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National Oceanic and Atmospheric Administration
National Marine Fisheries Service

***Southwest Fisheries Center
Honolulu Laboratory . . . a background document***



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A REVIEW OF THE HONOLULU LABORATORY - ITS HISTORY AND ACCOMPLISHMENTS, AND ITS IMMEDIATE PLANS

Background

The Honolulu Laboratory (HL) of the Southwest Fisheries Center traces its inception to Public Law 329 of the 80th Congress (1947). This Public Law authorized the exploration, investigation, and development of high-seas fisheries of the territories and island possessions of the United States in the tropical and subtropical Pacific Ocean and intervening seas. Funds for the laboratory became available in July 1948, and in 1949 under the capable direction of the late Dr. O. E. Sette the Pacific Oceanic Fishery Investigations (POFI), as it was known then, sent out its first research ships. By mid-1950, when POFI moved into its newly completed permanent laboratory building, a vigorous research program was already underway.

From an administrative perspective, HL has gone through several major changes in its 25 years of existence. Figure 1 summarizes these changes (shown on a time scale). They include reorganizations, changes in directors, changes in objectives, and changes in funding--as indicated by the number of personnel and ships in operation. Appropriations for HL have waxed and waned over the years, reflecting national priorities as perceived by the Executive branch of our government. At present, appropriations are lower than they have ever been--a fact of great concern to HL.

Scientific Activity

Until the 1970 reorganization creating NOAA, the research directions of HL were guided by the Tuna Industry Advisory Committee. The interaction between HL and this committee resulted in extensive, systematic explorations in the Pacific Ocean from the Aleutian Islands to New Caledonia, and from the American Continent to Palau in the Western Caroline Islands. The scientific history of the laboratory is marked with milestones of significant achievement. Some of the highlights of these follow.

- 1 The discovery and delineation of the easterly flowing Equatorial Undercurrent. This current, known as the Cromwell Current, has a flux of 400 trillion gallons per hour, 1,000 times as great as the Mississippi River. Its discovery solved one of the major oceanographic puzzles of our time, the great imbalance of the amount of water flowing westward in the Pacific Ocean as compared to the amount flowing to the east.

