SECOND MEETING
INTER AMERICAN TROPICAL TUNA COMMISSION
SAN JOSE, COSTA RICA
February 1, 1951

The second meeting of the Inter American Tropical Tuna Commission was held at the Casa Amarilla in San José, Costa Rica, beginning at 10:20 a.m., Monday, February 1, 1951.

Present were His Excellency Otilio Ulate, President of Costa Rica; their Excellencies Mr. Mario Echandi, Minister of Foreign Relations, Mr. Claudio A. Volio, Minister of Agriculture and Industries, and Mr. Alfredo E. Hernandez, Minister of Economics and Finance; Mr. José L. Cardona-Cooper, Chairman, and Mr. Virgilio Aguiluz, members of the Costa Rican Section; Mr. M. C. James, Secretary, Mr. Lee F. Payne and Mr. Eugene D. Bennett, members of the United States Section; Dr. M. B. Schaefer, Director of Investigations; Dr. W. M. Chapman and Miss Isla V. Davies of the United States State Department; members of the Costa Rican Advisory Committee; and others.

Minister Claudio A. Volio addressed the meeting as follows:

Mr. President, Honorable Members of the Diplomatic Body, Ministers of State, Gentlemen:

It is my privilege to have the honor of presenting a warm greeting of welcome to the Representatives of the Department of State of North America and the Members of the North American Section of the Tuna Tropical Commission. The Government of the Republic feels highly honored with such distinguished visitors and hopes that under the protection of our traditional peace the Commission will fulfill its most essential aims.

The presence in Costa Rica of such well known personalities of the scientific world fills our hearts with profound optimism, because this fact, shows itself the high ideals of two nations, at a time when the world lives an unfortunate moment, believing in the strength of the spirit, in the discipline of the mind and in the progress of science as indispensable means to forge for humanity a better world.

Our good fortune made possible the realization of the Agreement which gave origin to the Inter-American Tropical Tuna Commission, and in it, and in the scientific support of our friends, the North Americans, we rely today, that these ends may be fulfilled. The increasing world population and the interest that Governments take in raising the general standard of living obliges us to exploit our natural resources to its maximum without contributing to the dangers of dilapidation.

If other similar organizations have given satisfactory results it is logical that we should maintain high hopes that the work realized here from this day on, will be a success. If this is the case, the generous American People will be very grateful for the work of its technicians.

I take this opportunity to inform the Honorable Members of the Diplomatic Body, that honors us with their presence, that our Government and the Inter-American Commission have decided to accept as observers anyone who wishes to

witness the deliberations of this Second Reunion so that they may inform their respective Governments in the case that they may not have already received their credentials. Therefore, I invite to remain in the Assembly Hall not only the Representatives of these Countries which have been specially invited due to their geographical situation with reference to the tropical waters of the Eastern Pacific, but also to all members of the Diplomatic Body that would have interest in sending a report of their impressions to their Chancelleries and to all these present who may wish to know the activities of the Commission.

In the name of the President of the Republic and the Government, I declare this Second Reunion of the Inter-American Commission of Tropical Tuna Fish inaugurated and I formulate my very best wishes for its success.

The Chairman of the Commission, Mr. José L. Cardona-Cooper, then spoke as follows:

Mr. President, Honorable Members of the Diplomatic Body, Ministers of State, Gentlemen:

It is also very pleasant for me, as Chairman of the Inter-American Tropical Tuna Commission, to welcome our distinguished American visitors and to introduce them to the audience.

(Mr. Cardona-Cooper introduced Dr. Chapman, the Members of the American Section of the Inter-American Tropical Tuna Commission, Dr. Schaefer, and Miss Isla Davies. He continued as follows.)

Now I will take a little of your time for the benefit of those who do not know about the antecedents of our Commission, and about some precedents established by other international commissions in the history of fisheries.

The American Delegates have come to our country this time, to join our Delegates for the purpose of continuing the organization of the scientific investigations that this Commission must start in the very near future.

It was during the latter part of May, 1949, in the Hall of Conferences of the House of Foreign Affairs in Washington, that the Costa Rican Delegation discussed with the Representatives of the State Department, the basis of the Fisheries Convention by virtue of which the Inter-American Tropical Tuna Commission was established.

On the 31st of May, in the same year, Ambassador Esquivel, present here today, and Counsellor Hazera acting for Costa Rica, and Acting Secretary Webb (in the absence of Mr. Acheson) and the renowned scientist Dr. Chapman, representing the United States of America, signed said Fisheries Convention Documents.

On February 1, 1951, in the House of Foreign Affairs of Costa Rica, we are trying to accomplish that which was agreed upon in Washington.

The Inter-American Tropical Tuna Commission has undertaken a great responsibility: it has to deal with the complicated investigations regarding the populations of the species "Neothunnus Macropterus" (yellowfin) and "Katsuwonus Pelamis" (skipjack tuna) in the waters of the eastern Pacific Ocean; of the kinds of fishes used as bait in the tuna fisheries, and of other kinds of fish taken by tuna fishing vessels; these investigations concerning the abundance, biology, ecology, biometry and dynamics of these populations, and the effects of natural factors and man's activities on its abundance in order to maintain them at a level which will permit a maximum sustained yield.

In oceanic research the apparent slowness observed in obtaining practical and definite results is well understood. In spite of the marvellous ways and technical improvements which we have today, it is not easy for man to discover the great secrets hidden in the ocean.

We know that the investigations to be realized by the Commission will take some time. The Fisheries Convention has been agreed upon for a minimum term of ten years. It does not mean that before that period ends we will not have obtained satisfactory results. It is probable that, before that many years have passed, we will have discovered many secrets of the tuna's life, and the ways and means of assuring the conservation of tuna populations can then be applied immediately after. Precedents offered by the history of biologic investigations are very encouraging. Even supposing that many more years would be needed for this project, it would be wise and advisable not to give up, not to put this investigation aside. On the contrary, we must start, actively, as quickly as possible. And we are now looking for a prompt initiation of the work. I trust that all of us present here will be able to take advantage of these investigations. I trust that we all will know about its results. But, if fate should make it impossible for us, our survivors will be grateful to us. Future generations will understand our foresight and our efforts.

In order to leave a favorable and optimistic impression at this meeting, it is worthwhile talking about other international commissions with which we are familiar, and from which we have gathered experience. Both the International Pacific Salmon Fisheries Commission and the International Fisheries Commission (for the investigation of halibut) were established in accordance with treaties between the United States of America and Canada. These countries felt alarmed on account of the great depletion of the populations of those fishes found year by year in the Pacific; they also were fearful that both the salmon and the halibut fisheries industries would suffer the same fate that they experienced in the Atlantic Ocean. In spite of the situation becoming worse as time passed, the installation of the Salmon Commission encountered many obstacles. It took them about thirty long years of effort, from 1907, at which time a treaty was proposed, until 1937 when it was ratified by the Governments of both countries. The above interesting information has been given to show how many difficulties are met with in these great projects.

The establishment of the International Fisheries Commission (for the halibut) encountered no obstacles, as far as I know. It was created in 1924 with authority for biological investigation only. The Commission was able to render its first report in 1927, (three years later). It was reinforced by a new treaty in 1930 by virtue of which authority was given to interfere with the regulations of the halibut fisheries. The restrictions adopted were so successful, that in 1933 a new report by the former Fisheries Bureau of the U. S. Government was released, which encouraged all people interested in the halibut fisheries industries in both countries. Finally, the Treaty of 1930 was replaced, to great advantage, by another which was ratified in 1937.

