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Lake Nicaragua Fishery Resources

WILLIAM D. DAVIES

INTRODUCTION

In response to a request by the National Development Institute of Nicaragua (INFONAC) a fishery survey under the sponsorship of U.S.A.I.D./Nicaragua was conducted from February 28 to March 17, 1972 on Lake Nicaragua (Davies and Pierce, 1972). The objectives of this survey were to assess the economic potential of the fishery resources and provide assistance in developing a realistic program of catch assessment, management and extension for fisheries development on Lake Nicaragua.

The main sources of data used in preparing this report were from (1) published reports on the fishery resources of Lake Nicaragua, unpublished reports dealing with market development and proposed biological studies, and progress reports; (2) interviews with fishermen and other individuals concerned with transporting and processing fish products; (3) an experimental fishing survey (five days) of Lake Nicaragua on the research vessel, Gaspar; and (4) an aerial survey of Lake Nicaragua.

Population, nutrition, fish consumption and marketing

Nicaragua's population was estimated at 1.9 million in 1969, giving this country the second lowest population density of any country in Central America. On the other hand, the annual growth rate of 3.5 per cent is one of the highest in the region (A.I.D., 1970). Even though the average diet appears to be adequate in both calories and protein (F.A.O., 1967), an annual increase of at least 3.5 per cent in production of food crops will be required to maintain present levels.

Government statistics indicate a relatively low consumption of fish products. For example, the annual per capita consumption of beef is about 14 kg (30 lb) compared to only 2.18 kg (4.8 lb) of fish. Freshwater fish accounts for only 23 per cent of the total amount of fish consumed. Also it appears that per capita consumption of fish products has stabilized while consumption of beef is increasing (F.M. Ribeiro, pers. comm.).

Fish are sold by the pound in the supermarkets, but fishermen and local markets sell fish by the string, or by the piece in the case of gar (*gaspar*), *Lepisosteus tropicus*. A "piña" is a string of fresh fish, usually *guapote* (mainly *Cichlasoma managuense*, *C. dovii* or *C. friedrichsthalii*) or *mojarra* (*Cichlasoma citrinellum* and *C. nicaraguense*). It has as few as two fish when the demand is high, or as many as eight when the demand is low or the fish are extremely small. A string containing four to six fish weighs approximately 0.7 kg (1.5 lb).

During this survey the price of fish in supermarkets was 1.50 to 2.00 cordobas (\$0.21 to 0.28) per pound for sawfish filets and for whole *guapote*. In local markets, strings of fish were selling for 2.00 to 5.00 cordobas (\$0.28 to 0.70) depending upon the time of day, and dried gar was selling for

1.00 to 5.00 cordobas (\$0.14 to 0.70) depending upon the size of the piece. In contrast, prices for poultry and ground beef were 2.90 and 4.90 cordobas (\$0.41 and 0.68) per pound, respectively. It should be noted that the price of fish is highest just prior to Holy Week.

Fishermen selling their fish to middlemen appeared to be receiving a fair price as there was relatively little markup in the market price. For example, fishermen were receiving approximately 45.00 cordobas per dozen for dried gar weighing about 18 pounds (\$0.34/lb). These fish would not usually sell for more than 60.00 cordobas (\$0.41/lb, in the market.

Lake characteristics

The lake fisheries are strongly affected by the prevailing easterly winds which, during the period from January to May, commonly reach velocities of 20 knots (23 mi/hr). Therefore, most of the western shore of the lake (from Los Cocos in the north to Colón in the south) consists of wave-swept, debris-strewn, gray, sandy beaches. Exceptions to this are areas protected by large near-shore islands and peninsulas, and where rivers and streams parallel the shore before entering the lake.

On the wind-protected eastern side of Lake Nicaragua much of the shoreline is covered with flooded dead shrubs and aquatic plants. Apparently the shrub communities became established approximately seven years ago when a drought caused the water level to remain below normal for a long period. Water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*) are the dominant aquatic plants. These species are particularly abundant at the mouths of rivers and streams entering the lake and often form extensive floating plant islands. These islands are commonly colonized by a variety of other plant species, many of which are not truly aquatic, but they are able to grow due to the support of the water hyacinths and water lettuce.

