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Observations on the Commercial Potential of Tuna in the Oceanic Northwest Atlantic

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Abstract

Explorations using tuna longline gear in the oceanic northwest Atlantic, from off Cape Hatteras to east of Bermuda and north to near the Grand Banks, indicate that bluefin tuna, *Thunnus thynnus*, and yellowfin tuna, *Thunnus albacares*, are to be found in potentially commercial quantities.

Exploratory catches by the research vessels DELAWARE, CRAWFORD, SILVER BAY, SHOYO MARU and CAP'N BILL III are projected to a theoretical catch rate of 100 ten-hook baskets of tuna longline gear.

Bluefin tuna appear very abundant in the general area of the Gulf Stream from late fall to late spring; yellowfin tuna were taken in commercial quantities in the

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Gulf Stream off Cape Hatteras in the spring, and in lesser quantities in the area between the Gulf Stream track and the continental shelf in the summer and early fall.

INTRODUCTION

EXPLORATION OF THE OCEANIC NORTHWEST ATLANTIC using tuna longline gear from off Cape Hatteras to east of Bermuda and north to the southeastern edge of the Grand Banks, within the past decade has revealed that extensive concentrations of bluefin tuna, *Thunnus thynnus* (Linnaeus), and lesser concentrations of yellowfin tuna, *Thunnus albacares* (Bonnaterre), are common to the Gulf Stream during certain seasons of the year (Squire, 1962a; Mather, 1962). Other tuna species, such as albacore, *Thunnus alalunga* (Bonnaterre), bigeye tuna, *Thunnus obesus* (Lowe), and skipjack, *Euthynnus pelamis* (Linnaeus), have been found in the oceanic area, but rarely in commercially significant quantities. A projection of Japanese exploratory catches reveals that albacore are present in quantities of up to 2.0 tons per 100 basket set, and one exploratory station by a U. S. research vessel reported a projected catch of over 4 tons of bigeye tuna per 100 baskets of longline gear.

The world tuna catch for 1960 was estimated at about 800,000 tons and an increase to about 1,500,000 tons by 1970 has been predicted (Chapman, 1962). One of the major tuna fisheries of the world, that for the yellowfin tuna of the eastern Pacific, is believed to have exceeded its maximum sustainable yield (Schaefer, Broadhead, and Orange, 1962), and an annual quota has been proposed. Other tuna fisheries, which have not been as intensively investigated, may be approaching this condition. Therefore, if production is to increase as expected, new or only partially developed tuna resources must be utilized. Uda (1962) has shown interest in the development of the oceanic tuna resources of the northwestern Atlantic, and explorations indicate that this area can supply a portion of this predicted increment.

Summary of explorations for tuna resources in the oceanic northwestern Atlantic

Six vessels using sufficient quantities of subsurface fishing longline gear to give a reasonable estimate of production have conducted explorations in the oceanic areas of the northwestern Atlantic.

Extensive explorations of the oceanic area were begun by the U.S. Fish and Wildlife Service, Branch of Commercial Fisheries, early in 1957, using the research vessel DELAWARE. Eight cruises were made by this vessel from 1957 to 1960 to determine the gross distribution of tuna species inhabiting the oceanic areas during all seasons except late fall and early winter. The Japanese Fisheries Agency reported that in December, 1959, the research vessel SHOYO MARU explored in the oceanic Atlantic to north of the island of Bermuda on two lines of stations, the westernmost of which extended north to latitude 34° 18′N (Anon., 1960). The SHOYO MARU fished five days in the area, and the above report states that, "Since the northerly extremity of distribution of tuna would be the northerly extremity of the Gulf Stream, the present investigation must have traversed south and northwise perhaps all of tuna distribution waters in the western part of the Atlantic." However, this exploration obviously did not cross into the north frontal area of the Gulf Stream, the most productive area found during explorations of the DELAWARE.

The total daily catch at 13 stations explored by the SHOYO MARU in the

western north Atlantic, from latitude 21°55'N to latitude 35°18'N, averaged about 0.6 or 0.7 tons per day. Albacore was the most common tuna species taken with yellowfin catches being about 1/3 that of albacore.

A limited commercial attempt to fish the oceanic area with longlines was made by the Gloucester, Massachusetts, trawler GOLDEN EAGLE in late June, 1959. The vessel fished a total of 9 days in the area south of New England.

