

within the confines of the bottom line were actually shrimp buried in the soft mud. The shrimp being of greater density than the mud about them, they reflected a sharper signal, and therefore a darker and more precise line appeared on the chart. One drag of 36 minutes duration was made that netted 2200 lbs. of shrimp. The chart made during this drag showed an almost continuous "darker" line, and it was observed that during the entire drag, no slack appeared in the dragging cables.

"These findings of course were met with great interest from all of the observers. If this instrument could actually detect the presence of shrimp it would mean many hours of futile dragging saved each day; it would mean hundreds of dollars saved in wear and tear on gear, plus additional hundreds of dollars saved in operating costs to the boat owner.

"Here, indeed, was the dream of all shrimp fishermen—an instrument that could see shrimp.

"It is still too early to make the statement that the Bendix Recorder will "see" shrimp under any and all conditions, but it is a substantiated fact that under conditions encountered on the initial tests locating and charting schools of shrimp electronically has become a reality. Further tests are being conducted in an effort to prove further that shrimp can be located with such an instrument in this manner."

It is fully appreciated that not nearly all of the important aspects of the use of echo sounders in fisheries have been covered in this paper. Almost daily entirely new applications or variations of older applications are being discovered and the writer is incapable of keeping currently abreast of these new developments throughout the world. The principal applications and considerations have, however, been discussed and it is hoped that this discussion will provoke thought which may lead to the discovery of new applications in this area.

The Role Of Exploratory Fishing In The Development Of Commercial Fisheries

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ALL EXISTING COMMERCIAL FISHERIES have been discovered and expanded by exploratory fishing, performed either by private fishermen in the normal course of their business or by exploratory work of various governments. In established fisheries the pattern of development is a gradual exploration over increasing distances paralleled with the development of equipment suitable for developing the fishery. Eventually, the expansion is stopped either permanently or temporarily by the range of species and its ability to stand the drain of exploitation, by the limitations of standard fishing equipment and aids, or by the economics of production and marketing considerations. Many of our present fisheries have reached or are approaching one or more of these limitations.

For economic reasons commercial fishermen seldom make a bold jump to new areas remote from markets or make radical changes in equipment unless there is assurance that profitable fisheries are available for development, or that changes will add to their income. Pioneering in the fields of exploration and the development of superior equipment is expensive and usually beyond the means of the relatively small fishing enterprises. It must in part be a function

of Government if we are to expedite the expansion and improve the economy of our fisheries.

The objectives of exploratory fishing are to discover new and valuable fishing grounds, to devise effective methods of developing them and to establish practical fishery knowledge on which potential operators may base a sound decision on their utilization. The fishing equipment and effort must be of commercial proportions to enable potential operators to estimate the probable returns from a commercial venture.

Many years of commercial fishing have demonstrated that a concentration of effort on certain favored spots is required for profitable trips. Commercial fishermen also find that prolonged and indiscriminate running frequently ends in unsuccessful trips. Furthermore, the appearance of fish in a catchable state is an intermittent occurrence even on favored spots and during the proper season. Exploratory efforts must, therefore, be concentrated in promising areas over an extensive period of time or the apparent conclusions may be greatly in error.

Development of the Pacific Halibut Fishery

The north Pacific halibut fishery is an example of one that was explored and developed by private enterprise.

The primitive Indians are presumed to have used halibut ever since they came to the Pacific and early explorers found them at various points along the coast from Washington to the Shumagin Islands. Explorations by the Bureau of Fisheries steamer *Albatross* in 1888 found halibut along the Aleutian Islands, Bristol Bay and a "scattering" around Middleton Island, Kodiak Island and the Shumagin Islands (1). This is a case of exploratory fishing effort spread too thin resulting in erroneous observations in the light of subsequent developments.

Prior to the completion of the railroads to the coast in the period from 1887 to 1893, the halibut fishery was chiefly exploited for local consumption and the greater part of the catch came from nearby inside waters, now barren. Difficulties were encountered in opening trade with the East but halibut on the Atlantic banks were becoming scarcer causing larger dealers with better trade connections to become interested in Pacific halibut (2).

The development of the halibut fishery until 1910 was one of progressive location and exploitation of grounds in the more or less sheltered waters of Puget Sound, British Columbia, Hecate Strait and the banks off Vancouver Island. Since the earliest vessels were sailed, excessive delays were experienced in reaching market. In 1893 the first powered vessel entered the fishery using round bottom boats for fishing which had to be towed to the grounds. A great advance was made in 1895 with the introduction of dories which could be nested and carried aboard the large vessels in bad weather thereby eventually opening the way for a transition to a high seas fishery. According to first opinion the supply of halibut in Alaska was small, and in 1903 Moser, of the Bureau of Fisheries, believed that the halibut banks were principally off British Columbia and there was little prospect of a large commercial fishery in Alaska. However, great offshore banks were awaiting discovery (3).

