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A Review of the Investigation and Increasing Exploitation of the Fishery Resources of Venezuela

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Abstract

Venezuela has relatively productive seas along its 2,800 km of coastline and over its 90,000 km² of continental shelf; this productivity is promoted by the trade winds. About 40,000 Venezuelans earn their living by fishing, and 200,000 fish part-time for subsistence.

In western Venezuela there is a trawl fishery for shrimps, corbinas, croakers, and mullets. In central Venezuela, which has little continental shelf, there is

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less coastal fishing, but lobsters, tunas, and other fish are landed. In eastern Venezuela there is a large beach-seine fishery for sardines and anchovies, and a longline fishery lands tuna from the Caribbean and western Atlantic. Commercial mussel culture is being started.

Inland there are extensive fisheries for shrimp, in Lake Maracaibo, by beach seine, and for catfish, dorado, and cachama, by nets and traps, along the Orinoco especially around growing industrial centers.

The Centro de Investigaciones Pesqueras of the Ministry of Agriculture at Cumana, studies most of the country's fisheries by accepted, modern methods as far as its limited budget will allow, and has made considerable progress since its start in 1960.

INTRODUCTION

THE PURPOSE of this review is to summarize the status of Venezuela's fisheries, their immediate prospects, and the scientific study of them.

The Centro de Investigaciones Pesqueras of the Ministry of Agriculture in Cumaná is the only organization devoted entirely to the study of the fisheries; its work up to 1962 is described by Simpson (1963). The Instituto Oceanográfico of the Universidad de Oriente, also in Cumaná, and the Estación de Biología Marina de la Fundación La Salle, on the Island of Margarita, undertake related work in marine science. A small group at the Instituto Venezolano de Investigaciones Científicas is working exclusively on the shrimp fishery of western Venezuela.

The purpose of the Center is to provide sufficient knowledge of the nature, distribution, and magnitude of the fisheries resources to form the basis of a fisheries development program. It is generally believed that there is considerable economic potential in Venezuelan fisheries, but an assessment of the resources is necessary to enable major investment decisions to be made on an objective basis. Although it is not possible to predict the size to which the annual catch (97,000 tons in 1963) may be increased, it is implicit in present knowledge that the maximum sustainable yields of the fishery resources have not yet been reached.

The level at which it is economic to harvest a resource depends not only on the availability of the resource itself but on economic and technological considerations. These aspects of fisheries research and development are also being investigated by the Center.

The assistance of the statistics section of the Dirección de Recursos Naturales Renovables, Ministerio de Agricultura y Cría, in providing data on the catches and their values is gratefully acknowledged.

OUTLINE OF THE FISHERIES

Environment

MARINE: The coast of Venezuela is about 2,800 km long. The continental shelf is about 200 m deep at its outer edge and falls rather rapidly to 2,000 m. It is as much as 100 km wide off the state of Sucre and as narrow as 10 km off La Guaira. There are about 90,000 km^2 of shelf within the 200 m contour. The shelf is of uniform depth except for the Cariaco Trench (800 m deep) between Cumaná and Higuerote, about 60 km offshore. There are three important shallow gulfs: Venezuela, Cariaco, and Paria (Fig. 1).

Venezuela's eastern seaboard is bathed by the Guiana current, derived from the south-equatorial current system. The Guiana current is bounded on its eastern side by the equatorial counter-current and on its more northern side