In 1960, the Woods Hole Oceanographic Institution initiated a series of exploratory cruises in the oceanic area. To date two cruises for tuna have been conducted by the research vessel CRAWFORD in the western north Atlantic (Mather and Bartlett, 1962; Anon, 1962) and a limited amount of longlining was conducted by the chartered dragger CAP'N BILL III in 1961 and 1962.

The Bureau of Commercial Fisheries vessel SILVER BAY also conducted limited tuna explorations in 1961 in the Gulf Stream area south of Cape Hatteras.

TABLE 1

MAJOR EXPLORATIONS FOR TUNA, OCEANIC NORTHWEST ATLANTIC, FROM OFF THE CONTINENTAL SHELF TO APPROXIMATELY LAT. 30°N AND LONG. 51°W.

Vessel		Cruise No.	Date
1957			
R/V DELAWARE	U.S.F.W.S.	57-3	3/17 to 4/ 8/57
R/V DELAWARE	U.S.F.W.S.	57-5	6/ 8 to 7/ 3/57
R/V DELAWARE	U.S.F.W.S.	57-8	9/11 to 10/24/57
1958			
R/V DELAWARE	U.S.F.W.S.	58-2	4/21 to 5/11/58
R/V DELAWARE	U.S.F.W.S.	58-3	7/10 to 8/ 3/58
1959			
R/V SHOYO MARU	Jap. Fish. Agency	—	12/11 to 12/17/59
R/V DELAWARE	U.S.F.W.S.	59-1	1/14 to 2/ 5/59
R/V DELAWARE	U.S.F.W.S.	59-6	5/20 to 5/26/59
M/V GOLDEN EAGLE	Commercial	—	6/ 6 to 6/16/59
1960			
R/V DELAWARE	U.S.F.W.S.	60-6	4/21 to 5/ 6/60
R/V CRAWFORD	W.H.O.I.	56	11/12 to 11/27/60
1961			
R/V CRAWFORD	W.H.O.I.	62	4/19 to 6/ 8/61
R/V SILVER BAY	U.S.F.W.S.	33	9/27 to 10/ 4/61
R/V CAP'N BILL III	W.H.O.I.	—	10/17 to 10/28/61
1962			
R/V CAP'N BILL III	W.H.O.I.	—	10/ 9 to 10/15/62
R/V CAP'N BILL III	W.H.O.I.	—	10/23 to 10/31/62

Vertical distribution pattern and levels of abundance for the major tuna species in the oceanic area

During the course of these explorations, certain areas have at certain seasons appeared to have concentrations of tuna warranting commercial interest. In most seasons, these areas where higher catch rates of tuna have been observed are associated with the north frontal area of the Gulf Stream. This hydrographic feature of the northwestern Atlantic is analogous to the Kuroshio Current of the northwest Pacific, and certain similarities in the distribution of species common to both areas have been observed (Squire, 1962b). The oceanic area appears to possess subsurface stocks of tuna, and surface schooling behavior is

seldom observed. In fact, the only tuna species identified as schooling in the upper layer of the Gulf Stream was the oceanic skipjack. In the eastern Pacific it is reported that a well developed and relatively shallow thermocline is one of the reasons for the surface schooling behavior of tunas and the resulting successful surface live bait and purse seine fisheries (Brock, 1960). This hydrographic characteristic of a shallow thermocline is rarely found in the Gulf Stream area. If an oceanic fishery were to develop in the latter region, it would require the type of fishing gear that can effectively fish the subsurface areas.

Projected Catch Rates

Catch rates for longline explorations, as expressed in tons per 100 basket set—assuming that ten-hook baskets are used—are given for the winter, spring, early summer, summer, early fall, and late fall seasons (Figs. 1 to 6). These data are calculated from catch rates available from explorations of the research vessels DELAWARE, GOLDEN EAGLE, CRAWFORD, SILVER BAY, CAP'N BILL III, and the SHOYO MARU. Exploratory longline catches are projected to a theoretical catch from a set of 100 baskets of ten-hook gear (1,000 hooks), and expressed as number of tons. The dominant tuna species (number of fish) is shown after each exploratory station's catch by the letters: A—albacore, B—bluefin, Y—yellowfin, BLF—blackfin, and BI—bigeye. The United States' vessels all have used longline baskets having ten hooks each. The Japanese vessel used four hooks per basket and used 100 baskets (400 hooks) at each fishing station during explorations in the northwest Atlantic. The efficiency of the two types