Let us observe that, whether or not any difficulties have been found in the formation of these Commissions, the results obtained through both of them have shown up in a relatively short time, and have paid, to the contracting countries, more than one hundred to one in proportion to the installment expenses, as well as the functioning costs of these organizations. The above mentioned fisheries industries are now very prosperous. Depletion has stopped. The fishing grounds are becoming normalized and, therefore, offer good fishing again. The Commissions continue working with the enthusiastic approval of all responsible citizens of both nations.

Costa Rica has also been alarmed because of the great depletion of the "anchovetta" in its territorial waters and especially in the Gulf of Nicoya. The depletion of this bait fish, no doubt, has caused the reduction of fishing activities in our Pacific Port. The greatest attraction for the tuna fishing foreign boats was, until a few years ago, what seemed to be an inexhaustible source of "anchovettas" in the Gulf. The Inter-American Tropical Tuna Commission will devote particular effort to the bait research in our territorial waters. For this purpose a regional office, with laboratory and equipment, will be installed in Puntarenas. Our Government hopes this research will be successful and also, perhaps, the population of "anchovettas" in the Gulf of Nicoya will increase, even if not on as high a scale as in the good old days.

The United States of America has been especially noted for its conservation activities in order to protect its natural resources which God has bestowed upon them as a blessed Nation. In this endeavor they have been distinguished even more, for the well-organized way in which they act and, above all, for the technical application of scientific procedures whose efficiency has been proved. In this respect, they progress further with new findings, and obtain greater success every day.

Still, they are not quite satisfied. They also desire to disseminate these findings to all the Americas; to share their scientific experiences, and to cooperate in a most sincere effort to strengthen the Continent; to protect its reserves and to stimulate their increase; and as such, try to convert our Americas into a source of food in which sea products have a great importance, for their own benefit, and that of mankind.

I wish our Commission every success during this conference. Thank you.

Following the address of the Commission Chairman, President Ulate spoke briefly, greeting the Commission and wishing it utmost success. He then declared the inauguration ceremony closed, whereupon the President and members of his cabinet departed.

Mr. Cardona-Cooper, Chairman, presiding, asked Dr. Schaefer to outline the proposed research program for the current fiscal year and for fiscal 1952. Dr. Schaefer spoke as follows:

It is most gratifying to me personally to see gathered together here representatives, not only of the United States and Costa Rica, but of the several nations interested in the fisheries for the tropical tunas for the purpose of considering our program of scientific investigations, because it means that there is general recognition of the need for the gathering of basic facts

regarding the tuna and tuna-bait populations upon which a great fishing industry depends. The fishery for yellowfin and skipjack tunas in the waters of the Eastern Pacific Ocean has exhibited a very rapid growth and expansion during the last three decades, and it continues to grow year by year. This rapid growth has given rise to questions regarding the ultimate size to which the fishery can grow without reducing the stocks of tunas and bait fishes to an undesirable degree. It has also given rise to numerous speculations regarding the answers to such questions. Because our knowledge of these fishes and the effects of the fishery on their abundance is almost completely lacking, such speculations are contradictory and of little value. What is required is a body of facts concerning the conditions of life of the tunas and tuna-bait fishes, and the effect of fishing on them, on the basis of which the interested nations may so conduct the fisheries as to obtain the greatest sustained yield from them.

This Commission has been established for the purpose of obtaining these needed facts. The Treaty sets forth as its objective the gathering and interpretation of factual information to facilitate maintaining the tuna populations at a level which will permit maximum sustained catches year after year. It further stipulates the functions and duties of the Commission in pursuit of this objective.

The Commission at its July, 1950, meeting adopted a resolution outlining the general program desired to be commenced during this fiscal year; I am entirely in agreement with this resolution and the major lines of investigation selected to be first undertaken.

Pursuant to the provisions of the Treaty and the resolution passed at the July, 1950, meeting of the Commission, I have prepared an outline of the investigations which are proposed to be commenced this year as soon as an adequate scientific staff can be assembled, and a forecast of the course of the investigations during the following year. During the current fiscal year, between now and July 1, 1951, we plan to pursue eight projects:

1951 Program Outline

(Assuming $59,103. for period January - June, 1951)

1. Establish headquarters office and laboratory in the San Diego region.

2. Establish regional laboratory at Puntarenas, Costa Rica.

3. Commence investigations of biology and ecology of Central American bait species.

4. Gather available data on past baiting operations and tuna landings in Costa Rica from records of governmental agencies and other sources. Institute systematic record keeping on current baiting operations and tuna landings.

5. Institute regular biological examination of tuna landings at Puntarenas, San Diego, and San Pedro.

6. Conduct preliminary investigations toward establishment of a system of current recording of operations of the fleet and success of fishing by means of log books, interviews, and statistics of catch.

7. Commence gathering information and statistical data on the past history of the tuna industry, with particular reference to determination of intensity of fishing, yield, and abundance of tunas and bait species.

8. Possibly be able to commence on a limited scale study, at sea from fishing vessels, of tuna biology.

Initially the Commission's scientific investigations must be rather general in nature, preliminary inquiries being made into various questions by many approaches, maintaining great flexibility so that those lines of investigation which are found to be most fruitful may be efficiently developed. On this basis I have drawn up the tentative program.

The amount of $59,103. has been budgeted for the fiscal year 1951. This sum is not large in relation to the magnitude of the problems we are attacking. This, however, is not all to the bad since it is probably most efficient for us to commence the preliminary exploration of various lines of investigation in a small way, and then expand them as found desirable on the basis of the preliminary findings.

The United States share of the budget for this year is $57,626. Of this amount only $12,000 has been contributed. The remainder has been definitely promised, and is expected to be received momentarily. It must be recognized, however, that delay in the receipt of these funds is retarding the planned pursuit of the research program. It is understood that the Costa Rican share, $1,477, has been appropriated and will be available very soon.

Forecast for Fiscal 1952

The various lines of investigation instituted in 1951, proposed above, will be continued and intensified in 1952, with such modifications and changes as our experience in 1951 indicates. Development of comprehensive investigations of bait species in Central America should be possible. We should establish a regular system of biological examination of tuna landings at San Diego, San Pedro and Puntarenas to provide comparative data to reflect changes in composition of tuna stocks over the years. The collection and analysis of data on the past operations and catch of the fishery will be a major project from which some preliminary results might be available by the end of the year. If our preliminary studies in 1951 meet with success, we should, during 1952, be able to institute a regular system of log books and interviews for obtaining records of current operations, to be tried out on a selected sample of the fleet on an experimental basis. Studies of some aspects of tuna biology from commercial fishing vessels, if begun in 1951, will be continued in 1952, and otherwise will be commenced early in 1952.

We plan also to institute in 1952 studies into the essential features of the biology and ecology of the tunas, including required oceanographic work. The program, as we foresee it now, may be summarized under about eleven headings:

1952 Program (Assuming $333,000. Appropriation)

1. Procure adequate basic laboratory equipment and basic equipment for field work.

2. Continue field investigations of Central American bait species.

3. Continue regular biological examination of tuna landings.

4. Continue gathering and analysis of past years' data on development of fishery and changes in fish stocks.

5. Institute system of interviews and log book records for current operations of the fleet.

6. Conduct studies of tuna biology from commercial fishing vessels.

7. Compile and analyze existing data on the physical, chemical and biological oceanography of the region from Cape San Lucas to Peru.

8. Develop means of marking tunas for studies of migration, growth, and rate of fishing.

9. Conduct limited observations at sea from chartered craft on:

   Major projects:

   (a) Sub-surface distribution of tunas.

   (b) Physical, chemical and biological oceanography.

   Subsidiary observations:

   (c) Extent and time of spawning of tunas.

   (d) Abundance of forage fishes in offshore waters.