HONOLULU LABORATORY

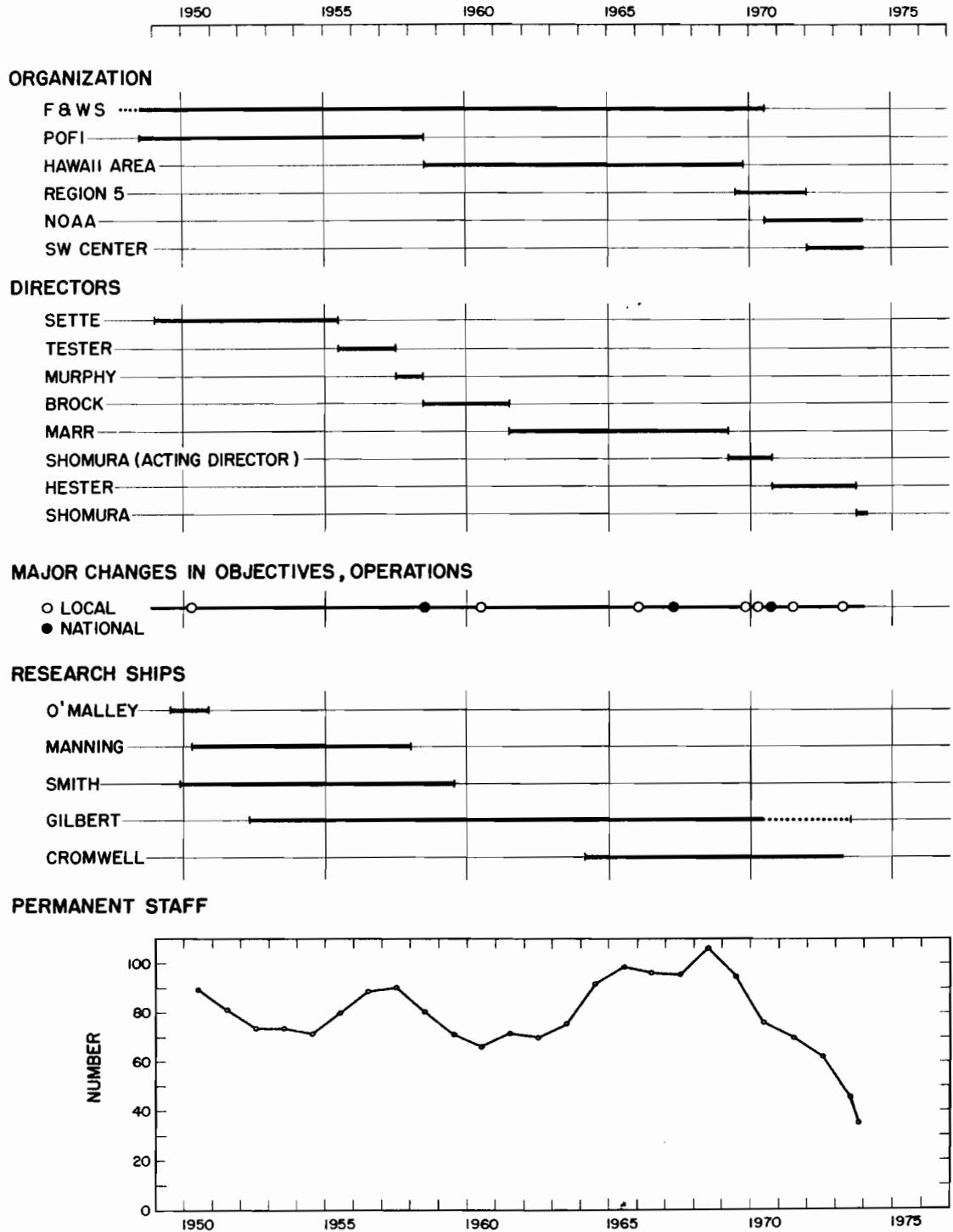


Figure 1

- 2 The location of a concentration of large tunas in an equatorial band and its relationship to the oceanographic and meteorological features of the Pacific Ocean. Owing to economic considerations, American industry failed to take advantage of this resource, but the Japanese did.
- 3 The ability to capture and hold alive for extended periods of time several species of tunas, e.g., skipjack tuna, yellowfin tuna, kawakawa, bigeye tuna, and frigate mackerel. HL was the first research laboratory to succeed in this. Even today, no other facility in the world captures and holds the delicate skipjack tuna. This ability has opened the way for significant experiments on the behavior and physiology of tunas. Items 8, 9, and 10 below are examples.
- 4 A description of the oceanography in the central Pacific Ocean. This description provides basic environmental information of the world of the pelagic fishes, information that is essential to the exploratory and developmental stages of a fishery.
- 5 An oceanographic atlas of the Pacific Ocean.
- 6 Migration models of the albacore and skipjack tuna.
- 7 The identifications and distributions of the larvae and juveniles of yellowfin and skipjack tunas.
- 8 Descriptions of the visual acuity of skipjack tuna and kawakawa.
- 9 A description of the auditory capacity of yellowfin tuna.
- 10 A detailed study of the hydrodynamics of kawakawa and its effect on behavior. Because of major similarities between kawakawa and skipjack tuna, many of the results of this study hold true for the latter species.
- 11 The discovery of potentially valuable shrimp resources in the Hawaiian Islands. The extent of these resources throughout the Hawaiian Archipelago has not yet been defined.
- 12 The ability to tag tunas and other fishes of similar size or larger with electronic transmitters and to track them for detailed studies of their movements and behavior. Although very little tracking of tunas has been done to date, skipjack tuna have been discovered to have remarkable navigational abilities and have been shown to stay close to the surface at night, facts which may be useful to fishing strategy. A short trial of tracking albacore has indicated a close relationship between albacore movements and temperature features in the ocean.