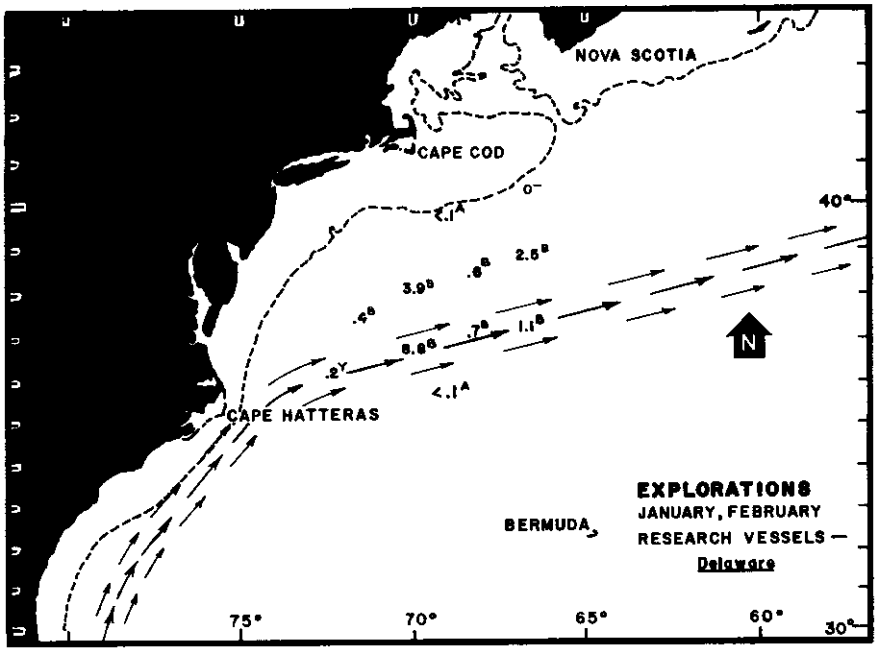

FIG. 1. Projected catch rates from explorations during January and February, expressed in tons per 100 ten-hook baskets.

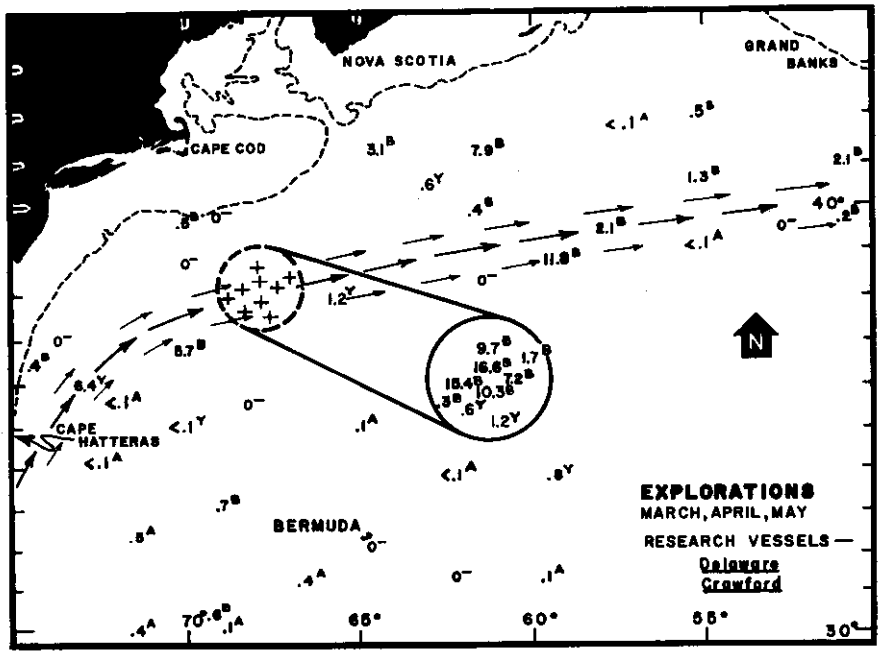

FIG. 2. Projected catch rates from explorations during March, April, and May, expressed in tons per 100 ten-hook baskets.

of fishing gear (Japanese and United States) cannot be directly compared for catch per unit of effort. In Fig. 6 the actual catch of the Japanese vessel is given, and in parenthesis is indicated the projected catch for 100 ten-hook baskets.

Projected catch rates for the January-February period (Fig. 1) ranged from 0 to 8.8 tons per 100 baskets. The dominant species was bluefin tuna, with the greatest concentrations found along the northern frontal zone of the Gulf Stream. Latitude 38°N., Longitude 70°W. approximates the center of observed distribution.

