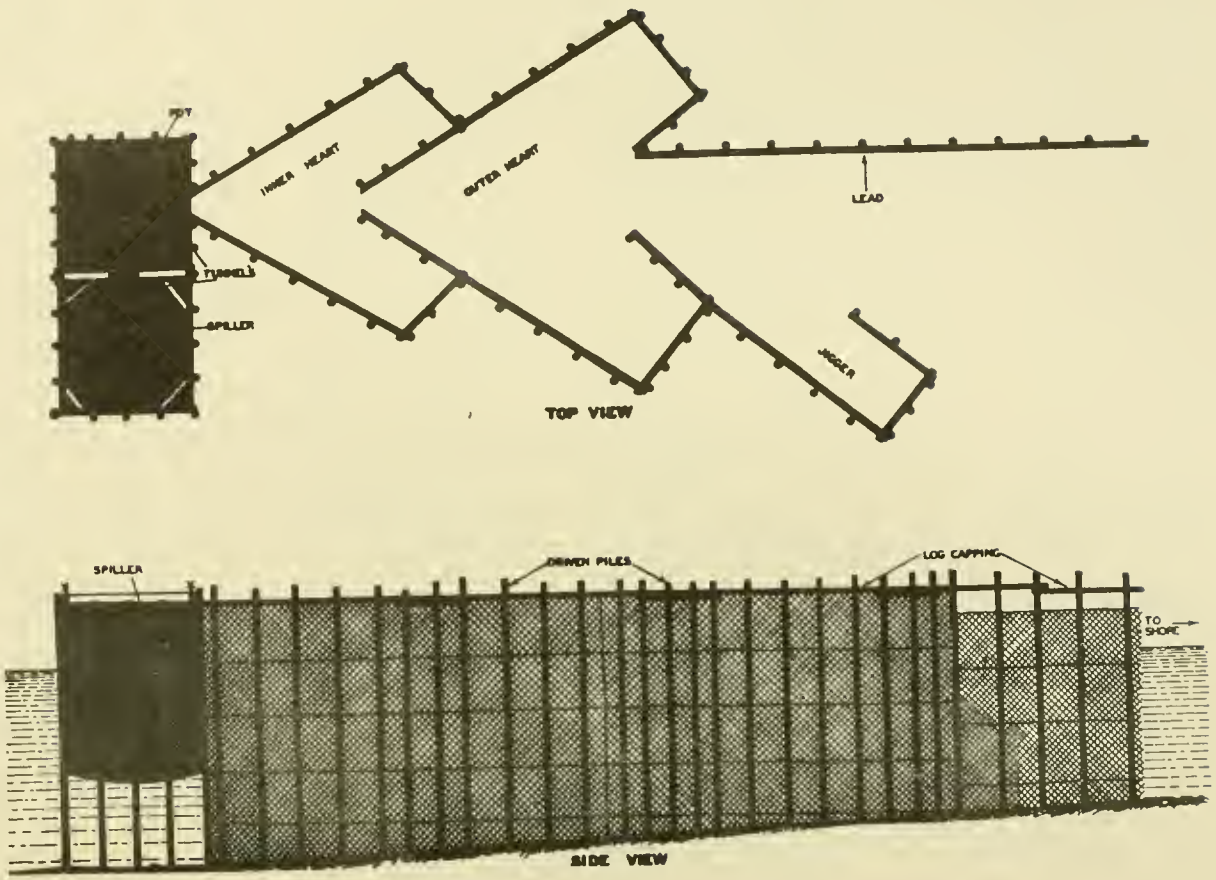
Nets:--Several kinds of nets are in regular use in the Caribbean area. They are made usually of imported materials supplemented by local products. Hanging lines may be of local fibers with floats made of local light woods. Weights are usually of stones.

Castnets:—The most frequently encountered type of net is the castnet (atarraya). These are used, usually in shallow water, for catching shrimp and small fish both for bait purposes and for eating. Castnets are knitted from light cotton line (No. 16 for small mesh, No. 6 cotton seine twine for heavier ones) and in a variety of small mesh sizes from about 1/4 to 1 inch stretched. Castnets are made in the shape of a cone or funnel and there is a wooden collar fastened to the apex. To the collar is attached a retrieving line. Castnets may be from 6 to 15 feet in diameter and 6 to 8 feet in depth. The bottom is heavily weighted with leads spaced from 4 to 6 inches apart on the periphery of the base of the net. Strings are attached about 12 inches apart to the cone converging at the center, passing through the wooden collar and extending several feet beyond. The retrieving line is fastened to these rib lines.

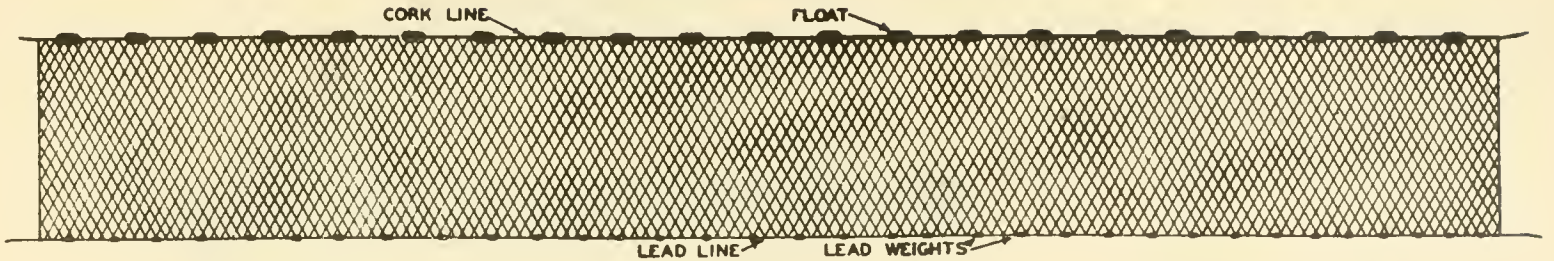
As used for fishing, the net is held by the fishermen under one arm while he holds the retrieving line and the apex of the net. The lead line or lower edge of the net is partially opened by holding it between the teeth at one point, and grasping the lead line at some distance from this point with the right hand. The net is then thrown with a sweeping motion of the right arm. When thrown correctly the net spreads out in a circle just before hitting the water. As the net sinks to the bottom, the heavily-weighted edge gathers together. This traps any fish under the net. The retrieving line is then hauled in and the catch removed. Some castnets have a series of pouches on the inside of the lead line. These serve to trap the fish more securely.

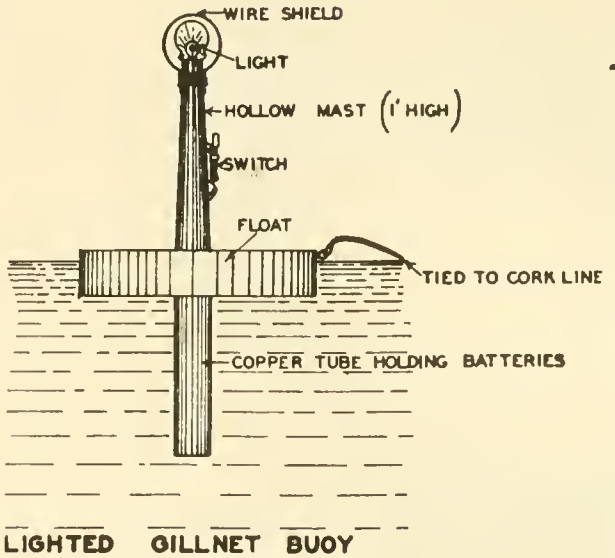
Haul Seines:—Where suitable conditions exist, haulseines (chinchorros) are used. These are rectangular nets which are set in a half-circle with the concavity facing the beach. The nets are then hauled up on the beach and the fish removed. Mesh sizes and length and depth vary greatly from place to place. Some beach seines designed to catch small fish have wings of perhaps 1- or 1 1/2-inch stretched mesh with a bunt section of 1/2-inch stretched mesh. Others may have a mesh size up to 4 or 5 inches in the wings to 2- or 3-inches in the bunt. The lengths run from less than 100 feet up to 600 feet or longer and the depths from 3 or 4 feet up to 10 or 12 feet. The nets are invariably made by the fishermen themselves. Seine twine in sizes 15, 18, and 21 thread is frequently used. Corks are usually made of local light woods. The cork and lead lines may be purchased or made from local fibers but imported ropes are preferred. Sheet lead or stones are used as weights. Usually the haulseines are handed down from generation to generation, with each generation using the net and keeping it in repair.

In order to use beach seines successfully, it is necessary to have a fairly smooth bottom and not too much surf. Usually, jacks, mullet, snook, pompano, and other shore fish are taken—sometimes in large numbers. The nets are usually not treated with preservatives but in some localities they are painted with ordinary house paint. At other

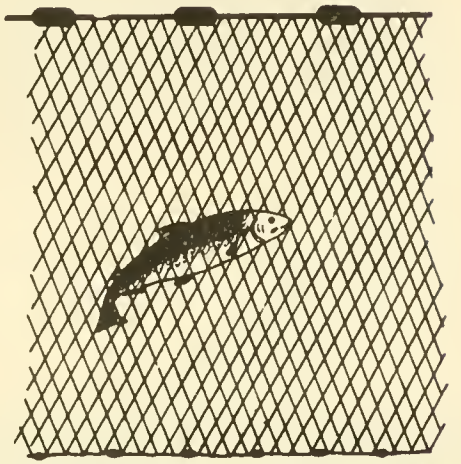

INNER HEART
OUTER HEART
LEAD
TUNNELS
SPILLER
JIGGER
TOP VIEW
SPILLER
DRIVEN PILES
LOG CAPPING
TO SHORE
SIDE VIEW

FISH TRAP



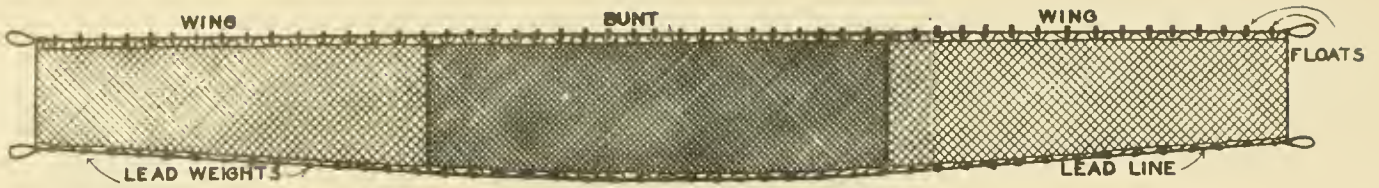


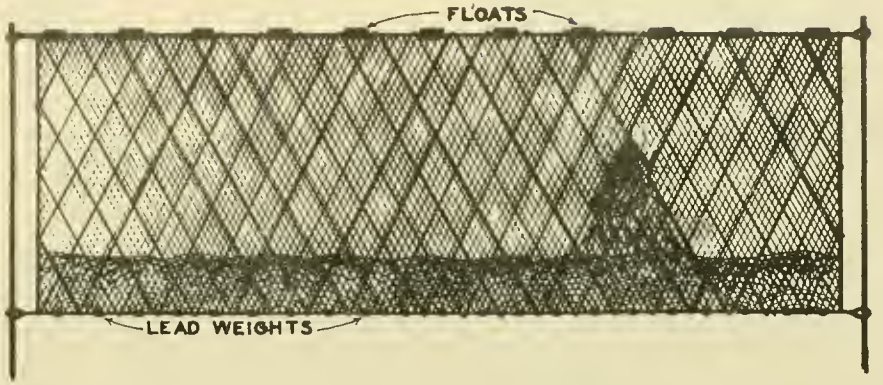
LIGHTED GILLNET BUOY



SECTION OF GILLNET SHOWING SALMON GILLED IN THE TWINE

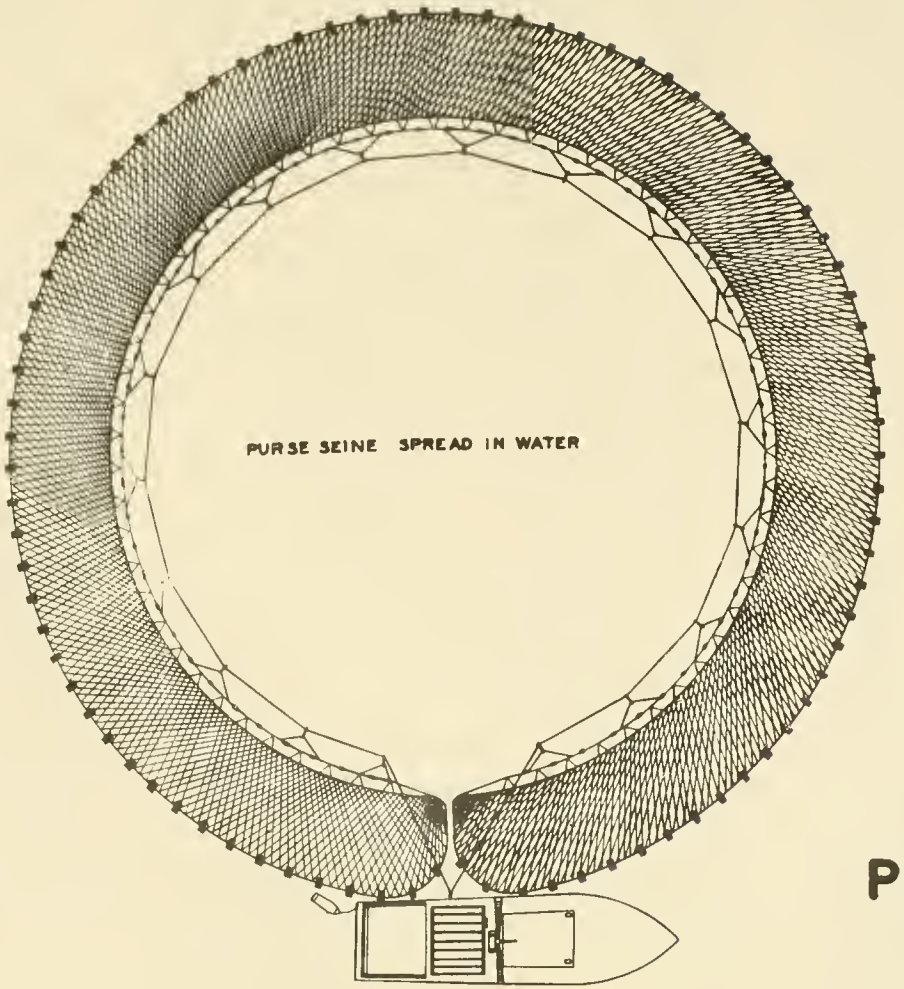
GILL NET

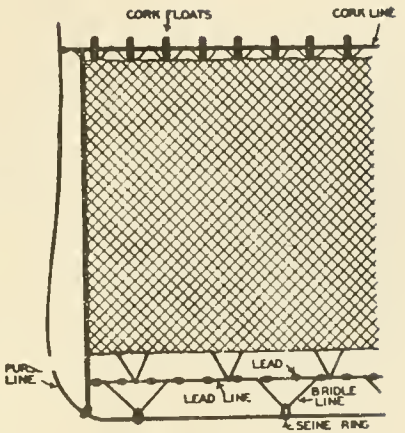

WING
BUNT
WING
FLOATS
LEAD WEIGHTS
LEAD LINE


FLOATS
LEAD WEIGHTS


COARSE MESH WEB
FINE MESH WEB
END VIEW

TRAMMEL NET





SECTION OF SALMON PURSE SEINE

PURSE SEINE

points they are tanned with a solution made of mangrove bark. At Isla Toas in Lake Maracaibo, a tanning vat utilizing mangrove bark was seen—the only one observed by the Mission.

At the Gulf of Cariaco in Venezuela, haulseines are used in the capture of "arenque" which are used for canning in the plants at Cumana. Watchers on the hills blow conch horns when a school of fish is sighted and the fishermen quickly man their boats. The piragua has the seine piled in the stern. As it starts out from the beach, one end of a hauling line attached to one end of the seine is left ashore. The boat is rowed from shore in a semi-circular course back to the beach with the net paying out. The net is then hauled to shore. When the catch is larger than immediate requirements the net with the catch is often left in the water. When fish are needed, a smaller net is dragged inside the large net and the necessary quantity of fish removed. The crew to operate a seine usually consists of 6 or 7 men but often more are employed. Sometimes an entire village will help—each person getting a small share of the catch.

Gillnets (filetes or "trasmallas"):—These are used to only a limited extent in the Caribbean area. They are rectangular in shape with the length varying between 20 and 150 fathoms and the depth from 1 1/2 to 2 fathoms. The size of the mesh varies according to the type of fish to be taken and it may be 1 to 5 or 6 inches stretched measure. The mesh size is important since the fish are caught when they attempt to pass through the meshes of the net. With the right mesh size, they are able to pass about as far as the dorsal fin insertion. Not being able to proceed further due to the size of the mesh opening, the fish attempt to back out and in so doing the twine lodges between the gill cover and the gills—thus suffocating the fish.

While linen thread is used for making gillnets in the United States, practically all in the Caribbean area are hand-knitted of cotton thread, usually about No. 16. Light rope, either hemp or sisal, is used for the cork and ground lines. Floats are usually of local light wood such as "bois flot". Gillnets are often treated with preservatives of local origin both for their protection against rotting of the net and for dyeing the web to make it less conspicuous in the water. Jarvis (1932) reports that in Puerto Rico, "gill nets are usually treated with a tanning solution made from the bark or berries of the (mamaye) tree. ..... nets treated in this solution have the brown appearance of webbing tanned with cutch and oak bark. On the southern coast (of Puerto Rico),gillnets which had been treated with a mixture of linseed oil and ultramarine blue were observed in several localities. The web is made of heavier material here, cotton seine twine in the smaller sizes and varied in color from sea blue to blue green. The water here is very clear".

Gillnets may be fished in several ways. They may be drifted at the surface or anchored at the surface or at any depth down to the bottom. They may be staked as a sort of trap or they may be set as a run-around net. In this latter method, the net is set in a circle around a spot where fish are believed to be present. By beating the water the fish are frightened into the meshes. Since the success of gillnets is dependent upon the fish not seeing the net, their use is most successful in turbid water or at night.

At Trinidad, gill nets average 70 fathoms long by 3 1/2 fathoms deep but may be as long as 150 fathoms. The head rope and foot rope are of No. 84 or 96 thread doubled. The mesh size is about 2 inches stretched. They are operated from small pirogues and are especially successful at night; a crew of two or three men is carried.

In Lake Maracaibo gill nets are used very extensively. The nets are anchored in the late afternoon and are hauled back in the early morning. When large schools of fish are available, the fishermen combine all of their nets to form one large one, and with this they circle the school and then frighten the fish into the net. Each net unit is about 20 fathoms long and 3 fathoms deep. Mesh is 3.2 to 4 inches stretched and the netting is 15-thread cotton twine. Floats are of corkwood (madera de corcha) and those are placed about every 30 inches along the cork line. Sheet-lead sinkers weighing about 3 ounces each are fastened about every 30 inches on the lead line. The nets are tanned with an extract made from the bark of the red mangrove. When the nets are not in use, they are hung from drying racks which are constructed in the shallow water, 300 feet or so offshore. When the nets are to be repaired or tanned, they are brought ashore. In fishing these nets, the unit or "tren" is employed. Each tren consists of a piragua of about 1.5 gross together with 9 or 10 nets.

Gillnets of much heavier construction are used in turtle fishing. These nets are called "volantes" in Puerto Rico. Each volante is from 5 to 40 fathoms long and 2 to 3 fathoms deep. The twine used is No. 24 seine twine. Mesh size is 20 to 24 inches stretched. The corks are of light wood and the weights are stones. Fiedler and Jarvis (1932) report that "Turtle nets may be fished either as drift or sunken nets. The latter type is anchored by stone killicks lashed in a loop of the lead line at each end of the net. Buoy lines with marker buoys are made from blocks of wood. The nets are set in locations known to be frequented by turtles, with a wooden decoy roughly shaped like a turtle attached to each net." Nets of this general type are used throughout the Caribbean where turtles are to be found.

Trammel Nets (trasmallas):--These are not used to any great extent in the Caribbean fisheries but Jarvis (1932) reports such nets used in Puerto Rico. Trammel nets are a modification of gillnets. They are of the same shape and those reported in Puerto Rico are 45 to 100 fathoms in length and 1 fathom deep. Trammel nets are constructed with 3 walls, or layers, of webbing all hung from a single cork and lead line instead of one layer as in the case of gillnets. The outside layers or walls are of large-mesh cotton twine, usually about 6 inches stretched mesh. The inner layer is of finer twine (in the United States usually of linen thread but in the Caribbean of light cotton twine) with a mesh size of about 1 1/2 inches stretched mesh. Trasmallas are fished much like gillnets but they are much less selective as to the size of the fish caught. When fish pass through the outer wall they hit the center, fine-mesh sections. Continuing, they push the middle layer through the coarse mesh on the other side and thus form a pocket in which the fish is entangled.

Dipnets:--These are of various types but are used primarily in catching spiny lobsters (langostas) on the reefs. These nets are called "naticos" in Puerto Rico. These nets are set on long poles. The hoop is usually placed at right-angles to the pole and the diameter of the hoop varies from about 12 inches to 24 inches. The bag of the net is made of cotton twine and it is conical in shape, with a depth of 1 to 2 feet. In fishing, the langosta is prodded out of the holes or cracks and the net is placed over the animal. The hoop is then moved laterally and the langosta rises into the bag and is thus trapped. Dipnets are used also to dip fish from weirs and in fresh-water streams. In Barbados dip nets are used to catch flying fish. These nets are shallow and of 1 1/2-inch mesh laced to a split bamboo hoop bent in a circle.

Italian seines:--As far as can be determined, these are used only at Trinidad. They are very similar to the Italian lampara seine. The seines average 140 fathoms in length by 15 fathoms in depth but the largest run up to 200 fathoms by 21 fathoms. Mesh size in the wings varies from 12-inch stretched (for turtles) to 1 1/2-inch stretched (for herrings). The bag or bunt is almost always 1 1/2 to 2-inches stretched. A typical Italian seine seen at Port-of-Spain, Trinidad, had two wings, each 15 fathoms in length, and a bunt 12 fathoms in length. The bunt was 15 fathoms deep at the center. The bag had 1 1/2 to 2-inch stretched mesh web. Two hundred meshes of the wings were 4-inch stretched; 100 meshes, 6-inch stretched; and 50 meshes, 12-inch stretched mesh. The nets are made locally of imported seine twine of 6- to 30-thread sizes. Sheet lead weights are used about every fathom on the lead line, giving an equivalent of about 8 ounces of weight for every 6 feet. The cork-line is strung with floats of block cork in the bunt and local light wood in the wings. The nets are tarred with light Stockholm tar.

In fishing, the nets operate from large pirogues, using a crew of 5 or 6 men. At Port-of-Spain, these boats are equipped with outboard motors but in other sections, oars are used for propulsion. Depths fished are from 10 to 15 fathoms in areas where fish are known to be present and in these localities blind sets are often made. The net is set in a circle from the boat and is then hauled by hand--one end from the bow and one end from the stern. There is no purseline. When the wings have been hauled in, the lead line is picked up and brought aboard and this leaves the cork line afloat with the bag entirely enclosed. The bag is then hauled in and the fish removed. Italian seines are used most successfully at night.

A variant of the Italian seine is the tuck seine. The tuck seine is larger and shallower--about 230 fathoms by 16 fathoms. These are operated with the tide and close to the

bottom. This type of gear, also, is most successful when fished at night. Italian seines and tuck seines are fairly efficient and they may catch up to a ton of fish per day. They, however, are more expensive to acquire and keep up than the simpler types of gear. Ten or more Italian seines were reported to be operating out of Port of Spain more or less regularly. They are fished usually from May through August. The value of these nets is around $500 each and a suitable boat would cost about $150 with the engine extra.

Hooks and Lines:--Hook and line gear is used extensively throughout the Caribbean area. It is the cheapest type of gear available during normal times and it lends itself to use by individual fishermen and small boats. Hooks and lines and other fittings are usually imported and made up by the individual fisherman, and for this reason there is infinite variation in the arrangement of the apparatus. In general, there are four types of hook and line fishing--trolling, still fishing (surface down to the bottom), line trawls, and rod fishing.

Trolling or "Towing" (a la carrera) (trolling lines=curricanes).--This type of fishing is conducted throughout the area. In this style of fishing, a lure or bait is dragged behind a sail or motor boat. When a fish strikes the bait and becomes hooked, it is hauled to the boat. In many instances this mode of fishing is carried on while running to and from the fishing grounds. Usually only one or two lines are dragged. In Venezuela, however, outriggers are placed on the boat which enables the fishermen to use 4 or 5 lines simultaneously. Usually heavy cotton line which may or may not be tarred is used. The hook is usually a large single hook. Sometimes leader wire of copper, bronze, galvanized iron, or stainless steel is used. In some areas where deep trolling is carried on for kingfish, this leader may be 30 or 40 feet long. Lures may be pieces of rag, frayed out ropes, a commercial spinner, a piece of cactus pulp, the inner part of an aloe leaf, a small fish or a piece of silvery fish skin. Swivels and other relatively costly and complicated fittings are not used to any great extent and the lines are hauled in by hand.

At Trinidad, trolling is extensively practiced and it accounts for the capture of a large proportion of the catch of Spanish mackerel and kingfish. The usual length of the leader, here, is about 16 fathoms of bronze wire or stainless steel wire. The bronze wire is usually No. 20 and 21 for Kingfish and 23 or 24 for Spanish mackerel although all sizes from 18 to 24 are used. A short manila line (No. 15 to 48) is used at the inboard end. Wilson trolling spoons Nos. 4, 5 or 6 are commonly used, but more often a No. 4 or 5 Kirby bend hook is employed with a herring or piece of skin from the flank of a Spanish mackerel as bait. When, as in August, the kingfish runs deep, up to 30 fathoms of bronze wire may be used, probably fishing down to 10 fathoms deep. The fishermen report that the long leader wires are necessary since the fish strike at the line and often sever it. It has been shown by experience that white cotton line actually catches less fish than colored lines or wire. While trolling is developed in Venezuela and in Trinidad, it is not usually used as a basic type of gear elsewhere.

Still Fishing:--This reaches its highest development in the fishery for groupers and snappers on certain banks. Small boats are used in inshore fishing and large schooners for the offshore work. In the Trinidad inshore fisheries, No. 21 line is used, equipped with a light sinker and 4, No. 4 or No. 5 hooks. Bait can be almost any type of fish or shellfish flesh. Some of the fishermen use a type of spreader called a trap stick. This is a stick about 2 feet in length, bent in one end like a crook or cane. A weight is attached to the bent end. The other unbent end of the stick carries a 6-foot line to which is attached 5 or 6 gangions, each 1 foot in length. Nos. 3, 4 or 5 Kirby bend hooks are attached to the gangion lines. In the Spanish-speaking countries, lines are known as "cordeles" and hooks are "anzuelos". In Puerto Rico, the lines are of heavy seine twine. A leader of strong wire is sometimes used and the hook or hooks fastened to this. Leads weighing up to 3 pounds are fastened to the line just above the hook. The "cala" is a type of hand line which carries a bow-shaped spreader of heavy wire. To each end of the spreader is fastened a gangion carrying up to 4 hooks each.

In the offshore bank fisheries the gear is much heavier and stronger. Each line may carry up to 21 hooks and a 10- to 15-pound weight at the bottom. The hooks are No. 3 size and they are attached to gangions of 10-pound hemp line, each 3 feet long. The handline is of 18-pound hemp. Bait is any type of fish available. As many as 10 to 15 of these lines

may be fished at one time from the deck of the schooner. The lines are hauled by hand and as many as 18 fish have been taken at one time.

Trawl-lines (espineles):--These are not used to any great extent but appear from time to time in most localities. This type of gear consists of a ground line made of heavy seine twine, usually tarred. To this line, about a fathom apart, are fastened short gangions or short lines attached at right angles, carrying the hooks. Each trawl line may have from 75 to 200 hooks. The ground lines are set on the bottom, usually in a straight line and often several units are attached together to form a longer string of gear. Each end of the ground line is anchored to the bottom with a stone or anchor. A buoy line runs from the anchor to the surface and a buoy is fastened to the line at the surface. The buoys usually are of local light woods, but bottles or empty kegs may also be used. The hooks are baited with pieces of fish or shellfish. In fishing, the line must be tended frequently, by underrunning it and taking off any fish that are caught as soon as possible. Otherwise, sharks probably would destroy the lines. The bottom must be fairly regular in order to use this type of gear since projecting rocks or coral heads probably would chafe and break the lines or tangle them in such a way that they could not be retrieved.

"Palangres":—These are specialized line trawls used for fishing sharks. The ground line may be of rope or chain and the gangions are usually chain. Very large hooks are attached to the gangions with heavy snap swivels. The gangions are fastened to the ground line with snap hooks or swivels. From 10 to 20 hooks are used in each section of the shark palangre. The palangres are fished in the same manner as other line trawls. Bait is porpoise or dolphin flesh when it can be procured but almost any type of bloody meat is usable.

Spinning:—A variant of hook and line fishing, similar to spinning as used in the United States, is found in Venezuela (guapeando) and Trinidad (coulican). In Trinidad coulicans consist of a simple rod and line. The rod is of two pieces, a stout handle and a light rod with a slight bend in the extreme six inches; the handle and the tip are lashed together, giving a total length of about 6 or 8 feet. The line is of bronze wire, about equal in length to the rod. A No. 6 hook is fastened to the wire and a lure is attached to the hook. The lure is made of limewood or other white wood (in Venezuela, a legbone of a bird is used) about 2 inches long, cylindrical in shape, and hollowed out by fire. The forward face is rounded off and has a small hole in the center through which the leader wire passes. A bunch of cotton threads is fastened to the upper part of the hook. These threads and the white wood or bone act as a lure. The rod, in fishing, is skittered back and forth over the surface with its terminal bend whipping in and out of the water. The line is cast at the end of each stroke. This method is used when fish are encountered beating on the surface of the water. Spanish mackerel, blue fish, and bonito are usually taken.

Live-bait Fishing:—Perhaps the most novel fishing development was observed in Cuba. A Cuban cannery operator developed, in 1941, a modified tuna-fishing technique based on the California method of live-bait fishing. The vessel used in Cuba has a live-well for carrying the live-bait fishes. A mechanically-driven water pump is located topside, about amidships. Connected to the pump is a pipeline which is fastened to the rail around the stern of the vessel. At intervals, there are spray nozzles directed outboard from the main pipe. When a school of fish is sighted, the pump is started and a spray directed into the water. Live-bait fishes are ladled overboard. By these means the fish are attracted near to the vessel. Poles carrying lines with feather jigs and barbless hooks are then used. The jigs are skittered and splashed into the water and the fish strike the jigs. As the fish are hooked they are swung onto the vessel. This method has been in use for some time and appears successful in taking tuna and bonito.

Bulling:—In the West Indies, an interesting method of attracting fish, known as "bulling", is used. A ball of ground up fish is wrapped in a piece of fine netting and sunk to some depth on a line. It is then jiggled up and down, enough to release some of the fishy material and oil. This spreads out and attracts any fish in the neighborhood. The fisherman fishes hand lines near the ball and these have baited hooks. The fish, which are attracted by the stale fish, are then often caught.

Spears and arrows:—Spears and bow and arrow are used mainly in lagoons and fresh water and most usually by Indian fishermen. The spears are light and have barbed heads. The staff is often 8 or 9 feet in length and the barb, about 5 inches in length, is made of steel, usually from an old file. Spear points may also be made of pointed and barbed pieces of bamboo. Usually a cord about 50 feet in length is attached to the point, while the other end is wound around a long reel of light wood, which acts as a buoy. The buoy is stuck on the distal end of the pole. The spear or javelin is used for snook and tarpon. In fishing, usually two men work together. One sits in the bow and directs the other, who is paddling. When within reach of a fish, about 60 feet distance, the man in the bow stands up in the boat with the spear in his right hand. He aims and throws at a single fish, which he may be unable to see through the water. The only thing visible is the fish's "wake"; that is, the ripple produced on the surface of the water as it swims along. By the ripple, the Indian can guess the species of fish, as well as the depth of the fish under the water. The spear is thrown so that it hits the water almost vertically. Upon striking the fish, the cord unwinds; the harpoon head and buoy become detached from the pole but are connected together by a cord. The buoy acts as a float and by this means the fish is retrieved. Spearing of fish also is carried on by torchlight at night.

Turtles are speared in a slightly different way. Here, no buoy is used. The harpoon line is about 30 fathoms long and attached to the boat. The harpoon pole is of palm wood, 2 to 3 inches thick at the butt and tapering down to a point at the other end. The harpoon end is known as a "peg" and is triangular in section with a single barb at each one of the lateral edges. It is only 1 1/2 to 2 inches long because it is designed to pierce only the carapace or shell of the turtle in order not to kill the animal by penetrating its flesh. When a turtle is sighted, the harpoon is thrown in the air so as to fall almost vertically onto the back of the turtle. When the animal is struck, it disappears in the water dragging the long line and the boat, but after a while, it becomes exhausted by the struggle. The boat is then swamped and placed under the turtle to haul it in. By rocking the canoe back and forth enough water is removed in order to float it and the turtle. The remainder of the water is bailed out. The harpoon head is extracted and the hole plugged up with a piece of cloth—otherwise the turtle might die.

Bows and arrows are used chiefly in the lagoons and rivers. The fishermen, sitting by the bank of a stream or in a boat will whistle in a low plaintive tone for hours believing that this will entice the fish. The point of the arrow is held but a short distance from the water. When a fish approaches, the arrow is shot. Since the arrow acts as a float, it bobs to the surface with the impaled fish.

Dynamite and Toxic Substances:--Dynamite is used rather extensively even though it is prohibited by law in practically every country. Besides being dangerous to the individual using it, it is a tremendously wasteful method. Most of the fish are not retrieved, and the ones that are retrieved are not of as good quality as those caught by other means. Many fishermen have lost arms and legs through accidents involving dynamite. The use of this illegal method also stultifies the development of other means of fishing.

Practically all countries prohibit the use of toxic substances for fishing but in spite of this, poisons are still used by the Indians in the fresh-water rivers and lakes. For this purpose "barbasco" or other vines are crushed with flat stones or wooden clubs, in order to release the poisonous milky juice. At a narrow part of the stream a weir or fence is constructed in the form of an angle with the point in the middle of the stream. At some distance above this spot, the crushed plant is thrown in the water and the poisonous juice spreads and stupifies all the fish in the neighborhood. The fish then float downstream and are caught by the weir or fence. Larger fishes, which are not entirely powerless, are harpooned. The smaller fishes are allowed to float downstream and recover in the unpoisoned water. The juice of the barbasco is also poisonous to man but it does not affect the wholesomeness of fish killed or stupified by it.

POTENTIAL FISHERY INDUSTRIES

There are so many factors involved in the prosecution of a fishery industry that it is difficult to classify the order of their interdependence. Quite obviously there must be a fishery resource capable of producting certain items of value. There also must be, somewhere, a market for the products. Between these two factors is a large array of important contingent factors that permit raw fish in the sea to be caught, cleaned, transported, preserved, converted into products of commerce, stored, distributed, and sold to the consumer. The entire chain of functions in fish-handling must be accomplished within cost limits that are determined by the price the ultimate consumer will pay for the product.

In the United States, the availability of fishermen, boats, gear, processing equipment, fast transportation, cold storage, finance, business enterprise, consumers, and wholesale and retail outlets equipped to handle fresh or preserved products, has made it possible to exploit virtually all of the fishery resources. In the Caribbean, on the other hand, relative scarcity of most of these has made it very difficult to establish fishery industries, even when it has been apparent that there is a reasonably large difference between the cost of purchasing fish from the fishermen and the price that can be expected from the consumer. The fishery industries have tended to take the simplest form possible, with a minimum of speculation and a limited investment of funds. Sail power has been relied on for water locomotion, and fishing operations in general are confined to operations near markets. Boats, gear, and transportation are cut to the minimum required to permit the fishermen to earn their living from day to day, and investment in processing equipment, markets, and merchandizing equipment has been kept at a minimum.

The circumstances of nature and history that have formed the Caribbean fishery industries have established them on a basis of high costs and limited production. Only the local reef (or bottom) dwelling species of fish--the snappers, groupers, goat-fishes, parrot-fishes, grunts, porgies, etc.--have been available for year-round capture with the simple types of boats and gear available to the Caribbean fisherman. Only a few of the migratory fish that appear spasmodically in season have been reaching the markets in the region. The bottom-dwelling species do not congregate sufficiently to permit their capture in large quantities. They can be reached in their native habitat only with handlines and stationary traps lowered from the surface. The catch-per-unit of fishing effort is, therefore, very low. The few fish captured must be sold at fairly high prices to provide subsistence for the fishermen and replacements for gear.

In the United States the bulk of the fisheries are reliant on seasonal supplies of fish. Utilization of the "runs" in the States is made possible by an extensive system of preservation facilities. This permits large stocks to be accumulated safely during periods of abundance. These stocks are thereafter gradually directed into year-round trade.

If more facilities for handling fish were available in the Caribbean area there would be a larger trade in fishery products than actually does exist. Whether the increased trade in fish alone would justify the installation of the facilities is a matter for conjecture, however.

The lack of facilities for preserving perishable food products of all kinds has been a powerful deterrent to the growth of all food production in the Caribbean area. The prospect of unloading peak production on glutted markets is discouraging to commercial fishermen and farmers alike. In some localities, at least, the installation of cold storage and canning facilities for fish should be justified commercially. The installation of a system of refrigerator plants to collect perishable foods in localities of abundant production and distribute it in the centers of population might also be feasible. Some such system as the latter might well prove to be essential to the large-scale production of foods in the Caribbean.

Unused Resources

As previously pointed out, the Caribbean area is not generally rich in fishery resources. Yet, practically every country in the area could increase the catch of fish in its waters--some considerably and others on a limited scale. Thus, strictly, there are sufficient unused resources to carry on and develop some new industries. While coral reef areas are not very productive, they can produce some fish. There are extensive reef areas not now fished. Lagoons and estuaries are usually fairly productive--on the South and Central American coastlines there are thousands of square miles of such habitat. Perhaps the greatest unused resource will be found in the pelagic fishes--both the long-range migratory species and the ones of lesser migrations. The shellfish resources outside of the popular langosta and conch are hardly utilized in most sections.

In weighing all of the available evidence, the Mission has concluded that Venezuela shows the greatest promise in the development of large-scale fisheries. Increased drying, salting, and canning industries and development of quick-freezing industries are possible here. There is also a distinct possibility of the establishment of a fish-reduction industry in Venezuela at Lake Maracaibo.

The Pacific Coast of Panama is regarded as a high potential producer. The fisheries here can develop quick-freezing and handling facilities, chiefly for tuna. A canning industry could be supported but the chief objective now should be to develop a fresh-fish supply for the Republic and for the Canal Zone.

Cuba's waters are capable of increased catches, as well. Cuba could supply more fish to its own markets as well as such export specialties as spiny lobster and fish fillets.

The area from Hispaniola around to Grenada and including Puerto Rico, the Virgin Islands, the Leeward Islands and some of the Windward group has some limited areas where small local industries could be established. These local industries could supply a part of the demands of the localities but they probably will never be able to satisfy any considerable portion of them. Developments here should be along the lines of fresh and frozen fish, for the supply generally is too small to justify the salting, drying, or caning of fish on a commercial basis.

The Atlantic coast of Central America is so undeveloped that it is doubtful that the fisheries could be industrialized on any considerable scale for some time. Since the fisheries would have to compete with agriculture for labor and other necessities, and since the region is relatively unpopulated, future developments will be slow. The resources have, of course, been utilized to some extent by Cayman Islanders. Whether they can stand any great further increase is unknown.

The fish resources of the Campeche Banks are normally utilized by fishing vessels from Mexico, Cuba, and the United States. Total catches are in the neighborhood of 15,000,000 pounds in normal years. There is no data as to the condition of the stocks of fish on these banks, but catches seem to remain high.

Central America's Pacific coast has possibilities in the production of fresh fish for local use and also to some extent for salting and drying. There are indications that increased activity in tuna fishing could be supported with quick freezers and storage plants for frozen fish.

Colombian fishery resources offer considerable inducement to development. The lack of transportation and handling facilities must be overcome, however, before any great production can be handled or marketed.

All of these developments will have to be predicated on economic feasibility. It would be disastrous to expend thousands of dollars to develop fishery industries without due regard for the available markets and the character of the resources. Each case is more or less special, and for this reason, more detailed studies should be made before definite action is decided upon.

Game fishing:—While Caribbean waters are populated by the same species of fish that are valued as salt-water game fish off the coasts of Florida, there has been almost no game-fishing development. The Caribbean area is well known to sportsmen. A few local fishermen and occasional visitors have tested the quality of the fishing. From available information, it appears that certain sections in the area will some day be famed for their sport fishing. It is anticipated that income from tourist fishermen in some communities will eventually become a very important factor in local prosperity. Tarpon, in particular, hold sport-fishing possibilities. Reports of the abundance of tarpon and their availability for sport fishing were received from Colombia, through Central America, and to Cuba. They are abundant near the mouths of all Caribbean rivers in these sections. Trolling for migrating fish was reported as occasionally excellent in most places visited and bottom fishing for snappers and groupers was also highly recommended. The routes of travel for big-game fish have not been traced through the area, but it is probable that when the routes are fully known, certain Caribbean communities will become favorite vacation spots for big game anglers. The north and south coasts of Cuba, the west coast of Haiti, the south coast of the Dominican Republic, and the west coast of Puerto Rico already are well-known among United States game fishermen. The development of game fishing tourist facilities in certain areas of promise offers possibilities for the future that overshadow the potential importance of commercial fishing.

Possibilities for Enlarging Caribbean Fishery Commerce

The survey made by the Caribbean Fishery Mission was undertaken to determine in what way the fishery resources and fishery industries of the Caribbean could give greater contributions to the welfare of the area. With this in mind, the Mission tried to determine, (a) what is the character of the fishery resources; (b) to what extent the resources are now used by existing fishery industries; (c) what the factors are that have retarded or spurred development in the Caribbean in the past; and (d) what action can now be taken to expedite more complete use of the resources.

From all available sources of information and by means of short inspections in fishing localities, the Mission became informed on the first three of these points. The following paragraphs discuss what action can now be taken to increase commerce in fishery products.

At virtually all points visited, certain things were noticed that the investigators considered could be changed to some advantage--minor improvements could be made in boats and gear, in operation of gear, in the handling of fish after catching, in marketing, in processing, and also in other particulars. Often conditions were noted that probably could be improved with some experimental alteration. Many local fishery industries were observed and the possibilities for use of resources now untouched were studied. Where it was possible to prepare specific recommendations for improvement of conditions, these were prepared.

It was recognized throughout the survey, however, that the Mission was limited in ability to solve by itself in the short time allotted most of the problems of fishery use in the Caribbean. The occurrence of fishery resources, the effectiveness of fishing gear, the costs of actual operations, the acceptance of new fishery products by consumors, and many other factors had to be studied in the light of probability rather than positive fact. Established fact was used wherever it was found, but it was continuously obvious that special fact-finding studies are necessary before the full possibilities of the fishery resources of the Caribbean can be positively known.

Several important facts were positively identified. The size of existing fishing operations and the present importance of local fish supplies to the area were determined within limits as accurately as the character of the survey permitted.

Under the existing conditions of War, it was necessary to view the possibilities and opportunities in fishery development and management in a different light than in peacetime. An effort was made to determine what immediate steps could be taken to improve local conditions during the emergency. In addition, however, the continuing or long-range

possibilities for fishery utilization were also examined. Action that can be taken to improve observed conditions can be classified into emergency and long-range items.

Emergency action:—The Mission recognized two main types of emergency action that are feasible and important in the Caribbean area. Other action may be classed in a third grouping. The three classifications are as follows:

a. The provision of fishing gear and supplies to fishermen already engaged in productive fishing.

b. Emergency fish-production projects.

c. Other emergency stimulation of production.

a. Emergency purchase of fishing gear and materials.

Through the entire Caribbean there was already an urgent need for replacement of fishing gear and other fishing materials. In many instances supplies of linen and cotton net twine, hooks, rope, sail canvas, leader wire, handline and trolling twine, and wire netting suitable for fish traps were entirely exhausted in local stores and warehouses. The war had disrupted trade in these articles and no concentrated effort had been made to obtain emergency supplies. As a result, fishing efforts were beginning to diminish and it was predictable that a serious decrease in the catch of fish would result unless some action was taken to obtain these necessary articles.

It is of considerable importance to Caribbean countries that they in some way arrange for the supply of needed articles to permit continued fishing. For some areas, this is certainly the most important matter that can be brought to the attention of local authorities.

The suggestions made to local fishery authorities in the British West Indies led to the purchase, some months ago, of materials for the fishermen in many of those islands.

b. Emergency production projects.

There are many fishery resources in the Caribbean that have promise of yielding considerable quantities of food if special efforts are made to obtain it. Particularly in the case of mullet does this promise exist. Other species that display possibilities generally, are the sharks, the jacks, Spanish mackerel, and the tunas. Certain other species show potentialities in a few localities.

Capture and use of many heretofore unutilized fishery resources may be feasible today in many areas solely because of the improved emergency demand for all flesh proteins. It may also be considered in the public interest to engage in such activities with the local government subsidizing minor losses or underwriting costs of speculative experiment. Certain types of gear now not used hold promise of success in fishing for many species of fish. Considerable public good could come of intelligent experimentation with promising projects.

The operation of emergency fish production projects appears most feasible under direct government operation or with assistance of the government. Private enterprise that has not under normal conditions created uses for these resources cannot be expected to develop industries unaided when war has complicated the procurement of facilities, gear, labor, and supplies. While more favorable prices can now be secured for products, the difficulties of procurement of fishing gear, boats, fishermen, and shore facilities are too formidable to be surmounted without government help.

c. Other emergency stimulation of production.

The fishery industries are important assets of each locality. All governments should be concerned in maintaining these industries throughout the war and should take every feasible step to continue and enlarge their productiveness. In addition to helping the industries obtain gear, boats, materials, and supplies, assistance can be provided in the

form of the fixing and enforcing of minimum price limits to the producer, encouraging purchase of fish by public institutions, popularizing the consumption of fish by publicity, encouraging cooperatives, setting reasonable price limits on supplies and materials, giving information on fishing and fish-handling techniques, loaning funds, and by other means. Units of industry can be easily disturbed in many ways by war conditions. It may reasonably be considered expedient for governmental action to supply temporary relief from conditions that otherwise would seriously handicap or ruin an industry if the cost is not out of proportion to the good accomplished.

Long-range fishery activities:--Throughout the past, the fishery industries of the Caribbean have been almost entirely neglected by the local governments. While other industries have received encouragement and active assistance through governmental investigations and research, loans, subsidies, tariff protection, inspection and grading of products, publicity, and demonstrations, the fishery industries have functioned almost without notice. Where governmental aid has been provided, it often has been supplied with the advice of unqualified "experts" or promoters. There has been an almost complete lack of fishery administrators in the services of the governments and some of the countries have functioned with a complete lack of policy of management of their fishery resources.

With the help of qualified fishery appraisers, each country, colony, or possession in the Caribbean should formulate and adopt an intelligent government policy of use of the fishery resources and initiate a fishery management program suited to the conditions existing in each jurisdiction.

It does not follow that each country should set up a complex system of management. The extent to which the processes of fishery promotion and management should be utilized in the administration of the fisheries in each Caribbean country is a matter that should be decided logically through scrutiny of the resources and their uses by persons fully acquainted with fishery processes and techniques. In cases where the industries obviously cannot become important, a minimum of activity should suffice. In all countries a system proportionate in size and cost to the needs for and possibilities in the system will be well worth while.

Fishery resources are valuable assets that must be used under governmental control if they are to be protected from over-exploitation or wasteful lack of use. While private enterprise usually takes advantage of opportunities for profit in use of the resources, it does not itself provide checks and balances to prevent excessive use of the most valuable resources nor does it care to venture into fields of speculative profits in the less promising resources. Uncontrolled operation of private enterprise in the fishery industries violates the public interest in that it encourages depletion of the most profitable fish supplies and neglects the least profitable. The operations of private enterprise should be restricted to prevent excessive use of certain resources and they should be encouraged and assisted to increase the use of others. Governments should organize fishery development and management agencies qualified and empowered to perform these functions to the extent made necessary by local circumstances.

It is not denied that there are many activities or studies that may be undertaken by persons relatively unskilled or uninformed in fishery development and management that will remedy certain uneconomic conditions of use or non-use. Government agencies should realize, however, that funds can be easily wasted and the well-being of the industries and the resources needlessly jeopardized through the placing of confidence in the hands of unqualified persons or persons who are qualified only in certain phases of the field. The field of fishery science is a broad one and one in which there are many specialized professions. Many so-called "fishery experts" may be excellent technicians in one branch of fishery science and in complete ignorance of other branches. The most accurate appraisal of needs for fishery work can be supplied by persons fully acquainted with the biological and technological fishery sciences as well as techniques of commercial fishing, and who possess a balanced perspective on the relative economic importance of these functions in fishery development and management.

Throughout the Caribbean area, development of fishery industries is affected by the same basic factors. Since conditions are surprisingly homogenous, and since fish are not

contained by international boundaries, action can be much more effective and economical if carried out cooperatively.

International organizations for the study of oceanography and fisheries have been successful elsewhere, and they could operate successfully in the Caribbean area. It is suggested that an organization be constituted to coordinate fishery development, management, and research activities. To accomplish these purposes, several stations might be established at various points in the region. Suitable locations are Mariel in Cuba, Mayaguez in Puerto Rico, and Trinidad in the British West Indies. Additional field stations could be established if found desirable and necessary. These stations would carry out necessary research and development projects and train personnel in the various branches of fishery management, research, and development.

Legends for Figures

Figure 1. Rigging multiple trolling lines.

Individual trolling lines.

A. Outrigger pole

B. Rubber trolling spring

C. Trolling line (12 pound white cotton twine)

D. Haul-in line (10 pound untarred gangion)

E. 5/0 barrel swivel

F. 5/0 trolling snap swivel

G. Jig

H. Oregon leader line

I. Stainless steel leader wire (#20)

Figure 2. Arrangement of trolling lines (top view).

Figure 3. Arrangements of trolling lines (from bow of boat).

Trawl line use and rigging.

A. Flag pole (12 foot bamboo)

B. Buoy Keg or Float

C. Pole Float (corks)

D. Pole Weights

E. Buoy Flag

F. Buoy line (6-thread tarred)

G. Dory anchor (12 pound)

H. Groundline (12 pound steam-tarred cotton)

I. Gangion line (10 pound, steam-tarred cotton)

J. Hook (small or large size halibut hook with flatted shank)

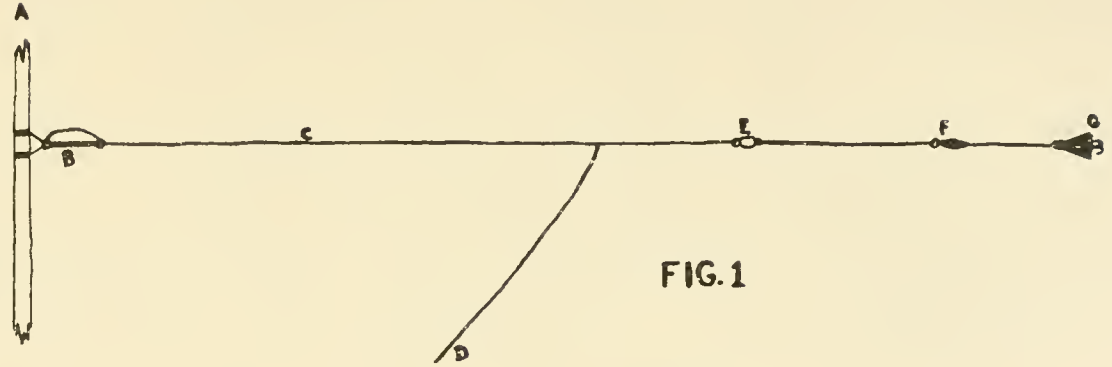


FIG. 1

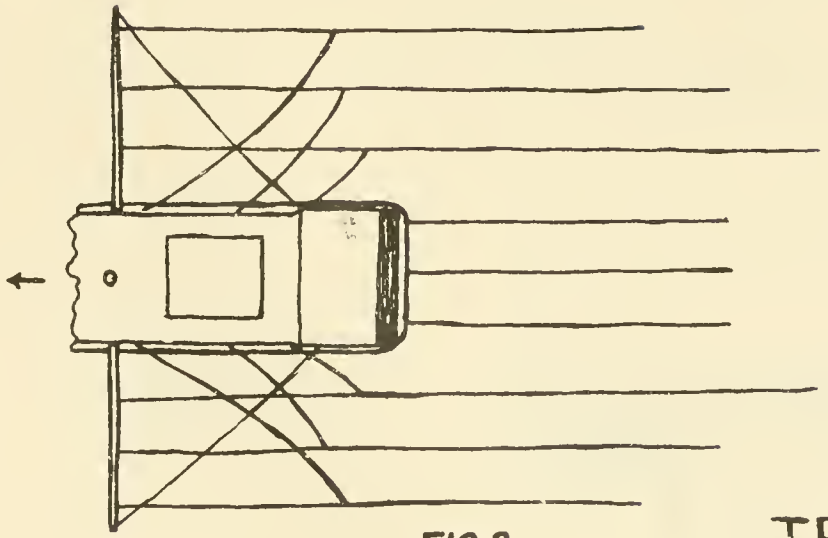


FIG. 2

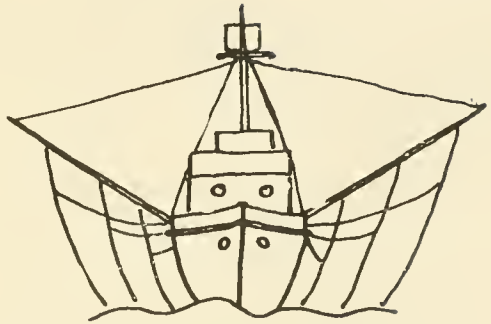
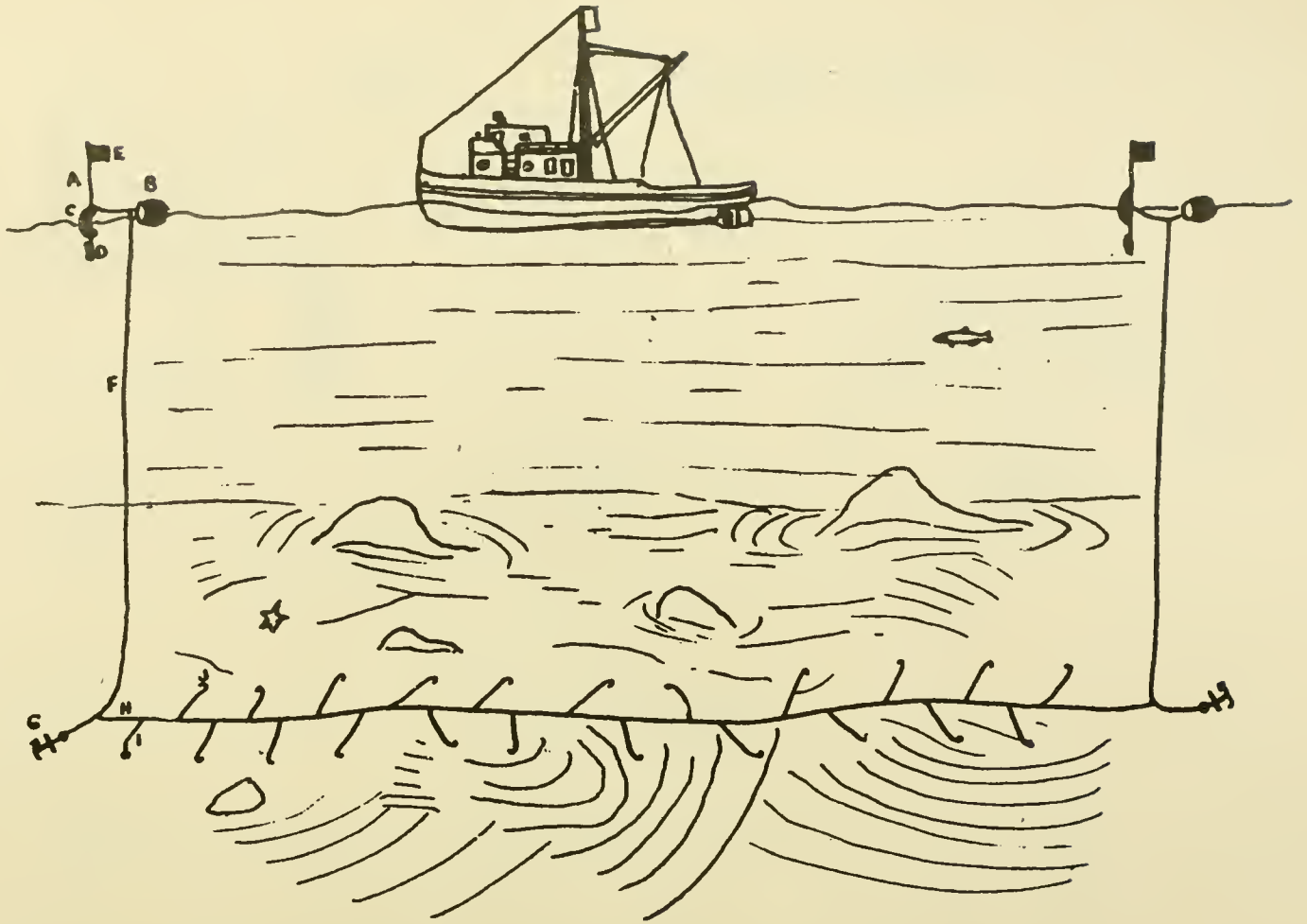


FIG. 3

TROLLING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THE FISHERIES AND FISHERY RESOURCES OF VENEZUELA

INTRODUCTION

The fisheries and fishery resources of Venezuela were studied as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service, and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in Venezuela consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service.