- 13 Predictions of the size of a season's catch in the Hawaiian skipjack tuna fishery. These predictions have been made a half year in advance using temperature and salinity variations monitored at Koko Head on the island of Oahu.
- 14 An understanding of the physics of eddy patterns in the lee of islands. This may some day lead to the ability to predict the distribution and changes in distribution of important commercial species.
- 15 A preliminary description of the subpopulations of skipjack tuna in the Pacific Ocean. This type of study is important for resource management, especially where international considerations are involved.
- 16 Descriptions of the reproductive parameters (capacity, seasons, geographic zones, size at maturity) of skipjack tuna, yellowfin tuna, bigeye tuna, and albacore.
- 17 Estimates of growth rates of four species of tunas: skipjack, yellowfin, bigeye, and albacore.
- 18 An estimate of the potential yield of the skipjack tuna resources in the Pacific Ocean. This is based on a synthesis of known biological information plus estimates of a few unknown factors. The study has led to the conclusion that these resources are quite underutilized, providing impetus for further development of the skipjack tuna fishery. The Laboratory's findings were instrumental in the formation in February 1970 of the Pacific Islands Development Commission, a non-profit corporation consisting of the chief executives of its four member governments: The State of Hawaii, American Samoa, Guam, and the Trust Territory of the Pacific Islands.
- 19 The age determination of local anchovy, nehu, from otolith markings, is significant in that this is the first demonstration that otolith markings can be used to determine the age of tropical fish species. Scale and bone markings have been the most reliable indicator of age in fishes, but these methods have not been effective in tropical areas because they lack marks that can be associated with time.

As may be expected in any research organization, not all endeavors have come to such successful conclusions. Results of other projects ranged from limited success to inconclusive. In this category were early experiments with purse seines, gill nets, substitute bait species, the frequency-modulated sonar, modifications in longline techniques, mass-rearing of baitfish, and artificial bait. However, even the results of these experiments added to our body of knowledge and contributed to a better understanding of the problems.

Over the years of active exploration, HL has accumulated a massive data bank. Much of the data has been analyzed and reported on. The information is by no means depleted, however, and there is still much to be learned by studying data as yet unanalyzed, and analyzing data from a variety of perspectives.

HL activities have included sponsorship of and participation in conferences and meetings of various levels. Through these means a great deal of cooperative research, cooperation, and goodwill have been generated among the countries of the Indo-Pacific complex. It is safe to say that HL has emerged as a leader in fishery and oceanographic research, and commands considerable respect for its accomplishments and experience in the Pacific Ocean.

Plans for the Immediate Future

Fiscal year 1974 was marked by a major budget cut. This resulted in the loss of the research vessels Charles H. Gilbert, decommissioned and put up for public sale, and the Townsend Cromwell, deactivated for an extended period of time. It also forced a severe reduction in manpower and the attendant scientific and technical skills. Eying the possibility of an equally lean FY 1975, it was agreed that a program had to be constructed for HL which would make best use of its existing capabilities and funding. It was decided that the major effort be directed toward the assessment and development of the skipjack tuna resources of the Pacific and Indian Oceans.

Considerations which affected this decision were (1) an increasing demand for tuna products; (2) the realization that of all the world's supplies of tuna, skipjack tuna is the one underutilized tuna resource; and (3) rapidly increasing foreign competition for the existing skipjack tuna.

The long-range benefits of the proposed program--if it leads to even modest levels of fishery expansion or development--are very large in comparison to the costs. From a national point of view increased domestic catches in the central, southern, and western Pacific will:

- o decrease the rate of dependency on foreign-caught fish, thus resulting in a balance of payments that is lower than it might otherwise be;
- o increase the efficiency of capital investment through increased use of vessels, thereby increasing United States productivity;
- o have important considerations in the conduct of international affairs.

The work plan calls for NMFS to perform a portion of the tasks, utilizing staff members of the SWFC Honolulu and La Jolla Laboratories.

Pending full program funding the gear design, construction, and testing and exploratory fishing work may be the responsibility of an independent contractor. The program will coordinate wherever possible with activities of Sea Grant, university, state, and other agencies.

