# Development of a New Long-Range Fishery for Flyingfish in the Southeastern Caribbean

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## ABSTRACT

Flyingfish of genera Hirundichthys and Cypselurus have been commercially important in the southeastern Caribbean for a number of years, particularly in Barbados. Barbadian commercial fishermen used sailboats until the mid-1950's when they converted to diesel-powered vessels. Flyingfish boats remained relatively small (less than 40 ft. in length) and made exclusively one-day trips to fishing grounds within 40 miles of Barbados until the late 1970's. At this time, 36 to 60 ft. vessels designed to stay at sea for up to 10 days began fishing the southeastern Caribbean from bases in Barbados. Most of the geographic expansion was southward to North Equatorial Current waters between Tobago and Grenada. Catches of flyingfish and larger pelagic species landed during the November to June fishing season in Barbados have increased considerably. At present, 32 long-range boats are operating. Lack of adequate cold storage, local distribution, and development of an export market have caused periodically acute saturation of the leeward coast Barbadian markets. Few useful fishery data are being collected. Initiation of a data collection program and formation of a fishermen cooperative are the first steps needed to begin solving these problems. Timely action would help insure the future of the fishery, mitigate some socioeconomic problems, and could induce economic growth through an increase in jobs both directly and indirectly related to the newly expanded fishery.

## INTRODUCTION

Flyingfishes constitute a large group of small pelagic species found in neritic and offshore waters in tropical and subtropical regions around the world. Small-scale fisheries for flyingfish operate in Polynesia, the Philippines, Japan, Vietnam, Sri Lanka, and India. Of these, the fishery in Japan is most intensive, employing drift gill nets, liftnets, fixed nets, and purse seines (Shiokawa, 1969). In the Western Hemisphere, flyingfishes are commercially exploited primarily in the Caribbean region and off northeastern South America.

Although some effort is expended by other countries, Barbados has long had the best-developed flyingfish fishery.

Brown (1942), Wiles (1948), and Hall (1955) reviewed aspects of the development of the Barbadian fishery, starting in the late 1800's. Mahon et al. (1982) discussed more recent aspects of the fishery. Wiles (1948) cited a number of present and potential problems, including lack of cold storage and poorly developed distribution system from landing ports to other areas of the island. More recently, Mahon et al. (1982) discussed the marked seasonality of flyingfish production alluding to socioeconomic impacts, indicating the persistence of most of the problems discussed 34 years earlier by Wiles. During and since the time Mahon et al. (1982) went to press, an intensive long-range fishery for flyingfish and other pelagic species has developed, which has considerably enhanced marketing and distribution problems in Barbados. The objectives of this paper are: (1) to briefly review relevant literature on flyingfish and summarize the history of the Barbadian fishery; (2) to describe the new long-range fishery; and (3) to discuss the socioeconomic problems and opportunities posed by this new development.

In general, the biology of flyingfish is poorly known. The literature is limited almost entirely to descriptive biology. Parin (1967) reviewed systematics of the group, and Parin and Astakhov (1982) reported recent advances. Vijayaraghavan (1973), Kojima (1971), and Kovalevskaya (1982) addressed aspects of the eggs and development of flyingfishes. A number of papers have discussed various flyingfish parasites (see, for example, Kamegai, 1971a, b) and several chemical analyses of flyingfish tissue for pollutants and protein content have been published (Kureisky et al., 1979; Weber, 1983). Regional distribution and relative abundance over time of several flyingfishes were variously reportd by Shuntov (1968), Kojima (1969), and Dharma Raja and Balakrishnan (1976). These kinds of data were presented by Nesterov and Grudtsev (1981) for the tropical Atlantic, and by Mahon et al. (1982) for the Barbados area.

Flyingfish of commercial importance are generally abundant on a seasonal basis. They appear to develop rapidly, reaching sexual maturity within the first year (Okachi, 1958; Lewis et al., 1962). Movements, although poorly understood, appear to be related to spawning. Strong, short-term fluctuations in relative abundance are apparently related to local oceanographic conditions (Lewis et al., 1962; Shiokawa, 1969). In several cases, river outflow is apparently the most important determinant of these conditions.

