

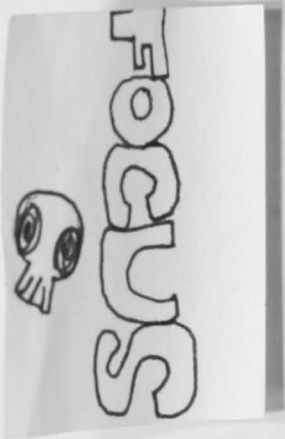
A PROGRAM

OF RESEARCH
AND DEVELOPMENT
FOR THE
PACIFIC COAST

TUNA INDUSTRY

U. S. BUREAU COMMERCIAL
FISHERIES

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United States Department of the Interior, Fred A. Seaton, Secretary
Fish and Wildlife Service, Arnie J. Suomela, Commissioner
Bureau of Commercial Fisheries, Donald L. McKernan, Director

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Washington, D. C.
June 1960

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PROGRAM OF RESEARCH AND DEVELOPMENT FOR THE PACIFIC COAST TUNA INDUSTRY

The United States tuna industry, the principal source of one of America's most popular fishery products, is a complex business enterprise beset by serious problems. The industry originated in southern California in 1903 when albacore was canned successfully for the first time. Tuna vessels, probing the adjacent seas, fished farther and farther south during the 1920's and 1930's and found the tropical tunas, yellowfin and skipjack, in increasing abundance. By the 1930's, the tuna fishing industry had become a major source of protein food from the sea, and an increasing number of canneries were being established to process the catch. As the fishery spread into tropical American waters, problems of preservation of the catch became more acute. A warm climate and trips that lasted many weeks frequently combined to spoil the fisherman's catch before he could land it. By a giant stride in technology--development of the brine refrigeration system--the industry met the challenge, however, and the landing of frozen tuna at southern California canneries from distances of more than a thousand miles became common.

While the tropical tuna catch consistently expanded the fishery for albacore along the west coast expanded and then collapsed. For more than a decade beginning in 1926, this highly prized species failed to appear in commercial quantities in waters fished by United States fishermen. The established United States market for albacore (white meat tuna) and well-developed procedures and equipment for handling frozen tuna made it feasible for the Japanese to fill this unsatisfied demand. The importation of tuna from foreign countries continued even after the return of albacore to local west coast waters in 1938.

World War II sharply curtailed the United States tuna fishery; the specialized, long-range tuna fishing vessels that had been developed for tropical tuna fishing were commandeered by the United States Navy. With the end of the war, the United States tuna fishery regained its importance and soon began to expand again. In a short time, however, the Japanese rebuilt their fleets and resumed the exporting of tuna to the United States on an even greater scale than before the war. In the past decade the American demand for tuna has continued to

grow, but the increased consumption has been supplied by foreign fishermen rather than by American fishermen. Consequently, the American tuna fishery has lagged while the tuna fisheries of other nations of the world have continued to forge ahead.

This lag in the United States tuna fishery is not associated, in any sense, with a failure of the supply or with overfishing of the stocks. Rather, it arises from the economic derangements resulting to a significant degree from foreign competition.

While tuna canned abroad is subject to various tariffs and comprises only 31 percent (106,269,000 lb. in 1958) of our tuna imports, frozen tuna is duty free and amounts to 69 percent (234,740,000 lb. in 1958) of our tuna imports. The lower price of Japanese tuna usually encourages its purchase. Also, the supply from foreign sources to United States canners can be scheduled well ahead of delivery, simplifying canning operations, in contrast with supplies from the smaller domestic fisheries, which vary with the seasons, weather, and other factors. The United States fisherman has been caught between the factors favoring imported frozen tunas and the rising costs of vessels and vessel operation. Unless some fundamental change occurs in either the foreign or the domestic situation that favors the United States fishery, the continued decline of the domestic tuna fishing industry appears inevitable. (While this tuna program has been under consideration, a trend towards the use of purse seines in the fishery has increased the efficiency of the United States tropical tuna fishery substantially.)

While we are emphasizing the competitive position of domestic and foreign fisheries and fishery products, a revolution in the domestic production of other protein foods--aided by government-sponsored research--has reduced the relative costs and improved the economic position of poultry and meat producers--also strong competitors of the fishing industry.