The Mission visited practically all of the localities in Venezuela where extensive marine fisheries are conducted. In addition, fresh-water fishery developments at Lake Valencia and near Merida were studied.

* * *

Note: Many persons aided the work of the Mission in Venezuela. Great credit must be given to Dr. Ivan D. Maldonado, Director of Ganaderia and of the Servicio de Pesqueria, and to his staff. The Venezuelan Commission of Inter-American Development, headed by Dr. Oscar Machado, spared no effort in assisting the work. The United States Diplomatic Mission, headed by Dr. Frank Corrigan, made particularly strong efforts to further the work and extended every possible assistance. The Standard Oil Company provided various services in the field. Mr. William Phelps and Dr. Guillermo Zuluaga helped immensely with observations gained by their extensive sport-fishing experience. Mr. Frank Storms of the Ingersoll Rand Company made available a great fund of information and supplied letters of introduction to persons in the field. In the fishing industry, Mr. Rafael Pardo of the Compania Anonima Asociacion de Pescadores de Margarita, Sr. Alejandro Oropeza of the Compania Cubagua de Conservas, and Sr. Francisco de P. Aristeguieta of the C. A. Industrial de Pesca, provided extensive assistance to the party. Besides these persons, hundreds of fishermen, port officials, and others helped.

The Mission could not have been a success without the aid provided by these persons, and to them we extend our thanks.

FISHERY RESOURCES

As a general rule, tropical seas do not support large local populations of fish. There are, however, a number of notable exceptions to the rule, and these are caused by certain known factors. Concretely, the marine waters of Venezuela provide an excellent example, for it is well known that enormous numbers of fish in a variety of species exist in this region. Some of these species now form a basis for comparatively large-scale fisheries. So far, there have been no signs of depletion of the species forming the commercial catch.

Oceanography

Currents:--Perhaps the most important factor affecting the productivity of Venezuelan waters is the oceanic currents. The north and south equatorial currents unite in about mid-Atlantic and a large part of the combined stream flows into the Caribbean Sea through the passages between the Windward Islands, between Trinidad and Tobago, between Grenada and Trinidad, and to a lesser extent through the Gulf of Paria. After passing into the Caribbean, the currents pass westward and then to the northward and westward, finally

reaching the Yucatan Peninsula. Since we are here concerned with the coast of Venezuela, the future course of the current will be dealt with elsewhere. It will suffice to say here that these currents continue, finally forming the Gulf Stream.

As the equatorial current sweeps along the Brazilian and Guiana coasts, it picks up and transports vast quantities of nutrient salts from the offluents of the great rivers of this region--the Amazon, Maroni, Courantine, Essequibo, and Orinoco. With these increased amounts of nutrients, the water becomes murky and oftentimes pea green with plankton, and great schools of pelagic fish feed on the margins of the current. Extensive areas for bottom fishing are to be found on the Guiana coast and these are now fished to some extent. A small part of the current sweeps through the Serpent's Mouth into the Gulf of Paria and picks up additional salts from several mouthsof the Orinoco and from other streams flowing into the Gulf. It then possibly forms part of a swirl or eddy in the Gulf and finally reaches the Caribbean through the Bocas between the Venezuelan mainland and Trinidad. The Gulf of Paria, shallow and rich in nutrients, is comparatively little fished except on the Trinidad side, but even here increased fishing could be supported without danger of immediate depletion.

The current continues along the coast of Venezuela between and outside of various islands which lay offshore--Los Testigos, Los Hermanos, Blanquilla, Orchila, Los Roques, Curacao, Bonaire, and Aruba. Inshore and almost parallelling the 100-fathom line is a counter current which is joined by swirls to form a massive eddy around the island of Tortuga. Until an intensive survey can be made of the Venezuelan coastal waters, little more can be said of the local currents. Enough data are at hand, however, to show that the currents are to a great extent responsible for a tremendous abundance of fish.

Bottom area within the 100-fathom curve:--Venezuela has a relatively large area of bottom shallower than 100 fathoms along its coast. In addition there are two large, more or less enclosed bodies of water--Lake Maracaibo and the Gulf of Paria--as well as smaller ones such as the Gulf of Cariaco, Unare Lagoon, Gulf of Coro, and others. There is approximately 1,750 miles of coastline. The 100-fathom curve is only about 6 miles off La Guaira but about 60 miles off in the neighborhood of Barcelona. In total, there are about 35,000 square miles of bottom area within the 100-fathom curve.

Mixing of waters:--A chain of islands lying from about 15 to 80 nautical miles offshore serves to break up the currents and assists in the mixing of the waters. Such upwelling as does occur will probably be found in these rather limited areas. Since the prevailing winds are the northeast trades which push the surface waters onshore these is little likelihood of upwelling on the mainland coast.

Ecology

Venezuela's marine environment presents a number of distinct ecological units.

Western area:--From the Colombian border to and including the Paraguana Pensinsula there is a wide coastal strip of barren desert. Most of the Lake Maracaibo area, however, is a low, swampy jungle with innumberable lagoons and channels. Many fresh-water streams and rivers enter the Lake particularly in the southern end. Lake Maracaibo itself is very shallow mostly with mud and sand bottom and with varying degrees of salinity from the head to the mouth. The Gulf of Venezuela is also shallow as far seaward as the latitude of Aruba. The greatest reported depths run from 5 to 7 fathoms to seaward and around 10 to 20 fathoms within the Gulf. The principal species reported in the catch of this area are curbinas, cazones, lizas, bocachicos, pez espada, robalos, bagres, and armadillos. This indicates that the major fishing emphasis is placed on shore fishes with very limited migration tendencies and on fishes which are to be found in salinities of varying degrees. It is also known that tremendous quantities of anchobetas and sardinas are to be found. The offshore pelagic fishes such as the tunas are missing. Because of the prevalence of shore fishes, little effort is placed on other species such as tunas or on ground fishes. The abundance of such easily caught fish make it unnecessary for the fishermen in the Maracaibo region to go far afield, and it is known that large banks where groupers and snappers abound are scarcely touched. In addition there are indications that runs of offshore pelagic fish are to be found in the outside waters since stragglers occasionally come into the Gulf. This is demonstrated by occasional catches of carite and jureles.

West-Central Area:--The next ecological unit to the eastward includes the region from the eastern side of the Paraguana Peninsula eastward to Las Roques and southward to Cape Codera. The greater area here is relatively barren but the nearby mountain slopes and river valleys support some vegetations. The 100-fathom curve is found rather close to shore and this limits the amount of bottom-fishing area. There is a chain of islands offshore which have excellent fishing grounds surrounding them. These are not used to any great extent thus far. The shore fisheries are relatively undeveloped since there are no large supplies of shore fish present. The principal species of fish taken in this area are carite, pargo, anchoa, mero, and lebranche. Of these the carite, anchoa, and lebranche are coastal pelagic species with migratory characteristics and the pargo and mero are bottom-dwelling forms. This indicates that there are two distinct groups of fishery activities--the coastal pelagic and the bank.

East-Central Area:--The region from Cape Codera to Punta Penas includes some of the richest fishing grounds in Venezuela, both partially developed and entirely undeveloped. It includes the fish-canning centers of Cumana and Porlamar and fish-curing activities around Isla Margarita and the Gulf of Cariaco. It includes also the ancient pearl fisheries around Islas Margarita, Coche, and Cubagua. The coast is practically all desert with mile after mile of surf-swept beach. Oftentimes lagoons line the inshore parts of the barren beaches. The two largest of these lagoons are Tacarigua and Unare. Both are reported rich in fish. The Gulf of Cariaco is surrounded by hills unproductive of vegetation, yet the waters are so productive that thousands of people are supported on its inhospitable shores. Isla Margarita from Colonial times has been a center for fishing--it is still that--and its hardy fishermen born and bred for generations to the sea-farer's life continue to be successful peasants of the sea. The remainder of the coast-line is barren also, with some fishery developments at Carupano and Rio Caribe. This section is scarcely touched, however, by the local fishermen, and vast resources of fish and shellfish are known to exist. The principal species taken are carite, anchoa, corocoro, jurel, liza, lamparosa, cabana, arenque, lebranche, and pargo. The carite, anchoa, cabana, jurel, lamparosa, lebranche, liza, and corocoro form a significant portion of the dry-salt fish output--while pargo is sold fresh and arenque is canned. The entire area is one of shallow to moderate depths and there are a number of small rocky islands such as Los Frailes and Los Testigos. Considerable areas of mud and sand, interspersed with coral structures, form the majority of the types of bottom, but rocky areas and shell bottoms are also to be found.

Eastern Area:--The coast from Punta Penas to the British Guiana border forms another definite unit. Included in this is the Gulf of Paria, the various mouths of the Orinoco, and a stretch of coast between them. The land portion of the area is practically all swamp and jungle with numerous channels, choked with mangroves. Only in the northern part does barren desert predominate. The extent of the fishing area is large, with a great many mud and sand shallows. Salinities vary greatly from the mouths of rivers to the open sea, and many types of habitat are found. In many respects the Gulf of Paria region may be compared with Lake Maracaibo. Included in this region are perhaps some of the richest potential fisheries of certain kinds of fish and shellfish, for the waters of the Gulf are rich in nutriment. Very little fishing is carried on in the Venezuelan portion of the Gulf but considerable activity is found on the Trinidad side. Inshore, the principal species are those that have a wide salinity tolerance, such as liza, robalo, sabalo, pez espada, bagre, mero, curbina, armadillo, and certain sardinas and anchobetas. In the more strongly saline water offshore, anchoa, carite, sierra, pargo, corocoro, and other species occur. There are numerous, hardly touched but exceedingly rich, bottom-fishing areas in the Gulf, and it is reliably reported that here a party of 2 men in a period of several hours caught 2,100 pounds of groupers and snappers with handlines. Whales, feeding on the enormous schools of small fish, often frequent the Venezuelan side of the Gulf. There are definite indications of an abundance of shrimp in the Gulf of Paria and this resource is practically unused.

Principal species and distribution

The fish population of Venezuela is typically West Indian or Caribbean in nature. Ninety classifications of fish are reported in the commercial catch but this is in no way indicative of the actual number of species since some classes such as "bagre" (catfish) may include 20 to 30 different species. Moreover, many species are not taken commercially and, therefore, do

not appear in the landing records. Venezuelan waters offer an attractive field for the taxonomist for there are many species yet to be classified.

The names applied to Venezuelan fish by the local fishermen follow quite well those used in other Latin-American countries, but there are many names used only in Venezuela. Until intensive study is made to clarify the taxonomy of Venezuelan fishes and to determine the vernacular name for each of them, this information must remain fragmentary and, doubtless, in some cases, inaccurate. The local names now in use are based on resemblances to Spanish or Mediterranean species. In some instances the names are of Indian origin. Oftentimes, the name of a single species varies according to the locality. In other cases, one name will be used to designate a number of closely-related forms.

The following list was compiled by interviews with fishermen and with the assistance of the Servicio de Pesqueria of the Venezuelan Government: (Scientific names are given in the General Report—pages 14 to 17.)

PRESENT FISHERY INDUSTRIES

The fishery resources of Venezuela have played a continuously important part in the life of her populations. The early Spanish settlers found fish to be abundant and good. Their early settlements were placed on the water's edge where fish was always readily available. The settlers along some of the country's more barren coastline were forced to rely on fish for most of their food supply when supplies from the mother country ran low. Parts of the 1,750 miles of seacoast "teemed" with fish during certain seasons and plentiful supplies were available in the rivers and lakes. The pearl fisheries of Isla Margarita were established in early colonial days. No doubt, adaptations of Europe's fishing gear were transferred to the New World to aid the colonists. Indian fishing methods were also adopted.

In this part of the world where shelter from rain was the only prime requisite of a habitation, the poor man could live off the sea with little capital and little manual effort. Thus thousands of people have lived and are living. The Venezuelan Ministry of Development (Fomento) stated in its 1939 report that about 20 percent of the population of Venezuela (or 750,000 people) lives from the fish in the sea, rivers, and lakes. These people are poor of means and live simply, eating fish and some vegetables and grains.

Much of the desire for fish among the colonizing people was gained in Europe, mainly in Spain and France, where they were fishermen or had grown accustomed to eating the fresh and salt products of European waters. Many of these people chose fishing as their occupation when they reached the new land. Coastal Indians, already established on a subsistence economy, have continued to rely on fish as an important food. Many poor or destitute people, some of them from families of liberated slaves, found the simple life of a fisherman to their liking. Fishing developed in Venezuela as the poor man's profession and as such it exists yet today.

Production

The bulk of fishing activity in Venezuela is concentrated at a number of points. The major areas are the Lake Maracaibo area, the Paraguana area, the La Guaira area, the Tacarigua and Unare Lagoon area, and the Cariaco, Isla Margarita, and Carupano area.

The catch of fish for commerce in Venezuela is estimated at about 100 million pounds. Official sources in Venezuela recorded a production of 7,681,000 kilograms of fresh fish and 6,242,000 kilograms of salt fish in 1940. To estimate the total catch, figures were converted to pounds, the salt fish to fresh fish in the round, and 40 percent added to cover catch not recorded. It was stated locally that the recorded figures did not represent more than 50 percent of the actual catch. The figure of 100 million pounds is, therefore, a conservative estimate.

A list of Venezuelan fish names with their English equivalents

anchoa	-	bluefish	cojinua	-	jack	palometa	-	Carangidae
arenque	-	herring	corocoro	-	grunt	pampano	-	pompano (large)
armadillo	-	gar	corocoro-queche	-	grunt	pampanito	-	pompano (small)
atun	-	tuna	cuna	-	cutlass fish	pargo	-	red snapper
bacalao	-	sergeant fish	curbina	-	drum	pargo de piedra	-	snapper
bagre	-	catfish	curbinata	-	drum	pargo-guacinuco	-	snapper
blanquilla	-	ocean whitefish	chicharro	-	sardine	pargo-loro	-	snapper
bocachico	-	Characinidae	chucho	-	ray	pez-espada	-	sawfish
bonito	-	bonito	dorado	-	dolphin	picua	-	barracuda
burrito	-	grunt	guasa	-	grouper	rabirrubio	-	snapper
burro	-	grunt	jurel	-	jack	raya	-	skate or ray
cabana	-	mackerel	jurelete	-	jack	robalo	-	snook
cachicato	-	grunt	lamparosa	-	lookdown	roncador	-	grunt
calamar	-	squid	langosta	-	spiny lobster	ronco	-	grunt
camaron	-	shrimp	lebranche	-	mullet (large)	sabalo	-	tarpon
candil	-	squirrelfish	liza	-	mullet (small)	sardina	-	sardine
carite	-	Spanish mackerel	macabi	-	bonefish	sierra	-	kingfish
carpeta	-	mojarra	machuelo	-	herring	sol	-	moonfish
cataco	-	sardine	manamana	-	Characinidae	tahali	-	cutlass fish
cazon	-	shark	mero	-	grouper	vieja	-	sergeant major
cazonete	-	shark	ojo-gordo	-	Clupeidae	zapatero	-	leather jack

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Note: This list of names is by no means complete but is given herewith as a basis for the understanding of the following sections of the report.

According to the catch statistics for 1940, published by the Servicio de Pesqueria, the carite is the most important species with 1,638,904 kilos sold as fresh fish and 1,189,150 kilos sold dry salted. The second fish in importance in the fresh-fish trade is the pargo with 935,334 kilos reported, and second in the salt-fish group is the liza with 647,649 kilos. In descending order in the fresh-fish group follow the corocoro with 776,444 kilos, the arenque with 362,080 kilos and the anchoa with 324,404 kilos. In the salt-fish classification in descending order are the anchoa with 591,867 kilos, the jurel with 480,900 kilos, the curbina with 388,724 kilos, and the cazones with 383,361 kilos.

The Cariaco, Isla Margarita, Carupano area produces the largest and most diversified group of fishery products. According to the 1940 statistics of the Servicio de Pesqueria, 5,556,622 kilos or 12,224,568 pounds of fresh fish and 4,386,618 kilos or 9,650,560 pounds of salted and dried fish are handled in this region. In addition, canneries are engaged in processing a number of species. The yield of the pearl fishing industry has always been large in the export trade. Within recent years, shark fishing for livers, hides, teeth, and flesh have been greatly stimulated by export demands.

Distribution

With the bulk of Venezuela's population living on or near the coast, the establishment of a fresh-fish commerce of considerable proportions was a natural development. Along the 1,750-mile seacoast, however, distances have often been so great as to make it very difficult to transport fish in fresh condition from areas of abundance to the centers of population. Thus, La Guaira and Caracas, in the comparatively barren center of the north coast, are not satisfactorily supplied with fresh fish. Maracaibo and the towns on Isla Margarita, however, are well supplied from nearby fishing grounds. Many other coastal towns are supplied by local fishermen.

Iced and salted fish are transported to population centers by sailboat, motorboat, truck, or train as conditions and facilities permit. Negligible cold storage and very limited ice-making facilities are available. Population centers not directly on the coast, even if only a few miles inland, receive unreliable and meager supplies of fresh fish. Dry-salted and canned fish are supplied in abundance to interior markets, even through the country areas.

Trade in fish is usually carried on over regualr channels of transportation with few facilities being constructed especially for fish. Coastwise steamers and sailboats, trains, and trucks bring products to the consuming centers. There they are customarily sold in stalls in public markets. Much is sold also by hawkers, particularly in coastal towns. Only a few private retail stores handle fresh fish.

Fishermen

As indicated previously, about 20 percent of the population of Venezuela obtains its livelihood from fishing in the sea, in the rivers, and in the lakes. In 1936, the Ministerio de Hacienda reported that there were about 6,425 fishermen engaged in commercial fishing in boats over one ton gross. This is regarded as a very low figure and the Mission estimated that at least 20,000 commercial fishermen were engaged in the Venezuelan fisheries in 1942. In addition, there should be added the not inconsiderable numbers of part time fishermen and others who operate only on a semi-commercial or subsistence scale.

Most of the fishermen of Venezuela live on the coast. It can truly be said that they are "peasants of the sea", for little else offers itself in this region as a means of livelihood. The majority of them are descended from Spanish stock and the background of their activities goes back to Colonial days.

Almost all of the fishermen live in a primitive manner, close to the sea. Their food consists of fish, eked out at times with vegetables and cereals. Their homes are usually

constructed of bamboo and mud with palm leaves forming the roof. The furnishing of these huts is limited to the most indispensable articles. Many of the fishermen are migratory. That is, they travel from place to place following runs of fish or visiting places where their experience has found that good fishing is to be had.

With the activities of the present Venezuelan Government, the lot of the fishermen is being improved greatly. Many of them have been able to become the owners of several nets and boats. Some of them have obtained work with canneries and other fishery enterprises.

The Ministerio de Agricultura y Cria through its Servicio de Pesqueria has created a Fisherman's Loan Fund which advances money to the fishermen for motorizing their boats and for acquiring better equipment. The formation of fishery cooperatives has been stimulated and the more worthy of the poorest fishermen have been advanced materials for the construction of boats and gear. Technicians have been engaged to instruct the fishermen in better means of production and preservation of their catch, and an exploratory service is endeavoring to find new fishing grounds.

The fishermen of Venezuela compose a valuable segment of the population for they create wealth from resources which, if properly managed, will last indefinitely. They also serve the important purpose of supplying an essential part of the diet of the country. From their numbers can come seamen and excellent personnel for naval service.

While fishermen the world over are highly individualistic, Venezuelan fishermen have demonstrated that they can work as a team, for they regularly operate types of gear which require cooperative effort. It is known that formal organizations of fishermen exist in Venezuela and these are known as "gremios". Every fishing village, moreover, is a coherent organization in itself, and the fishermen have relatively little contact with people outside of their villages. Because of their close-knit community life, it is believed that cooperative efforts of the fishermen would be possible in Venezuela. The occupation of fishing seems to be well established in a great many instances fishing has been the occupation of certain families for generations. Young boys assist their fathers and older brothers in catching and drying the fish and, as they grow older, they may acquire their own boat and fishing apparatus. Many of the nets have been handed down from father to son for several generations. Each generation maintains the net and passes it on to the next.

During the survey, many fishermen were interviewed and much opportunity was had to observe them at their work. They appear to be very industrious and exceedingly capable in handling their boats and gear. In general, they seemed to be of a high type both in intelligence and in physique. They have a definite pride in their calling and seem well content with their work. The efforts expended in bettering their economic conditions will be beneficial not only to them but also to the Republic.

Boats

The census of the country has not been finished, but the following data can be considered as approximate and they have been taken from the Report of the Ministry of Hacienda for the year 1936.

Licensed for Fishing

Custom House	Number of Boats
Pampatar	404
Carupano	130
Puerto Sucre	147
Guanta	64
La Guaira	42
La Vela	42
Puerto Cabello	93
Las Piedras	143
Maracaibo	220
Total	1,285

In 1936, the Venezuelan Government reported that 1,285 craft ranging from 1 to 5 tons each were licensed for fishing. This figure did not include unregistered boats or those of less than 1 ton. Since there are many small boats used in the coastal fishery, and since there has been considerable expansion of fishing since 1936, the present size of the fishing fleet is probably considerably greater than was reported. The Mission estimated that at least 3,000 craft of all types were in regular use for fishing in 1942.

All of the larger boats used in the Venezuelan fishery are of sailboat types--some are equipped with auxiliary motors, especially those used in transporting fish. These vessels range from 40 to 50 feet in length. These sailboats are known generally as "goletas".

Some motor boats of other types are in use as cannery tenders. At least 10 small motored fishing launches were in use in the shark fishery at Isla Margarita. These average about 18 feet in length and are only partially decked.

Smaller sailboats ranging from 15 to 20 feet are much used for trolling and handline fishing. At Isla Margarita these boats utilized a lateen sail. Here also the trolling boats were equipped with outriggers for spreading the lines. These sailboats were well constructed in local yards, utilizing for the most part imported woods. Their design is most adaptable to the type of fishing carried on. Sailboats of much the same type were seen in use very generally on Lake Maracaibo region but they were equipped with centerboards and those in other places were not. A type of boat in use in the Gulf of Cariaco and the Isla Margarita is the "piragua".

Fishing gear

The great abundance and ready availability of the marine fishes on the coast of Venezuela, coupled with the large number of fishermen, have made it unnecessary to employ highly mechanized forms of fishing apparatus. The gear now in use varies somewhat from place to place, but it is all of more or less simple type. Many of these have been used since Colonial times. Chiefly, they are beach seines (chinchorros), small specialized haul seines (mandingas), gill nets (filetes), pots (nasas), and handlines (cordeles).

Lake Maracaibo:--The predominant kind of fishing apparatus in use is a modification of the chinchorro (haul seine) used here as a gill net. This net is set in the late afternoon and hauled back in the early morning. When great schools of fish, such as the curbina, gather, the fishermen combine their nets to form one large net. With this they circle the school and then frighten the fish into the meshes.

Each chinchorro is 20 fathoms in length and 3 fathoms in depth. The mesh measurement is 8 to 10 cm. stretched (3.2 to 4 inches) and the netting is made of 15-thread cotton twine. Formerly the nets were made of linen thread. The floats are of corkwood (madera de corcha) placed every 30 inches on the corkline. Three-ounce leads (sheet lead) are fastened at intervals of about 30 inches on the lead line. These nets are tanned with an extract made from red mangrove bark. At Isla de Toas a concrete tanning vat was in use--the only installation of this kind seen in the Caribbean. When the nets are not in use, they are hung from drying racks which are constructed over the shallow water, about 300 feet offshore. Miles of these racks were observed, paralleling the shore of the Lake. When the nets are to be repaired or tanned, they are brought ashore.

In fishing these nets, a unit or "tren" is employed. Each tren consists of a canoe (piragua) displacing about 1.5 tons, together with 9 to 10 nets. Each piragua is manned by 3 men. The owners of the trenes usually do not engage in fishing themselves but hire them out to fishermen. The owner receives half of the proceeds and must keep the nets and boat in repair. The other half goes to the 3 fishermen. In June 1939, the nets were estimated to cost about 40 Bolivares each. Since then the price has mounted with the greater scarcity of materials. In 1939, 218 trenes were in use in various parts of the Lake. This would represent about 2,180 nets. Since this date, the number has probably increased.

Handlines are used to a somewhat lesser extent than the chinchorros but their contribution to the catch is considerable. Usually these lines are fished from a "cayuco". Sharks are sometimes taken on special handlines. One such line was observed at Isla de Toas made up of insulated

electric cable wire. A large piece of wood was placed 2 feet from the large shark hook. The hook was connected to the wood by means of heavy wire. It was said that the wood lodged in the shark's mouth and thus guarded the cable from breakage. Significant numbers of sawfish are taken by spears and harpoons.

No other kinds of gear are now in use in the Lake.

Paraguana:--Small chinchorros are in use in this region. In fishing, one end is held on shore and the other perpendicular to the shore some distance out. When fish approach within range, the offshore end is circled to shore and the net hauled in.

Handlines are fished for bottom species by the fishermen of Cutuora and La Vela. A few fish pots are in use, and the National Government has distributed chicken wire to encourage the poor fisherman. Other types of fishing are not carried on. Because of poor demand, there has been no incentive to use more efficient types of gear even though there is a great abundance of fish.

There has been no estimate of the amount of gear but reports (1939) state that 100 boats and 663 fishermen are employed.

Central Zone:--In the Central Zone, including Puerto Cabello and La Guaira, hooks and lines, both for trolling and bottom fishing, and fish pots are in general use. Few, if any, nets are in use by the fishermen of Puerto Cabello and La Guaira, for the type of shoreline does not lend itself to this sort of fishing. The use of modern otter trawls has been attempted on several occasions but so far the results have been poor. In the lagoons of Tacarigua and Unare, net fishing again becomes predominant and great quantities of fish are taken by chinchorros.

Eastern Zone:--The greatest industrialization of the fisheries has taken place in this area and, as can be expected, the greatest use of diversified types of gear. In spite of experimentation and the attempted introduction of modern types of fishing gear, their widespread adoption has not occurred. The probable reason is that the present means of production are adequate to meet the present demand. There has been no legitimate reason, so far, for the introduction of more complicated and expensive production methods, for labor is cheap and abundant, and the fish are easily caught in large numbers. It can be assumed that when the more simple means of production fail to supply the demand, more efficient types of gear and boats will make their appearance. These new units may fish on the same population of fish or they may utilize stocks of fish now unused.

The chief type of net used is the chinchorro. According to the size of the mesh, they may take arenque, carite, jureles, or anchoa. Chinchorros are hand-made of imported twine. Cotton twine from the United States is known as "guaral" and is now being used very extensively, although linen is favored and Italian hemp is used also. No net preservatives of any kind are employed and the nets are dried in the hot sun. Fishermen here claim that preservatives burn the netting. The corks or floats are made of corcha, a wood akin to balsa, and the leads or sinkers are cut from sheet lead. Ropes are usually made locally by hand from native fibers and it is claimed that this product is excellent when wet, but stiff and hard when dry. The nets average from 30 to 60 fathoms in length but larger ones are used. The depth of the seines is from 3 to 4 fathoms. Fifteen to twenty men are employed in setting and hauling the net. The men are paid in shares, with the owner of the net agreeing beforehand to the size of the share.

As at Maracaibo, the fishing unit is the tren. The trenes here, however, are much larger than those of Maracaibo since they include 30 nets and 6 to 7 boats each. Some of the larger boats are equipped with motors. It is reported that there are 300 trenes of nets operating in the Gulf of Cariaco. If this is true, there are about 9,000 nets, 180 to 360 feet in length each, in the Gulf of Cariaco alone. At Carupano, there are 4 trenes of nets--each 1,350 feet in length and 30 feet deep. Chinchorros are used to a great extent on Isla Margarita and they are of the same construction and type as above. No estimate has been made of the number in use.

Gill nets (filetes) are used to a considerable extent--particularly around Isla Margarita. These are used in capturing carite, cabana, sierra, anchoa, and other fish. The filetes are made of heavy linen thread and hung from corklines strung from wooden floats. The nets are not treated and are dried in the sun. The average size is about 90 feet long and 9 feet deep.

Castnets (atarrayas) are used to a considerable extent, chiefly in fishing for bait.

Handlines, using a number of hooks, are regularly employed in certain bottom areas for taking pargo and mero. From 4 to 6 men fish in each boat. The bait is usually arenque. Most often the lines are of heavy cotton and carry 5 hooks of sizes from No. 3 to No. 10. Some handline boats have taken as high as 1,600 kg. of fish a day. Depths of water fished in are up to 40 fathoms.

Trolling lines are used to a considerable extent, chiefly for carite and sierra. Usually the lure used is shaped like a sardine. Most of the trolling boats are equipped with outriggers and in this way they can fish 3 to 4 lines per boat. The lines utilize a very long wire leader--up to 20 or 30 feet in length. Ordinarily, 30 to 40 fish may compose the day's catch but catches of a ton or more are not unknown. Trawl lines are used only as "palangres" to catch sharks. Much of the equipment used was purchased in the United States and the form and construction of these long lines is practically identical to the Florida shark-fishing apparatus. A galvanized chain, about 3/4 inch size, is used as a ground line. This carried 20 to 40 large hooks fastened by means of snap hooks on chain gangions. Porpoise meat is used as bait.

Fish pots (nasas) are used to a limited extent. They are of chicken wire with wooden frames. Nasas are set without buoys and are located with grapnels. Buoys are not used because the fishermen feel that their pots will be robbed by other fishermen if they can easily be found.

Fishing with live bait (arenques) is practiced very generally and gives excellent results. Arenques are seined and impounded in a piragua that is filled with water. Fresh salt water is admitted from time to time in order to keep the arenques alive. The fishermen go out to the fishing grounds in this piragua and when fish are sighted, the live bait is dipped out to attract them. Short lines baited with a bone lure or other lure are used at this point to capture the fish attracted by this device. The fishermen often catch anchoas by using the legbone of a bird threaded to the shank of a hook. This is called fishing "guapeando".

Harpoons are used at times, particularly in taking porpoises for bait.

Several of the larger fishing companies have introduced purse seines but these were not in use in 1942. Attempts have been made also to use otter trawls, but these have failed.

Prices

Venezuela has an estimated annual consumption of fish (in fresh-fish equivalents) of 30 pounds per person. This compares with a total of about 30 to 35 pounds (in fresh-fish equivalents) per person in the United States and 69 pounds per person in Puerto Rico. In active cattle industry and widespread home raising of poultry make fish relatively unimportant in some sections but in other sections fish constitute virtually the only flesh protein food available. The comparatively low price of fishery products makes them attractive to the consumer. In Caracas in June 1942, high-grade fish sold at retail with a maximum price of 1.20 Bolivares per kilogram (16-1/3 cents U. S. per pound). In production areas on the coast, select fresh fish were retailing at 0.50 Bolivares per kilogram (7 cents U. S. per pound) and cheaper species sold from 0.15 to 0.30 Bolivares per kilogram (2.0 to 4.1 cents per pound). Locally-prepared salt fish retailed at coastal points of production for 0.50 to 1.00 Bolivares per kilogram (7 to 14 cents U. S. per pound). The Maracaibo market on June 16, 1942, posted the following maximum retail prices for certain fresh fishery products and beef.

Maximum retail prices for certain fresh fishery products and beef.

Maracaibo, Venezuela, June 16, 1942

	Bolivares per kilogram	Cents U. S. per pound equivalents
Red snapper and Spanish Mackerel		
-with head	1.50	20.5
-without head	1.75	23.9
Grouper	1.25	17.0
Shark, common	1.00	13.7
Sawfish	1.25	17.0
Beef, various cuts	(1.50 to 2.50)	(20.5 to 34.1)

Note: In Porlamar on Isla Margarita, fresh fish sold for 0.50 Bolivares per kilogram (7 cents U. S. per pound) while fresh beef at that point was priced at 2.50 Bolivares per kilogram (34 cents U. S. per pound).

Venezuelan prices are high, particularly for imported products, and the comparatively low prices for fish in certain localities permit workers to purchase fairly frequently. Fishermen and laborers on daily wages draw about 3 Bolivares or 90 cents U. S. for a day's toil.

In the interior of Venezuela, nationally salted and canned fish are regular articles of diet. Flat cans of sardines with 110 to 130 grams of contents retail widely at .50 Bolivar per can (15 cents U. S.). Salt fish is sold for .50 to 1.50 Bolivares per kilogram (7 to 21 cents U. S. per pound). This salt product varies widely in quality. It is somewhat inferior to the salt fish of world commerce in keeping characteristics, usually has higher water content, and is some times rancid even before leaving the producer.

Marketing

Much of the difficulty in securing widespread use of fresh fish is in the lack of facilities for handling fish in that condition. The catch often reaches the consumer in a poor state owing to lack of cover for the fish and ice in the boats, lack of packing in ice during transportation, and lack of cold-storage and sanitary-displaying spaces. If adequate facilities were provided this would tend to raise the price of fish. This would result in a reduction of potential buying power, but this tendency should be more than offset by reduction of loss from spoiling of shipments. Increased consumer's demand for the fish should result from the bettering of quality. Ensuing increased production would result in enlarged profits to producers and handlers and lower prices to consumers.

In Venezuela the production or harvesting of perishable food commodities is confined largely to the amount of such crops thay can be sold locally without special handling or storage facilities. This limitation keeps the industries so small that their unit costs of production are high. To lower unit production costs, changes should be made in the processes of production, distribution, and marketing together. These activities are interdependent. The relatively few attempts at fisheries development that have been made in many Latin-American countries have been limited to only one phase of the problem and, consequently, have met with such questionable success that they have discouraged rather than encouraged the investment of private funds in the fishing business. Attempts to make larger catches of fish reportedly have been successful on several occasions but these supplies of fish have been larger than the markets have been accustomed to absorb. The surplus either has been held until unfit for food or been sold at prices too low to justify the additional catching effort. Small markets and refrigeration units constructed with limited funds in an effort to hold or merchandise fish in improved manner have had difficulties because of limited, irregular, poor-quality, or high-priced supply.

Cold-storage facilities are extremely limited in the Caribbean area. Where established, they have been constructed to accommodate supplies shipped in from other countries or local supplies collected for export to high-priced foreign markets. Imported perishables are priced far above the purchasing power of the average Venezuelan. These products, purchased by the comparatively small wealthy class, are able to absorb cold-storage charges without difficulty. Products destined for sale to the low-income classes, however, could not easily carry the extra charges when considered on the basis of existing production and handling costs.

Canning

The present fish-canning industry in Venezuela was initiated in 1938, chiefly through Government loans to three companies. One company had its headquarters at Maracaibo but has since been liquidated. Another was ocated at Cumana, Estado Sucre, and this enterprise is operating on a large and successful scale. The third was located at Porlamar, Isla Margarita, and it, too, has been successful. Before 1938, canning operations were very rudimentary and practically confined to one small hand cannery at Puerto Cabello which prepared an expensive

specialty product. This enterprise when visited in 1942 was practically out of business. Since 1938, two more canning companies have been established--one at Cumana and one at Porlamar. In 1942 the one at Cumana was progressing well and the one at Porlamar was not being operated. The latest information indicates that the latter has been moved to Cumana.

All of the Venezuelan canning plants are located in modern, well-constructed buildings. They are served with electricity and fresh water. A good standard of cleanliness is maintained and, in general, they compare favorably with small canneries of the same type in the United States.

Canning machinery used is of Norwegian, Danish, German, and United States manufacture. The accessory machinery also has a rather diverse origin. While much of the machinery is of comparatively old type, it serves the purpose well. The typical line, as observed in the Venezuelan canneries, consists of can-forming machines for preformed cans or can-making machines of the flat or club type. All Venezuelan canned-fish products are hand packed. Steam boxes are used throughout and there are no vacuum sealers. Closing is done by hand or automatic closers. The cans are washed and labelled by hand.

Several of the companies have refrigeration and ice-making facilities which are used in connection with the canning operations.

While the canneries can produce a useful product in some volume for national use, as they now operate, rearrangement of the lines in the plants would add greatly to their efficiency. Certain other technological improvements could also be made to increase production and quality of the pack. Among them may be cited the need for scaling the arenque used in all of the inexpensive and most of the higher-priced items. While the products gain wide acceptance in Venezuela as they are, they would not in export markets since the scales would probably be objectionable to most consumers.

A comparatively large number of canned products are prepared. The basis of these packs is the arenque, a herring-like fish ranging up to 8 or 9 inches in length, which occurs in great numbers in the Cumana region. From this species, "sardines" in hot sauce, in oil, as "escabeche", 1/ "chirelita", 2/ stuffed, and in tomato sauce are manufactured. These items are packed in flat 110-gram (7/8" x 4") or club-size (1-1/8" x 4") cans. Also, from this species "salmonete" is prepared. This is a relatively low-cost product packed al natural with brine added. Two sizes are prepared, one with a net weight of 150 grams (2-1/8" x 3-1/2" can) and the other of 320 grams (2-1/2" x 4") or 450 grams (No. 110 can). Anchovy filets are also prepared from arenque by at least one company in 110-gram weight cans.

Bluefish are canned as "salmon" in 450-gram cans and al natural. Spanish mackerel is packed, either in oil or al natural in 450-gram or 370-gram containers. Tuna is canned in oil in 240-gram cans or in 130-gram flats.

In addition to the above, various shellfish are packed--among them mejillones 3/, "pepetonas" or "moules", and clams. Some are packed in oil in flat cans and some in larger cans al natural. Other products are being experimented with and new ones are appearing constantly.

Several of the companies now are engaged in processing sharks. The flesh is salted and sun dried and usually sold as "bacalao". One company is preparing an excellent herring product in brine and spices packed in kegs of various sizes. Oil used in packing is olive oil, peanut oil, or sunflower oil.

Raw materials are bought either from the fishermen or produced by fishermen working for the company and using company-owned boats and gear. The prevailing price for arenque for canning was 70.00 Bolivares (about $21.00 U. S. Price per pound is about 1¢ U. S.) per 2,200 pounds in 1942 when the fish were purchased from independent fishermen. When the cannery produced its own fish, the cost was about half this figure. The supply of fish seems quite regular from month to month but the sizes are said to vary.

1/ The fish are fried in oil then packed with spices.
2/ A variation on the hot sauce type.
3/ A mollusc of undertermined species.

Arenque are caught by fishermen, chiefly in the Gulf of Cariaco. Watches (vigias) on the cliffs signal the arrival of a school by blowing on conch shells. When this signal is heard, the fishermen man their piraguas and place their haul seine around the school. The ends of the net are brought inshore and the fish impounded if there are many. When the cannery desires fish, a smaller net is used inside the large one to haul the fish out. These are loaded into piraguas and towed to the cannery. At the cannery the fish are put into baskets and carried ashore through the surf. There is no wharf nor shore facilities for handling the fish rapidly. The fish are cleaned by a group of women working in a shed outside of the cannery and the fish are then taken inside for canning. This entire operation takes but a short time, and all fish seen were absolutely fresh.

Cannery help is plentiful and about 600 persons are employed in the canneries more or less regularly—chiefly in cleaning the fish and cleaning and labeling the cans. Fishermen laborers when working for the company receive 4 to 6 Bolivares per day (about 1.20 to 1.80 U. S. per day)—others doing more important work get more. Factory hands receive 3.50 Bolivares per day.

According to the Servicio de Pesqueria, the chief fisherman receives about 8 Bolivares per day and laborers and sailors about 3. Female cannery workers receive 0.25 Bolivares per hour in daytime and 0.37 Bolivares per hour from 6 in the evening to 6 in the morning of the following day. It was noted, however, that the majority of Venezuelan fishermen prefer to work with a share of the catch and not at a salary or daily wage.

The canning plants described in this section have never operated to their full capacity because of difficulties in obtaining cans and material. The total pack in 1941 was approximately 75,000 cases, based on 48 1-pound cans per case. The possible production would be about 100,000 cases, if cans were available. In 1942, the shortage of cans had already caused some dislocation and it is probable that the situation has not improved materially.1/

Practically the entire output of Venezuelan canneries is consumed within the country. Within the past year, however, several shipments of canned fish were made to Trinidad. It was found that the distribution of nationally-canned products was excellent—many isolated retail outlets had good stocks and have reported that the items sold exceedingly well. A sample of prices at the cannery follows:

Sardines in oil	100-can (130 gm.) case	30 Bolivares	($ 9.00)
Tuna in oil	100-can (240 gm.) case	100 Bolivares	($30.00)
Salmonete, al natural	100-can (150 gm.) case	23.50 Bolivares	($ 7.05)

The Government of Venezuela has placed a control on the prices of canned fish where the cost is not greater than 40 Bolivares. In direct purchases, 10 percent profit is allowed; and in indirect, 3 percent.

Salting and drying

The salting and drying of fish is a highly important phase of the fishery industry of Venezuela. For the most part, this activity is carried on by individual fishermen or by small groups of fishermen. Some of these groups are run on a cooperative basis. One large company, also engaged in canning, prepares herring in brine and spices and also dried shark meat. A large shark fishing company, located at Porlamar, Isla Margarita, produces respectable quantities of dried shark meat. Samples of this product, examined by the Mission, were judged very good, for the flesh was well dried, hard, and almost white in color. There was no objectionable odor or flavor.

Preparation of salted and dried fish is probably as old as fishing itself in Venezuela. The methods are relatively simple and the coastal regions of the country are well suited for this activity for there the air is dry and the region enjoys much sunshine and regular breezes. Salt is obtained by the evaporation of sea water. In 1919, dry-salt fish produced on the coast and outlying islands was sent into the interior of Venezuela in large quantities

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1/ Latest information indicates that cans are now being made available.

and significatn amounts (493,552 pounds) were also exported to the Dutch West Indies, to Trinidad, and even to the United States and Puerto Rico. (Radcliffe, 1922).

The chief species salted are carite, liza, anchoa, and jurel, but many others are also utilized to a lesser extent. Indeed, the surplus of any catch over the immediate needs for the fresh market is salted and in the more isolated communities practically the entire catch is so preserved. In statistics published by the Servicio de Pesqueria for 1940, 63 varieties appear as dry salted in varying amounts. The total recorded production for 1940 were 6,242,000 kilos (13,732,400 pounds). This, however, is an approximate figure and does not include the entire production. Venezuelan authorities state that it represents about 50 percent of the total. Therefore, the calculated amount would be about 27,500,000 pounds for 1940.

The fish are landed from the fishing boats and the fisherman and his family immediately start to clean and prepare the fish. Even the youngest assist. The fish are gutted and washed, the gills removed; heads are left on. A series of gashes is made to allow better salt penetration and salt is rubbed in. The fish are then placed on platforms of bamboo in the sun and allowed to dry. At other places they are laid on the ground. When partially dried, they are removed and sold, either in the markets or to buyers for sale in the interior. In only a very few instances are the drying platforms shaded.

The resulting product does not compare in quality to the better grades of salt cod, for the moisture content is higher, the butchering is not as well done, the color is darker, and the odor is not as good due to the oxidation of the oils. In spite of these drawbacks, however, the product is very popular on the Venezuelan market and it was explained that the oxidized oily odor was not judged unfavorably since it indicated, to the consumer, that the fish was "rico" (rich).

There is no doubt, however, that with technological improvements a product acceptable to export markets could be prepared in large volume.

Salted fish enjoy a wide distribution in Venezuela's interior and the prices are low enough for many of the less-prosperous groups to enjoy this product fairly often.

Shark-products

There has been, for a number of years, considerable activity in fishing for sharks, particularly for the hides which were exported to the United States to be tanned into leather. Subsidiary to this has been the sale of teeth and fins and the preparation of dry-salted shark meat. With the discovery of the high vitamin-A content of shark-liver oil, great stimulation of shark-liver production has occurred. That the natives knew that shark-liver oil was beneficial to their health previous to the scientific discovery is witnessed by the fact that many drink it, not only when troubled by illness, but as a general tonic.

The center of the Venezuelan shark fishing industry is Porlamar, Isla Margarita. There were three companies engaged in 1942 with headquarters on Isla Margarita. Another was operating at Cumana with prospects of others entering the field in this region and at other coastal ports. At least 15 motor boats ranging up to 35 feet in length were in use. These boats were equipped with pulpits for harpooning porpoises and block and tackle for hauling in the sharks. Porpoise flesh was the most popular type of bait. The catching apparatus consisted of line trawls (palangres) made up of 3/4-inch galvanized chain as a groundline carrying 20 to 40 large shark hooks on gangions 6 to 8 feet in length which were fastened to the groundline by snap hooks.

Because of difficulty in obtaining suitable shark hooks from the United States or elsewhere, locally-made hooks were finding extensive use. The hooks made in the United States were said to be soft and inadequately tempered besides being made incorrectly. Snap hooks, swivels, and chain must all be galvanized. It was reported that several years previously a

lot of shark fishing gear was sent to Venezuela by a commercial shark hide processing firm from the United States. One Venezuelan company had acquired galvanized chain of Brazilian manufacture.

Reliable observers on the ground reported that an average of about 600 sharks per month are taken. One company equipped with 7 boats produced in 1941, 3,550 hides and about 1,300 gallons of liver oil. (The latter was the product of 3 months' activity). The total yield for three companies would be about 100 percent more according to estimates. The rate of yield reported above had been maintained during the first 5 months of 1942 and one company estimated that they would produce about 5,500 gallons of liver oil in this year provided that shipping space was available and the demand was steady.

A number of species are taken, including the hammerhead, the nurse, and the tiger sharks. Others are also taken but little is known of the actual species. So far, there seems to be no depletion in the stock but the porpoises used for bait are becoming scarcer.

The fresh shark livers are cut into small pieces and rendered in double-boiler cauldrons over open fires. The oil is not refined in any way but attempts were being made to obtain a centrifuge. The livers used are absolutely fresh with no signs of deterioration. The oil is barreled in 55-gallon drums and shipped to the United States.

The hides are all carefully removed and flensed on a beam to remove fat and flesh. They are then salted down. Large stocks had accumulated in 1942 due to transportation difficulties.

The fins are dried in the sun and are shipped to local markets or, as formerly, to the United States. Jaws and teeth are also saved and exported. The flesh is cut into fillets, washed, brined, and salted. It is then placed on flakes for drying in the sun. The finished products seem to be well accepted and are of good quality--better than most of the other dry-salted products of other species seen.

Pearl fishing

One of the most important fisheries in the Isla Margarita region during normal times is pearl fishing. The grounds in this vicinity have been worked for centuries and the Spanish colonists used every means to continue and export the yield. For many years, the pearl fisheries have been regulated by the National Government, and the laws and regulations have been administered quite successfully.

Venezuelan pearls are, in general, not of as consistently high quality as those from other places but Venezuela has produced many excellent specimens. Usually the types are of odd shapes such as the baroque. The pearls, too, are often colored. In normal times most of the pearls are exported to France, sent to India to be drilled, and then back to France to be used. The seed pearls are used on dresses and certain types of hangings and the larger ones are manufactured into jewelry items. The War has cut off this market. In order to relieve the situation, the Venezuelan Government has purchased outstanding stocks and has prohibited further fishing until markets are restored.

No detailed study was made of the vessels and methods used in the pearl fishery but many pearling vessels were seen at Porlamar. Some of these were being used for fishing. Many have small auxiliary motors and others are equipped with outboard motors. The boats are of small schooner type and appear to be excellent sea boats and well constructed.

Exports

Exports of fishery products in 1940 totaled 75,300 pounds of which 11,400 were shipped to Aruba, 54,500 to Curacao, and 9,400 pounds to the United States. These 1940 exports included fresh as well as salted fish. No duties were imposed. The most important exported products were fish hides, fish "sounds", and shark fins.

Imports

Imported fishery products reach consumers through regular trade channels, needing no special refrigeration or handling facilities. In 1940 almost 100,000 cases of canned sardines were imported, all other itmes being comparatively negligible. Imports are subject to high duties (16-1/3 cents U. S. per pound for canned salmon, dry-salt cod, and many other fishery items; 3.8 cents per pound for canned sardines).

Venezuelan customs records list a total of 7,809,000 pounds of fishery products imported in 1940. The value of these imports was $570,454.00. Of the total, 6,567,000 pounds, valued at $407,000, was received from the United States. Canned sardines formed 86 percent of the imports, by weight, and of the United States shipments 88 percent was of this product.

Per capita consumption

Using the calculated total catch figure of 100 million pounds and adding to it the 7,809,000 pounds of fishery products imported, the per capita consumption of these products is calculated at about 30 pounds annually. This figure is considered low since about 20 percent of the population is said to live from the sea. Most of these persons catch their own fish, and these products do not enter into commerce.

Venezuela's fishing industry provides a very important element in the country's diet. The 30 pounds of fish per person supplies a large part of the essential proteins and minerals for body building. In this country of predominantly low-wage workers, the price of food is an important factor in public health. Fish, the lowest-priced, flesh-protein food, is relied on for a basic and indispensable part of the diet by the greater part of the population. This factor and the income and employment provided by the fishery industries make the fishery industries very important to the life and welfare of Venezuela.

THE ORGANIZATION AND ACTIVITIES OF THE FISHERIES SERVICE OF THE VENEZUELAN GOVERNMENT

Functions concerning fisheries in general are placed in the Ministerio de Agricultura y Cria (Ministry of Agriculture and Animal Husbandry). The Servicio de Pesqueria (Fisheries Service) is one of a number of services under the Direccion de Ganaderia (Division of Stock Raising). The work of the Servicio de Pesqueria is divided into the following categories: Law Enforcement (Control y Vigilancia), Exploration (Exploracion), Technology, (Capacitacion), and Fish Culture (Piscicultura). These various divisions conduct the following activities:

Law Enforcement

1. Protection and conservation of marine species.
2. Rational exploitation of the fishery resources.
3. Statistical information.
4. Inspection of the functioning of the Service.

Exploration

1. Discovery of fishing grounds.
2. Investigations on industrial possibilities of marine products.
3. Study of fishing grounds.
4. Observations on the habits and migrations of the fish.
5. Determinations of spawning times.
6. Taxidermic preparation of fish for scientific classification.
7. Study of the tides, winds, temperature and salinity of the waters, aquatic fauna, and plankton abundance, etc.
8. Study of certain water conditions which at times destroy fish (turbio).

Technology

1. Practical instruction on the construction and operation of modern methods of fishing (nets, traps, etc.).
2. Development of methods and modern systems for the preservation of fishery products on a commercial scale.
3. Methods of transporting live or refrigerated fish.
4. Organization of cooperative fishing associations.

Fish Culture

1. Experimental projects on transplantation of fish, molluscs, and crustacea to places where it is considered that appropriate conditions for their culture exist.

2. Study of natural hatching and growing places of fish, molluscs, and crustacea on their spawning grounds. Their biological conditions, sedentary species residing therein, migratory species, and those which come to these areas to spawn.

3. Experimental projects on artificial fertilization and incubation of fish eggs.

The central office of the Servicio de Pesqueria is located at Caracas and here the administration and direction of the field offices is conducted. There is a small staff to carry on the necessary administrative work and the preparation of special reports. The Fishery Inspectors carry out the enforcement of laws and regulations, collect statistics on the fishery, issue fishing licenses, conduct special surveys, and act as representatives of the central office. Patrol vessels are attached to each of the district offices.

A report of the Servicio de Pesqueria describes the field organization in some detail. There are three main fishing zones and one for the interior. The Eastern Zone extends from Punta Playa, in the Federal Territory of Delta Amacura, to the mouth of the Unare River in the State of Anzoategui. This zone is staffed with the following personnel: officer in charge and an officer for law enforcement, residing in Porlamar; a control officer in Carupano; a sub-inspector at Juangriego; a sub-inspector at Cumana; a sub-inspector at Puerto de la Cruz, and seven honorary Fishery Commissioners at the following fishing ports: Pampatar, Puerto Fermin, La Guardia, Punta de Piedras, Boca del Rio, Boca de Pozo, and San Pedro de Coche. The officer in charge administers ad honorem the pearl fishery which is also controlled by a Revenue Officer located at Porlamar. The floating equipment of this zone is composed of two motor patrol boats for the protection of the pearl beds during closed fishing seasons; a motor launch for the law enforcement and control of fisheries; and a motorized live-well boat for demonstrations of transporting live fish.