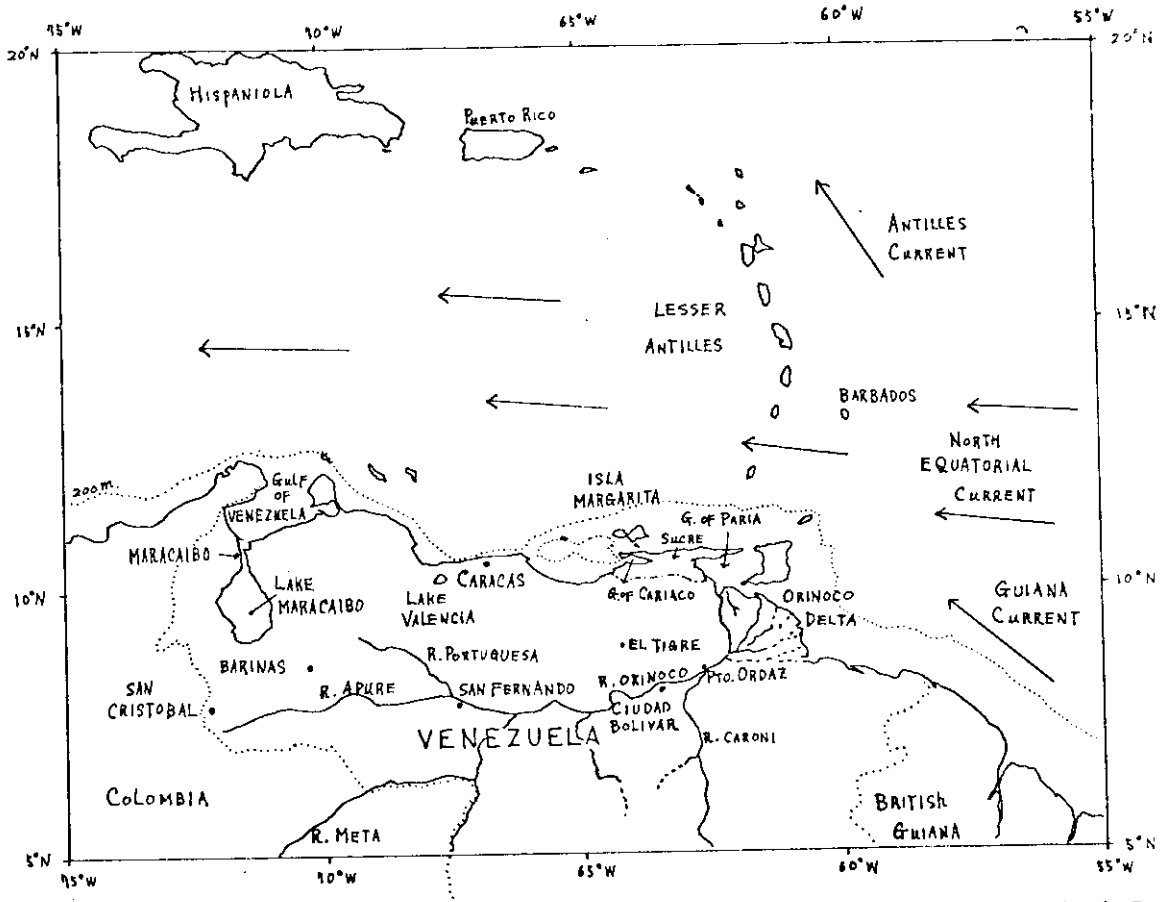

FIG. 1. Map of Venezuela (except southern part) and adjacent parts of the Caribbean Sea and Atlantic Ocean.

by the north-equatorial current. On its western side, the Guiana current receives freshwater, especially in the rainy season (May-November) from the Amazon, Orinoco, and other rivers. These river waters are considered to be rich in nutrients that favorably influence the ecology of the continental shelf and nearer offshore waters (Gade, 1962).

Northern Venezuela, in the trade-wind zone, experiences wind-induced upwelling along its coastline, which markedly increases primary productivity (Curl, 1960). High primary productivity has been found in the upper 50 m between the Island of Margarita and the Península of Araya (Fig. 2) (Ballester, personal communication). High primary productivity is sometimes found in the Gulf of Cariaco; standing crops greater than 3.0 ml/m³ of phytoplankton and greater than 800 ml/1000 m³ of zooplankton have been observed between December and April, when upwelling is strongest (Simpson, 1963). Off Venezuela these waters support sizeable fish stocks, many of which are commercially exploited: sardines, anchovies, and tunas, in the east; various demersal fishes and shrimps, in the west.

Several coastal lagoons are focuses of subsistence fisheries. The chief ones are Sinamaica, Tacarigua, Unare, Píritu, and Arestinga (Figs. 2 and 3). In the dry season they are very salty, and brackish in the rainy season.

FRESHWATER: More than 1,000 Venezuelan rivers flow into the Atlantic Ocean, Caribbean Sea, Lake Maracaibo, and Lake Valencia. The Orinoco river, the second largest in Latin America, is 2,700 km long. Lake Maracaibo has an area of nearly 13,000 km² and a maximum depth of 50 m. It is connected to the Caribbean Sea by the Gulf of Venezuela. Lake Valencia is a closed basin only 25 m deep, at most, with an area of 375 km² (Vila, 1960).

Fisheries

ECONOMIC IMPORTANCE: Commercial fishing in Venezuela occupies about 2% of the full-time labor force (36500 fishermen in 1963), and produces less than 1% of the gross national product, estimated at 26 billion Bolivars in 1962. Subsistence fishing is the part-time occupation of about 200,000 people. About 7,000 are employed in the processing industry.

Table 1 shows the annual catches and their worth to the fisherman since 1953. Here and elsewhere in the text, ton means metric ton (1,000 kg).

TABLE 1

TOTAL ANNUAL LANDINGS OF FISH IN VENEZUELA FROM 1953 TO 1963, AND THEIR VALUES IN BOLIVARS AND U. S. DOLLARS

Year	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Catch in tons×10³	63.36	51.77	70.09	61.28	83.68	77.21	83.81	85.66	83.59	94.87	97.40
Value in Bs×10⁶	37.73	32.02	39.73	38.58	45.54	41.75	45.59	50.24	51.15	55.74	56.47
Value in US$×10⁶	11.27	9.17	11.86	11.51	13.65	12.48	13.72	15.01	11.35 (15.29)	12.38 (16.64)	12.54 (16.85)*

The most valuable fisheries, in terms of value to the fisherman, in 1963, were: shrimp (Bs6,208,000), tuna (Bs4,600,000), sardine (Bs3,057,000),

*The bolivar exchange rate was 3.35:1 US$ from 1953 to 1960 and at about 4.50:1 thereafter. Values in parenthesis, here and in similar tables in the text, are at the original rate of 3.35:1.

FIG. 1. Map of Venezuela (except southern part) and adjacent parts of the Caribbean Sea and Atlantic Ocean.