In Barbados, flyingfish of genera Hiryundichthys and Cypselurus comprise the majority of the catch. H. affinis has constituted over 50% for a number of years (Hall, 1955; Lewis et al, 1962; Mahon et al., 1982). Lewis et al. (1962) provided extensive biological data on this species, reporting an extended spawning season, the size at recruitment to the fishery, sex-specific length frequencies, growth, and stomach contents. They also provided hydrographic data supporting the

hypotheses discussed by Whiteleather and Brown (1945), Hall (1955), and later by Mahon et al. (1982), that large short term fluctuations in abundance shorty follow periods of increased rainfall along the coast of South America. The consensus of the literature is that pulses of flotsam from the southeast, which tend to attract and hold flyingfishes and larger pelagic species, originate from periods of high outflow of the Orinico River and are carried northeast toward Barbados by the North Equatorial Current. The largest catches of both flyingfish and dolphin are made at these times (Mahon et al., 1982).

## RECENT HISTORY OF THE BARBADOS FLYINGFISH FISHERY

The traditional and continuing economic importance of flyingfish in Barbados is due, at least in part to a combination of limited demersal resources associated with a narrow insular shelf, and the highest population density in the area (presently estimated to be 1528 persons per sq. mile). From the 1800's through the mid-1950's, Barbadian fishermen prosecuted the fishery using 18 to 28 ft. wooden sailboats. These boats sailed offshore early each morning, drifted during the day with sails down, and returned to shore in the evening. Schools of flyingfish were attracted solely by wicker chum baskets filled with crushed flyingfish. They were captured with small baited hooks on handlines and, when densities were high enough, by scooping fish directly from the sea surface with hand nets.

Vessels powered by inboard diesel engines replaced virtually all of the sailboats by the late 1950's. During the late 1960's and early 1970's, there was a rapid increase in the number of these one-day boats. Drift gill nets, first introduced in 1948, were widely employed by this time, in addition to fish-attracting devices (FAD's) in the form of floating bundles of dried sugar cane stalks and leaves tendered from the boats by lines. It appeared to fishermen as though catch per boat-day decreased significantly near shore as the number of boats increased, compelling them to travel further offshore in search of Schools of flyingfish, returning late in the evening. Until this time, most of the boats were similar in size to the traditional sailing vessels. As the distance travelled increased, however, a number of fishermen installed larger, faster diesel engines. In many cases, new one-day boats were 36 ft. in length and were equipped with 80 to 180 hp engines, causing a sharp increase in operating costs. These new boats were equipped with navigation lights, electric bilge pump, compass, radio, and life jackets, and they were insured. Fuel costs tripled, and in some cases the total operating costs increased four- or five-fold.

One fisherman-boatowner, John Harding, at this time perceived the need to stay at sea for more than one day. He built a 2.5 ton capacity, heavily insulated ice box in his 30 ft., 36 hp wood boat. By staying at sea for 2-3 days, he cut his fuel expenses in half and increased his catches considerably. This soon led to the practice of long-range fishing for flyingfish.

Two large vessels with 8-10 ton ice holds were built between 1978 and 1980 in Barbados for the purpose of extended commercial fishing trips for flyingfish. By 1982, approximately five such boats had been finished. One of these was the Supertest, a heavily-constructed wood boat, 45 ft. long with a 14 ft. beam, 150 hp diesel engine, accomodations for a crew of 6, and a 12 ton capacity ice hold, built by John Harding and one of the authors (AH). At present, approximately 32 long range boats between 35 and 60 ft. in length with 5-12 ton ice holds are fishing. About one-third are fiberglass or fiberglass on wood, and the rest are entirely wood. All but one are powered by single 80-225 hp diesels, and remain at sea for 4 to 14 days.