The Central Zone extends from the mouth of the Unare to Puerto de Chichirivichi in the State of Falcon and has the following personnel: an official in charge, a control officer and two sub-inspectors in La Guaira, a sub-inspectors in La Guaira, a sub-inspector at Puerto Cabello, and an honorary Fishery Commissioner at Los Roques. A motor launch for patrol and a live-well boat are attached to tnis zone.

The Western Zone extends from Punta de Chichirivichi to Punta Castille te in the State of Zulia. The personnel consists of an officer in charge and a sub-inspector at Maracaibo, a sub-inspector in La Vela, and an honorary Fishery Commissioner at Las Peonias, La Canada, Palmarejo, Isla de Toas, Sotavento, El Hato, and Las Cabeceras. A patrol vessel is detailed to this zone.

The jurisdiction of these zones extends to the territorial waters of the Venezuelan islands in the Caribbean.

The Fish Culture Zone includes Lake Valencia and the rivers and lakes of the Andes in the States of Trujillo, Merida, and Tachira. The personnel includes an officer in charge, under contract, of the cultivation and propagation of trout in the region of Los Andes and a caretaker of Lake Valencia for the pools at Boca del Rio. This region is equipped with a tank truck for fish transport.

The Servicio has taken over the activities of the pearl fishery with the exception of the revenue branch.

The Servicio has performed many functions, among which are the following:

1. Giving fishing supplies to needy fishermen and prizes for outstanding achievements of fishermen.

2. Assisting with technical knowledge on motorization of boats and more efficient means of building boats and gear.

3. Giving technical assistance to industrial plants in preparing new products.

To assist in the development of better fishing boats and the use of more modern fishing gear, the Servicio has constructed a model fishing vessel at Isla Margarita. This vessel was built under the supervision of a Basque expert and is represented as being of the most modern and usable type.

The length between perpendicualrs is 16 meters (about 52 feet), beam, 3.60 meters (about 12 feet); and depth, 1.90 meters (about 6 feet). The planking is of pitch pine and the ribs and keel of native woods. There is a small deckhouse placed about amidships--living quarters and engine room are below deck. There is a small cold-storage compartment. There is a mast amidships about 18 feet high. The motor is diesel—of 60 horsepower--and a speed of 10 to 12 miles per hour can be developed. The vessel is built much like a pilot boat with a great amount of overhang in the stern. The bow is an extreme clipper type. There is a great deal of sheer in the deck lines.

The vessel is to be equipped with modern fishing gear, including a purse seine, trawl, and with apparatus for fishing sharks. An auxiliary motor on deck drives a machine for handling the gear.

One of the most important functions of the Servicio de Pesqueria is the collection of statistical data on the catch and the issuance of licenses. The Servicio provides its field officers with the following instructions:

1. The fisheries data have as their object the compilation of the necessary information to prepare summaries showing the number of persons employed and the value of the fishing industry.

2. These data should be collected in person by an official of the Servicio at the fishing camps (rancherias), and the official gathering the information will also sign the completed forms.

3. The forms to be used are printed and bound in books of 100 sheets in triplicate. There are to be distributed as follows: the red to be delivered to the owner of the rancheria, the yellow to the Ministry, and the white to remain in the book for the use of the issuing office.

4. The cooperation of the owner of the rancheria should be obtained in assigning correct values for all permanent structures and apparatus used in fishing.

5. Since approximate calculation as to the number of people employed will not be accepted, exact figures must be obtained.

6. The official collecting these data may, within the limit of these instructions, decide the order of their collection depending on transportation facilities and the location of the rancherias. To do so, he must prepare a plan for the collection that includes all the rancherias in his jurisdiction, showing the time when he will be there, the date of travel, and the approximate cost. The report should be sent to the main office as soon as possible since it is desired to initiate the analyses of these data as soon as possible.

The following instructions were sent out to the officials in charge of the issuance of fishing permits:

1. Each book contains 100 permits in triplicate. The red copy is to go to the licensee, the blue to the Ministry, and the white is to be retained by the issuing office.

2. These licenses replace the old ones. Consequently, the renewals should be completed as soon as possible and the fishermen should be warned to use only the new ones.

3. Special care is to be used in filling out the forms. The information should be ascertained with the greatest accuracy since these data are to be used as a basis for future statistical analyses.

4. Each office has control of the numbering of their permits, taking care to see that they are issued in chronoligical order. No permits are to be destroyed since this would destroy the numbering system.

5. It is anticipated to use these data for a compilation of the statistics of the fishery industry soon and, for this reason, all reasonable promptness should be shown.

For this reason the central office takes the greatest interest in seeing that the work contained in these instruction is carried through with the greatest possible speed and accuracy. These records will constitute a major part of the efficiency ratings of the zone and sub-inspectors.

The Ministry has issued a number of statistical and license forms covering practically all phases of the fishing industry.

POTENTIAL FISHERY INDUSTRIES

Unused resources and potential markets

Reports of the Venezuelan Ministry of Development (Fomento) describe fishery resources in that country's waters that are far in excess of present uses. Immense schools of sardines "from island to island" are said to move along the north coast. These are preyed on by enormous numbers of birds and fishes. Extensive resources, at present scarcely touched by fishing operations, are described as occurring in the Gulf of Venezuela and Lake Maracaibo sections as well as elsewhere.

Existing fishing operations apparently do not tax the fishery resources in any point along Venezuela's coast. Fishing methods in use are capable of producing only relatively small catches of fish and operations are narrowly confined in location and intensity by scarcity of population, lack of mobility in fishing craft, undeveloped fish transportation facilities, and the comparative poverty of the fishermen and their families.

The Government of Venezuela has tried to enlarge the fishing industries and to improve the lot of the fishermen. Through the Government, the sardine-canning industry of the Gulf of Cariaco and the Isla Margarita area was developed. Other less successful projects have been instituted. Under stimulation of war prices, export of salt and canned fish to Trinidad is being accomplished. Venezuela, however, still appears to be utilizing far less fish than the resources can reasonably spare. More aggressive fishing with advanced techniques and enlargement of operation should increase the yield tremendously.

Possibilities exist in several fields for the enlargement of commerce in Venezuelan fish. These possibilities are discussed under the following heads:

1. Fresh and frozen fish for increased local consumption and export.

2. Salt fish for increased local consumption and export.

3. Canned fish, fish meal and oil, and other fish products.

Fresh and frozen fish for increased local consumption and export:--While possibilities exist for enlargement of Venezuela's catch of fish, there appears to have been little incentive for improvement of fishing techniques and effort under existing conditions of transportation, storage, and marketing. Lack of ice and cold-storage facilities have made it possible to use seasonal surpluses of fish for only salting or canning, and shortage and high prices of ice have handicapped the shipment of fresh fish to inland or distant points. Markets have been poorly equipped to handle fresh fish.

For these reasons, attempts to furnish the capital city, Caracas, and many other centers of population with fresh fish have attained only very limited success. It is estimated that half a million to one and a half million more persons could be added to those already buying fresh fish regularly in Venezuela if an efficient system covering all phases of fresh-fish production and handling were developed. Radical change should be effected in all fish-catching methods and handling processes, providing reasonable sanitary precaution and preservation by ice and freezing.

It is anticipated that the unit cost of fish production can be so greatly reduced by the adoption of mass-production methods that the costs of adequate handling can be easily absorbed and the price of fish to consumers made markedly lower. Low-priced, fresh, and clean fish products will sell in greatly increased quantities in all populated parts of Venezuela, and at a few points where there are high-income groups, such as in Caracas and Caripito, fresh fillets and specialty products of relatively high price could be marketed to advantage.

Bluefish, Spanish mackerel, red snapper, and some other fishes occurring in abundance in Venezuelan waters have comparatively high value as fresh or frozen fish for sale on United States markets. The quantities that could be secured for export would be considerable and should justify the establishment of a fish-export industry in Venezuela when adequate transportation becomes available. Products should be filleted or steaked, packaged, and quick frozen to conform to United States trade requirements. Low-temperature boat transportation is necessary for such products. These quick-frozen fishery items would be fully adaptable to limited sale in Venezuela and other Central-and South-American areas.

Salt fish for increased local consumption and export:--Although nationally-produced salt fish is distributed widely to coastal and interior communities, there appear to be possibilities in enlargement of national trade in the commodity if the product would be better prepared or lower priced. These conditions probably could be accomplished by lowering of unit production costs through mass production of fish and the development and adoption of improved and standardized methods of salting and drying.

Venezuelan salt fish are poorly prepared when judged by standards established in the international salt-fish trade. Without improvement of the products, Venezuela could sell scarcely any of its salt fish to buyers from other nations. However, if products can be and are prepared to comply with export requirements, and prices lowered to acceptable figures, Venezuelan salt fish would find an immense emergency market throughout the West Indies, which normally import more than 125 million pounds of salt and pickled fish each year. Restrictions in shipping have reduced materially the imports that have been reaching these islands over the long ocean routes from northern sources. The deficiencies in imports could be at least partially filled by Venezuelan salt fish. It appears that the West Indies should offer an immediate market for 50 million pounds or more of this product. Additional amounts could be supplied to Colombia and Central America. Adoption of mass-production methods should reduce unit costs sufficiently to permit price quotations acceptable to foreign commerce. Trade created in this way could be continued after the war if prices were sufficiently attractive.

It is recognized that the species of fish found in Venezuelan waters are not adequately tested to determine their potentialities as first-grade salt fish. Therefore, experimental work in fish preservation is a prerequisite to development of export trade in Venezuelan salt fish.

Canned fish, fish meal and oil, and other fish products:--Venezuela's shrimp resources might prove to be the basis of an extensive industry. Frozen and canned shrimp hold enviable

positions among food commodities and dried shrimp and shrimp meal may find favorable markets.

Fertilizer, fish meal, and oil from Lake Maracaibo, anchovies and other fishes would find ready sale in all Latin America. A local source of fertilizer of this type and meal for stock and poultry feeding would have price advantages over imported products. The Caribbean, with its economy based on agriculture, should be receptive to an extensive trade with Venezuela in fertilizers and fish meals.

Possibilities in the use of sharks have not been fully explored. Salted and dried shark meat has been produced in quantities for several years, but the industry that produces this product relies on income from other exported shark products for the support of its operations.

A considerable export trade in shark-liver oil shark fin, hides, and teeth was created before Caribbean shipping shortages halted transportation to markets in the United States. Unless transportation for these products can be made available and prices for their United States sale kept at sufficiently high levels, it is doubtful if shark fishing can be engaged in profitably until after the war. Salted and dried shark meat appear to make a very good product but the sale of this item alone possibly cannot be sufficiently remunerative to justify continuance of shark fishing on a large scale.

RECOMMENDATIONS

Venezuela is relatively far advanced in the use and management of the fishery resources. An excellent framework of organization, regulations, and activities has been provided in the Ministerio de Agricultura y Cria. The Government of Venezuela appears to realize that the fishery industry is an important segment of the economy of the country and that resources hold considerable promise for further development. Venezuela produces practically all of its nationally-consumed fishery commodities.

While the present state of development is commendable, it is apparent that there are great possibilities for increased utilization of the fishery resources. Even with a large fishing population and a well-established system of trade in some fishery commodities, the use of the resources has not been commensurate with the possibilities. In the opinion of the Mission, the people of Venezuela do not seem to realize that there are vast quantities of valuable fish and shellfish now unused. Venezuela has an internal market that is able to absorb much larger quantities of fishery products. Moreover, Venezuela's neighbors in the Caribbean and in North America offer a promising market. Through planned development, Venezuela can improve the economic status of her coastal population, can better the national standards of her citizens, and increase her importance in the commerce of the world.

The following recommendations indicate how Venezuela can expand her utilization of the fishery resources.

I

General Recommendations

It is recommended that:—

1. The Servicio de Pesqueria be strengthened by the addition of the best technically trained personnel available. While the structure of the Servicio de Pesqueria is well fitted for its responsibilities, it appeared that it was deficient in some particulars. There was an obvious lack of personnel trained in the fishery sciences (aquatic biology, technology, engineering, and economics). This factor has been the main contributing cause to a retarded growth of the fishery industry. Credit must be given to the Venezuelan Government of recent years for stimulating and initiating fishery enterprises, but their efforts have been incomplete insofar that they have not provided for basic research on the character and extent of the fishery resources, improvement of production and processing techniques, and distribution and consumption of fishery products. Although the prosecution of the fisheries and the attendant processing and distribution activities are being carried on by private enterprise, the Government

has the basic responsibility of assuring that this resource is utilized and conserved to the best interests of the country.

2. The Servicio de Pesqueria devise, initiate, and maintain a definite program of fishery management involving technical studies, the fostering and promotion of fishery industries, and the conservation of the resources. The Servicio de Pesqueria, in the past, has initiated and carried out projects of various types to assist the fishing industry. Many of their projects have been commendable. In general, however, they have been carried out as independent short-term projects with little or no indication of being a part of a program having definite objectives. Inasmuch as the most efficient use of the resources demands long-range study and planning, it sould be the duty of the Servicio to devise on over-all program with definite objectives. This program should include the necessary technical studies to foster and promote the fishery industries and conserve the resources. This program can be best drawn up with the assistance and guidance of trained fishery technicians.

3. The Government of Venezuela, through its Servicio de Pesqueria, initiate an emergency program to assist the fishery industry in maintaining as high a level of production as is possible. One of the most pressing problems confronting the fishery industry in Venezuela is the growing shortage of materials and supplies brought on by the war. Since the individual units of the industry have so far been unable to cope satisfactorily with this situation, the Government must take action if the fishing industry is to survive. Steps should be taken immediately to secure and distribute needed items at the lowest possible cost.

II

Specific Recommendations

The following recommendations are presented covering special problems that demand particular notice. They should compose parts of an over-all fishery program.

A. Biological

It is recommended that:--

1. Scientific investigations on the taxonomy of Venezuelan fishes, not only of commercial but also of non-commercial species, be undertaken. Present nomenclature of fish presents a confusing basis for all fishery-management work. This must be overcome in order to make statistical and biological information understandable.

2. The condition of the stock of arenque in the Gulf of Cariaco be investigated to determine the condition of the stock.

B. Technological

It is recommended that:--

1. Improved techniques for the drying and salting of suitable fish be undertaken in order to prepare more acceptable products for export and local consumption. Salted fish observed by the Mission could not be regarded in general as conforming with export standards. Improvements in color and odor should be accomplished easily and could result in a much superior product.

2. During shortages of tin cans the canneries agree to eliminate all high-priced specialty products and that special emphasis be placed on producing standardized packs of such products as "salmonete" and "sardinas en aceite". It is further recommended that the canneries remove scales from the fish used for their canned products, since the presence of scales is objectionable in these products. Canneries can re-arrange machinery to secure greater efficiency.

C. Engineering

It is recommended that:—

1. The experimental fishing vessel recently constructed be placed in operation as soon as possible and that it be remodeled to afford more efficient use of the deck and hold space.

2. Further study of boats suitable for fishing in Venezuela be made.

3. That the construction of fish traps or pounds be studied as well as other forms of fishing gear not now in use in Venezuela.

D. Exploration

It is recommended that:—

1. The extent and character of the shrimp population of Paraguana, Maracaibo, and the Gulf of Paria be established by suitable exploration.

2. The anchovy population of Lake Maracaibo be examined to determine its suitability for a reduction into fish meal and oil.

3. Exploration be carried on in offshore areas to determine the practicability of capturing tuna and swordfish in commercial quantities.

4. The possibilities for enlargement of the shark-fishing industry be explored. In addition to stimulating fishery enterprise, this would also decrease the number of predators on other species of fish. Dry-salt shark meat was judged to be one of the best salt-fishery products produced in Venezuela.

5. The extent and character of other important food fishes and shellfishes be determined as a basis for future expansion of the fishery industries. Expert analyses of these data will divulge many opportunities for increased activities in fishery commerce and will ensure that the most economic use is made of the fishery resources.

E. Economics

It is recommended that:—

1. The Venezuelan Government promote the expansion of the fresh-fish industry. For this purpose, efforts should be directed toward the improvement of marketing and transporting facilities, and installation of ice-making, quick-freezing, and cold-storage facilities. It is considered very desirable that a thorough study of the economic factors concerned be made for the purpose of determining how extensive a development is feasible.

2. The statistical program be continued and expanded to include a greater coverage of the fishery industry.

F. Fish Culture

It is recommended that:—

1. The work of the trout hatchery at Macuy be continued with the object of stocking suitable lakes and streams.

2. Planting of carp be discontinued in Venezuelan waters pending an investigation of of the desirability of using native species, for fish-stocking purposes. The introduction of foreign species often results in damage to the waters and to valuable native fishes. Venezuela appears to have numerous species of fish that are well suited to the environment and which can probably be used with much better results.

G. Administrative

It is recommended that:--

1. A mutual interchange of ideas and administrative and technical personnel be planned with other nations of the Hemisphere.

THE FISHERIES AND FISHERY RESOURCES OF COLOMBIA

INTRODUCTION

The fisheries and fishery resources of Colombia were studied as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior and the field party in Colombia consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service.

Although Colombia possesses an extensive coastline along the Pacific the Mission visited only the fishing localities on the Caribbean side.

* * *

FISH RESOURCES

Comparatively little is known of the distribution and abundance of the fishes of the Caribbean coast of Colombia and there is practically no information on the oceanographic and ecological factors which affect fish life in Colombian coastal waters. Because of this, it is necessary to piece together such information as can be found and interpret it in the light of experience in other sections of the Caribbean. Therefore, the following sections must be regarded as having certain limitations as to exact details.

Oceanography and Ecology

The Caribbean coast of Colombia extends for approximately 640 miles in a southwest direction from the Venezuelan border to the Panamanian border. There are few islands or banks to be found offshore and there is a relatively small amount of bottom within the 100-fathom curve. From the Venezuelan frontier on the southeast side of the Goajira Peninsula to Santa Marta the only inhabitants are the Indians and occasional fishermen. With the exception of the town of Riohacha and several very small villages, there are no centers of population. The coastline is quite regular and is indented by the Bahia Honda, by El Portete, by Laguna Grande and by a series of small coves--Los Ancones. The entire coastline is quite barren--sandy beaches are interspersed with rocky cliffs and low mangrove swamps.

From Santa Marta to Punta San Bernardo, the dominant feature is the Magdalena River with its great network of channels and cienagas. In this section are the three major coastal cities, Barranquilla, Cartagena, and Santa Marta. The 100-fathom curve ranges from five to 30 miles offshore and there are a large number of small cays, islands, and banks inside the 100-fathom curve. Most of the bottom is sand or mund and coral structures are much in evidence. Around the cienagas are dense mangrove swamps. Of these the Cienaga Grande de Santa Marta is the largest. It connects through channels to the Magdalena and also to the Caribbean below Santa Marta. From Punta San Bernardo to the frontier with Panama there are few population centers and little is known of the fishery activities of the people inhabiting the region. Here, as in the preceding section, are a number of cienagas and bays. Among them are the Golfo de Morrosquillo and the Golfo del Darien. Into each of these gulfs flows a large river--into the first, the Rio Sinu; and into the second, the Rio Atrato, one of the largest in Colombia.

With three large rivers flowing into the sea and with extensive lagoons and side channels, it is not surprising that species with brackish water tolerance are abundant on the immediate coast from Santa Marta to the Panamanian border. These species include the tarpon, snook, mullet, various catfish, shrimp, and oysters. From Santa Marta eastward to Goajira, the type of fish taken changes somewhat and in this region some of the migratory species such as tuna, and bonito appear.

The south equatorial current does not affect greatly the coast of Colombia. From off Cabo La Vela the great body of the current runs about due west and diminishes in velocity as it spreads over a greater area. At Cabo La Vela the main axis is about 65 miles offshore. On encountering the influence of the Magdalena River, the stream is sometimes diverted to the northeast. This may also be due in part to a countercurrent which continues along the coast from Cartagena to the Rio Magdalena and beyond, at a velocity of one-half to one knot. The countercurrent runs about 30 miles offshore.

Westward of the Rio Magdalena a part of the main stream is deflected southward into the Golfo del Darien; between this branch and the shore is the countercurrent.

No studies have been made of the nutrient salts available in the waters of the coast of Colombia but there must be considerable supplies because of the large outwash from the land.

Species and Distribution

The fish fauna of the Atlantic coast of Colombia is typically West Indian. Comparatively few species are taken commercially and the majority of these are of the type which spend part of their lives in brackish water. Probably the bulk of fish consumed in Colombia are river fish.

In the region from Ancon de Cinto to the north coast of Riohacha the following species are most predominant in the catches: (See pages 14 - 17 for scientific names.)

A List of Colombian Fish with Their English Equivalents

Lisa and Lebranche	Mullet
Pargo	Red Snapper
Pampano	Pompano
Mero	Grouper
Roncador	Grunt
Jurel	Jack
Robalo	Snook
Sierra	Kingfish
Macabi	Bonefish
Carite	Spanish Mackerel
Picua	Barracuda
Tiburon and Cazon	Sharks
Sardina	Sardines
Lamparosa	Carangidae
Sabalo	Tarpon

According to reports, mullet, pompano, grunts, snook, jacks, and bonefish are caught by haulseines on the beaches. These are taken throughout the year. The red snapper, grouper, and shark are taken 15 to 30 miles offshore with hook and line and are caught

throughout the year. Kingfish, Spanish mackerel and barracuda are taken by hook and line fished near the surface, and the best time is in the period from May to August. Schools of kingfish, Spanish mackerel, barracuda and sardines are seen at some 10 miles offshore during the same period. Tarpon are taken fairly close inshore, usually with hook and line, but frequently with dynamite.

Shrimp are taken in inshore sections particularly in brackish water areas.

In the Cienaga Grande, all the fish taken are brackish water types. Among them are a number of types of mullet, "mapale", croakers, mojarras, tarpon, snook, characins, and three species of "chivo". Also taken are shrimp and mangrove oysters. The entire catch of fish here is taken with dynamite, castnets, and hook and line. The oysters are gathered by hand and the shrimp by castnets. There is widespread activity in burning shells for lime, and it is said that the limeburners employ both living oysters and dead shells for this purpose.

From Punta de Gaira to the mouth of the Rio Viejo, the following kinds of fish are taken:

Tarpon	Mullet	Anchovies	"Dulcino"
Spanish Mackerel	Jacks	Red Snapper	"Arepa"
Barracuda	Sardines	Grouper	

The red snapper and grouper are taken 8 to 10 miles offshore in 50 to 100 fathoms with handlines. "Arepa", jacks, and small barracuda (gangancho) school in depths up to 8 fathoms. Tarpon, mullet, Spanish mackerel, barracuda, jacks, and sardines school near the coast and are often taken with the use of dynamite.

Tarpon may be caught at any time of the year, but the best months are February to October and they are most abundant during April and May. Spanish mackerel are most abundant in the months from April to June, barracuda from May to August, mullet of one species (lebranche) December to May, of another species (lisa) May to August, jacks all year around, and sardines April to August.

The species and their distribution along the remainder of the coast follows rather closely the examples given above. While tunas and swordfish may possibly be found further offshore none are now taken.

Comparative Abundance of Species

So little is known of the abundance of fish on the coast of Colombia that it would be futile to draw any conclusions except general ones. Until a much expanded fishery is conducted, along with the necessary exploratory, statistical, and biological studies, little can be said. There is perhaps already some depletion of coastal types of fish in some areas due primarily to the use of dynamite. From all accounts, however, it is apparent that the marine fisheries of Colombia can produce a great deal more fish.

FISHERY INDUSTRIES

Early colonizing centered in the high plateau areas, and settlements on the coasts and along the rivers were established chiefly to facilitate commerce to and from the interior. Therefore, only along limited sections of the seacoasts and in the courses of the main rivers have the native fishes of Colombia been important in the food of Colombians. Native Indians of these sections had long since grown accustomed to catching fish for a major part of their food. In the areas where fish abounded, along the coasts and in the larger sluggish

rivers, new fishery industries were established where pearl oysters were found. An agricultural country, Colombia was well supplied with other meat and only in isolated communities were fish relied on for subsistence.

Distribution and Marketing

Continuous movement of commerce up and down the rivers made a condition conductive to a limited trade in salted native fishes. This became a standard item of river trade. Salt-water fish were salted in coastal fishing communities and shipped up-river to river settlements, and fresh-water catfish were salted at points of abundance in the rivers and transported to points further inland.

With the establishment of artificial ice plants in Barranquilla, Cartagena, and other points, some traffic in iced fresh fish also has developed. Commercial fishing activity is centered in the lower reaches of the Magdalena River and near its mouth. Some salt-water fish is carried by airplane from Barranquilla at the mouth of the Magdalena River to Bogota. Other inland communities receive little if any salt-water fish, and those along the river courses are supplied with fresh-water fish.

Fish distribution is unorganized. Several concerns in coastal cities buy fish from the fishermen, reselling them to inland firms, to peddlers, and in retail trade. In the main, however, fish are brought to public markets and sold in market stalls by agents for the fishermen. Markets are constructed on or near the water, and much of the catch is sold directly out of the boats by the fishermen. Any surplus fish is salted or smoked. In Barranquilla, much of the catch that is brought to market is cleaned and salted by the salesmen or the fisherman between sales, the salted fish being packed for sale in towns farther up the river. Fish are shipped in boxes by river freight boats. Considerable difficulty is experienced by the fishermen in bringing their fish to markets, however, as they have only oars, and poles to propel their dugout canoes against the river currents. Only a few fish are purchased directly in the fishing communities by buyers with motor boats. No fish is held in cold storage.

Processing

No fish are canned in Colombia, but large quantities are salted and smoked. Both of the latter processes produce dry products that will remain edible two or three weeks under normal conditions. This gives ample time for transportation and sale, as well as a moderate amount of storage by consumers.

Imports and Exports

The volume of fishery imports flowing into the Colombian ports in 1940 totaled 1,951,000 pounds valued at $206,000 United States. Of the volume received, 83 per cent came from the United States. The 1940 totals were much smaller than those of 1939, when 3,661,000 pounds, valued at $358,000 were imported. Only 58 per cent of the 1939 volume was shipped from the United States. In both years, the predominant item in import trade was canned fish. Limited quantities of dry-salt fish were received. Exports of nationally produced fishery items were non-existent.

Production

Only vague information was available to indicate the magnitude of Colombian fishing activities and the commercial catch of fish. A few estimates on the volume of local trade were obtained. From these estimates, coupled with observations, a total commercial catch of fish of about 3 1/2 million pounds a year was calculated. This total includes 2 1/2 million pounds of salt-water fish and one million pounds of fresh-water fish. The volume of fish caught for personal and family use, undoubtedly, eclipses the commercial totals.

Per-capita Consumption of Fish

The per capita consumption of fish in Colombia is low compared to many other Latin American areas. The 9,240,000 inhabitants consume, normally, not much more than ten million pounds of fishery products. The per capita consumption of fish, therefore, is not greatly in excess of one pound per year. Perhaps the greatest single factor that keeps consumption of fish at a low figure in Colombia is the abundance of agricultural food crops. In river valleys and plateaus large quantities of root and green vegetables, fruits, cattle, and poultry are raised and the individual sections, separated as they are by difficult means of transportation, are fairly self-sufficient in food. The transportation of fishery products is relatively costly (1.5 cents United States per pound on regular freight from Barranquilla to Bogota) and these items must compete with locally-grown food products at all points. In addition, except during several days in the year, there is no ban by the Catholic Church on the use of meats. Fish usually sells for a higher unit price than meat.

The Mission was informed that in Colombia and possibly others of the Spanish-American Republics, special Roman Catholic decrees were in force that grant immunity from the usual Church meat restrictions. These decrees (Bull of the Crusades 1400 to 1500 A.D.) specified that the faithful of the Spanish dominions were permitted to eat meat on all the days of Lent and other days of fast and abstinence except Ash Wednesday, the last Friday of Lent, the last four days of Holy Week, and the vigils of the feasts of the Nativity, Pentecost, the Assumption, and Saints Peter and Paul.

Church restrictions on meat eating often constitute one of the most important factors affecting fish consumption. In Colombia, the removal of a portion of these restrictions, undoubtedly, contributes to keep consumption of fish very low.

Prices

The price of Colombian fish is comparatively high in this country of comparatively low wages. Daily wages of 0.85 to 2.03 pesos (50¢ to $1.19 United States currency) do not permit purchase of much fish at 0.50 to 1.40 pesos per kilogram (13.3¢ to 37.4¢ United States per pound). In the interior, fresh fish on ice sold at retail for 0.80 to 1.20 pesos per kilogram while the price at markets near points of production were 0.50 to 0.60 pesos per kilogram. The price of meat was quoted widely at 0.50 pesos per kilogram. Salt fish was priced at 1.40 pesos per kilogram.

At the time the survey was made (June, 1942), grocery stores were selling one-pound cans of pink salmon at one peso each and of red salmon at 1.40 pesos. These are the equivalent of 59¢ and 81¢ United States, respectively.

Fishermen

A recent estimate of the Colombian Institute de Fomento Industrial places the number of fishermen at 2,116. To this number must be added a considerable body of fishermen who fish for personal use only and also some who fish for the market only at irregular intervals.

Indeed, except in the vicinity of the large cities such as Barranquilla, Santa Marta, and Cartagena, it is doubtful that commercial fishing industries exist. Along vast stretches of coast, fishing is carried on as a subsistence activity in much the same manner today as it was centuries ago. Fish furnished to the inhabitants of the coastal zone are an easily caught and usuable food.

The economic level of the Colombian fisherman is very low and he lives under almost primitive conditions. Most are of mixed blood with negro and Indian strains predominating. On the coasts of the Goajira and Darien the population is almost predominantly Indian. During recent years, some fishermen of European extraction have made their appearance but usually they gravitate toward other lines of endeavor or go into the marketing aspects of

the fisheries. In so doing, they have often antagonized the native fishermen by trying to exploit them.

There is little hope that much can be done immediately toward improving the life of the majority of the fishermen. To do this would require considerable education and the establishment of organized fishing industries. This should not be construed as a criticism of the Colombian fishermen for it is known that they are hardworking and friendly folk. The case is that these people have, for generations, used only rudimentary forms of fishing gear and they have found it unnecessary, thus far, to produce great quantities of fish, for their present markets are limited.

Boats

Approximate figures on the number of fishing craft in the eastern part of Colombia indicate that 529 are used for fishing.* This does not include the western and central part of the coast or small dugout canoes, sail boats, and auxiliary sailboats that are used occasionally for fishing, freighting, or sport fishing. As an estimate, it may be assumed that approximately 1,200 craft of varying types engage in fishing activities at some time or other.

By far the greatest number of fishing craft in Colombia are dugout canoes (cayucos). These are all locally constructed of native woods by hand labor. They range in length from about six feet to 30 or 35 feet. A cayuco examined at Cartagena was 18 feet long and five feet wide. Others, seen at the fish market at Barranquilla, were about 25 feet in length and five to six feet in width. Most cayucos have ribs built into the inside of the hull to strengthen it and they are equipped with thwarts. Many, used in the sea, are fitted with one or more masts and sails, while those used in canals or cienagas are poled. The predominant shape is that of a canoe. The craft are usually double-ended and have rounded sections. There is usually no decking. Keels are very shallow, if they exist at all. Cayucos are subject to great variation in size and shape depending on the builder. Although they are expertly handled by the native fishermen, they cannot be regarded as good fishing craft.

A relatively small number of sailboats, resembling the Venezuelan "goletas" are in use. These vessels are used chiefly for freighting but engage in fishing at times--chiefly offshore. These vessels range up to 50 feet and are built of wood. Some of these craft are equipped with motors and it is reported that six of this type were in use at Santa Marta.

Little is known of the fishery activities of the inhabitants of the islands of San Andres, Providencia, and the cays owned by Colombia off the coast of Central America. Evidently there is considerable turtle fishing at times and probably fish are caught, both for use on the islands and for salting for export trade.

Gear

All of the fishing apparatus in use at the present time may be classed as simple and rudimentary. The predominant forms are the castnets (atarrayas), haul seines (chinchorros), and handlines (anzuelos = hooks). The use of dynamite, while illegal, is widespread. Spears and harpoons are used to some extent particularly in the cienaga and river fishing. Fish pots (nasas) are used to a limited extent. Practically all the fishing apparatus is constructed by the fishermen from imported materials.

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* These figures were reported to the Institute de Fomento Industrial at Bogota on May 21, 1942 by Sr. Raul Franco.

Castnets:—These are used quite extensively--particularly in shallow water--either from shore or from a boat. Janson (1941) in an unpublished report to the Instituto de Fomento Industrial, reports that in Cienaga Grande the fisherman throws a ball of wood into the water some 30 feet away from the boat. It is believed that the fish, feeling the impact of the ball in the water, flee but return almost immediately out of curiosity. The fisherman then casts his net covering and trapping the fish. Janson writes that this system seems disadvantageous because so much dynamite is used in fishing that the fish have become wary with the result that when the fisherman throws the ball of wood they flee and do not return.

The castnets are of four different mesh sizes ranging from about 3/4" stretched to about 1 1/2" stretched mesh. They are built of imported cotton twine. The radius varies, but an average net would probably measure eight to 10 feet. The catch made by these nets is small and in most places the fish taken are used for bait.

Beach Seines:—These are used quite extensively where suitable areas exist. Fishermen of Taganga (near Santa Marta) utilize seven chinchorros in their fishing. Some of these are 60 fathoms in length. They require eight to 10 men to fish them and they are set only when schools of fish are seen to be available. The nets are set from a cayuco which sets the net in a semi-circle from the shore. The ends of the net are gradually hauled to shore and finally the center is pulled up on the beach with the fish entrapped within its meshes.

In the Goajira region, the Indians use a very small chinchorro, two to three meters in length. They also use a larger type with 8-inch mesh for capturing sharks.

Beach seines are highly useful where suitable conditions occur but those in use at the present time in Colombia are generally too small to capture quantities of fish.

Hook and Line:—This type of fishing is carried on in practically every region where fishing occurs. The hooks are imported and in some cases the lines are also. Every fisherman has a special way of his own to rig his equipment.

Dynamite:--While the use of dynamite is illegal, so many fish are taken with it that it must almost be regarded as a means of production. There is no doubt that this activity should be discouraged since it is not only extremely harmful to the fish resources but also definitely dangerous to the men using it. Many fish go to waste and those which are taken are not of as good quality as those taken by other more legitimate means since they decompose much more rapidly. The use of dynamite stifles what ingenuity the fishermen may have to develop more efficient methods.

POTENTIAL FISHERY INDUSTRIES

Unused Fishery Resources

As noted in a previous section, little is known of the extent and type of the fish resources of the Caribbean coast of Colombia. There are vast stretches of coastline, of cienagas, and bays now only sparsely fished, if at all. Except on the immediate coast, fishing is limited to a few fishermen who venture out in their cranky cayucos to catch pargo (snapper) and mero (grouper). The limitations of the fishing craft and gear used are great.

There are a number of unused resources but the development of each calls for technical guidance, modern machinery, and the outlay of capital.

Sharks are practically unutilized even though they occur in large numbers. Some interest has been shown in developing such a fishery, primarily for liver oils.

Bottom fish, such as red snappers and groupers, have borne most of the brunt of hook and line fishing but there are numerous areas where these fish can be taken in abundance.

Shrimp are now taken only in the cienagas or lagoons. Larger and better shrimp will doubtless be found along the coast in deeper waters.

Sardines, anchovies, and other herring-like fishes appear to be abundant and probably could furnish a good deal of fish with proper production methods.

The offshore pelagic fish such as tunas, dolphins, swordfish and others may be available to Colombian fishermen. Certainly the schools of kingfish and Spanish mackerel along the coast are now used to a very limited extent.

Shorefishes such as snook, mullet, croakers and others are now taken to some extent but not nearly to the limit of their possible yield.

Indeed, it may be said, that with the exception of certain very limited intensively fished regions, the entire coast of Colombia has unused fishery resources of one kind or another. Their development awaits only the need for the products they can supply.

Potential Markets

There appears to be little need and incentive for a concerted effort to enlarge Colombia's fishery industries at the present time. Local food supplies are apparently sufficiently large to meet local demands. Difficulties in obtaining equipment for more modern fishing efforts make such activities impractical during the present emergency. Colombia may well lay plans for the development of use of her fishery resources after the war, however. Other nations would import frozen langosta, or spiny lobster, and fillets and steaks from snappers, groupers, and other fishes. These, catfish, and other species can be salted more effectively and sold on local and foreign markets. Sharks can be caught and the products used in local industries. The west coast might be the site of a cold storage unit for tuna en route to the United States.

It is believed that through introduction of modern gear, operated in conjunction with cold storage facilities and improved marketing facilities, that fresh fish can be made more abundant on the markets and prices can be lowered, thereby making fish more generally available to low-salaried consumers. This development could coincide with a move to build up export trade in special frozen products.

The foregoing projects appear to be feasible to enlarge local industry and income. They would also, particularly insofar as they increase local use of salt-water fishes, improve the nutritional standards of the Colombian diet.

It is suggested as a means of improving the efficiency of the shipment by air of fresh coastal fish to interior points, that fillets be used instead of whole or gutted fish. This would eliminate the paying of high-priced transportation charges on inedible portions of the fish, which cost is ultimately paid by the consumer. The saving in transportation charges should cover filleting costs and permit the choice meat portions contained in the fillets to sell to consumers at a price much the same as was charged for whole fish previously.

GAME FISHING

Captain Tom Gifford, fishing guide of Florida has made a report on the big-game fishing possibilities around Barranquilla. He indicates that tarpon are more abundant in this region than in any other that he has seen. Also, he writes that there should be possibilities for fishing tuna and other game fish offshore. With the excellent hotel accommodations offered in Barranquilla and other conveniences readily available, Barranquilla can probably develop great activity in sport fishing. He writes that "The Fishing off Barranquilla will be divided into three seasons:

December to May - Dry season fishing.

Because of prevailing high winds during these months, the fishing will be done mostly in the large bay east of the city, and in the Magdalena River.

May through August -

During these months the big-game fish of the Atlantic are on the move, and can be caught in waters from two to five miles off shore. Sailfish, blue Marlin and Allison Tuna comprise the largest fish that will be taken. At this same time of year, and on through to December, tarpon fishing will also be very good".

FISHERY ACTIVITIES OF THE COLOMBIAN GOVERNMENT

The Government of Colombia does not maintain any organization dealing with administration and research on marine fisheries. The Ministry of Was has jurisdiction over activities in the field of marine fisheries. In the fresh water fisheries, the Ministry of Agriculture employs a fish culturist and several other employees. A small hatchery for trout is operated near Sogamoso and plants have been made in a number of mountain streams. The Instituto de Fomento Industrial has supported several surveys of the marine fisheries with a view toward establishing modern, large-scale fishery industries.

RECOMMENDATIONS

Colombia obviously has extensive fresh and salt-water fishery resources coupled with a large potential market, both in Colombia and elsewhere. Because transportation systems, handling facilities, and preserving industries have not yet developed to a point where large-scale fish production can be handled, relatively little advantabe is now being taken of the available opportunities. While it is difficult to visualize any great immediate development of the Colombian fisheries, the country can proceed to expand its fish production along modern lines in connection with its national development program.

Since the Instituto de Fomento Industrial in Colombia is the agency most active in promotional work, it is suggested that this Institute establish a definite program to arrange for further studies to determine what steps should be taken to develop the fisheries of the Republic.

Inquiry should be made into:

1. Expansion of the fresh-fish industries, including production, transportation, and marketing phases.

2. Enlargement of dry and salt-fish production and use.

3. Establishment of canneries suitable to local needs and conditions.

4. Establishment of large-scale freezing and cold-storage facilities to handle tuna for export.

5. Production of vitamin potent oils from shark and other fish livers.

THE FISHERIES AND FISHERY RESOURCES OF PANAMA

INTRODUCTION

The fisheries and fishery resources of Panama were studied as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in Panama consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service.

The Mission, in its survey during July 1942, confined its activities to the Canal Zone and to contiguous parts of the Republic, for it is here that the greatest unfulfilled demand for fish exists.

The Republic of Panama, because of its location, is important in any consideration which affects the Caribbean area. With a long coastline on both the Pacific and Caribbean sides, its fisheries should be able to produce abundant fish not only for local consumption in the Republic and in the Canal Zone but also for export. That the fisheries of Panama have never produced sufficient fishery products to take care of even local demands in spite of vast resources is a fact and a challenge.

Note:

As in other countries visited, the assistance of various individuals aided greatly in the work.

The Ministry of Agriculture and Commerce of the Republic of Panama through its head, Dr. Ernesto R. Febrega; First Secretary, Sr. Julio E. Huertematte; and Sr. Genaro Martinez,Jr., Chief of the Section of Mines and Fisheries, assisted the survey in many ways.

Officials of the United States Embassy aided in arranging for interviews with Panamanian officials and in other ways.

For making field work possible, acknowledgment is made to the United States Navy.

A great deal of valuable informationwas obtained through the officials of the Panama Canal.

To all the above and to many others, the Mission extends its thanks.

FISHERY RESOURCES

Character of the Coasts

Panama has long coastlines, both on the Caribbean and on the Pacific. On the Caribbean side the coast extends about 480 miles from the Colombian border, at Cape Tiburon, to the Costa Rican border at the Rio Sixaola. The Pacific coastline extends from the Colombian border, near Point Cocalito, to the Costa Rican border at Burica Point—a distance of about 770 miles.

Caribbean Coast

From Cape Tiburon the shoreline trends northwestward to Brava Point, thence almost due westward to Manzanillo Point. From Manzanillo Point it courses west-southwestward to Buppan Bluff and then north-westward to the Costa Rican frontier. The shape of the coastline, then, is like an "S" when viewed from east to west.

The coastal characteristics are quite varied. In some sections there are miles of sandy, surf-swept beaches; and in other areas the shore is faced with high cliffs. Some sections are impenetrable mangrove swamps. Coral ledges, reefs, and heads are common for practically the entire length of the coast. There are many isolated rocks and a few islands.

From Puerto Escoces to San Blas Bay, a distance of about 100 miles, there are many small cays and rocks. The Mulatas Archipelago and Holandes Cays in this section sweep around to the northwestward and westward at a considerable distance from the main coastline. The cays are mostly low, flat, sandy, and thickly wooded; they lie in clusters, separated by navigable channels leading to secure anchorages all along the shore. Some of the cays have springs of good water and convenient spots for landing and careening small craft. Holandes Cays, the principal off-lying cays, are about seven miles in extent and their eastern end lies about 18 miles eastward of San Blas Point.

The Gulf of San Blas is six miles wide at the entrance and it indents the shoreline about six miles. Numerous creeks and rivers discharge into the Gulf but their entrances are obstructed by bars. There are a number of small islands off San Blas Point—among them is Porvenir, a famous tourist attraction. From San Blas Point to Colon there are a number of small bays and coves and also some small isolated rocks and shoals. There has been some commercial activity in this region in connection with planting coconut palms. Limon Bay is the Caribbean entrance to the Panama Canal. Cristobal-Colon, on this Bay, is the principal population center on the Caribbean coast of Panama. From Limon Bay, the coast is fairly regular with sand beaches, rocky areas, and cliffs. Off the shoreline are numerous small ledges—in places forming a barrier reef. Between the Chagres River outlet (near Limon Bay) and Punta de Coaita (8° 48' N. 81° 15' W), a distance of about 80 miles, a heavy surf breaks continually and there is no sheltered anchorage and no safe landing, except in native boats under favorable circumstances and at spots known to coasters and fishermen. Mosquito Gulf is a shallow bight taking in most of the coast from Plantation Bay to Cape Valiente. It offers no protection for it is open for the entire distance. An island, Escudo de Veraguas is located in the western part of the Gulf and this is almost surrounded by a small bank with heavy coral growth.

The Chiriqui Lagoon, a large indentation on the coast, is 30 miles in length from east to west, 12 miles wide at the center, five miles at its eastern end, and 10 miles at its western extremity. It offers secure anchorage for all types of vessels. Tiger Channel, the main entrance, is open to the northward and is three miles wide between Toro Cays and Water Cay; southward of this line the shoals are numerous and the deep channels between them are comparatively narrow, but there is no bar. The shores of Chiriqui Lagoon, for the most part, are low and swamp but there are a few sandy beach areas. The north side of the Lagoon is fringed with detached shoals and coral heads. A number of creeks enter the Lagoon and some are navigable for small canoes. Chiriqui Grande is the principal settlement and there are

narrow-guage railroads used in connection with the banana plantations in the region. The only developments are those of large fruit companies. Depths in the Lagoon run to about 20 fathoms.

Almirante Bay is northward of the western end of Chiriqui Lagoon and it extends about 15 miles from east to west, and 13 miles from north to south. The shores are very irregular and numerous islands lie in the southeastern part. It possesses excellent accommodations for almost any type of vessel and safe anchorages are available. The shores of the Bay are very fertile and have been developed by banana companies. The eastern and western sides are very low, swampy, and densely wooded. Several small streams enter the south-western and western parts of the Bay, but these are navigable only for a short distance by small canoes. Columbus Island, Provision Island, and other smaller islands form the northeast margin of the Bay. Boca del Toro, between Columbus Island and Provision Island is the principal entrance, and the channel varies from 3/4 to 1/4 mile in width, with depths up to 13 fathoms. The town of Bocas del Toro is the capital of the province of the same name and it is located on the north coast of Almirante Bay on a peninsula forming the southeastern extremity of Columbus Island, It owes its importance to the banana shipping trade. Bocas del Drago is a northern entrance to Almirante Bay and it is narrow and tortuous. The town of Almirante is located on the west side of Almirante Bay at the head of Ambrosio Bight. It is the headquarters of the United Fruit Company and is the exporting point for bananas. Narrow guage (36 inch) railroads give some access to the interior plantations. There is a concrete wharf and other shipping facilities.

From Almirante Lagoon, the coast trends northwestward to the border. There is a dark sandy beach, fringed by reefs upon which the sea breaks with considerable violence. The whole of the interior is swampy and there is an extensive fresh-water lagoon called Sansan. This is deep enough for canoes and it is said to connect with the Rio Changuinola (seven miles northwest of Tirbi Point) and the Rio Sixaola (14 miles northwest from Tirbi Point).

The winds and the weather of this coast are affected considerably by the migration of the equatorial belt of calms. This belt reaches its southern-most point in February when it extends along and just south of latitude five degrees north. During the months of January to April, inclusive, this calm belt, although moving slowly northward, remains south of Panama, and the trades blow with great strength and constancy from north and northeast. This period is known as the dry season.

As the belt of calms moves slowly northward, the trades are frequently replaced by calms and light variable winds. The transition month is May, when the rainy season begins. During the latter part of June the trades regain some of their strength due to the increased pressure over the North Atlantic, and, although this effect is quite pronounced over most of the Caribbean, it is very slight in this region.

As pressure over the Atlantic weakens in August and September, calms and light winds are again frequent. Then, as winter approaches, the belt of calms slowly retreats southward to be replaced again by the trades.

Near the coast the prevailing winds are influenced by local land and sea breeze effects. It appears that if the prevailing wind is onshore, as it is over most of the area, it will be strengthened toward midday by the sea breeze and weakened in the early morning hours by the tendency to develop a land breeze. If the prevailing wind is not directly onshore but at an angle with it, the effect may be not only a weakening but also a turning or deflecting of the wind.

For example, at Colon where the coast extends northeast-southwest, all winds are deflected to the west or northwest during the afternoon under the influence of the sea breeze; under the influence of lower temperatures over the land during the night and early morning, northerly component winds will tend to shift through north toward northeast and southerly winds will back through southwest and south through southeast.

During the middle of the rainy season, westerly winds are frequent along the coast. These winds are known as "vandavales". In general, wind velocities are highest during the dry season, a secondary maximum appearing usually in July.

Tropical cyclones do not visit this coast, but the persistence of southerly winds seems to indicate the formation of these storms to the north.

The region lies near the thermal equator and, therefore, the annual range in temperature is small. April is the warmest month and November the coolest.

Annual precipitation is heavy and most of it falls during the rainy season, May to December, but in extreme western Panama the rainfall is heavy at all seasons. The greatest frequency of thunderstorms and the greatest amount of cloudiness occurs during the rainy season.

At Cristobal, the mean annual temperature for 27 years is reported as 80 degrees F. with a maximum mean of 85 and a minimum mean of 76. There is a diurnal range of six to 10 degrees F., being smaller in the dry season. The mean relative humidity for 29 years is 83 per cent, the most humid months being from July to November. The average amount of rainfall shows a mean for 65 years of 129.06 inches with the greatest amount in November (22.25 inches). There was an average of 230 rainy days per year as calculated from readings of 28 years. During the dry-season, winds have an average velocity of about 15 knots, but frequently exceed 20 knots for considerable periods. In the rainy season, the average velocity is about eight knots, but winds of greater velocity may be experienced during the passage of local rain squalls.

The Caribbean coast of Panama lies in a deep bight and the equatorial current does not affect it since it cuts across the mouth of the bight from off the Goajira Coast to off Cape Gracias a Dois. The countercurrent from the north passes the Panama coast fairly close inshore, and continues along the Spanish Main. It acquires its greatest force between Manzanillo Point and Farallon Sucio, is reported to run at a velocity of 3-1/2 knots at times, and generally sets to the northeastward. However, wind shifts cause irregularities in the force and direction of the flow so that the currents on this coast may be found to be quite irregular at times. Local currents are sometimes encountered and these may form eddies and other localized phenomena. In general the countercurrent is found close inshore and it usually has an eastward drift.

Tides are almost inconsequential. The mean rise and fall is about one foot and the greatest variation, about two feet, is at Cristobal. The height is affected more by the wind than any other factor.

The edge of the 100-fatham line is at relatively short distances off the coast. At San Blas Point it is about four miles off and at Colon five or six miles distant. In the Mosquito Gulf it is about four or five miles off but around Escudo de Veraguas it lies about 20 miles off. Limon Bay, the Gulf of San Blas, Chiriqui Lagoon and Almirante Bay are all within the 100-fathom depth. The average distance offshore averages hardly more than four or five miles and there are no off-lying cays or banks of any consequence except in the Mulatas Archipelago, Holandes Cays, and Escudo de Veraguas. The bottom is predominantly coral mud and sand. There are areas of coral growth and some rocky areas. Heavy mud may be found around river mouths.

Average sea-water temperatures range from 79.6 degrees F. in February to 82.6 degrees F. in October. The changes are due, doubtless, to heating offects of the sun and to winds. The waters of inshore areas are often turbid due to the pounding of waves on the beaches, to the suspended matter carried by the numerous streams, and to the outwash from the heavy rains. At times discolored water and drift may be encountered 30 or 40 miles offshore but usually the offshore waters are clear and blue.

Very little is known of the abundance of fish on the Caribbean coast of Panama although it has been reported repeatedly that the area is quite barren. While this may be true, there is evidence to indicate that considerable supplies of fish may be found around the inshore banks and cays. Possibly the reason for the lack of fishing is to be found in the unfavorable weather conditions, lack of population and markets, poor transportation, and emphasis on commercial agriculture.

Pacific Coast

The entire Pacific coast of Panama lies within the Tropical Zone and the climate is hot and humid with abundant rainfall. The principal climatic factor is the North Pacific high pressure area.

The Pacific coast of Panama runs in a general east-west direction. Starting at Burica Point, the border with Costa Rica, the coast runs northward and then eastward to form Bahia Charco Azul (David Bay). This Bay lies between Punta Burica and Isla Parida 30 miles away and has an approximate extension of 16 miles into the hinterland. The western shore of the Bay is high but the northern shore is low and cut by several rivers. There is a sandy beach. Good anchorage is to be found in the bay and there is deep water close inshore on the western side. Puerto Armuelles in the northwest corner of the bay is quite well sheltered and it has shipping facilities for bananas, coffee, cattle, and other products. A network of narrow-guage railroads connects it with various interior points in Chiriqui Province.

The delta of the Chiriqui River lies in the eastern side of the Bahia Charco Azul northward of Isla Parida. It is formed by a number of small, low islands that entend 17 miles from Boca San Pedro on the west to Boca Chica on the east. These islands are interconnected by entensive shoals which break heavily. Within the islands, the low coast is a labyrinth of small streams and esteros. Small boats may navigate the waters to reach Pedregal which in turn is connected to Ciudad de David by highway and by rail. The largest islands are Isla Sevilla, Isla San Pedro, and Isla Parida. These are well wooded and have grassy areas for grazing cattle and horses. Many smaller islands and rocks practically surround Isla Parida. From the eastern part of the Chiriqui Delta region, the coast trends east-southeasterly for about 25 miles to Boca de Santiago. This coast line is broken by several streams. From March to November there is a south-westerly swell which beats on this portion of the coast. Puerto Nuevo is an estuary formed by the mouths of the Rio Santa Lucia, Rio Santiago and a number of smaller streams. This port is protected in all directions and it affords excellent protection for small vessels with depths of seven to eight fathoms over a mud bottom. A number of islands, mostly wooded, are found in this general area. Small vessels, drawing up to four feet can reach the port of Remedios on the Rio Santa Lucia.

Between Punta Entrada, the southern limit of Puerto Nuevo and Puerto Guarida, at the entrance of Bahia Honda, 23 miles to the south-southwest, the coast is very irregular, being intersected by several rivers and indented by a number of small bays. The principal bays are Ensenada Pajaros, Ensenada Rosario, and Ensenada Monita. All these are open and exposed to west winds. Offshore are the islas Secas and the Islas Contreras--small rocky islands--some of them wooded. They offer secure anchorage for small vessels. Off Bahia Honda are the islands of Medidor and Canal de Afuera, both offering anchorage for small boats.

Bahia Honda is an excellent harbor, for it is deep, safe, capacious, and easy of access. There are extensive mud banks at the eastern end of the bay, but elsewhere, the shores are relatively steep-to. Isla Talon occupies the central part of the Bay. Depths gradually decrease from 20 to 25 fathoms near the entrance to five fathoms eastward of Isla Talon. Much of the bottom is green mud.

Southwest about 15 miles from Bahia Honda is the Isla Coiba, the largest island off this coast. It is about 21 miles long and has a maximum width of 13 miles. The interior is quite mountainous and is forested, but there is some swampland on the west coast. Several anchorages are available but no good harbors exist where shelter from all winds is afforded. The island has been used as a penal station and good water is plentiful. Numerous rocks and smaller islands occur around Isla Coiba. The largest of these is Isla Jicaron which is heavily wooded and high. Westward of Isla Coiba is Hannibal Bank and still further west Isla Montuosa. There are a number of rocks in the immediate vicinity.

The coast between Bahia Honda and Punta Brava, the western entrance point of Bahia Montijo, 20 miles to the east-southeastward is rugged and has several detached rocks lying off it. There are no good bays in this section.

Bahia Montijo is about 17 miles long from north to south and 5 to 14 miles wide. Near the middle of the bay is Isla Leones, and near the head of the bay and along the shores are

several islands. Two large rivers, Rio San Pedro and Rio San Pablo discharge into the bay above Isla Leones; several smaller streams, also, enter and the effluents of these rivers make the waters of the bay muddy. The entrance to the bay is screened by Isla Gobernadora, and Isla Cebeco. Both are high and surrounded by shoals. There is good shelter for vessels in the bay. The bottom is of mud and grey sand.