   (e) Feeding habits of tunas.

10. Develop and test specialized scientific equipment.

11. Commence design of specialized high-seas research vessel for the Commission's scientific work.

By way of providing further details on some of the above points in order to present our ideas more fully, I may present the following information:

1951 Program Details

Studies of Central American bait species

The various problems with which we have to deal are not all of the same degree of urgency. The most urgent problem, at least the one which seems to involve the greatest controversy, is the determination of the status of the stocks of bait fishes, and the means by which they may be most effectively utilized by the fishery. It is proposed, therefore, that studies of the bait resources be given high priority. To start with, we must ascertain the species used as bait and the places where they occur. We must commence gathering data to determine whether the stocks of the several areas are or are not independent of each other. Studies of these factors of ecology and life history of importance to solution of the problem of maximum yield can probably be most profitably conducted by at first concentrating primarily on one important and typical area. I should judge that the Gulf of Nicoya is most suitable for this purpose.

Field studies of biology of bait species of Central America will require eventually a small vessel capable of running from one place to another in the open sea, and with living accommodations for two or three persons. Such a craft, however, is not within the budget limitations of 1951, and in any case exact specifications should depend on a better knowledge of just what is needed than we now possess. Means of collecting necessary biological and hydrographic material will be needed during 1951, however. It is therefore planned to procure a small speedboat type of craft for use in the regular studies on the Gulf of Nicoya.

Collection of catch statistics and related data in Costa Rica

a. Collection of statistics and data of past years

In order to trace the growth of the Central American bait fisheries, to understand the role of Puntarenas as a port of landing for tunas, and to form a basis for establishment of a system of collection of local statistics on current baiting operations of the fleet, it is necessary that we go into the matter of existing records on past events in Costa Rica. Such records may exist among government agencies or private enterprises of one sort and another. How extensive or how useful they may be we will not know until we look into the matter. At the very least, customs records of entries and departures, records of bait permits, etc., will be of value, and it may be hoped that more detailed information will develop as we look into the subject.

b. Collection of data on current baiting operations and tuna landings

It is proposed to set about devising a suitable system of record keeping on the vessels utilizing the bait fisheries to provide estimates of intensity of fishing and catch of bait species. Such data is absolutely essential to the management of the bait fisheries. With the cooperation of the fleet and of local governmental agencies, it should be possible to accomplish this with little difficulty.

Collection of biological information from examination of tuna landings

One of the major advantages in studying species which are the objects of a large commercial fishery is that the fishery is continually sampling the fish populations. By drawing suitable sub-samples from these catches, many problems in the life history and biology of the species may be investigated efficiently and cheaply. We plan, therefore, to institute in Puntarenas and also in San Diego and San Pedro, as quickly as available personnel and funds permit, regular biological examination of samples of those catches, the dates and localities of origin of which can be ascertained from the vessel masters. Due to need to get the bait work started first, and due to the limited funds at our disposal, it may be about April or May before such work gets underway at the California ports. The resulting data will provide means of commencing studies of age and growth, racial distribution, size at maturity, and spawning seasons and places of the tunas.

Preliminary studies of means of recording current operations of the fleet by means of interviews, log books and catch statistics

The single most vital phase of the Commission's work, if it is to succeed, is the establishment of a workable system of keeping track of the detailed operations of the fleet: the places fished, quantities and kinds of gear operated, how much effort spent baiting and the results thereof, how much effort spent in tuna fishing and the catch. Such data are fundamental to gaining an understanding of the dynamics of the fishery and its effects on the tuna populations and bait populations. They are absolutely essential to the realization of the objectives of the treaty.

In addition, the men of the fleet constitute a vast body of observers, whose observations of the occurrence and non-occurrence of fish and of concomitant conditions of wind and sea, depth of water, currents, forage fishes, etc., if systematically recorded, will furnish an excellent source of information on the habits and behavior of the tunas.

The problem here is to obtain the cooperation of the men of the fleet by (1) making the means of obtaining the needed information as simple as possible (2) making any record keeping conform as nearly as possible to such methods as already may be in use and (3) keeping the information from individual operators confidential. It may be that some kind of log books will be the best means of getting the data we want, or it may be by interview with the vessel masters and crews upon return to port, or a combination of the two. During this year I hope only to make a good start toward ascertaining what may best meet our requirements and toward gaining the cooperation of the fleet in this project.

It cannot be overemphasized that such data, and all other information on individual enterprises, must be kept strictly confidential, that the scientific staff must not make them available to any person, government, or organization except in a summarized form which will preserve the security of individual enterprises.

Compilation of statistical and other information on the past history and growth of the tuna fishery

Current catch statistics and related information on the operations of the fleet are essential. In order to understand what is taking place currently, we must, however, also have knowledge of what has happened in the past. From the existing records we hope to be able to recapitulate the course of development of the fishery, to learn something about the variations in abundance of tunas and bait fishes, and something of the possible relation of changes in abundance to amount of fishing and other factors.

Sources of information to be explored with these purposes in mind are (1) statistical records of the State of California (2) records of tuna canneries (3) log books and other fishing records kept by vessel skippers and (4) articles in trade journals and newspapers.

We cannot hope to get very far into this project during fiscal 1951. I believe that with the cooperation of the State's scientists, the canners and the men of the fleet, we will be able to assess the possibilities and magnitude of the task, devise a system of procedure, and commence copying of existing records. I expect that gaining access to the past records of fishing vessel operators will be a very slow task due to their natural reluctance to give out "trade secrets."

Here again it is imperative that the Commission adopt a firm policy against revealing in any manner the records of individual operators to anyone except those members of the scientific staff authorized to deal with such data. Any breach of confidence may be expected to dry up important sources of vital information.

1952 Program Details

Procurement of adequate basic laboratory equipment and basic equipment for field work

During 1951, in order to make possible the initiation of important research projects, only the bare minimum of equipment for preliminary phases of those projects will have been purchased. By 1952 we will have both the need for and the preliminary information needed for the primary "tooling up" of the investigations. An appreciable fraction of the funds this fiscal year will be spent for the basic equipment and facilities needed for our scientific work ashore and at sea, including a small but adequate and seaworthy boat for the bait studies.

It is to be hoped that the return of priority procedure on procurement of scientific gear and general price increases do not throw completely awry our plans and estimates for procurement of equipment in fiscal 1952.

Compilation and analysis of existing oceanographical data

The tunas, being high-seas pelagic fishes, are influenced in their distribution and behavior by the properties of the ocean in which they live to a much greater extent than species which live on the bottom or close inshore. The space and time variations of the physical, chemical, and basic biological properties of the sea are, therefore, at least as important a frame of reference as the geography of the region of study. If we are to arrive at an understanding of the variations of tuna catches and their causes, we must therefore have a good knowledge of this oceanic frame of reference for our observations of the tunas themselves. The first step in this direction is the study of the oceanographic data which have already been gathered in the past from the region of interest to us. Although these are not extensive, their study will give a basis of planning as efficiently as may be possible the observations needed to be made by the Commission. This task should be completed by mid-year and form a basis of planning such initial oceanographical work as we may wish to conduct during the latter part of the year.

I have arbitrarily indicated Cape San Lucas to Peru as the limits of the sea region to be studied by the IATTC, on the following bases: (1) This includes the major part of the region of the present fishery for yellowfin and skipjack. (2) The region north of Cape San Lucas is under rather intensive study already by the Sardine research program. The oceanic circulation up to perhaps 500 miles offshore will require to be investigated. We cannot, of course, hope to cover in any detail this vast region in our own vessel work, but shall necessarily confine such studies to general surveys plus such critical studies of selected areas as may be required.