Until 1910 the process of development had been based on exploration for new banks, their successive exploitation and partial depletion. However, the evolution of the fleet and more efficient fishing methods maintained production. By the use of dories the vessels could proceed to open waters, but fishing under

these conditions rendered impractical the transfer of fish by hand to the mother vessel. Finally, in 1902, a net was devised and placed on the bottom of the dory whereupon the entire catch could be lifted aboard at once by power. This seemingly simple improvement permitted the catching and handling twice as many fish per day and illustrated the minor mechanical things on which a great fishery depends (4).

The year 1910 marked the beginning of an important era in the fishery, for privately owned, able deep sea schooners were being introduced to compete with company owned steamers, reliable gasoline and distillate engines were available, mechanical developments were made, and the shift to deep sea fishing began. From 1911 to 1913 the building boom for schooners reached its peak and the fishery was extended offshore along Southeast Alaska to Yakutat, banks had been found near Prince William Sound, and to the south, banks were discovered off Oregon. Significantly, Thompson states, "Here as elsewhere demonstration of the mere presence of fish was not sufficient for the best fishing spots and seasons had to be learned from experience" (5).

From 1915 to 1923 new banks were not eagerly sought but methods were steadily improved enabling the fisherman to prosper on only a fraction of their former yield per unit of gear. Electric lights were introduced, enabling fishing throughout the long winter nights of Alaska. Cable anchor winches permitted anchoring on banks, better pilot house control of the engine facilitated hauling gear, dories were lifted aboard by power and electric lights were developed for buoys marking the gear. A most radical change on the schooners was the development of long line fishing in 1913, eliminating the need for dories. The lines were set over a chute on the stern and hauled over rollers on the side by a power driven gurdy instead of by the hand-hauling methods of the dory. The long line allowed a greater freedom, for the gear could be set as convenient over long distances instead of in a block, as was necessary for safety of men in the dories, and fishing in stormy weather became possible. Prior to 1914 nearly all halibut fishing was done from dories but in 1928 93 percent of the gear was operated by the long line system and dory fishing was finally made illegal because it was best suited for shallow waters where small fish predominated (6 & 8).

By 1920 the Diesel engine had reached a high degree of perfection and the refusal of the oil companies to market low priced distillate fuel stimulated its adoption. By 1923 many installations of powerful Diesels were made, for they could be operated at higher efficiency on low cost fuels, resulting in the possibility of longer cruises and the reduction in fire hazard. As the schooner developed in efficiency, these privately owned, more economically operated boats displaced the company owned steamers (6).

The period of 1923 through 1928 was one of intense exploration and exploitation of the banks off central and western Alaska. At that time there was a seaworthy fleet propelled by powerful Diesels which could run long distances very economically, and techniques had been developed whereby 20 to 25 miles of gear could be periodically set and hauled over a distance of 50 to 75 miles in a day. As was the case with older banks, those west of Cape Clear had been known from early days and attempts had been made to fish them long before their real exploitation began. However, it was not until 1923 that exploitation of the distant banks was begun in earnest by large schooners. New banks were progressively explored and exploited further to the westward until, in 1928, the first halibut from Bering Sea were landed.

Of parallel importance to the development of fishing areas was the periodic construction of cold storage plants at strategic locations along the coast. The encouraging effect of such facilities in promoting the exploration for new banks are obvious for a poor trip could be sold and the vessel re-outfitted for another trip (7 & 9).

As a result of depletion of the fishery a treaty was signed with Canada in 1923 imposing a closed season of three months in the winter, and in 1931 a seasonal limit on the catch was imposed by the International Fisheries Commission created under the treaty. In 1932, because of the depression, voluntary action was taken by the fishermen to spread the catch over the season and stabilize the market (10, 11). Most fisheries on the Pacific Coast are seasonal and many boats from other fisheries, together with an increasing Canadian fleet, participated in the halibut fishery, resulting in a progressively shorter season. In 1942 changing economic conditions and opportunities in other fisheries resulted in abandoning the curtailment plan (12, 13, 14). In 1929 the local fishery extended over a period of 9 months but in 1948 the catch limit was taken in only 32 days (15).