The decline in the domestic tuna fleets has been drastic. In 1951, 210 large bait boats and 80 purse seiners were in the long-range tuna fleet fishing in tropical waters. At the end of 1959, by contrast, this fleet contained less than 115 clippers and approximately 60 large purse seiners. Similarly in 1951, some 3,000 vessels

participated in the west coast albacore fishery, while in 1959, only 1,000 remained. The owners and crews of the surviving vessels have improved their harvesting efficiency in order to reduce production costs and to slow the steady decline in earnings. As a result, in 1958, the smaller fleets were still able to harvest a tuna catch greater than that of any other food fish. Deterioration of the United States domestic tuna industry cannot be dismissed as of small consequence. As late as 1958, the value of the domestic tuna catch, exceeded in value only by the shrimp and salmon catches, was \$45 million. The tuna catch accounted for 12 percent of the value of the marine harvest in this country. The wholesale value of the 14,100,000 cases packed in the United States in 1958 was \$162 million.

As has been pointed out, the early history of the tuna fishery was one of production, activity, and expansion. But the situation has changed. The vast increase in the use of tuna in America has been supplied by increasing quantities of fish from foreign sources. Almost half of the clippers and purse-seine vessels operating in 1951 have left the fishery and the others are becoming obsolete. Few people want to invest in tuna boats, and many boat owners are going bankrupt. Fishermen know that if their earnings drop further they will be forced to look for work elsewhere. These experienced fishermen, once among the most prosperous of our people, are gradually being forced to accept unskilled employment at a much lower economic level.

The United States canners have somewhat different problems than those of the fishermen. They must process raw tuna in large quantities to survive--larger quantities than can be caught by the dwindling United States fleet. As the consumption of tuna increase in this country, the canners become more and more dependent on foreign sources for their raw material--a dangerous position. Furthermore, their costs of production must be competitive. Increasing tuna imports on the one hand and declining American production on the other threaten future price and supply problems that must be solved.

LEGAL BASIS FOR THE PROGRAM

Under the Fish and Wildlife Act of 1956, the Bureau of Commercial Fisheries has been given the responsibility of assisting the fishing industries to solve their problems. Among other things, Congress declared "that the fish, shellfish, and wildlife resources of

the Nation make a material contribution to our national economy and food supply.... (and)....that the fishing industries strengthen the defense of the United States through the provision of a trained seafaring citizenry and action-ready fleets of seaworthy vessels...." Congress further declared that "the fishing industry, in its several branches, can prosper and thus fulfill its proper function in national life only if certain fundamental needs are satisfied by means that are consistent with the public interest and in accord with constitutional functions of governments...." Among the needs cited in the Act are--

Protection of opportunity--maintenance of an economic atmosphere in which domestic production and processing can prosper; protection from subsidized competing products; protection of opportunity to fish on the high seas in accordance with international law; (and)

Assistance--assistance consistent with that provided by the Government for industry generally,....including, but not limited to--

- (a) services to provide current information on production and trade, market promotion and development, and an extension service,
- (b) research services for economic and technologic development and resource conservation,....

With the Bureau's responsibilities in mind and to study the industry's problems more fully, Bureau representatives met with members of the tuna fishing industry in May 1959 at La Jolla, California.¹ The industry made a series of recommendations to the Bureau, which have been reviewed carefully and weighed in the light of Government policy and the resources of personnel and money that might be available. While the legislation authorizing and directing the Bureau to assist the fisheries is broad, the program proposed to aid the tuna fishery stresses those activities that give the most promise of being useful to the industry.

THE TUNA FISHERY PROGRAM

The tuna fishing industry's economic difficulties result primarily from foreign competition, which has reduced the demand for domestically caught fish and has depressed prices. Major segments of the industry have strongly supported the imposition of tariffs or quotas to control imports of tuna into the United States. But relief from such measures has not materialized. Other solutions must be found to assist the industry, particularly the hard-pressed fishermen. The Bureau of

¹ Bureau of Commercial Fisheries, 1959. Tuna industry conference papers, May 1959. U. S. Fish and Wildlife Service Circular 65, 110 pp.

Commercial Fisheries proposes to assist the tuna fishing industry in three major fields.