Development of means of marking and recovering tunas

The need for tracing the movements and growth of individual tuna and for measuring directly fishing intensity is so great that a special effort is warranted to develop a suitable means of marking and recovery of tunas for such purposes. Methods of marking employed in the past by Europeans, American, and Asiatic investigators have been singularly unsuccessful and it is, therefore, believed that an intensive research effort will be required to solve this problem. Several untried possibilities for doing the job suggest themselves; they should be evaluated, together with any other new methods that can be devised. Trials of marking methods may be conducted from commercial fishing vessels or from the Commission's chartered vessel (see below) incidental to other work.

Vessel operations from chartered craft

Vessel operations during 1952 are planned to consist of limited studies of important problems which cannot be approached otherwise. Because of the necessary delays in acquiring scientific equipment needed for work at sea, and because of the need for antecedent surveys of available information with respect to oceanography, we do not contemplate more than four or five months of vessel operation at the most.

Until we have some better knowledge of the exact kind of vessel and equipment needed for the Commission's high-seas research work, it would be unwise to proceed to acquire a ship of our own. It is, therefore, planned to conduct the Commission's vessel work from chartered craft until such time as we are in a position to specify rather completely just what we require. This, however, has the disadvantage that we are limited to the use of equipment of a portable or semi-portable nature. Equipment requiring permanent installation or requiring special modifications of the structure of the vessel for its employment is interdicted.

I tentatively plan that our limited vessel work will be confined during 1952 to two major projects, incidental data being simultaneously gathered on four subsidiary lines of investigation.

Special fishing trials should be conducted, employing sub-surface long lines, to determine whether there is, in deep water, a population of large yellowfin tuna not generally available to the surface fishery. From the results of commercial fisheries conducted by the Japanese in the Western Pacific, from results of similar commercial fisheries near the Hawaiian Islands, and from the investigations of POFI in the Central Pacific, it appears that there is a size-connected vertical movement of this species. The surface fish, as off the American West Coast, are relatively small specimens; at the same time deep-set long lines capture fish of much larger size and but few of the small sizes taken by the surface fishery. Studies of age and growth from size frequencies both off Central America and Hawaii indicate that the yellowfin tuna are very rapid growing and that the surface fishery is operating on only two or three youngest age classes, the older fish being mostly deep and not generally available to present fishing methods. The determination of whether or not there is in sub-surface waters a stock of large, older tunas not being exploited by the fishery is of the highest importance to our understanding of the problem of management of this fishery to obtain maximal yield. The experiment required to determine this is adequate sub-surface fishing by means of tuna long lines. Plans are being made to conduct such experiments during 1952 from a suitable chartered vessel.

Studies of the current systems, distribution of important chemical constituents, and studies of biological productivity will probably be desirable to be commenced during 1952. Details of these studies cannot be forecast at this time, since they are dependent on a careful review of information already available but not studied from the fisheries standpoint. We shall proceed, however, concomitantly with this review of existing data to accumulate basic equipment required, and to develop plans for making necessary observations at sea from chartered craft.

At the same time the Commission's vessel work is being conducted on these projects, it will be possible to accomplish incidentally a good deal on some other lines of investigation. By means of plankton hauls for tuna eggs and larvae, and by means of night-light fishing, we may expect to gather material toward an understanding of the spawning habits of the various tuna species. From night-lighting and perhaps by other means, we may form some idea of variations of abundance of tuna "feed" with other factors. Data on feeding habits of tunas will be forthcoming from examination of stomach contents of specimens captured long-lining and caught by incidental trolling when engaged in oceanographic work; these data will be of value to supplement information gathered aboard commercial vessels.

Development and trial of specialized scientific equipment

One of the reasons why high-seas fisheries research work is so costly is the time it takes to collect the material required from vast areas of the sea. Another reason is the time and manpower required ashore to "process" the collections and data gathered at sea, since we usually arrive at our solutions to problems in fisheries and oceanography by rather involved inductive processes depending on indirect measurements.

The importance of improved instrumentation to speed this work, which is going to be covering some 600,000 square miles of ocean and some 1,500 miles of shore line, is very great. For this reason we should, I believe, give specific attention to this matter and devote special effort to devising and testing improved equipment required.

Design of high-seas research vessel for the Commission's work

There are definite limitations to the work we can do from chartered vessels. For example, effective sound-ranging gear, which will probably prove to be one of the most valuable tools we have for measuring abundance of tuna schools by direct means, must be built into the ship. Other equipment, such as plankton towing gear, hydrographic collecting gear, shipboard chemical equipment, etc., can be made portable or semi-portable, but a good deal of efficiency is gained by a permanent installation. Most important, however, is that chartered craft are, of necessity, vessels which have been designed for commercial fishing, or at least for some other purpose than the uses to which we will put them, and therefore cannot possibly be as effective as a vessel specifically designed for the purpose for which it is to be used. A tuna clipper, for example, is wonderfully well developed for fishing for tunas off Central America with live bait, but it is a very poor ship for doing physical and chemical oceanography, or for plankton work, and is almost useless for long-line fishing. A halibut schooner type of vessel is preferable for all these purposes, but the quarters are not properly arranged for tropical living. I have had a good deal of experience using vessels for purposes other than those for which they were designed and I am convinced that it is very wasteful of funds over even a short period.

We should not, however, go into vessel construction until we know exactly what functions we want our vessel to perform, and the operational characteristics required to perform them. For that reason we should depend on chartered craft for essential sea work during 1952 and 1953. We should learn enough of the requirements, however, to commence design of our own vessel during 1952, and request funds for completing the design and letting a contract for construction the following year, fiscal 1953.

After some discussion of the program, the motion was made, seconded and unanimously carried: That the research program as presented by Dr. Schaefer for the remainder of this fiscal year, and for the fiscal year 1952 (July 1, 1951 to June 30, 1952) is approved and adopted.

The meeting adjourned at 12:00 noon to reconvene at 2:00 p.m.

The afternoon session opened at 2:25 p.m. with the Commissioners and Dr. Schaefer present. Chairman Cardona-Cooper presided and called the meeting to order.

Budget for fiscal 1951. Dr. Schaefer stated that inasmuch as the Commission's work had not been started until January 1, 1951, the requirements were somewhat less than the budget adopted at the first meeting on July 18, 1950. He suggested that the revised budget figure be adopted by the Commission. Thereupon, there was made and seconded the following motion, which was unanimously carried: That the budget for that part of the fiscal year beginning January 1 and ending June 30, 1951, be adopted in the total amount of $59,103.00 of which the United States share is $57,626.00 and the Costa Rican share is $1,477.00.

Budget for fiscal 1952. Director Schaefer stated that the budget for 1952 had been originally proposed in the amount of $370,320 but had not been approved by the United States Government in the total amount submitted because of the defense program and other considerations. He stated that the figure approved by the President of the United States and now pending before the United States Congress for the United States share is $332,000. During the following discussion it was brought out that the Costa Rican share will be an amount in addition to the $332,000, computed at the ratio to be adopted in accordance with the terms of the Convention, namely, the comparative utilization of tuna by the two countries. Dr. Schaefer stated that the reduction in funds would be absorbed by a shorter period of vessel operation and postponement of purchase of some equipment. The Chairman explained that the 97 1/2 -- 2 1/2 ratio had been adopted as a temporary basis due to the lack of statistics but that since the July meeting some computations had been made and that he now felt the division of expenses could be made in accordance with the terms of the Convention. Thereupon, it was moved, seconded, and unanimously carried that the budget for the fiscal year ending June 30, 1952, should be in the amount of $332,000 as the United States share with the Costa Rican share to be added to that amount and to be determined in accordance with the terms of the Convention.