The number of samples within the area is small, yet bluefin tuna catch rates are sufficiently encouraging to warrant commercial interest. However, unfavorable sea conditions resulting from winter storms would seriously hamper commercial fishing operations in the Gulf Stream during this season.

Explorations during the spring season (Fig. 2) have been more extensive, and the projected catch rates peak to a high of 16.6 tons of tuna per 100 baskets of longline gear. Bluefin is the dominant species during the spring season throughout the Gulf Stream area. South of the Gulf Stream track to the vicinity of Bermuda, scattered catches of yellowfin and albacore were reported, but none of the catches appear to be of commercial interest. During late spring an excellent catch of yellowfin tuna was made in the warm core of the Gulf Stream east of Cape Hatteras. This encouraging catch yielded a projected weight of 6.4 tons per 100 baskets.

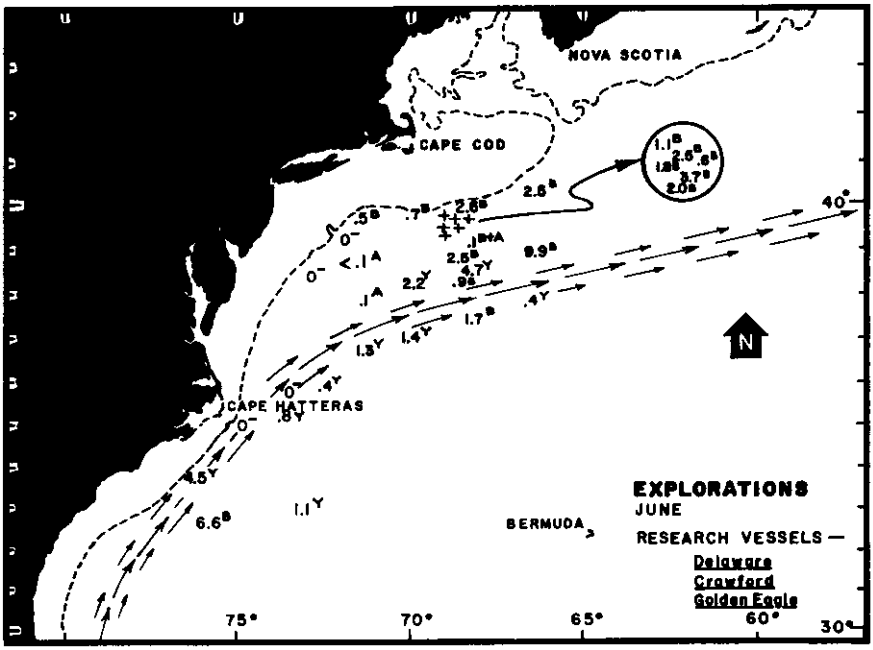

FIG. 3. Projected catch rates from explorations during June, expressed in tons per 100 ten-hook baskets.

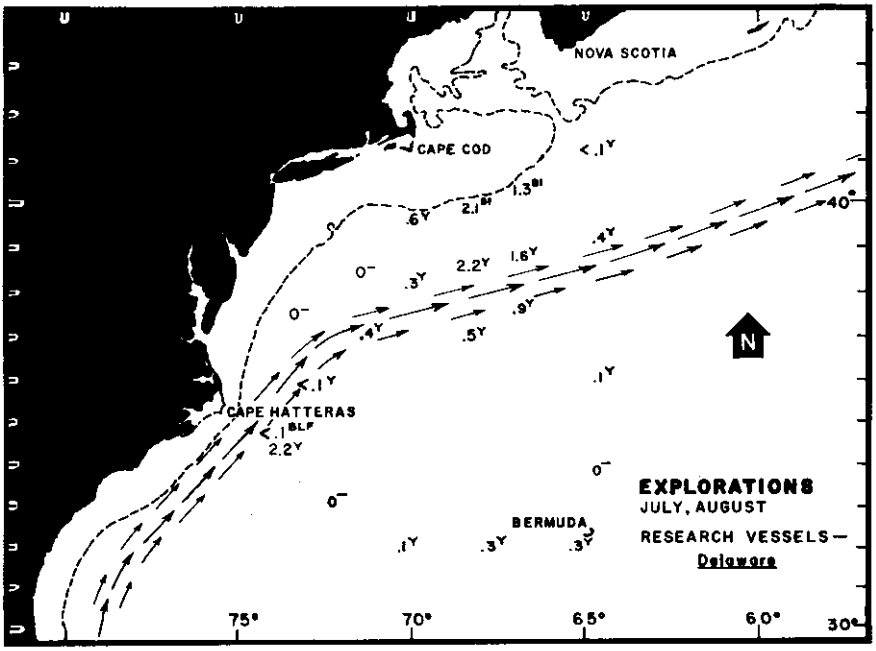

FIG. 4. Projected catch rates from explorations during July and August, expressed in tons per 100 ten-hook baskets.