From Punta Duartes, the eastern entrance point of Bahia Montijo, the coast trends southward to Punta Mariato. There are some isolated rocks and small islands. Small vessels may find shelter at several points, namely Bahia Arenas and near Punta Naranjas.

From Punta Mariato to Morro Puerces, 27 miles, the shore is bold and steep-to. From March to November, it is impossible to land on this coast.

From Morro Puercos to Cape Mala, 29 miles, there are a number of bights. The coast is low and fronted by moderate depths. There are a number of small rocks near shore and a few off-lying islets. There is a fairly extensive area of bank alongshore.

The Gulf of Panama is limited by Cape Mala on the west and Pinas Point on the east. The distance between these points, from east to west is 108 miles and within this line the Gulf recedes to the northward 92 miles. At the head are the bay and city of Panama, Balboa, and the Pacific entrance of the Panama Canal. The Isthmus of Panama encircles the Gulf.

There are a large number of islands in the Gulf. The Islas Mona and Otoque from one group; Tobago, Urava and Tobaguilla another; Flamenco, Perico, Naos and Culebra a third; and the Archipelago de las Perlas a fourth.

From Cape Mala, the coast runs northwestward and thence northeastward to form Parita Bay. This bay has low shores covered with mangroves and is fronted by mud flats. There are a number of small rivers entering it. From Parita Bay the shore trends northeastward to Punta Chame and it is formed by a continuous beach, named Playa Grande, which fronts a low wooded bank. There are extensive shoals all along the coast.

From Punta Chame to Bruja Point, ther is a shoal bay with several outlying banks and rocky islets. There are mangroves along almost the entire coast except where bluffs interrupt. Bahis Chame is nearly filled with large mud banks. Punta Chame is low and sandy. Between it and Cabra Loma Bank there is a harbor with from three to eight fathoms of water. From Chame Point to the head of Panama Bay, shoal water is found and the shore is low and mangrove covered. There are numerous islands and rocks. At the head of Panama Bay is Balboa Harbor and the entrance to the Canal. Balboa offers complete facilities for vessels and is a center of transportation. From the Canal the shoreline passes the harbor of Panama City which is shallow and open. The bottom is mud and there are numerous reefs and shoals. The coastline extends eastward for about 25 miles to the Rio Chepo. Shallows occur all along the shore. The Rio Chepo has the Isla Chepillo at its mouth and is navigable for some distance upstream. There are several small villages in the vicinity. Depths are very shoal in this area with extensive sand and mud banks.

From Isla Chepillo to Rio Chiman, a distance of 32 miles, the coast is low and covered with mangroves. There are several shallow streams. Extensive mud flats, dry at low water, extend from one to three miles from the coast, and outside the flats is a shoal bank with the outer edge about eight miles off. From Rio Chiman the coast trends south-eastward. The rivers of Trinidad and Buenaventura enter the ocean at this point. There are some isolated rocks and islets on the coast. Some areas of shallows occur and the sea beats heavily on them at times.

Bahia San Miguel is 14 miles wide between Punta Brava and Punta Garachine and recedes about 20 miles to the eastward. A flat with five to eight fathoms extends across the entrance. Inside the bay, depths increase. The waters are generally discolored by mud brought down by the rivers entering the bay, and, during the rainy season these streams carry large floating trees which menace navigation. There are numerous islets, rocks and shoals with narrow tortuous channels between them. The bottom is chiefly of mud. The town of La Palma is found inside the bay, on the south side. Two large rivers, the Sabana and

the Tuira empty into the bay. The Tuira is navigable 35 miles upstream for boats of 15-foot draft, during the rainy season.

From Point Carachine the coast is high, bold, and wooded and it trends for about 36 miles in a south-southeastward direction to Bahia Pinas.

Bahia Pinas is formed by a small peninsula and the mainland. It is 1-1/2 miles wide at the entrance and extends 2-1/3 miles to the northward. There is a depth of 20 fathoms at the entrance. The bay gradually shoals to five fathoms at a distance of 1/3 mile from its head where there is a white sand beach.

South of Bahia Pinas is the Bahia Jarque, a large shallow bay with a depth of only about two feet.

From Punta Pinas to Ardita Bay, about 32 miles, the coast is high, rugged, and thickly wooded having deep water close to shore.

Prevailing winds are from the northward and westward, with frequent squalls from the southwest between the months of June and December. In the Gulf of Panama, the winds are regulated by the seasons; the prevalent wind, however, is from the northward. In the fine season, starting in December, the winds are regular and constant, bringing good dry weather. Ti the southward of the Gulf, they blow harder, and off the coast of Veraguas (a province of the Republic of Panama lying between the Isthmus of Panama and the Isthmus of Chiriqui) fresh gales (force 8 Beaufort) in January and February are not uncommon. In April and May, the northerly winds are less regular and more from westward directions, with calms, light sea and land breezes, and occasional squalls from the southwestward. In June the rainy season sets in and the southerly winds become stronger; still the northwesterly wind is mostly found after noon, and vessels sailing from Panama will have, generally, fair wind until south of Cape Mala. Offshore, northward of latitude 5 degrees N. and between longitude 80 degrees and 110 degrees, there is a region of calms and doldrums, accompanied by rains and squalls.

At Balboa the mean air temperature for 29 years is 80 degrees F. with a mean maximum of 87 degrees and a mean minimum of 73 degrees. The monthly means vary but little--from 79 to 81 degrees throughout the year. Mean relative humidity for 29 years is 73 per cent in October and November. The average rainfall for 38 years is 69.72 inches, with the greatest amounts, between 10 and 11 inches, in October and November. A total of 172 rainy days is the average for 22 years of observations.

Tides have a much greater range on the Pacific side. At Cape Mala the spring range is 13 feet and the mean range 10.3 feet. At Isla Iguana (near Cape Mala) the flood tide sets northward and the ebbtide to the southeast. The latter movement is the stronger, expecially between the months of December and June. At Balboa the spring range 12.6 feet. At Bahia Charco Azul the spring range is calculated at about 10 feet and the mean range about seven feet.

The Pacific coast of Panama has a relatively large area of bottom within the 100-fathom line. From Punta Burica to Puerto Armuelles, the coast is steep-to and the average distance offshore is only one to two miles. From Puerto Armuelles the 100-fathom curve trends southeastward including Islas Ladrones and Isla Montuosa. From Isla Montuosa to the west point of Isla Coiba there is a bight about 15 miles wide and extending shoreward (northward) about the same distance. The line skirts Isla Coiba and passes outside of this island and Isla Jicaron and continues eastward to Punta Mariato. Thus, the entire region inside of Isla Coiba and Punta Mariato is less than 100 fathoms in depth. From Punta Mariato to Morro Puerco, the coast is again steep-to with the 100-fathom curve only one to four miles offshore. From Morro Puerco to Cape Mala the distance offshore increases to 10 to 15 miles. The 100-fathom line cuts almost due east from Cape Mala to Pinas Point including all of the Gulf of Panama. From Pinas Point to the Colombian border the line parallels the coast at a distance of only about one mile off.

The oceanographic conditions on the Pacific coast of Panama are fairly well known through the work of Schott, Murphy, and others.

In reviewing their findings, it is emphasized that the Humboldt or Peruvian Current does not affect the waters of the Gulf of Panama for it does not cross the Equator anywhere near the South American mainland, and furthermore, there is always the warm waters of the equatorial countercurrent far out of its normal position.

Schott (1931) figures the oceanic conditions affecting the area under consideration. He shows an area of extensive upwelling in the Gulf of Panama during February and March with a surface temperature of 24 degrees C. within the Gulf. Surface water temperatures gradually increase southward and offshore. Upwelled water flows out of the Gulf past Malpelo Island and is dissipated. Another current flows northward along the coast of Ecuador and Colombia. The equatorial countercurrent water at this time does not extend into the Gulf of Panama or along the Central American coast.

During August and September the situation is completely changed. At this time the north-northeast winds are at the lowest ebb and upwelling has ceased completely in the Gulf. Surface water temperatures of 28.2 degrees C. are found in the Gulf and these gradually drop offshore. Warm equatorial countercurrent water is found along the entire Panama coast. The circulation is from west and southwest into the Gulf of Panama and then northwestwards along the coast. Thus there is a partial swirl or eddy in the Gulf of Panama.

In certain abnormal years such as in 1891, upwelling is intensified within the Gulf and temperatures of 22 degrees C. have been recorded. This cool upwelled water flows southwestward and then westward.

From these findings it is evident that the Gulf of Panama area and contiguous coasts are well provided with nutrient salts, particularly in the winter months. The constant flow and mixing of the waters greatly increases the productivity. From an oceanographic standpoint, the Panama Pacific region should be very rich in marine life.

Species and Distribution

The ichthyology of the Panama region--both on the Caribbean Coast and on the Pacific coast—has been well studied and reported. One of the most recent complete works is by Meek and Hildebrand (1923). In this work all the known species are listed. It is reported that the fishes of the Pacific coast of Panama generally reach a larger average size than those of the Caribbean side and that there is a greater number of species. Thus, 403 species are recorded from the former and only 238 from the latter in the above cited work. This apparent great discrepancy, however, is modified by certain factors which indicate that the actual difference in the number of species may possibly be considerably less when more extensive collections are made.

The fishes of the Pacific coast belong to the North American fauna rather than to the South American even though there is some overlapping of species. Thus, in general, the Pacific Panama fauna appears to range from the Gulf of California to Ecuador and the Atlantic fauna from Florida to Brazil.

There is considerable parallel between the faunas of the two sides of the Isthmus. Meek and Hildebrand list 72 species as common to both coasts. Of this number, 22 are identical and were collected on the coasts of Panama while 48 are regarded as more or less cosmopolitan types. It is concluded that at some period of geologic time, there was a passage available for fish migration between the two oceans. The Panama Canal, however, is not regarded as such a route for purely marine species even though some brackish water forms such as the snooks, mojarras, and gobies could find their way from ocean to ocean.

The following families are listed:

Scientific Name (Family)	Common Name	Remarks
Branchiostomidae	lancelets	not used for food
Orectolobidae	nurse-sharks	
Galeorhinidae	gray sharks	used for food-Panama
Carcharhinidae	ground sharks	" " " "

Scientific Name (Family)	Common Name	Remarks
Cestraciontidae	hammerhead sharks	used for food-Panama
Vulpeculidae	thresher sharks	
Isuridae	mackerel sharks	
Squalidae	dog-fishes	
Pristidae	sawfishes	
Rhinobatidae	guitar fishes	used for food-Panama
Rajidae	skates	
Narcaciontidae	electric rays	
Dasybatidae	sting rays	used for food-Panama
Myliobatidae	eagle rays	
Mobulidae	sea devils	
Siluridae	catfishes	important for food-Panama
Synbranchidae	synbranchoid eels	
Derichthyidae	long-necked eels	
Anguillidae	true eels	
Leptocephalidae	conger eels	
Muraenesocidae	pike eels	used for food
Myridae	worm eels	
Ophichyidae	snake eels	
Muraenidae	moray eels	
Elopidae	tarpons	used at times for food
Albulidae	bonefish or ladyfish	" " " " "
Clupeidae	herrings	important for food
Engraulidae	anchovies	used for food and bait
Synodentidae	lizard fishes	some used for food
Belonidae	needlefishes	" " " "
Hemiramphidae	halfbeaks	" " " "
Exocoetidae	flying fishes	" " " "
Fistulariidae	cornet fishes	
Syngnathidae	pipe-fishes	some used for food
Atherinidae	silversides	" " " "
Mugilidae	mullets	important food fishes
Sphyraenidae	barracudas	" " "
Polynemidae	threadfins	very " " "
Holocentridae	squirrel fishes	occasionally used for food
Mullidae	surmullets	important for food
Scombridae	mackerel and mackerel-like fishes	very " " "
Trichiuridae	cutlass fishes	used for food
Nomatistiidae	roosterfishes	
Carangidae	cavallas or carangs	important food fishes
Pomatomidae	bluefishes	" " "
Rachycentridae	sergeant fishes	used for food
Coryphaenidae	dolphins	" " "
Stromateidae	harvest fishes	" " "
Apogonidae	cardinal fishes	
Centropomidae	robales	important food fishes
Serranidae	sea basses	" " "
Lobotidae	triple tails	" " "
Priacanthidae	big eyes, catalufas	food fishes
Lutianidae	snappers	very important food fishes
Haemulidae	grunts	" " " "
Kyphosidae	rudderfishes	food fishes
Sciaenidae	croakers	very important food fishes
Pomacentridae	desmoiselles	limited use as food
Triglidae	sea robins, gurnards	limited use for food
Uranoscopidae	stargazers	
Scorpaenidae	scorpionfish	
Echeneididae	remoras	

Scientific Name (Family)	Common Name	Remarks
Hepatidae	surgeonfish	limited use as food
Labridae	wrasses	
Scaridae	parrotfishes	
Ephippidae	spadefishes	used as food
Chaetodontidae	butterfly fishes	
Gerridae	mojarras	important food fish
Opisthognathidae	jawfishes	
Cheilodipteridae	cardinal fishes	
Sparidae	porgies	important food fish
Gobiidae	gobies	" " "
Gobiesocidae	clingfishes	
Cephalacanthidae	flying gurnards	
Batrachoididae	toadfishes	
Dactyloscopidae	star-gazers	
Blennidae	blennies	
Cerdalidae	--------	
Ophidiidae	cusk eels	used for food
Brotulidae	brotulid eels	
Bregmacerotidae	--------	
Pleuronectidae	flounders	used for food
Soleidae	soles	" " "
Balistidae	triggerfish	
Monacanthidae	filefishes	
Ostraciidae	trunkfishes	
Tetraodontidae	swellfishes	
Diodontidae	porcupine fishes	
Fierasferidae	Portuguese man-of-war fishes	
Antennaridae	frogfishes	
Ogcocephalidae	batfishes	

While a great many species are found in the markets of Panama, the major portion of the commercial catch is of corbinas (Sciaenids), pargos or red snappers (Lutianids); sierras or carites, Spanish mackerel (Scombroids), meros or groupers (Serranids), crevalles or jacks (Carangids), robalos or snooks (Centropomids), lizas or mullets (Mugilids), and bobos or threadfins (Polynemids).

Around Cape Mala there are occasional sailfishes and marlins with tuna very abundant during the summer months. At Parita Bay, a very productive area, corbinas and anchovies occur in great numbers, and the same is true of Chame Bay. In these areas also, are large supplies of mullet, robalo, jacks and other important species. The Pearl Islands region is very productive. Here marlin, sailfish, jewfish and other groupers, red snappers, croakers, tuna, and skipjack can be taken on a large scale.

Around San Miguel Bay are great amounts of anchovies, corbinas, groupers, snappers, and croakers. Tuna are to be taken in great quantities offshore--as much as 200 to 300 tons per boat in five days.

The Panama region offers habitat of every kind for fishes. There are extensive brackish to fresh-water areas for such species as tarpon, mullet, snook, sawfish, anchovies, grunts, groupers, snappers and croakers. There are extensive beach areas where jacks, weakfish, pompanos, herrings, anchovies, lizard fish, harvest fish, rudderfish, and others abound. Reef areas are rich in groupers, snappers, grunts, and a myriad of others. Spanish mackerel, bonito, sergeant fish, and many more types are found in much of the area. Sailfish, marlins, tunas, dolphins, flying fish and other pelagic species are often found inside the Gulf of Panama. Sharks have a widespread abundance.

All evidence points to the conclusion that the Pacific coast of Panama is tremendously productive and that it could sustain a greatly increased fishing effort. The Atlantic coast

may be productive in some areas but is definitely not as rich in fish as the Pacific side.

A report of the Pacific Sailfish Club reports that bonito, dolphin, Spanish mackerel, marlin, sailfish, wahoo, and tuna are abundant from May to November and most abundant from June to October (the rainy season). From December to April, corbina, pompano, snook, and groupers and snappers are most abundant. Groupers, jacks, roosterfish, sharks, and snappers are available all year around. The variation in water temperatures has a considerable effect on the abundance of certain species such as the Spanish mackerel, mullet and threadfin and on the migratory pelagic fishes such as tunas and sailfish. Greatest catches are taken from March through August.

PRESENT FISHERY INDUSTRIES

In spite of tremendous possibilities for expansion, the fishery industries of Panama have not assumed an important place in the economy of the Republic. Production, handling, and marketing facilities are rudimentary and Panama is almost entirely dependent on imports of fishery products.

The fishery resources of Panama have been subjected to no extensive exploration in the history of this republic. Only her pearl fisheries, now virtually non-existent, were exploited commercially in colonial days when the population in business centers was busily engaged in the concentration and passage of world trade in and through the Isthmus.

The native Indians have always used fish for food and quite a large catch has been taken for years by these people for their home use. On the Pacific coast they still employ brush weirs for this purpose.

The larger communities grouped along the Canal have received comparatively little native fish. A few local fishermen, mostly Indians or blacks, living in coastal villages, supply irregular quantities of Pacific fish to the market in Panama City. Other fishermen from Panama City operate boats and nets in nearby waters. The food supply is further augmented in normal times by fresh fish from the Caribbean brought into Colon by Cayman Island live-well fishing vessels. At the time of the visit of the fishery mission, commerce in fresh fish had declined severely from that of several years earlier.

All local fish is sold fresh. None is salted, pickled, or canned. The demand for fish is so great that there is no surplus from sales of local fish even during times of relatively large seasonal catches. It is reported that never since the Japanese fishermen were ejected from Panamanian waters has fish been abundant on Panama markets. Considerable quantities of frozen fish fillets were being imported from the United States for sale in the Canal Zone commissaries at the time of the Mission's visit and this was described as usual practice. Some fillets from the United States were offered to the retail buyers at prices lower than those of some locally-caught fish.

Rationing of tires was reducing the truck deliveries of Panama fish to the markets. Distribution of fish from Panama City to points of sale along the Canal was unaffected by rationing as this was accomplished by rail.

Imports of fishery products for the Republic for the years 1940 and 1941 averaged $2\frac{1}{2}$ million pounds with a value of approximately 250,000. In terms of raw fish (before processing) these imports represent a total of $7\frac{1}{2}$ million pounds. Exports, including reshipments, were negligible.

Combining imports and local fish production, a normal total for fish consumption in terms of raw fish can be set roughly at 10 million pounds. Comparing this total with a normal population of 632,000 in the Republic, a per capita consumption of 15 pounds per year is calculated. This is the highest average in Central America but it is much less than that of most other areas with similar abundance of nearby food fish supplies.

At the time of the visit of the Mission to Panama, fish were being received in quantities insufficient to meet demands. Hotels, restaurants, clubs, public institutions, the United States Army and Navy, and the Canal Zone Commissaries were competing for the available supply with the civilian population. These organizations were purchasing most of the available supply before it could be offered for retail sale. Consequently, virtually no fresh fish was being consumed by the civilian population. Prices, both wholesale and retail were relatively high, as indicated by the following, July 1942, maximum prices published in the Public Market in Panama City:

	Maximum Wholesale Price per lb.	Maximum Retail Price per lb.
Red Grouper	25¢	35¢
Corbina (drum)	22½¢	30¢
Mackerel, snook, snappers	17½¢	25¢
Other fishes	12½¢	17½¢

Production

Landings of fish in Panama have fluctuated from about 1½ million to 4 million pounds per year. In addition to the landings reported there is a considerable personal-use fishery and a well-developed sport fishery in Panama Bay. The highest production figure (4 million pounds) was attained during the years before 1936 when some 24 Japanese fishermen operated in the Bay of Panama. Since 1936, when these fishermen were prohibited from further operations, the catch has approximated 2 million pounds annually. Restrictions on boat operations, shortages of fishing gear, highly-competitive labor markets, and other war-time factors have forced current production to new low levels--less than 1½ million pounds. The normal value of the catch to the fishermen is about $250,000 annually. The present reduced catch has a value to the fishermen the same or greater than the normal much larger catches because fish prices have advanced sharply. The most important species marketed are Corbinas, drums, pargos, snappers, robalos, snook, sierras, Spanish mackerel, jureles, lizas, mullet, jacks, cojinoas, runners, meros and groupers. In addition to these, sharks, threadfins and many others are taken regularly and appear in the markets. At least 50 species are marketed, depending on the season.

The principal fishing grounds in the Gulf of Panama region are around the islands and in the bays adjacent to the canal entrance, although fishing has been suspended for the duration in this region. Important fishing grounds are located around the islands of Otoque, off Chame Point, on the beach near Chorrera, around Chepillo Islands, in the estuaries of the Bayamo and Chico Rivers, around the Pearl Islands and off Chiman.

These are all within 100 miles of the Panama City market. In other parts of the Republic, fishing is conducted in localized areas to supply local needs.

Distribution

Fish for the Panama market is brought in usually in the boats of the fishermen. In 1942-43 an attempt was made to run a transport vessel for fish, buying the catch from the fishermen at outlying points and carrying it to market on ice. Lack of sufficient supplies of fish has thwarted this development. In 1941-42 the Panamanian Government through the Division of Fish and Mines attempted a fish pickup system by truck, but this failed, too, because of lack of sufficient fish. Some fish is shipped from Panama City to Colon by rail. It is packed on ice in wooden containers. A fish-handling organization in Panama City supplies fresh fish to cafes, clubs, and hotels. The fish is delivered by truck. This organization could handle a considerable volume of business with its equipment but recently the volume of business has dropped off. In July 1942, ice could be purchased at 55 cents per 100 pounds but there was a limited supply. It was reported that additional plants were to be

in operation soon, thus increasing ice production to such an extent that a sufficient amount would be available for packing fish. Cold storage facilities were extremely limited but authorities stated that new construction would release greater amounts of storage space for civilian use. The main markets for fishery products in the Republic and Canal Zone are concentrated and enjoy excellent communication facilities. The problem of distribution of fish is relatively unimportant provided regular and sufficient supplies of fish can be secured.

Fishermen

In July, 1942, it was reported that 529 fishermen were employed in fishing on a more or less commercial basis with others working part time or for their own use. The fishermen are of heterogeneous stock, mostly Indian and Negro mixtures. Even normally, there is considerable competition for labor, so that many of the more progressive fishermen take work more remunerative that fishing in the Canal Zone, or in other fields. At times other racial groups such as Japanese, Spaniards, Portuguese, and Greeks, as well as West Indians have been engaged in fishing.

The economic level of the average fishermen is low and his earnings relatively small.

Boats

All of the boats used in the fishery industries of Panama are small. In July, 1942, there were 214 of various classes. Of small motor boats there were 29. Chalupas or small sailboats numbered about 150. In 1942 a larger fishing-type vessel was purchased and used as a pickup boat.

Most of the fishing craft in use are built locally but these are not particularly good for fishing.

Wind conditions are such in the Bay of Panama that the use of sailing vessels is sometimes difficult. On the Caribbean coast heavy winds and seas render small boats unusable for months at a time.

At La Palma, in San Miguel Bay, small dugout canoes are used occasionally for fishing. These range from 12 to 25 feet in length and are hollowed from a single log. Some are pointed fore and aft—others have square sterns. They have round bottoms and a shallow keel. Paddles are usually used for propulsion but sails are also used.

Sailboats of the felucca type (chalupas) were observed in Panama Bay. These range from 27 to 30 feet in length and are decked, except for a small cockpit. There is hold space for nets and iced fish. These craft are equipped with a lateen-type sail and are double-ended. The rudder is outboard and these little boats are reputedly good sailers.

Conditions for fishing with small craft are more favorable in the rainy season and there is somewhat better fishing. Panama Bay is sometimes choppy, but heavy swells are uncommon. The conditions for fishing are much more favorable on the Pacific side than they are on the Atlantic coast.

Much of the fishing during normal times is done at night. This is done for two reasons; first because it is believed that the nets catch more fish at this time; and second, because the fish must be placed on the markets early, and disposed of the same day in order to prevent decomposition. The fish markets are usually open only in the forenoon.

Gear

The types of fishing apparatus are of the same classes seen elsewhere in the Caribbean. Cast nets are used extensively and are quite successful. Hook and line fishing for bottom

species as well as for surface species is an important activity. Haul seines up to 300 feet in length with 1½ inch stretched mesh in the bag and three inch stretched mesh in the wings are employed. The netting is tarred. Some 35 of these were reported in 1942. Weirs are employed in the esteros and these catch good quantities of fish because of the tidal conditions in Panama Bay. Fish pots made of bamboo or wire are used to a limited extent. Harpoons, spears, and bows and arrows are employed chiefly by the Indians in the lagoons and sheltered waters. No figures are available as to the amount of these types of gear but their use is widespread. A group of residents of Panama attempted, in 1942, to utilize traps for fishing. It was found that chicken wire was the best material for the leads and good quantities of fish were caught. Because of neglect and mismanagement, however, this enterprise was not altogether successful from a business standpoint.

The Japanese fishermen in their operations used handlines in fishing for groupers and snappers and nets for other species. Their activities indicated that such gear diligently used could catch relatively large amounts of fish.

All fishing gear is made up by the fishermen from imported twine and fittings. Such items as floats and sinkers and some rope may be made from local products.

Dynamite has been used to a considerable extent in Panama as it has in many other places. In addition, various vegetable poisons have been used from time to time in certain localities.

POTENTIAL FISHERY INDUSTRIES

The marine resources of the Republic are many and varied. They offer infinite opportunities both for supplying local needs and for export. In a sense all of the fish resources are relatively unused. Some are used to a limited extent — others are not used at all.

Unused Fishery Resources

Many species such as the groupers, snappers, corbina, snook, mullet, Spanish mackerel, and grunts occur in large numbers almost throughout the coastal regions of Panama. While some fishing is carried on to utilize these species in small conveniently-situated areas, by far the greatest fishing grounds are untouched. These species and others of like type can form the basis for an extensive fresh-fish industry with surpluses either frozen or salted or dried.

The tunas, of which there are great numbers, are caught to some extent by tuna-fishing vessels from California. But in this case, also, there are vast resources still unused. These fish, most efficiently used for canning, could contribute much to the economic welfare of the Republic if facilities such as quick-freezing, refrigeration, and canning were available. Ample supplies of bait fishes, nearness to the fishing grounds, a central strategic location and good harbor facilities make the establishment of a Panama-based tuna fishery very logical from every standpoint.

Quantities of shellfish are to be found--among them are shrimp, spiny lobster, clams and crabs. These could form the basis for considerable fishing activity, certainly for local use and possibly for export. The abundance of sharks indicates that success would attend sharkfishing industries. Liver oils, meat, hides, fins, and other products could be derived from these with profit.

There is a lack of fertilizers and stock feeds--not only in Panama but throughout Central America and the Caribbean. Wastes from canneries, salteries, and the fresh-fish trade, as well as specialized fishing operations, would supply raw materials for the operation of reduction plants.

Potential Market

The Republic of Panama itself offers a good market for locally-produced fishery products. In addition the population of the Canal Zone, a relatively high-income group, could utilize greatly increased amounts. Ships transiting the Canal furnish a good outlet of considerable size. The nearby Republics and the Caribbean area as well as the United States would furnish markets for certain items.

Frozen tuna could be shipped to the United States very easily in normal times both to the Atlantic and Gulf coasts as well as to California. Cheaper grades of canned fish might find a ready market in Central America and in the Pacific Islands. Dried and salt fish could be sold in the Caribbean area.

Reduction of imports of fishery products, limiting of supplies of other flesh proteins, and inflation of population have developed a favorable market for sales of fresh fish. If fish were to be made more available, it is presumed they could be marketed in at least the volume used in normal times, were prices retained on the same relative level. During the war, local fish-production projects should also attempt to substitute locally-caught fish for fishery imports normally received, so that there would be no definiency due to shortage of the usual fish in the diet and so that a very minimum of shipping space would be devoted to those imports. Fish might also be substituted for shortened supplies of meats.

It is anticipated further that fish could be distributed in vastly increased volume if it were marketed at prices low enough to be available as regular items of diet for the low-income workers. Such low-priced fish would do inestimable good to the health of the civilian population. While fish at 17½ cents a pound is beyond the reach of even the average wage earner in Panama ($500 per year), except on special occasions, fish at five to 10 cents a pound could become a staple article of diet. If mass-production methods were applied to the fishery for Panama's Pacific fishes, such a lowering of price might easily be accomplished.

The current catch of about 2½ million pounds could reasonalby be increased to 10 million pounds with prices remaining relatively the same as they were prior to the war, and, if prices for certain species were dropped to five to 10 cents per pound, up to perhaps 50 million pounds could be marketed.

The extent of the potential market for fishery products produced in Panama is limited only by the quality of the products and their price in competition with other items. The central location, large supplies, and relatively low-production cost should enable Panama to compete on a favorable basis.

GAME FISHING

For a number of years; the Bay and Gulf of Panama have been popular with game fishermen. Here, under excellent conditions, hundreds of persons have enjoyed this exciting sport. In 1932, the Pacific Sailfish Club was organized and this organization has enjoyed great success. In 1938, there were 184 members, with many others taking advantage of its facilities. This club has put the game fishing in Panama on a true sportsman basis by qualifying the types of gear to be used. It has contributed considerably to the knowledge of certain species. Some 23 sport-fishing boats were owned by club members in 1933 and the number has increased. There has been, in addition, a number of boats of excellent type for charter. The club has consistently publicized the excellent fishing in Panama Bay with great advantage to the Republic.

A publication of the club lists the following species as being caught in Panama Bay by sport fishermen:

A list of fish caught in Panama by sport fishermen

Common Name	Scientific Name
black marlin	Makaira marlina
Pacific Sailfish	Istiophorus Greyi
corbina, white	Cynoscion albus
corbina, yellow	Cynoscion phoxicephalus
corbina, Stolzmann's	Cynoscion Stolzmanni
corbina, Gulf	Cynoscion othonopterus
corbina, striped	Cynoscion reticulatus
cutlass fish	Trichiuridae
dolphin	Coryphaenidae
garfish	Belonidae
ten pounder	Elops affinis
bonefish	Albula vulpes
milkfish	Chanos chanos
Pacific amberjack	Seriola Colburni
rainbow runner	Elagatis bipinnulatus
leatherjacket	Oligoplites sp.
jack crevally	Caranx hippos
common green jack	Caranx caballus
big-eyed jack	Caranx marsinatus
striped jack	Caranx vinctus
blue jack	Caranx medusicola
blue crevally	Caranx stellatus
dorade	Gnathanodon speciosus
thread pomoano	Citula dorsalis
threadfish	Blepharis ciliaris
goggle eye	Hymnis Hopkinsi
bumper	Chloroscombrus orqueta
moonfish	Vomer declivifrons
lookdown	Angyreiosus sp.
palometa	Trachinotus Kennedyi
Spanish mackerel	Scomberomorus sierra
yellowfin tuna	Neothunnus macropterus
wahoo	Acanthocybium solandri
Mexican bonito	Sarda velox
ocean skipjack	Katsuwonus pelamis
black skipjack	Euthynnus lineatus
Mexican barracuda	Sphyraena ensis
papagallo	Nematistius pectoralis
rock bass	Paralabrax sp.
southern jewfish	Promicrops itaiara
parrot rock bass	Paralabrax auroguttatus
leather bass	Dermatolepis punctatus
broomtail grouper	Mycteroperca xenarcha
Colorado grouper	Mycteroperca olfax
spotted cabrilla	Epinephelus analagus
flag cabrilla	Epinephelus labriformis
rose coney	Cephalopholes popino
creole fish	Paranthias sp.
southern creole fish	Paranthias furcifer
deep-water thread bass	Centristhum signifer
enjambre	Petrometopon panamensis
Pacific guaseta	Alphestes multiguttaus
Pacific vaca	Hypoplectrus lamprurus
serrano	Prionodes sp.
squirrelfish	Diplectrum sp.
rhegma	Regma thaumasium

A list of fish caugth in Panama by sport fishermen
(Continued)

Common Name	Scientific Name
soapfish	Rypticus nigripinnis
tripletail	Lobotes pacificus
striped snapper	Hoplopagrus Guntheri
blue and gold snapper	Lutianus viridis
dog snapper	L. novemfasciatus
Colorado snapper	Lutianus colorado
Jordan's snapper	Lutianus Jordani
mullet snapper	Lutianus aratus
spotted rose snapper	Lutianus guttatus
yellowtail snapper	L. argentiventris
Pacific rabirrubia	Rabirubia inermis
snook	Centropomidae sp.

Besides the species named in the preceding table, there are others such as sharks which might furnish sport.

In 1939, 104 sailfish were recorded in the archives of the club and 42 were released after capture. Seven black marlin were also taken. The North American record for black marlin is given as 622 pounds, and this fish was caught in Panama Bay in 1936.

The future for game fishing in Panama is bright. If the commercial fisheries were developed as enthusiastically, they would indeed be great.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

The Republic of Panama has remarkably rich fishery resources that are surprisingly little utilized. Further advantages for establishment of fishery industries are afforded by concentration of population, relatively high average income, excellent transportation systems and comparatively good foodhandling facilities. With the development of modern procedures, a great fishing industry can be established in Panama.

The Panama Canal Zone and the adjacent area of the Republic of Panama is one of the most important strategic areas in this hemisphere. Because of the dependence of the Zone on the Republic of Panama and vice versa, it is impossible to separate the two in respect to the supply, marketing, distribution, and regulation of fishery products. Because of the strategic importance of this area, every possible means must be used to insure a steady supply of food. Wherever and whenever it cen be accomplished, food supplies should be of local origin in order to conserve to the fullest extent shipping space which could be used for other purposes. With tremendous increases in both the civil and military populations and with the difficulties in obtaining shipping space for food commodities, the question of adequate subsistence becomes pressing. In addition, it has become more and more difficult to obtain certain classes of food products from the United States.

Recommendations for Immediate Action

1. That a central food control and production agency be set up to take the responsibility of providing subsistence for the populations in this area.

2. That a fisheries engineer and technologist be an integral part of this agency.

3. That several purse-seine type boats be made available by the Navy for fishing. If this is not possible, then boats of the shrimp trawl type should be procured. If possible, some of the experienced fishing personnel of the Navy should be detailed to assist in training Panamanians in fishing.

4. That such nets, hooks, lines, and boats as are necessary for replacements be made available.

5. That experimental fishing be carried on in conjunction with the commercial activities.

6. That pound nets, purse seines, shrimp trawls, and other modern gear be used in experimental production work.

7. That adequate cold storage and ice capacity be made available to handle fishery products.

Long-Range Recommendations

1. That action be taken to create an industry to supply all needs for fresh fish in the Republic and the Canal Zone as well as to supply requirements of ships transitting the Canal.

2. That salt-fish production be expanded to the point where it will supply the needs of the Republic.

3. That a fish-canning industry suitable for preparing products acceptable to world commerce be established.

4. That quick-freezing and cold-storage facilities be provided for the purpose of storing fresh tuna for canning locally or freezing and storing frozen tuna for transshipment.

5. That various other fish-preserving industries such as the smoking, and filleting of fishery products, and the manufacture of fish meal and oil be established.

6. That docking, fueling, provisioning, and other necessary services for vessel operation be established.

7. With growth of the fishing industries, that governmental services covering fishery statistics, conservation and management of the resources, and technology be established.

A Plan for the Development of the Fisheries of Panama

Suggestions as to how the fisheries of Panama could be developed immediately to meet war-time demands were made in "A Plan for the Development of the Fisheries of Panama" (Lobell and Lucas, 1942). This plan is incorporated in the following recommendations:

Recommendations

It is recommended that:

1. A corporation be formed in Panama.

2. This corporation be manned with the best management and technical staff available and have sufficient capital to commence and continue on a large scale. It is estimated that $750,000 would be adequate for this purpose.

3. The corporation be given special consideration as to its scope of operations (within the limits of military necessity) by the United States Navy, Army, Canal Zone, and Panamanian government authorities.

4. The first activities of the corporation should be to utilize present fishermen and production facilities as well as present handling and distribution units to the fullest extent.

5. The corporation be permitted to carry on exploratory and development programs consistent with the demand for fishery products.

6. The Board of Directors include representatives of both governments and the Army and Navy.

7. High priority ratings be established for essential needs of the corporation.

8. Consideration be given to expansion of the fishery industries beyond the supplying of existing needs of local markets. This, concretely, refers to the handling of frozen tuna for export and to the establishment of canneries, salteries, and other processing units.

Discussion of Recommendations

1. Formation of Fishery Corporation:

It is recommended that a corporation be set up in the city of Panama. This is to be financed with United States and Panamanian funds either from governmental or private sources. The advantages of such an agency are as follows:

a. It will secure adequate cooperation from government and private persons.

b. It will provide a responsible group to cooperate with the United States Canal Zone and military authorities as well as with Panamanian officials.

c. It will give freedom of action which probably would not be obtained if under the direct control of any single government agency, either United States or Panamanian.

d. It will present a public service approach instead of a profit approach, although the agency is planned to be selfsupporting.

e. It would provide for expansion after the war and conservation of the resources under a definite management and development program.

f. It will provide for civilian as well as military food supplies.

g. It would insure efficient management.

h. It will make possible immediate action in securing priority ratings on facilities, materials, and labor.

2. The Staff and Financing:

The most important element of business enterprise in Latin America is management. Management of a fishery corporation of this type requires men of unusual training, experience, and business intuition.

The corporation should be capitalized at the entire amount necessary to meet the full local demands for fish. This will involve an increase of production from the present level of about 2 million to 10 million pounds annually. All earnings of the corporation can be placed in a reserve fund for further expension. The sum of $750,000 is considered adequate to secure the desired increase in production.

3. Essential Operation Privileges:

While a purely private enterprise might find it difficult to operate, a government corporation perhaps could operate with the direct assistance of the United States Navy, the United States Army, the Panama Canal authorities, and the Government of Panama. By "direct assistance" the following is meant:

a. Permission to fish in all areas except where military necessity demands that there be no movement of fishing boats or installation of stationary fishing gear.

b. Except under absolute emergency, the immunity from seizure for boats and other property necessary to the conduct of fishing.

c. Relaxation of such Panamanian and Canal Zone civil regulations as are incompatible with the plan of operations of the corporation.

4. Initiation of the Corporation's Activities:

Existing fishing operations in Panama offer an acceptable beginning point for development. These activities should first be organized to attain their greatest efficiency with present equipment and personnel. Thereafter, the production should be enlarged concurrently with the increased demand and accumulation of facts that would justify the legitimate expansion of fishing effort. It is obvious that expansion must be accelerated as much as possible, but this should come only as a result of technical experience. Therefore, the corporation must initiate a research program. For this purpose adequately trained technicians must be employed in the following capacities: fishery engineering, fishery technology, and fishery economy.

5. Exploration and Development:

Very little is known of the abundance, most efficient means of capture, migrations, and other characteristics concerning the fishes in tropical waters. It is possible that there are large potential fisheries in the Panama region which can be developed. At present, local fishing methods are primitive, adjusted to the capture of a few fish at a high unit cost, and ill-adapted to the taking of most of the migratory species. A logical program of development would determine which modern types of gear and methods of fishing are adaptable for the conditions in these waters. If any of these methods can be used satisfactorily, fish can be produced much more cheaply and in much greater quantity than with the present means.

It is painfully evident that the coasts of the Americas have been thoroughly surveyed by nationals of non-American countries, ostensibly for fisheries exploration. These contacts have led, in some instances, to the granting of fishing concessions injurious to the interests of the Western Hemisphere. A fisheries corporation under joint United States-Panama control would be a wholesome departure and would nullify the reasons for other countries operating within our strategic areas.

6. Board of Directors:

Because the success of this corporation is based on cooperation from other agencies, it is advisable to have these agencies represented on the Board of Directors. It is possible that a part of the Board can be made up of the group suggested in section 3 (d).

7. Priority Ratings:

In view of the importance of this project, the highest possible priority ratings should be established for materials necessary for the initiation and operation of this corporation.

8. Post-War Expansion:

Unlike many other emergency measures, this corporation is not dependent on emergency conditions for survival. Conversely, when normal commerce is re-established, its opportunities for expansion will be greatly increased. Tuna fish, usually transported in fishing boats from the fishing grounds near the Equator to the canneries in California, could be landed and frozen in Panama. From this point they could be forwarded to either coast in refrigerated steamers or canned in Panama. This would increase the fishing efficiency of the boats and would, also, enable the Gulf Coast and Atlantic Coast fish canneries to pack tuna. Many other products, such as frozen fillets, spiny lobster, and fertilizers, and salted, smoked, and dried fish can, undoubtedly, also be produced in any reasonable plan of expansion. A number of these products are already produced in the United States and shipped to Panama and neighboring countries. The local production of these items, particularly fertilizers and cheap food products, will assist materially in the economics and nutrition of those countries.

Prior to the war with Japan, the United States imported millions of dollars worth of products which can, to a large extent, be supplied from Latin America. The location and richness of fishing grounds adjacent to Panama insures that a significent portion of our imports can be obtained there.

THE FISHERIES AND FISHERY RESOURCES OF COSTA RICA

INTRODUCTION

The fisheries and fishery industries of Costa Rica were studied as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in Costa Rica consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service.

During July and August of 1942, the Mission visited practically all of the localities in Costa Rica where extensive marine fisheries are conducted.

For a number of years, Costa Rica has exported fishery commodities to the United States. At the same time, the local consumption of fresh fish has been almost negligible. One of the objectives of the fishery Mission, therefore, was to determine the reasons for the lack of fish consumption in the interior of the country.

Note: The Costa Rican Inter-American Development Commission through its President, Sr. Manuel F. Jimenez Cortez, assisted the Mission in many ways.

The Ministry of Agriculture of the Costa Rican Government aided by procuring background information and by loaning the assistance of an employee to accompany the Mission to Puntarenas.

Mr. Robert Scotten, United States Minister to Costa Rica, and his staff aided in many ways, and Charles L. Luedtke, Agricultural attache, assisted greatly. Consular officers helped collect material at Puntarenas and Port Limon.

The United Fruit Company cooperated with the Mission, particularly in the Port Limon area.

FISHERY RESOURCES

Character of the Coasts

Costa Rica has coastlines on both the Caribbean and Pacific. On the Pacific side the coast is about 360 miles in length and on the Caribbean, about 181 miles. Both coasts were visited by the Mission.

Pacific Coast:--The Pacific coast of Costa Rica extends in a northeasterly direction from Burica Point (the boundary with the Republic of Panama) to Salinas Bay, which it shares with the Republic of Nicaragua. In this stretch of coastline there are a number of large bays. Among these, from east to west, is the Gulf of Dulce, the Gulf of Nicoya, the Gulf of Culebra, Elena Bay and Salinas Bay. In addition, there are several smaller bays, such as Golfito, Ballena, Potrero, Culebra, Potrero Grande, and Juanilla. The only population center of any consequence on the coast is Puntarenas situated on the east side of the Gulf of Nicoya and connected with San Jose and the interior plateau by rail.

The physical nature of the coastline is more or less typical of the Central American Coast. That part of the coast open to the sea is usually sandy beach, sometimes backed by low, swampy, mangrove areas and sometimes by high, rocky cliffs. Numerous small, rocky islands and ledges occur along the coast and in the bays. Further offshore the bottom may be sand or mud mixed with shells. The presence of offshore banks has been reported from time to time but definite information is still lacking. The 100-fathom curve is found at distances from ½ to 30 miles offshore. Within the 100-fathom curve, especially in the Gulf of Dulce, deep holes are found. Thus 110 fathoms is found at the head of the Gulf of Dulce while near the mouth only 10 fathoms is reported. For the most part, however, the depths shelve off gradually to 100 fathoms and then abruptly to 200-1000 fathoms.

Few rivers of any size empty on the Pacific side. The largest are the Rio Tempisque, Rio Viego, Rio Coto, and Rio Esquinas. The spring tides rise 10.8 feet and neaptides, 8.5 feet at Puntarenas.

There are two seasons, the rainy and the dry, the former generally lasting from April to November. During the rainy season, the winds blow from the south-southwest and in September and October often reach gale force, accompanied by heavy rain. During the dry season calms prevail, but in the evening there are often violent "chubascos" which blow from a direction between north and east and are accompanied by heavy rain; these storms seldom last longer than 3/4 hour.

Oceanographic conditions along the coast of Central America are not well known; but in some localities, such as the Gulf of Panama and the Gulf of California, upwelling followed by great production of phytoplankton takes place in certain seasons of the year. It is not definitely known that similar conditions occur in other regions in this general area; but the indications of swift currents, numerous eddies, and rapidly changing conditions would be conducive to thorough mixing and local vertical movements. These should be expected to enhance the productivity of the waters. A further indication of mixing is provided by the range of average surface water temperatures. Off Costa Rica, the coolest water, 80.2 degrees F., is found in November and the warmest, 82.0 degrees F., in May.

The surface waters of the Pacific coast of Costa Rica are derived from the Equatorial Counter Current. This is a somewhat irregular current which sets to the eastward between the northeast trade drift and the Equatorial Current and carries a body of warm water to the coast of Central America. Though the limits of the counter current are imperfectly defined, it appears to be comprised between the Equator and the parallel of 8 degrees N.--its greatest width is never more than 5 degrees of latitude, and it generally keeps between latitude 5 degrees N. and 8 degrees N. The velocity of the current appears to be from ½ to 2 knots. At about 8 degrees N., just outside the 100-fathom line on the Costa Rican coast, the Equatorial Counter Current seems to split. One portion swings northwestward along the coast of Central America, the other moves southeastward and joins a current moving southwestward from the Bay of Panama.

The inshore waters are affected to some extent by the fresh-water outwash from the land, by local mixing around islands and shallows and by local tides and wind conditions. There is reason to believe that the inshore waters are of higher productivity than the offshore waters.

Ecological conditions favor at least three types of fish populations. Offshore, in the clear warm waters, the pelagic types such as tuna, swordfish, marlins, dolphins, and flying fish are often abundant. Inshore, away from river mouths, the sea basses, pompanos, jacks, roosterfish, Spanish mackerel, and others are found in great numbers during certain seasons. In brackish waters, snook, groupers, grunt, mullet, threadfin, snappers, and catfish occur. Their abundance is less affected by seasonal changes.

Caribbean Coast:--On the Atlantic or Caribbean coast there is approximately 131 miles of shoreline extending from the Rio Sixaola to the Rio Colorado, which forms the boundary with Nicaragua. The greater part of the exposed shoreline is low-lying with dark sandy beach. Rocky reefs and coral are found in many places. Back of the barrier beaches, there are considerable lagoon and estuary areas and mangrove swamps. The best harbor is Port Limon--other small coves and estuaries exist, but they are suitable only for very small boats. Along the entire exposed coast there is no protection from the northeast trades, and the continous high surf makes small boat operations hazardous.

A number of rivers enter the sea along the Costa Rican coast. Usually, entrance to these rivers is difficult and dangerous because of heavy swells on the shallow bars. Among these rivers is the Rio Hone near Point Cahuita, and the Limon and Cieneguita Rivers at the head of Limon Bay. At the head of Moin Bay, there is a lagoon lying parallel to the coast northwestward for about nine miles. This lagoon is called the Estero de Moin and a number of rivers enter it. The principal ones are the Bartols, the Blanco, and the Toro. This lagoon is navigable by launches and canoes.

From the mouth of the Estero de Moin the coast trends northwestward for about 65 miles. It is low and densely wooded and is fringed by the usual dark sandy beach. A large part of this coast is backed by a series of lagoons which lie a short distance inland and extend parallel to the shore. Several rivers discharge along this coast. The Rio Mantina is navigable for small canoes but is difficult to enter. The Rio Pacuare discharges about 9 miles further up the coast and has 9 feet over the bar in rainy seasons. The Boca Parasimina is a lagoon entrance near which is the common mouth of the Rios Parasimina and Reventazon. Seventeen miles northwestward of Boca Parasimina is the Boca de Tortuguero, a lagoon entrance near the mouth of Rio del Tortuguero. The Colorado River, southermost outlet of the San Juan River is deep and rapid with a bar depth of 8 feet. It is, however, dangerous of access, for the sea breaks heavily practically all the time. Within the entrance there are two lagoons, Agua Duce Lagoon extends to the northward and Simon Lagoon to the southward.

In general, the entire coast is inhospitable and offers little shelter or possibility for small-boat fishing. The only areas where such fishing might be conducted is in the lagoons or in the few sheltered outside localities.

The 100-fathom curve lies from about 1 to 7 miles offshore. In most places there are depths of 3 to 4 fathoms, $\frac{1}{2}$ mile offshore with the depths gradually increasing to the 100-fathom curve. The bottom everywhere is of light olive-colored mud with coral reefs and rocks in some areas. At all times, a heavy swell rolls in from the northeast and breaks with violence. While good holding ground may be found 3 to 4 miles offshore, there is no protection from the trade winds.

The entire coast is paralled by a southward and eastward setting counter current. This current has its origin near the Gulf of Honduras and splits near Cape Gracias a Dios. The inside branch swings southward along the coast and then eastward to off Lake Maracaibo. The outer branch turns northward off the north coast of Panama and, skirting Roncador and Serrana Bank, joins a branch of the Equatorial Current. The inside counter current runs about 30 miles offshore and its velocity is from 2 to 3 knots in the rainy season. The surface-water temperatures range from 79.1 degrees F. in February to 82.7 degrees F. in September.

The migration of the equatorial belt of calms is of considerable meteorological importance in the region immediately north of Panama. The belt of calms reaches its southermost point in February when it extends along and just south of the 5-degree N. latitude line. During the months of January to April, inclusive, the calm belt, although moving slowly northward; remains south of Panama, and the trades blow with great strength and constancy from north and northeast. This period is known as the dry season.

As the belt of calms moves slowly northward, the trades are more frequently replaced by calms and light variable winds. The transition month along the north coast of Panama and Costa Rica is May when the rainy season begins. During the latter part of June, the trades regain some of their strength due to the increased pressure over the North Atlantic and, although this effect is quite pronounced over most of the Caribbean, it is very slight in the region just north of Panama and Costa Rica.

During the middle of the rainy season, west winds are frequent along the coast from Cabo La Vela in Colombia westward to the Nicaraguan coast. These winds are known as "vendevales". Wind velocities are highest in the dry season with a secondary maximum occurring usually in July.

There is little definite data as to the salinity of the Costa Rican waters. Since there are a number of rivers entering and since rainfall is heavy, it can be expected that the coastal waters are less saline than normal for the open sea. It may also be expected that a considerable supply of nutrient salts is available to bolster the productivity of the waters. Little is known, however, of the actual abundance of fish in this region for weather and sea conditions are such that little or no pelagic fishing is carried on.

Species and Distribution

There are indications that the lagoons support an abundance of fish as tarpon, mullet, snook, threadfins, mojarra, groupers, grunts, croakers, anchovies, and others. Reefs and banks support populations of groupers, snappers, grunts, and other reef types. Possibly Spanish mackerel, barracuda, kingfish, and others can be taken offshore if suitable equipment is used. There should also be shrimp, oysters, and spiny lobster in various localities. Turtle fishing has been carried on extensively, and Port Limon is the center of this activity. Some shark fishing has been done, particularly around the mouth of the Rio Colorado.

From the standpoint of oceanographic and weather conditions, it appears that the best possibilities for large-scale fish production will be found on the Pacific Coast rather than on the Caribbean.

FISHERY INDUSTRIES

Fish has never played an important part in the feeding of Costa Rica. While native coastal populations have relied on fish for much of their food supply and a few fishermen with dugout canoes and simple gear have caught a few fish for commerce, no organized local trade in native fish has ever been established. Costa Rica is an agricultural country that has ample food supplies for its people in its own beef, poultry, vegetables, and fruits. The development of the fishing industry to feed Costa Ricans has never seemed necessary. Agricultural products are both plentiful and cheap.

Distribution

The limited amount of imported fish products utilized is handled through general lines of food wholesaling and retailing. Fish is used for fast days and holidays as prescribed by Church obligations, and salt fish is said to appear for sale in grocery stores only during Lent. Fresh fish is caught for commerce at Pentarenas and Port Limon and is sold locally,

usually without ice, in waterfront stores and by peddlers. In addition, between 600 and 1,200 pounds of fish are iced and shipped to San Jose weekly from Pentarenas. In San Jose this fish is sold in several small stalls in the public market. Little fresh fish, if any, reaches other interior parts of Costa Rica. All transportation is by rail.

Exports

During the past several years, Costa Rica's fisheries for home consumption have been supplemented by the establishment of a comparatively large export fishery. Turtles and tortoise shell have been exported (In 1939, turtles, 163,000 Kg. valued at $8,600 and tortoise shell, valued at $2,197) from Port Limon to United States markets and elsewhere for years, but no large-scale exportation of fish has been undertaken. The establishment of a cold-storage plant at Puntarenas (Pacific side) for freezing and holding tuna for export was accomplished by foreign capital about 1932. Tuna caught in nearby waters were to be frozen solid and accumulated for shipment to tuna canneries in California. Through this plant, there were about 10 million pounds of tuna exported in 1939, the most active year to date. In 1940, about 4 million pounds were exported. Several fishing vessels, usually manned by alien fishermen, were brought in to conduct the tuna fishing. A small tuna cannery has been constructed on adjacent property. This plant canned a limited pack of tuna in 1942, all of which was marketed in Costa Rica.

In 1940, the refrigeration plant was operating to capacity, the limiting factor being a lack of transportation for frozen tuna from Puntarenas to California. Lack of shipping space was still a limiting factor in 1942 and the smaller tuna fishing boats were utilizing their time in shark fishing whenever the plant was full of tuna. The livers of these sharks were being frozen for shipment to the states.

Imports

Imports of fishery products normally amount to 700,000 pounds annually and were composed mainly of canned and salt fish. From this total, converted into whole, fresh-fish equivalents, and combined with an estimated 1 million pounds of fresh fish consumed, it is determined that Costa Rica's 650,000 people use about 4 pounds of fish per person per year. This is a very low average when compared with the rates of consumption for other nations.

Prices

Fixed maximum prices for fresh fish in the public market in San Jose at the time of the trip of the Mission (July 1942) were 1 colon (about 18 cents 1/) per pound for fish with heads attached and 1.20 colones (about 22 cents) for fish without heads. Fresh-beef prices ran from 1 to 1.4 colones (18 to 25 cents) per pound. The fixed fish prices and those for beef are sufficiently high to remove these items from the regular diet of the poorer classes of Costa Ricans.

On the Central Highland, $100 is estimated for the yearly income of the wages earner. The average wage earner in San Jose itself is said to earn about 5 colones (roughly $1.00) per day.

Fishermen catching fish for the fresh-fish trade in both Puntarenas and Port Limon were tied together in organizations that controlled the price to be paid to the fishermen. A price of .30 colon or more per pound of fish in the round was generally agreed upon. Compliance with agreed prices were rigidly enforced, covering the operations of fishermen in or out of the organizations. Rail tariffs from Puntarenas to San Jose were less than 1 cent per pound.

1/ United States currency equivalents are used in this report.

