

The two main species are corvina (*Cynoscion virescens*) and roncador (*Microgogon furnieri*).

4. Between 25 and 60 fathoms, the sea floor is rocky. A topographical survey and fishing charts would be necessary before attempting any commercial exploitation.

5. The loss of our nets twice off the continental shelf prevented us from collecting data in this area. It would be advisable to conduct topographical surveys of this area before conducting further exploratory fishing.

---

## The Shrimp Fishery in Western Venezuela

JOSEPH J. EWALD

*Instituto Venezolano de Investigaciones Cientificas*  
*Caracas, Venezuela*

### Abstract

Shrimp is the most valuable fishery in Venezuela. This fishery has developed rapidly over the last six years and shows indications of further development. Approximately 98% of all shrimp fished in Venezuela (3.9 million kg in 1963) come from the Lake of Maracaibo and the Gulf of Venezuela. Most of the production is exported to the United States as frozen product.

The Instituto Venezolano de Investigaciones Cientificas, with assistance from the University of Miami Institute of Marine Science, has begun a study of various biological and technological problems connected with this young fishery. The work is being supported by the Venezuelan Ministry of Agriculture.

Two methods of fishing are used. A fleet of trawlers fish the large shrimp in the Gulf, and numerous fishermen using large beach seines and cast nets fish the small shrimp found in the shallow waters of the adjoining Lake.

Preliminary investigation has shown eight species of shrimp (two caridean, six penaeid) to be present in commercial catches. Five of the penaeid species occur in large numbers. Programs of commercial and supplementary sampling, tagging, and post larval sampling, plus studies on maturation and larval and postlarval identification are designed to increase the knowledge of a previously neglected fishery.

SHRIMP IS TODAY Venezuela's most valuable fishery product (Table 1). In 1963 a total national production of more than 8.5 million pounds was reported. This was worth approximately \$1.4 million to the fisherman; because of its prime importance as an export item, its value to the economy of the country is substantially greater. More than 7 million pounds of processed Venezuelan shrimp was marketed outside the country in 1963 (Table 2), with by far the largest amount going to the United States.

Western Venezuela produces over 98% of this shrimp (Fig.1), and is responsible for the large increase in total Venezuelan production over the last few years.

Thus it is evident that western Venezuela possesses another valuable natural resource besides the petroleum that has made it so famous. But whereas petroleum reserves eventually will expire, the fishery has the potential of continual production, if wisely exploited.

### The Area Under Investigation

The area discussed here includes the Gulf of Venezuela, the Lake of Maracaibo, the connecting waterways of the Bay of Tablazo and Maracaibo Straits, and other adjacent inlets of the Gulf (Fig. 2). This area, some 400 miles to the west of Caracas, has hot, arid or semi-arid, sandy flat-lands in the north, with an average rainfall of 12 inches per year, and the tropical rain forests in the south with a rainfall of 177 inches per year.

TABLE I  
VENEZUELAN NATIONAL PRODUCTION, 1963

Rank	Total weight	Rank	Value to the fisherman
1. Sardine	76,016,749 lbs.	1. Shrimp	\$1,365,843
2. Croaker	11,824,245	2. Snapper	1,237,255
3. Yellow tail	9,966,871	3. Tuna	1,010,137
4. Shrimp	8,580,239	4. Mackerel	970,075
5. Manamana	7,209,331	5. Croaker	870,830
6. Tuna	6,795,921	6. Sardine	715,955
7. Mullet	6,738,976	7. Mullet	518,844

Common name	Scientific Name
Sardine	<i>Clupanodon pseudohispanicus</i> (Pey), <i>Harengula sp.</i> , <i>Sardinella anchovia</i>
Croaker	<i>Cynoscion sp.</i> (at least two species)
Yellow tail	<i>Cetengraulis edentulus</i> (Cuvier)
Shrimp	<i>Penaeus</i> (four species), <i>Xiphopenaeus kroyeri</i>
Manamana	<i>Suprasinelepicthys laticeps</i> (Cuvier and Valenciennes)
Tuna	<i>Caranx crysos</i> (Mitchill), <i>Thunnus albacares</i> (Bonnaterra), <i>Thunnus thynnus</i> (Linnaeus), <i>Thunnus obesus</i> (Lowe)
Mullet	<i>Mugil curema</i> Valenciennes
Pargo	<i>Lutjanus analis</i> (Cuvier y Valenciennes), <i>Lutjanus aya</i> (Bloch), <i>Lutjanus griseus</i> (Linnaeus)
Mackerel	<i>Scomberomorus maculatus</i> (Mitchill)