During this period substantial catches of bluefin tuna appear to be possible in the north frontal area of the Gulf Stream at 72°W., with concentrations extending to below the southeastern edge of the Grand Banks, the eastern limit of tuna explorations conducted to date.

Sea state conditions moderate in the northwest Atlantic during the spring season, resulting in an increasing number of days when commercial fishing can be conducted successfully.

The month of June generally can be regarded as the transition period in the oceanic zone north of the Gulf Stream (Fig. 3). Bluefin tuna, the dominant species during winter and spring, are found at the higher latitudes, and yellowfin tuna appear as the dominant species in the Gulf Stream area. Explorations during this period indicate a maximum catch rate of 9.9 tons per 100 baskets at a station having a dominant catch of bluefin tuna, and 4.7 tons per 100 baskets at a station having a dominance of yellowfin tuna. Of particular interest is the catch rate of yellowfin tuna off the Cape Hatteras area and a catch of large bluefin south of Cape Hatteras and east of the Gulf Stream track. Yellowfin taken during explorations made in late spring and early summer are larger fish than those appearing later in the year. Although this is a transition period in species dominance for the oceanic area, profitable catches of tuna should be possible.

Although yellowfin were taken over a wide area during the months of July and August (Fig. 4), the peak catch at a yellowfin dominant station was projected to be 2.2 tons per 100 baskets. Bigeye tuna was the dominant species

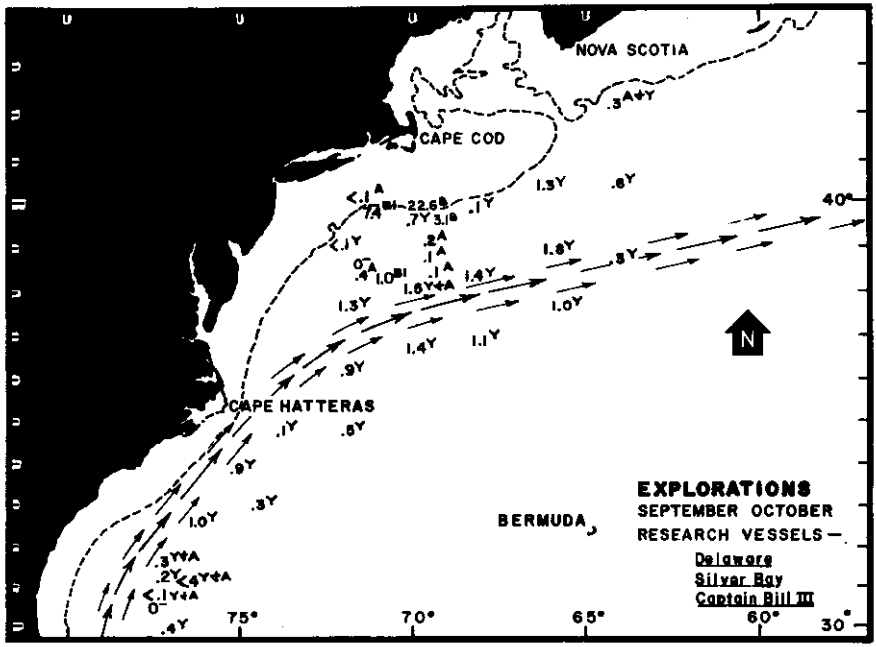

FIG. 5. Projected catch rates from explorations during the months of September and October, expressed in tons per 100 ten-hook baskets.

at two stations near the edge of the continental shelf, yielding a projected catch rate of 2.1 tons per 100 baskets.

Explorations indicate yellowfin tuna to be dominant during the early fall (Fig. 5), with projected catch rates at many of the stations ranging from 1 to 1.8 tons per 100 baskets in the north frontal area of the Gulf Stream. A projected catch rate of 7.4 tons was reported for bigeye tuna near the edge of the continental shelf. Limited explorations south of Cape Hatteras in the Gulf Stream area have not indicated large concentrations of tuna in these months (Anon., 1961). In October the movement of bluefin tuna from the continental shelf begins as indicated by one projected catch of 22.6 tons per 100 baskets, but explorations have not shown this species to be present in the Gulf Stream frontal areas in any quantity.