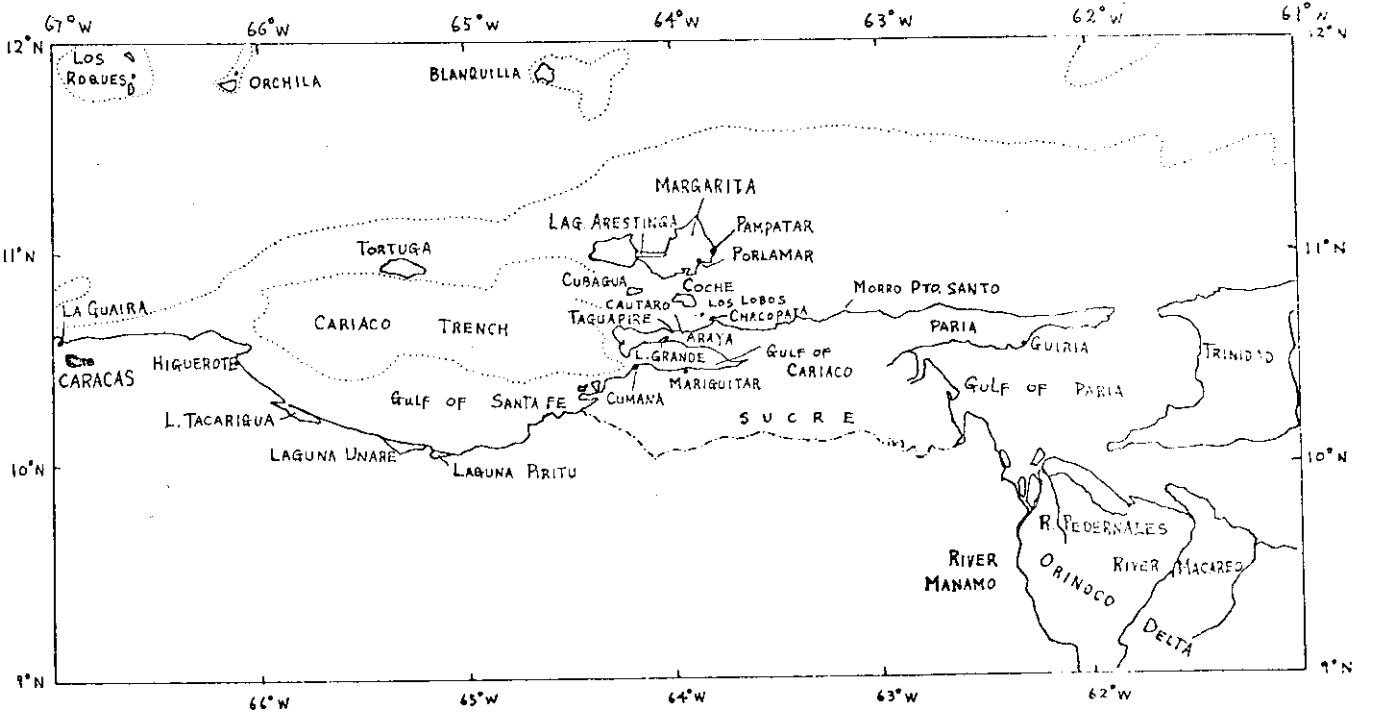

FIG. 2. Map of northeastern Venezuela.

and lobster (Bs437,000). In terms of value per ton, these fisheries show remarkable differences: shrimp (Bs1,500), tuna (Bs1,500), sardines (Bs90), and lobster (Bs3,500).

The estimated value of the boats and gear of Venezuela's fishing fleet is about Bs56,000,000 (US$12.5 million). There are about Bs20,000,000 (US$4.5 million) invested in the fish industry (e.g. canning plants). The value of the catch after processing and distribution is about Bs190,000,000.

The principal ports used by fishing vessels are Cumaná, Porlamar, Pampatar, Morro Puerto Santo, Punto Fijo (Guaranao) and Maracaibo (Figs. 2 and 3). As fishing ports, all are deficient. Morro Puerto Santo and Guaranao are used nearly exclusively by fishing vessels; the others are primarily for coastal shipping. The construction of new fishing ports, and their optimum locations, are under study (Ministerio de Obras Públicas, 1961).

Most of the fish-processing plants are in or near Cumaná in eastern Venezuela. Sardines, tunas, pearl oysters, and mussels are canned; anchovies and other fish offal are converted to meal (3,000 tons annually). Shrimps are packed frozen and canned in western Venezuela. About 20% of the national catch of fish is salted.

The marketing of fish is still inadequate; only one wholesale market (Coche, in Caracas) exists. Schneider and de Leon (1961) made a study of fresh-fish marketing. Evidently, the structure of the present market restricts fishery development. Wholesaling and retailing are inefficient and cost as much as 400% of the price paid to the fisherman. Poor transportation and storage facilities are the main causes of this high cost. Overland transport is by small trucks using ice chips as refrigerant.

Practically no advertising has been done to create a bigger market for fish products and relatively little attention has been paid to the possibilities for fish exportation.

This situation prevents the establishment of modern fishing methods on a broad scale. Most fishing vessels lack space and power to permit the use of modern gear and storage methods; their range is also limited.

MARINE: In western Venezuela the main, organized commercial fishery is the trawl fishery of the Gulf of Venezuela. In 1963, 59 large and small trawlers were operating, employing about 400 fishermen. Their gross tonnages were from 22 to 112 tons. Small boats fish near the shore, using gill nets, hand lines, and pots ("nasas"). The small boat operators, claiming interference by the trawlers, have frequently disputed fishing grounds and, in 1959, a local socio-economic crisis was averted by drawing an arbitrary line from Punto Fijo to Punta Paijana (Fig. 3) shoreward of which the trawlers are not allowed to operate. Nor are they allowed to fish within an eight-mile limit elsewhere. It is desirable that a scientific basis be established for the regulation of trawling in the Gulf. Meanwhile, the small boat operators have been encouraged to use a small trawl ("patin") to catch shrimp inshore.

In recent years the trawl fishery has been taking about 8,000 tons (including shrimp) annually, worth about Bs10,000,000 and supplying about 80% of the fish consumed in Caracas.

Beach-seining for shrimp and other fish is done extensively in Lake Maracaibo and hand lines are used from small boats.