The Lake of Maracaibo covers an area of approximately 5,500 square miles, making it the largest lake in South America. Its watershed, covering over 35,000 square miles, is bordered on the east, south, and west by mountain ranges reaching a maximum elevation of 16,400 feet. The Gulf of Venezuela covers an area of some 6,500 square miles and can be sub-divided into two parts (Calabozo Bay and the Outer Gulf) by a ridge running north-south in its middle. Calabozo Bay has a maximum depth of 89 feet, while the outer Gulf ranges from 55 feet on the ridge to more than 263 feet at its mouth. The shallow Bay of Tablazo and Straits of Maracaibo have been crossed by a channel (dredged in 1956) with a minimum depth of 39 feet, which permits

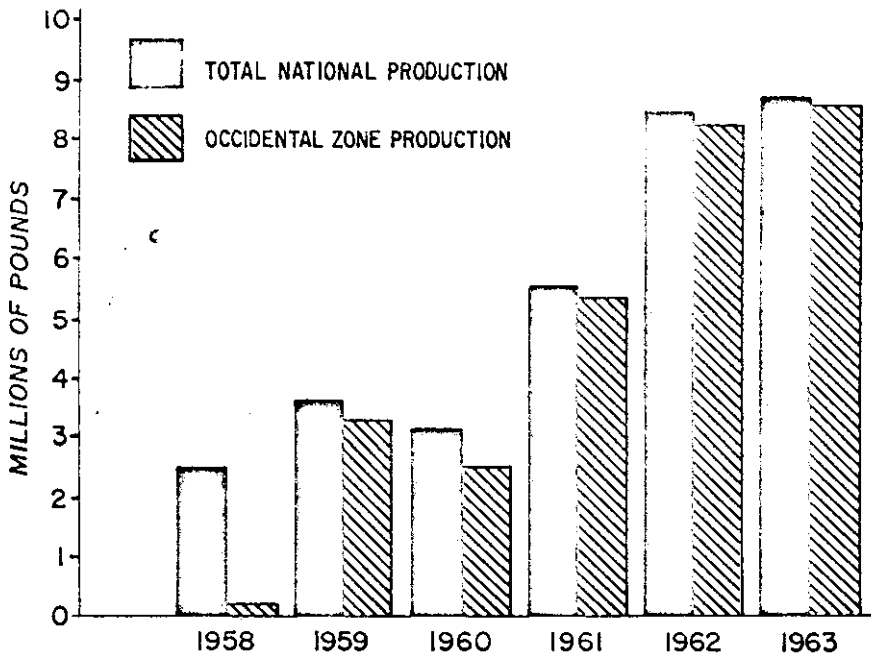


FIG. 1. Comparison of total national shrimp production with that of the occidental zone of Venezuela.

access to the lake by the super-tankers. The lake reaches a maximum depth of 115 feet in the south-east.

The waters of the lake are primarily a mixture of the outflow of the numerous rivers to the south and the influx of sea water through its mouth to the north. Sea water collects at the bottom of the lake. There is a wind driven counter-clockwise circulation resulting in a divergence which brings sea water to the surface at the center and also results in a remarkably uniform distribution of

TABLE 2  
VOLUME AND DESTINATION OF VENEZUELAN SHRIMP EXPORTS

Annual exports		Destination of Exports, 1963	
Year	1000's lbs.	Country	1000's lbs.
1957	17.6	Aruba	12.7
1958	11.0	Belgium-Luxemburg	15.4
1959	2.2	Curaçao	1.8
1960	292.6	U.S.A.	7322.9
1961	3,091.0	Spain	50.0
1962	7,858.0	Italy	12.1
1963	7,422.8	Holland	8.3
1964 <sup>1</sup>	2,479.7	Japan	0.2

1. First four months only

surface chlorinity throughout the lake. Until 1958 this salt content had fluctuated around a mode of 0.750 ppt (one part of seawater in twenty-five parts of fresh-water) for over 25 years (Redfield and Doe, 1964). During the last eight years, chlorinity has risen sharply to a high which is more than double any previously recorded value.