Fishermen

There exist no definite figures on the number of fishermen employed in the fisheries of Costa Rica but the number of full-time workers is doubtless very small, probably not more than 150. For the most part, fishing is carried on as a secondary or subsidiary occupation along with agricultural and stevedoring work. On the isolated section of the coast it is almost entirely a personal subsistence fishery. Most of the fishermen on the Caribbean coast are West Indian negroes who have drifted into fishing by choice. On the Pacific side, the Indian mixtures are most predominant. All the fishermen live on a narrow margin of existence. On the Caribbean coast the seasonal abundance of turtles has provided a cash crop of some importance, and on the Pacific coast a limited development of fresh-fish trade with the interior and the activities of the Pacific Refrigeration Company has bettered the economic conditions of the fishermen somewhat.

The fishermen of the Caribbean coast are not organized into a formal group but informally they have agreed among themselves as to the amount of fish they should land and the prices for which they sell their catch. It is said that this group has taken punitive action on a number of occasions against violators of their agreements.

The United States high-seas tuna fleet calls from time to time at Puntarenas and, in addition, there have been some units of this group based at Puntarenas and delivering tuna to the freezing plant there for processing and delivery to the United States. Formerly, Japanese fishermen had been employed in the operation of a tuna vessel based At Puntarenas. Since the war, however, they have been replaced by Costa Ricans. In 1942, there were a number of fishermen from the United States fishing in Costa Rican waters using vessels of United States registry based at Puntarenas.

It was reported in 1942 that Indians were engaged in shark fishing at Rio Colorado.

Boats

The native fishermen use only the most simple types of boats. On the Caribbean side, these are mostly dugout canoes or cayucos. Oftentimes, they are fitted with sails and at other times they are rowed, poled, or paddled. Probably the total number of fishing craft does not exceed 100.

On the Pacific side, particularly at Puntarenas, boats of better types are used. Small sailboats up to 20 or 25 feet in length are used for fishing for sharks. A few small boats are used to take fish for sale in San Jose. It is reported that small launches are used in fishing, but none was observed.

In 1942, a number of United-States-owned and registered small tuna clippers and purse-seine type vessels were engaged in fishing for tuna and sharks for the Pacific Refrigeration Plant. Another vessel, the Victoria II (formerly the "Amano") was taken over by the Costa Rican Government from its Japanese operators. This vessel was first operated entirely by Costa Ricans and was later leased to California interests and captained by an American citizen and crewed by Costa Ricans. Later information indicates that this boat was lost at sea during the early part of 1943.

There is a shipyard and facilities for construction small vessels at Puntarenas, but the lack of suitable supplies of wood and fittings makes boat building operations slow at this time.

Gear

Fishing apparatus is of simple type consisting primarily of hook and line gear. This basic type is used in handline fishing on or near the bottom, in trolling from small sailboats, and in series in line trawls or "palangres".

Nets are used to a more limited extent and consist chiefly of small haul seines or "chinchorros" and hand castnets, "atarrayas". On the Pacific side, weirs are sometimes

built across the channel of an estuary to trap fish which can be removed at low tide.

Fish pots or "nasas" are used to a limited extent and almost entirely on the Caribbean coast. On this coast, also, the Indians are reported to use spears and harpoons in taking the larger kinds of fish.

The modern tuna-fishing vessels employ the standard live-bait fishing technique wherein the tuna are attracted by small bait-fish ladled overboard, and caught on barbless feather "squids" attached to a short line fastened to bamboo poles. Bait is seined along shore by means of small seines or lampara nets. The shark-fishing boats utilize chain, line trawls equipped with large shark hooks. Bait for these is obtained by harpooning porpoises.

The capture of turtles has been an important fishery for a number of years. Hawksbill and other species come ashore on the beaches not far from Port Limon and are captured and brought to the "kraals" or pounds in Port Limon for holding. In normal times relatively large numbers were shipped to the United States and some to Panama and Colombia. The hawksbill shell fromed a considerable item of commerce at one time for it was sold at good prices in Europe. This shell was used in the manufacture of jewelry and toilet articles. Cayman islanders participated in this fishery, visiting the outer cays. The best turtle season is reported from April to August.

Canning and Preserving

With the exception of a very limited local activity in air-drying surplus catches, the only preserving industry is that at Puntarenas. Here there is a small tuna cannery of the California type, equipped with good machinery of modern manufacture. This cannery is operated in conjunction with the freezing plant. A good pack of canned tuna is prepared and is sold in Costa Rican markets. The capacity is not large, probably about 8 to 10,000 cases per year when conditions are favorable for its operation.

The freezing plant is one of the largest in Central America. It first operated as a service to California tuna fishermen and froze and handled tuna for export. Now it is leased to a large California tuna-canning company and handles the catch of company-leased boats.

The physical structure of the freezer is modern and well planned and constructed of corrugated galvanized sheet steel and concrete. Electric power and ample water are available. There are 3 ammonia compressers of 10" by 10" size giving a large refrigeration capacity. There is storage space for 850 tons of ice and for 450 tons of frozen tuna. Temperatures are maintained at -5 degrees F. in the ice-storage rooms and -20 degrees F. in the sharp-freezing room. The plant is located on a sandy strip of beach facing the Gulf of Nicoya. About 500 yards to the rear of the plant is a channel, the Estero, where an unloading dock is located. Fish are unloaded here into flat cars which run on rails, or into trucks for carrying to the freezer.

The plant was started in 1936 with United States capital and the machinery, also of United States origin, was installed by technicians from the United States. While the plant has had many vicissitudes, it appears that these have not been caused by any failure of the plant equipment. Operated properly, this installation can perform a much-needed and valuable service to the tuna canning and producing industry.

Potential Fishery Industries

While there are probably considerable unused fishery resources on the Caribbean coast of Costa Rica, those of the Pacific coast are greater and more available. Weather conditions and lack of good harbors offer considerable difficulty toward procecuting extensive fishery industries on the Caribbean coast. With the exception of very limited local fishery operations and the activities of the large tuna fishing vessels, the fish resources of the Pacific coast are unused. That there are tremendous possibilities both for shore fishing and for off-

shore fishing is evident, for the coast of Costa Rica has been relatively well explored from a commercial standpoint by tuna fishermen. The Pacific coast offers a number of good harbors and some fairly extensive fishing grounds, particularly in the Gulf of Nicoya. The greatest emphasis thus far has been placed on items of export value such as frozen tuna and shark livers. These activities can be increased greatly because sufficient resources do exist. Perhaps the greatest opportunities, however, are to be found in fishing the shore species for the fresh and frozen fish trade--the catch to be processed in Costa Rica and sold in Costa Rican markets or for export to other Central American communities. Considerable demand exists for dry-salt fish to be sold at reasonable prices. With management, this can be a considerable factor in stimulating the shore fisheries.

Great quantities of mullet, shark, grunts, groupers, snappers, threadfins, snook, sea bass, and anchovies are available along the coastal beaches and in the lagoons and estoros. Doubtless, shrimp occur in considerable quantity.

The Caribbean coast can still supply turtles and spiny lobster for specialty sale. Snappers, groupers, kingfish, Spanish mackerel, and other species occur in some abundance. The lagoons, doubtless, could produce many mullet, snook, tarpon, mojarra, and shrimp. If Costa Rica desires to expand its national fishery industries, the raw material is at hand to do so.

The low cost and abundance of beef and other agricultural products in Costa Rica make it essential that fresh fish be sold at extremely low prices to the consumer in that country if large quantities of fish are to be handled. Prices for all products have been rising recently. However, the fishermen's organizations in Costa Rica continuously ask such high prices for fish that the general rise in prices for foodstuffs probably will not result in increased fishing activity.

It is reasonable to suppose that about 3 million pounds of fresh fish could be marketed in Costa Rica if prices were made sufficiently low to make fish available to the people. To handle the increased volume, it would be necessary to place outlets in many small communities not now having such facilities. Nowhere in Costa Rica is there much urban concentration of people. For this reason, enlargement of the fresh-fish trade would be difficult and costly and, unless large savings per unit of catch could be applied through use of mass-production methods, the enlargement of the fresh-fish trade would be highly speculative.

RECOMMENDATIONS

The coastal fishery resources of Costa Rica are not extensive but the Pacific offshore regions offer considerable promise. There is no doubt that the shore fisheries of both coasts could supply the present and potential fish requirements of the Republic. Excellent transportation is available from both coasts and there is sufficient ice capacity to care for the needs of the fishing industry. If the Republic of Costa Rica desires enlarged fish supplies, they can be provided by the following means:

1. Introduction of methods and gear designed to produce large quantities of fish at low cost. Pound nets, traps, gill nets, and haul seines could be utilized for this purpose.

2. Installation of adequate shore facilities for the collection, storage, and handling of the catch at Puntarenas and other points.

3. Construction of suitable retail marketing outlets in the interior of the Republic.

THE FISHERIES AND FISHERY RESOURCES OF NICARAGUA

INTRODUCTION

The fisheries and fishery industries of Nicaragua were studied as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in Nicaragua consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service. During August 1942, the Mission visited practically all of the localities in the country where extensive fisheries are conducted, with the objective of determing the extent of present fisheries and fishery industries and to evaluate the possible potential development.

Nicaragua is the largest of the Central American Republics having a coastline of about 300 miles on the Caribbean and about 200 miles on the Pacific. Besides this marine coastline, there are two large lakes. Lake Nicaragua is about 92 miles long by 34 miles wide, and Lake Managua is 32 miles in length and 10 to 16 miles in width. In spite of these considerable water areas, Nicaragua produces little fish for its own use or for export.

* * *

Note: The members of the Mission were assisted greatly by the Nicaraguan Inter-American Development Commission under the Chairmanship of Sr. don Rafael A. Huezo. The President of the Republic, General Anastasio Somoza, showed keen interest and made certain facilities available. Col. Dr. Luis Manuel Debayle, Minister of Health, with his great interest in nutrition, aided in planning and carrying out the field work of the Mission. The officials of the United States Legation in Managua, headed by the United States Minister, Mr. James B. Stewart, cooperated in many ways and furnished useful background data. Mr. William Jaquiss, interested in the commercial development of certain fisheries, accompanied the Mission on a field trip to the Pacific Coast and assisted in many ways.

Caribbean Coast: In general, the coast is low lying with sand beaches on the exposed sections. In isolated places, bluffs or cliffs make their appearance but even here there are usually sand beaches. Several large rivers such as the Rio San Juan, Rio Grande, Rio Prinzapolka, and Rio Coco, as well as many smaller streams, enter the Caribbean along this coast. The outer coast is often surf swept and dangerous with innumerable reefs, cays, and shoals, as well as isolated rocks.

Many lagoons which connect to the open sea through channels are found back from the coast. The principal ones are the lagoons of the Rio San Juan, the Laguna de Bluefields, Laguna de Perlas, Laguna de Wounta or Walpasixa, Laguna de Karata, Laguna Tuapi, Laguna Zambo, Laguna Belanona, Laguna Wana, and Laguna Dakura. Besides these, there are innumerable smaller ones. It is possible to travel for many miles along these coastal lagoons by small boat since many are connected by channels. Numerous small streams enter the lagoons, and, in the rainy season, the numerous small streams extend the lagoons ever considerably more area than they occupy during the dry season. The lagoons are very shallow, have mud bottoms, and are surrounded by mangrove swamps.

Very few people live on this coast. The only established towns of any size are San Juan del Norte (Greytown), Bluefields, and Puerto Cabezas (Bragman's Bluff). A few small settlements, isolated except for water transportation, are also found. Indians live in places along the coasts where fishing and hunting is possible.

Commercial development on this coast can be attributed to the activities of var ous fruit companies engaged in banana growing and to shipping, mining, and cutting of mahogany and other woods. Only waterborne and air transportation is available between points on the coast and the interior.

Offshore, from Monkey Point to the Northward boundary, there is a labyrinth of coral reefs, cays, islets, and shoals. The Pearl Cays and the Miskito Cays are the principal groups. The 100-fathom line is found but six miles off in the extreme south. From here, it trends in a northeasterly direction until at the latitude of Cape Gracias a Dios it lies about 95 miles off. The depths throughout are quite irregular with shallow water of 6 to 9 fathoms quite near to the seaward edge. This edge is quite steep-to, dropping 50 to 100 fathoms in a relatively short distance. It is calculated that there is approximately 100,000 square nautical miles of bottom within the 100-fathom curve not including the considerable shallow lagoon areas. The bottom is principally of coral mud, mud, sand, and shells. Heavy clay occurs in several areas. Over a considerable part of the bottom, coral structures are covered by a shallow layer of mud or silt. As mentioned previously, there are numerous rocks, cays, reefs, and shoals.

The chief water movement in this region is southward. This is formed by a countercurrent which originates in the Gulf of Honduras, skirts the Bay Islands on the Honduran Coast, and then swings southward along the Nicaraguan Coast before continuing to the eastward along the coasts of Costa Rica, Panama, and Colombia. The currents and sets on the coast are irregular and not too well known since they are affected by winds and bottom contours.

Over the Miskito Bank, north of the 13th parallel, the normal set is to the northwest, with a drift of 1/4 to 3/4 knot. This is formed by the margin of the Equatorial Current. The set and drift are affected by the cays and bottom contours. Between Kisura Cay and Valpatara Reefs the current has been known to run due north with a drift of 1 knot. Over the Miskito Bank offshore, south of the 13th parallel, the Caribbean countercurrent is found. From the 13th parallel to Cape Gracias a Dios a littoral current sets northward, parallel to the shore with a drift of 1/4 to 1/2 knot.

Immediately onshore the water is often discolored due to the outwash from the land. This region, also, is fairly brackish but the fresh water is well mixed further offshore by surf and current action.

But a short distance offshore, it is sufficiently saline to support coral growth. Still further offshore, the water becomes quite clear during calm periods but roilly during heavy weather. This entire area, particularly in the area of broken bottom, should be quite produc ductive due to the thorough mixing of the waters.

In general, the ecology falls into five groupings:

(a) the lagoons: brackish water, mangrove swamps, and mud bottom

(b) the open beaches: surfswept, sand bottoms.

(c) the coral reefs and cays.

(d) open areas of fairly deep water: surface layers

(e) open areas of fairly deep water bottom: mud, sand, shell, and coral bottoms.

In spite of heavy surf conditions, there is shelter for small craft in many areas. There are, however, few suitable ports for landing or upkeep of vessels.

The northeast trades are the dominant winds on this coast and they are very constant. Tropical storms visit the area from time to time and are most frequent in September and October. The trades are sometimes interrupted by the equatorial belt of calms from June to

October. During the late fall, winter, and early spring, northers sometimes occur along this coast. By the time they reach this area, however, the force is diminished.

Observations by ships on the Nicaragua coast show northeast winds prevailing throughout the year with east winds giving the second highest percentage. The trade wind is of greatest strength and constancy in January and July. September and October are the months of lowest velocity.

Along the coast the winds are lighter with a tendency to blow from the northwest, especially during the winter months. A light land breeze is frequent in the early morning hours.

Rainfall is heavy most of the year although falls are lightest in February, March, and April. During the remainder of the year, there is almost incessant rain, eight out of ten days being rainy at Bluefields. The amount increases from north to south: Cape Gracias a Dios has 90 inches per year; Bluefields, 155 inches; and San Juan del Norte, 250 inches.

Temperature and humidity are high throughout the year, but the heat is mitigated somewhat by the trades. The hottest months are April and May, and September and October; the coolest month is January.

Sea-water temperatures range from a high of 82.7 degrees F. in September to a low of 79.1 degrees in February.

Pacific Coast: The Pacific coast of Nicaragua maintains a general southeasterly direction from the Gulf of Fonseca to the eastern boundary at the head of Salinas Bay, a distance of about 200 miles.

In general, the coast is cliffy, broken by stretches of sandy surf-swept beach and more rarely lagoon and river mouths lined with mangrove swamps.

At the extreme north, the Estero Real, a broad, navigable river, enters the Gulf of Fonseca. The Tamarinda River enters the sea about 30 miles southeast of Corinto and it is navigable for a short distance. There are, also, a few other small rivers and creeks that form lagoons back of the beaches, but these streams disappear during the dry season. The coast is subject to heavy swells and there is little shelter for vessels except in the Gulf of Fonseca, in Corinto Harbor, and at San Juan del Sur. Small craft can find refuge in these places and at a few other places. There are no off-lying islands or banks of any size--only isolated rocks and small shoals close inshore.

The 100-fathom curve lies about 30 miles offshore. The bottom slopes quite gradually. The bottom is predominantly sand, shells, and mud and quite regular in its topography although isolated rocks may occur. The portion of the Gulf of Fonseca within Nicaragua is shallow with the greatest depths not over 8 fathoms.

The population on this coast is very small and almost the only activity in the coastal towns is shipping. Corinto is connected with the capital, Managua, by rail and through Corinto goes practically all the imports and exports of the country's interior.

The dominant winds on this coast during January to March are the northeast trades. Near to the coast, however, the winds are more frequently northwesterly. In the warmer months, from April to September, the equatorial belt of calms lies over the coast and frequent calms, as well as southerly winds, occur. From September to December, strong northerly winds may be felt. An average of five tropical cyclones occur annually during the summer and fall, and thunder squalls are frequent during the rainy season of summer and fall.

The mean air temperature varies little throughout the year. The coastal region lies entirely in what is known as the hot temperature zone or "tierra caliente". There is a slight decrease in mean temperatures from south to north and the diurnal variations also become greater. The Pacific coastal region is, in general, warmer than corresponding latitudes on the Caribbean side.

Rainfall is abundant and there is a well-marked wet and dry season. The rainy season extends from May to November and the balance of the year constitutes the dry season. There is sometimes a decrease in rainfall for several weeks during the summer; this is known as the "veranilla". Average rainfall is between 60 and 80 inches annually. During the rainy season, there are frequent thunderstorms accompanied by gales from the west and southwest. The violent local squalls which occur in connection with these thunderstorms are known as "chubascos".

In the winter, northeasterly and northerly gales of the norther type are experienced. These are called "papagayos" and occur in the coastal waters and in inlets and harbors such as the Gulf of Fonseca, the harbor of Corinto, and in the Gulf of Papagayo. The wind force may be as high as 10 to 12 on the Beaufort scale and the storms may last for a few hours or for several days.

The waters of the coast are tropical and are influenced by the Equatorial Counter Current which drifts northwestward offshore along the coast. It is deficient in nutrient salts and warm. It is doubted that any considerable mixing occurs on this coast to enhance the productivity of the waters. Conditions along this coast, however, are not well known, and it is possible that future research will indicate upwelling. Surface-water temperatures vary from 78.4 degrees F. in February to 82.5 degrees F. in May. This range indicates that there may be increments of warmer or cooler water at certain seasons.

The ecological conditions are of four general types:

(a) estuarine and lagoon: brackish water, mangrove swamps, and mud bottoms.

(b) the open beaches: surfswept, sand bottoms.

(c) open areas of fairly deep water: surface layers.

(d) open areas of fairly deep water: mud, sand, shell, and rock bottoms.

Species and Distribution

Caribbean Coast: The species to be found on the Caribbean coast belong to the typical West Indian fauna, but certain pelagic species such as tunas, swordfish, sailfish, and marlins are probably lacking in the inshore waters.

As far as can be determined, there has been no fishery exploration or taxonomic studies made on the Nicaraguan Caribbean coast. For this reason, it is impossible to give a complete, accurate picture of the fish fauna. It is possible, however, to list the general kinds of fish and their probable distribution.

(a) Lagoons: brackish to fresh and super saline, mud and sand bottom, mangrove swamp surrounded. Wide variations in temperature, salinity, and turbidity.

Principal types

tarpon	oysters	mojarras	sawfish
mullets	gobies	threadfins	crabs
grunts	shrimp	groupers	sole
anchovies	snooks	snappers	gars

(b) Open beaches: more normal saline than (a) but slightly brackish at some seasons, sand or shell bottom. Often turbid. Surf.

Principal types

bumpers	pompano	silversides	flounders
seabass	porgies	lizard fishes	clams
sheepshead	grunts	anchovies	moonfish
spadefish	gobies	herrings	rays
blennies	snook	mullet	butterfish
puffers	tarpon	bluefish	barracuda
jacks	sharks	harvest fish	
croakers	sardines	needlefish	

(c) Coral reefs and cays: little, if any, salinity fluctuations from normal, usually not turbid, temperatures constant, depths to 15 fathoms. Bottom of coral, coral mud, coral sand, flocculent detritus. Sheltered and surf-swept areas.

Principal types

wrasses	demoiselles	barracuda	pork fish
moray eels	angel fish	jacks	spiny lobster
groupers	trumpet fishes	cardinal fish	goatfish
hinds	cornet fishes	seabass	croakers
tangs	Holocentrids	grunts	ribbon fish
corvina (Odontoscion)	chaetodons	scorpionfish	blennies
triggerfish	filefish	trunkfishes	threadfins

(d) Open areas offshore, surface layers: normal salinities, temperatures, oceanic circulation.

Principal types

Spanish mackerel	sharks	rays	rudderfish
kingfish	frigate mackerel	anchovies	myctophids
tuna	bonito	halfbeaks	
jacks	scads	flying fish	
barracuda	sardines	dolphins	

(e) Open areas offshore, bottom: depths up to 100 fathoms, banks, mud, sand, shell, rocky bottom. Normal temperatures, salinities.

Principal types

groupers	sharks	pork fish	frogfish
snappers	rays	croakers	batfishes
grunts	Holocentrids	scorpionfish	
eels	cutlass fish	wrasses	
flounders	seabass	filefish	

The above listed groupings are incomplete and possibly inaccurate in some respects, but they are given here as a general outline of species and their distribution according to environment. The abundance, seasonal occurrence, and availability is not known.

On the Pacific side, ecological conditions are somewhat different from those on the Caribbean. Rainfall is much less-- salinities are usually high, even in inshore waters. Lagoon and estuarine areas are relatively limited and there seem to be little or no coral reef or offshore bank or shoal areas. Information regarding the species and distribution of Nicaraguan coastal fishes is sparse, but the species are typical of the fauna from California to Ecuador.

(a) Lagoons and estuaries:

mullets	snappers	gars	sawfish
snook	threadfins	grunts	drums
mojarras	oysters	groupers	anchovies
crabs			

(b) Open beaches:

seabass	mullet	jacks	drums
silversides	flounders	moonfish	roosterfish
sardines	bonefish	rays	grouper
anchovies	lizard fish	sharks	gobies
pompano	snook		

(c) Offshore pelagic:

dolphins	sharks	tuna	flying fish
Spanish mackerel	wahoo	bonito	

THE FISHERY INDUSTRIES

With fishery resources fairly plentiful at all times, fish unquestionably have played an important part in the feeding of the people of Nicaragua in the past. The Indian populations of Central America have a long history as hunters and fishermen. The bow and arrow and spear are reportedly relied on by the many Indians still living along the rivers that flow into the Caribbean Sea.

During recent imes, development of the fishery industries has been very limited. Some trade in fresh fish has been established on a very restricted and sporadic scale from the Pacific coast ports to centers of population along the railroads. What fish does appear in these centers, however, seems to be mostly the product of local streams and lakes of the immediate area. Agricultural products provide the main foods of the people of Nicaragua and fish are used only occasionally as they become available to capture in simple forms of fishing gear. Most of the fish caught are, undoubtedly, utilized by families of the fishermen. It is estimated that the normal commercial catch of fish in Nicaragua totals about 300,000 pounds yearly.

Some home salting and smoking of fish is done by the fishermen, mainly to preserve their own catch for home use.

Imports of fishery products are normally relatively small. In 1940, 75,000 pounds of these items, valued at about $9,000 in U. S. currency were received, and in 1941, 150,000 pounds, valued at about $20,000, arrived. Export trade, mainly in turtles from Bluefields on the Caribbean coast, was valued at $8,000 in 1940 and $7,000 in 1941.

The people of Nicaragua consume less than one pound of fishery products per person per year. This is extremely low.

Salt-water fish are available in small retail stores and from peddlers in the coastal villages. On both coasts, fish sell for the equivalent of 5 cents U. S. per pound. Spiny lobster demands 10 to 15 cents 1/ each. Meat, poultry, and eggs also sell at low prices, but as the average wages of the working classes are low (40 to 60 cents per day), purchasing power for such foods is limited.

Undoubtedly, a factor in the low, per-capita consumption of fish in Nicaragua is the comparatively high duty imposed on imported fishery food products. Dried, salted, and smoked itmes must absorb a charge of 12 cents per kilogram; canned salmon, 14 cents; canned tuna and mackerel, 28 cents; and canned sardines 30 cents.

Fishermen

It is impossible to state, with any degree of accuracy, the number of fishermen engaged in fishing in Nicaragua, but probably fewer than 100 or so are employed as regular, commercial fishermen. On the Caribbean coast, full-time native fishermen are few. Many of the Indians and some of the townspeople may fish for their personal use from time to time or collect oysters for sale. The available market is so small that there has been no great incentive for fishery development. In addition, fishing must compete with labor demands for stevedoring and for the banana plantations. Such organized fishing as is conducted is carried on by fishermen from the Cayman Islands who catch turtles and collect sponges. These may also fish for groupers and snappers which they transport to the Canal Zone in live-well boats. On the offshore islands, spiny lobsters are collected for sale in export markets. At Puerto Cabezas, a group of Miskito Indians supply fish and spiny lobsters to the town at irregular intervals.

On the Pacific side, fishing is a little better developed and there are a few regular, full-time fishermen engaged, particularly at Corinto and possibly in the Gulf of Fonseca. During normal times, however, fishing as a vocation has strong competition from stevedoring and agricultural occupations. More recently, interest in shark fishing and disruptions of shipping has awakened greater interest in fishing. Until a regular demand for fishery products is created within the country, there is little opportunity or excuse to increase the

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1/ United States currency equivalents are used in this report.

number of fishermen. There is little doubt, however, that sufficient number of men who can become good fishermen are to be found in the coastal regions.

Boats

Practically the only craft in general use for fishing are the "cayucos" or dugout canoes. These may range up to 20 feet. They are used not only for fishing but for freighting and transportation. On the beach at Puerto Cabezas, where there was a temporary colony of Miskito Indians, 30-foot sea-going craft were hauled up on the beach. These vessels were of whaleboat type with outboard rudders, and they carried a good spread of sail. The boats were of about 7-foot beam and the sections of V-shape. Altogether, the lines were fine with easy runs. The bowsprits were short and stubby and bent downwards. These boats were not decked but thwarts were arranged for seating and for the mast step.

Cayman Islanders fishing off the coast use larger vessels, up to 40 or 50 feet. Many are equipped with live wells and are good in a sea way. They are usually fitted with a heavy spread of sail and some may have small auxiliary motors. These vessels are built on the Cayman Islands.

On the Pacific side, some small sailboats are used in fishing. These are built locally and, usually, do not exceed 20 feet in length. Here, also, cayucos are used quite universally.

There are no real fishing boat types on either coast—the craft in use being primarily general-purpose types. No definite figures are available as to the number of boats in use for fishing, but it is known that it is small, probably fewer than 75 since the demand for fish in the country is limited. There has been no real incentive to acquire or construct better fishing craft, but this may come with increased interest and demand for fishery products.

Fishing Gear

In common with the type of activity and boats, fishing apparatus is simple. Castnets are used widely along the shores and these are knitted from imported twine. Small beach seines are used on sandy beaches. These are hand made of imported cotton twine. Floats are of native wood and weights are either sheetlead strips or stones. Spiny lobsters are taken with dipnets. The hoop is offset on the wooden handle and the bag is 18 inches to 24 inches in length. The hoop is placed over a likely crevice in the coral and the region explored with a prod. When the lobster is flushed out, it rises and becomes enmeshed in the bag. The net is closed with a lateral sweep and brought to the surface with its contents. Hook and line gear is used quite universally for fishing on banks offshore, in inshore areas, and for trolling. Fish pots are used to a very limited extent. Harpoons and spears are used for fishing, particularly by the Indians. The fish are baited to the surface by means of bait attached to a line. When they appear, the harpoon is thrown. The use of bow and arrow in fishing by Miskito Indians is reported.

Modern shark fishing is carried on by means of the regular apparatus of chain leaders and heavy hooks on a ground line which is buoyed and anchored.

Weirs or "corrals" were reported to be in use in estuarine localities. These are made of stakes and netting and serve to trap the fish on the falling tide.

* * *

POTENTIAL FISHERY INDUSTRIES

Possibilities to enlarge commerce in native food fishes within Nicaragua are restricted by the low purchasing power of the population, low food prices in general, abundance of meat, poor transportation facilities, and absence of fish-handling and marketing facilities. Until some of these factors have been altered, the opportunities for extensive marketing of fresh fish will be severely limited.

Opportunities for the expansion of fisheries depend very largely on the existence of fishery resources of magnitude in Nicaraguan waters. The potentialities of the area are not positively known, but they are such that they justify further consideration if the people of the area desire increased industry, income, and improvement of diet. Marketing facilities throughout the country are suitable for distribution of salt and canned products and could be altered to handle large quantity of fresh or frozen fish.

The possibilities for enlarging the fishery industries of Nicaragua are as follows:

Production

(a) Greater fishing activity on present species in present fishing areas.

(b) Fishing for unused species in present fishing areas by using old or new techniques.

(c) Exploration and development of new fishing areas by old or new techniques.

Nicaragua on its coasts and offshore offers excellent potentialities for any one or all of these.

Processing

(a) Greater use of present facilities and techniques.

(b) Introduction or new or expansion of old facilities and techniques.

Nicaragua lacks adequate facilities but there is justification for establishing them and for development of new techniques.

Marketing

(a) Expansion of present markets.

(b) Development of new markets in the Republic.

(c) Development of export markets.

There are potentialities in large-volume sale of low-priced fishery products and limited sale of medium-priced products in Nicaragua. Handling and marketing facilities would be needed for this trade in addition to necessary producting and processing facilities. Neighboring republics could be supplied with some fishery items.

On the Caribbean coast, opportunities exist in the greater use of the reef and bank fishes such as groupers and snappers, as well as the inshore fishes such as mullet and snook. With increased catches and better markets, both domestic and foreign, it would be necessary to provide processing equipment--freezers, canneries, or salteries. Spiny lobsters, either frozen or canned, would provide an exportable article. Under wartime conditions, it may be quite impossible to accomplish anything because of difficulties in obtaining equipment, but in normal times great possibilities exist.

On the Pacific coast the greatest possibilities lie in prosecution of a tuna fishery offshore. This fishery, however, is a highly-modernized activity, requiring a considerable investment in boats, equipment, personnel, and processing plants. The shore fisheries might be an important factor, too, for supplying fresh fish to the interior via railroad.

An increase in fresh-fish use could be developed by the use of railroad transportation for iced fish to Managua and other interior centers. It is felt that there is sufficient abundance of easily-caught shore fish to take care of these needs. Costs of production, handling, transportation, and marketing, however, must be kept low enough to enable the lower-income groups to purchase fish regularly.

The fishery for sharks offers opportunities, particularly if the flesh is processed by drying or salting. The shark livers can be sold on foreign markets for extraction of vitamin A. A fishery for shrimp can probably be developed with the catch being dried. The development of these new fishery industries, possibly, must await the return of more normal conditions because of present difficulties in obtaining equipment.

Potential Markets

While Nicaraguans like fish, it has never been the principal factor in the feeding of the interior parts of the Republic. The limited coastal populations have been able to procure marine fish either by their own efforts or by purchase from fishermen. The interior population has long used the fresh-water fishes, but the basic protein is land-produced beef, pork, and poultry. Nicaragua is primarily an agricultural, stock-raising country, and Nicaraguans rely on those products for practically their entire diet. There is no doubt, however, that the consumption of fish can be increased if it is sold at reasonable prices. The outstanding problem is whether the relatively limited markets would justify considerable investments in boats and gear.

The Caribbean coast is practically isolated from the rest of the Republic in regard to fish transportation. The limited population already uses considerable fish. It appears that the only outlets for increased production would exist in the export market. It would have to be determined whether such markets can be entered by Nicaraguan-produced fishery products on a profitable basis.

The Pacific coast is in direct rail communication with the largest population centers in the interior. Therefore, any fish to supply those centers would have to come from this coast. There is great demand for frozen tuna and for shark livers in the United States. It is quite possible that Nicaragua could participate in supplying this demand if freezing and storage facilities were available. Corinto could be made the site of this activity.

CONCLUSIONS AND RECOMMENDATIONS

Both coasts of Nicaragua offer fairly extensive fish resources, but the lack of population and poor transportation and handling facilities make commercial utilization of these resources difficult. Large agricultural production has supplied the population with enough proteins to make the establishment of large-scale fisheries unnecessary. With the exception of coastal settlements and the region lying along the railroad between Corinto and the interior, there is little chance that perishable fishery products could be distributed on any large scale within the country.

The chief promise for Nicaragua's fishery development lies in export markets, taking advantage primarily of spiny lobster, turtles, shrimp, red snapper, and grouper. On the Pacific coast, the offshore fisheries can provide the basis for export industries in frozen tuna. The shark fishery might be developed, particularly for vitamin-potent oil and the flesh could be salted and dried for domestic use.

It is recommended that the Government of Nicaragua appoint an officer to assist in the development of fisheries in the Republic and to collect fishery statistics.

THE FISHERIES AND FISHERY RESOURCES OF HONDURAS

INTRODUCTION

The fisheries and fishery industries of Honduras were studied, in August 1942, as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in Honduras consisted of Milton J. Lobell, Fishery Engineer, and Clarence R. Lucas, Fishery Economist of the Service.

During August 1942, the Mission visited practically all of the localities in Honduras where extensive marine fisheries are conducted.

The Republic of Honduras, with a coastline on both the Caribbean Sea and the Pacific Ocean, normally consumes little fish. However, during the visit of the Mission to the country, it was found that an enterprise, employing airplanes for transportation, was regularly supplying fresh fish from the Pacific coast to Tegucigalpa, the capital, at prices less than half those normally charged. In addition, the fish was in much better condition than that formerly sold at irregular intervals. This indicates, conclusively, that large potential markets for fresh fish exist in the interior of the country if it can be delivered in pure condition and sold at moderate prices.

Note: The Mission was assisted in many ways by the Honduran Commission of Inter-American Development under the chairmanship of Sr. don Ignacio Agurcia. Sr. don Jorge Coello, the secretary, and Sr. don Jose Augusto Padilla, vice-president, gave excellent cooperation.

The Diplomatic Mission of the United States, headed by Mr. John D. Erwin, rendered a great service to the Mission through the Legation in Tegucigalpa, and through the various consular offices.

Henry Klapisch, manager of a fishery enterprise, made a great deal of information available to the investigators.

FISHERY RESOURCES

Character of the Coasts

Caribbean Coast: The Caribbean coast of Honduras is the most important in size, population, and development, and it appears to have the largest potential fishing area.

In general, the coast is low and swampy and fronted by a low sandy beach which is often covered by stunted trees and low brushwood. Back of the sandy beaches are many extensive lagoon areas and mangrove swamps. The largest of these lagoons is the Caratasca Lagoon which parallels the coast for about 35 miles and has a width varying from 10 to 16 miles. There is a long shoreline haveing many indentations and islets. A number of small streams enter the lagoon and the depths run from 14 to 18 feet in the deepest part. The lagoon communicates with the sea through a channel which is 3/4 mile wide. Its entrance is fronted by an extensive bar which has depths up to 8 feet. Further to the northwest is Brewer's Lagoon which is connected to the Caratasca Lagoon through branches of the Patuca River. This lagoon has a channel to the sea with depths up to 7 feet. Yuan, Negro, and Criba Lagoon from the next series and then there is Tocomacho Lagoon near Cape Camaron. Several smaller lagoons occur westward of Cape Camaron. These are the Hutago, Lemus, Guaimoreto, and Abarado Lagoons.

There are few good harbors for large vessels but fishing craft could find shelter in the various sheltered lagoons. Puerto Cortez and Puerto Castillo are the best ports.

There are a number of islands and cays lying off the coast. The most important are the Bay Islands; Roatan, Bonacca, Utila, and the Caratasca Cays. The Bay Islands are populated, and they offer shelter for small boats.

Offshore from Cape Gracias a Dios to Patuca Point there is found a great expanse of shallow water with many cays, reefs, and shoals. The 100-fathom line is about 90 miles off Cape Gracias a Dios and about 15 miles off Point Patuca. A number of important banks occur in this section. They include Gorda Bank, Rosalind Bank, Serranilla Bank, Thunder Knoll, and others. This bank area covers a total of about 30,000 square nautical miles, mostly all in depths less than 50 fathoms. Much of the bottom is of sand, coral, pebbles, and there are some spots of mud. Off the bank area the depths increase rapidly. From Point Patuca westward, the 100-fathom line roughly parallels the coast with the average distance offshore being about 10 to 15 miles. Roatan and Bonacca lie outside soundings, but the westernmost island of Utila is just on the 100-fathom curve. The bottom in this section is predominantly mud but there is some sand. A number of rocks and shoals and reefs are to be found, principally close inshore.

The development of this region, from Trujillo to Puerto Cortez is due, principally, to the operations of large fruit companies engaged in banana growing. The population centers of Puerto Cortez, Tela, Ceiba, and Trujillo (to a lesser extent) are banana-shipping ports. Railroads connect Ceiba, Tela, Puerto Cortez and San Pedro Sula in the interior. Airlines connect with Tegucigalpa, the capital, and with British Honduras. Except for this, the Caribbean coast is virtually isolated from the interior and Pacific coast.

The Honduras coastal and offshore regions are affected markedly by currents. Outside of the Bay Islands, the main stream of the equatorial current runs to the west-northwest at its usual velocity of 1/2 to 1 knot, until it approaches the cays and banks in the Gulf of Honduras. Here it is diverted to the north and north-northeast and runs along the coast of Belize and the eastern coast of Yucatan with a velocity of 1-1/2 to 2 knots in the rainy season.

Inside the cays, southward of Belize, a counter current sets southward into the head of the Gulf of Honduras. Thence, it turns eastward, running along the coast within the limits of soundings as far as Trujillo, increasing in velocity during the rainy or summer season. Between Trujillo and Cape Gracias a Dios, the stream along shore is uncertain, both in force and direction. This counter current from the north, which has made the circuit of the Gulf of Mexico, passes through the Yucatan channel under the warm waters of the equatorial current and follows the coast of British Honduras to the southward into the bight, and

then along the coast of Honduras near the shore. It does not appear on the surface until it passes Chincorro Bank, where it escapes from the influence of the warm water of the equatorial current and passes into the cooler regions of the northers.

Around Turneffe Islands, Lighthouse, and Glover Reefs (British Honduras) the current almost invariably sets to the southward, also on the inside passage from Belize to Puerto Barrios, turning to the eastward at the latter point and flowing along the coast inside the 100-fathom curve as far as Patuca Point, where it turns again, following the shoreline to Cape Gracias a Dios. From this point to Gorda Point, it runs close to the shore, inside the 10-fathom curve, and then sweeps to the northeastward along the shore of the Spanish Main.

This current is affected by tides to a certain extent, which have a range of 1-1/4 to 1-1/2 feet, the rising tide setting northward and the opposite tide to the southward and eastward; the current establishing the dominant flow being strongest with the tidal current and weakest against it.

The axis of the equatorial current passes between Rosalind Bank and shoals, past Misteriosa Bank, to the western side of Yucatan Channel, its influence extending far to the westward, particularly when the northwest trades blow strongly. On the shoals, it extends westward as far as Vivario Cays, and thence to the northward of Chincorro Bank, with very little current between the Swan Islands and the reefs outside Belize; but, when the northers have stopped, the surface influence is felt as far as Bonacca and Roatan Islands, where the current turns again to the northward.

These complicated movements increase the difficulty of navigating around the Bay Islands, as the currents are so uncertain. There are further complications with the tides which have a mean range of 2-3/4 feet at Bonacca and 2-1/4 feet at Roatan. As a result of these movements, two eddies, apparently, are developed, one in the Gulf of Honduras, and the other to the northward of Utila Island with counter-clockwise movements.

In midsummer, owing to heat expansion, the equatorial current is strongest and covers the greatest area; in late summer, owing to evaporation, the trade winds are strongest, and in autumn hurricanes occur because of the sudden atmospheric changes. Any of these conditions may cause a deflection in surface movement between Rosalind Bank and Cozumel Island; and, when the current is deflected, it runs directly by the Bay Islands toward the Belize Cays. When it strikes there, it turns to the northward, running strongly toward Cape Catoche and sometimes attaining a velocity of four knots between Cozumel Island and the mainland.

The summer conditions induce greater irregularity in the currents around the Gulf of Honduras and the Bay Islands than those of winter. The equatorial current and the counter current run in nearly opposite directions near the Bay Islands in the summer season, which in itself would cause a whirl in the Gulf of Honduras, and it is further complicated at this point by tidal conditions.

Within the 100-fathom curve, the current is with the falling tide, but at the islands of Roatan and Bonacca the current is with the rising tide and against the other stream. The currents in the Caribbean Sea are generally strongest when the sea is smoothest.

In the winter season, the equatorial current is confined to narrow limits and runs almost directly from Punta de Gallinas to Cape Catoche in an easy curve, while the cool streams from the north, assisted by the northers, flow down the coast past Chinchorro Bank and Lighthouse Reef, through to the Bay Islands, and along the coast to Cape Gracias a Dios.

Average sea-water surface temperatures in the Gulf of Honduras are coolest in February (78.4 degrees F.). They rise gradually to 83.4 degrees F. in September and then drop to the minimums in February. Over the northeast coast and Miskito Bank region, February temperatures of 78.8 degrees F. are the coolest average monthly readings. There is then a rise to September when average temperature reaches 83.2 degrees F. From September on, the temperatures drop to the February minimums.

The winds along Honduran Caribbean coast are easterly throughout the year with a pronounced diurnal variation. In the late night and early morning, calms and light offshore winds are frequent. During the day and into the night, the trades blow, sometimes attaining considerable strength in the afternoon.

Seldom do strong winds blow in the early morning except during the months of November and December. Nearly every year during these months, there are a few days with northerly winds of gale force and with heavy rain continuing throughout the 24 hours.

Rainfall is plentiful throughout the year with a maximum in November and a minimum in March, April, and May. The amount increases from east to west along the coast.

The climate is hot and humid, the temperature ranging from 74 degrees F. in January to 81 degrees F. in May.

The coast is affected to a considerable extent by northers--cool winds from the north of continental origin. These occur only from October to April. They have effects of lowering water temperatures and modifying current and surf conditions. Tropical cyclones or storms sometimes cut into the Gulf of Honduras region and are most frequent in September and October.

The months of best weather for fishing craft occur from February to July, but there are other limited times when good weather for fishing is afforded. During the period of the northers, surf conditions are often very heavy, rendering small-boat operations hazardous in the open sea.

Pacific Coast: The Pacific coastline of Honduras is limited to the northeastern shores of the Gulf of Fonseca--an extension of some 40 miles from the boundary of El Salvador at the Goascoran River to the Nicaraguan boundary between the Rio Negro and the Estero Blanco. Practically the entire region is one of extensive shoals with greatest depths in the channels of about 60 feet. Much of the area is estuarine with low-lying mangrove swamps. There are a number of large bays--among them being Cismayo Bay, San Lorenzo Bay, and the estuaries of Rio Pedregal and Rio Bernardo. Tigre Island, on which Amapala, the principal port, is located, is the largest island in Honduran territorial waters on this coast. Much of the inshore area is navigable only with very small craft. There is ample shelter and good anchorage, and Amapala is rated as a good port.

Land and sea breezes blow regularly from the end of February to the beginning of May. The former are light, and blow from early evening until morning from northeast and from north-northwest. The sea breezes set in about 11:00 in the morning and last until about 8:00 in the evening, and these blow fresh from south and southwest. During these months, the atmosphere over the land is thick.

During the rainy season, from May to October, the weather is variable with occasional heavy rain squalls from the east, but when the weather is settled, light variable winds prevail from northeast or north-northeast. From October to February, heavy northerly winds may be expected, sometimes lasting more than a week and interrupting all communications by boats in the open gulf. In the intervals, when northerly winds are not blowing, slight variable winds prevail.

Communications by road are available between San Lorenzo at the head of San Lorenzo Bay to Tegucigalpa, the capital.

Tidal currents are often strong with practically no slack water. This causes whirlpools in certain localities. Bottom is chiefly mud with some sand areas.

Species and Distribution

Caribbean Coast: The Caribbean coast is regarded as the most productive because of the extensive lagoons on the coast and the tremendous reef areas to the northeast. The principal types of fish are those of the lagoons and estuaries and those of the reefs. Inshore, pelagic

types are also available at certain seasons. Offshore, pelagic types might be encountered at a considerable distance offshore.

Lagoons and estuaries:

mullet	anchovies	sawfish	jacks
snook	grunts	sharks	groupers
tarpon	weakfish	shrimp	snappers
mojarra	croakers	oysters	

Reefs:

groupers	Pomacentrids	morays	goatfish
snappers	tangs	grunts	carangids
Holocentrids	wrasses	spiny lobsters	

Inshore, pelagic:

kingfish	barracuda	herring
Spanish mackerel	sharks	sardines
carangids	snook	mullet
anchovies	silversides	

The turtles of the region are reported to outrank the fishes in importance. The principal varieties are the loggerhead, the hawksbill, and the green turtle. From March to September, they inhabit the small cays by the thousands while during the remainder of the year, plentiful supplies may be taken in the adjoining waters. The meat of the green turtle is in most demand as food.

Many of the fish species are found throughout the year, but kingfish and Spanish mackerel are most abundant from July to October when they appear in large schools.

The western portion of the coast is not as productive in fish as the eastern section, and reports indicated that fishing around Puerto Cortez was not good during most of the year even though there was some indications of seasonal abundance of certain species.

Pacific Coast: On the Pacific side, the fishing grounds in territorial waters are confined to shallows and to estuarine habitats. Here, mullet, snook, pompano, weakfish, drums, grunts, sharks, rays, seabass, groupers and snappers of some species, cabezon, jacks, and many other species are available in some quantity.

THE FISHERY INDUSTRIES

Only the coastal inhabitants utilize the fishery resources of Honduras. In this country, agriculture is the main producer of food as well as the main industry. Beef is low priced as are other locally-produced meats and eggs. Fish normally enter into commerce on a very small scale. Imports of preserved fishery products, though limited, provide much of the fish consumed in Honduras, imported canned fish being conspicuous on grocery shelves in all communities.

Prior to 1942, trade in fresh fish was confined to coastal areas, although a reported 600 pounds a week reached the capital, Tegucigalpa, by road. This fish, selling for the equivalent of 25 cents* per pound in the round, was usually of poor quality after a slow journey from Amapala on Tigre Island in the Bay of Fonseca. Fishermen reportedly received about 7 1/2 cents per pound for these fish. No other organized marketing of fresh fish existed in Honduras although individual fishermen sold fish locally at all inhabited points on both coasts. Fish at 15 to 25 cents per pound was forced to compete with beef at 10 to 20 cents, and other agricultural products at similarly low prices.

* United States currency equivalents are used throughout.

The total, annual catch is estimated at about 300,000 pounds. Imports, normally, total about 200,000 pounds yearly--more than half of which is canned sardines. The annual, per-capita consumption of fish, therefore, is less than one pound (converted to basis of fresh, whole fish).

Late in 1942, a fish dealer from the United States set up a business of marketing fish in Tegucigalpa that were shipped by airplane from Amapala. This project was yet in its initial stage when observed in September 1942. A house in Tegucigalpa was reconditioned into a market and the 200 to 1,200 pounds received each Tuesday and Thursday were sorted there and iced for advertised sales on Wednesday and Friday. Prices were cut from the usual 25 cents per pound to 12 1/2 cents. A steady stream of customers buying fish were observed. It was reported that supplies were insufficient to supply the demand. Fishermen at Amapala were receiving a reduced price for fish delivered to the collection point but, with fish plentiful in the Bay of Fonseca, they were being better paid than they were formerly because of the greatly increased volume of business. Clams at 7 1/2 cents per pound in the shell and other shell-fish items, also, were being offered to Honduran citizens.

However, this new marketing development was dependent on a highly-speculative type of transportation system that seemed to be established on a tentative basis. It, also, was utilizing, as fishermen, laborers who in normal times are employed as stevedores in loading and unloading ship cargo. The project does, however, demonstrate the favorable public acceptance of fish-marketing developments that provide quantities of good, wholesome fish at comparatively low price. Tegucigalpa, with between 35,000 and 40,000 inhabitants, was immediately and enthusiastically supporting a new fish market that was furnishing products at the rate of 2 1/2 pounds per capita per year. This was accomplished with only one retail outlet and without an established demand for fish.

The manager of this business hoped to raise the volume of sales to 4,000 pounds a week and to produce, also, shark-liver oil and hides.

Fishermen

There is no indication as to the number of individuals engaged in fishing on the Honduran coasts, but estimates indicate that about 200 are employed more or less regularly. Of native, full-time professional fishermen, there are but few on either coast but possibly more on the Pacific side than on the Caribbean. In normal times, the demand for agricultural and stevedoring labor offers greater inducements than fishing. On the Pacific side, where shipping is the only industry, fishing becomes more important.

On both coasts, the Indian populations fish primarily for their own needs. This is particularly true on the Caribbean coast. The fishermen have never developed any extensive commercial fishery because transportation and handling facilities are lacking.

The Miskito Bank area, however, has for years been visited by fishermen from the Cayman Islands. Their chief activity was turtle fishing and their catch was carried in their schooners to Florida ports, to the Canal Zone, and to Jamaica. They also collected some spiny lobsters and caught groupers and snappers both for their own use and for sale in the Canal Zone. The Cayman Island fishermen are reputedly the best fishermen and sailors in the Caribbean, and their knowledge of the waters and fishing conditions in the Western Caribbean is very complete.

The Gulf of Fonseca has been visited by United States tuna vessels in search of bait and, for a number of years, a tuna fishery has been prosecuted offshore by California vessels.

That Honduran fishermen can supply a wider market, if developed, was demonstrated in 1942 when buyers purchased entire catches for forwarding to Tegucigalpa by plane. The fishermen were paid in cash and their catches increased greatly. There are numerous indications that a class of excellent fishermen can be developed in Honduras if sufficient incentive is furnished to compete with labor demands in agricultural and other activities.

Boats

There are no statistical data covering the number and types of craft used in the fisheries of Honduras, but it is estimated that some 100 craft are employed. For inshore fishing in lagoons and estuaries, dugout canoes are the predominant type. Small rowboats and a few small sailboats find use, also. As far as is known, there are no motorized boats in use for fishing in Honduras. Medium-sized sailing craft are used by the Cayman Islanders for turtle fishing and transporting. These vessels are built on the Cayman Islands and are well built and seaworthy. Many are equipped with live wells and a few with auxiliary power.

Fishing Gear

Fishing apparatus is of the simplest types. Castnets are in use on both coasts. Beach seines are used to some extent, particularly on the Pacific side. Only a few fish pots are used. Harpoons and spears are utilized by the Indians in the eastern part of the Caribbean coast. Hook and line gear is used extensively both for bank fishing and, to a lesser extent, in trolling. There is no indication that any modern gear is in use except by the United States tuna-fishing vessels on the Pacific side. Weirs or corrals are used to some extent on the Pacific side in the various "esteros".

All of the fishing gear is assembled by the fishermen--usually from imported material.

POTENTIAL FISHERY INDUSTRIES

The operation of the new fish market in Tegucigalpa demonstrates that there is a ready market for fresh, salt-water fish in Central American communities if the fish products are of good quality and priced to compete with other food commodities. The ease with which fish are obtained for this new enterprise demonstrates that fish supplies of some considerable magnitude lie in Honduran waters. Further increases in the volume of fresh fish shipped to Tegucigalpa, undoubtedly, could be made if prices were kept low and the quality good. It appears, however, that the most promising development in this regard would be to utilize truck rather than air transportation from the Bay of Fonseca. The resources could serve the maximum public service through the capture of edible fish supplies on the Pacific side by mass-production methods; storage of large seasonal supplies to maintain a flow to consumers through periods of scarcity of supply; operation of efficient and sanitary transportation units from point of production to point of storage and from point of storage to point of sale; and operation of a number of modern retail distribution units in the centers of population.

Unused Resources

The greatest potentialities for expansion of Honduran fisheries are in the lagoon areas of the northeastern Caribbean coast and the extensive reef areas to the East. Here, there are resources of fish, shellfish, and turtles that have gone practically unused in a commercial sense. The only item of interest in this field has been in turtles. Even though great possibilities in the resources are to be found, the state of development and transportation is such that it is doubtful that much greater use can come until the necessary handling and preserving facilities are available and until a market can be developed. It is extremely doubtful that the local market could use enough fish to make any great development worthwhile, yet there is reason to believe that the coastal area and San Pedro Sula with its contiguous area could support an increased production of fish. Until the interior can be reached by relatively inexpensive transport means, it is possible that the greatest markets will be provided outside of Honduras.

The abundance of groupers and snappers, both high-quality fish, indicate that live-well boats could be used for transport either to Honduran coastal ports, to Jamaica or Cuba, to the Canal Zone, and to the United States. Vessels of the type used on the Campeche Banks

could be used with great advantage in this activity. Good possibilities for a salt-fish industry along the coast exist, and this product could find a ready market not only in Honduras but also in other Caribbean areas. For the war period, developments will probably have to be confined to fresh fish and to salt-fish activities.

Under normal conditions, possibilities of canning sardine, shrimp, and spiny lobsters are present. Freezing of spiny lobsters, fish fillets, and other specialties has large potential promise. There is evidence indicating that a small industry could be established for the reduction of fish into meal and oil.

On the Pacific coast, possibilities for fishery expansion also exist. With improved transportation facilities to interior population centers, the fresh-fish trade could be expanded further. Operations for salting surplus catches should be successful for sale in interior markets.

Since Honduras has access to the open sea, there is a chance to participate in the wealth of the tuna runs of this region. Since, however, these operations require large capital investments, great technical skills, and the establishment of special facilities, it is felt that any development along this line would be quite impossible during the War and should be scrutinized in detail even in normal times.

It is evident that large unutilized resources exist in Honduran waters. It is doubtful that sufficient demand exists in Honduras to justify extensive operations, even though larger amounts of fish could be sold. After the War, possibilities will be great but will depend upon, to a large extent, the available markets for the produce. If such markets are available, facilities for handling and transportation, as well as for production, must be established.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

Honduras is primarily an agricultural country with practically no highways or railroads. The Republic has very few facilities for the distribution and sale of perishable articles with a result that each locality has to supply its local demands for such goods. Wage scales are low except on the northern coast, and purchasing power remains very low.

Until recently, fishing activities were confined almost entirely to personal-use operations. On the north coast, however, where regular and more lucrative employment was to be had, most of the fish consumed was brought in from the offshore islands. Very little, if any, fresh fish finds its way into the interior.

Inasmuch as local food-production is sufficient and the present fishery methods are capable of supplying the local demands, emergency measures are unnecessary.

With the return of normal conditions after the War, it is believed that Honduras might develop an export fishery based on the spiny lobster of the north coast and tuna on the south coast.

It is suggested that the Government of Honduras give consideration to the appointment of a fishery officer whose duties would include collection of statistics of fish production and preparation of reports on various phases of the fishery industries.