Development of the Alaska King Crab Fishery

The American fishery for Alaska king crabs is an example of one acquiring its start solely because of explorations by the Fish and Wildlife Service. About 1930 Japanese crab canning activities were extended across Bering Sea to the southeast side, and eventually into Bristol Bay, and in 1940 alone four factory ships took in excess of 8,000,000 crabs. For several years prior to 1940 occasional small American packs were put up in Cook Inlet, and in 1938 a floating cannery operation was attempted, without financial success, for the necessary exploratory work soon exhausted the limited capital of the enterprise. Increasing exploitation of a fishery by the Japanese in waters adjacent to Alaska raised serious questions as to whether American interests were making adequate use of domestic fishery resources. Initial inquiry disclosed that lack of knowledge of areas of abundance, methods of taking and canning king crabs and the fear of not being able to compete with the low Japanese costs of production were primary obstacles retarding development. Since the cost of the necessary exploration work would be prohibitive for private enterprise, Congress authorized the Service to make the study in 1940 (43, 42).

The explorations established the presence and seasonal locations of a large king crab population in Bering Sea, and lesser, but commercially exploitable quantities, on the south side of the Alaska peninsula. By the use of commercial scale gear the work disclosed when, where and how commercial catches of crabs could be made and discovered large quantities of bottom fish. Explorations by the Service during 1949 in the northeast portion of Bering Sea found that crabs and fish were present but widely scattered, and did not compare in apparent abundance with that in the southeast portion of the Sea. Bottom temperatures and depths also appeared to have a marked influence in the catch (45, 46).

Exploitation of this resource was delayed by World War II but the encouraging results of the explorations caused the captain of one of the exploratory vessels to build a boat in 1945 suitable for the fishery. In 1946 this and another vessel owned by a company organized to exploit Bering Sea started the commercial fishery, and in 1947 the value of their catches was greater than the cost of the explorations (49). In 1948 a federally owned factory ship,

operated under contract by a private company, entered the fishery and received over 387,000 crabs (48). The high cost of operating a steamship and canning crabs at sea has deterred others from exploiting the fishery in this manner but increasing interest is developing in freezing the crabs for fresh markets which are expanding (48, 49).

Development of the North Pacific Albacore Fishery

The North Pacific albacore fishery is an example of one that has been stimulated by Government sponsored explorations, made in conjunction with the efforts of commercial fishermen.

Albacore was the initial species exploited by the Southern California tuna industry and has been an important item from the beginning of the industry until 1925, when this fish apparently disappeared and did not reappear in any quantity until 1938. In 1930 many schools of albacore were reported off the central Oregon Coast and individuals were taken incidentally by fishermen. In August of 1936 a sardine purse seiner caught a ton from a large school a few miles off the Oregon Coast (16, 17). During 1937 significant commercial landings were made by numerous trollers, and in 1941 an estimated 500 boats were engaged in the fishery during August. In 1948 it is probable that the size of the fleet approached 1000 boats (16, 17, 18).

In 1939 a local canning industry was started at Astoria, Oregon, following a careful study of the recorded occurrence of albacore in the past. The relationship of water temperatures and the presence of schools convinced the fishermen and packers that an annual run of albacore could reasonably be expected. With the entrance of a large fleet, in part consisting of more seaworthy seine boats and halibut vessels, the exploited area spread along the Oregon and Washington coasts and well offshore. An all time high of 34 million pounds was landed in 1944, but the catch has declined to less than 15 million pounds annually since 1945.

Canadian boats also entered this fishery in 1939, taking most of their catches off Washington and Oregon. In 1948 the Canadian Department of Fisheries started exploratory fishing operations, resulting, in 1949, in the finding of large concentrations of albacore off the Queen Charlotte Islands (16, 21, 22). Concerning this discovery, Scagel states, "It (the exploration) has provided concrete evidence concerning conditions off-shore which have in many respects been incompletely or incorrectly known. Many fishermen were skeptical of the report, as the find disagreed so completely with the preconceived notion about albacore distribution, but it took only a few venturesome vessels to draw the whole fleet to the Queen Charlotte Islands."