The Bay of Tablazo is a typical transition zone abounding in rich mangrove habitat whose hydrography is influenced greatly by seasonal changes in rain and wind. Extensive mangrove areas also occur in the Gulf of Coro and the

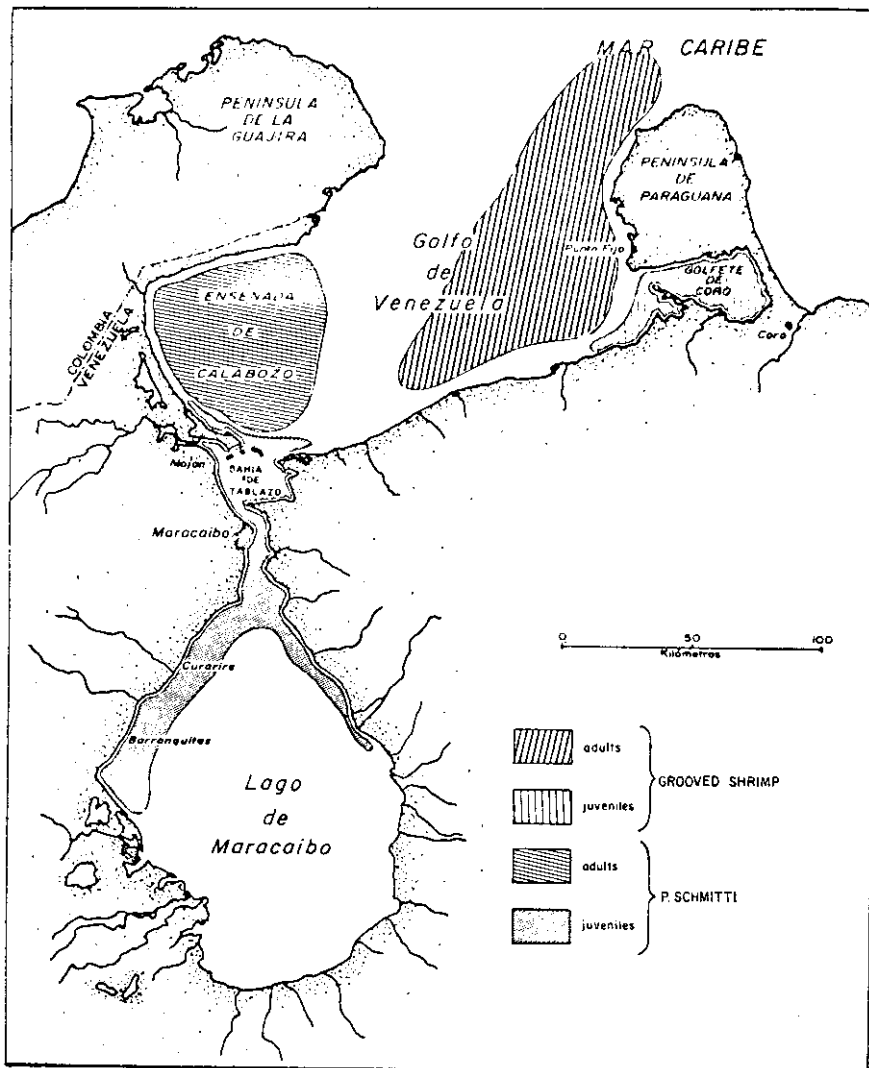


FIG. 2. Shrimp grounds of the Maracaibo estuary.

lagoons on the western shores of the Gulf.

A trade wind-driven clock-wise circulation in the Gulf of Venezuela carries a surface layer of lake water north along its western beaches where it is slowly mixed with sea water from the east. At the ridge there appears to be a zone of active mixing, and salinities rise to 30-35 ppt.

Horizontal and vertical water temperatures vary from 28-31C in the lake. Few temperature observations have been made in the Gulf, but surface waters in the outer Gulf apparently range from an average of 28C in October to 25C in February.

Two events occurring within recent years have created considerable concern among government officials and industry people because of their possible effect on the fishery. One is the rapid expansion and modernization of facilities (boats, plants, export markets) resulting in a rapid increase in production. This has occurred over the last seven years and shows indications of continuing in the future. The planned addition of as many as 40 new trawlers would more than double present fishing effort. Is there a limit to which this expansion should be allowed?

The other event is the recent intrusion of excessive amounts of sea water into the lake, causing millions of dollars of damage each year to the oil installations due to corrosion, barnacles, and shipworms. Various installations, such as the partial blocking of the channel, have been proposed. What might these do to the shrimp fishery?

Such questions, and the many related ones, can only be answered by scientific investigation. Except for a brief survey by M. J. Lindner several years ago, there has been no fishery biological investigation in this area.

Faced with these problems, the Venezuelan Fund for Agricultural Research (Fondo Nacional de Investigaciones Agropecuarias) has undertaken to support a biological investigation of this shrimp industry. The Venezuelan Institute for Scientific Research (IVIC), in cooperation with the Institute of Marine Science of the University of Miami, began the work in September, 1963. This paper discusses the preliminary efforts of what is anticipated to be a continuing and expanding attempt to provide information on a previously neglected natural resource.