THE FISHERIES AND FISHERY RESOURCES OF BRITISH HONDURAS

INTRODUCTION

The fisheries and fishery industries of British Honduras were studied, in August 1942, as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service, and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in British Honduras consisted of Milton J. Lobell, Fishery Engineer, and Clarence R. Lucas, Fishery Economist of the Service.

British Honduras is a British Crown Colony on the Central American mainland. The population is very small and practically all concentrated on the coast. The waters of British Honduras are studded with reefs and cays, and there is every indication that fishing would be successful. The Mission visited Belize, the capital, in August 1942, to determine the condition of the fisheries and to appraise the possibilities of expansion if this were desirable.

Note: The Mission acknowledges the great interest and assistance of Mr. Thomas Masson, the Collector of Customs of the Colony, and of Mr. Culver E. Gidden, American Vice Consul stationed at Belize. The latter has prepared an excellent statement of the fisheries of British Honduras and this is drawn upon in the preparation of this report.

FISHERY RESOURCES

The Character of the Coast

The Colony of British Honduras has a coastline only on the Caribbean. It extends northward from the Guatemalan boundary at the Sarstoon River to the Rio Hondo, the Mexican boundary. The coast is approximately 200 miles in length, disregarding the numerous bays and lagoons, islands and cays. Much of the coast is low-lying and backed by extensive mangrove swamps and lagoons. For considerable stretches, there is sandy beach. Just back of the beach, there is often extensive brushwood areas, and further back, lagoons and swamps. On the higher lands are scrub pines and other trees. A number of rivers and creeks enter the sea on this coast, but most are navigable only for small flat-bottom boats or canoes. Usually the bars at the entrance are shallow and obstructed by sand bars. The banks are often indefinite mangrove-swamp areas and there are numerous creeks extending in all directions. The principal rivers are the Sarstoon, Sibun, Belize, Rio Nuevo, and Rio Hondo, but there are many smaller ones. Extensive lagoon areas, many unnamed, are found along the coast. One of the largest is the Placentia Lagoon, which extends for about 10 miles parallel to the coast.

The edge of the bank of soundings, to the depth of 100 fathoms, fronting the head of the Gulf of Honduras, is about 20 miles offshore abreast Negro Head; thence, its edge trends north-northeastward for 35 miles to a sharp elbow named Gladden Spit, distant 22 miles from the mainland. Here it curves northwestward and northward to another elbow, 34 miles distant, and 15 miles from the coast; whence, it continues its northerly direction for 50 miles to Ambergris Cay at the entrance to Chetumal Bay.

The whole of the line is skirted at the very edge by small, low cays and reefs which are of dangerous character and which in most parts have a heavy surf.

Within the cays and reefs is the Inner or Main Channel, the southern approach to Belize. Most of the Cays here are small and bare and are composed of coral, rock or sand. Some support palm trees and grush, others have mangrove growths. A few have fresh-water wells available. The cays are often frequented by fishermen for fishing and drying their catches.

Outside of the 100-fathom curve are Glover Reef, Lighthouse Reef, and Turneffe Cays. These are each practically surrounded by a barrier reef, but small channele are available to small boats. The bottom is chiefly of coral, coral sand, and coral mud around the reefs. Closer inshore, there are large expanses of mud bottom, and in some areas sandy bottom. The river mouths may be mud or sand, depending upon the degree of washing.

Prevailing winds are from southeast to east; they blow from the middle of February until the end of September, increasing in strength about the end of February. North, northeast, and northwest winds blow from the end of September to the middle of February. The northwest winds, however, blow for only about 20 days. Northers occur mostly in November and December, though they are occasionally experienced as late as the end of February, but they never blow at a force of more than 4 to 5 (Beaufort scale), the weather being as a rule fine and cool with them. Gales occur during the summer months, and are generally from the southeastward. Calms are almost unknown and south and southwest winds are rare.

The mean range of tides at Belize is 1.2 feet with a spring range of 1.5 feet. These tides are much influenced by wind. Easterly winds have the effect of raising the water, northerly winds cause it to fall; directly the wind comes to the northward of east, a set to the southward ensues, which sometimes attains a velocity of 1-1/4 knots. In the winter months, when the northers blow, there is a fall at times of from 2 to 2-1/2 feet, at this time there is also a strong southerly set in the offing.

Rainfall is abundant throughout the year, the least coming in March, April, and May. The amount increases from north to south, averaging 52 inches at Corozal and 172 inches at Punta Gorda. The climate would be very oppressive were it not for the prevailing winds which blow off the ocean during the hot months. May to September are the warmest months with an average of 81 degrees F. and December and January the coolest, with an average of 74 degrees F.

Oceanic Currents: The main stream of the Equatorial Current flowing through the Caribbean runs outside of the Bay Islands (Honduras) in a west-northwest direction at a usual velocity of ½ to 1 knot, until it approaches the cays and banks in the Gulf of Honduras. Here it is diverted to the north and north-northeast and runs along the coast of Belize and the eastern coast of Yucatan with a velocity of 1-1/2 to 2 knots in the rainy season.

A countercurrent from the north, which has made the circuit of the Gulf of Mexico, passes through the Yucatan Channel under the warm water of the South Equatorial Current and follows the coast of British Honduras to the southward into the bight, and then along the coast of Honduras. It does not appear on the surface until it passes Chinchorro Bank, where it escapes from the influence of the warm water of the South Equatorial Current.

Around Turneffe Islands, Lighthouse and Glover Reefs, the current almost invariably sets to the southward, also in the inshore passage from Belize to Puerto Barrios, turning to the eastward at the latter point. This current is affected to a certain extent by the tides which have a range of 1-1/4 to 1-1/2 feet, the rising tide setting northward and the opposite tide to the southward and eastward; the current establishing the dominant flow being strongest with the tidal current and weakest against it.

The South Equatorial Current is strongest and covers the greatest area in midsummer. In the winter season, it is confined to narrow limits and runs almost directly from Punta de Gallinas (Goajira, Colombia) to Cape Catoche (Yucatan) in an easy curve, while the cool stream from the north, assisted by the northers, flows down the coast past Chinchorro Bank and Lighthouse Reef, then to the Bay Islands and along the coast to Cape Gracias a Dios. Surface-water temperatures vay from a minimum of 78.4 degrees F. in February to a maximum of 83.4 degrees F. in September. The inshore waters are often turbid due to outwash from the land. Further offshore, however, the waters are clear and blue.

Productivity is regarded as comparatively good because of the presence of quantities of nutrient salts in the water and the possible mixing of these waters by the currents found in the area. Lagoon areas are productive of certain varieties, with great salinity tolerances, such as tarpon, shrimp, snook and mullet. The reefs and cay areas support quantities of groupers, snappers, grunts, and spiny lobsters, and there are occasional occurrences of bonito and tuna from the open waters. On the edge of soundings, there evidences of good runs of such pelagic fishes.

Species and Distribution

The principal species appearing in the markets of British Honduras are snapper, kingfish, jewfish (grouper or seabass), Spanish mackerel, barracuda, rockfish, mullet, and bonito. In addition to these, however, are many other varieties. The marine fauna is typically Caribbean and practically every Caribbean family is represented.

In the lagoons and sheltered inshore areas, snook, mullet, tarpon, grunts, drums, threadfins, mojarras, sawfish, some groupers and snappers, jacks, gars, anchovies, herrings, silversides, sardines, and others are found.

The reefs and offshore banks support populations of groupers, snappers, grunts, seabass, and a host of other typical reef species, such as squirrel fish, wrasses, angel fish, tangs, butterfly fish, and moray eels.

In the channels and clear areas, Spanish mackerel, sharks, kingfish, barracuda, runners, bonito (occasionally), halfbeaks, pompano, and other fishes are available.

Offshore, on the edge of soundings and beyond are the tunas, dolphins, flying fish, bonito, frigate mackerel, and others.

Very little is known of the actual abundance and seasonal variations in the populations, but the catches have always been sufficient to supply the needs of the Colony.

Oysters, crabs, and clams may be taken in inshore areas and spiny lobsters on the reefs. Turtles are encountered all along the cays and have been fished for many years. Conchs are abundant and are used locally. Some have been exported to nearby republics. It is reported that groupers abound in the vicinity of Glover's Reef, Cay Gloria, and the Sapodilla Cays, spawning in December and January. Spiny lobsters are most plentiful in the vicinity of Cay Caulker, Ambergris Cay, Glover's Reef, and Turneffe Islands. The greatest abundance of kingfish is found in June outside the reefs. Jewfish occur throughout the waters of the Colony. It is reported that they possibly spawn in May and are exceedingly plentiful in September. Snappers, widely distributed, seem most plentiful in May and June. Barracuda are found in the largest quantities, in the markets, during the months of July and August. Tarpon are abundant and are to be found in March, April and May near the mouths of most rivers.

FISHERY INDUSTRIES

The fresh-fish industry of British Honduras is a very effective unit of local food supply. The comparatively small population of the capital of this Colony lives within reach of the public market. Here, fishermen in sailboats arrive with fish either in containers without ice or in live wells constructed in the centers of the vessels. Fish are sold alive direct from these live wells or bargained for over displays lined up on the bows of the fishing boats, while these craft are moored, nose in, along the waterfront side of the market. Other fish are displayed on a line of stone-topped market tables close to the water's edge.

Fresh fish are usually plentiful in the market and are sold cheaply, costing the consumer 5 to 10 cents (U. S. or British Honduras value) per pound and 7 cents per pound is charged for salt fish. It is estimated that a normal year's sales total 400,000 pounds on this market and that the sales of the entire Colony amount to 500,000 pounds. In addition to this, much fish is consumed by the families of fishermen in the scattered rural population established on the shores of the coast and the rivers. Virtually, all commerce in British Honduras has been waterborne until recently, and the life of the Colony has necessarily become established on the water's edge. In the past few years, good roads have replaced the water courses in the carrying of a portion of the traffic.

Fish for the Belize market are obtained within 15 miles of the mainland coast. Much is taken from the waters surrounding the offshore cays. Considerable quantities are salted and dried on these small islands for the Belize trade. Scattered fishing activity occurs along the Colony's 180 miles of seacoast.

Spiny lobsters are captured to supply a long-established local demand. In 1923 a cannery for preserving these crustacea was established by the Franklin Baker Company. It was thriving in 1925 but has since ceased operations, due, reportedly, to difficulty in getting adequate supplies of spiny lobsters. The canned product was exported. Also produced for export trade were sponges, tortoise shell, shark hides, and alligator hides. Today, export trade in all fishery products is suspended, pending resumption of regular shipping service to the United States and England.

Sponges were cultivated in British Honduras waters; and, in 1933, about 115,000 cuttings were growing around Turneffe Cay. This activity was promoted and fostered by the local Government. In 1935 there were reported to be 300,000 wool and velvet sponges under cultivation. It was estimated that by 1937 approximately 3/4 million sponges could be exported if favorable markets existed. About 1938 a blight struck the sponges of the Bermudas and spread southward. It destroyed the sponges in British Honduras and since 1939 there has been no further sponge-culture attempt made.

Retail fresh-fish prices of 7 to 10 cents per pound appeared to be very favorable for all classes of consumers in British Honduras. Wages for unskilled labor were $1.00 to $1.25 a day,

and semiskilled labor was being paid about $2.50 per day at the time of the Mission's visit. Fresh meat (beef) was priced at 12 to 20 cents per pound.

It is calculated that the annual per capita consumption of fishery products, domestic and imported, converted to whole-fresh-fish equivalents, is 11 pounds.

Fishermen

It is estimated that between 250 and 500 fishermen are engaged in full time fishing activities with a considerably greater number fishing on a part-time basis or for personal use. All are of negro stock except a few who are Indians. The British Honduras fishermen appear quite capable in handling their boats and gear and are able to supply sufficient catches to satisfy local needs. It has been reported that from time to time fishermen from nearby countries and other colonies have encroached on the fishery grounds within British Honduras.

In common with the general conditions in the Caribbean countries, fishermen in Bri ish Honduras are quite poor and they live on a narrow margin of subsistence. Their lot possibly is better in this Colony than in many other places, for there is a steady and well-developed market for their products and their operations fit into a good general scheme of distribution and marketing. Production costs are very low and fish plentiful. In normal times, there is opportunity for export of relatively high-value products, such as shark hides, turtle shell, and spiny lobsters. The fishermen are very independent, however, and will not work for others if they can possibly avoid it.

Boats

The most commonly-used boat in the fisheries is the "dorey", ranging from 16 to 40 feet in length and carrying a considerable spread of sail. These boats usually employ a crew of two men and are equipped with live wells. They are locally built and are of good design, being double-ended with outboard rudders. They are usually decked over forward, and often there is a cockpit. The well is placed amidships and is covered with a hatch.

Some larger sailing vessels, called "smacks", are also used in fishing. These range from 2 to 6 gross tons and require a crew of three to five men. These vessels usually are equipped with live wells and are capable sea boats. They may have been introduced by fishermen from the Cayman Islands, for they are similar to types from there.

Many dugout canoes are in use. These may reach a size of 40 feet in length and 5 feet in width. They are double ended and keeled. Because of their form, they are fast but "cranky". Mahongany, cedar, guanacaste, and other local woods are used. Those used in sheltered waters are usually paddled, but others, used in the sea, are equipped with sails.

In the streams and lagoons, flat-bottom dug-out canoes called "pitpans" are used. These are long and narrow and draw but little water. Both bow and stern are square and project like a small platform. On this a man can stand while poling the pitpan.

Considerable boat-building is carried on at Belize and the boats are of good construction and design. Local woods are used, but fittings and other supplies are imported.

In total, it is estimated that 500 boats of various types are in use in the fisheries of the Colony; of these, about 150 call at Belize.

Fishing Gear

Most of the catch is taken on handlines. Some trolling is carried on while running to and from the fishing grounds. Nets are in use in the northern part of the Colony and in river mouths and lagoons. It was estimated that there were about 30 beach seines ranging

from 200 to 500 feet. These were almost all of 2-1/2-inch mesh, but some seines with 4-inch mesh were reported. The latter were 6 feet in depth and 1/4 mile long. A few turtle nets of 8-inch mesh, 30 feet in length, were in use.

A very few fish pots were reported in 1942, not more than 10 or 12, and these were in need of repair. Spiny-lobster pots were reported to number about 75.

Castnets are used extensively for bait and to catch mullet for sale.

In the northern part of the Colony, the use of shore weirs or traps is reported. These are made of chickenwire and are designed to block off a channel and lead the fish to a concentration area where they can be taken. These were reported to be about 50 feet square and equipped with a tunnel.

An American citizen, who had been fishing in Mexico, was attempting, in 1942, to carry on a shark fishery for livers and hides. He was using the regular type of shark-fishing long lines constructed of chain.

The Indians use bow and arrow, harpoons, and spears to take fish in the rivers and lagoons. The use of various fish poisons in the streams has been mentioned by various authors.

Most of the fishing gear used is homemade from imported materials. Such items as hooks, leader wire, chickenwire, sinkers, and twine are usually imported, as well as canvas, boat fittings, paint and tools.

POTENTIAL FISHERY INDUSTRIES

Unused Resources

Possibly the greatest under-utilized resources of British Honduras waters are those which have export value. It is reported that sections near Belize, which have been intensively fished with seines, are becoming depleted. It is certain, however, that other areas both north and south of Belize are under-utilized so that fish supplies for local use can be obtained.

There are possibilities for increasing the catch of such pelagic fishes as bonito, tuna, and frigate mackerel by trolling. The edge of the 100-fathom curve should offer a good area for such operations.

During normal times, British Honduras exports some fishery products such as spiny lobsters, turtles, shark hides, and alligator skins. This probably can be continued after the war, when transportation becomes more available and markets are re-opened. Possibly, the sponge industry can be resurrected. There is some indication of possibilities in salting and drying fish for export. From previous experience, however, it is doubted that any large-scale processing industries could be organized, based on any of the known aquatic resources. There are some possibilities of small-scale industries as named above and, also, in the quick freezing of fish fillets for export.

It is the opinion of the Mission that British Honduras has developed an excellent local-use fishery, but that there are not large enough, known, unused resources to justify any large extractive developments.

Potential Market

There is little potential market in British Honduras for any increase in locally-produced fishery products since the population is practically all coastal and well served with fish already. If sufficient low-cost production of salt and dried fish can be attained, there are possibilities of selling product in nearby countries. A small quick-freezing unit and cold-

storage plant located at Belize could probably handle sufficient lobster tails and fish fillets to make an export business worthwhile. Perhaps turtle steaks could be popularized if quick frozen. These products might all be sold in the United States. Shrimp might be dried or frozen for local or for export markets.

Sharks might be exploited to a greater extent if markets exist for the products.

To improve the status of the local-fishery industry and the lot of the fishermen, make more regular the supply of fresh fish, and increase fish consumption, it is suggested:

a. That somewhat higher prices, at least for a few choice species, be allowed the fishermen to permit them to obtain larger live-well vessels and maintain supplies of gear and equipment.

b. That holding boxes be constructed for keeping reserve supplies of live fish for market use to tide over periods of scarcity. Such live-boxes (about 8' x 25' x 5') are used to hold fish alive for the Havana, Cuba, market. It is suggested that these be operated cooperatively by the fishermen or as a public service conducted on a cost basis.

No inquiry was made into the sanitary condition of the water in the area where the live-well fish are held in Belize prior to sale. It is emphasized that unpolluted water is a requisite to the holding of fish in live wells.

Game Fishing: The prospect of game fishing as an industry in British Honduras is a bright one, if suitable accommodations can be provided. Tarpon, jewfish, snook, crevalle, tuna, bonito, and many other gamefish species may be found to lure the sportsman. If popularized, this activity might overshadow the commercial fisheries in return to the Colony.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

1. This Colony has only about 65,000 people, with the greatest concentration at Belize and along the coast.

2. It is felt that the fishery industry of British Honduras is conducted along very practical lines. Little needs to be done to improve either catching or marketing. Prices are very low and fish are abundant.

3. With the approach of normal times, British Honduras may contribute materially to an export fishery for spiny lobsters, turtles, and other special products.

THE FISHERIES AND FISHERY RESOURCES OF EL SALVADOR

INTRODUCTION

The fisheries and fishery industries of El Salvador were studied, in August 1942, as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in El Salvador consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service.

While the Mission was interested primarily in the countries having a Caribbean coastline, El Salvador was visited to obtain comparative data for the Pacific coast area.

El Salvador is the smallest and most densely populated Republic in Middle America. The soil is extensively cultivated and the economy is agricultural. An excellent system of rail and highway transportation exists, and there are fishery resources on the coast which could supply all national requirements. Fish, however, is not now consumed in any appreciable quantity away from the immediate coast.

Note: The Mission expresses its appreciation to Senor don Luis Alfonso Duran, President of the Salvadorian Commission of Inter-American Development, to Dr. Rafael Lima and Sr. Alberto Monterey Sol, who accompanied the investigators, and to many others who assisted in carrying out the fact-finding program.

Thanks are also expressed to the United States Diplomatic Mission in El Salvador for the cooperation extended.

FISHERY RESOURCES

Character of the Coast

The Pacific coast of El Savador extends from the Guatemalan boundary at the Rio La Paz to the boundary with Honduras at the Goascoran River. The length of the coastline, disregarding the indentations, is about 160 miles. The principal ports are Acajutla, La Libertad, and La Union. Of these, only the latter offers a sheltered harbor, the others are open roadsteads.

There are several large indentations on the coast, the largest being the Laguna de Jaltepeque and Jiquilisco Bay. The west side of the Gulf of Fonseca is Salvadorian territory and the remainder of the Gulf is shared by Honduras and Nicaragua. Most of the coastline is a sandy beach with high cliffs breaking in occasionally, particularly between Acajutla and La Libertad. Where there is low swampy ground as near river mouths and lagoons, mangrove swamps predominate. A number of rivers enter the sea along the coast, with the largest being the Rio Lempa and the Rio San Miguel. The bottom slopes off gradually to the 100-fathom line which lies 30 to 40 miles offshore. There are no islands offshore and no banks of any size. The bottom within the 100-fathom curve is predominantly mud and sand, and there are very few rocky areas.

The coast is exposed to the full sweep of the Pacific and the swells are oftentimes very heavy, particularly in the winter months. The currents are quite variable, sometimes easterly and sometimes westerly, with an average strength of about 1½ knots. The neap range of tides runs about 8 feet, with the spring tides about 10 feet at La Libertad. During certain seasons, heavy winds occur and violent local squalls known as "chubascos" accompanied by thunderstorms are quite common during the rainy season from May to November. Sea-water surface temperatures range from 78.9 degrees F. in January to 82.5 degrees F. in May. Most of these waters are derived from the high salinity Equatorial Counter Current which drifts northwestward along the Central American Coast. While the open ocean is not very productive, there are, at times, vast schools of tuna and other mackerel-like fishes. Only on the immediate coast and in the lagoons and bays are there large resident populations of fish.

Species and Distribution

Available to the Salvadorian fishermen are two groups of fish--these are the shore and lagoon species and the pelagic species. By far the greatest contribution is made by the former. Included are the mullets, mojarras, catfish, grunts, snappers, threadfins, herrings, jacks, snooks, groupers, sharks, and anchovies or sardines, rudderfish, and gobies. Sea bass, weakfish, barracuda, and mackerel may sometimes be taken. The offshore types such as the tunas, roosterfish, and dolphins are taken only very occasionally.

The abundance of many of the species is seasonal while others may be taken throughout the year. Little is known of the abundance and extent of the fishery resources but it is clear that an increased catch could be taken without endangering the supply. The greatest abundance occurs from June to September and, during this time, there is much more fishery activity than in the other months. Hildebrand, who made fishery studies in El Salvador during January and February 1924, states that, "Two brief collecting trips were made to salt water, and there, too, fish appeared to be scarce. It is well understood, however, that the abundance of fish in salt water usually varies greatly with the season, and the results obtained from the two short visits made are not sufficient to form the basis for any conclusions."

FISHERY INDUSTRIES

Many fishermen using simple methods supply fish to coastal communities of El Salvador. Perhaps 500 pounds of fresh fish a day reach the markets of San Salvador, the Capital. Considerable quantities of local fish are salted for personal use of the fishermen and their families. Imported salt fish are sold in the cities during Easter week only.

As far as can be determined, the lack of consumption of fish in El Salvador is not due to scarcity of fish but is more directly traceable to the low retail price of meats. Meat prices, normally, average 16 cents U.S. per pound as compared to an average price of 21 cents per pound for fresh fish. Normally, about 500,000 pounds of fishery products are imported, and these imports, converted to a base of whole fresh fish and combined with a catch of perhaps 700,000 pounds, indicate an annual per-capita consumption of about one pound per person.

Boats

The majority of boats in use for fishing are dugout canoes, "cayucos". These are made by hand and serve for transportation as well as for fishing. Some of the cayucos are equipped with outboard motors but the usual form of propulsion is by oars or by poling.

Sailboats are used, particularly around La Union. These are all small--not over 25 feet in length. In the summer season when fishing is at its height, launches may be used. There are an estimated 200 craft of all types used in fishing.

Gear

Types of fishing gear are simple. Nets are small and many are made of locally-produced henequen fiber. The principal type is the castnet (atarraya) which is used in shallow water. Some small beach seines are also fished, especially during the summer time when as many as 10 "trenes" of fishing nets and boats catch fish for salting and drying.

Another fishing method in common use is the blocking off of a channel by means of a weir or net strung across the mouth. When the tide recedes, the fish are left high and dry in the channel and then are picked up.

Hook and line gear, both on the bottom and for trolling, is utilized to some extent, particularly in and near the ports of La Libertad and La Union.

It is reported that certain toxic substances and dynamite are also sometimes used, even though prohibited by law.

Fishermen

The fishermen of El Salvador are relatively few in number and most of them work at fishing only incidentally to other pursuits such as agriculture and stevedoring. In 1940, there were about 11,000 persons reported to be living in the coastal zone.

When fishermen are hired by a boat owner or middleman, they receive 0.75 colones per day, which is the average for other kinds of labor. Rowers earn 1.00 to 1.25 colones for a long day's work. These wages do not include any subsistence and usually, because of tidal conditions, it is impossible to work a full day.

In 1940, there was an estimated 134 fishermen who worked more or less regularly. This number is augmented at various seasons by others who fish only during periods of abundance of fish. Also, in the summer months, fishermen come to the coast from the highlands of the Republic to catch and salt fish which they later sell.

Fish-Handling Facilities

It was reported in 1942 that there were four cold-storage plants in El Salvador. Two were located in Salvador, one in Usulatan, and one in Zacatacoluca. The price of ice is controlled by the producers, being 1.10 colones for 100 pounds in San Salvador and 1.50 colones for 100 pounds in Zacatecoluca. The plants are all convenient to highway and rail transportation.

At the time of the survey, cold-storage charges were 30.00 colones per month for 2.5 cubic meters, but it was noted that special concessions would be made if the demand were greater for fish storage. The plants in San Salvador have, between them, two refrigerated rooms, one 9 x 18 x 7.5 feet and the other 9 x 9 x 7.5 feet. Temperatures of 7 to 10 degrees C. are regularly held in these rooms (45° to 50° F.). These two installations are controlled by one company and they are reported to have good sanitary facilities. Small quantities of fresh fish, packed in boxes with ice, are shipped by rail from La Union and Usulatan to various points. The railroad charges 1.10 colones for 100 pounds from La Union to San Salvador and 0.77 colones from Usulatan to San Salvador. A charge of 0.26 colones per 100 pounds is made for the return trip of the box which is filled with ice.

Fish is also shipped by truck from La Libertad and from Zacatecoluca to San Salvador at charges of from 0.30 to 0.40 colones per 100 pounds. The charge for transportation of dried fish from Usulatan to San Salvador by rail was quoted as 0.33 colones per 100 pounds.

El Salvador has excellent communications both by highway and rail, and the shipment of fresh fish could be increased greatly. If the commerce in fresh fish were larger, shipping charges could, doubtless, be reduced. Practically all centers of population can be reached by rail or highway, and it is reported that 16 cities with a total population of more than 300,000 can be reached by these means. Even though approximately two-thirds of the population is rural (1940 - 1,119,091) and only one-third urban (668,839), communications are so good and distances so short that fresh fish could be made available to almost all sections of the country.

Fish is usually sold in the public markets along with meat, vegetables, and other produce. The fish is vended from ice chests but there are no special facilities for selling the fish.

Locally-mined salt can be produced for 1.50 to 2.00 colones per 100 pounds, and it is reported that this is of excellent quality.

Prices

An interesting comparison between fish prices in 1939 and in 1940 was supplies by the Salvadorian Development Commission.

Average prices of fresh fish (in colones)

Department	1939	1940
Santa Ana	0.29	0.32
Ahuachapan	.44	.45
Sonsonate	.23	.21
La Libertad	.44	.64
San Salvador	.41	.39
Chalatenango	.21	.25
Cuscutlan	.21	.25
La Paz	.23	.29
San Vicente	.21	.24
Cabanas	.19	.22
San Miguel	.20	.14
Usulatan	.21	.23
Morazan	.30	.26
La Union	.39	.24

POTENTIAL FISHERY INDUSTRIES

The possibilities for any great increase in fish production in El Salvador are somewhat limited. This is due to a relatively limited coastline and fishing area, the sharp seasonal occurrence of many varieties of fish, the lack of trained fishermen and efficient boats and gear, the high incidences of malaria on the coast, and the absence of any great demand for fishery products.

There seems to be, however, sufficient fishery resources to justify greater fishing effort both in the lagoons and on the coast, as well as offshore. There are certainly definite possibilities in the tuna fisheries, but the entrance into this field would call for the investment of relatively large sums of money. The inshore fisheries for snook, mullet, grunts, and other species could be enlarged both as to fresh fish and to salt and dried fish. With organized methods of production, distribution, and marketing, the daily consumption, which is at present only 500 pounds for the 100,000 persons in San Salvador, could be increased.

With meat prices low, it would be difficult to increase sales of fresh fish without a lowering of prices. Whether fish prices can be reduced and still leave enough margin to pay for all operations incidental to fishing, transporting, and selling the fish is problematical. It would probably be necessary to use mass-production fishing methods to lower unit-producing costs.

It is considered possible that the coastal fishery resources of El Salvador are sufficiently rich to support mass-production fishing on a scale suitable to fill all local fresh-fish demands. It is also possible that they can support a canned-fish industry with tuna and sardines, a fish-meal industry, and an export business in frozen and canned fish. Certain abundant fishes might well be salted for marketing as a low-priced product to provide food for the poorer people of the country.

FRESH-WATER FISHERIES

The fish populations of the lakes and streams of El Salvador have been levied upon for years both for home use and for sale in the larger population centers. The supply, however, has not kept pace with the demand and, therefore, year by year the fishery resources in the lakes and streams have become more and more depleted.

Hildebrand (Manuscript - 1924) writes: "El Salvador is, indeed, fortunate in having many beautiful lakes within its boundaries, but from an economic standpoint, the value of the fish which may be produced therein can never be great."

The lake fishermen utilize small rafts or "balsas" and fish with hook and line or with castnets (atarrayas). They are very expert in the use of the latter and are reported to fish them under the water as well as at the surface.

The fish caught are small in size and the number of fish taken is also small. Hildebrand names the more important species found. These are Astyanax fasciatus (plateada or sardina); Galeichthys guatemalensis (bagre); Rhamdia guatemalensis (filin); various Cyprinodontes (chimbolas); Thyrina guija, a silverside (pepesia, manjuda, alfiler, rovaleto); Mugil cephalus, mullet (liebre ancha, liza); Agonostomus monticola, fresh-water mullet (tepemechin, chimbera, liza); several species of Centropomus, the snooks (robalo or rovalo); the family Cichlidae, or mojarras (burro, achiba, chamarra, chincoys, conga, mojarra, guapote, istatagua, moro, pando; and the species Gobiomorus maculatus, goby (guvina). All of these fish are small.

Many are sold fresh, but salting and drying is also important. In the market of San Salvador, fresh-water fish command relatively high prices, and there is a strong and regular demand for them.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

This country is the smallest and most densely populated of the Central American republics. It has no Atlantic coastline. It is almost entirely agricultural and there is a relatively small coastal population.

Very little fresh fish from the sea reaches the interior although excellent transportation facilities (both highway and rail) are available. At present, some fish is taken at Puerto Triunfo and carried by oxcart to the railroad for shipment to San Salvador. A small fish-salting activity for internal consumption is carried on. At present, there is no danger of food shortage in El Salvador, which produces an abundance of low-priced agricultural products.

There is every indication that an organized fresh- and dried-fish industry could succeed. Marine fish are abundant, of good variety, and there are sufficient experienced fishermen and small boats which can be used in the fishery. The cost of nets is very low since a native fiber (henequen) is extensively used in their construction.

A considerable amount of shark livers can be produced, particularly at La Union and in Jiquilisco Bay if the demand is present. In addition, excellent sources of bait and offshore-tuna supplies would make this area valuable as a collecting point for tuna.

It is suggested that the Government of El Salvador give consideration to the appointment of a fishery officer whose duties it would be to collect statistics on the fishery industries and to keep informed on developments in the local fishery activities.

THE FISHERIES AND FISHERY RESOURCES OF GUATEMALA

INTRODUCTION

The fisheries and fishery resources of Guatemala were studied, in September 1942, as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in Guatemala consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service.

Guatemala is the northernmost of the Central American Republics and has a coastline on both the Caribbean and the Pacific. The majority of the population lives in the interior of the country and thus far there has been no successful way of supplying them with marine fishery products at a price they can afford to pay.

Note: The Mission wishes to acknowledge the assistance of Senor don Jose Linares, President of the Guatemalan Commission of Inter-American Development and the various officers of the United States Diplomatic Mission in Guatemala, all of whom assisted the investigators in every possible way.

Fishery Resources

Character of the Coasts: Guatemala has coastlines both on the Pacific (200 miles) and on the Caribbean (about 70 miles).

Caribbean Coast: The Caribbean coast of Guatemala extends from Rio Motagua, the coundary with Honduras, to the Sarstoon River which forms the frontier with British Honduras. The configuration of the coast includes a stretch of wave-swept beach from Rio Motagua to Cape Three Points. Besides the Rio Motagua, the Rio San Francisco del Mar enters the sea in this area. From Cape Three Points, the coast trends in a southerly direction past Hospital Bight, a small bay, and then to Puerto Barrios, the principal town in the region. Near Puerto Barrios is the small bay of Santo Tomas. From Palma Point, the northwestern point of Santo Tomas Bay, the coast trends northwestward to Livingston Bay. The small town of Livingston is situated on the western part of the Bay. Entering Livingston Bay is the Dulce River which connects the Bay with El Golfete, a small lake (about 18 square miles in area). Connected to El Golfete by a channel is the Gulf of Dulce, a body of fresh water with about 200 square miles of area. A number of fresh-water streams enter the Gulf, and the little settlement of Izabal on the south shore is the only population center. From Livingston Bay the coast trends in a northwesterly direction to the Sarstoon River.

The coastal waters of Guatemala on the Caribbean side are shallow with sandy and muddy bottoms. Where the coast is low, impenetrable mangrove swamps are found. Along the coast from Rio Motagua to Cape Three Points, there is often heavy surf. The area of Honduras Bay (from Cape Three Points to the Sarstoon River) is generally well sheltered. Practically none of the area is subject to oceanic currents, the chief influences being the outwash from the rivers, local tides, and wind influences.

Practically all the available fishing area can be considered as a brackish or fresh-water environment. Salinities vary from fresh in the Gulf of Dulce to almost normal off-shore concentrations on the outer northeast coast. Inshore, the outwash from rains probably reduces the salinity considerably.

There are sheltered waters and good harbors for fishing craft. Transportation by rail is available from Puerto Barrios to Guatemala City, but the population in the coastal area is limited and travel conditions difficult due to heavy rains and infrequency of rail service. There are few, if any, facilities at present for the establishment of large-scale fishing enterprises.

Pacific Coast: The Pacific coast of Guatemala extends in a westerly direction from the boundary with El Salvador (Rio La Paz) to the Rio Suchiate, the boundary with Mexico. Practically the entire length of the coast is sand beach interrupted only be river mouths which break through in the wet season. Two ports, Champerico and San Jose, exist but these are both open roadsteads with no protection from storms or heavy seas. There are a few very small settlements such as Istapa scattered at intervals along the coast. Behind the sand beaches and extending for practically the entire coast is a series of lagoons. One of the largest of these is the Chuquimulilla Lagoon. Into these flow the rivers which have their sources in the mountains. There is constant shifting of the location and extent of the lagoons depending on the season, surf, and other conditions. In the wet seasons, the lagoons overflow through gaps in the sand-barrier beaches. Lining the lagoons are mangrove swamps. The lagoons have an enormous variation in salinity and, therefore, fish survival is based on ability to withstand these changes. Offshore from the beaches, the bottom slopes gradually to the 100-fathom curve which lies 30 to 40 miles offshore. The bottom is generally of fine sand, but there are some muddy patches. There are no islands along the coasts or deep indentations.

Species and Distribution

Most of the species of fish to be found on the Atlantic Coast of Guatemala are those which have a high tolerance to changes in the salinity of the waters. Thus, on much of the

sheltered coasts, in El Golfete and in the Gulfo Dulce, the most important types are the mullet, snook, weakfish, tarpon, anchovies, some species of groupers, herrings or sardines, sharks, and grunts. Oysters and shrimp occur in considerable quantities. Further offshore in deeper water and on the open coast where the salinities remain more constant, Spanish mackerel, kingfish, barracuda, jacks, snappers, groupers, and other species are found. On the reefs, spiny lobster are to be taken and in some areas turtles are found in quantities. Since Guatemalan territorial waters are a considerable distance from the oceanic currents and migratory routes of such species as tuna and swordfish, these probably will not enter the commercial catch.

On the Pacific side, groupers, Spanish mackerel, snappers, sea bass, snook, and various jacks are taken. Mullet, shrimp, and various small anchovies and sardines occur in the lagoons. Offshore, there are, doubtless, considerable amounts of tuna-like fishes to be found. Sharks, too, occur in considerable numbers.

Fish are reportedly abundant on both coasts but little factual evidence is at hand to corroborate the reports. At the least, however, greater strain could be placed on the marine resources if the suitable incentive exists.

THE FISHERY INDUSTRIES

Production

No statistics are kept of commercial fish production, but it is estimated that the Atlantic-coast region produces about 60,000 pounds annually and the Pacific coast about 40,000 pounds, making a total of 100,000 pounds for the country. In addition to these figures, there might be added the catch of the coastal populations which is consumed in the homes of the fishermen. It is extremely doubtful that the total catch by all means is more than 250,000 pounds annually.

Distribution

Very little fresh, marine fish is sold in the interior, practically all being sold in the coastal towns. Occasionally, iced fish is shipped by train from Puerto Barrios to the nearby towns of Morales, Quirigua, and Zacapa. Fairly regular but exceedingly small supplies reach Guatemala City, 198 miles from Puerto Barrios. At Livingston, some fish is salted for local consumption but this actually is on a very small scale.

On the Pacific side, some fish caught near Iztapa on the Chuquimulilla Canal are brought to San Jose for shipment to Guatemala City by railroad. The types most usually shipped are groupers and snappers.

Fishermen

No material is available on the number of persons engaged in fishing, but the number of fishermen of all types probably does not exceed 200. Indeed, it is doubtful whether there are any who follow fishing as a full time vocation. Most of the fishing activity is carried on by residents who fish only incidentally to other work. On the Atlantic side, fishing is done by Caribs. Since, in normal times, other forms of employment are available, there is little incentive for fishing as a regular business. If a man owns a dugout canoe and a net he is classed as a fisherman even if he supplies only his own needs.

On the Pacific side, fishing is carried on as a more regular business but there are few full-time fishermen. The resident population, in normal times, works at other occupations and fishing is an incidental to other occupations.

Boats

The only boats used for fishing are small cayucos which are used not only for fishing but for transportation and other tasks as well. The total number of fishing craft is probably less than 100. It was reported that several small fishing boats were constructed on the Pacific coast during 1942 but that these were wrecked soon after completion.

Fishing Gear

Small haul seines are used to some extent, particularly on the sandy beaches of the lagoons. Castnets, used to capture mullet and shrimp are found mostly on the Atlantic Coast. Hook and line fishing is carried on most extensively, and practically all the coastal natives use this form of gear. Spears and harpoons are used for the larger fish.

All of the equipment is handmade and does not represent any great outlay of cash.

Fish in the Economy of Guatemala

Guatemala probably has made less use of its fishery resources than any other Central American Republic. No doubt, this is due to the fact that the economy of the country is agricultural, and foods not raised on the land are imported.

Imported fishery products normally provide from $\frac{1}{2}$ to 1 million pounds of food. These imports, converted to whole, fresh-fish weights and combined with the production of local fresh and salt fish, indicate that the 3-1/4 million people of Guatemala consume less than 1 pound of fish per person per year.

There is no organized system of fresh-fish production and distribution in Guatemala. Limited quantities of fresh fish, caught by a few native fishermen operating simple fishing gear, reach inland communities at irregular intervals. These conditions result in high-unit prices for products and the marketing of fish of questionable quality. The limited public demand for such fish has not encouraged the enlargement of the fishery industry.

Potential Fishery Industries

The fishery resources on the Pacific coast of Guatemala have the greater promise for development. There, mass-production methods can probably provide products at sufficiently low-unit cost so that they can be marketed at low prices widely throughout the country. Considerable quantities of iced and frozen high-grade fish, whole, filleted, and steaked can be marketed in Guatemala City and perhaps other points; but, for the outlying communities, a hard dry-salt product would probably be necessary to meet the limitations in price and facilities for marketing. Canned fish could also be prepared and distributed in some quantity.

Because of very low wage rates and low per-capita income in Guatemala, food products must be very low priced to be adaptable to wide-spread trade in rural areas. It may be possible that some of the Pacific fish could be prepared for use by these low-income people if profits were confined to an absolute minimum and taxes and transportation rates reduced to favorable levels.. If low-priced and nutritive salt-water fish products could be added to the diet of the rural population, it would greatly improve the health of these people.

Since little factual evidence regarding the abundance and extent of Guatemala's marine resources is to be found, it is difficult to make precise statements regarding the potentialities. Enough information is at hand, however, to indicate that there are fairly extensive resources yet unused. On the Atlantic coast there are, doubtless, considerable supplies of mullet, snook, shrimp, oysters, mojarra, groupers, and other species. On the offshore reefs, spiny lobsters could be taken in fair numbers.

For miles, the Pacific coast of Guatemala is backed by lagoons and estuaries. While the variety of species in this type of habitat is somewhat restricted, the productivity of these areas is high both in fish and in shrimp. A considerable increase in the amount taken from from these areas could be expected.

The offshore fisheries present the greatest possibilities but the utilization of these requires a considerable investment in boats, gear, handling facilities, etc. Large schools of tuna and tuna-like fishes are to be found but a short distance offshore. If tuna and other species can be caught in large quantity, a ready market exists for export. The lack of suitable harbors for large fishing vessels and the lack of adequate shore facilities are factors which must be overcome, however.

Fresh-water Fisheries

Guatemala possesses a number of fresh-water lakes and streams and fish have been taken from these by neighboring Indians for centuries. While the total amount of fish caught is comparatively small, the activity of fishing assumes great importance during certain times of the year, chiefly during Holy Week.

Attempts were made by the monks during Colonial days to introduce new species and to increase the production of fresh-water fish by cultural methods.

CONCLUSIONS AND RECOMMENDATIONS

While both coasts of Guatemala have some possibilities for expanded production of fishery products, the Pacific coast is the more promising. However, lack of buying power, and a complete agricultural economy so severely restrict commercial possibilities in the development of large-scale food fishery industries as to make this development almost impossible without governmental encouragement.

The waters of Guatemala have fishery items of definite export value, particularly tuna and sharks. It may well be that fishery industries based on these items could also supply low-cost fishery products to the Guatemala population.

It is suggested that the Government of Guatemala appoint a fishery officer to collect fishery statistics and to keep informed on the fishery situation in Guatemala.

THE FISHERIES AND FISHERY RESOURCES OF CUBA

INTRODUCTION

The fisheries and fishery resources of Cuba were studied, during September and October 1942, as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries. Fish and Wildlife Service, United States Department of the Interior. The field party in Cuba consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service. The Mission visited practically all of the localities in Cuba where extensive marine fisheries are conducted.

Cuba, with an extensive coastline washed by the warm waters of the Caribbean Sea, the Gulf of Mexico, and the Atlantic Ocean, for a number of years has produced fishery products for world commerce. Cuban sponges and spiny lobsters normally enter the markets of a score of countries, and several other items are shipped to the United States directly to the north.

Note: The work of the Mission was facilitated greatly through the cooperation of the Ministry of Agriculture of the Cuban Government. This Ministry made it possible for Dr. Luis Howell Rivero, Dr. Mario Sanchez Roig, and Sr. Emilie de Mesa to accompany the Mission on various field studies and to assist in the survey in other ways. The Ministry, also, rendered help in providing and arranging for transportation to the various parts of the Republic.

Sr. Mariano Guas Pagueras of the Fabrica Nacional de Conservas assisted greatly in the work of the Mission, and grateful acknowledgment is made in appreciation of his efforts. Through its president, Senador don Jose Manuel Casanova, the Cuban Commission of Inter-American Development offered tremendous encouragement and facilitated the activities of the Mission in every conceivable way.

The United States Ambassador and his staff cooperated with the Mission in many ways, and this assistance is acknowledged with pleasure.

FISHERY RESOURCES

The distribution and abundance of marine life is not ruled by haphazard coincidences but is subject to fixed factors involving definite oceanographic conditions. With almost the same certainty as a geologist can detect likely regions to explore for oil or minerals, the fishery technician can recognize areas where there are indications of fish abundance. Among the strongest of these indications are the configuration and type of oceanic currents, the topography of the coast and sea bottom, and the annual variations in the temperature of the water. While many years of study are necessary in order to collect sufficient data to make definite predictions, there are sufficient data in the case of Cuba to predict the presence of large potential fishery resources.

Oceanography and Ecological Conditions

Cuba lies in an enviable position in relation to the oceanic currents. Fishery activity based in Cuba can take full advantage of the narrowing down and concentration of all the currents passing through the Caribbean, for these must flow into the Gulf of Mexico through the Yucatan Channel. Furthermore, all of the major currents flowing out of the Gulf of Mexico must pass through the Straits of Florida, another concentration point easily available to Cuban fishermen. On the north coast, another current is squeezed between the Bahamas and Cuban coast in the Old Bahama Channel. In addition to these main oceanic currents, there are a number of smaller counter currents which serve to circulate the coastal water masses and to aid in the distribution of nutrient salts and food organisms. In several localities, the interactions between the currents and counter currents tend to form eddies or whirlpools where great quantities of food organisms gather and reproduce. For this reason, enormous numbers of certain species of fish are to be found in these regions. A full consideration of the current phenomena is most important to a correct evaluation of the potential fishery, for it has been shown repeatedly that migratory species such as tuna, swordfish, and others tend to follow the currents, and that even the abundance of sedentary species is intimately connected with the current phenomena.

Shallow-water areas: By far, the most productive areas for non-migratory fish are to be found within the 100-fathom curve. Cuba has some extensive shallow areas, particularly on the south coast. The largest of these, the Gulf of Batabano, extends from Cape Frances on the west to Golfo Cazones on the east and from the mainland to the Isle of Pines. The area contains about 8,000 square miles (nautical) of shallow water which is interspersed with numerous coral reefs, cays, and shallows. The greatest depth is only seven fathoms, with by far the greatest areas being less than four fathoms deep. The seaward edge of the Gulf is very steep-to and depths up to 2,300 fathoms are found within a few miles offshore.

From Golfo Cazones to Casilda, depths are predominantly great along the shore and the only exceptions are a few very small banks and some fair-sized bays such as Cochinos, Cienfuegos, and Casilda.

An extensive shallow-water area is to be found from Casilda to Cape Cruz. This area is partially enclosed within an arc of coral reefs and cays, cut by numerous channels. Among these cays is the Laberinto de Doce Leguas. Within the enclosed area are innumerable cays and reefs. Depths range up to about 16 fathoms, but practically all of the region is more shallow than 10 fathoms. The entire area contains about 6,000 square miles, including the Gulf of Guacanayabo.

The remainder of the south coast from Cape Cruz to Cape Maysi is notably lacking in shallow-water areas, and the 100-fathom curve is found but a few miles off the coast. The only exceptions are to be found at Santiago and Guantanamo where fair-sized bays cut into the mainland.

The north coast, also, has several fairly extensive areas of productive bottom. To the extreme west, from Cape San Antonio to Bahia Honda, the Gulf of Guanacabibo and its extension eastward along the coast forms an extensive potential fishing area. Depths range

up to 12 fathoms. From Bahia Honda to Matanzas, the bottom-fishing area is extremely limited, being confined to a very narrow coastal strip not exceeding a mile or two in width. The only exceptions are the small bays of Cabanas, Mariel, Habana Harbor, and Matanzas.

From Cardenas eastward to Nuevitas, a stretch of 260 miles, there is a coastal belt of shallow water varying from 5 to 50 miles in width. Countless numbers of cays and coral reefs dot this expanse. It is very shallow, averaging only 1 to 2 fathoms in depth. On the seaward side, there is a very steep drop-off into the Old Bahama Channel and Nicholas Channel.

The remainder of the north coast has relatively little bottom-fishing area. The only exceptions are the bays of Manati, Padre, Nipe, and Tanamo, and a small section between Punta Cebollas and Punta Mangle. Depths of two to three hundred fathoms are found immediately offshore.

Cuba is fortunate in having a large number of well-distributed harbors, capable of sheltering small fishing craft, and many of these are accessible by rail or by highway. Fishing operations can be carried on during the greater part of the year in most localities, and when adverse weather conditions affect fishing in the outside waters, there are great expanses of sheltered areas where fishing may be continued.

Species and Distribution

More than 450 species of edible fish are taken in Cuban waters. Of these, only a relative few are economically important at the present time. The great bulk of the catch is composed of groupers, snappers, mullet, kingfish, Spanish mackerel, and jacks. The most heavily-exploited species are the bottom forms and the reef fish. While a great number of coastal-pelagic forms such as sardines, Spanish mackerel, jacks, robalo, drums, and croakers are present, the types of gear in use do not capture great numbers.

A large part of the potential fishery wealth of Cuba is to be found in the offshore-pelagic types of fish. Among these are the various species of tunas, swordfish, marlin, wahoo, and dolphins. At the present time, these are practically unutilized, except for very limited commercial canning operations and for sport fishing.

Various crustacea and mollusks occur in great abundance, particularly in the shallow-water areas mentioned previously. Among these groups are the spiny lobster, the morro crab, the mangrove oyster, and several species of clams. Since these species are quite available to fishing, and since a very good market for them is found, not only in Cuba but for export, there are increasing signs of overfishing, particularly in the case of the morro crab.

Shorefish, including the reef and bottom fish as well as the coastal fishes of limited migration, have a wide distribution in Cuban waters, for they occur in practically all areas where sufficient shallow water is found. Thus, Batabano Bay supports a large fishery for these species. It is doubtful that a fishery for these types would be successful in the eastern portion of the Island, for there are only very limited shallow-water areas. Without a doubt, fishing operations for these species could be increased, particularly along the north coast where there is comparatively little activity at the present time.

The offshore species such as tuna are now little used. There are definite indications that enormous numbers of the various migratory species pass Cuba at certain times of the year. A large and productive fishery could be established using these species as a basis. However, until commercial exploration is carried on, there remains only fragmentary evidence of the actual size of the migrations. Among the indications are the experiences of sport fishermen, not only in Cuban waters but also in the Bahamas and in Florida. At least one enterprise in Cuba captures bonito (albacore) for canning. This indicates that such species are present and available during a large part of the year. The operations of this company have disclosed that tuna can be caught a relatively short distance from the shore with various types of equipment, and activities have been centered just outside of the Cayos San Felipe on the southeastern edge of the Gulf of Batabano. It has been found that the edge of the Island shelf is the most

productive region. Further exploration should be carried on in the numerous areas where like conditions are to be found.

From a careful consideration of the oceanic and ecological factors and of the species of fish involved, it is indicated that the waters of Cuba are not now being used to their full capacity. It seems strange that Cuban fishing boats have been so active in fishing in relatively distant areas when so much available fishing ground remains untouched around Cuba itself. Doubtless, the reason can be found in the economics of the fishing industry and in the lack of transportation and handling facilities at many of the more isolated fishing ports.

THE PRESENT FISHERY INDUSTRIES

With supplies of fish and shellfish accessible at many points along her 2,170 miles of coastline, Cuba has been relatively well supplied with these foods since the colonizing of the New World began. The many harbors and bays came to shelter hundreds of fishing craft, and communities devoted entirely to fishing were established adjacent to the best fishing areas. A sponge industry was developed. Eventually, large schooners from Habana ventured to the Campeche Banks off Yucatan, to waters off the west coast of Florida, and to other relatively distant banks to catch the highly-prized groupers and snappers. The industry devoted itself to supplying Cuban markets, and it also engaged in producing several premium items for foreign trade. Frozen and canned spiny lobsters and frozen frogs' legs were exported, as well as sponges, shark, and turtle products.

Production

During recent years, the annual take of fish in Cuba, according to reports, has fluctuated between 10 to 20 1/ million pounds, and the shellfish take from about ½ to 2 million pounds. The total value of these products ranged from over 3 million dollars down to about 1 million dollars annually. The sponge take, normally, has been valued from 300 to 500 thousand dollars per year.

Distribution

There are fishing ports around almost the entire coast-line of Cuba. Fish are sold and consumed locally at all fishing points. From these ports, most communities on the Island are supplied with some fresh fish. Rail and road facilities from the main centers of production are comparatively good. Some distant points suffer disadvantages in competing in the main markets because of transportation charges. Habana provides the best market and consumes over half of the total commercial catch. Normally, all of the main productive centers ship fish to Habana.

Fishermen

Reliable estimates place the number of full-time fishermen at about 40,000 and this number is augmented considerably by part-time fishermen and by others who fish for personal use.

Cuban fishermen are capable and hard working and are excellent seamen. Their boats are well built and are well kept. Cuban fishermen seem to have a definite pride in their calling.

There are a number of fishermen's organizations, among them a "gremio" of fishermen who fish in the Campeche Bank fishery.

In recent years, refugees from European countries have added to the fishing population. With them they have brought new ideas and new techniques.

1/ It appears that the figures of catch of Cuban fish have been calculated conservatively. Including fish used by fishermen's families, the total catch of fish may exceed considerably the figures quoted.

There are definite indications that the Cuban fishermen, while individualistic, are capable of engaging in cooperative efforts. There is no doubt that the living conditions of this class can be improved greatly by government assistance.

Boats

The fishing industry in Cuba employs more than 12,000 vessels of various types ranging from 150-ton schooners, equipped with auxiliary engines and ice boxes, to small one-man sailboats or rowboats. In general, most of the fishing vessels are of the schooner type, equipped with sails. A number of these have installations of auxiliary engines, either gasoline or diesel. On extended trips, fish are kept in live wells or packed in crushed ice in the hold. Many of the smaller and medium-sized boats are engaged in sponge fishing during a part of the time; and, for this reason, these are designed primarily for sponging activities. Several motor vessels of more modern design are now to be found in Cuba, and at least one of these is engaged in the tuna fishery, having been built expressly for that use. While it is felt that the fishing schooners are a good type of vessel for handling some types of fishing gear, they have many limitations, and there is little doubt that new types of craft will be introduced with the expansion of the pelagic fisheries.

All of the Cuban fishing vessels are built of wood and most of them are constructed in Cuba. Some of the older and larger schooners were brought in from New England and Nova Scotia. The Cuban shipbuilders have proved to be apt, and almost any type of fishing vessel can now be built locally.

The Campeche Bank fleet, based in Habana, comprises about 60 vessels ranging from 60 to 105 feet in length. There are 10 of 150 tons and 10 of 100 tons. Most of the vessels are the property of several large fishing companies, but some of them are privately owned. They are all of schooner type and some are equipped with motors (expecially those using ice boxes). The others have no motors and carry the fish in live wells. It is said by some observers that vessels equipped with live wells cannot be equipped with motors, since it is reported that the holding of live fish is impracticable when a motor is used.

At various places along the Cuban coast, large dugout canoes or "cayucos" are used. At least one of these was equipped with a motor.

Practically all of the large vessels used are concentrated at Habana and Batabano. In the other ports, the vessels are much smaller.

Fishing Gear

Practically all of the commercial catch in Cuba, as is true in other areas of the Caribbean, is taken by methods which stress the fisherman as an individual rather than as a team or group utilizing mechanized or mass-production equipment. It was observed that handlines, small beach seines, castnets, and fish pots are the predominant types of gear in use. As far as could be determined, purse-seines, otter trawls, and other types of mass-production apparatus were lacking. This indicates that the yield of the average Cuban fisherman is small and that there is a wide field for introduction of more productive methods both for species now taken and for species which are now neglected. Since the catch-per-fisherman is low at the present time, every effort should be made to increase it. In fishing activities, this is best accomplished by team work and by the use of mass-production methods.