Thus, two distinct fleets now operate in Barbados, the one-day boats, locally called "petters," and long-range vessels or "ice boats." Petters, of which there are approximately 500, often fish 2 to 5 miles offshore, ranging as far as 40 miles out during a day of fishing. Catches commonly range from a few hundred to 1500 flyingfish. Dolphin, wahoo, kingfish, yellowfin tuna, sharks, and occasional billfish supplement the catch. Petters catch these larger pelagics trolling lures to and from the fishing grounds, and opportunistically on baited handlines fished while drifting for flyingfish.

The Barbados day boat fishery currently employs approximately 1000 to 1500 full- and part-time fishermen, ranging in age from 16 to 60 or so years. Average age is approximately 30 to 35 years. Several fishhouses in Bridgetown, employing a total of 80 to 100 cleaners, handle the de-boning of fish brought in by the day boats to this area. The finished product is a completely boneless, flat, rounded fillet weighing an average of approximately 3 ounces. These fillets have long been the premier seafood delicacy on the island, served in fast food and gourmet restaurants as fish sandwiches or entrees.

## THE NEW LONG-RANGE FISHERY

A number of substantial changes accompanied the initiation of the long-range fishery. The range of the fishery was expanded from the vicinity of Barbados primarily to the productive waters of the North Equatorial Current between Tobago and Grenada, approximately 140 miles to the south-southwest. Total catches of both flyingfishes and larger pelagic species landed in Barbados have increased significantly, due less to introduction of new fishing methods than to intensification of those already in place. Fishing power on the long-range vessels relative to petters is increased by the larger crew size (usually 4, compared to 2), larger capacity, and the ability to drift day and night for a number of days, allowing relatively larger concentrations of both flyingfish and their predators to accumulate throughout harvesting activities.

Individual long range fishing vessels make substantially larger catches of both flyingfish and larger pelagics than other individual vessels from Barbados. Ice boats catch larger pelagics by trolling two dead, rigged flyingfish at all times

when underway. They are also equipped with 5 or 6 additional 300 lb. test monofilament handlines which they fish opportunistically for dolphin, wahoo, kingfish, yellowfin tuna, albacore, sailfish, marlin, and mako and other sharks. While drifting, the ice boats deploy 800 m lines with three sugar cane bundle-FAD's, in addition to the traditional chum basket. Periodically, the FAD's are restrieved. Schools of flyingfish and sometimes dolphin or tuna which have been attaracted to the FAD's are thus drawn to the boat. Before the FAD's are let back out, they must be cleared of the massive amounts of highly viscos flyingfish spawn deposited among the sugar cane stalks. Usually, flyingfish are scopped when they beconme abundant around the vessel, a more efficient method because of the extraction time required for gill netting. The problem of flyingfish spawn accumulation is also present for gill netting and scoop netting. Meshes must periodically be cleared so as not to become inoperable. All flyingfishing stops when tuna, dolphin, or other predators arrive as crew members handline the bigger fish, using live flyingfish for bait.

Ice boat operators tend to be cautious about insuring the quality of their catch. Flyingfish harvesting halts at frequent intervals so that fish on deck can be placed in thin layers, with finely-ground ice between layers, in the hold below decks. All larger fish are gutted, gilled, and packed in ice soon after capture.

Most ice boats return to Barbados with an approximate average of 18,000 flyingfish (approximately 6000 lbs.) and from perhaps 300 to 2000 lbs. of larger pelagics during the November to June fishing season.

## PROBLEMS AND OPPORTUNITIES

The rapid development of the long range fishery for flyingfish in the southeatern Caribbean has created socioeconomic problems in Barbados, mostly for fishermen. It also underscores the almost complete lack of scientific knowledge about the exploited stock or stocks. While the fishery is still young, a number of these problems can, once clearly defined, become opportunities.