- (1) By helping the domestic fleets find and catch fish more quickly;
- (2) By helping the fishermen deliver higher quality fish to the canneries and, in turn, help the processors improve their products;
- (3) By keeping the domestic industry well informed of activities and developments respecting tuna, both domestic and world-wide, as they may affect production and marketing in the United States, so that the industry can plan its operations intelligently under changing conditions.

Some of the research and services necessary to accomplish these purposes are already under way on a modest scale. Roughly 80 percent of the increased effort will fall into item (1), finding more fish more quickly. With regard to item (2), assisting fishermen and processors to improve their products, some basic research on the chemical composition of tuna was initiated recently. In general, the expansion in the second item, approximately 10 percent of the increased assistance, will involve basic studies, the application of which, especially with respect to processing, will be left to the industry. Item (3), keeping the industry well informed, is already being undertaken in connection with current conditions in the domestic tuna industry. In the other hand, there are significant opportunities for improving the flow of foreign information so vital to domestic operations. Item (3) also is scheduled to receive about 10 percent of the increased aid in the tuna program.

Improving Operational Efficiency

The primary purpose of the Bureau's biological and oceanographic research concerned with tuna in the eastern Pacific is to help United States tuna fishermen improve the efficiency of their operations. Since scientists of other agencies are studying the fishes and the characteristics of the ocean, the Bureau's tuna research efforts in these fields will supplement their work and vice versa. It is most important that our activities be integrated with those of such agencies as the California Department of Fish and Game, the Fish Commission of Oregon, the Washington Department of Fisheries, the Pacific Marine Fisheries Commission, the Inter-American Tropical Tuna Commission, and other groups conducting tuna research in the eastern Pacific.

The chief problem faced by our tuna fishermen is that of reducing the time consumed in catching the fish. This is imperative if the fishermen are to cut production costs. Fishermen are continually working to reduce their fishing time by improvements in their vessels and gear and by means of auxiliary aids. Marked improvement, associated with the increase in purse seining, has taken place recently, and it is hoped that these gains in efficiency can be maintained. Nevertheless, a great amount of time is spent in scouting for concentrations of tuna and in attempting to catch schools that refuse to bite or are unsuitable for seining. Reduction in scouting time is the crux of the problem, both in the tropical tuna fishery and in albacore fishery. It is believed that the Bureau can help here and, to this end, its scientists at the Stanford and San Diego Biological Laboratories are accelerating or initiating studies of the oceanic environment, tuna and bait fish behavior, and operations of the tuna fleets, to provide the requisite basic information.

Learning Effects of Environmental Changes

The ocean environment of the several kinds of tuna is ever changing, with consequent effects on the abundance and distribution of each kind of tuna and on the ability of the fishermen to find and catch them. Changes in the strength and location of the great and small ocean currents and in the amount of deeper water moving into the surface layers, affect the temperature, salinity, fertility, and abundance of life in the ocean waters--sometimes favorably and sometimes unfavorably. The tuna fishermen's luck is good or bad accordingly.

Changes in environmental conditions may be on a large scale, affecting the whole ocean and enduring for year-long periods, or they may be local and transient. We do not know enough about them even to recognize when a change is in the making or, when it is upon us, to tell whether it is a large-scale, enduring one or a small-scale, transient one. By hindsight, we are beginning to distinguish one from the other and to gain some insight into the processes which initiate the changes.

Since 1956 in its Biological Laboratory at Stanford, the Bureau has been studying the relation of ocean-wide pulses to long-term weather patterns over the Pacific Ocean. Since about the same time the Bureau also has been financing a Scripps tuna oceanography research project to study local oceanographic changes in the eastern tropical

Pacific to discover how these changes affect the abundance and distribution of yellowfin and skipjack tuna. In the central Pacific, the Bureau's Honolulu Biological Laboratory has, for a longer period of time, been investigating the relation between oceanographic conditions and the abundance of yellowfin tuna, skipjack, and albacore. These three oceanographic studies complement each other and will lend support to the new tuna program getting under way from the Bureau's San Diego Biological Laboratory.