A novel type of fishing was observed near La Coloma where several small canneries are located. This utilizes a motor vessel fitted with a live well in which small, bait fishes are carried alive. A small water pump is located amidships and this is connected to a series of spray outlets placed around the stern of the vessel. When a school of bonito is sighted, the pump is started and streams of water sprinkled onto the surface of the sea from the various outlets. Nets full of bait are thrown overboard and the combined commotion of the water spray and bait attracts the school. They are then caught in the same manner as the California tuna, that is with bamboo poles and short

lines carrying a small, barbless, feathered hook. This method has been proved feasible and is now in use.

The Campeche Bank fishery utilizes handlines for the capture of the highly-prized groupers and snappers. Some trolling may be done on the voyage to and from the fishing grounds.

At Batabano, the majority of the fishing boats use short, haul seines, which they employ on the outlying cays and shallows in order to capture the various snappers, grunts, and hinds. They, also, use handlines at times.

In many of the fishing sections, extra large castnets are in regular use. One with a radius of about 15 feet was observed near Manzanillo.

Spiny lobsters are taken by hand from the shallow water near the reefs and with long-handled dip nets which have a long-bagged net hung from an offset hoop. The hoop is placed over the lobster and, since these crustacea practically always rise when disturbed, they become entangled in the bag. The net is then swept horizontally, closing the bag over the hoop and preventing in this manner, the escape of the animal. Some lobsters are also tak n in pots and occasionally they may be caught in haul seines or in castnets.

The sponge fishery relies on long poles 20 to 25 feet in length which are armed with steel hooks. Sponge fishing is carried on from small rowboats with a larger vessel as a base. The crews of the row-boats are each composed of two men. One man maneuvers the rowboat and the other, lying prone on the stern, peers into the depths with a water glass. The pole is laid horizontally in the skiff and it is balanced in a Y-shaped crotch which stands vertically in the skiff. This crotch is about two feet high. When a suitable sponge is discovered, the boat is maneuvered into position; and, at the correct moment, the fisherman kicks the pole upward, thus destroying the balance and causing the hooked end of the pole to slide into the water. As soon as this occurs, he guides the pole to the sponge, hooks it, and then raises the sponge to the surface. It is evident that this type of fishing calls for excellent judgment and coordination.

Prices

Prices current in Cuba in October 1942 were high because of a relative shortage of fish. War conditions had affected Cuban fishing more than that of most other Caribbean areas. The Fisheries conducted in the shallow Gulf of Batabano on the southern coast were furnishing most of the fish reaching Habana markets. The important Campeche Bank handline fleet which normally brings into Habana up to 10 million pounds of groupers and snappers annually had discontinued fishing because of an alleged inability to pay war-risk insurance and higher fishermen's wages. A number of these vessels were being rebuilt for carrying freight. In other communities, some fishing units were finding it more profitable to engage in other work. At Isabela on the northern coast, some fishermen were finding that they could employ their boats to best advantage in handling wood. While retail prices were high in the markets, it was reported that the fishermen were being paid little, if any, more than normally. It was apparent that price incentive to produce more fish was lacking. With gear replacements almost impossible to obtain, and costly if available, many fishermen were engaging in other occupations.

Although fishermen were paid from 1½ cents to 10 cents per pound for fish in round, the consumer was paying 25 to 30 cents per pound for eviscerated fish at the market. Meat was being sold for an average of 16 cents per pound. During normal times, reportedly, 15 cents per pound is the average price paid for fish in Habana.

Cuban minimum wage scales in general are reported to be 1.30 pesos ($1.30) a day for laborers in rural districts, and 1.50 pesos a day for laborers in urban areas, with special social benefits, such as paid vacations, in effect increasing these wages by about 20 per-

cent. Fishermen may earn 50 to 100 pesos per month but the average earnings are considerably lower. Under these wage circumstances, the prevailing prices do not stimulate the consumption of fish among the laboring people.

Marketing

Most of the retail sales of fish in Habana are made from display tables in the two large public markets. These display tables are loaded with the vendor's stock of fish, shrimp, oysters, clams, and spiny lobsters. Water is carried to the tables in buckets. Fish on display, when the markets were visited in October 1942, appeared to be clean and fresh. In one of these markets, the Cuban Ministry of Agriculture inspects all unsold stocks when they are removed for night storage and again at 10 o'clock in the morning. In this market the fishery display tables extended for about 1,200 feet, and in the other market there was about half this amount of space devoted to the fish trade.

An interesting fishery activity in Habana is the sale of mangrove oysters from small stationary stands in the main business centers. Vendors obtain the oysters in the shell and sell them in oyster cocktails with tomato sauce for a few cents a glass. Hundreds of oyster cocktails are consumed daily by Habana's citizens as they stop at these stands during the course of the day's business.

Canning and Preserving

A considerable development has occurred in the canning and freezing industries in Cuba, but little salted or smoked fish is produced.

In October 1942, there were five small canneries and four of these were in operating condition. These canneries, which specialize in canned spiny lobster, have recently expanded their activities to other types of fishery products. At least one is preparing an excellent grade of canned bonito. Others are experimenting with other species.

The canneries are all small, usually consisting of one line, and all of the products are hand packed. They are usually well arranged and clean, and their products are quite acceptable. At least one enterprise sells its products regularly in the United States market.

The daily production is small, probably not exceeding 100 cases per day. Two canneries are located at La Coloma, two at Batabano, and one at Casilda.

Two, modern, sharp-freezing plants were visited, one in Habana and one at Batabano. It is not known whether others exist. The Habana plant has a large capacity, while the one at Batabano is considerably smaller. Prior to the dislocation of this industry due to shipping difficulties, frozen spiny-lobster tails, fish fillets, and frogs' legs were processed for export.

At times, some fish is salted at Habana, particularly groupers and snappers. There is, reportedly, some salting of shark meat. Definite possibilities exist for a salt-fish industry of considerable magnitude if the raw material can be procured in sufficient and regular supply.

Exports

Much of Cuba's fishery activity, normally, is based on the export of certain specialty products to the United States. A sizeable trade in live spiny lobsters that existed some years ago has been converted recently to an even more active commerce in frozen and canned spiny-lobster tails. A number of small canneries and freezing plants have been built to handle this trade and fishermen have come to consider the funds realized from the sale of spiny lobsters as a necessary element of income. During the War, increasing difficulty in securing shipping space and containers has virtually stopped the export trade, causing a lowered demand for spiny lobsters and a consequent drop in fishing interest. Canning for

local consumption has also suffered.

Exports of fishery products just prior to the War totaled about 500,000 pounds valued at $100,000. Canned spiny-lobster exports to the United States, the main customer, composed a large part of these shipments in 1938, 1939, and 1940. In 1938, only 123,000 pounds of this product valued at $34,500 were shipped; in 1939 the trade was enlarged to 230,000 pounds, valued at $48,000; and in 1940 commerce reached 314,000 pounds, valued at $69,500. Discontinuance of European shipments accounted for much of the difference between 1939 and 1940. Fresh and frozen fish and frozen spiny-lobster tails were next in importance among exported items.

Imports

Cuba's normal imports of fishery products are about 17 million pounds, for which about 2 million dollars is paid. The two most important items among the products received are dry-salted codfish and canned sardines. The former normally provides about half of the weight of all imports and the latter about a third. Most of the other items are canned, dried, salted, or smoked. Normal imports of dry-salted cod are about 8 million pounds and those of canned sardines, 6 million pounds.

Per-Capita Consumption

Cuba's imported fishery products, normally, provide a larger element of the Republic's food supply than does the catch of fish by Cuban fishermen. Based on equivalents of whole, fresh fish, Cuba's per-capita fish consumption averages about 18 pounds per year. Cuban-caught fish compose 4 to 5 pounds of this figure; dry-salted cod, about 8 pounds; and canned sardines, about 1½ pounds.

CUBAN FISHERIES AND THE WAR

Even under present conditions, Cuba can produce sufficient fishery products to provide for the requirements of the Republic. In order to do so, however, an adequate study of present conditions is required and an organization capable of directing the activities of the industry is essential.

Relations to War Economy

The fisheries represent a type of resource which requires only harvesting to be made available. This resource, if used correctly, is self renewing. No planting, cultivating, or fertilizing is necessary. In periods of depression and unemployment, the use of marine fisheries adds greatly to the economic well-being of the population. At a time when most imported fishery commodities are impossible to procure, the fisheries in the Republic should be stimulated. Cuba can also lend a helping hand to its less-fortunate neighbors by assisting to supply needed fishery products. A population of healthy, hard-working fishermen is an asset to any country--it would be to Cuba. War-time nutrition is a problem to many countries, for the stresses of emergency conditions often cause malnutrition. A regular supply of fishery products, sold at reasonable prices, would raise the nutritional level of the less prosperous classes.

Cuba's existing fresh-fish industry is an admirable system of use of local resources. Some enlargement of these fisheries might be accomplished by improvement of market conditions to conform with the highest sanitary standard compatible with the cost involved and the public service rendered. Prices to the fisherman should be permitted to rise to approximate as nearly as possible the consumer's buying price, allowing the wholesaler or middle man a reasonable profit.

Steps should be taken to keep the existing fishery industries operating throughout the War. The industry is an important asset of Cuba. Its boats, gear, shore facilities, and communities probably can be maintained in operation if attention is paid to its condition during the War and its needs administered to. Assistance can be provided as occasion demands by such means as fixing and enforcing minimum price limits to the fishermen, establishing maximum prices to the consumer, encouraging purchase of fish by public institutions, popularizing fish by publicity, encouraging cooperatives, obtaining fishing supplies and materials, and setting reasonable price limits on supplies and equipment.

During the War, the development of large, new fishing industries doe not appear feasible unless comparatively large emergency food supplies are needed that can be obtained from the fishery resources. For such emergencies, the established fisheries have limited adaptability because the types of gear in use permit only a comparatively small production of fish for the fishing effort employed. Other types of gear used on these and other fishes give more promise for the creation of stocks of low-priced fish that could replace imported salt cod in the diet of low-income consumers.

Possibly, sufficient quantities of other fishes occur that could be salted and exported to Puerto Rico or other points of war-time stress. These other fishes include the jacks, the mullets, Spanish mackerel, the tunas, and possibly some others. The availability of these fishes in this area has never been accurately determined. They have never been used to any great extent in commerce because, being migratory, they are available for capture only for short periods or seasons and they are not normally caught by stationary gear operated from sail or rowboats. When large catches have been made in the past, with such gear as seines, the markets have been unable to absorb, at reasonable prices, the quantities secured. Salting techniques have not been adequately perfected to give the fishermen encouragement to catch such fish for the salt-fish trade.

The use of these migratory fish appears feasible only through operation of special projects sponsored by the Government of Cuba or with its assistance. Private enterprise that has been unable in normal times to create a system of use for these resources cannot logically be relied on to use them when War has made facilities and gear difficult to obtain, even though prices may have increased. In addition to fishing gear, boats, and fishermen, shore facilities for processing and holding fish supplies must be provided to prosecute such fishing operations.

While it is possible to test the availability of migratory fish by sampling, these findings cannot usually be applied without devoting at least a year of investigational work. This is true because these species are usually seasonal in their appearance. Often, complete reliance can be placed on methods used elsewhere in fisheries for the same or similar species. In any such efforts, assistance of trained fishery technicians is needed to make observations, to specify gear for use, and to analyze the effect of the operations on the resources.

POTENTIAL FISHERY INDUSTRIES

While Cuba's economy is predominantly agricultural, nationally-produced fish have become important in the nutrition of the country. While the population of less than 5 million people can be nourished with relative ease from the abundant rich soil of the island, fish is recognized widely as a desirable food and, apparently, is consumed habitually because of its abundance and regularity of supply, good quality, and relatively reasonable prices. Imported dry-salted cod is utilized particularly because of its high nutritive value and its very low cost to the consumer.

Unused Resources

Cuba is using but a small part of her available fishery resources. While some areas such as Batabano are probably overfished, the fisheries in other areas on both the south and north coast could be prosecuted more intensively. Furthermore, the bulk of the fishing intensity is placed on a relatively small number of species, and these species are chiefly the bottom and reef forms. Vast quantities of mullet, jacks, snooks, sardines, and anchovies are available

but are not utilized to any great extent.

Practically unused are the offshore migratory species such as tuna and swordfish. Other migratory fish such as kingfish and Spanish mackerel are fished only to a limited extent. While runs of these fish are probably seasonal, they can contribute greatly to the supply.

Sharks are utilized to some extent, but increased activity in shark fishing is probaby dependent on fishing for other kinds of fish oron higher prices for shark products.

Various types of crustacea such as crabs and shrimp are not taken in significant quantities, even though there are definite indications of potentially greater yields.

The supply of oysters definitely can be increased not only through more intensive harvesting of wild types but also by oyster culture.

It must be pointed out, however, that the foregoing statements are based primarily on indications. To determine accurately the extent of these resources, commercial exploration is necessary and the use of an experimental fishing vessel highly desirable.

Potential Market

Cuba has a tremendous potential market for fish products not only within the Republic but also in the United States. In addition, Haiti and other West Indies localities can readily assimilate great quantities of fishery products.

With little additional effort, Cuba can produce a variety of products for export. Adequate quick-freezing apparatus is now available in Cuba and frozen fillets of preferred types can be produced in large quantities if the raw materials are furnished in a regular volume. With the improvement of the shipping situation, there are many markets available for this type of product. In addition, frozen lobster tails have already proved profitable on the U. S. market. This can certainly be revived and probably increased.

The canneries in Cuba can turn out at least 40,000 cases of excellent, canned, fishery products per year. The production to date has been chiefly of tuna and lobster. The continuation of this industry is highly desirable in order to supply not only the demands of the Cuban markets, but also the demands of export markets.

The salting of fish is another field which should be entered into, but, in this case, new fishing techniques will have to be developed to supply the necessary raw materials at a reasonable price. There are many species of fish which lend themselves to salting. Some of these varieties are to be found in Cuban waters. The chief consideration to be borne in mind is that to be successful, the salt-fish industries must have access to large quantities of cheaply-produced fish; otherwise, the finished product will be too expensive to enter competitive markets.

After the War, Cuba may be able to find extensive uses for some of the unused fishery resources. Here, the migratory fishes also present the greatest possibilities. These fish will be adaptable to frozen- and fresh-fish marketing and export if refrigeration facilities are available to hold them. Some may be canned for Cuban and other markets. Some may be suitable for salting. Other industries, such as shark fishing, clamming, and turtle fishing, may be enlarged.

GAME FISHING

The place of salt-water game fishing in the future of Cuba should not be minimized in planning for Cuba's future. As in the United States, species suitable for game fishing can be used for both commerce and sport. Cuba has rich supplies of fish off both north and

south coasts that are prized highly by game fishermen. These supplies should be carefully watched to prevent depletion that will depreciate their values in the future. An increase in tourist travel in Cuba is inevitable and the value of this tourist trade to Cuban commerce should eventually become one of the most important sources of the country's revenue. For these tourists and the thousands of United States citizens who would like to establish vacation homes in Cuba, the game fishes are going to be a very strong attraction. Among the most important of these game species are tarpon, bonefish, king mackerel, Spanish mackerel, tuna, jacks, and marlin.

CONCLUSIONS AND RECOMMENDATIONS

I

Because of the great value of Cuba's existing fishery industry, the large potential importance of her unused fishery resources, and the vulnerability of her resources to depletion from over fishing, it is recommended that Cuba adopt a national fishery policy and that steps be taken to formulate and initiate a national fishery program. The national policy should provide direction to the Cuban fishery industry to make the greatest possible contribution to the War effort that the resources can safely give. It should also provide for the long-range management of Cuban fishery industry to insure that the resources are used and conserved to the best interests of the people of Cuba.

II

To accomplish the objectives of a national fishery policy, it is recommended that there be established as a part of the government a national fishery agency with the following characteristics:

1. This agency should have complete responsibility for the administration of the fishery resources. It also should have authority to adequately discharge these responsibilities. If laws that provide for such work are not now existent, they should be enacted.

2. This agency should be staffed with the most competent technical and administrative personnel available in Cuba. If desired by the Cuban Government, fishery experts from the United States might be engaged to assist in the initial development of the agency and the planning of its program.

3. This agency may be set up either as an independent organization or as a branch of some established governmental agency.

III

It is recommended that the national fishery agency establish sections dealing with the following fields of research.

1. Fishery technology and exploration;
2. Fishery biology; and
3. Fishery statistics and economics.

In addition to this, it sould undertake, as desirable, rehabilitation of depleted areas, fish and shellfish culture, sanitary inspection of processing and markets, and other operations.

Discussion

The Mission was impressed by the richness of Cuba's fishery resources and the amount of interest in fishery development. Cuba's coastal fishes must be systematically protected by the Government against overfishing if they are to be a continuing asset to the Republic, and

other planned governmental controls must be applied if the fishing industry is to be a thriving and contributing factor to Cuban commerce and national welfare.

Technological Studies and Exploration: The fishery agency should perform technological studies and exploratory activities. The former is concerned with the most efficient use of the catch by the development of new products and new techniques for preserving fishery items. The exploratory work has as its objective the locating of new sources of supply and the development of more efficient means of producing the catch. The section embodying these activities would have the following duties:

1. To undertake, immediately, research projects to produce salt fish on a large scale.
2. To undertake research activities to develop better methods of preserving Cuban fish and shellfish.
3. To undertake exploratory fishing with new types of fishing gear.
4. To develop methods for the better use and preservation of fishing gear.
5. To undertake studies designed to develop better methods in the handling and marketing of fresh fish.
6. To develop uses for types of fish and shellfish not used at the present time.
7. To conduct special surveys on the needs, supplies, and costs of fishing gear.

Biological Studies: Since fish are living organisms, biological studies are essential to effective fishery management. Species that now make up the commercial catch in Cuba are highly susceptible to depletion by overfishing. Through well-conceived biological investigations and analysis of catch records, overfishing can be detected and corrective measures devised. Fishery regulations based on hearsay and incomplete data are worse than useless, for they not only may do untold harm to the resources, but they also tend to weaken the prestige and authority of governmental agencies and endeavoring to enforce them.

The duties of the biological section should be as follows:

1. To identify the various species which compose the commercial catch and determine their seasonal abundance in various localities.

2. In instances where the depletion of a species is suspected, to determine as clearly as possible the life history of the species. This should include the growth rate, spawning time, spawning grounds, age and size at maturity, and other characteristics.

3. To carry on such special short-term projects as may be necessry in the investigation and development aspects of the fishery.

Fishery Statistics and Economics: One of the most valuable functions of a fishery management agency is the collection and compilation of statistics. The statistics will give a definite and accurate picture of the extent and value of the fishery industries; and interpreted with biological findihgs, will provide a systematic basis for the preparation of regulations for efficient use of the resources. In no case should collection of these data become an end in itself, but should be directly designed to obtain a better knowledge and management of fishery industries.

The following statistical and economic studies should be made immediately to provide a basis for War measures to stimulate production. Current data under these categories should also be kept continuously to provide a basis for fishery management operations:

1. Study of the characteristics of the fishing fleet, including the number, type, size, distribution, and use of the various units.

2. Study of the number and distribution of the fishermen.

3. Study of the type, size, number, distribution, and value of the fishing apparatus.

4. Study of the capacity and location of facilities for the handling of fresh fish.

5. Study of canning and freezing plants, including information concerning their present and possible production.

6. Study of fresh-fish marketing to determine the species, quantities, seasons of supply, origin, trade, practices, and prices paid to the fishermen, wholesalers, and retailers.

7. Study of transportation, packing, and handling practices and costs.

8. Study of the catch or "yield" of fish and shellfish and the manufacture of fishery products.

To adequately follow trends of production and fluctuations in productivity of the various fisheries, it is regarded as extremely essential that a permanent catch record system be instituted. This system should show the species taken, the quantity, the type of gear used in making the capture, the port of landing, and the approximate value of the catch to the fisherman, These data should be kept as currently as possible.

At the present time it appears most feasible to maintain catch records with the cooperation of the Seccion de Capitanias of the Marina de Guerra, but strong effort should be made to give adequate instructions to the officers who collect these data. A system of fishing licenses should be an integral part of the catch record system.

War Program

The national fishery agency should immediately embark on a war program to (a) maintain existing fishery operations throughout the War; and (b) stimulate emergency fishing operations to obtain food supplies from unused resources.

Specific projects that are suggested to aid in accomplishing these objectives are as follows:

1. The reestablishment (if not already done so) of the Habana-based handline fishery for snappers and groupers which has been tied up due to certain difficulties caused by war conditions. In this connection, it may be necessary to establish a wholesale and retail market at the wharf in Habana where snappers and groupers are landed.

2. Development of a salt-fish industry at Manzanillo and Casilda, utilizing the reported abundance of mullet in these areas. A product preserved in brine similar to that produced in the South Atlantic states from mullet should be considered in connection with this project.

3. Establishment of a shrimp-trawling industry, especially out of ports along the south coast such as Batabano, Cienfuegos and Manzanillo.

4. Use of available storage facilities for fish as well as meat products, particularly in Habana.

5. Development of uses for species at present not utilized, particularly for low-priced consumer markets.

6. Reduction of transportation charges of fresh-fish shipments from landing points to consumer markets.

7. Establishment of a fishery laboratory at Mariel. This will provide an appropriate place for actual field studies.

8. Reconditioning of the dismantled fishing schooner lying at Mariel. This vessel could be used for commercial exploratory fishing.

THE FISHERIES AND FISHERY RESOURCES OF HAITI

INTRODUCTION

The fisheries and fishery resources of Haiti were studied, in October 1942, as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in Haiti consisted of Milton J. Lobell, Fishery Engineer and Clarence R. Lucas, Fishery Economist of the Service.

The Republic of Haiti, for many years, has imported fishery products not only from its neighbors but also from distant sources. A small and rudimentary fishing industry has been conducted along its coasts but this never has been able to satisfy even a small portion of the needs of the country. Under emergency conditions, a local industry producing a substantial portion of the needs of the Republic would be highly desirable.

Note: The investigators were assisted greatly by the Haitian Commission of Inter-American Development, of which M. Abel Lacroix is President and M. Andre Liautaud, General Advisor, and, more recently, Minister of Haiti to the United States. The Ministry of Agriculture, through its Minister, M. Heraux, and the Damien Agricultural School cooperated greatly. M. Andre Audant, Chief of the Section of Zoology and Entomology, accompanied the investigators and prepared an excellent detailed report on the fisheries with the assistance of Mr. Allen Hulsizer, a technical advisor to the Haitian Government, from the United States. The United States Minister and his staff offered every assistance and interest in the work.

FISHERY RESOURCES

Character of the Coast

Haiti, which occupies the western third of the island of Hispaniola, lying between Cuba and Puerto Rico, is bounded on the north by the Atlantic Ocean and on the south by the Caribbean. To the west is the Windward Passage and to the east, its neighbor, the Dominican Republic. The Haitian coastline extends from the Bay of Manzanillo to Cape San Nicolas Mole on the north and from Pedernales to Cape Tiburon on the south. Practically the entire west coast is included in the Gonaive or Leogane Gulf and Gonaive Channel. The total coastline measures about 1,100 miles. Off the coast are three large islands, Tortuga Island on the north coast, Gonaive Island on the west coast, and Vache Island on the south coast. There are also some smaller islands such as the Grande Cayemite and La Grosse Caye.

Very limited shallow-water fishing areas are to be found. In general, the 100-fathom curve is found but a short distance off the coast. On the north coast, there is a belt of shallow water three to five miles wide from about Fort Liberte to Port Paix. On the west coast, the areas from Porta Piment to Pointe Diable, from Dasque to Goave (Port-au-Prince Bay) within the Bay des Cayemites, and from Cape Dame Marie to Cape Carcasse offer the only shallow waters except for very narrow coastal strips on the southwest coast. On the south coast, there is a considerable shallow-water area from Trou Grosse Pierre to Point des Flamands and a lesser one from Jacmel to the Dominican border.

Many small bays and coves are found along the coastline, and there is good shelter for small fishing boats. A considerabel portion of the coast is fringed with reefs; and channels which can be used by small vessels are present. The coast itself is, in general, cliffy, but there are large areas of sandy and gravelly beach and low-lying marshy areas and mangrove swamps. The hinterland usually rises rapidly to form high ridges. Fairly extensive areas of muddy and sandy bottom are found close to shore, but often these are surrounded and spotted with rocks, coral heads, and reefs. Many small streams and rivers enter, but few, if any, are navigable since they usually have extensive bars at their mouths. There are few off-lying banks. The coastal fringe of shallow water does not deepen gradually as a rule. Inshore depths are shallow and drop off very quickly at the 100-fathom line. Surf and sea conditions are often so heavy as to render small-boat fishing impossible. This is particualarly true on the south coast and on the north coast.

Climate: The prevailing winds are from the northeast from December to April and from the east the remaining time. Their force averages 12 knots in the first and third quarters of the year and 10 knots in the second and fourth quarters. There are few calm days but no extremely heavy gales, with the rare exception of hurricanes which affect the coastal regions.

The tides on the Haitian coast have a range of between two and three feet with the flood usually setting to westward and the ebb to eastward.

The range of temperature and the amount of rainfall is much effected by the rugged topography of Haiti. The trade winds bring to the north coast a more equable marine climate than that of the south and west coasts where temperatures have reached 90 degrees or higher in every month of the year, with extremes of 100 degrees on the west coast in July and August. Between December and March, cool spells occur, with temperatures of 60 degrees, accompanied by average daytime temperatures of 80 degrees and above. At midsummer, the night temperatures average around 72 degrees, and day temperatures about 92 degrees on the west coast, with somewhat warmer nights and cooler days on the remainder of the coast. The rainfall varies greatly from place to place, even on the coast. The driest areas are Mole St. Nicholas, Gonaives, and Tiburon which receive only 20 to 25 inches of annual precipitation; the amounts rise to as much as 60 inches elsewhere on the south and west coasts. Rainfall seasons are quite irregular, but, in general, the months from December to March constitute the driest part of the year on the south and west coasts, whereas the least rain falls in June or July along the north coast.

Oceanic Currents: The waters of Haiti are affected considerably by ocean currents. On the north, a branch of the North Equatorial Current passes approximately 20 miles offshore, flowing from east to west over depths ranging upward to almost 2,400 fathoms. This current carries little or no nutrient material but it is one of the major migration routes of tuna, marlin, swordfish, and other species having migratory habits. Another current, originating off Cape St. Nicolas Mole, flows southwestward through the Windward Passage and joins the eastward flowing Cuban Counter Current off Cape Dame Marie. The latter passes eastward about 25 miles off along the coast at a speed of 0.5 to 0.6 knots and disperses in Mona Passage. Sixty to 70 miles off the south coast is another branch of the North Equatorial Current. This flows westward through the Caribbean at a speed of from 0.5 to 0.7 knots. This Current is possibly another channel or route for migratory species. The waters of Haiti are regarded as rather poor producers of fish since there are no large supplies of nutrient salts available for plankton production. Even the inshore waters are clear and blue. There is little chance for upwelling and the ocean currents in this region are poor in nutrient salts.

In the eastern portion of the Windward Channel a current with a velocity of about 3/4 knot sets northward around Pearl Point, but beyoud a distance of six miles offshore, this current usually sets westward or west-southwestward. Close northward of Cape St. Nicolas Mole, this inshore northerly current meets a constant westerly current which sets along the northern coast of Hispaniola; tide rips set up by the meeting of these currents are plainly visible. This westerly current flows from Cape Haitien and through Tortuga Channel at a rate of about one knot; between Juan Rabel Point and Cape St. Nicolas Mole the current increases in strength and inclines toward the land. Close inshore along this latter stretch of coast, there is sometimes a northeasterly-setting current.

Species and Distribution

The fish population and its distribution in Haitian waters is typically West Indian. Beebe and Tee-Van, in 1928, listed 270 species in 84 families which they found in a small part of Port-au-Prince Bay. The total number of species from the island of Hispaniola is placed at about 324. It may be broken down in the following general groups:

(a) Offshore, pelagic, migratory:

tuna	swordfish	marlin	sailfish

(b) Offshore, pelagic:

dolphin	flying fish	barracuda	ocean sunfish
sharks			

(c) Deep-sea, demersal:

groupers	snappers	hinds	morays

(d) Inshore, demersal, and reef:

groupers	snappers	grunts	squirrelfish
wrasses	hinds	scorpion-fish	angelfish
spadefish	Pomacentrids	seabass	Holocentrids
morays	triggerfish	puffers	flounders
threadfins			

(e) Inshore, pelagic:

pompano	jacks	mullet	mojarra
anchovies	herrings	sardines	sharks
halfbeaks	barracuda	bonefish	silversides
spadefish	sergeantfish	grunts	harvestfish
weakfish	tripletails	croakers	snook
porgies	butterfish		

(f) Brackish, estuarine:

mullet	snook	tarpon	mojarra
halfbeaks	anchovies	jacks	threadfins
grunts	croakers	groupers	sharks

Names of Haitian Fish: Haitian fish names are based on French sources. As is usual with local, common nomenclature, there is often wide variance with the true taxonomic relations. The same species may go under a number of names depending upon color variation, size, sex, or locality. Several species, more or less similar, may have only one name. The local names vary from place to place.

Distribution and Abundance: Enormous schools of round herrings (Jenkinsia lamprotaenia) silversides, sardines, and bumpers are found in the outer parts of Port-au-Prince Bay and are seined or dynamited. Lane snappers are reported as abundant, with other snappers also present in substantial numbers. Sharks and rays are taken in some quantities for the market. Eels are present, both the Anguilla and moray types. The latter are taken in traps or by spearing. Croakers and grunts appear in the markets occasionally and mullet frequently. Jacks, harvest fish, cutlass fish, soapfish, hinds, groupers, barracuda, threadfin, snook, mojarras, gobies, and tangs appear quite regularly.

The majority of catches made at the present time falls into classes (d), (e) and (f), as given in the preceding outline (page 178), with only very small contributions from the other groups.

According to reports submitted by M. Andre Audant, the most important fishing centers, the principal species caught, and seasons are these listed on page 181.

The abundance of fishes in the most easily-reached and easily-fished areas is doubtless very low. This was indicated by the catches observed in Port-au-Prince. The majority consisted of small, immature reef species. When the more enterprising fishermen visited the less frequented areas, good catches of choice fish were taken.

While fairly intensive fishing is carried on in some areas, there is every indication that better boats and gear would increase the catch, by opening new grounds and by making a greater range of species available. Moreover, greater advantage could be taken of the seasonal abundance of certain species such as jacks.

A list of Haitian fish names with their English and scientific equivalents.

Haitian Name	English Name	Scientific Name
brochet	snook	Centropomus undecimalis
saumon	snook	C. parallelus
bechine	barracuda	Sphyraena spp.
palriot	---------	Anisotremus virginious
lippe	---------	A. surinamensis
crocro tete-feuilles or caco gris	grunt, grey	Haemulon macrestomum
crocro gueule-rouge	grunt, redmouth	H. flavolineatum
pargue dent-chien or carde roulesse	dog's tooth snapper	Lutianus jocu
pargue	schoolmaster snapper	L. apodus
sorb or card claire	mutton snapper	L. analis
vivanot jolle-blue	snapper	L. aza
vivanot	silk snapper	L. vivanus
tete ronde or juif	big-eye catalufa	Priacanthus arenatus
viella rouge or nague coleur rouge	red grouper	Epinephelus morio
tienne or nagul	nassau or white grouper	E. striatus
tassard	kingfish	Scomberomorus cavalla
camard	jack	Caranx hippos
carangue gros-yeux	jack	C. latus
carangue grasse	jack	C. chrysos
carangue france	pompano	Trachinotus carolinus
carangue a plume	pompano	T. falcatus
la lune	moonfish	Selene vomer
banane	bonefish	Albula vulpes
lebranche or garmot	mullet	Mugil braziliensis
barbaray rouge	red goatfish	Upeneus martinicus
barbaray jaune et gris or souris jaune	yellow goatfish	U. maculatus
cartinau, marianne or frere jacque	squirrelfish	Holocentrus spp.
jacquot	parrot fish	Scaridae
marguerite	butterfly fish	Chaetodontidae
grand-ecaille	tarpon	Tarpon atlanticus
caille	sardines	Clupeidae
sardine d'or	sardine	Sardinella humeralis
sardine rouge	sardine	S. macrophthalma
Zanchois	anchovies	Engraulidae
harang	herring	Clupeidae
aileronde	sole	Soleidae
rodeau	sheepshead	Archosargus unimaculatus
gros yeaux or diol pas blue	porgy	Sparidae
vingt-quatre heaures	scorpion fish	Scorpaenidae
espadon	sawfish	Pristispectinatus
coutelas	cutlass fish	Trichiurus lepturus
maman-balatre	sailfish	Istiophorus spp.
crapeaud	toadfish	Batrachoididae
cheche	squid	----------
Chouf-chouf	puffer	Tetraodontidae
pantoufflier	hammerhead shark	Sphyrnidae
requin	dusky shark	Carcharhinus obscurus
diable de la mer	manta ray	Manta birostris
cazard	Spanish mackerel	Scomberomorus spp.
grandgele	red hind	Epinephelus guttatus
petit negre	brown hind	Epinephelus sp.
argente	lane snapper	Lutianus synagris
sard rouge	red snapper	L. campechanus
carde gris	grey snapper	L. griseus
portugais	black angelfish	Pomacanthus archatus
sous-ge	blue tang	Acanthurus hepatus

Principal fishing areas, species, and seasons.

Port-au-Prince Bay (Cape St. Marc to Leogane including La Gonaive Island

Species	Season
red snappers	March to May
jacks	July to September
parrot fish	all year

Gonaives Bay

tarpon	all year
sharks	" "
barracuda	" "
snappers	" "
sardines	" "
kingfish	" "
jacks	" "

Port-de-Paix

barracuda	June to November
jack	" " "
kingfish	" " "
herring	" " "
tuna	" " "
snappers	" " "

Miragoane (Leogane to Baraderes and southwest border of La Gonaive)

snappers	
herring	
jack	July to September

Cape Haitien

sharks	all year
tarpon	" "
jack	October to December
parrot fish	" " "
grunts	" " "
"codfish"	" " "

Cape Haitien (con't)

Species	Season
snappers	January to March
seabass	" " "
catfish	" " "
kingfish	April to June
barracuda	July to September
herring	" " "
snappers	" " "

Jeremie (Baraderes to Cape Tiburon)

sardines	spring
jack	July to September
parrot fish	summer

Cayes (Tiburon to Bainet)

jack	abundant
seabass	
snappers	
grunts	

Jacmel (fishermen go south to Saltrou since Jacmel is a poor area)

herring
sardine
grunts

PRESENT FISHERY INDUSTRIES

Little if any change has marked the fishery industries of Haiti for many years. The fishing craft and apparatus used, the grounds fished, and the marketing and distribution channels remain essentially the same as they were years ago. The Government has, in the past, given little attention to the peasant of the sea. His economic level has remained low and his contributions to the welfare of the Republic have been masked by the more important agricultural activities.

Production

Until late in 1942, there was no measure of the catch available except estimates. In March 1942, it was estimated by M. Gomez of Port-de-Paix (engaged in the fish business in this place for several decades) that the total national catch was between 72,000 and 100,000 kilograms per year (155,500 to 224,000 pounds). M. Andre Audant of the National College of Agriculture reported in January 1943 that the total catch extimated on the basis of a survey conducted under his supervision amounted to about 2,065,000 pounds per year. While the difference between these figures is considerable, it may be due in part to the inclusion, in the latter figure, of fish not entering commerce. Audant estimates that the Port-au-Prince Bay region produces 600,000 pounds per year; Gonaives Bay, 500,000 pounds; Port-de-Paix, 100,000 pounds; Cape Haitien, 100,000 pounds; Miragoane, 200,000 pounds; Jeremie, 300,000 pounds, Cayes, 225,000 pounds, and Jacmel, 40,000 pounds.

Distribution

There is very little organized commerce in fresh fish--the only market of any size and purchasing power being Port-au-Prince. This market draws its supply mainly from Port-au-Prince Bay, with little orno fresh fish being received from other parts of the Republic. In the outlying districts, fish is landed on the beaches by the fishermen and is sold or bartered to consumers in the neighborhood. Some small amounts may be carried inland by peasants visiting the coastal towns for the purpose of selling some of their produce. Before the War, fishermen or traders from the Bahamas called at north-coast ports bringing in dried and salt fish, fish oils, and conches which were traded for Haitian agricultural produce. Export restrictions have caused the cessation of this movement.

Fishermen

It is reported, on the basis of the above-mentioned survey by M. Audant, that there are 3,017 fishermen engaged in full or part-time fishing. Their distribution by regions is shown in the following table.

Number of Fishermen in Haiti by Regions

Region	Number
North Frontier to Coracol	20
Coracol to Cape Haitien	161
Cape Haitien to Borgne	10
Borgne to Jean Rabel	393
Jean Rabel to Anse Rouge	115
Anse Rouge to Grande Saline	220
Grande Saline to Deluge	72
Deluge to Port-au-Prince	128
Port-au-Prince to Leongane	138
Leogane to Baraderes	100
Baraderes to Carcasse	1,257
Carcasse to Torbeck	181
Torbeck to Cotes de Fer	187
Cotes de Fer to Bainet	10
Bainet to Jacmel	10
Jacmel to Anse a Pitres	15
TOTAL	3,017

Beebe and Tee-Van (1928) reported that a small colony of Greek fishermen was located at Port-au-Prince. This group engaged in net and hook and line fishing. Their particular specialty was the capture of tunas (Gymnosarda spp.) and frigate mackerels (Auxis sp.) in the outer parts of Port-au-Prince Bay. They also took other species for sale in the local market. This colony, apparently, has been dispersed for there was no mention of its existence in 1942.

The Haitian fisherman, as a general rule, does not spend all his time in that activity but also works on the land, Generally, anyone who has a boat of some type and a net or hooks and lines becomes a fisherman. There is however, a body of full-time fishermen.

The average Haitian fisherman is poor and he is exploited to some extent by middlemen and market women. He prefers not to sell his catch at retail in the market, but rather disposes of it directly from the boat when he lands. Since he has but a limited market for his product, he does not work to his full capacity, and surplus catches must be thrown away or sold at low prices. Therefore, he gauges his labor to produce what he thinks he can sell at the standard market prices.

Boats

All of the craft used in the Haitian fisheries are small and locally built of imported and domestic materials. The largest are sailboats up to 30 or 35 feet (3 tons, gross) and 34 of this type were reported. These vessels are rather clumsy and cannot be regarded as very seaworthy or well built. They are not designed for the use to which they are put and, consequently, cannot operate very efficiently even though they are well handled by the fishermen. None is equipped with live wells or ice-boxes. These boats may at times be used for other purposes such as freighting agricultural products. When fishing, they may carry a crew of 4 to 6 men who operate pots, gill nets, hook and line, and small haul seines. They have a fishing radius, at present of 10 to 20 miles.

Slightly smaller sailboats, of the same general type and characteristics, average 15 to 18 feet in length (2 tons, gross). There were 107 reported. These are used to fish gill nets and fish pots, and, at times, for trolling and handlining. Their fishing radius is from 4 to 8 miles.

Boats from 12 to 15 feet long (1 ton, gross) are reported to number 608. These are small sailboats, crudely built and not seaworthy. They are used only in sheltered waters. These are used in fishing with hook and line and fish pots. The crew may be two to three men. They have a fishing radius of two to four miles.

The smallest craft are the dugout canoes, and 636 were reported. These are usually paddled--occasionally a small sail may be used on the larger ones. Usually, these are utilized for hook and line fishing and for tending fish pots. They have a fishing radius of two to six miles.

Rafts or floats are also employed to some extent, and 71 were said to be in active use. These are built of native logs. They are used in handline fishing and, occasionally, for tending pots. Their contribution to the total catch is small.

With a small expenditure of funds and with technical assistance, better types of fishing craft could be built in Haiti since wood is procurable locally and good shipbuilders may be found in the Republic.

Fishing Gear

Fishing apparatus is of the simplest type. Handlines are used extensively, both for bottom fishing and for trolling. The materials are imported usually, but native ingenuity has devised substitutes in some cases for lines, floats, and leads. Some of the more progressive fishermen set up to 20 lines from the gunwale of their boats and others set flag

lines carrying as many as 900 hooks. Handlining is carried on up to depths of 50 fathoms.

Fish pots are utilized very generally throughout the fishery and these, usually, are made of split bamboo, with few, if any, covered with chicken wire. They are all locally built by the fishermen. The pots are usually buoyed and baited. At least 10,000 of them are fished and the total number is probably 20,000. These pots are set on fairly shallow bottom in the neighborhood of reefs and rocks. The average catch has never been definitely determined, but it is known to vary from a few pounds to 60 or 70 pounds for 48 hours. The pots are set and remain on the ground until worn out. Individual fishermen operate from 2 to 10 pots, and sometimes more.

Gillnets are used to some extent and these are set either at night or in the daytime. The nets are relatively short and shallow and are handmade. Twenty-seven were enumerated, with others reported at several ports.

Haul seines in use number 54. These are used on beaches to take anchovies, sardines, mullet, and other shore species. These nets are fairly small and they are handmade by the fishermen.

Native wood called "bois flot" is used for corks; and stones are often used as weights. Native fibers made into rope serves as buoylines and for other purposes. Bait consists of small fish, the pith of sour oranges, or the flesh of spiny lobsters.

As far as could be determined, no preservative treatment is given the nets. They are handed down from generation to generation--each successively keeping the net in repair.

Even though local materials are used as completely as possible for making gear, there are shortages of some imported materials due to the War. These essential items are sail canvas, fish hooks, nails, and seine twine.

Income

The income of the Haitian peasant is so low that he has very little money for the purchase of foodstuffs. Therefore, what food he does find necessary to buy he considers absolutely essential for his well-being. Low-priced concentrated food, able to remain edible without refrigeration, are, therefore, demanded by this trade. Dried, salted, and pickled fish are consumed in many countries under such circumstances. The main foods, however, under these conditions of low income must be raised or captured by the peasant himself or obtained by barter with fellow peasants.

In Haiti the farmer has learned to draw his very restricted subsistence from the soil. His other requirements are few and he produces little to be sold or exported. Where these peasants live near the sea and have become fishermen, they subsist in similar fashion. Fish taken provide the fisherman's family with food and serve through barter to provide for other simple wants. A considerable amount of fish, also, is sold in commerce.

Prices

Prices range from 2 to 20 cents (U.S. equivalent) per pound. The highest prices are paid in the markets in Port-au-Prince, where in the latter part of 1942 the average retail price was 5 cents per pound, with a range of 3 to 20 cents per pound. The retail price for locally-produced beef was said to be 10 cents a pound, chickens were obtainable at 20 cents each, and eggs sold at about 1 cent apiece, although the best eggs were 40 cents a dozen.

Imports

Imports of fishery products, which normally averaged nearly 9 million pounds a year, have been dropping in the past few years. In the fiscal year 1941-42, imports of these goods totaled

only 1,636,000 pounds. This decline in imports before the War was due to increased prices. Then, since the War began, shipping difficulties have also caused reductions. A high import duty (about 3-1/3 cents per pound plus 20 percent surtax) on dry-salt fish has contributed to a lowering of the imports. The rate for pickled or smoked fish has been half that for dried products.

Per-Capita Consumption

Present consumption of fishery products in equivalents of fresh fish as taken from the water is about 2 1/2 pounds per person per year. This is a decline from a figure of about 10 1/2 pounds per person established in the 20 years prior to 1936.

Marketing

Most of the fish brought to the market in Port-au-Prince arrives in the fishermen's boats. Women vendors sell the catch from stalls equipped with concrete benches in a public fish market. Some fish is also sold from displays spread on the ground in the general market square. The market area of the capital city is close to the water and adjacent to a poor dwelling section. Conditions there were unsightly and, undoubtedly, unsanitary. In Port-au-Prince, fried fish are sold on the street corners by women. These fish are usually small sardines, anchovies, or mullet; but, any small fish is used. The fish is fried in a pan held over a charcoal pot and is sold for a very low price. A considerable amount of fish is sold by this means and the corner vendors enjoy a brisk trade.

POTENTIAL FISHERY INDUSTRIES

Unused Resources

Even though Haiti does not have extensive shallow-water areas along its coast and, even though the productivity of the sea in this area is not great, there is evidence to show that unused fishery resources are available.

The immediate coast, especially on the north and west is fairly intensively fished, but the south coast could stand greater fishing effort. Even in the Bay of Port-au-Prince, there are areas which have been little fished because of their distance from shore and because the depths are greater than can be fished with the present gear. It is felt that further effort could be applied to fishing in the region of the Grande Cayemite, Cape Dame Marie to Cap Carcasse, and between Trou Gresse Pierre and Point des Flamands. With little bottom fishing now being conducted in depths more than 50 fathoms, opportunity exists for deep-water hand-line fishing.

Perhaps the greatest possibilities will be found with offshore pelagic species such as tuna, swordfish, and marlin and with inshore pelagic species such as Spanish mackerel, king-fish, jacks and others.

With the present fishing methods and with present handling and preserving facilities, it has been impossible to taken advantage of the seasonal abundance of many of the species frequenting Haitian waters.

With greater catches made by more efficient means, it should be possible to expand the fish-salting program already instituted by the National College of Agriculture. To make this program more successful, the question of supply and distribution of salt for this purpose should be examined.

Trade in fresh fish can be expanded by providing holding facilities for excess catches. This might well be initiated with the use of live wells on the fishing boats. Live cars anchored outside of the polluted area of harbor water would provide storage space for live groupers, snappers, and other valuable species. Improved marketing conditions and a system

of fresh-fish distribution to outlying towns would increase the demand for fresh fish. Later, if and when circumstances permit, a fish-refrigeration unit should be set up to perform the services of holding fish and, also, of supplying cheap ice to the fishermen. With these facilities, it would be possible to increase the radius of production of fishing boats and to store fish in periods of gluts to take care of periods of scarcity.

Governmental Fishery Activities

Prior to October 1942, there was no agency in the Government of Haiti concerned with fisheries. In that month, a Fishery Service was created to foster and promote the fishery industries of the Republic.

This Service can do much to insure that the fishery resources available to Haitian fishermen are used to best advantages. For this purpose, it may be desirable to disseminate information on fishing methods, gear, and boats, enlarge knowledge of fish salting and drying, provide credit to assist in construction of new fishing units, and encourage the building of docking facilities and clean and sanitary public fish markets. During the War, it may be necessary to pool requirements for gear and supplies and transmit orders through a central Government channel to secure results. Use of live-well vessels to permit Port-au-Prince fishermen to make longer trips from the capital city should enlarge the quantity available for consumers and improve quality. A terminal landing point well outside of polluted waters must be provided for use of such live-well vessels. Possibly, several Bahamas fishermen with live-well vessels could be induced to fish out of Port-au-Prince for at least a trial period.

As fishery resources become subjected to more intense use, it is increasingly important for Government officials to recognize that most fishery resources can be over-fished, resulting in decreased yield and wasted fishing effort. Regulation of use may be necessary if the resources are to be sustained from year to year. Government should be fully cognizant of the character of the resources and their ability to produce, and should procure information at regular intervals on the use of and condition of the resources. These data form a basis for making restrictive regulations or the stimulation of fishing effort.

CONCLUSIONS AND RECOMMENDATIONS

While productivity of Haitian waters is not high, there is a considerable fishing area near at hand than cannot be fished by methods now in use. Lack of transportation except by sea makes the distribution of perishable fishery products difficult and low-purchasing power limits the opportunities for successful fishery enterprises.

It appears that the best use of Haiti's fishery resources would be to encourage a personal-use fishery by coastal dwellers, instructing these people in the preparation of cured fish so that surpluses would not be wasted. Over and above this activity a fishery for the better classes of fish might be carried on by full-time fishermen employing larger vessels with live-wells and more efficient gear. The center of this latter activity might well be Port-au-Prince Bay with the fishing boats making voyages of fairly long duration to more remote fishing grounds. To provide storage for the catches, it sould be possible to install live cars in the unpolluted sections of Port-au-Prince Bay. Marketing conditions should be improved by moving all fish-selling and handling activities to one location. The sanitary standards of this market should be rigidly enforced and there should be adequate provision for docking boats. Retail-selling outlets similar to Haiti's meat stores might be operated, or fresh-iced fish might be vended from sanitary, insulated fish carts.

It is suggested that the Government of Haiti detail an official to study the fishing methods used in Cuba and the Bahamas.

THE FISHERIES AND FISHERY RESOURCES OF THE DOMINICAN REPUBLIC

INTRODUCTION

The fisheries and fishery resources of the Dominican Republic were studies in October 1942 as a part of a survey of the entire Caribbean area made by a Mission of the United States Government under a cooperative arrangement between the United States Department of the Interior, Fish and Wildlife Service and the Office of the Coordinator of Inter-American Affairs. The Mission was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in the Dominican Republic consisted of Milton J. Lobell, Fishery Engineer, and Clarence R. Lucas, Fishery Economist of the Service.

The Dominican Republic occupies the eastern two-thirds of the island of Hispaniola, having a coastline on the Caribbean as well as on the Atlantic. The Republic has had considerable interest in the fishery development and several surveys of its fisheries had been made prior to 1942.

Note: The Mission is indebted to the Dominican Commission of Inter-American Development and to Colonel McLaughlin, of the Dominican Government, for assistance in carrying out the necessary field work and for making previous studies available. The United States Minister, Mr. Avra M. Warren, and his staff aided in many ways. Mr. W. Tapley Bennett, Jr., of the United States Legation, accompanied the Mission on its field trip and assisted in many other ways.

FISHERY RESOURCES

Character of the Coast

The Dominican Republic has in reality two coasts, both ending at Cape Engano, the eastern tip of the Republic. The north coast extends approximately 350 miles in a southeasterly direction from the Bahia de Manzanillo, boundary with Haiti, to Cape Engano. The south coast trends in an easterly direction from the town of Pedernales to Cape Engano, a distance of about 300 miles.

Both coasts are steep-to, with the 100-fathom line from one to eight miles offshore. The only localities where there are considerable bottom areas within the 100-fathom line are between the Bahia de Manzanillo and Cape Isabela (Monte Cristi Bank), in the Bahia Samana, off Cape Engano, around the Isla Saona, between Isla Catalina and Cape Caucedo, between Punta Palenque and Punta Salinas, on Ocoa Bay, and around the Islas Beata and Alta Vela. Altogether, it is doubtful that the total area within the 100-fathom line exceeds 4,000 square miles or an average of about six square miles for every mile of coastline. Off the north coast are two large banks. The largest, Silver Bank, lies 35 miles due north of Cabo Viejo Frances and covers an approximate area of about 1,200 square miles, with depths up to 20 fathoms. Navidad Bank, somewhat smaller, covers an extent of about 250 square miles and is located about 35 miles north of Cape Samana. It has depths up to 17 fathoms.

North Coast: The north coast is marked by the occurrence of numerous reefs and shoals which usually form barriers cut by channels. Small islets and rocks occur and the Monte Cristi Bank region is spotted with them. There are numerous small sheltered localities where small boats can anchor, but the coastal waters are so strewn with reefs and shoals that excellent knowledge of the area is necessary for navigation. The shore varies considerably. There are extensive areas of low, sandy beach interspersed with high, bare or wooded cliffs. At the heads of some of the bays and near mouths of rivers mangrove swamps occur.

South Coast: The south coast has several fair-sized islands. At the eastern end is Isla Saona, 13 miles long and about 3 miles wide. A lagoon of brackish water occupies a portion of the Island. At the western end of the south coast is Isla Beata and Isla Alta Vela. Much of this coast, from Isla Saona to San Pedro de Macoris, is lined with high cliffs. Inshore shallows and reefs make navigation difficult. Small indentations in the rocky cliffs form coves or "caletas". These usually have sandy beaches. On proceeding westward, the shore becomes lower and there are more sandy beaches. There is sufficient sheltered anchorage for small fishing boats.

From surveys made in 1937 and 1938 by Sr. Jose Mosqueiro Manso, a technician employed by the Dominican Government, it appears that fairly extensive areas of muddy and sandy bottoms are to be found on the south coast from Punta Magdalena to Punta Mortero and from Punta Salinas to Punta Palenque. Bottom on the north coast varies from sandy to muddy and to rock and coral reefs.

Climate: The island of Hispaniola is a land mass of sufficient size to influence the tropical marine climate. The range in temperature is increased and rainfall is much affected by the topography. The trade winds bring to the north coast a more equable marine climate than that of the south and west coasts, where temperatures have reached 90 degrees F. or higher in every month of the year, with extremes of 100 degrees F. on the west coast in July and August. Between December and March cool spells occur with temperatures of 60 degrees F. or slightly below, but on the coast the average minimum temperatures of the coolest month range from 65 degrees to 70 degrees, accompanied by average daytime temperatures of 80 degrees and above. At midsummer, the night temperatures average around 72 degrees F and day temperatures about 92 degrees F. on the west coast, with somewhat warmer nights and cooler days on the remainder of the coast, the smallest daily range being 8 degrees F. (77 degrees to 85 degrees) at Puerto Plata, from July to September.

Rainfall varies greatly from place to place, even on the coast. Thus, Barahona receives only 20 to 25 inches of annual precipitation; the amounts rise to as much as 60 inches elsewhere on the south coast and reach nearly 80 inches on the northeast coast. The rainy seasons are

quite irregular but usually the months from December to March constitute the driest part of the year on the south coast, whereas the least rain falls in June or July along the north coast.

Storms: The Dominican Republic is greatly affected by hurricanes, and records show at least 20 severe tropical storms from 1851 to 1935. A disastrous hurricane on September 3, 1930, devastated the city of Ciudad Trujillo (Santo Domingo). More than 2,000 persons were killed and there was great property damage.

Tropical storms which do not pass sufficiently near the south coast to make their presence evident in the weather condition sometimes cause heavy seas which appear with such little warning that they are dangerous to shipping and fishing.

Sea Temperatures: The surface temperatures of the sea on the north vary from 75.9 degrees F. in March to 82.5 degrees F. in September, a range of 6.6 degrees F.; while on the south they vary from 78.4 degrees F. in February and March to 82.9 degrees F. in August and September, a range of 4.5 degrees F.. Over the entire year the waters to the south average about 1.5 degrees F. warmer than those to the north. The sharpest differences occur in March and April, when the southern waters are 2.5 degrees F. warmer than those to the north and the least are in August when there is only 0.2 degrees F. difference.

The range of sea surface temperatures on both coasts, and particularly on the north coast, indicates that considerable mixing of water occurs. Whether this is due to upwelling or to wind-driven contributions of cool surface water has not been established, but there are indications that parts of the north coast may be quite productive. One such place, the Monte Cristi Bank, already has considerable reputation as a fish producer. There are probably other localized areas where fish are abundant, on both south and north coasts.