In eastern Venezuela the principal fishing method is the beach seine, used to take sardines and anchovies, and sometimes thread herrings ("machuelo")

which augment the anchovies in the production of fish meal. Lately, bagres (Ariidae) have predominated during a shortage of anchovies. There is a bottom longline fishery for snappers and groupers off the Guianas and Orinoco Delta.

There is a developing longline fishery for yellowfin and albacore tuna; most of the catch is landed in eastern Venezuela, but some is landed at La Guaira (Caracas). The recent annual catch has been between 3,000 and 4,000 tons and there are prospects of continued expansion.

Some pearls are still taken around the Island of Margarita, but another bivalve, the pepitona or "pata de cabra," is apparently replacing the pearl oyster ecologically and economically; it is taken by small drags ("rastras") and is canned or eaten fresh.

Another incipient, potentially valuable fishery in eastern Venezuela is based on mussel culture. This is being developed, with government assistance, in the Gulf of Cariaco and around Margarita, and promises to be an important element in eastern Venezuelan fisheries. Following successful attempts at myticulture, experiments on culture of the edible oyster are now being made.

Throughout Venezuela, small-boat fishermen, using unmechanized gear, such as cast nets, handlines, and gill nets, exploit a large number of species for subsistence. These species include pargos (snappers), meros (groupers), bagres (catfish), mackerels, mullets, and shrimps.

INLAND: Freshwater fisheries are found around Ciudad Bolivar, San Fernando, Barinas, and San Cristóbal. The main fishing gears are traps, gill nets, handlines, and cast nets. The total annual catch is between 8,000 and 10,000 tons, worth

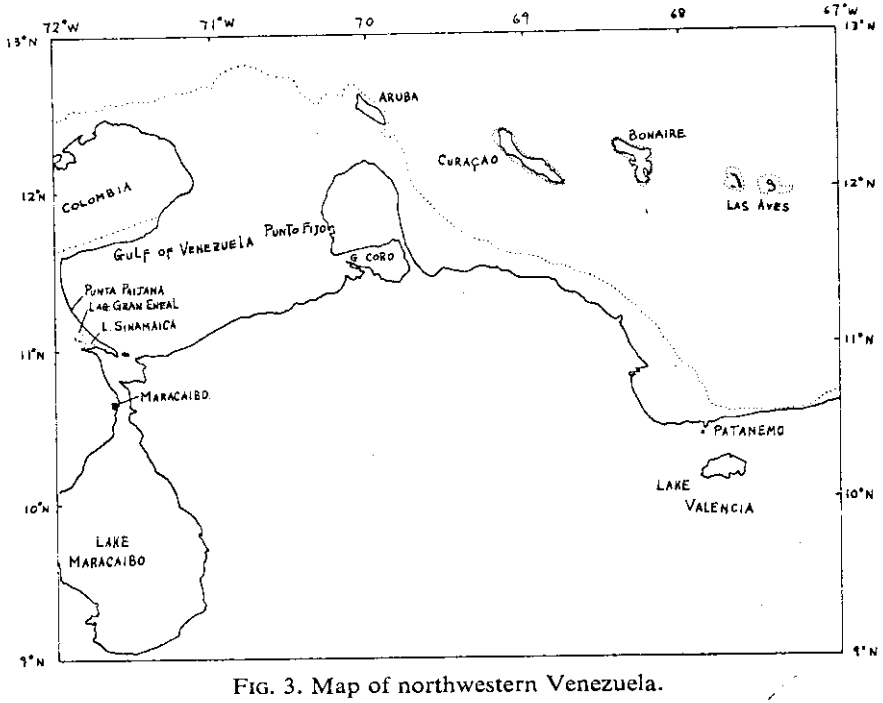

FIG. 3. Map of northwestern Venezuela.

about Bs6,000,000. Inland fisheries should continue to gain importance as industrial centers are established in the interior, as at Ciudad Bolivar, Puerto Ordaz, and El Tigre (Fig. 1).

Until recently there was a turtle fishery in the upper reaches of the Orinoco. Between 1959 and 1961, from 5,000 to 16,000 turtles a year were taken. Studies for the Ministry of Agriculture by the Central University showed that this resource was being depleted, and legislation was enacted prohibiting the capture of turtles for five years from January, 1962.

PRINCIPAL RESOURCES UNDER EXPLOITATION

Clupeoids

SARDINE: Commonly known as "arenque," this species *(Clupanodon pseudo-hispanicus)* supports the third most important commercial fishery. Table 2 shows the catches and their worth to the fishermen for the last five years.

TABLE 2

TOTAL ANNUAL LANDINGS OF SARDINES IN VENEZUELA FROM 1959 TO 1963, AND THEIR VALUES IN BOLIVARS AND U. S. DOLLARS

Year	1959	1960	1961	1962	1963
Catch in tons $\times 10^3$	30.7	30.6	23.4	32.3	35.3
Value in Bs $\times 10^6$	2.66	2.65	2.03	2.80	3.06
Value in US$ $\times 10^6$	0.80	0.80	0.45 (0.61)	0.62 (0.84)	0.68 (0.91)*

This sardine is considered to have a discontinuous distribution inshore from the Gulf of Venezuela to the Gulf of Paria. Nothing is known of the offshore distribution.

The fishery takes advantage of the large number of sardines in the Gulf of Cariaco between December and May. The Gulf is 56 km long and from 3 to 14 km wide; the maximum depth is 90 m but most of it is shallower.

