

## PACIFIC OCEANIC FISHERY INVESTIGATIONS

## Statement of Program

by

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## ABSTRACT

A brief statement is given of the equipment, methods, region of study and principal objectives of the Pacific Oceanic Fishery Investigations of the United States Fish and Wildlife Service.

The Pacific Oceanic Fishery Investigations with headquarters at Honolulu, T. H., is a division of the U.S. Fish and Wildlife Service engaged in the exploration and development of the high seas fishery resources of the mid-Pacific. Since the tunas constitute the group of pelagic fishes in this region having a large immediate economic potential, our efforts are being concentrated on elucidating the facts regarding the distribution, ecology and behavior of this group and developing means for their efficient and profitable capture.

For the sea-going phases of our work, we have three research vessels. The HUGH M. SMITH, an ex-Navy auxiliary, is a 128-foot ship outfitted to conduct oceanographical studies of all sorts as well as semi-commercial-scale tuna fishing by means of live bait, trolling, and long-line fishing. Conversion and outfitting of this vessel was completed in November 1949. After a shake-down cruise in Hawaiian waters, she departed in early January 1950 for an extended oceanographical and biological collecting cruise to equatorial waters which she successfully completed in early March. The HENRY O'MALLEY is a sister ship to the HUGH M. SMITH, but she is equipped for conducting live bait fishing, and trolling on a full commercial scale and for semi-commercial scale long-line fishing. She is also equipped for taking sub-surface temperature observations by means of the bathythermograph as well as with automatic surface temperature recording equipment. Her conversion and outfitting was completed in November and after a local shakedown cruise near Honolulu, she started in January on a cruise to the Line Islands region to explore the commercial tuna fishing potentialities of that area but was forced to return by an engine casualty which has not yet been rectified. The third vessel, the JOHN R. MANNING, is a newly-built 85-foot purse seiner especially designed and constructed for experimental and exploratory fishing by

commercial scale purse seining. She is also equipped for trolling, for long line fishing and is capable of carrying live bait for possible employment in developing new techniques of seining, and like the O'MALLEY, has facilities for making surface and sub-surface temperature observations underway. This vessel has just recently been completed and is now completing a local shakedown and training period near Honolulu prior to departing for a voyage to the Line Islands region.

With these vessels for making observations at sea, the staff of 20 technical and scientific personnel (in addition to vessel crews and clerical people), are undertaking scientific investigations designed to furnish a scientific and practical basis for the development and management of the sub-tropical and tropical tuna fisheries of the mid-Pacific. Three major lines of investigation are being pursued: basic investigations of the biology, ecology and life history of the tunas, fishing exploration to determine variations in abundance and availability of tunas to conventional commercial gear, and experimental fishing to develop new forms of gear and new techniques of employing conventional gear.

The commercially most important tuna species occurring in the tropical and sub-tropical mid-Pacific region are the oceanic skipjack (*Katsuwonus pelamis*), the yellowfin tuna (*Neothunnus macropterus*), and the big-eyed tuna (*Parathunnus sibi*). The little tunny (*Euthynnus yaito*) and the frigate mackerels (*Auxis* sp.) occur only in the vicinity of land masses and are of minor importance commercially because they are not used for canning, which is the principal use of tuna by American enterprise. The albacore (*Thunnus germon*) occurs most abundantly in temperate waters, but is captured incidentally to other species by sub-surface gear in the tropics also. Bluefin tuna (*Thunnus thynnus*), another temperate zone species, is taken in the tropics even less frequently than the albacore. Our researches are, therefore, primarily directed to the study of the first three species named above, which are the only ones having a large commercial potential at this time.

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## BIOLOGICAL, ECOLOGICAL AND LIFE HISTORY STUDIES

Basic to the development of rational plans for the exploitation and management of the tuna resources of the mid-Pacific is the accumulation of the fundamental facts regarding the biology of the several tuna species, the conditions of the sea in which they live, and the relationships of the oceanic conditions to the life and behavior of the tunas and to the organisms upon which they feed.

Through accumulation and analysis of morphometric measurements made on tuna from different regions, to be supplemented later by tagging experiments, we are attempting to determine whether or not the population of each species in different regions of the Pacific are or are not independent of each other and, in the former case, the geographical limits of the several populations.

Since the tunas, being high-seas, pelagic fishes are oriented to conditions of the oceanic environment, we are attempting to learn how the variations in abundance and behavior of the tunas are related to the environment as a basis for devising improved fishing methods. The variation of potential productivity of different sea areas is also of importance for reaching conclusions as to which regions are capable of high sustained yields of tunas. To these ends we are conducting oceanographical surveys with the SMITH to correlate with the results of exploratory fishing by the other two vessels. Particularly important in this respect is the study of the equatorial and counter equatorial current system and the enrichment by upwellings associated therewith. Specific experiments to correlate occurrence of tunas with local variations in environmental conditions will be conducted by all three vessels.

Study of the age and rate of growth of the tunas, important to the problems of population dynamics of these species, is being undertaken by means of study of size frequencies and markings on scales and vertebrae. Preliminary results for the size frequency approach have been most illuminating and have indicated a rapid rate of growth of species studied. Study of scales and vertebrae seems to be less fruitful, but the subject has not been covered thoroughly as yet, and this deserves considerable attention since it is desirable, if possible, to devise methods of determining the age of individual fish.