Perhaps the most immediate problem associated with the newly-developed fishery is the local market and lack of distribution inland. The general problem is not new, but it has been intensified by increased landings from the ice boats. As Wiles (1948) noted, the main landing ports of Speightstown, Bridgetown, and Oistins are limited to the leeward side of the island. Because of lack of cold storage, and poorly developed distribution, a single ice boat may saturate the local market for up to two days. Whole flyingfish that sell for up to 30 cents (U.S.) ex-vessel each at the beginning of the season drop to as little as 5 cents during the glut of mid-season. Simultaneously, people on the windward coast and inland are often not able to purchase as much fish as they would like. Local entrepreneurs can to some extent alleviate the problem through profitable transportation of fish from the ports, but

wasted product due to spoilage will persist until economical cold storage facilities are constructed.

Given improved local distribution, it is unclear whether present levels of production would exceed local demand. With the current rate of expansion, and especially with further increase in fishing power per vessel, saturation of the Barbadian market is inevitable. This creates obvious opportunities for earning foreign currency through export. Lanier (1981) and Matton (1982) described the present and potential world demand for small pelagics, and Suda (1973) and Yesaki (1977) discussed potential catches and gear technology.

The loss of revenue to fishermen and unsatisfied fish demand of parts of the population of Barbados, associated with flooded markets, are immediate problems. However, these losses are minor compared to the continuing opportunity cost of not having developed an export market. The single largest obstacle to overcoming these barriers is lack of cooperation between fishermen. Formation of a cooperative organization has successfully overcome similar problems elsewhere in the Caribbean Basin (for example, the Northern Fishermen Co-op in Belize). The second step would be construction, by the cooperative, of adequate cold storage facilities and a processing plant, with capacity contingent upon development of export markets. Only then would introduction of more efficient gears, such as the Japanese purse seines, or perhaps a small-scale mother ship system, be feasible.

Equally important to organization of the industry in Barbados is the pursuit of mutually beneficial fishing agreements with both Trinidad and Tobago and Grenada. These two countries are not nearly as sophisticated in harvesting flyingfish as the Barbadians, yet much of the best fishing occurs in their fishery conservation zones. One possibility would be for Barbadian vessels to act as mother ships for the smaller outboard vessels operating out of Tobgo, purchasing flyingfish directly from the smaller vessels.

The socioeconomic opportunities described above assume that flyingfish stocks in the southeastern Caribbean can sustain present or increased levels of effort. Thus, while ignorance of flyingfish biology and population dynamics is a potential threat to the continuation and further development of the fishery, it also represents an opportunity for meaningful research. Critical questions include: (1) stock structure--distribution and approximate abundance of exploited species; (2) biological parameters--lifespan, and rate of growth and mortality; (3) age structure of the population; and from these, (4) estimated present biological status and potential sustainable yield from the stock.

At present, few data are being collected, despite the economic importance of the fishery. Collection of representative length frequency data and hard parts for aging should begin immediately. A single fishery officer or student could accomplish this with just a few days of effort per month. Similarly, several other basic biological data could be easily collected at the same time, including fecundity versus weight

and average sex ratios in the catch. Estimated total catch and effort, as well as catch per unit effort data, would also be relatively easy to collect since the majority of the catch is landed at three ports.

While the rapid development of the new long-range fishery has created both socioeconomic and fishery management concerns, it has at the same time introduced a number of opportunities for the people of the southeastern Caribbean. Timely action from both within and outside the region could at the least result in the realization of some economic improvements. Continued lack of attendance to these concerns will just as likely result in more extensive problems.

## LITERATURE CITED


Brown, H.H. 1942. The sea fisheries of Barbados. Bull. Dev. Welf. W. Indies 1: 1-32.

Dharma Raja, S.K. and G. Balakrishnan. 1976. On the index of abundance of flyingfish populations in the inshore waters of Tamil Nadu and Pondicherry. Indian J. Fish. 21(2): 566-568.

Hall, D.N.F. 1955. Recent developments in the Barbadian flyingfish fishery and contributions to the biology of the flyingfish, Hirundichthys affinis (Gunther). Colonial Office, Fish. Publ. 7: 1-41.