Gade (1961) estimates its volume at 31 km^3. About 80% of the catch is made in the Gulf; the rest is made along the west coast of the Península of Araya and around the Gulf of Santa Fe. Sometimes catches are made along the north coast of the Península and around the islands of Margarita, Coche, and Los Lobos (Fig. 2).

From December to April the sardines are at the peak of spawning (Simpson, 1963). They spawn mainly in the Gulf because it provides the high standing crop of plankton to feed the juvenile sardines during this period. This high productivity is caused by the upwelling induced by the north-east trade winds.

Sardines are fished by beach seine, and one set usually catches the whole school. Although schools of more than 400 tons have been taken in one set, Simpson (1963) has calculated that 59% of the schools are less than 100 tons and 91.5% are less than 200 tons. The captured school is kept alive in the net till emptied by the vessels that take sardines to the factories daily.

The beach-seine method is efficient and economical; the average catch per man per year is about 200 tons (Schneider and de León, 1961). However, it

*See foot-note to Table 1.

exploits only the periphery of the resource and is limited by the low accessibility of the schools. With increasing demand it seems inevitable that more modern and mobile fishing gear, such as purse-seiners, will replace the beach seine.

At present we cannot state the maximum sustainable yield of this fishery. Data since 1957 show no obvious shift towards smaller average fish size or much smaller catches per set, suggesting that the fishery is not endangering the resource. Current policy is to encourage more exploitation while continuing the collection and analysis of data.

ANCHOVY: Known locally as the "rabo amarillo," this species *(Cetengraulis edentulus)* is found discontinuously along the eastern coast of the Americas from Mexico to Brazil (Hildebrand, 1943: Whiteleather and Brown, 1945; Schultz, 1949). In Venezuela it has a discontinuous distribution from the Gulf of Paria to the Gulf of Venezuela. In the east, it is found along the north shore of the Península of Araya and the Gulf of Paria and around the islands of Margarita and Coche. It rarely enters the Gulf of Cariaco.

This anchovy is also caught by beach seine, mostly within a few miles of Taguapire on the north coast of the Península of Araya. Table 3 shows the recent annual catches and their values.

TABLE 3

TOTAL ANNUAL LANDINGS OF ANCHOVIES IN VENEZUELA FROM 1959 TO 1963 AND THEIR VALUES IN BOLIVARS AND U. S. DOLLARS

Year	1959	1960	1961	1962	1963
Catch in tons $\times 10^3$	1.47	2.12	4.51	4.35	4.54
Value in Bs $\times 10^3$	38.09	55.49	126.09	126.17	136.24
Value in US$ $\times 10^3$	11.37	16.55	27.99 (37.39)	28.01 (37.41)	30.25 (40.70)*

There is no closed season, but about 95% of the catch is made between May and November (the rainy season, when the sardine fishery is less intense).

The anchovy is made into fish meal. Venezuela uses over 7,000 tons of fishmeal a year, but produces only about 3,000 tons from anchovy, thread herring, sardine and tuna offal, and several species of catfish (Ariidae). In 1963, when anchovy were not readily available to the fishermen, unusually large catches (200 tons) of catfish were used for fish meal.

We need to increase our knowledge of the distribution and abundance of the anchovy, not only to make the importation of fish meal unnecessary but to develop its use as bait for longliners that expect to operate out of Güiria soon.

THREAD HERRING: The common name of this species *(Opisthonema oglinum)* is the "machuelo." It is distributed discontinuously along Venezuela's coast from Lake Maracaibo to the Orinoco Delta. It is abundant in the Gulf of Santa Fe, around the islands of Margarita, Coche, and Cubagua, and along the north coast of the Penínsulas of Araya and Paria. It is taken incidentally by beach seine and cast nets and is used as bait or consumed locally.

Scombroids

TUNA: Three species of tuna are taken from the Caribbean Sea and the western

*See foot-note to Table 1.

Atlantic Ocean by longliners operating out of Venezuelan ports. They are known locally as "aleta amarilla" (*Thunnus albacares*), "albacora" (*T. alalunga*), and "ojo grande" (*T. obesus*), of which relatively few are caught.

This recently developed fishery has prospects for growth. The catches since 1960 are shown in Table 4.

TABLE 4

TOTAL ANNUAL LANDINGS OF TUNAS IN VENEZUELA FROM 1960 TO 1963 AND THEIR VALUES IN BOLIVARS AND U. S. DOLLARS

Year	1960	1961	1962	1963
Catch in tons $\times 10^3$	1.14[1]	2.01	3.54	3.09
Value in Bs $\times 10^6$	0.92	2.25	4.22	4.59
Value in US$ $\times 10^6$	0.28	0.50 (0.67)	0.94 (1.26)	1.02 (1.37)[2]

At present most of the fishing is done in two areas: (1) Caribbean Sea, within the co-ordinates 62°-69°W by 12°-17°N, or west of the Lesser Antilles; and (2) Atlantic Ocean, within the co-ordinates 49°-59°W by 7°-12°N, or well off British Guiana and the Orinoco Delta. Occasionally the longliners go as far west as Panama and to the north of Puerto Rico, and out into the mid-Atlantic.

The fleet consists of about eighteen Venezuelan vessels and three vessels jointly owned and manned by Japanese and Venezuelan crews. Most of these vessels operate out of eastern Venezuelan ports (Cumaná, Pampatar, Mariguitar), though some are based at La Guaira.

The longline fleet, as a whole, has not kept detailed records of its fishing effort and catches by suitably small areas and periods of time. The three vessels carrying mainly Japanese crews have, however, kept careful records since 1959. A preliminary study of the fishery, based on these excellent though limited data, is nearly complete and will soon be published. To overcome the lack of detailed data, logbooks are being issued to boat captains.