Headquarters in the United States. The Chairman asked the Director to explain why headquarters should be located in or near San Diego, California. The Director explained that both San Pedro and San Diego, California, had been considered as possible sites. He stated that San Pedro is crowded at the present time and to his knowledge there was not readily available suitable space in San Pedro. The Scripps Institution of Oceanography located in La Jolla which is near San Diego has made an offer of suitable space, and has made available temporary quarters at its Field Activity on Point Loma. The Commission expects to work in close cooperation with that Institution and to use some of its facilities, including library and educational facilities. A further consideration is that San Diego has a majority of yellowfin and skipjack tuna landings, and probably the majority of the masters and owners of tuna vessels with whom the staff of the Commission will be dealing reside in San Diego. Thereupon, the following motion was offered, seconded, and unanimously carried: That the headquarters office and laboratory of the Commission be established at a suitable place in the vicinity of San Diego.

Establishment of a regional office in Costa Rica. Commissioner James pointed out that it was obvious from the program as outlined by the Director and adopted by the Commission that much work would have to be done in Costa Rica and for that purpose a regional office and laboratory would be necessary, for which the port of Puntarenas would be most suitable. It was further pointed out that the Commission at its meeting in Coronado July 18, 1950, had expressed its intention of having a regional headquarters at Puntarenas. It was thereupon moved, seconded, and unanimously carried: That the action of the previous meeting be formally approved and ratified and that regional headquarters be established at Puntarenas.

Time of annual meeting. Commissioner Sloan pointed out that the Convention required a meeting of the Commission to be held at least once each year and that in order to have the Commission budget prepared and adopted in time for presentation to the United States Government in accordance with its budgetary procedures it would be well to hold that annual meeting not later than August 15 of each year. It was thereupon moved, seconded, and unanimously carried: That the regular annual meeting of the Commission be held at a place and specific time to be decided by the Chairman in consultation with other Commissioners, not later than August 15 of each year.

Bank account in Costa Rica. Commissioner Payne presented a prepared motion which was seconded and unanimously adopted with one change: namely, "(Colones)" to be added after the word "funds" in the motion. The motion as adopted read as follows: That the Director of Investigations is authorized to open an account in a Costa Rican Bank in which shall be deposited such funds as may be necessary to pay for materials and services payable in Costa Rican funds (Colones); he is further authorized to purchase with the Commission's United States funds on deposit in San Diego, Costa Rican funds as required for these purposes.

Confidential nature of individual records. There was some discussion during which was stressed the strict necessity of maintaining the absolutely confidential nature of records of individual boat operators, canners, and other persons. It was pointed out that there would be extreme reluctance on the part of vessel operators to furnish detailed information unless they were assured that the records would be kept in strictest confidence. It was also pointed out that the boat-catch records of the State of California were required to be kept confidential. The following motion was thereupon made, recorded, and unanimously carried: [In order to ensure the confidential character of records of catch statistics of individual tuna boats, records of fish receipts and other records of individual company operations, and all other similar records regarding individual persons, companies, or enterprises, the Director of Investigations is instructed to keep such records at all times in secure storage and to permit access to them only to those members of his staff working with them in the conduct of the scientific investigations; these statistical and other records will under no circumstances be made available to any other person or agency except in the form of general summaries which will preserve the security of the operations of the individual.]

Approval of agreement with Scripps Institution. A form of agreement with Scripps Institution of Oceanography, which had been previously read by all Commissioners, was discussed. Commissioner Sloan moved to dispense with the reading of the agreement and this motion was seconded and unanimously carried. Thereupon, it was moved that the agreement with Scripps Institution, a copy of which is in the possession of all Commissioners, be adopted, and that a copy of the agreement be entered in the record of this meeting. The motion was duly seconded and unanimously carried. In discussion the question was then raised whether the Chairman should be specially authorized to sign the agreement on behalf of the Commission. Thereupon, it was moved, seconded and unanimously carried: That the Chairman be authorized to execute the agreement for and on behalf of the Commission.

Commissioner Bennett stated that the Commission appeared to have completed the business before it. He said he thought great credit was due to Chairman Cardona-Cooper and to his fellow members of the Costa Rican section for having so well arranged the program of the meeting and having handled it so capably that the Commission was able to transact its business expeditiously and to complete the agenda with unanimous action on all the items in much less time than had been anticipated. He extended on behalf of his fellow United States Commissioners, Dr. Chapman and Miss Davies, his compliments to the Chairman for all that he had done in these respects. He also, on behalf of his United States colleagues, made formal expression of appreciation for the most courteous reception that was extended by President Ulate, Minister of Foreign Affairs Echandi, Minister of Agriculture Volio, Minister of Finance Hernandez, and other public officials, citizens of Costa Rica, and representatives of the fishing industry. He said the United States section had heard a great deal of the beauties of Costa Rica, the fine people who are her citizens, and that all the visiting Americans had had the delightful experience of not being disappointed -- in fact, he said, they would leave the country with higher respect because of all that they had seen. He asked, on behalf of the United States Commissioners, Dr. Chapman and Miss Davies, that upon his return the Director of Investigations write to the President and to the Ministers who have extended these courtesies and convey to them the gratitude and appreciation of the visiting Americans.

The other members of the United States section concurred in these expressions and in the request.

Chairman Cardona-Cooper responded by thanking the United States Commissioners for their visit, by which he said he felt highly honored. He said that he and his fellow Costa Rican Commissioners had tried to reciprocate in such small way as they could the efforts which the Americans were making in assisting the welfare of such an important industry for the country of Costa Rica, in undertaking the work of these scientific investigations. He thanked the United States Commissioners again for their efforts and asked that they understand that their very kind words were highly appreciated. He expressed the hope for a very successful enterprise.

Upon motion duly made, seconded, and unanimously carried, the meeting thereupon adjourned.

APPENDIX A - DETAILS OF RESEARCH PROGRAM

The fishery conducted by United States vessels for the tropical tunas of the Eastern Pacific has grown with great rapidity during the years since the end of the last war, increasing in intensity in the regions previously fished and expanding both offshore and southward to encompass an ever-increasing area. At the same time, several Central American and South American countries have begun to develop local fisheries for the same species, the products of which are mostly exported to the United States. The result has been an increase in the landings of yellowfin and skipjack tunas from 121 million pounds in 1945 to 318 million pounds in 1950, with a further increase in the making in 1951.

This increasingly intense tuna fishery has not been without effect on the nature of the fishery. There is evident increasing competition between vessels in the more frequented fishing areas. There has been, during the last three years, a regular and persistent increase in the fraction of catch composed of skipjack which are somewhat less desired than yellowfin tuna. At times the fleet suffers from difficulty in obtaining the bait fishes required to catch these tunas. None of these are in themselves indicative of harmful effects on the fish stocks, but they do point out that the industry has grown to the point where it is imperative that knowledge be gained of the nature and extent of the fish resources on which the fishery depends if further development of the fishery is to be most productive. The rational utilization of the bait and tuna stocks to produce maximum yields may become a pressing economic and political problem at an earlier date than we now realize. Such rational utilization depends upon the application of extensive knowledge of the biology, ecology and population dynamics of the tuna and bait stocks. This knowledge we do not now possess; it is the mission of the Commission's scientific staff to obtain it.

Briefly, the objectives of our research program are to determine for the stocks of yellowfin and skipjack tuna, and for the stocks of bait-fish in the Eastern Pacific, how they fluctuate in abundance and in availability to the fishery in response to (1) variations in conditions of the environment and (2) variations in the amount of fishing. When we know these things we will be able to accomplish the purpose of the Treaty "to facilitate maintaining the populations of these fishes at a level which will permit maximum sustained catches year after year." This is, however, no simple problem possible of a quick solution.