Oceanic Currents: There are oceanic currents on both coasts and, also, local tidal and wind-driven movements of water. To the south, from 20 to 60 miles offshore is the Cuban Counter Current which originates off Habana, flows westward and southward around Cape San Antonio, then eastward and southward along the coasts of Cuba and Hispaniola, where it finally disappears in the Mona Passage. This current has a speed of from 0.5 to 1.0 knot off the coast of the Dominican Republic. From 30 to 100 miles further offshore, a branch of the North Equatorial Current flows westward, having passed through the channel between Martinique and St. Lucia in the Lesser Antilles. This current has a speed of 0.5 to 0.7 knot off the Dominican coast. There are indications that both currents carry populations of migratory fish. The offshore current has swordfish and tunas, while the inshore counter current has Spanish mackerel, albacore, bonito, kingfish, and other species of more limited migratory tendencies. In certain seasons and in certain years, probably dependent on the characteristics of the counter current, large schools of fish frequent Mona Channel.

To the north, a branch of the North Equatorial Current passes from 20 to 50 miles offshore in a deep channel between the Dominican coast and Silver and Navidad Banks. This current is a part of the North Equatorial Current which does not pass into the Caribbean. From the middle Atlantic it flows westward, skirting the Virgin Islands. Off Puerto Rico it splits, one branch becomes the Bahama Current which flows northwestward along the outside of the Bahamas and the other branch continues westward off the coast of Hispaniola. This current carries little or no nutritive material, but large schools of pelagic fish follow its margins on their extensive migrations.

From an oceanographic standpoint, the Dominican Republic has relatively good possibilities, but the abundance of fish is probably seasonal, and much more intensive study will be required before definite information can be supplied.

Species and Distribution

The fishes found in the waters surrounding the Dominican Republic are, with certain rare exceptions, the same species that inhabit all of the region between Key West and Brazil. In

addition, species of wide distribution, such as the tunas, dolphins, swordfish, marlins, and sailfish, pass through Dominican waters.

The waters have some fish the year around but the greatest concentrations occur on the north coast from September to March, and on the south coast from March until September.

Dr. Maximo F. Conde, a technician employed several years ago by the Government of the Dominican Republic, listed the following native names of fish caught in this area. (Scientific names are given in the General Report, pages 14 - 17.)

A list of Dominican fish names with their English equivalents

carite	- Spanish mackerel	chicharro	- goggle-eye scad
sierra	- kingfish	guavina	- goby
cero	- cero or kingfish	manchego	- lane snapper
jurel	- jack, horse-eye	pez de Dios	- ------
bonito	- bonito or albacore	capitan	- hogfish
chillo	- ten-pounder saucer-eye porgy	vieja	- ------
		pargo prieto	- gray snapper
lisa	- mullet	casabe	- bumper
colorado	- snapper	sardina	- sardine
barracuda	- barracuda	corvina	- croaker
sama	- muttonfish	cabezon	- ------
cotorra	- margate fish	balapis	- ------
cherna americana	- grouper	cabra	- hind
loro colorado	- red parrot-fish	mora	- hind
loro verde	- green " "	medico	- doctor fish
loro azul	- blue " "	pargo colorado	- red snapper
cojinuda	- hardtail jack	anguila	- eel
cro-cro	- grunt	lebranche	- mullet
cherna criolla	- nassau grouper	monte	- ------
cherna judia negra	- black seabass	mariposa	- blue angelfish
cherna blanca	- grouper	paguada	- spadefish
manchada	- spotted grouper	toro marino	- catalufa or big-eye
boca larga	- snook	mantequilla	- butterfish
sabalo	- tarpon	jabonero	- ------
gurupa	- ------	aguajil	- ------
palometa	- harvest fish	sable	- silver-fish
casabito	- ------	gata	- nurse shark
picuda	- baracuda	alecrin	- shark (Galeocerdo)
crevalle	- crevally	cari-cari	- ------
pluma	- jolthead porgy	tiburon de ley	- shark (Carcharhinus)
pluma negra	- grass porgy		
colirrubio	- yellowtail snapper	cabeza de batea	- shark "
arrayado	- sailor's choice	galano	- shark "
chopa	- rudderfish	remoto	- shark "
		tigre marino	- shark (Galeocerdo)
cazon de playa	- ground shark	bocayate	- snapper
dentuzo	- shark (Hypoprion)	pulpo	- octopus
cornuda	- hammerhead	lambi	- sea snail
pez sierra	- sawfish	jaiba	- crab
pargo amarillo	- schoolmaster	bulgao	- sea snail
corcobado	- look down	almejas	- clams
ronco	- grunt	ostras	- oysters
ronco blanco	- white grunt	ostiones	- oysters
zapatero	- leather jack	tortugas	- turtles
salmon	- goatfish	carey	- hawksbill turtle
atun	- tuna	tinglar	- ------
		congrio	- conger eel

Dominican fish names with their English equivalents (cont.)

dorado	- dolphin	viejaca	- ------
cabrilla	- seabass	balao	- halfbeak
madrigal	- rock salmon or amberjack	peto	- wahoo
		vaca	- little tuna
boca colorada	- grunt	morena	- moray eel
guaguanche	- barracuda	escribano	- ------
agujon	- needlefish	volador	- flying fish
peje-puerco	- oldwife	trompetero	- trumpet fish
robalo	- snook	barbudo	- threadfin
mojarra	- mojarra	candil	- squirrelfish
jarea	- ------	machete	- cutlassfish
tonina	- dolphin	cartinan	- ------
cachalote	- sperm-whale	lista-negra	- ------
macarela	- mackerel	plateado	- ------
bacalao	- ------	jocu	- dog snapper
ballena	- whale	ojanco	- ------
macabi	- bonefish	chucho	- ray
chapin	- trunkfish	quia-quia	- jack
banano	- ------	ojudo	- jack
langosta	- spiny lobster	civi macho	- jack
langostina	- shrimp	cibi amarillo	- jack
		obispo	- ray

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In addition to the forms listed above, there are others of greater or lesser importance. With the inaccuracies inherent to the task of assigning common names of fish in Spanish to common names in English or to scientific names, there are probably errors in the above list. Little can be done, however, until an exhaustive taxonomic study is made.

Ecology: The waters of the Dominican Republic contain all of the representative types of tropical marine ecology. Offshore is the blue, clear, oceanic environment with its scarcity of planktonic food and small fishes. Here pass the tunas, dolphins, marlins, swordfish and sailfish which occasionally pause to pursue and capture the silvery flying fishes. Along the shores and in the depths, where reefs and rocks are found, are numerous representatives of the hinds, groupers, snappers, grunts, porgies, wrasses and squirrelfish. Where the coast is open and along the sandy beaches are mullet, croakers, Spanish mackerel, barracuda, porgies, sardines, anchovies, pompano, jacks and others. In the brackish estuarine conditions, such as at the head of Samana Bay, will be found mullet, tarpon, mojarra, snook, grunts, croakers, groupers, snappers, shrimp, anchovies, and like types. Sharks and rays throughout most of these ecological areas will be found. Spiny lobsters usually live around the reefs, oysters in brackish waters attached to mangroves or pilings, and clams on sandy beaches. Turtles are found at sea or, when laying their eggs, on surf-swept beaches.

Little is known of the seasonal occurrence of most of the above species, their abundance, their life histories, or migrations. Until the necessary studies are made, it is possible only to approach the real center of the problems affecting fish and fishing in these waters.

THE FISHERY INDUSTRIES

The Dominican Republic is one of the very few Caribbean countries which maintain a collection system for fishery statistics. These data are collected by month, species, and port of landing. Since these figures represent only the commercial portion of the catch, the considerable yield from fishing for personal consumption is not recorded. Therefore, the published catch statistics must be regarded as minimums. There is a licensing system which gives a good indication of the number of fishermen and boats in the country.

Production

Catch statistics were made available for 1939, 1940, and 1941 by the Secretary of State for Agriculture, Industry, and Labor of the Dominican Republic. These figures indicate that the total recorded catch for 1939 was 731,343 pounds; for 1940, 913,840 pounds; and for 1941, 1,105,957 pounds. Data were obtained for 27 ports. In 1939 the largest catches were reported from La Romana, 143,609 pounds; from Calderas, 125,046 pounds, and from Boca del Soco, 117,220 pounds. In 1940 the principal port was Calderas, with 156,619 pounds. Bayahibe reported 145,261 pounds and San Pedro de Macoris, 104,963 pounds. Samana, with reported landings of 191,781, was the principal fishing port in 1941. Barahona was second, with 104,350 pounds, and Chavon and Bayahibe third, with 103,325 pounds.

The principal species in 1939 were colorado (probably red snapper) with 86,697 pounds landed, cojinuda (hardtail jack) with 58,784 pounds, and jurel (jacks) with 34,927 pounds. In 1940 the greatest amounts reported were of colorado, 77,523 pounds; cojinuda, 62,499 pounds; and mero (grouper) 54,272 pounds. In 1941 landings included 140,224 pounds of colorado, 67,957 pounds of cojinuda and 56,963 pounds of carite (Spanish mackerel). Listed in the landing records are reported catches of 42 kinds of fish and shellfish in 1941, 40 in 1940, and 29 in 1939.

The largest catches during 1939 were made in September and October with an average of about 95,000 pounds for each of these months. Catches in January and February were less, with only about 6,000 pounds reported for each. During 1940, the best catches were reported for April, 113,233 pounds; August, 111,360 pounds; and May, 110,375 pounds. The variation in the amount of fish landed by months indicates that seasonal variations of abundance of fish does not seem to have a very great effect on the size of the catches but that they are affected by other factors.

Distribution

The largest market for fresh fish is Ciudad Trujillo and its nearby towns, and fish is supplied to this market usually from Azua, Palenque, Nizao, Haina, and Nigua and from around Ciudad Trujillo itself. At times, some fish is shipped in by truck from Samana Bay and from other points. At the more isolated localities, local demand only is supplied. Fish are purchased by wholesalers from the fishermen at the point of landing. The wholesalers carry them to the city and sell to retailers. In Ciudad Trujillo fish is sold at the Model Market, in the the Plaza, and in the Hospedaje; but the best and most modern retail outlet is the Model Market. Practically all transportation of fish is by truck, with the fish packed in boxes with crushed ice. In small communities fish may be sold in the local markets, by hawkers, or by the fishermen themselves at the landing point.

In Ciudad Trujillo fish may be sold only in the Model Market, where a rental of $40 (U. S. currency) a month is charged for a stall, in the Plaza, or in the Hospedaje, where a rental fee of one cent a pound is charged for a table.

Fishermen

While there is no census of fishermen, a good indication of the number may be gained from the license records. Thus in 1940, 1,284 men were engaged in fishing from boats and 87 from shore, and the total recorded number was 1,371. In 1941, there were 1,373 boat fishermen and 26 shore fishermen--a total of 1,399. In the first nine months of 1942 there were 1,169 boat fishermen and 214 shore fishermen, totaling 1,383. To these figures must certainly be added the considerable number of persons who fish for their own use. In the first nine months of 1942, it was reported that 22 percent of the fishermen of the Republic were fishing in the Province of Samana, 19.2 percent in the Province of Barahona, and 15.7 percent in the Province of Seibo.

The typical Dominican fisherman lives with his family in very simple fashion, usually in small fishing villages. He handles his boat and fishing gear well and prefers fishing to

other occupations. His income is small but he usually is content with little. He is quite independent but friendly and cooperative. As far as could be determined, there were no formal organizations of fishermen, although the fishing village itself often forms a close unit.

Article 9 of the fishing Law (Number 1518), dated 1939, sets forth the license fees for fishermen and boats. It states:

1. For a sail or motor boat with a crew of more than three and engaged in industrial fishing 1/ $50.00 2/

2. For a sail or motor boat with a crew of three or less and engaged in industrial fishing $30.00

3. For a sail or motor boat with a crew of more than three, engaged in commercial fishing 3/ $15.00

4. For a sail or motor boat with a crew of three or less, engaged in commercial fishing $10.00

5. For a sport fishing boat $5.00

6. For a small boat, skiff or canoe $1.00

Article 11 states that "enjoyment of exceptions for fishing will be granted:

1. To persons engaged in investigations; and

2. To persons who use no boats or those called 'fishermen of the coast', provided that they use only poles and hook and line."

1/ Industrial fishing refers to fishing wherein the catch is subject to processing in whole or part before being sold.

2/ In United States currency equivalent.

3/ Commercial fishing refers to fishing wherein the catch is to be sold without processing.

Boats

License records for the year 1941 of fishing boats report that a total of 587 craft of all types were registered for fishing. Of this number, one was listed as a motor boat, one as a motor launch, 5 as large rowboats, 41 as large sailboats, 3 as sailboats with auxiliary motors, 194 as canoes (cayucos), and 342 as small skiffs or rowboats without sail or motor. The largest number of boats was registered in the province of Seibo, 113; composed of one motor launch, 16 large sailboats, 41 cayucos, and 55 small skiffs. The province of Samana had a total of 108 craft made up of one motor boat, 4 large row boats, 102 cayucos, and one small skiff.

The motor vessels are of general type not designed particularly for fishing. The sailboats range from 15 to 35 feet in length, are fairly well built, and are quite usable for the type of fishing engaged in. The cayucos range up to 25 or 30 feet and are constructed from logs hollowed out into canoe form. The small skiffs are a heterogeneous collection of small rowboats, often cranky and poorly built. They are usable only for fishing in sheltered waters. Practically all boats in use in the fisheries in the Republic are built locally.

Fishing Gear

There are no data regarding the actual number and kind of fishing apparatus in use; however, it is known that the principal types of gear are beach seines (chinchorros), fish-pots (nasas), castnets (atarrayas), and hook and line, used both for bottom fishing and for trolling.

The chinchorros are not large and are handmade from imported materials. There are probably none larger than 100 to 150 meters in length. A regulation states that such nets must have minimum bar measures of 2 centimeters (about 2" stretched measure) in the bag, 4 centimeters (about 3.2" stretched) in the remainder of the bunt, and 6 centimeters (about 5" stretched) in the wings.

The nets are set from small boats in a circle facing the beach. A crew of 5 to 12 men is needed. The nets are hauled in by hand from the beach, trapping any fish in the ground covered by the sweep of the net. A fairly smooth and regular bottom is required. Chinchorros cannot be used successfully where surf conditions are heavy.

Atarrayas are used quite generally and require the services of only one man. They are fished in shallow water and the catches are quite small. Regulations specify that castnets used for catching fish for sale must have a minimum bar measure of 16 millimeters (about 1-1/4" stretched) and for catching fish for bait, 10 millimeters (about 3/4" stretched). These nets are knitted by the fishermen from imported materials. They vary considerably in size, some may have a spread of 15 feet but usually they are smaller.

Fish pots or nasas are of the same general type as used elsewhere. They are constructed with a wood framework covered either with woven, split bamboo or by chicken wire. In most general use is the one-tunnel type with the shape of a broad arrowhead. These are fished on the bottom in rocky or reef areas. Usually they are not buoyed.

Hook and line gear is used as desired by the individual fisherman with considerable variation as to rigging. Materials are imported. Bottom fishing is carried on from small boats either anchored or drifting over suitable bottom. Trolling is conducted from sail-boats and one to three lines are used at the surface.

Harpoons are employed, but their use is limited by law to sharks and rays; and fish spears must not have less than five centimeters between the three prongs. Regulations are also in force for minimum mesh sizes of certain types of gill nets, for shrimp drags, trammel nets, for fish trawls, and for paranzella-type nets.

Fishing with dynamite or with poisons is strictly prohibited. In addition, building of weirs or other obstructions is not permitted. Dragging or trawling within 600 feet of the mouths of rivers, ports and estuaries is prohibited, and the use of any form of gear other than hook and line in pot holes and pools in rivers is also proscribed.

Various technicians have recommended the use of trawl nets for bottom fishing in various areas—particularly on the south coast, where they have reported areas of mud and sand bottoms. Apart from the hazards to the nets which, doubtless, would be encountered in the way of isolated rocks and coral heads, it has been found that in tropical waters clear bottom areas are singularly lacking in amounts of fish to make such operations worth while. Some fish may be caught but the supply is quickly exhausted. This has been demonstrated by the work of the experimental fishing vessel (the W. B. Lewis) of the Puerto Rican Division of Fish and Game, on the west coast of Puerto Rico.

The present types of gear appear to be sufficiently productive to supply the present market, but any great increase in fish production must look to more productive types of gear.

Prices

Prices for fish are set by the government according to grade or quality. Carite is regarded as a first-class fish and a price of 8½ cents per pound is paid to the fishermen on the beach. At Ciudad Trujillo the price is from 12 to 16 cents per pound wholesale, and retailers sell for 20 cents per pound for the whole fish, or 25 cents per pound in steaks or fillets. While colorado is regarded as a second-class fish, the price structure is about the same as for carite because the supply is always less than the demand and because these fish are harder to catch.

Cojinuda, sama and bermejuela list as third-grade kinds of fish and the fishermen receive about six cents per pound. At retail, these species sell at 9 to 12 cents by the piece and 18 cents in steak or fillets. Jurel, mero and pargo bring 4½ cents per pound to the fishermen, 8 to 11 cents per pound to the retailer, and 12 to 14 cents to the consumer. The lowest grade of fish, which includes all small fish, sells for 3 cents per pound to the wholesaler on the beach, 6 to 8 cents to the retailer in Ciudad Trujillo, and 8 to 10 cents per pound to the consumer. These prices are reported to vary somewhat depending on the abundance or scarcity of fish.

Canning and Preserving

There are as yet no canneries or other plants devoted to the processing of fish. As far as could be determined, but little fish is salted or dried, and there are no plants engaged in sharp freezing. The capacity sufficient for present needs is provided by present ice-making plants, but any expansion in the fresh-fish trade would require larger installations. Some cold-storage space is available in Ciudad Trujillo and elsewhere in the Republic, but the amount is relatively limited. Recently, however, a large meat-processing plant equipped with modern freezing and ice-making machinery has been completed. This plant, located in Ciudad Trujillo, would be very suitable for freezing and storing fish. In the Model Market located in the capital, fish are kept in small mechanical refrigerators with which each stall is equipped.

Exports

According to statistics furnished by the Division of General Statistics of the Dominican Government, 300 kilos of fishery products valued at $159.00 was exported in 1940; and 200 kilos valued at $80.00 was shipped in 1941.

Imports

Imports from 1938 to 1940

		Salt cod-fish and other dry-salt fish	Smoked fish	Canned fish and other fishery products
1938	Pounds	2,870,000	1,376,000	5,959,000
	Value	$ 147,700	$ 46,200	$ 221,900
1939	Pounds	3,317,000	1,410,000	5,265,000
	Value	$ 161,500	$ 40,000	$ 242,100
1940	Pounds	2,506,000	1,177,000	3,811,000
	Value	$ 112,000	$ 38,500	$ 160,000

Normal imports of fish have varied between $500,000 and $1,000,000 in value. The imports from 1938 to 1940 are listed in the table given above.

Marketing and Other Economic Considerations

The fishery industries of the Dominican Republic play a relatively unimportant part in its economy. Although fish are not greatly relied on for food in this agricultural country, they are at least fairly abundant off the coast and furnish an important element in the country's food supply. With local food commodties comparatively low-priced throughout the Republic, fish cannot sell in quantity at prices high enough to pay for transportation from distant points.

About 250,000 pounds of fresh fish are purchased yearly by the 70,000 inhabitants of Ciudad Trujillo. This is sold over market tables in two of the three public markets, and in the third it is sold from enclosed booths equipped with refrigerators. Market fees add about one percent per pound to the prices to consumers. Fish bought at the beaches for 3 to 8 cents a pound are here sold to consumers at 8 to 25 cents a pound, and for chickens 25 cents a pound is charged. Eggs sell for 36 cents a dozen. All of these products sell for much lower prices in the country and in small towns where middlemen are eliminated and market charges not assessed. In the country, eggs sold at four for 5 cents, chickens at 20 to 25 cents each, and fish for 5 to 10 cents per pound.

Computed in fresh-fish equivalents, imports of fishery products provide, normally, about 40 million pounds of food annually. Per capita consumption of fish products of all types, both domestic and imported, in terms of fresh fish, is about 25 pounds per year.

POTENTIAL FISHERY INDUSTRIES

The waters surrounding the Dominican Republic support a large variety of fish and shellfish. In common, however, with other localities in this part of the Caribbean, the actual abundance of individual species is not high. There are indications of considerable seasonal fluctuations in the supply and abundance of fish. The Republic, however, has fairly considerable areas where fishing activity could be increased. Among these areas are the Monte Cristi Bank, Samana Bay, around Cape Engano, around the Isla Saona, in Ocoa Bay, and around Isla Beata. In addition, the two extensive offshore banks, Silver and Navidad, on the north, might be fished with suitable boats and gear. Fishing probably can be intensified on such species as mullet, snook, shrimp, grunts, mojarra, and other inshore species. Bottom species, such as grouper and snapper, probably can be caught in greater numbers.

The biggest opportunities for expansion of the fisheries, however, appear to be in the direction of the pelagic species. Just offshore, these would include Spanish mackerel, kingfish, bonito, barracuda, and others; and these might be taken by trolling, in gill nets, or by purse-seines if the characteristics of the schools were favorable. Further offshore, there are large migratory schools of tuna and swordfish. These would best be caught by trolling methods or with harpoons. If bottom conditions are favorable in Samana Bay, the use of fish or shrimp trawls might be profitable, but this activity should be controlled closely. If schools of fish pass close inshore, there should be excellent possibilities in the use of fish pounds or traps. These could furnish cheaply-produced fish for use in a salting and drying industry. The region from Isla Saona to Cape Samana is considered the most suitable, but traps might be successful at Punta Salinas and Punta Palenque.

With an excellent network of communications, the Dominican Republic should develop a more efficient distribution and marketing system for fresh fish. It is believed that there are sufficient resources at hand to supply a much greater demand.

Fish-salting and drying industries can be established using the cheaper varieties of fish such as mullet, snook and shark. The resources of these species can supply a great increase in the catch.

In general, it may be stated that the marine fishery resources of the Dominican Republic are capable of producing a considerably increased yield of fish.

The Dominican Republic, as most other Caribbean countries, has thus far developed fisheries based on her comparatively stationary populations of bottom fishes. While some migratory fishes are caught, the migrant species are not fished for intensively. Virtually, all fish are caught with simple gear and boats that are not adaptable to mass production methods.

It is questionable whether the present markets of the Dominican Republic would support a mass-production fishery, even if the resources were sufficiently bountiful to provide great quantities of fish. However, fish within price limits that the laborer could afford to pay would be an advantage to the economy of the Republic as well as to health of the people.

Mass-production methods might provide sufficient volume of fish at low prices to develop a considerably increased demand within the Republic, as well as to supply fish for export, fresh, frozen or salted. Limited opportunities may also lie in export of specialties such as spiny lobster and shrimp.

GAME FISHING

Certain waters off the Dominican Republic offer excellent opportunities for game fishing, and a steadily increasing group of residents are enjoying this sport. Off the Monte Cristi Bank, sailfish, marlin, and tuna angling is available. In Samana Bay, tarpon, crevallies, and other species are present and in Mona Channel, tuna, bonito, Spanish mackerel, barracuda and kingfish may be taken. On the south shore, Spanish mackerel, kingfish, grouper, snapper, barracuda, and other species are available to anglers.

With excellent hotels, good communications, and modern facilities, the Dominican Republic offers attractive vacation possibilities to sport fishermen.

CONCLUSIONS AND RECOMMENDATIONS

Waters of the Dominican Republic support sufficient resources in fish and shellfish to justify further fishery development. Locally-produced fish seems to be available in many parts of the Republic, but prices generally are higher than the majority of the population can afford to pay. Much more fish could be marketed if prices were lowered.

With lower prices, a considerable expansion of the fresh-fish industry would result. Perhaps the basic limiting factor of all is the lack of sufficient low-cost production. This might be remedied by introducing more efficient means of capturing fish. With increased production, unit costs would be lowered and this would enable the salting of surpluses for export. Both fresh and salt fish could be sold in Puerto Rico and possibly in Haiti.

It is recommended that the Dominican Republic continue its governmental activities in the collection of fishery statistics and other operations. Present governmental fishery research and control is vested with the Secretary of State for Agriculture, Industry and Labor. This Department collects fishery statistics and makes investigations.

THE FISHERIES AND FISHERY RESOURCES IN THE BRITISH WEST INDIES

(Eastern Group)

INTRODUCTION

The fisheries and fishery industries of the Eastern Group of the British West Indies were studied during April and May 1942, as a part of a survey of the Caribbean area made by a Mission of the United States Government under an arrangement between the Fish and Wildlife Service of the United States Department of the Interior, the Office of the Coordinator of Inter-American Affairs, and the Anglo-American Caribbean Commission.

At a meeting of the Anglo-American Caribbean Commission at Trinidad in March 1942, the critical food situation in the various British Colonies of the Caribbean area was discussed; and, in recognition thereof, the Commission decided that an immediate survey should be made of the fisheries to determine their present and potential yield, their contribution to the economy of the area, and possibilities for their immediate expansion to replace imported food products.

Prior to this time, the Department of the Interior and the Office of the Coordinator of Inter-American Affairs were developing a program for a factual survey of the fisheries and fishery resources of the various American Republics in the Caribbean area. Learning that the Anglo-American Caribbean Commission was interested in similar studies in the Eastern Group of the British West Indies, a conference was held of the three agencies concerned. As a result, it was decided that the personnel selected for the surveys in the American Republics would assist the Commission in their studies.

The survey was under the direction of Reginald H. Fiedler, Chief of the Division of Fishery Industries, Fish and Wildlife Service, United States Department of the Interior, and the field party in the British West Indies consisted of Milton J. Lobell, Fishery Engineer, and Clarence R. Lucas, Fishery Economist of the Service, and Herbert H. Brown, Director of Fisheries Investigations, Development and Welfare in the British West Indies.

The following sections were prepared and submitted to the Anglo-American Caribbean Commission immediately after the survey of the Eastern Group of the British West Indies had been completed in May 1942. Consequently, they do not have the same general editorial form as the reports for the other Caribbean areas. More complete reports have already been published (1942) by Herbert H. Brown, the British member of the survey party. These include reports on the fisheries of Barbados, Trinidad, Togabo, and British Guiana. Further detailed reports are to be made by him on the fisheries of the remainder of the British Colonies in the area.

This report is presented here for the purpose of drawing attention to immediate needs of this area in order to assist in maintaining fish production at a more normal level. It should, therefore, be regarded as a plan for emergency action rather than a long-range development plan.

The Area in General

The fisheries and fishery resources of the islands in the Eastern Group of the British West Indies have a social and economic importance not generally realized. The 1,018,000 inhabitants (excluding British Guiana) normally consume 25½ million pounds of fishery products per year, valued at more than 2 million dollars. These products include 14½ million pounds of fishery imports valued at 1-1/5 million dollars and 11 million pounds of locally-produced, fresh fish valued at 1-1/10 million dollars as sold by fishermen.

The local production of fresh fish is harvested by approximately 6,936 fishermen, equipped with about 2,340 boats and gear estimated to number 22,000 fish-pots, 250 seines, 150 gill nets, 5,000 lines, and other less important gear. Regular employment in the

fishery industries, also, includes thousands of market women, hucksters, and other persons. Boat-builders, outfitters, and others are less directly concerned but derive considerable benefit from the fishery industries. Moreover, there are thousands of families living on or near the coast who engage in non-commercial fishing for their table. The regular fishermen are characterized by a self-reliant and independent outlook, and many are capable of adapting themselves to new techniques.

Trinidad contributes 57 percent of the total catch, the Leeward Islands and the Windward Islands 17 percent each, and Barbados 9 percent.

Available supplies of fishery products have decreased to about one half of the normal level since the beginning of the War. This is due to (a) greatly reduced imports of salt and canned fish, and (b) curtailment of local fishing effort.

The fish shortage combines with corresponding decreases in meat supplies to create a serious and critical situation. Immediate and drastic action must be undertaken to check the progressive deterioriation in the food situation and particularly that of protein foods. If immediate action is not undertaken, there will be rapid decline both in nutritional standards and in morale.

Imports of fishery products have normally been the mainstay of the protein diet of virtually the entire population. Shipments of these products must be maintained at as high a level as possible.

Shortage of fishery imports has not stimulated the local fishery industries correspondingly; actually, the contributions provided by these industries have also declined. Shortage of gear replacements and attraction of fishermen to more remunerative work have left the local fishery industries in a very serious condition.

While present production is not more than one third to one half below that of normal, it is anticipated that almost an entire cessation of production will ensue if no steps are taken to remedy the situation.

The decline in fishery industries can be counteracted immediately by (a) providing gear to the fishermen and (b) adjusting controlled prices to provide a greater incentive.

The marine resources are capable of making an increased contribution to the food supply. A program of development begun immediately could, within a few months, contribute materially to the fish production. This program should include (a) a sea-going survey of commercial fishery operations, (b) parallel technological development to convert West Indian fishery resources to the best possible commercial uses, (c) practical demonstrations to the fishermen of proved techniques developed by the above, and (d) government assistance in financing approved fish-production projects.

The fisheries of the West Indies have been neglected in the past and, therefore, have not contributed to the economy of the region to the extent of their capabilities.

To adjust this over the coming years, a long-range development and management program should be instituted by the Colonial Governments. This should provide for (a) collection of adequate fishery statistics, (b) stimulation of production, (c) adequate conservation measures, and (d) elimination of uneconomic and unhygienic marketing practices.

The findings of the survey party are interpreted in the light of war-emergency conditions. The recommendations derived therefrom are designed to take care of immediate needs for the maintenance of fish supplies.

Food shortages, population increases, break-down of transport facilities, increased labor demands, and enlarged purchasing power make urgent recommendations necessary. Advantage must be taken of every possible means of increasing the supply of locally produced foods, and particularly of animal proteins. The demand for such food is not now satisfied and can-

not be satisfied by local initiative alone. For this reason, it is essential that the fisheries, an important but undeveloped source of food of outstanding nutritional value, be stimulated by the governments concerned.

The extent of the fisheries and fishery industries in the Eastern Group of the British West Indies is shown in the following statistical tables compiled from official records in the various Colonies.

Fishery Industries of the British West Indies (Eastern Group), 1942

Operating Units Employed

	BOATS	MEN	POTS	SEINES		GILL NETS		TROLL LINES		HANDLINES	
	Number	Number	Number	Number	Lgth. of ea. in ft.	Number	Lgth. of ea. in ft.	Number	Total length in ft.	Number	Total length in ft.
Leeward Islands											
Antigua	175	700	3,000	4	300	3	300	350	21,000	Few	2/
St. Kitts-Nevis	75	320	3,000	3	300	--	---	175	10,500	Few	2/
Montserrat	75	300	1,000	2	300	--	---	100	3,000	Few	2/
Barbuda and British Virgins	220	450	2,000	12	300	--	---	300	6,000	Few	2/
TOTAL	545	1,770	9,000	21	6,300	3	900	925	40,500	Few	2/
Windward Islands											
Dominica	50	200	400	50	300	--	---	100	7,000	Few	2/
St. Lucia	200	400	500	15	700	--	---	400	30,000	Few	2/
St. Vincent	150	400	150	10	1,200	--	---	300	18,000	200	40,000
Bequia	100	330	150	10	1,200	--	---	200	12,000	200	38,000
Grenadines	50	200	200	---	-----	--	---	100	6,000	100	19,000
Grenada	80	300	400	16	1,000	--	---	160	10,000	240	70,000
TOTAL	630	1,830	1,800	101	5,500	--	---	1,260	83,000	740	167,000
Barbados	561	1,193	1,500	10	360	---	---	340	20,000	550	45,000
Trinidad & Tobago	600	2,070	10,000	(10	1,270 1/)	150	960	1,000	60,000	70	42,000
British Guiana				(100	600)						
by handlines off shore	7	70	------	---	----	---	---	-----	----	---	-----
GRAND TOTAL	2,343	6,936	22,300	242	----	153	---	3,500	----	---	----

1/ Italian type

2/ Data not available

THE CARIBBEAN AREA -- BRITISH WEST INDIES

Imports of Fishery Products, British West Indies, 1941

(Eastern Group) excepting British Guiana

PLACE	CANNED FISH		OTHER FISHERY PRODUCTS		TOTAL FISHERY PRODUCTS	
	POUNDS	VALUE	POUNDS	VALUE	POUNDS	VALUE
Leeward Islands						
Antigua	15,750	$ 3,000	679,000	$ 38,000	694,750	$ 41,000
St. Kitts-Nevis	37,890	6,800	889,400	46,000	927,290	52,800
Montserrat	7,430	1,300	275,420	15,200	282,850	16,500
Barbuda and British Virgins	1,570	300	2,350	100	3,926	400
TOTAL	62,640	$ 11,400	1,846,170	$ 99,300	1,908,300	$ 110,700
Windward Islands						
Dominica	1/	1/	1/	1/	350,000 2/	$ 23,000 2/
St. Lucia	1/	1/	1/	1/	578,750	39,000
St. Vincent	13,660	$ 2,900	555,690	$ 32,700	569,350	35,600
St. Vincent Grenadines						
Grenada Grenadines	23,570	4,400	860,190	54,700	883,760	59,100
TOTAL	-------	-------	--------	-------	2,381,860	$ 156,700
Barbados	200,000	$ 41,980	3,696,200	$214,500	3,896,200	$ 256,480
Trinidad and Tobago	1,035,250	$186,600	5,317,500	$463,100	6,352,750	$ 649,700
GRAND TOTAL	---------	--------	---------	--------	14,539,620	$1,173,580

1/ Data not available

2/ Estimated

Fishery Industries of the British West Indies (Eastern Group) 1/

Total Catch, 1940

PLACE	Pounds	Value
Leeward Islands:		
Antigua	700,000	$ 70,000
St. Kitts-Nevis	300,000	30,000
Montserrat	300,000	30,000
Barbuda and British Virgins	450,000	45,000
TOTAL	1,750,000	$ 175,000
Windward Islands:		
Dominica	200,000	$ 10,000
St. Lucia	400,000	40,000
St. Vincent	400,000	40,000
Bequia	350,000	35,000
Other Grenadine Islands	200,000	20,000
Grenada	300,000	30,000
TOTAL	1,850,000	$ 175,000
Barbados	1,000,000	$ 100,000
Trinidad & Tobago	6,000,000	600,000
British Guiana by handlines off shore	500,000	50,000
TOTAL	7,500,000	$ 750,000
GRAND TOTAL	11,100,000	$1,100,000

1/ Figures represent the approximate normal catch prior to war-time reduction in fishing effort.

Conclusions and Recommendations

Conclusions and recommendations are given below for each of the important geographic sections of the Eastern Group of the British West Indies. These are taken in the following order: Leeward Islands; Dominica, St. Lucia, St. Vincent, The St. Vincent Grenadines, Grenada and Carriacou (Windward Islands); Trinidad; and Barbados.

LEEWARD ISLANDS

General Conditions

Fish is a staple article of diet for all classes in the Leeward Islands, and imported salt fish has been the basic protein food of the laboring classes. In 1940, about 550 fishing craft employing 1,800 fishermen landed 1,750,000 pounds of fresh fish valued at approximately $175,000. In addition to this, imports of all classes of fishery products amounted to 1,850,000 pounds valued at approximately $111,000. With a reported population of 97,000, the annual per-capita consumption of fish products of all types converted to a whole fresh fish is 94 pounds.

The fisheries of the Leeward Islands are conducted with small, locally-built boats of good design, not exceeding 30 feet in length, equipped with sails and capable of operating within 10 to 15 miles of shore, but dependent on wind and current conditions. None is equipped with motor, live-well or ice-box. The dominant type of gear is the fish-pot. Seines and other nets contribute a significant part of the catch. The fish supply is on a day-to-day basis with no carry over of stocks. In the larger communities, fish are sold by market women at regularly established fish markets. In smaller communities, where no fish markets exist, fish is bought by the public and by hucksters on the beach where the fishing boats land. In normal times, the inland communities are generally well supplied with fresh or lightly-salted fish through huckster distribution.

An extreme scarcity of fish was found at the time of this survey (April-May, 1942). There has been a significant decrease in the catch. This is attributed to (a) shortage of materials for construction of gear, (b) decreased numbers of fishermen due to labor demands elsewhere, and (c) insufficient return to the fishermen under the present Government-controlled prices. These factors have caused the withdrawal from the fishery of more than 50 percent of the normal number of craft and a corresponding decline in the landings.

Conditions tending to aggravate the scarcity of fresh fish and reduced supplies of imported fishery products are (a) the increases in population caused by the establishment of bases, (b) the increased purchasing power due to higher wages, and (c) the curtailment of imports through restriction of regular transport.

Means for increasing the supply of fishery products include (a) the diversion of sufficient shipping space to transport salt fish from the normal sources of supply in North Atlantic ports, and (b) the establishment and expansion of local fishing effort. An immediate increase of locally produced fish is possible since (a) sufficient craft of good fishing types are available, (b) productive fishing areas are accessible, (c) the native types of fishing gear and methods in use are well suited to local conditions, and (d) experienced fishermen will return to the fishery when conditions are more favorable.

A considerable increase in the catch would make fresh fish more easily obtainable not only to the regular consumers, but also to the military bases. The need for imported fishery products would lessen. If a surplus of fish were present after all the demands for fresh fish had been satisfied, then the surplus could be salted.

Recommendations

It is recommended that:

1. The local fishery industries be expanded to relieve the shortage of fresh and salt fish.

2. The deficiencies in imported fish products be made up as far as possible by locally-produced fresh fish.

3. The fishing industry be stimulated by making immediately available wire mesh for fish pots, twine for haul seines, fish-hooks, rope, sail canvas, and other necessary accessories. These supplies should be made available to fishermen of known ability at the lowest possible cost.

A wide range of controlled fish prices be instituted to allow higher prices for first-grade species. This would stimulate the production of the higher-priced species for the premium trade; and automatically, through the increased fishing effort, enlarge the yield of lower-priced species for the low-income consumers. It is recommended that the maximum retail price for first-grade fish be 16 cents per pound and that the maximum prices of other fish be fixed accordingly, with possibly three or four grades to cater to the demands of all existing classes of consumers. On no account should the prices of the cheapest grades of fish be advanced.

DOMINICA

General Conditions

This Colony is relatively primitive in its economy and largely self-sufficient. Fish is a staple article of diet, being consumed by all classes. Imported salt fish is not used to any large extent. Competent observers report that there is no danger of an acute food shortage on this island.

The present fish supply is regarded as fairly adequate. Sales of fish are limited since many families catch their own supplies, and there is little incentive for the establishment of a commercial fishery. Fishermen use dugout canoes and bamboo fish pots of local manufacture. About 50 haul seines are fished more or less regularly, and the catch is distributed among the people helping with the fishing. It is estimated that there are about 50 canoes with 200 fishermen employed in the commercial fisheries. The average annual production of fish is about 200,000 pounds with a value of about $10,000.

Migratory fish are to be found near the Island in some quantity during certain seasons. The best fishing area for these species is on the leeward side and in the deep channel between Portsmouth and Saint's Islands (which lie just off the south end of Guadeloupe). Fishermen from Guadelope operate quite close to Dominica while engaging in this fishery. It is questionable whether Dominica can produce any fish for export, but there is no question that enough can be produced for local consumption.

Recommendations

It is recommended that:

1. Because of its relative isolation from the other islands in the British West Indies and its self-sufficiency, no immediate expansion of the fisheries be undertaken.

2. In order to maintain the catch of fish at a normal level, it is recommended that a relatively small amount of seine twine, hooks, rope and sail canvas be made available to the fishermen.

ST. LUCIA

General Conditions

The economy of the coastal region of this island is affected to a large extent by the fishery industries. Fish is a staple article in the diet and is used by all classes. Imported salt cod has been an important factor in the diet of the laboring classes.

In normal times, the catch for the island is about 750,000 pounds annually, valued at $75,000, and this is produced by about 200 boats and 725 fishermen. Imports of fishery products are in the neighborhood of 600,000 pounds annually, valued at about $39,000. This gives a total supply of 1,350,000 pounds of all kinds of fishery products. Consumption in whole, fresh-fish equivalents is approximately 45 pounds per person per year.

The majority of the fishing boats are of the dugout canoe type, but a much better craft called the "whaleboat" is also used. The dominant types of gear are beach seines for the in-shore waters, and handlines and trolling lines for the offshore waters. The available bottom-fishing area is limited to a narrow coastal shelf and fishing is confined almost entirely to the leeward side of the island. Fishing is on a day-to-day basis with but little opportunity for the carrying over of stocks. The fish are transported to market mainly in the fishermen's own boats since there are practically no good highways for truck transportation. There are two important selling points on the island, Castries and Vieux Fort. Fish may be sold at other points, either on the beaches as they are landed or consumed on a more or less family subsistence and barter basis. Limited quantities of fish are gutted and lightly salted and sold inland by hawkers.

The reduction in the supply of fish is due to (a) restrictions placed on fishing activities by military necessity, (b) attraction of the fishermen to other more remunerative work, and (c) shortages in supplies of fishing gear.

The present fishing fleet is capable of producing more fish. The pelagic fisheries show definite possibilities for expansion and could be more fully exploited by an increase in the number of boats locally-called "whaleboats". The landings of edible marine products could be further augmented by captures of porpoise and black-fish. It is reported that construction work is tapering off and this will mean the return of many fishermen to their normal employment. A temporary surplus of fish could be held for possibly as long as a week in cold-storage facilities which are already available in Castries. The demand for fish is so great and the lack of meat so acute that it appears impossible that present fishing effort could produce more than a temporary surplus.

Recommendations

It is recommended that:

1. The fishery industry be stimulated immediately.

2. The discarded cable wire at hand be made immediately available to the fishermen for construction of fish-pots. If demonstrations or samples of drawn-wire pots be necessary, they should be provided. Seine twine, hooks, leader wire, hand lines, rope, and sail canvas should be furnished to the fishermen at the lowest possible cost. A direct subsidy of one to two cents per pound might be paid to the fishermen to enable them to defray the cost of gear advanced to them by the local government.

3. The local government assist in the construction of the type of boat known as the "whaleboat". These boats to be rented or sold to fishermen on convenient terms. The design of these boats should be bettered by the addition of greater sheer, higher top-sides and half decks.

4. An organized system for the collection of fish from the relatively isolated fishing villages be instituted by means of motor boats equipped with ice boxes.

ST. VINCENT 1/

General Conditions

The scarcity of fish has not approached an acute condition in St. Vincent, but the local authorities are keenly aware of food problems not only for St. Vincent but also for nearby islands.

Fishing at St. Vincent is not as highly important to the economy of this island as in other islands of the British West Indies. Most of the fishing is carried on in the general region of Kingstown with the object of supplying the Kingstown market. Fish taken in other parts of St. Vincent is consumed chiefly in the immediate vicinity in which it is landed.

Some fish are lightly salted and sold in the interior districts by hawkers. Kingstown is the only large organized market on this island. The bulk of fish is sold on Saturdays and is brought to Kingstown by the Bequia fishing fleet. The limited amount of fish available during the week is produced by Kingstown boats or by boats from Layou or Barruallies. The fresh fish supply for St. Vincent has remained at a fairly constant level, but the consumption of fish could be materially increased. A relatively large amount of corned fish produced in the Grenadines is sold in the Kingstown market.

There are approximately 150 fishing craft and about 10 haul seines used in St. Vincent proper employing about 400 fishermen. The annual production of fish for St. Vincent is about 400,000 pounds, valued at about $40,000. Total fish imports, including fresh and corned fish from Bequia and salt and dried fish from other sources abroad, is approximately 1,300,000 pounds annually. The per-capita consumption is in the neighborhood of 76 pounds per year (in fresh, whole-fish equivalents).

The only cause for the reduction of the catch is the shortage of fishing gear, and cumulative decreases in the landings are likely to develop in the near future from this cause.

Since St. Vincent is privarily an agricultural community, the number of regular fishermen is relatively small, and the Island relies to a large extent on the efforts of the fishermen of the Grenadines for its supply of fish. The actual amount of available fishing bottom around St. Vincent proper is small, and with the exception of the fishing villages of Layou and Barruallies, there are no organized fishing communities. Therefore, no considerable expansion of the fisheries of St. Vincent may be expected.

Recommendations

It is recommended that:

1. At the present time, and under present conditions, no great expansion of the fisheries of St. Vincent proper be undertaken.

2. In order to maintain the supply of fish to the Kingstown market during the week, the local Government take steps to furnish fishermen immediately with supplies of seine twine, handlines, leader wire, hooks, rope, sail canvas, and other needed fishing supplies.

1/ St. Vincent is here considered apart from Bequia and the St. Vincent Grenadines.

THE ST. VINCENT GRENADINES 1/

General Conditions

The fishery industries and ship-building are the bases of the economy of these islands, with agriculture being subordinated to a very minor position of practically a subsistence type. These Islands produce fish not only for local consumption but also for sale in nearby islands. In addition, whale, porpoise, and blackfish hunting is undertaken on a small scale.

The present supply of fish is more than adequate and allows for export to other islands. The fisheries of the St. Vincent Grenadines make use of about 125 boats, practically all of the "whaleboat" type, with lengths up to 30 feet, built mainly in Bequia. None is equipped with a motor. Approximately 430 fishermen are employed in these fisheries. The chief methods of fishing are by hand-lining and trolling. Harpoons are regularly carried in the larger boats for the capture of porpoises, blackfish, marlin, and other large aquatic animals. In addition, at Bequia, 10 haul seines are used. Minor forms of gear are fish-pots, castnets, gill nets. The annual catch, most of which is marketed in other localities, is estimated at 450,000 pounds with a value of $45,000. A significant proportion of this amount is corned.

Any decrease in the yield of this fishery can be attributed to shortages of fishing gear, since most of the inhabitants of these islands have been fishermen for generations, and there appears to have been very little diversion of labor to other work.

The Grenadines are here regarded as the most promising area for expanding production of the fisheries. An immediate increase in the catch can be expected if adequate supplies of fishing gear are provided. In addition, if the fullest use of this gear is combined with adequate care for the fish caught, the production can be increased very considerably. While the gear and methods used are in general quite efficient, various modifications, such as the use of out-riggers in trolling, would give a greater yield in this type of fishery.

In order to utilize the increased catch, the surplus could be salted for export.

Recommendations

It is recommended that:

1. Encouragement be given to the expansion of the fisheries in the St. Vincent Grenadines mainly for export to augment food supplies in the neighboring Colonies.

2. Mesh wire, seinetwine, handlines, trolling lines, hooks, rope, sail canvas, leader wire and other accessories be made immediately available to the fishermen.

3. Appropriate measures be taken immediately to give instruction to these islanders in the latest methods of curing fish.

4. Inter-island commerce in fish be relieved of all duties for there are no local producers to be protected, and the net result is only a stultification of an industry that should be encouraged as a basic food producer.

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GRENADA AND CARRIACOU

General Conditions

The economy of Grenada is based on specialized agriculture and the fisheries may be regarded as a secondary source of food. In spite of this, however, this island is dependent on fresh and salt fish as the cheapest source of protein food; and, even though there are plenty

1/ These include Bequia, Cannouan, Union, Mustique, and a number of other small islands and keys.

of other foods on the market, the lack of animal proteins will doubtless make itself felt in the reduction of efficiency in the laboring classes. The supplies of fish to Grenada have dropped off appreciably.

The fisheries of Grenada employ about 400 fishermen and about 110 fishing craft. The boats are of relatively good design, of similar construction, but smaller than those of Bequia. The principal types of gear are handlines and trolling lines. Haul seines are used to some extent but fishpots are relatively unimportant. The annual catch approximates 400,000 pounds to the value of about $40,000. Annual imports are 884,000 pounds valued at $60,000, and the per-capita consumption of all classes of fishery products, based on whole, fresh-fish equivalents, is in the neighborhood of 49 pounds annually.

The great bulk of the fish is sold on Saturdays, with comparatively little being sold during the other days of the week. The important marketing centers are Grenville, St. George's, Sauteurs, and Gouyave, with Grenville serving the largest population. The Grenville market is supplied by sloop shipments, chiefly of corned fish, from Carriacou. Fresh fish is brought principally from Gouyave and is transported by hawker. The St. George's market is supplied chiefly by local fishermen and receives considerable amounts from Gouyave and other small fishing centers on the leeward coast.

A marked decrease in catch has been caused by emigration of fishermen to Trinidad and by acute shortages of fishing gear and supplies.

There has been an almost complete cessation of salt-fish imports from the North Atlantic area. While this development has not affected higher-income consumers, it has decreased the food supplies available to the lower-income groups who have relied on this type of food as a basic item in their diet. Thus far, there have been no adequate supplies of acceptable substitutes.

In order to maintain even the present reduced catch of fish, it will be immediately necessary to make fishing gear and supplies available to the fishermen; for, if this is not done, fishing must soon be terminated except for very minor activities.

Recommendations

It is recommended that:

1. An attempt be made to restore the fisheries to the former level, but at least to maintain them at their present level.

2. Fishing gear consisting of mesh wire, seine twine, handlines, trolling lines, hooks, sail canvas, rope, and other essentials be made available to the fishermen as soon as possible. In order to compensate to some extent for the decreased number of fishermen, a motor vessel be procured, capable of towing small craft to and from the fishing grounds. This larger vessel would, also, fish. It would serve as a depot for the catch which would be cleaned and iced on board. It might be found practicable by this means to increase the length of the fishing trips by remaining on the grounds for several days. In addition, the larger mother vessel might operate a number of large fish-pots.

TRINIDAD

General Conditions

Fish normally constitutes a very important part of the food supply of Trinidad. It is particularly important as a low-priced source of animal protein. In 1940 imports of fishery products into Trinidad totaled 6-1/3 million pounds, valued at $650,000. There is an estimated local, fresh-fish production of 6 million pounds, valued at about $600,000. In whole, fresh-fish equivalents, the normal per-capita consumption of fishery products in Trinidad approximates 68 pounds annually.

About 2,100 fishermen, utilizing 600 small fishing craft, including 200 boats equipped with outboard motors, engage in commercial fishing off the coasts of Trinidad in normal times.

Fishing is done mainly by handlines, troll lines, and fish-pots off the north coast; by seines and gill nets in the productive northwest area; and by seines and lines on the west and south coasts. Half the catch is marketed in Port of Spain and San Fernando, where it is sold at controlled prices through municipal marketing channels.

Shortages of supplies are hampering existing fishing efforts. Materials for net and line replacements are increasingly scarce and high-priced. Wire for fish-pots has become unobtainable. A continued lack of parts for outboard motors will soon immobilize many of the boats.

Land transport of fish to Port of Spain cannot be continued because alternative roads to the north coast have not yet been built; and, in any case, truck transport, from the east, south, and west coasts has been complicated by the shortage of truck tires.

The supply of fresh fish in Trinidad has been more seriously affected by war-emergency activities than that of any other of the British West Indies of the Eastern Group. The fishery industry has been disrupted by (a) the loss of fishermen to more remunerative work, (b) the inclusion of the principal fishing areas within military reservations, and (c) the closure of several sea and land routes by which fish are normally carried to market. As a result, local production has been reduced to about half of its normal turnover rate, or about 3 million pounds per year. This reduction, coupled with serious shortages in imports of salt and canned products, has made fish of any kind exceedingly scarce.

The local food scarcities are aggravated by the influx of a large number of relatively highly-paid workers. This has resulted in a generally increased purchasing power, thereby creating a much larger demand for animal proteins. Other important factors are: (a) The curtailment of shipping space for food imports, (b) the price competition for deep-sea red snapper by British Guiana, (c) the supplying of locally-caught fresh fish at uncontrolled prices for provisioning vessels in transit, and (d) a controlled price structure leading to black market practices.

The production of locally-produced supplies of fishery products can be stimulated by: (a) a planned resettlement of displaced fishermen, (b) provision of fishing gear to supply replacements, (c) adjustment of controlled prices where necessary to provide added incentive to the fishermen, and (d) provision of sea-borne transport facilities to replace the rapidly declining road transport and the inefficient use of small fishing boats for fish transport. These measures are designed to give efficient utilization of production units now in existence and, also, insures that the output of these units will be made available wnere most needed.

Further relief of scarcity in fishery products can be provided by the formation of local, fishery development projects. These should be Government financed and managed and include (a) location and construction of stationary fish traps or pounds of the type used in the Alaska salmon industry, (b) provision of a fishing vessel capable of exploratory and experimental fishing to locate undeveloped fishing areas and to determine how these can be used most successfully, and (c) a fishermen's credit fund to finance new enterprises.

It is recommended that:

1. The local fishery industries be expanded to relieve the shortage of food.

2. That the deficiencies in imported fish products be made up as far as possible by locally produced fish.

3. (a) The fishing industry be stimulated by making immediately available mesh wire for fish-pots, seine twine for nets, fish hooks, rope, sail canvas, spare parts for outboard motors, and other necessary accessories.

(b) One or more refrigerated motor vessels be placed in operation to transport fresh fish from points of production to consuming centers.

(c) The displaced fishermen be resettled in other fishing areas for the duration of the emergency conditions so that their skills and implements will be continued to be employed in food production. This only can be accomplished with the fulfillment of item (b).

(d) The present controlled prices be adjusted to present the maximum incentive to fishing operations as well as to protect the consumers' interest.

4. The Government undertake a fisheries development program. This program should include the following projects: (a) establishment of stationary fish traps or pounds, (b) operation of a fishing vessel for practical exploration and experiment, and (c) establishment of a fishermen's financing fund.

BARBADOS

General Conditions

Fish is a staple article of diet for all classes in Barbados, and imported salt fish has been the basic protein food of the laboring classes.

In 1940, 371 sailboats, 65 larger and about 100 smaller rowboats, employing 1,200 fishermen, landed about 1 million pounds of fresh fish in Barbados, valued at approximately $100,000. Three million pounds, valued at $225,000, of all classes of imported fishery products, were also consumed. With a reported population of 193,000, the annual per-capita consumption of fish products of all types is 20 pounds.

The dominant fishery is for flying fish, conducted from small locally-built sailboats of an excellent sea-going model. These boats also troll. They average 23 feet in length and 6 feet in draft, and operate in deep water within 5 miles of the land. No motors, live-wells, or ice-boxes are used. Deep handlines and fish-pots are important, expecially during the hurricane season when the flying fish fishery is euspended. The fish supply is on a day-to-day basis, with little or no carry over. Prices closely follow supplies. Fish markets are established at Bridgetown, Oistins, and Speightstown from which the bulk of the supply is distributed by women hawkers, both in towns and throughout the countryside. Hawkers, also, distribute the landings of fish from about 20 open beaches around the island.

There has not yet been a reduction in the supply of fresh fish because of war-emergency conditions, but shortages of supply of fishing gear will make themselves felt in the near future.

The present fishing fleet is capable of producing more fish by the use of multiple trolling lines to utilize the pelagic fisheries more fully.

Experimental fishing operations should be undertaken for the development of new techniques and application of methods not now in use; for example, bait fishing for dolphin, multiple trolling and flag lines for large pelagic fish, drift nets for flying fish, trawl lines, and improved fish-pots.

Recommendations

It is recommended that:

1. The fisheries be maintained at as high a level as possible.

2. In order to arrest deterioration of fish supply, the Government secure for the fishermen supplies of mesh wire, seine twine, leader wire, hooks, rope, sail canvas, and other accessories.