In 1949 explorations by the Fish and Wildlife Service, primarily directed to assess the possibilities off Alaska, found albacore from the Washington coast to a distance of 300 miles off Dixon Entrance (18). In 1950 the Fish and Wildlife Service exploratory vessel found albacore 480 miles off the coast of southern Oregon several weeks before the normal start of the commercial season, by following an analysis of anticipated surface water temperatures. Continuous explorations were made over a period of 3½ months from southern Oregon to Cape St. Elias in the Gulf of Alaska, and at distances up to 500 miles offshore, and the tuna fleet was advised by radio each day of the findings. A demarcation between favorable tuna water temperatures and the colder waters of the Gulf of Alaska was found to exist near Dixon Entrance, close to the Alaska boundary. Japanese type long lines were tried with inconclusive

results but the tests of gill nets were highly successful and over a ton was taken in a single 300 fathom set. A prime problem in the past has been to get the albacore to bite even when fish are plentiful. If net-caught albacore produce a good canned product, the results of these tests may revolutionize the fishing methods. The Service is now undertaking canning experiments to determine the quality of gill net caught albacore (23).

Oceanographic data, length and weight of fish, and stomach samples were collected by the Service exploratory fishing vessel, so that environmental factors effecting the migratory habits and commercial concentrations of the albacore could be correlated. Over 400 albacore were tagged and one was kept alive for 18 hours in a bait tank. No tag recoveries have been reported. However, three fishing vessels have reported catching tuna bearing tag marks. An uncharted sea mount was discovered which shows evidence of supporting bottom fish (23) and may be a potential albacore ground.

Here, then, is an exploratory program within a fishery and beyond its normal range, to advise the fisherman of the presence of albacore, to encourage expansion, develop more effective gear and to correlate factors in order to facilitate fishing this far ranging species. This may lead to a year round fishery such as has been developed by the Japanese through exploration.

Development of the Southern Tuna Fishery

The development of the southern tuna fishery is an outstanding example of the pioneering spirit of our fishing industry.

From the beginning of the fishery in 1911 and until 1918, the white meated albacore tuna was the mainstay of the industry. The catch was made within 50 miles of the southern California coast. Now the center of tuna production, through explorations and enterprise of the fishermen, has shifted to the coasts of Costa Rica, Panama, and the Galapagos Islands, and is prosecuted by the most elaborate and expensive fishing vessels in the world. Low albacore catches in 1916 and 1918 encouraged the taking and canning of bluefin, yellowfin and skipjack tunas in that order. By 1918 the increasing demand for tuna caused purse seine vessels of 46 to 60 feet in length from Puget Sound and Alaska to participate in the fishery, mainly to capture bluefin. In 1920 the industry employed an aeroplane successfully to locate fish, and several large clippers now carry aircraft to search for tuna and bait (24-28).

The period from 1918 to 1930 was one of extensive explorations and expansion of the fishery to the south. Exploration by bait boats and purse seiners off lower California began in 1918. By 1923 46 per cent of the tuna delivered to American cannery was caught in this area. In 1927 it increased to 77 per cent. In 1922 salmon trollers or "jig fishermen" from Monterey were quite successful in taking tuna off southern California. This began the substantial small boat fishery now extending well down the coast of Lower California. The fish were taken both inside and outside Mexican territorial waters, but the American vessels were obliged to enter Mexican ports for anchorage, supplies, bait and to sell their catch, thereby coming within the jurisdiction of Mexican authorities and causing international complications. Friendly relations had been established in 1923 with Mexican authorities, but in 1924 the fees were doubled, resulting in hardship to the industry. The fishermen's need to escape high fees and to find a more dependable year round supply of tuna resulted in a radical change in 1925, when the first long range refrigerated tuna clipper was con-

structed to carry large quantities of live bait and operate from the home port without touching Mexican ports. From 1926 and on the trend to large clippers became pronounced and a period of exploration and exploitation of more distant grounds began. In 1927 the fishery was well established to Cape San Lucas and trips were made to the Socorro Islands (about 1000 miles from San Diego and 200 miles off Mexico) and the Clarion Islands. In 1929 explorations were made along the coast of Central America and to Cocos Islands, 2400 miles south of San Pedro and to Clipperton Island, 1700 miles distant, which disclosed plentiful supplies of tuna. In 1930, the "bonanza" Morgan Bank was discovered off the coast of Mexico and the nearby Uncle Sam Bank was exploited materially for the first time. Allaire Bank was found, and several trips were made to Cocos Island and to the Galapagos Islands, 3000 miles distant from San Diego. Promising information on schools of tuna among the islands of the Mid-Pacific also developed (24-35).