The fishery does not satisfy domestic demand, but importation is being denied in order to stimulate growth of the national tuna-fishing fleet.

OTHER SCOMBROIDS: There are small localized fisheries for mackerels and bonitos, known locally as cachorreta (*Scomber colias*), cabaña (*Auxis thazard* and *Sarda sarda*), carite (*Scomberomorus regalis, S. cavalla*, and *S. maculatus*), and jurel (*Caranx hippos*). They are sold fresh in the fish markets or are used for subsistence.

Molluscs

PEARL OYSTER: This species (*Pinctada margaritifera*) is especially abundant around the islands of Margarita, Cubagua, and Coche (Fig. 2) but is found in several places along Venezuela's coast and throughout the Caribbean. Isla Margarita is famous for its pearl industry which has not flourished for many years. A full description of this fishery is given by Galtsoff (1950) who points to the need to study this fishery thoroughly and recommends how this be done.

[1]This figure is the catch landed in the State of Sucre only, representing at least 80% of of the catch.

[2]See footnote to Table 1.

A few pearls are still harvested and the oysters are eaten fresh or canned for national consumption.

PEPITONA: Known also as the "pata de cabra" (goat's foot) this bivalve *(Arca occidentalis)*, like the oyster, is taken by dredge around the islands of Margarita and Coche and from the Península of Chacopata on the north coast of Araya. It may be replacing the pearl oyster ecologically and economically. The catch in recent years has been between 500 and 600 tons at a worth of about Bs 80/ton. It is eaten fresh and canned. Control and study of this resource are similar to those of the oyster.

MANGROVE OYSTER: This edible oyster *(Crassostrea rhizophorae)* grows in mangroves attached to the aquatic roots of the mangrove *(Rhizophora mangle)* and is taken for fresh consumption in various parts of the Gulf of Cariaco, especially in Laguna Grande, and at Cautaro, Higuerote, Patanemo, and in Lake Maracaibo (Figs. 2 and 3). Like the pearl oyster and the pepitona, it offers prospects for cultivation and export. Patanemo produces most edible oysters (about 200 tons annually) and supplies the demand in Caracas.

MUSSEL: The "mejillón" *(Mytilus edulis)* has been taken sporadically from natural beds for canning and for direct consumption. The annual catch has been between 150 and 200 tons valued at Bs700/ton. Mussel culture, much as it is practiced in Spain, France, and other European countries, has been started in eastern Venezuela. The spat ("semilla"), juveniles 1-2 cm long, is wrapped with gauze around ropes or bamboo pools hung in the water from an anchored raft. By the time the mussels have attached themselves, the gauze rots away. One experimental raft off the coast of Margarita produced 2,000 kg of mussels 10-15 cm long from 50 kg of seed in 5 months. This excellent rate of growth has been achieved subsequently on other rafts. Venezuela appears to have an environment for myticulture superior to that of Europe, the present center of mussel culture. The coast has many enclosed bays where rafts are protected from excessive wave action; waters with high standing crops of phytoplankton, especially during the upwelling season, and with adequate currents to supply the plankton to the mussels; a relatively small annual temperature range that allows rapid and uninterrupted growth of the mussels. Although two crops a year are obtainable, the second, corresponding to the period of least upwelling, is likely to be less good than the first. It may be possible to start cultures so that each crop shares the upwelling season or to situate the rafts in the best locations for each season; this latter idea may involve transporting the loaded bamboos overland from one raft to another to take advantage of locally good conditions in the poorer season.

The Centro de Investigaciones Pesqueras has designed a cheap, easily built raft, and credit has been arranged through the Banco Agrícola y Pecuario for the construction of 100 rafts. The bio-economic study of this fishery (Romero, MS) showed that the total cost of establishing one raft, including native wood (mostly mangrove), styrofoam for the floats, bamboo poles, mussel seed, labor, and depreciation is less than Bs4,000 and the expected net profit is 115%. The rafts will be built in groups of five, each group built and maintained by five fishermen. Each raft should produce about 10 tons of mussels a year worth about Bs750/ton. The best areas for myticulture are in the Gulf of Cariaco and around Margarita. At present the mussel seed is obtained from natural beds near Morro Puerto Santo (Fig. 2) but experiments on the collection and growth of larvae from the culture rafts themselves are being carried out.

SHRIMP: The shrimp fishery is conducted chiefly in the Gulf of Venezuela and in Lake Maracaibo, mostly on the western sides. Large and small ("patin") trawlers exploit the Gulf, while beach seines are used in the Lake. Roughly 30% more shrimp are taken in the Gulf than in the Lake. The annual catches since 1961 are shown in Table 5.

TABLE 5

TOTAL ANNUAL LANDINGS OF SHRIMP IN VENEZUELA FROM 1961 TO 1963 AND THEIR VALUES IN BOLIVARS AND U. S. DOLLARS

Year	1961	1962	1963
Catch in tons $\times 10^3$	2.49	3.80	3.90
Value in Bs $\times 10^6$	3.94	6.08	6.21
Value in US$ $\times 10^6$	0.88	1.35	1.38

The shrimp fishermen at present make only superficial distinctions between the kinds of shrimp they capture: white, brown, and red, for example (Ewald, MS). These color descriptions are imprecise and should regulations become necessary it would be essential to define the resources by species. The fishermen in Lake Maracaibo catch a freshwater shrimp *(Macrobrachium).* A grass shrimp (Carideae) is also found in the Lake. Unlike the other, penaeid shrimps, *Macrobrachium* carries its eggs and has long been regarded by the fishermen as a migratory reproductive phase of the penaeids caught in the Gulf.