Kamegai, S. 1971a. The determination of a generic name of flyingfishes muscle parasite: A didymozoid whose ova have occasionally been found in human feces in Japan. Jap. J. Parasitol. 20(3): 170-176.

Kamegai, S. 1971b. A trematode from the gall bladder of the flyingfish from Japan. Jap. J. Parasitol. 20(4): 274-275.

Kojima, S. 1969. Studies on the migration and spawning habit of the flyingfish, part 3: Behavior of the fish schools in the spawning ground. Bull. Jap. Soc. Sci. Fish. 35(11): 1055-1059.

Kojima, S. 1971. Studies on the migration and spawning habit of the flyingfish, part 4: Distribution of eggs in the spawning ground. Bull. Jap. Soc. Sci. Fish. 37(4): 284-288.

Kovalevskaya, N.V. 1982. The basic features of reproduction and development of flyingfish (Exocetidae). Vopr. Ikhtiol. 22(4): 582-587.

Kureishy, T.W., M.D. George and R. Sen Gupta. 1979. Total mercury content in some marine fish from the Indian Ocean. Mar. Poll. Bull. 10: 357-360.

Lanier, B.V. 1981. The world supply and demand picture for canned small pelagic fish. FAO Fish. Tech. Pap. 220: 111 p.

Lewis, J.B., J.K. Brundritt and A.G. Fish. 1962. The biology of the flyingfish Hirundichthys affinis (Gunther). Bull. Mar. Sci. 12: 73-84.

Mahon, R., W. Hunte and R.E. Hastings. 1982. Seasonality in the commercial marine fisheries of Barbados. Proc. Gulf Caribb. Fish. Inst. 34: 28-37.

Matton, E. 1982. Markets for frozen small pelagic fish. FAO Fish. Tech. Pap. (221): 131 p.

Nesterov, A.A. and M. Ye. Grudstev. 1980. The quantitative distribution of the flyingfish of the family Exocoetidae (Beloniformes) in the tropical Atlantic. J. Ichthiol. 20(3): 137-140.

Okachi, I. 1958. Studies of morphological characteristics and growth of flyingfishes caught in the Japan Sea. Ann. Rep. Japan Sea Reg. Fish. Res. Lab. 4: 15-24.

Parin, N.V. 1967. Scomberesocidae (Pisces, Synentognathi) of open waters, pp. 33-51. in: The Pacific Ocean. Acad. Sci. USSR Inst. Oceanol.

Parin, N.V. and D.A. Astakhov. 1982. Studies on the acoustico-lateralis system of beloniform fishes in connection with their systematics. Copeia 1982(2): 276-291.

Shiokawa, T. 1969. Study of the swimming habits of flying fish in the spawning season. FAO Fish. Rep. 3(62): 579-590.

Shuntov, V.P. 1968. Quantitative count of flying fish in the eastern Indian Ocean. Vopr. Ikhtiol. 8(6): 985-991.

Suda, A. 1973. Development of fisheries for nonconventional species. J. Fish. Res. Board Can. 30: 2121-2158.

Vijayaraghavan, P. 1973. Studies on fish eggs and larvae from Indian waters: I. Development of eggs and larvae of Hirundichthys (Hirundichthys) coromandelensis (Hornell). Indian J. Fish. 20(1): 108-137.

Weber, R.R. 1983. DDT and PCBs in equatorial Atlantic organisms. Mar. Poll. 14(7): 274-275.

Whiteleather, R.T. and H.H. Brown. 1945. An experimental fishery survey in Trinidad, Tobago, and British Guiana, with recommended improvements in methods and gear. Anglo-American Caribbean Commission, Washington, D.C.: 1-130.

Wiles, D.W. 1948. The fisheries of Barbados and some of their problems. Proc. Gulf Caribb. Fish Inst. 1: 65-69.

Yesaki, M. 1977. Innovations in harvest of pelagic resources. Mar. Fish. Rev. 39(3): 14-23.