The aim of the Bureau's Stanford Biological Laboratory is to gain sufficient understanding of the broad-scale oceanic changes ultimately to predict them and, with the findings from the more specific studies of the other laboratories on particular species of fish, to predict also the major, upsetting fluctuations in the abundance and availability of important open-ocean fishes, including the tropical, subtropical and temperate ocean tuna. It is probable that only such ocean-wide studies can lead to the understanding of and the ability to foretell such major events as the apparent disappearance of the albacore from our coastal Pacific waters in 1926 and their reappearance in 1938.

The research at Stanford has brought to light a vast number of data pertaining to ocean changes which, until now, have been neglected by oceanographers and fishery biologists. These data still are largely unavailable owing to the large amount of processing required to make them useful. Sea-surface temperatures, for instance, need to be charted on a month-by-month basis to develop a Pacific Sea Surface Temperature Atlas. Such an atlas would depict the changing temperature pattern month by month through many years so that, on the one hand, one can study how the temperature changes with the major shifts in the overlying weather and, on the other hand, how the changing temperature pattern affects the abundance and distribution of each of the important ocean fishes, including the tunas. A Saltonstall-Kennedy project has been proposed to produce such an atlas.

Although the present accumulation of oceanographic data is formidable, the future volume and variety will be even more so since oceanographic laboratories along the Pacific coast are collecting data at an ever-accelerating rate on an increasing number of elements in the ocean environment. A "data bank" for pooling, processing, and retrieving these data for use by research agencies working on fishery oceanography in the Pacific is needed. The National Acad-

emy of Sciences Committee on Oceanography has recommended such a service in the form of a national oceanographic data center. In the meantime, the Bureau's Biological Laboratory at Stanford is making some progress, in liaison with a number of agencies that also collect oceanographic data, toward making such data available for research in its own and other laboratories.

To provide for more specific application of oceanographic and biological findings to the problems of the tuna fishing industry, the Bureau established the San Diego Biological Laboratory in the spring of 1959. This Laboratory is the center for studies of the tuna of the eastern Pacific and of the tuna fishing operations of the fleets. It will be concerned alike with tropical tunas, albacore, and bluefin. Three principal investigations are under way here on a modest scale: operations research, forecasting tuna availability, and tuna and bait-fish behavior.

Developing Fishing Patterns

The purpose of operations research is to develop an optimum fishing strategy based on the integrated experience of all segments of the several tuna fishing fleets and the results of biological and oceanographic research. Several factors contribute to a tuna skipper's fishing success. The more obvious ones are his and his crew's accumulated experience, shore reports on current fishing conditions obtained before sailing, and information received at sea from other boats. That some skippers have more knowledge and information than others and that this permits shorter fishing trips and reduced production costs is well documented. Acceptance of vessel and gear improvements also reduces the trip time. We are confident we can provide information that would reduce the average length of fishing trips by analyzing the combined experience of the crews in the several fleets and integrating the results with those obtained from other research projects.

Predicting Tuna Availability

The investigation on forecasting tuna availability is designed to obtain information about the tuna and their environment that will help us understand the causes and mechanisms underlying the changes in tuna availability. Ultimately, we hope to be able to predict changes in availability.

Oceanographic investigations

Oceanographic studies made during the past several years by the Scripps Institution of Oceanography of the University of California, the Inter-American Tropical Tuna Commission, and the Bureau of Commercial Fisheries have provided a rather good picture of the general circulation of the eastern Pacific Ocean and the reasons for the concentrations of tuna in certain general areas. Concentrations of fish in these regions are related to systematic features of the ocean circulation and frequently are quite consistent from year to year in time of occurrence. Fishermen know this and, if the areas were small, our studies would not be needed.

Unfortunately, these general regions encompass many thousands of square miles and notable variations occur from year to year and season to season in the positions of the center of good fishing within them. In addition, extensive changes in tuna distribution and their relative abundance occasionally occur. For instance, tropical tuna are usually particularly available off Central America in the spring of the year; in 1959, they were not. Albacore usually approach our coast in June in the general area of Guadalupe Island; in 1959, they were found first off Point Conception. To be able to anticipate such gross variations and eventually the smaller ones would be useful. The California Department of Fish and Game has been successful in the last few years in predicting the time of appearance and area in which albacore first appear off the west coast on the basis of sea-surface temperatures.