The fish of Lake Nicaragua

About 45 species of fish, representing 27 genera and 16 families, are known to occur in Lake Nicaragua (Villa, 1971; Astorqui, 1971). A large proportion of these are of marine origin or have a high tolerance for saline water. For some time the lake was thought to support landlocked populations of marine fishes (two elasmobranchs and the Atlantic tarpon). Recent studies of the biology and movements of the bull shark, *Carcharhinus leucas*, and the sawfish, *Pristis perotteti* (Thorson, Watson and Cowan, 1966; Thorson, 1971), show that they move freely between the lake and the sea. These fish were found in considerable numbers in experimental gill netting by Hagberg (1968) in the Granada area of Lake Nicaragua.

While some other species are abundant in the lake, only the shark, sawfish, tarpon (*Megalops atlanticus*), *guapote*, *mojarra*, gar and possibly a few others are considered of commercial importance.

Fishing activities

Lake Managua and Lake Nicaragua support a relatively small number of full-time fishermen (fishermen fishing more than 50 per cent of the time). It appears that the small commercial catch from Lake Managua does not reach the local markets of Granada and Managua. Lake Nicaragua, with approximately 600 fishermen harvesting approximately one million pounds of fish per year, supplies these markets with the majority of freshwater fish sold.

The majority of fishermen usually fish only during the dry season (November to March). During this time the catch has a market value of two to three times as much as at other times of the year. Consequently, many fishermen tenant farm during the months of April to October and fish only occasionally for their own consumption.

SURVEY RESULTS

Sawfish and shark fishery

Even though it is reported that sawfish and shark have always made up a significant portion of Lake Nicaragua's fish catch, it has only been in the past three years that a substantial increase in this fishery has occurred. The principal reason for this increase is the establishment of a fish processing plant located in Granada. The plant has a cold storage capacity of 13,636 kg (30,000 lb) and a freezing capacity of 909 kg (2,000 lb) per day. To assure a steady flow of sawfish the company has contracted with approximately 50 fishermen in the San Carlos area. Some of the fishermen are provided with gill nets and/or boats and out-board motors. The fishermen are paid \$0.05 to \$0.07/lb for dressed meat. Also, the company provides cold-boxes and ice to groups of fishermen for storing their catch until it is picked up by the company's transport boat. The company has two transport boats that are utilized alternately to deliver ice and pick up the fishermen's catch at San Carlos. Generally both boats make one complete trip every five or six days. The two boats have a combined cold storage capacity of 8,409 kg (18,000 lb). However, the amount of fish (mostly sawfish filets) delivered to the processing plant each week seldom exceeds 2,275 kg (5,000 lb).

Although sawfish is the company's current interest, it has begun processing *guapote*, *mojarra* and gar with the hope of expanding its operation. The *guapote* and *mojarra*, as well as the sawfish and shark, are usually sold fresh-frozen to local supermarkets. The sawfish and shark meat are usually sold packaged in 1-lb quantities in plastic bags, whereas *guapote* and *mojarra* are sold whole (gutted). The gar are dried and usually sold locally; occasionally some have been exported to Guatemala City.

Even though some sawfish and shark are caught throughout the lake, most of the present effort is near San Carlos where the lake flows into the San Juan River. This trend has increased each year since the sawfish fishery was intensified three years ago. There are some indications that this fishery may be overexploited: 1) the fishing effort has consistently moved closer and closer to where these marine species must enter or leave the lake; and, 2) the high number of tags recovered (more than 50 percent according to Thorson, pers. comm.). Based on the limited data



FIG. 1. The principal commercial fishery in Lake Nicaragua is shark (shown here) and sawfish, for which fishermen receive approximately \$0.05/lb for dressed fish.

gathered during this survey, the sawfish catch may be higher than desirable for sustained yields.

It should also be mentioned that dried fins of the sawfish and shark bring a premium export price and there are indications that a large number of these fishes is harvested each year for the fins alone.

Sawfish and shark fishermen make their own nets. The mesh size most commonly used is 150- to 250-mm (6- to 10-in) stretched mesh. This range will take both sawfish and shark, and occasionally tarpon. The net is made from almost any heavy cord available, but those observed during this survey were constructed of several kinds of binding twines that fishermen had obtained as scrap from a local industry. The nets are usually only about 1.5 to 2.5 m (5 to 8 ft) deep, but they may be several hundred meters in length. They are fished on the bottom in water ranging from 3 to 12 m (10 to 40 ft) deep.