The subject of maturation and spawning of tunas, important both with respect to seasonal variations in availability and with respect to the problems of population dynamics, has been until recently very obscure. We have good evidence that the yellowfin, big-eyed and skipjack all spawn near the Hawaiian Islands, as well as elsewhere, and we are planning to undertake research to learn something of the

geographical, vertical and seasonal distribution of spawning in this region.

The primary fishing technique, both on the American West Coast and Hawaii, is by means of using live bait to chum-up fish to be captured by hook and line. Unfortunately, the small fish used for live bait are notably scarce among the various islands of the mid-Pacific. It, therefore, is of importance to learn enough about their biology and behavior, and about those factors in their physiology related to holding and transporting them, to enable the most efficient use of the quantities available.

## EXPERIMENTAL FISHING TO DEVELOP NEW GEAR AND NEW FISHING TECHNIQUES

Standard forms of gear (live bait, purse seines, long lines) in use in other regions may or may not be effective means of capturing tunas in the new regions which we are seeking to develop, and it is almost certain that even if they are effective to some degree, they may be improved in efficiency. The problem of improving gear of the several types and of devising new kinds of gear may be approached by applying various physical principles in the light of knowledge of the behavior of the fish and of the practical problems of shipboard operations, and involve both biological and engineering techniques. We shall seek through biological study of the reactions of tuna to various stimuli, both in captivity and at sea, to arrive at new ideas for the development of effective gear. Prior to the arrival of these results, however, there is a great deal to be accomplished in the way of learning the limitations of such conventional gear as the purse seine in this new region by trying it out on fish schools under actual operating conditions and so arrive empirically at ideas for improving gear and techniques.

It is expected that the knowledge of relation of distribution and behavior to environmental factors, mentioned earlier, will be also of value in the development of new gear and techniques of fishing. This should be particularly true of such sub-surface gear as long lines, the depths of fishing of which formerly have been arrived at on a purely trial and error basis.

There also appears to be room for much profitable development, by means of improved materials and mechanization, of already well known fishing methods. The tuna long line seems particularly likely to be made an effective and efficient gear by such an approach.

This gear is used in the Hawaiian Islands and in Japan. In the Hawaiian Islands a small boat carrying 4 or 5 men handle 20 or 30 "baskets"

of gear by hand or by the aid of primitive line pullers. Only the high price of fish, all of which go to the fresh market, makes this a profitable operation. Japanese vessels of large size employ line haulers of more advanced design, a single vessel handling up to 200 baskets; but crews of about 25 men are employed. The rates of production per man are such that they would not be profitable under American economic standards. At the same time, however, American fishermen, except in Hawaii, exploit only the young tunas which school at the surface and are passing up the opportunity to fish the older fish which live at deeper levels. It seems likely that rather simple applications of technological progress to the long line fishing method may make possible profitable American long line fisheries. An attack will be made on this problem the coming year.

#### **EXPLORATORY FISHING TO DETERMINE GEOGRAPHICAL AND SEASONAL VARIATIONS IN ABUNDANCE AND AVAILABILITY OF TUNAS FOR LOCATING PROFITABLE FISHING AREAS.**

As noted earlier, the tunas are not evenly distributed in the sea, but are concentrated in time and space in accordance with peculiarities of the oceanic environment and the seasonal cycles of their lives. The oceanographical variations are being measured as previously described and studies are being conducted of the life history and ecology of the tunas. Intimately related with these studies is the practical application of their results, charting by means of fishing on a commercial or semi-commercial scale the abundance of the fish and their availability to the fishermen.

This exploratory fishing must be conducted by standard gear calibrated in regions of known tuna abundance to be meaningful in a commercial sense. At present the only gear which we feel is sufficiently standard for this purpose is pole and line fishing, using live bait for chum. This will be the method

first employed in our exploratory activities. The HENRY O'MALLEY and the HUGH M. SMITH will conduct live bait fishing this spring and summer in the vicinity of the Hawaiian Islands to give us a measurement of their effectiveness as compared with the local live bait fishing boats and crews. They will then conduct exploratory fishing in the Line Islands and Phoenix Islands regions.

Meanwhile, with the development of effective purse seining and long-lining techniques and gear, we hope to put ourselves in a position to standardize these forms of gear later and to employ them also in exploratory operations.

#### **REGION OF STUDY**

Although the area in which we are authorized to work extends from Hawaii to the Western Carolines and southward to Samoa, this is obviously too vast a region for us to study intensively at one time with the facilities available. We have, therefore, chosen to study first a region contiguous to the Hawaiian Islands because of the simplified logistics, because of the fact that tunas are known to occur throughout the region in some quantity, and because it is logical for a commercial fishery to expand from its present location to the nearest adjacent profitable fishing area. The region in which we propose to work initially reaches from Midway to the Phoenix Islands and from Hawaii to Malden Island. While this is less than one third of our authorized area, it is as large as we can handle at once. Indeed, perhaps it is a bit too large. Probably several years will be required to explore this area thoroughly, after which we will work further westward.

In this region, the University of Hawaii and the Territorial Division of Fish and Game of Hawaii are also studying local tuna and bait fishery problems. The programs of the three organizations are mutually supplementary and some phases are being undertaken jointly.