The species known to exist and taken by the shrimpers, with their known distributions and in order of predominance, are:

Penaeus schmitti: The white shrimp of Lake Maracaibo, Gulf of Venezuela, Cumaná, Island of Margarita, Laguna Píritu, Gulf of Paria.

P. aztecus: The brown shrimp of Lake Maracaibo, Gulf of Venezuela, and the Island of Margarita.

P. duorarum: The red shrimp of the Gulf of Venezuela, the north coast of the Península of Araya, Island of Margarita, Gulf of Paria.

P. brasiliensis: Another red shrimp of the Gulf of Venezuela and the Island of Margarita.

Macrobrachium sp.: Lake Maracaibo and the Gulf of Venezuela.

Xiphopenaeus kroyeri: The grass shrimp of Laguna Unare, Laguna Píritu, the Island of Margarita and the Gulf of Paria.

The Orinoco delta, at the mouths of the rivers Manamo, Pedernales, and Macareo, is a possible location of new exploitable shrimp resources.

Scientists at the Instituto Venezolano de Investigaciones Científicas under contract to the Fondo Nacional de Investigaciones Agropecuarias are studying certain aspects of the biology and ecology of the shrimp of Lake Maracaibo and the Gulf of Venezuela. (Ewald, MS.)

LOBSTER: This crustacean *(Panulirus argus)* is abundant around the islands off central Venezuela where coral abounds: Los Roques, Blanquilla, Orchila, Tortuga. A few may be taken in eastern Venezuela. The catches for 1961, 1962, and 1963, were 106, 143, and 123 tons, respectively, worth about Bs3,500/ton. There is little doubt that this fishery could be expanded.

CRABS: Marine and semi-terrestrial crabs abound along the coast and are taken by subsistence fishermen who catch them with cast nets (incidentally), spears, and by hand, particularly in the east. The semi-terrestrial or spray-zone crabs are called "jaibas." With proper creation of a market and appropriate processing techniques these crabs could be exploited commercially.

The Trawl Fishery

Omitting the substantial shrimp catch, this fishery takes about 5,000 to 6,000 tons a year worth about Bs5,000,000.

The trawlers exploit a large variety of species, though only two or three predominate in any given locality. The chief species are: curbinata *(Cynoscion)*, corocoro and roncador (both *Haemulon*), lamparosa *(Selene)*, lebranche and lisa (both *Mugil*), calamar or squid, and cazón *(Mustelus)*.

Inland Resources

Many species of freshwater fish are exploited commercially and for subsistence. The most important species, the catches of which often exceed 1,000 tons annually, are: barge (*Rhambdia quelen* and R. *sabae*), cachama (*Colossoma brachipomus)* and dorado or morocoto *(Brachyplatystoma* sp.). Other important species are: coporo *(Prochilodus)*, laulau or valenton *(Brachyplatystoma)*, rayado *(Pseudoplatystoma)* and cajero *(Phractocephalus)*. The catches of these species, in 1963, exceeded 300 tons. These freshwater fishes are worth, on the average, about Bs650/ton.

SCIENTIFIC STUDY OF THE FISHERIES

The only governmental agency fully engaged in studying the nation's fisheries is the Centro de Investigaciones Pesqueras at Cumaná. Although it is not adequate for the huge task, it has made encouraging advances since its inception in 1960 (Simpson, 1963). The Center is a dependency of the Ministerio de Agricultura y Cría and grew out of the Laboratorio de Biología Pesquera, also of the Ministry of Agriculture, at Cumaná (Petersen, 1958).

The following is a brief account of the studies already made, in progress, or with prospects of being started in 1965.

SARDINE: The commercial catch has been sampled since 1956. Length-frequency histograms have been drawn for each month. These histograms often show substantial overlap between modes, and analysis of the size composition has not been made. The data are now being recast by sub-areas and seem to be much more amenable to analysis.

Length-weight data are available since 1957, but before a proper growth curve can be plotted it will be necessary to extend sampling into the smaller and larger fish that do not enter the commercial catch significantly.

Scales from each sample have been mounted since 1956. They show much promise for ageing the sardine, but only recently has a biologist started a thorough study. Otoliths were also worked on briefly and are promising enough to be included with the scale study.

The commercial catch has a sex ratio of about 1:1, based on 33,000 specimens taken between 1957 and 1960 (Simpson, 1963).

Spawning activity has been investigated by measuring the sexual maturity of the adults and by sampling the surface waters off the State of Sucre for planktonic sardine eggs, month by month. The fish are probably 2 to 3 years old at maturity.

The embryonic development of the sardine has been elucidated and resembles that of similar sardines, as the California sardine (Ahlstrom, 1943; Simpson and González, in press).

A morphometric study has recently been started; its results will be compared with an electrophoretic study now being evolved.

A brief but simple investigation has just been completed on the efficiency of the fishery as it now exists. The captured sardine school is kept alive in the beach seine and is used at whatever rate the cannery wishes. The balance of the school is kept alive for as long as 50 days. About 20% of the sets last longer than 15 days; about 10% last longer than 10 days. Since one factory has been able to reduce this to 3%, presumably others could, given greater efficiency.

ANCHOVY: This fish resembles the sardine in many respects and has been studied along similar lines. Length-frequency data seem to be more tractable than those of the sardine, perhaps because the commercial catch is restricted to a small part of the north coast of the Península of Araya.