The boats used are larger than the 3- to 5-m (10- to 16-ft) boats utilized by *guapote*, *mojarra* and gar fishermen. The fishermen lift their nets each morning before the winds come up. They may leave their nets in the same place for several weeks, depending upon their catch. If they are fishing primarily for sawfish, it is not necessary to run the nets every day. Only the rostrum of this species becomes entangled and it can live for several days. Sharks, however, must be processed immediately as they die quickly after being gilled.



FIG. 2. Commercial transport boats collect, transport and process shark and sawfish into fillets which sell in local markets in Managua for approximately \$0.25/lb.



FIG. 3. The *Isletas de Granada* where *mojarra* and *guapote* are caught with hook and line and sold fresh in Granada and Managua. Usually there is at least one family on each of the islands.



FIG. 4. Typical fishing canoe under construction on shore of Lake Nicaragua. Depending upon size, canoes cost between \$40 and \$100.

Guapote, mojarra and gar fishery

Whereas expansion of the sawfish fishery is limited, the fishery for *guapote*, *mojarra* and gar represents an untapped resource which only awaits the stimulus of assured markets for development. For example, the eastern shore is yielding what has been roughly computed to be less than one pound per acre. This is an extremely low average figure and probably a higher rate of cropping is taking place in local areas. However, most tropical waters are capable of substantially greater sustained yields, considerably in excess of 10 kg/ha (9 lb/a). Other evidence that greater yields are possible was gathered during the survey by fishing a monofilament gill net 30.5 m (100 ft) in length, 1.2 m (4 ft) in depth, 75-mm (3-in) stretched mesh, and a twine size of 0.3 mm (0.012 in) diameter. The population of *mojarra* was dominated by senile fish. Usually fish of this condition would not readily be found in even a moderately fished stock.

Should market demands increase, there is good reason to believe that the fishery could be rapidly expanded by investments in improved gear, particularly monofilament nets, vessels capable of extending the range of the fishermen and refrigeration facilities for storage and transport to insure fish of good quality when they reach the market.

The preferred habitat for these species in Lake Nicaragua appears to be in and around the aquatic weed beds. Some *guapote* and *mojarra* are also found among rocks. Apparently, the very large gar move off-shore and return to the shallows to spawn during the rainy season. Little effort is made by the local fishermen to catch these fish off-shore.

The gill-net fishery for *guapote*, *mojarra* and gar is essentially a family enterprise. One family may own from one to three canoes and fish two nets per canoe. The nets, constructed from cotton or nylon multifilament twine, are usually 19 to 30.5 m (60 to 100 ft) long, 0.9 to 1.2 m (3 to 4 ft) deep, and have a mesh size (stretched measurement) of 75 to 125 mm (3 to 5 in). Nets of this type cost the fishermen approximately 100 cordobas (\$15.00) for nylon and 35 cordobas (\$5.00) for cotton. Floats are whittled from wood, and weights are made of fired clay. The majority of fishermen indicated a preference for nylon, but because nylon costs more, cotton nets are still used.

Although most of the *guapote*, *mojarra*, and gar are taken with gill nets, some are caught by hook and line, particularly in the rocky areas such as the islands around Granada. The *guapote* and *mojarra* fishery around the islands is unique in that these fish are usually caught by women and children who use small fish and worms as bait. Their catch is kept in liveboxes in the lake until there are enough fish to take to market in Granada where they are sold fresh. Based on the numbers of fresh fish observed in the local market on two separate occasions during this survey, the catch from the islands must account for several hundred pounds each day.

The west side of the lake has much less catch potential than the wind-protected, shallow and weedy eastern shore. These weedy areas are apparently prime habitats for gar, *guapote* and *mojarra* since most of the fishing effort is there. Gill nets are the most common type of fishing gear used but

some fishermen also use hooks and harpoons, the latter being primarily used for taking gar.

Most of the canoes used in this fishery are wooden dug-outs. These normally cost between \$40 and \$50 if purchased, and approximately \$20 and \$25 if the fisherman makes it himself. Larger log canoes cost as much as \$100.