### ***The Fishery***

The shrimp fishery in this area employs three types of gear: stern trawls, Florida-type double-rigged trawls, and beach seines.

The stern trawler fishery operates out of Punto Fijo, on the Paraguaná Peninsula. In 1964 there were 42 trawlers engaged in fishing large, single trawls over the stern. These boats are operated by five- to eleven-man Italian crews: they are 39 to 85 ft. long; some are of steel construction; they weigh up to 145 tons. These vessels fish in areas of the Gulf where fishing is legal, concentrating on the outer Gulf (Fig. 1). Large quantities of fish such as snappers, mackerel, and yellowtail are caught as well as shrimp.

In 1964 a fleet of 11 Florida-type double-rigged shrimp trawlers was based at Maracaibo. These boats concentrated on the western area of Calabozo Bay and fished exclusively for shrimp. Five of these trawlers were owned by the largest processing plant in the area.

There were some 53 additional boats working in the Gulf, owned independently of the processing plants. Some of the smaller stern trawlers were

being converted to double-rigged units. There was talk of bringing additional Florida-type trawlers into the fishery.

The third shrimp fishery of the area takes place in the shallow waters along the north-west and north-east coast of the Lake of Maracaibo, in the Straits, the Bay, the Gulf of Coro and, to a lesser extent, in the coastal regions of the Gulf of Venezuela. In 1964 approximately 2,000 of the 4,500 small boat fishermen in the area fished for shrimp. The typical fishing unit consists of five men working out of a 12 ft. dug-out (mandinga) powered by a 40 hp outboard motor. Cast nets are also used in more inaccessible areas. Small shrimp are the most important part of the catch of the "mandinga" fishermen, but estuarine and fresh water fish are caught as well. Fisheries for snapper, mullet, and other species are found in these same areas.

### ***Regulation of the Fishery***

Both governmental and self-imposed regulations are in effect on the shrimp fisheries. Each year fishermen (both trawler and small boat) are required by the Venezuelan government to obtain new licenses to fish. Licenses can be revoked for failure to abide by certain established rules on the type of gear used, the size of netting, and prohibited areas.

Probably the most controversial of these rules prohibits fishing by trawlers the mouth of the Pajana river (on the south-western shore of the Gulf). This south of a line drawn from Punto Adaro (on the Paraguana Peninsula) to rule also prohibits trawler fishing within eight miles of the shoreline north of this line. This eliminates Lake Maracaibo and a considerable area of the Gulf from trawl fishing. The rule resulted from the sometimes bitter conflict that erupted several years ago when trawlers first moved into the area and the small boat fishermen were fearful of destruction of their livelihood. Originally all of the Gulf was ruled off limits, but the rule has been relaxed a number of times since. Permits are now given to a few boats to fish south of the line for exploratory purposes. One small trawler fished in the lake in 1964. The present investigation benefited from this by receiving samples and information on abundance of shrimp.

Perhaps the second most powerful control over fishing pressure is the relative inefficiency of the large stern trawlers. Some of these boats are being converted to double-rigs. Whether they will be able to compete with the Florida-type shrimp trawlers is still to be seen.

### ***The Market***

About 6,000 pounds of western Venezuelan shrimp are consumed daily by the Venezuelan market, principally in Maracaibo and Caracas. The rest of the production, some 7 million pounds, is exported as frozen tails. In 1964 there were 15 freezer plants in Maracaibo and one in Punto Fijo, but only nine of these were in operation in the fall of that year. The three largest plants had a daily processing capacity of about 15,000 pounds. Several small plants operated only when the catch was large and the price consequently low.

Except for one plant (the largest in the area) all fishermen operate independently from the buyers. This has resulted in a fiercely competitive primary market. The local buyers can afford to pay more than the freezer plants and therefore fill up the trucks first. For the remaining part, the freezer plants then bid among themselves. The local consumption is fairly steady, so if production is high the plants are in a much more favorable bargaining position than if production is low. Production is not sufficient to supply all the plants

and several small plants have recently gone out of business.

The economics of the fishery have been unsettled since the inception of the export market. Attempts have been made by the plants to stabilize their own supply. Some plants hope to bring in additional boats which they will control. There were also efforts to unite all plants into one bargaining unit to eliminate the competition.

### **Species**

An examination of the commercial catches from the entire area over the past year has revealed that there are eight species of shrimp caught, of which the first five listed below are important.