Length-weight data are available and are to be worked up as soon as the whole length range has been sampled.

The scales show less promise than the sardine's but will be studied concurrently until their true usefulness is established.

The sexual maturity, sex ratio (about 60% females in the commercial catches), and spawning activity have been established but, like the sardine, our knowledge is incomplete.

The embryonic development has been elucidated (Simpson, in press).

As electrophoretic techniques are mastered and practice in interpretation of results is gained, the anchovy will be subjected to them.

A morphometric-meristic study has led to surprising and confusing results which suggest unusual sensitivity to local environments or an unfortunate choice of characters, commonly used ones though they are.

THREAD HERRING: Some work on this fish was started in 1962 but has not gained momentum owing to lack of trained personnel and to its relative unimportance. It is open to the same techniques as applied to sardines and anchovies and can be taken up at any time.

TUNAS: At present the work on tunas is restricted by lack of data. The establishment of procedures for gathering fishery statistics has been the main task of this program since its inception in 1964. The program is sponsored by the Fondo Nacional de Investigaciones Agropecuarias. Although some of the vessels have been supplied with logbooks, it is too early to tell how effective they are.

A preliminary study suggests that there are real differences between the two main fishing areas (Caribbean and western Atlantic) and the two species (yellowfin and albacore) with respect to indices of abundance (no. fish/100 hooks) both weighted and unweighted by the number of sub-areas (1-degree rectangles). At present the average catch rate is between 1% and 8% for yellowfin and 0.2% and 2% for albacore.

The sampling of the commerical catch for length, weight, other body dimensions, sex ratio, sexual maturity, and stomach contents encounters a difficulty that is presently being overcome. The tunaboat crews have always degutted their catch before freezing. The Center's extension workers are

endeavoring to get them to bring in 20 or 30 unstripped fish each trip as a scientific sample. Since the fishermen fear that the whole fish will spoil the rest of the catch, the sample would be from the last day's fishing and to that extent non-random.

The Laboratory of the Bureau of Commercial Fisheries (U. S. Fish and Wildlife Service) in Honolulu has done some serological work on blood samples of Caribbean tunas collected by the Center's personnel. In spite of the difficulties in securing these samples we do not expect to abandon this activity, meanwhile our own electrophoretic studies of tunas are being considered.

MOLLUSCS: At present the Center is extending its program of mussel culture and disseminating its findings in the fishing community. Particular attention is now being paid to the design of collectors of larvae, so that seed mussels may be available for the culture rafts without recourse to natural mussel beds. A study of the predators of the cultured mussels has just been started. Some useful work on the biology of the mussel has been done by workers at the Universidad de Oriente at Cumaná.

CRUSTACEA: Although the Center is not itself engaged in any study of crustaceans, it reviews the work of a group at the Instituto Venezolano de Investigaciones Científicas studying the shrimp resources in western Venezuela. Studies in other parts of the geographical range of the commercially important species are planned.

TRAWL-FISHERY: In spite of a genuine need for it, no work is being done on this fishery; it is beyond the Center's present resources.

INLAND FISHERY RESOURCES: No effective study of freshwater fishes is being done. A group at the Universidad Central studied the Orinoco Turtle fishery, which led to prohibition of the fishery.

OCEANOGRAPHIC AND OTHER STUDIES: The Center is not equipped to undertake full-scale oceanographic studies of Venezuelan waters and relies upon the Instituto Oceanográfico of the Universidad de Oriente to carry out such work. However, the Center does make bi-monthly observations of temperatures, salinity, oxygen, and zooplankton and phytoplankton standing crops, at a fixed station in the middle of the Gulf of Cariaco (10°30'N, 64°W). These are important for monitoring upwelling and the influx of oceanic water. The Center expects to augment these observations by measurements of phosphate, nitrate, nitrite, chlorophyll *a*, and primary productivity.

Outside the Gulf, the La Salle Marine Biological Station on Margarita makes observations of phytoplankton (chlorophylls, primary production) and provides much needed taxonomy of Venezuelan fishes (Cervigón, 1961).

CONCLUSIONS

The contribution of the fisheries to the national food supply has increased by about 50% during the last ten years (Table 1), growing somewhat faster than the population which increased by an estimated 45%.

There is no obvious indication that there is any overfishing (except the Orinoco turtle resource). Where certain species sometimes become relatively scarce, the cause is probably due to cyclical environmental changes rather than to the influence of the fishery.

Too many of the fishing boats now in use are not suitable for the installation

of modern fishing gear and refrigeration equipment. Fishing methods are, with few exceptions, not modern or efficient enough to carry the nation's fisheries rapidly forward, and the need to introduce modern technology is urgent.

This means the construction or purchase of new fishing vessels to engage in trawling, longlining, and purse-seining, using modern acoustic equipment. The beach-seine fishery of eastern Venezuela, however efficient it might be in terms of catch/man/year, suffers drastically from the moderate accessibility of the fish to the gear. Purse-seining, much as practiced in the Peruvian and Chilean anchovy fisheries, might be introduced. The establishment of a purse-seining fleet would tend to cause the fishing community to gravitate to a few fishing ports rather than to live in dozens of hamlets all along the coast as at present. The establishment of fishing ports, with their numerous allied industries, would have a beneficial effect on the nation's economy.

There is a need for a rapid and accurate estimate of fish stock abundance. This will be achieved by echo-sounding, tagging, egg survey, and sampling of fish with calibrated fishing gears. Such scientifically planned exploratory fishing is being developed by the Center. Plans for economic development of the fisheries resources will depend on assessments of distribution and potential yield.

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