From 1931 to 1950 the trend has been to explore intensely for and to exploit profitable spots in the previously discovered area from southern California to the Galapagos Islands and for distances up to 500 miles offshore. However, in 1933 an exploratory trip of 9000 miles was made to the South Seas and the Hawaiian Islands. Signs of tuna were plentiful but they would not bite and only 45 tons were taken. Other vessels have ventured to the coast of Peru but generally little fishing is done south of the Galapagos Islands. Catching adequate supplies of live bait became a problem in 1932 and power boats were introduced in 1935 to increase efficiency in capturing bait. Explorations for bait, to meet the needs of the growing fleet, were conducted in bays of Central America, and bait grounds were found in Nicaragua, Costa Rica, Panama, Columbia and Ecuador at the Galapagos Islands, where diving gear is required to free the nets from bottom obstructions. The requirements of the fishery has resulted in the development of all-purpose wells for carrying fuel, fish and live bait. Some of the larger clippers carry from 15 to 20 tons of live bait (36, 37, 42).

The introduction and development of the large tuna clipper after 1927 left the purse seiners still handicapped by Mexican taxes and restrictions, but they depended largely on the sardine and mackerel fisheries. Consequently, the need for expanding the range of this fleet was not so pressing. Furthermore, their earnings in the tuna fishery were erratic, depending on the abundance of bluefin tuna, and there was some doubt if yellowfin tuna could be successfully caught in a seine. In 1933 a mothership plan was tried off Central America with seine boats but the results were not encouraging. However, a seiner returned a catch of 80 tons from the Galapagos. Periodically the purse seiners were temporarily banned from Mexican waters or subjected to restrictions and in 1927 interest developed in adequate refrigeration to render purse seiners independent of that country. In 1947 the Pacific Exploration Company, agent for the Reconstruction Finance Corporation, operated a mothership off Central America and the purse seiners were able to capture yellowfin tuna successfully (40). In 1948 several privately owned freezer ships, almost entirely dependent on purse seine-caught fish, were operated off Central America with good results (41) and several long range seiners about 100 feet and over in length, designed to fish tuna most of the year, appeared in the fishery. These are generally fitted with a part brine and part ice system to permit thorough freezing of the early part of the catch in wells. The boats also have a large hold for icing the

remainder of the catch. These boats can also be used in the sardine fishing. (24, 31, 32, 36, 40, 41).

Development of the Overseas Japanese Tuna Fisheries

The development of the overseas Japanese tuna fisheries is the foremost example of the discovery of fisheries through government exploration and subsidy during the initial stages of development. Japan has been forced to depend on aquatic resources, not only for food for her population but for export commodities, to maintain her economic position. Consequently, the exploration and development of fisheries has been a prime concern of the government.

Soon after World War I, when the Japanese gained control of the Mandated Islands, they began to take an interest in developing fishing operations in the southwest Pacific. Between 1923 and 1925 several fishing experts found favorable prospects for commercial operations, and by 1930 various companies had established bases in the Mandated Islands, the Philippine Islands, and the Dutch East Indies, primarily to take skipjack. Operations were on a small scale, designed to catch skipjack with live bait and pole-and-line gear within 40 miles of the land bases during a single day's fishing operation. Increasing quantities placed on the home market caused prices to fall, and protests in 1937 from operators in Japan resulted in regulations limiting the overseas production of skipjack (50).

Long lining is a method developed by the Japanese for taking albacore, yellowfin, big eye and black tunas at subsurface levels. During the 1930's the tuna catch by this gear in coastal and off shore home waters approached its maximum and it became evident that increased production would require the exploitation of overseas fishing grounds. Furthermore the opening of foreign markets for tuna products in 1929 created enthusiasm for developing new fisheries (51).

The success of the Japanese long line fishery has been based largely on the ability to locate fishing grounds, since it is impossible by ordinary methods to detect the presence of far-ranging tunas when they are swimming at subsurface levels in many different parts of a vast ocean. Commercial interests were unwilling to invest the money and expend the effort to locate promising grounds in distant waters, so Japanese government fisheries organizations sponsored the exploratory phase. Their exploratory vessels compiled and disseminated a huge amount of data on the catch of fishing voyages and correlated this with various oceanographic factors such as temperatures, current drift and depth of the ocean bed. After the explorations had indicated an area to be suitable for exploitation, Japanese commercial vessels, partly subsidized by government funds, continued the development of the area. Profitable trips to the newly-located grounds eventually resulted in intensive exploitation by commercial vessels (53).