Explorations by the R/V CRAWFORD in November, 1960, indicated that bluefin tuna were very abundant along the continental slope from longitude 72° to 66°W. Projected catch rates from 6.4 to 65.0 tons per 100 baskets were obtained at four stations. During this period of migration of bluefin from the continental shelf areas toward the Gulf Stream area the concentrations of the subsurface tuna resources are extensive and should be of commercial interest.

Explorations by the SHOYO MARU within the areas shown of Figs. 1 to 6 indicate a dominance of albacore with catches of yellowfin and a few bigeye in the western half of the Sargasso Sea area.

Catches were remarkably consistant for albacore at the five stations fished, ranging from 3.2 to 4.6 fish per 100 hooks.

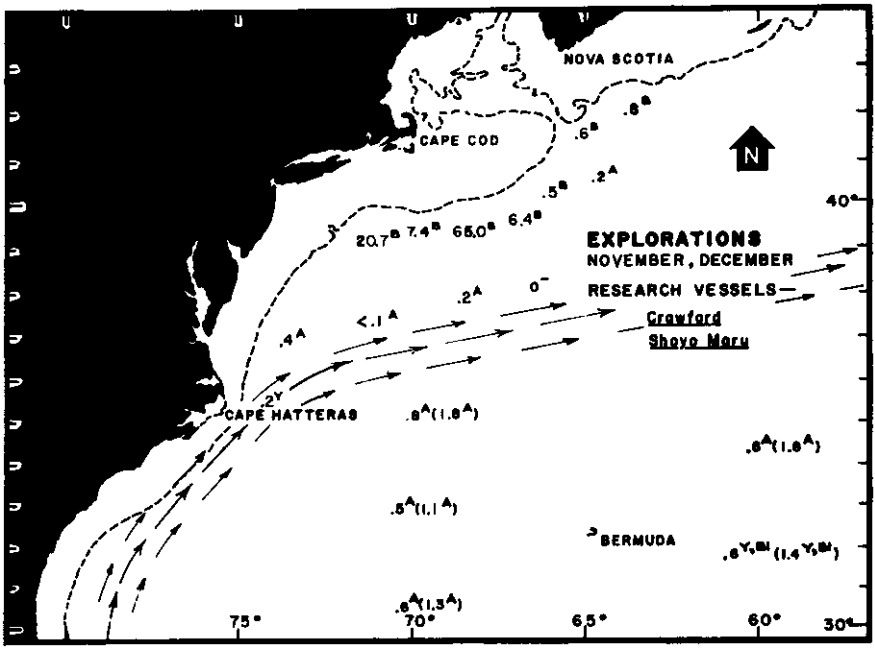

FIG. 6. Projected catch rates from explorations during the months of November and December, expressed in tons per 100 ten-hook baskets.

SUMMARY AND CONCLUSION

The United States' commercial fishing industry has not used the Japanese subsurface tuna longline technique in any large scale commercial fishing operations. A limited amount of commercial longlining has been conducted in the Gulf of Mexico, and a small boat tuna longline fishery has existed in the New England area during the late summer. The question of whether the United States industry, using seaworthy, oceangoing vessels and experienced fishing crews, can produce tuna at a profit by oceanic longlining has yet to be demonstrated. However, as the result of explorations in the oceanic northwestern Atlantic, the commercial fishing industry has shown an interest in the possibilities of oceanic longlining.

Catch rates, projected from exploratory data, have been shown to be of a magnitude that if ex-vessel tuna prices in northeastern North American ports for longline-caught bluefin tuna were at a level to provide an economically profitable operation, considerable oceanic longlining would result. Catch results in the oceanic area were obtained by single exploratory vessels operating as independent units, over a period of five years. Explorations were usually conducted over a wide area, using a grid type of coverage, to determine the large scale distribution of tuna species. Information was not available from other fishing vessels on the distribution and abundance of tuna through radio communication, an advantage that two or more vessels could have if commercial longlining were attempted in the oceanic northwest Atlantic.

In the oceanic area, illustrated by Figs. 1 to 6, a total of 165 fishing stations are indicated. Though these fishing stations are widely scattered in time and space, sufficient information has been obtained to indicate that bluefin tuna and, to a lesser degree, yellowfin tuna are to be found in or near the Gulf Stream frontal area in potentially commercial concentrations.

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