We believe that adequate oceanographic research will eventually make it possible for scientists to predict where tuna will be most available at a particular time. The Scripps Institution of Oceanography of the University of California, under a 3-year contract with the Bureau of Commercial Fisheries, is investigating the oceanographic and climatic influences on the distribution and behavior of tunas in the eastern tropical Pacific. The Inter-American Tropical Tuna Commission is also engaged in ecological studies in the tropical region; the studies are an important element of the Tuna Commission's conservation research. The research programs of these two groups are well integrated and are gradually increasing our knowledge of the relation between the tropical tunas and their environment.

Little attention has been given in the past to studies of the response of albacore and bluefin tuna to changes in their environment. Since considerable effort is being given to

ecological studies of the tropical tunas, scientists of the San Diego Laboratory, in close cooperation with those of the California Department of Fish and Game and the fishery agencies of Oregon and Washington, plan to give substantial attention to the albacore and bluefin. Before planning our own observations at sea, we feel that it is desirable and necessary first to examine the wealth of oceanographic data collected since 1949 by the California Cooperative Oceanic Fishery Investigation (CCOFI) in connection with research on the California sardine and anchovy. The purpose here is to determine whether changes in the oceanic environment along the west coast from Baja California to the Pacific Northwest are responsible for variations in the seasonal appearance, distribution, and relative abundance of the albacore and bluefin. It is our hope that this study will give us an understanding of the causes underlying changes in availability of these species. We expect to extend our oceanographic observations to the west and north of the broad coastal belt studied during the sardine research and to include characteristics of the sea qualities of the water other than those studied in the past.

Much time and effort will be expended before accurate forecasting of tuna availability is realized. In the meantime, however, much of the oceanographic data being collected can be interpreted and made available quickly and continually to fishermen to help them plan more productive fishing trips.

Fish behavior studies

The investigation of tuna and bait-fish behavior at the San Diego Laboratory is an essential project in our opinion. In fact, the Bureau's Honolulu Biological Laboratory has considered behavior research a most important part of its program for the past 3 or 4 years, and we plan for the two laboratories to work together closely in this field. Learning how to predict the general distribution and availability of tunas and then how to assist fishermen to converge on areas of concentration is but one step. There still remains the problem of catching the fish. Present fishing methods can be expected to improve gradually but advances in this field will be much faster if we can provide fishermen with basic scientific information on the responses and behavior of the tunas and of the important bait fishes used to take them.

The behavior research will offer a particular challenge because so little research of this nature has been done on either the tuna

or their bait, or on the behavior of commercial fishes in general. Thus, we have no guidelines or precedents to follow. We anticipate that the behavior research will be most rewarding because knowledge of patterns of behavior is basic to increasing fishing efficiency. Such knowledge can be expected to make present fishing methods more efficient and might well suggest entirely new methods of harvesting.

Improving Quality of Tuna Products

Following their capture, the tuna are cooled and held under refrigeration until the vessel is due in port days or weeks later. By the time the cannery is reached, the fish are partly thawed preparatory to unloading. The tuna are then unloaded on to carts, conveyors, or flumes, and are gutted and precooked. Subsequently, the meat is cooled and the loins cleaned, packed in cans, and processed.

Variations occur during the handling and processing that often have unanticipated effects on the final product. The Bureau approach to finding answers for these variations is in technological research--long-term, fundamental research on the components of the fish with respect to how these react under the conditions encountered during the handling and processing and then showing the fishing industry how to use these findings to produce a better product. The food industry generally shows a continuing improvement, not only in the better quality of existing products, but also in the development of new and varied products. The tuna industry, to maintain its position, must offer the public a product highly competitive with other protein foods. Basic information in the technological field is needed to ensure that the tuna industry will keep pace with advances in competitive fields.

Considerable progress on the basic chemistry of fish oils has been made since 1954 at the Seattle fishery technological laboratory and elsewhere. These studies are scheduled to continue and will have application to the tuna industry, since tuna is an oily fish with problems concerned with oxidative deterioration and rancidity. Ultimately, applied research may be needed to show how these basic findings can be adapted to assist the tuna industry in developing improved processing techniques.

Oil is only one component of tuna. The major constituent is protein and we know very little about tuna protein and how it reacts to handling and processing variables

encountered in the tuna industry. Processing problems, such as scorching and even "green" tuna, are probably tied closely to alterations in protein. A limited amount of research on the problem of "green" tuna was conducted intermittently to 1959. It is proposed that this research be resumed.