During the decade prior to World War II the Japanese tuna vessels ranged throughout the entire western Pacific Ocean as far east as the Hawaiian Islands, south to the areas around New Guinea and the Dutch East Indies, and southwest into the Indian Ocean. Many of the voyages, especially those to the Indo-Pacific region and the Mandated Islands area, were explorations to determine the best fishing grounds for future development. Since albacore had the greatest export value of all the tunas fishing grounds for this species were surveyed and extended each year and eventually to the mid-Pacific area, which proved

to be an important winter fishing ground for albacore. Major fishing grounds for the yellowfin tuna and marlins were located in the tropical zone and in 1938 commercial long line fishing by large vessels based in Japan was started in the Mandated Islands area. Japanese mothership operations are now permitted in the Mandated Islands area and excellent catches are being made.

Role of Exploratory Fishing in the Gulf, Caribbean and Atlantic

The present fisheries of the Gulf were discovered and developed by the industry, but with the exception of the snapper and grouper fishery all are prosecuted within sight of shore or in relatively shallow water. Despite the tremendous development of the shrimp fishery the potentialities of the waters beyond a depth of 25 fathoms are virtually unknown except as a result of exploration now being performed by the F. W. S. *Oregon* and that done in former years during biological work of the Gulf Fishery Investigations. The *Oregon*, operated out of Pascagoula by the Service's Branch of Commercial Fisheries, is now working on Gulf problems and has found considerable quantities of presently exploited species of shrimp beyond the depths normally fished and new species in depths beyond the range of the present standard gear. Additional work may well discover new shrimp resources of great magnitude, as was the case with the development of the offshore halibut fishery.

Shrimp were found in the Gulf of Paria and off the coast of British Guiana in 1944 and are now being taken off Mexico and Panama. A survey of the fishery of resources of the Caribbean area in 1942 disclosed that shrimp are found in greater or lesser amounts mainly near lagoons, river mouths and entrances and it was concluded that shrimp fisheries can be developed in localized areas. Shrimp are known to be present off Brazil where they are taken by cast nets and haul seines in the early days of our shrimp fishery. They are also present off Argentina (54-57). The exploration and exploitation of these distant resources may not now appear feasible, but at the inception of the California tuna fishing the thought of eventually fishing at the Galapagos Islands probably appeared equally fantastic. The Amazon River system with its large delta and extensive estuary waters in many respects resembles the Mississippi and Gulf area. By analogy, the waters off Brazil may show, through exploration, promise of a shrimp fishery approaching that of the Gulf, which could be exploited by refrigerated vessels.

The menhaden fishery is confined to a narrow belt along the shore and the season rarely exceeds 5 months in any locality. Whether menhaden are confined to shore is a subject of speculation. If offshore migrations occur, explorations will disclose their existence. It may, however, be necessary to develop and test electronic equipment to locate offshore schools of menhaden and to devise special equipment to effect their capture.

Spanish mackerel, bluefish and little tuna are known to be present in the Gulf and along the south Atlantic states, and thread herring and little tuna were found off Florida in 1944. Spanish mackerel are also thought to be generally distributed throughout the Caribbean area, and while they have only been available to shore fishermen at certain seasons it may be possible to take them offshore in quantity. A fair number of schools of spotted bonita (little tuna) and Spanish mackerel have been seen off Tobago during exploratory surveys (54, 58, 59). Doubtless a thorough search of the literature would reveal many reports of these species, but exploratory work is necessary to determine how, when and where they can be caught in commercial quantities outside the already established fishing areas.

The range of the Atlantic bluefin tuna is known to extend from the Gulf of Mexico to Nova Scotia, and various reports of their presence off Brazil have been made. Tuna have also been noted by the *Oregon* in offshore waters of the Gulf. Long range migratory species such as tuna, swordfish and marlins occur seasonally through the Caribbean along fairly definite channels. The Oceanic species of blackfin bonita was taken off Tobago during exploratory work and such oceanic varieties as marlin and wahoo have been reported by sportsmen (42, 54, 48). General opinion has been that the clear surface water of the Caribbean will not support any large quantities of fish because of low plankton content. Yet the Japanese, through the use of long lines, fishing at depths of 20 to 70 fathoms below the surface, have found an extensive tuna fishery in clear tropical oceanic waters. However, long line fishing was found to be better in the Equatorial Counter current which is somewhat richer in the lower forms of life than the Equatorial currents. In other areas concentrations of fish may be found which can be captured with well-established American fishing methods. Despite the apparent absence of surface signs of tuna, exploration and the development of suitable gear may disclose a profitable fishery.

The fishing fleet of the Gulf and South Atlantic States has been rapidly expanding and new resources may be necessary to maintain the prosperity of the industry. These can and will be found through exploratory fishing and exploited as our markets and economic conditions require.

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