The attainment of the objectives of our research program requires that we determine if each species is composed of a single stock, of a number of semi-independent stocks, or a number of completely independent stocks. If a species is composed of a single stock, fishing in one part of the fishing area affects the abundance of the species of tuna or bait-fish,

as the case may be, in all parts of the fishing area. If, on the other hand, there are a number of independent stocks, the reduction of numbers of one of them by fishing or natural fluctuations will have no effect on the others. Partial mixing of semi-independent stocks is an intermediate condition which is possibly the situation among the tunas, in which case fishing on one stock has limited effects on others.

We must obtain a rather complete knowledge of migrations, growth, age, spawning habits, feeding habits, schooling behavior, and other factors in the biology of the various species of tunas and bait fishes, in order to arrive at an understanding of the effects of the fishery on the stocks. The abundance of a species and the yield of the fishery for it are the products of complex interactions of the species with its environment and with the manner of application of the fishing effort. We cannot evaluate catch data in respect to determining the condition of the fishery until we obtain at least an elementary understanding of these interactions, which involves a knowledge of important details of the life history and biology. We cannot even correctly formulate the problem of measuring abundance by means of catch data except in the light of some knowledge of the life history of the species concerned.

It is needful that we obtain a good knowledge of the ocean current systems and other factors of the oceanic environment in which the tunas live since, being high-seas, pelagic fishes throughout their life cycles, the conditions of the oceanic environment are important determinants of changes both in abundance and in relative availability to the fishery from year to year, as well as of differences in productivity of different parts of the sea.

Finally, in order to determine the optimum yields which may be obtained from the tuna fisheries, we must know for the stocks of tunas and of bait-fishes how a given amount of fishing affects the stock on which it is applied. Most important, we must be able to measure these things quantitatively with sufficient accuracy to enable us to relate changes in size of stock to specified changes in the intensity of fishing or to specified variations in environmental factors.

Starting, as we are, with almost no knowledge of the most important aspects of the biology of the tunas and bait fishes, with a poorly recorded fishery, in a region of the sea which is less well know than any other area between the Bering Straits and Chile, this seems a formidable problem. It will certainly take time to solve it. We do know, however, how to go about solving it, what avenues of research to follow to find the facts we need.

The program of investigations planned for fiscal 1951 and 1952 was designed to "tool up" the investigations and to make a start on the several avenues of research which might be expected to lead to the knowledge required. Because of delay in the 1951 financing, we have, to date, made only a small start on two or three lines of study. These, however, have been most stimulating in the vistas which they open to us. For example, the work we have been able to do has revealed a wealth of most important data among the uncollected records of the fleet which will be useful in measuring changes in abundance and yield over a series of some years, both with regard to tunas and bait fishes.

The research program during fiscal 1953 will be a natural and logical development of those lines of investigation commenced in 1951 and 1952. We cannot at this time, of course, predict which lines of investigation will prove most fruitful. Our job is to discover, regarding the populations of tunas and bait fishes, the facts which are required to understand the relationships of the fishery to the size of stocks and to the yield. We must, therefore, proceed from one fact to the next, following where successive discoveries lead us. For this reason, our program, like all productive scientific programs must maintain very great flexibility to adapt itself to the results of the studies as they progress.

It was expected that during fiscal 1952 we should have practically completed the procurement of basic equipment for laboratory and field work, and that we would have made considerable progress on studies both ashore and at sea. Due to the extensive delay in funds for 1951, and the almost disastrous reduction in the budget for 1952, very great curtailment of plans has been mandatory. Specifically, we must delay until 1953 the procurement of practically all equipment (including a boat for bait studies) and must eliminate all work at sea, except possibly some very limited preliminary studies in co-operation with Scripps Institution of Oceanography, and all studies of tuna biology. Essentially the 1952 program under the reduced funds available must be cut to approximately that outlined at the first Commission meeting in July 1950, less studies of tuna biology.

In order to develop the investigations during fiscal 1953 to the extent necessary to discharge the Commission's obligations under the Treaty, it is estimated that we will require a budget of $424,000. in that year.

The program of investigations contemplated for 1953 with this amount of funds may be considered under the following headings:

1) Compilation and analysis of catch statistics, log-book records, and other data regarding the bait fisheries and tuna fisheries, in order to study success of fishing, changes in abundance and yield and shifts in areas of baiting and fishing.

2) Research into age and growth, rates of mortality, maturation and spawning, racial composition, feeding habits, schooling, and other important aspects of the biology of the tunas by the following means:

(a) Systematic quantitative sampling of the commercial landings
(b) Studies aboard commercial fishing vessels
(c) Special studies at sea from research vessels
(d) Collection of special data by our own or co-operating observers in critical localities

3) Tuna-tagging studies to determine migrations, degree of independence of stocks, and degree of exploitation by the fishery.

4) Investigations of the life histories and ecology of the several species of tuna-bait fishes, and studies of the relationships of the fisheries to the stocks of bait fishes.

5) Investigations of the oceanic circulation and other aspects of the physical, chemical and biological oceanography, and the relationships thereof to the abundance and behavior of the tunas.

1953 Program Details

1) Compilation and analysis of catch statistics, log-book records, and other data regarding the bait fisheries and tuna fisheries, in order to study changes in abundance and yield, success of fishing, and shifts in fishing and baiting areas.

In order to study changes in the size of a fish stock in response to changes in amount of fishing and variations in environmental factors, and the yield which may be obtained by the fishery at various levels of stock, what is known as the "population dynamics" of the stock, we must be able to measure the stock and measure the yield. Such measurements are possible by means of proper interpretation of detailed records of the operations of the fleet respecting areas fished, amount of fishing, and yield obtained - both the total yield and the yield per unit of fishing effort. From the analysis of such records covering a period of years we can determine how the stock has changed in abundance from year to year, how the fishery has developed and expanded to new grounds, and we can relate these changes to the intensity of fishing and total catch.

It is necessary that suitable data of this sort be available over a considerable series of years. Since compilation of current data would thus require many years to give us the materials needed, we always hope to find available records of the past which may be useful for research on the problems of population dynamics. Therefore, one of the first things we have done is to survey this possibility in the case of the tuna and tuna-bait fisheries. It has been discovered that among the old log-books of the tuna fleet is a magnificent body of data for the quantitative study of the fishery for yellowfin and skipjack tunas and some information, albeit not very complete except in a few instances, on the fishery for bait species. Records of the canneries' fish receipts by individual boats also constitute a useful body of data for study of changes in abundance of tunas. The statistical records of tuna landings compiled for many years by the State of California will also be very useful to us.

Important as are the records of past years, even more important is the collection of detailed information on current operations of the fleet. Indeed, as I have pointed out before, the establishment of a workable system of gathering detailed information on current fishing activities and results is the single most important phase of our work. We have, therefore, given the problem of devising and establishing such a system highest priority. It is gratifying to be able to report that the development of a log-book system of gathering detailed data on both bait and tuna fishing is meeting with a very high degree of co-operation from the men of the fleet. The working of such a system depends, however, on the constant attention of representatives of the Commission of a caliber that will develop and deserve the confidence of the vessel masters. For this purpose we will require port contact men both at San Pedro and San Diego.

The collection of the vast amount of available data on past and current operations of the fleet and the analysis thereof to develop measurements of abundance, and to devise a rational and useful theory of the response of the tuna stocks to fishing, will require the attention of several of our scientific staff and a number of clerical workers. Most of the preliminary compilations should be completed in fiscal 1952 and some worthwhile results be forthcoming during 1953.