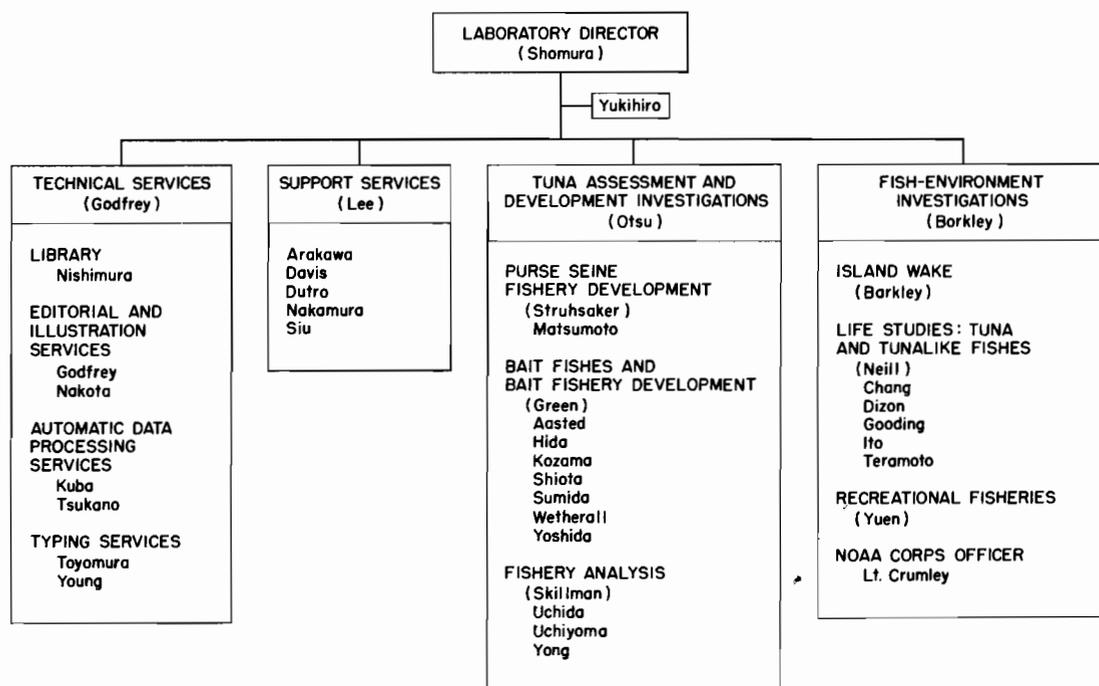
PRESENT ORGANIZATION OF THE HONOLULU LABORATORY

Honolulu Laboratory Structure and Current Programs

HL, under the direction of Richard S. Shomura, is divided into four groups: The Tuna Assessment and Development Investigations (TADI), headed by Tamio Otsu; Fish-Environment Investigations (FEI), under Dr. Richard A. Barkley; Technical Services, headed by Ms. Mary Lynne Godfrey; and Support Services, under the supervision of Edwin K. W. Lee.

Tuna Assessment and Development Investigations is structured to handle the assessment and development of skipjack tuna in the Pacific and Indian Oceans. Fish-Environment Investigations is organized along three separate lines of study. In FY 1974 the Island Wake

HONOLULU LABORATORY ORGANIZATIONAL AND STAFFING CHART



Studies will complete the investigation into the effect of islands on the physical dynamics of the ocean. Life Studies: Tuna and Tunalike Fishes will study the reaction of tunas to the environment and will concentrate initially on skipjack tuna and water temperature. Recreational Fisheries is a small first step by HL to provide much needed research in areas of interest to the sport fishermen. Plans are to study the relationship between the distribution of billfishes and the environment, and to evaluate the status of the fisheries for billfishes.

Following is a Brief Statement of Each of Honolulu Laboratory's Several Programs

MARMAP III: SKIPJACK TUNA, PACIFIC AND INDIAN OCEANS

Principal Investigators: Tamio Otsu, Roger Green, Dr. Paul Struhsaker

The skipjack tuna is an underutilized species with considerable potential for development. The development of skipjack tuna fisheries in the central, southern, and western Pacific is urgent from the point of view of increasing the supply of tuna for the U.S. tuna industry and helping the people of the Pacific Islands expand their economic bases and their employment. In response to these needs, a major effort of the Honolulu Laboratory's research program is the conduct of various studies that will assist in the development of skipjack tuna fisheries.

- 1) A limited supply of skipjack tuna baitfish has impeded the establishment of new tuna fisheries and the growth of existing ones in many areas of the Indo-Pacific. During fiscal year 1974 we will complete a comprehensive background document summarizing what is known of the availability, distribution, and behavior of the various species composing the baitfish resources of the central, southern, and western Pacific, to serve as a basis for further studies of the resource.

We plan to augment the local bait supply of the Hawaiian fishery by transporting the northern anchovy, Engraulis mordax, from California to the Hawaiian Islands. A combination of economic and technical considerations indicates that a transport tank via roll-on/roll-off freighter is presently the most feasible system, and a pilot program has been initiated. A 5,000-gallon aircraft refueling system is being modified and equipped with a life-support system. The first trial shipment of baitfish is planned for March 1974. Final objective will

be to encourage and advise private interests in developing a full-scale, bait-transport program.