1. *Penaeus schmitti* Burkenroad, ("camarón blanco")
2. *Penaeus duorarum* Burkenroad, ("camarón rosado sin mancha")
3. *Penaeus aztecus* Ives, ("camarón marrón")
4. *Penaeus brasiliensis* Latreille, ("camarón rosado con mancha")
5. *Xiphopenaeus kroyeri* Heller, ("sea bob," "siete barbas")
6. *Macrobrachium amazonicum* Heller, ("camaroncito del río")
7. *Macrobrachium acanthurus* Wiegmann, ("camarón del río", "brazo largo")
8. *Trachypenaeus similis*

In the eastern and south-eastern regions of the Gulf *P. duorarum* is dominant the year round, whereas *P. schmitti* is the most important species in the Bay of Calabozo and in the lake. At times *P. aztecus* and *P. brasiliensis* are abundant in catches from the outer Gulf. *X. kroyeri* is found throughout the Gulf but seems to be more concentrated in the Calabozo Bay. Because of its low abundance and its weak market it is the least important of these five species. *Trachypenaeus similis* is only occasionally found in commercial catches.

In the Maracaibo estuary (the Straits, the Bay of Tablazo, and the lake) immature *P. schmitti* account for 90-100% of the catch during most of the year. In March and April, 1963, an abundance of grooved shrimp (predominately *P. duorarum*) was recorded in the lake south of Barranquita and at times this species accounted for approximately 60% of the catch in that area. This is particularly interesting because farther north in the lake no more than 5% grooved shrimp have been found in the catch. Proceeding south in the lake increasing numbers of *M. amazonicum* are encountered. These are present in commercial catches in proportions as high as 15%. They are often processed as "white shrimp."

Sampling of the Gulf of Coro has revealed large numbers of small grooved shrimp and *X. kroyeri*. There is a small local fishery there.

Considerable difficulty has been encountered in the positive identification of the small grooved *Penaeus* shrimp found throughout the system. The term "grooved shrimp" is thus sometimes used here instead of a specific species when dealing with this size of shrimp. Dr. Isabel Pérez Farfante, of the Radcliffe Institute for Independent Study, has been sent samples of all species encountered in the area and some of the taxonomic problems will be cleared up with her assistance.

### **Production**

The Ministry of Agriculture has for several years maintained offices (Inspectorias) in Punto Fijo and Maracaibo for purposes of administering the fisheries of the area. Records are kept of production. Some of these are of questionable accuracy due to the complexity of the fishery, and to the manner

in which they are collected. Procedures are being refined and more accurate data should be available in the future.

Approximately three quarters of the shrimp production of the area comes from the trawlers in the Gulf of Venezuela and the rest from the small boat fishermen.

### **Life Cycle**

An attempt is being made to determine spawning areas and important nursery areas for the various species. Some preliminary information has been obtained for white shrimp, and less reliable data for the other species.

An histological study of female white shrimp from both the lake and the Gulf has revealed that only sexually immature shrimp exist in the lake, but that there are a high percentage of ripe or spent females in Calabozo Bay. Spawning probably occurs in Calabozo Bay the year round, with a peak in April and May. Attached spermatophores have been found on many female white shrimp, but only in this area.

This information is contrary to local belief that white shrimp spawn in the southern part of the lake. The belief is apparently due to the fact that fishermen catch large numbers of egg-carrying *Macrobrachium amazonicum* in this area and assume that this is the same species as those white shrimp encountered further north in the lake and in the Gulf. *P. schmitti* (and all penaeid shrimp) spawn directly into the water and do not attach their eggs to their swimmerets as do caridean shrimp like *Macrobrachium*.

Histological examinations have also revealed that mature shrimp of the other *Penaeus* species occur throughout the outer Gulf area. The Gulf of Coro may be a principal nursery area for these species. But the occurrence of large numbers of immature grooved shrimp in the southern part of the lake suggests that this area also serves as a nursery ground to a greater or lesser extent.

Large numbers of both *P. schmitti* and grooved post-larvae have been captured entering the mouth of the Maracaibo estuary. No systematic sampling of the plankton has been undertaken yet but some such post-larval sampling is planned to begin in 1964.

A marking program is being planned for 1965. If, as suspected, there is a migration of shrimp from lake to Gulf, a marking program should reveal its character.

Venezuela is taking an important step forward in the utilization and conservation of a valuable renewable natural resource. The Venezuelan shrimp industry is still young and partly as the consequence of this research it will become of increasing value in the future.