2) Research into age and growth, rates of mortality, maturation and spawning, racial composition, feeding habits, schooling, and other important aspects of tuna biology.

Before we can arrive at an understanding of the responses of the tuna stocks to changes in the environment or to variations in intensity of fishing, we must know a good deal about the lives and behavior of the fishes which compose the stocks. First, of course, we must know just what stocks we are dealing with; whether each species is composed of a single stock or of a number of independent stocks, or perhaps a number of semi-independent, partially intermixing stocks. Then we must also discover how these stocks are replaced by birth, growth, and death. To understand how the abundance is influenced by natural conditions in the sea and by the impact of the fishery, we must find out a good deal about the behavior of the tunas - such matters as feeding, aggregation into schools, variable distribution in the sea according to size, and so forth. The many elements of the biology and life history of the tunas will be approached by collection of materials in a number of ways:

(a) Systematic quantitative sampling of the commercial landings at San Pedro, San Diego, and Puntarenas

The existence of a large extensive commercial tuna fishery greatly aids our scientific studies by bringing in to port large samples of the tuna populations it exploits, from which we can draw representative sub-samples for the study of some of the important phases of the biology. In particular, by this means we may obtain materials for study of racial composition (independence of stocks) by means of morphometric analyses, for study of growth and age, and for determination of age and size of maturity and time of spawning. The collection of these materials involves the careful systematic sampling of the tuna landings. This work is planned to be done partly in co-operation with the California Fisheries Laboratory which is gathering some market-measurement data at present.

(b) Studies aboard commercial fishing vessels

A good many aspects of tuna biology cannot, of course, be approached from work on the shore. In order to study such things as schooling behavior and feeding habits, observations must be made at sea. For the collection of some kinds of morphometric measurements, freshly-caught tunas must be employed. Very young larval and juvenile tunas are not taken

commercially so must be collected by the scientific worker himself. The same is true of the collection of natural tuna-food organisms. To a degree, at least, it is possible to do this sort of thing from commercial fishing craft in the course of their regular work by sending out special scientific observers aboard them. It is planned to utilize this possibility to the fullest extent, since this offers a means of gathering very large quantities of useful data and materials at small expense.

(c) Special studies at sea from research vessels

There are, of course, a good many kinds of information which we require regarding the biology and life history of tunas which can be gathered neither ashore nor from commercial fishing vessels. For such things we must rely on work at sea from research vessels. For example, we need to find out whether there exist stocks of tunas at depths not fished by the present fishery (as discussed in our 1952 program), and whether the tuna populations extend well offshore beyond the relatively narrow belt now exploited by our fishermen. This can be done only from vessels particularly engaged in such tasks.

These projects are of basic importance, because we need to know whether or not the fleet is exploiting the tuna stocks completely in its present area of fishing, which consists essentially of the surface waters within 200 miles of the shore. It is particularly important to ascertain whether in the Eastern Pacific, as has been found true in the Western and Central Pacific, there exist in deep, sub-surface waters populations of large, old yellowfin and big-eyed tunas, which in our area would be little subjected to fishing by present methods, and therefore, might constitute an untouched brood stock.

Similarly, the collection of tuna eggs and larvae to determine extent of spawning requires the employment of special collecting gear and a ship to use it from. Knowledge of extent, in space and time, of spawning is important, because considered together with other kinds of information, it furnishes a basis of estimating in a preliminary fashion the likelihood of encountering in the tuna fisheries large fluctuations in year-class strength of the sort which give rise to large variations in production of some heavily exploited fisheries, such as that for the California sardine, and which may be of major importance to the tuna fisheries as they become more intense.

Some of these things can be done in connection with the vessel work involved in studies of physical, chemical and biological oceanography (see below), some must rely on special cruises with fishing craft of suitable type. We cannot, of course,

plan these things in final detail until we have at hand the results of our 1952 work. It may be estimated, however, that we will require about two months vessel operation for studies of biology and distribution of adult tuna and bait species, and three months vessel operations for oceanographical studies, and studies of tuna eggs and larvae and of tuna-food organisms, during 1953.

(d) Collection of special data by our own or co-operating observers in critical localities

For the elucidation, in particular, of the problem of the geographical limits of the tuna stocks (and perhaps also the bait stocks) supporting the fisheries covered by the Treaty, it will be necessary to obtain measurements and specimens from regions not normally visited by our fishing craft. These data may be obtained in some instances by co-operating scientists in other agencies. In other places it will be necessary for our own scientists to gather the required data and specimens.

In this connection should be particularly mentioned the important problem of determining whether the tuna stocks of the Eastern Pacific are or are not independent of those of the Central Pacific - whether the yellowfin and skipjack populations of the coasts of the Americas are or are not continuous with those of the Marquesas and Tuomotos. Morphometric data from the last mentioned areas are required to compare with similar data from our area, and their collection may require special efforts by our staff. This problem is of very great importance both from the standpoint of management of our tuna fisheries, and from the standpoint of international relations respecting the fisheries of various areas of the Pacific.

3) Tuna-tagging studies to determine growth, migrations, degree of independence of stocks, and degree of exploitation by the fishery.

As discussed above, the determination of the degree of independence of the tuna stocks is a matter of fundamental importance to the assessment of the condition of the fishery and to its rational exploitation and management. The problem of determining independence of stocks may be approached by comparison of measurements of series of specimens from different areas, but the results of such studies are seldom entirely conclusive, because statistical differences in measurements of fish from different areas does not preclude some degree of migration between them. It is important, therefore, to also obtain information from the movements of marked specimens to determine the rate and degree of such migration between areas. The study of migrations by means of marked individuals is also important in order to elucidate any regular patterns in the migrations of the members of a stock, such as those connected with maturation and spawning, seasonal changes in feeding areas, movements in response to seasonal oceanographic changes, and so forth. Knowledge of the migration patterns of a tuna species is a necessary element

in considering the manner in which the fishery affects the stock. It is also possible by means of marking and subsequent recovery of individuals to obtain direct measurements of rates of growth at different sizes. This, indeed, may turn out to be the best means of measuring growth in these tropical pelagic species where the methodology applied to fishes of northern latitudes - reading of age by marks on scales or other hard parts - seems to be impossible or uncertain of application. Finally, by means of large-scale, quantitative marking experiments it may be possible to estimate the degree of exploitation of the tuna stocks and, by considering this together with statistics of total catch, to arrive at estimates of the numbers in the sea of tunas of catchable size.

The marking or tagging of tunas is a matter of great difficulty because of the large size yet delicate nature of these fishes. It is believed to be possible, however, and we regard the development and application of tagging or marking methods to be of highest importance to our research program. Since it involves, of necessity, work at sea, it is a relatively costly undertaking even in the initial stages. The extent and value of information to be obtained by this means, however, most certainly justifies the expense involved.

If it is possible to develop a suitable, simple means of marking tunas which may be employed by the men of the fleet, it is highly probable that a very extensive program may be conducted at little expense by interesting a number of the captains of commercial seiners and bait-boats in marking and liberating a series of tuna each voyage. We must be certain, however, that the mark employed would result in a reasonable number of recoveries, since we could not expect to maintain the interest and confidence of the persons concerned unless the program were successful. Therefore, it is necessary that a marking method be developed and thoroughly tested by our scientific staff before such an extensive program is considered.

The budget estimates for 1953 envisage that it will be possible to develop a suitable tag or mark and apply it in a preliminary tagging program of moderate scope - something in the neighborhood of 3,000 specimens.