Fishing in the weedy areas is done mainly in the early morning hours starting at 1:00 to 2:00 a.m. Fishermen set shallow nets along the edge of the weed beds and, using poles and paddles, strike the weed beds and water in an attempt to drive the fish into the nets. Then the nets are picked up, the fish removed, and the nets set again in another area where the procedure is repeated. Interviews with a number of fishermen indicated that as many as nine such sets could be made in one night. The fishermen normally return home by midmorning at which time the catch is cleaned, processed, and marketed.

During the dry season these shallow, weedy areas become quite clear. Therefore, it is very likely that the fish can easily see the heavy twines that the fishermen use in making the gill nets. This may be the reason that the fishermen have chosen to "drive the fish into nets" rather than leave nets unattended overnight.

Because the fishing area on the eastern side of the lake is far from the principal markets on the west, almost all of the catch from this area is sold in the salt-dried form. This is satisfactory for the gar which, according to the fishermen and consumers alike, is not eaten in the fresh form. But it is not suitable for the *guapote* and *mojarra* since their quality is much poorer in the dried form than in the fresh form.

For the dried gar there is another problem. The traditional method of "fast" drying is impossible during the rainy season as the resulting product is either over-salted or nearly spoiled by the time it is sold. The poor quality of dried fish during the wet season is probably one reason that the demand is low at this period.

The low demand results in a low price and therefore discourages the fishermen from putting much effort into fishing. This is unfortunate since gar fishing is reported to be much better during the rainy season than it is during the dry season. Smoking is out of the question since wood is usually scarce and too costly to use in smoking fish. Therefore, if gar is to be marketed in quantity and be of good quality during the wet season, economic methods for drying or smoking must be developed.

Sport fishing

Some sport fishing is done on the lake, particularly in the quiet waters among the Isles of Granada (*Las Isletas*). However, there is no real effort to expand this industry. Tarpon and snook (*Centropomus parallelus*) are present to some extent throughout the lake, but possibly not in sufficient numbers to guarantee success. However, the greatest deterrent is the lake's rough water condition and the distance of the prime fishing grounds from adequate tourist facilities.

The exception to this is the tarpon fishing camp located on the upper San Juan River, where fishermen are flown directly from Managua. The camp accommodates 16 fishermen at a time at a cost of approximately \$100 per day per fisherman. Another camp has recently been established nearby and problems have already developed over rights to fishing grounds. In the lake, the greatest potential for snook fishing is probably in the San Carlos area. Here fishing should be excellent, judging from observations and in-

terviews with fishermen. However, weather conditions in this area are only suitable for outdoor activities for four to six months out of the year.

SUMMARY

Data collected during this survey indicated that the number of full-time fishermen has not increased appreciably over the past several years. However, it is likely that, if the demand for fish were to increase, a number of the present part-time fishermen would increase their effort to full-time. Indications are strong that the fish catch from this lake could at least be doubled by the existing population of fishermen, using the same gear, if market conditions were such as to encourage greater fishing effort.

The lake's overall fisheries resources are far from being exploited to their maximum, with the possible exception of the sawfish and shark. If the estimated current annual harvest of 45,455 kg (1,000,000 lb) is accurate, the lake is yielding only 0.56 kg/ha (0.5 lb/a), which amounts to slightly less than 50% of the freshwater fish consumed in Nicaragua.

RESUMEN

Los datos colectados durante este estudio indican que el número de pescadores de tiempo completo no ha aumentado apreciablemente en los últimos años. Sin embargo es posible que, si la demanda aumentase, muchos de los pescadores de tiempo parcial pasarían a ser de tiempo completo. Hay fuertes indicios de que la actual población de pescadores de este lago podría, al menos, duplicar la pesca actual usando las mismas artes de pesca, si tan solo las condiciones del mercado fueran suficientes para ameritar el esfuerzo adicional.

Los recursos pesqueros de este lago están lejos de ser explotados al máximo, con la posible excepción del pez sierra y el tiburón. Si la producción anual estimada, de 45,455 kg (1,000,000 lb), es exacta, el Lago está produciendo solamente 0.56 kg/ha (0.5 lb/a), lo que constituye menos del 50% del pescado de agua dulce que se consume en Nicaragua.

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