A knowledge of the nature of alterations in protein, vitamins, oils, and other components is also needed to enable the tuna processor to make optimum use of his cannery waste in preparing such products as meal, oil, and pet food. Basic technological research is proposed on all the major components of tuna. It should then be followed by sufficient applied research to show the tuna industry how to use the findings of the basic research.

Currently, the Bureau has no technological research laboratory facilities in the California area. Pending establishment of such a laboratory, a one-man field station has been set up at Terminal Island for limited applied work and for liaison purposes. In the meantime, basic technological research on tuna has been initiated at the Bureau's Seattle Laboratory, the only Bureau laboratory on the Pacific coast equipped for such work.

A shoreside investigation, under contract with Philip R. Park Research Foundation has been underway for several years on the methods of handling, freezing, and thawing tuna, under simulated at-sea conditions, with respect to quality and yield of the canned product. Consideration is being given to supplementing this study with an engineering examination of refrigeration methods at sea.

Increasing Knowledge of World Fisheries

The domestic tuna industry is affected by the complex of activities and developments in the various foreign tuna fisheries. United States prices are responsive to world supply and demand. New technological developments in foreign lands affecting vessel design, processing, and marketing are of great interest to our fishermen and canners. Biological findings affecting world tuna resources, particularly when related to availability and abundance, have an important bearing on our industry. This knowledge permits our fishermen and processors to make more effective day-to-day decisions in the conduct of their operations; it also allows them to make more intelligent long-range plans. The same type of information aids the Bureau project its research and services in

the directions that are most effective for our domestic tuna industry.

It is proposed to broaden the reporting on worldwide developments and trends in fishing and marketing. Important sources of this information are the various Embassies and Consulates to be augmented wherever possible by additional fishery attaches. In some cases, specialists in foreign fisheries, possibly citizens of the country, will be used to collect and sift the information. A project to provide the information in useful form is recommended. This information on the tuna fisheries of the world will be supplied directly to key installations, including the Bureau's California area office, where it will be examined and analyzed on a worldwide basis and made available currently to the industry.

The traditional system of reporting daily and monthly to the tuna industry and others on fishery prices, shipments, landings, legislation and related matters will be continued. The acquisition, analysis, and publication of valid statistical information on the United States tuna industry, with information obtained from the States and from industry itself, will also be carried on.

Financial and Marketing Assistance

At present, the Bureau of Commercial Fisheries assists the tuna industry in financing fishing vessels and operations through its fisheries loan fund and mortgage insurance program. Under the fisheries loan program, created by the Fish and Wildlife Act of 1956, the Secretary of the Interior makes loans for financing and refinancing the operation, maintenance, replacement, repair, and equipment of fishing gear and vessels, and for research into the basic problems of fisheries. The fishing vessel mortgage insurance program is planned to

assist the industry in the financing of the construction of new fishing vessels and in the reconstruction of older vessels. We expect it to be implemented as soon as certain legal difficulties in connection with the funding of the revolving fund are resolved.

Market research and promotion activities of the Bureau were authorized in the Saltonstall-Kennedy Act of 1954 which charges the Bureau with various responsibilities, including "to develop and increase markets for fishery products of domestic origin . . ." The program developed under this act has been designed to aid those industries having the greatest need.

Since the tuna industry has a significant promotion of its own, the Bureau's tuna consumer-education program, including contact with home economists and recipe leaflets, does not seem to require enlargement and none is planned for tuna. The Bureau will endeavor, however, in the future as in the past, to support such special marketing studies as are needed and are appropriate.

The Bureau maintains a modest and routine scrutiny of the wholesale and retail prices of certain canned fish, including tuna. From time to time, special projects, such as the economic study of the albacore fishery being undertaken under contract by the San Diego State College, are prosecuted. There are no plans at this time for expanded activity in this field.

Since much of the domestic tuna industry is based in California, the tuna program we have outlined will be administered in California. Direction of activities will, of course, remain with the Director of the Bureau of Commercial Fisheries and his staff. Care will be taken that all segments of the industry are kept fully advised of our activities and findings. Through this tuna program, the Bureau plans to do its part in revitalizing this important American industry.