4) Investigations of the life histories and ecology of the several species of tuna-bait fishes, and studies of the relationships of the fisheries to the stocks of bait fishes

The catching of tuna employing live-bait accounts for 80% of the landings of yellowfin and skipjack tunas. The supply of bait is, therefore, of highest importance to the tuna fisheries. Large fluctuations in bait populations which have occurred in the past, and may be expected to occur in the future, pose questions as to whether they are due to natural causes or over-fishing. In the latter case, it is important to determine how the maximum yield may be obtained from each stock of bait fish. In the former, it is important to be able to understand what natural factors cause the fluctuations and, if possible, be able to forecast them.

Just as in the case of the tunas, the problems presented by the rational utilization of the bait-fish stocks require that we obtain a detailed knowledge of the life-histories and ways of life of the species concerned, that we

determine the independence or inter-independence of stocks of different baiting grounds, that we obtain measurements of abundance and catch, in order to proceed toward the goal of determining what yield may be obtained from each of the several bait stocks on a sustained-harvest basis.

The program of research on bait species involves four phases:

(a) Studies of biology and ecology of bait species in the Gulf of Nicoya and adjacent baiting areas by staff scientists at the laboratory at Puntarenas. Intensive studies will be conducted of the ecological conditions of the Gulf in relation to the abundance, behavior, reproduction and growth of anchovettas and other bait species there. By means of periodic visits to adjacent baiting areas, such as the Gulf of Fonseca and Panama, the findings in the Gulf of Nicoya may be related to conditions on other baiting grounds.

(b) Collection of specimens through the co-operation of the fleet. Collection by the fleet of random samples of hauls of fish taken for bait makes possible much wider coverage than is possible by any other means. Such samples, of course, are composed only of those sizes taken for bait and at only those seasons when the fleet is using the baiting areas in question. Such samples, however, are of value for studies of racial affinities of bait populations, age and growth, and possibly time of spawning and size at spawning if the fishery operates on mature fish. Such samples are also important for determining just what part of the stock, with respect to fish sizes, the tuna fishery exploits.

(c) Compilation and analysis of log-book statistics of baiting operations of the tuna fleet to determine the quantities of different species of bait fishes taken by individual boats each year from various areas, in order to measure changes in abundance in different areas, total quantities of bait used from each area, and seasonal as well as annual fluctuations in the availability of the bait supplies. These catch statistics are fundamental to a proper understanding and management of the bait fisheries, because they are the best means of measuring objectively and quantitatively the fluctuations of abundance yield, and intensity of fishing from year to year on each baiting ground, and so arriving at an understanding of the relative importance of fishing and natural causes of mortality, and of eventually arriving at some estimate of maximum expected yields.

Both in this phase of the bait-fish studies and the preceding one, the excellent co-operation being given by the tuna fleet is of utmost importance.

(d) Marking programs to determine the degree of intermingling of populations of different areas and to measure the sizes of the populations and the rate of exploitation of each. The

development phase of this part of the program is an easier job than in the case of tuna marking, and a program of adequate scope can be rather confidently planned for fiscal 1953.

5) Investigations of the oceanic circulation and other aspects of physical, chemical and biological oceanography, and studies of the relationships thereof to the tuna fisheries

The tunas, being high-seas, pelagic fishes are related not to the features of the land, but rather to the features of the sea in respect to their abundance, aggregation, and behavior. True, they are found often in relation to various banks or other geographical features, but as consideration of the seasonal and annual variations in such relationships makes obvious, these relationships are secondary in nature - the tunas are associated with the features of the sea which in some instances may be associated with the topography of the bottom and in others may not. It is becoming more and more apparent that, in order to arrive at an understanding of factors controlling the success of the tuna fisheries, an understanding of the sea in which they live and how they are related to it is absolutely essential.

This involves basically two kinds of measurements: first, measurements of the properties and processes in the ocean and their variations in space and time and, second, measurements of the variations in abundance, aggregation, and behavior of the tunas to correlate with the oceanographic information. The most important source of information of the latter sort is the commercial fishing fleet. The records of success of fishing operations and associated observations recorded by the fleet in log books will be the most effective body of data for studying variations in abundance of the commercial sizes of tunas. For measurement of distribution and abundance of very young stages - the eggs and larvae - and perhaps of large, old tunas that may live in the sub-surface layers, we must make special measurements by means of suitable gear; plankton nets in the first case and long-lines in the latter case.

For studying the distribution of physical properties in the sea, and for elucidating the physical and biological processes which affect the tunas, there are required studies in physical, chemical, and biological oceanography which demand the employment of sea-going research vessels and equipment. The available knowledge of the sea areas where most of the tuna fisheries are pursued is quite meager. Fortunately, the Scripps Institution is planning a Navy-sponsored oceanographic cruise in our general region for the coming winter in order to obtain information on the general circulation pattern, and it is hoped that we will be able to arrange for some additional observations particularly suited to elucidating the circulation and the distribution of properties in areas of particular importance to the tuna fisheries. On the basis of these data plus information previously available from the few past studies reported on in the literature, we may plan detailed studies for fiscal 1953.

It is also contemplated that we may be able to interest a few co-operative and reliable captains of the tuna fleet in gathering limited, but extremely valuable, oceanographical information in the areas of greatest interest to us

by means of routine bathythermograph observations made daily during their voyages. These data, if obtainable, should be very valuable in measuring seasonal variations in temperature distributions and in some of the features of the circulation, and furnish a basis of relating the distribution of tuna catches thereto. The proper evaluation of such data, however, requires first a better knowledge than we now possess of the broad features of the oceanic circulation and distribution of properties in the Eastern Pacific in general.

Our estimates for fiscal 1953 are based on three months of operation at sea of a research vessel which will make observations on physical and chemical oceanography, on abundance of planktonic organisms including tuna eggs and larvae, and on abundance of organisms making up the food-chain which supports the tunas. It is not planned that the Commission will acquire a vessel at this time. It is planned that we will arrange for co-operative use of vessel facilities of Scripps Institution of Oceanography as far as practicable and, if needed in addition, will charter a small commercial vessel of suitable type for installation of semi-portable oceanographic collecting gear.

Budget Estimates by Projects

For purpose of fiscal control, the budget for the above program of investigations has been broken down into natural categories of expenditures, which do not correspond exactly to the items of the program as outlined above. These groupings are based primarily on the kind of work involved, but to some extent on geographical location. The breakdown by these "projects" is as follows:

Project A -	General expenses of headquarters laboratory, including Director's salary and expenses, and laboratory and office expenses jointly chargeable to all activities	$ 68,350.
Project B -	Research on biology, life history, ecology and utilization of bait species; expenses of Puntarenas laboratory	67,050.
Project C -	Study of current and past operations of the fishing fleet from catch statistics, log-book data, and other sources; measurement of changes in abundance and yield of the tuna stocks; expenses of office at San Pedro	36,400.
Project D -	Research on biology, life history, ecology and population dynamics of tunas (including tagging program)	59,300.
Project E -	Analysis and evaluation of data on the physical, chemical, and biological oceanography of our region of study	32,200.
Project F -	Vessel equipment and operation; observations at sea	160,700.
	Total	$424,000.

The budget estimate is also tabulated according to the "object classes" of the U. S. Budget as follows:

Estimates by U. S. Federal Budget Objects

01	Salaries and wages		$147,400.
	Full time employees (14 professional scientific 20 sub-professional and clerical)	$130,600.	
	Part time and irregular employment	16,800.	
02	Traveling expenses		17,800.
03	Transportation of things		800.
04	Communication services		2,100.
05	Rents and utility services		11,750.
06	Printing, binding and reproduction		7,500.
07	Other contractual services (including vessel operating expenses)		105,500.
08	Supplies and materials		9,550.
09	Equipment		121,600.
	Total		$424,000.