- 2) We will utilize domestic and foreign tuna fishing information and statistics to determine optimal fishing strategies for both purse seine and pole-and-line vessels fishing in the Indo-Pacific region.
- 3) The efficiency of harvesting skipjack tuna may be increased through the use of the recent Japanese-developed automatic pole-and-line fishing machine, and/or through the establishment of a workable trolling system for small vessels. In Hawaii, where experienced skipjack tuna fishermen are in short supply, an automatic pole fishing machine will be tested on a local skipjack tuna vessel. To explore the economics of a small-craft trolling system, our Laboratory will first undertake a paper study. If feasible, a system patterned after west coast albacore trolling rigs will be tested during peak fishing months in American Samoa.
- 4) Participation in the Pacific Islands Development Commission's (PIDC) cooperative program for the development of the tuna resources of the central, southern, and western Pacific calls for the preparation of a document containing all previous tuna research and exploratory fishing information, participation in the PIDC-Industry tuna purse-seine development program, and provision of continuing fishery information and intelligence.
- 5) During fiscal years 1975 and 1976 experiments will be conducted in the central Pacific utilizing several types of devices that could attract and aggregate skipjack tuna. An obvious benefit would be a more efficient harvesting of these tuna schools by purse seine and pole-and-line fishing gear.
- 6) Technical knowledge gained through the foregoing activities will be made immediately available to fisheries officials of Pacific Island areas of concern to the United States.

FISHERY ANALYSIS: TUNA MONITORING AND ASSESSMENT,
PACIFIC AND INDIAN OCEANS

Principal Investigator: Dr. Robert A. Skillman

The Southwest Fisheries Center has developed a plan for the exploitation of the skipjack tuna resources of the central and western Pacific. The plan is designed to place major emphasis on stock assessment, fishery monitoring, and various aspects of fishery liaison.

In addition to the development of the skipjack tuna resource, we plan to monitor the status of exploited Pacific stocks of other tuna and tunalike resources of U.S. concern through the systematic collec-

tion and analysis of fisheries data. The stock assessments and production models of other tuna species will aid in resource management and economic planning, and will provide the background needed for international negotiations.

Anticipated accomplishments of the program for fiscal years 1974, 1975, and 1976 are (1) the collection of data from the several tuna fisheries operations in the Pacific Ocean and also in segments of the Indian Ocean. This is to provide the basis for assessments of distribution and abundance, activities which will be kept relevant to industry needs by our continuing liaison with the fishing industry; (2) assessment of skipjack tuna, resulting in current reports on the status of stocks; (3) complete reports on the longline fisheries of the Pacific and Indian Oceans, and "status of stock" reports on the albacore, bigeye tuna, and yellowfin tuna populations of these fisheries.

Increases in funding would open possibilities of the placement of observers on U.S. vessels performing exploratory fishing operations in the western Pacific, and of the tagging of skipjack tuna in the Caroline and Marshall Islands of the western Pacific, enabling us to describe the stock structure on a seasonal basis.

ISLAND WAKE INVESTIGATIONS

Principal Investigator: Dr. Richard A. Barkley

Island Wake Investigations explores the hypothesis that island wakes enhance organic production by causing upwelling into the surface layers of the adjacent waters, and that this increased production and resulting enrichment accounts for the observed increase in availability of scombrids in the vicinity of islands, banks, and seamounts. Since the success of commercial fisheries is often dependent upon aggregations of fishes, the understanding of this association cannot be overlooked. Observations being analyzed were obtained during two cruises of RV Townsend Cromwell to the Line Islands in the central Pacific. Plans call for the synthesis of these results into a self-consistent model of the physical, chemical, and biological structure of the island wake systems observed during the field program. Ensuing quantitative estimates of availability of forage for larval, juvenile, and adult scombrids define the "carrying capacity" of the nearby open ocean. Such a comparison will confirm or disprove our hypothesis that the association of scombrids with islands is quantitatively related to an increase in food supply.

The methods developed during this study will also be applicable to larger scale problems of coastal boundary layer systems where upwelling predominates, and to predictive models based on energetics and food chain dynamics.

SKIPJACK TUNA OCEANOGRAPHY

Principal Investigator: Dr. Richard A. Barkley

The influence of variables in the marine environment on the populations of skipjack tuna needs to be examined. There is considerable information on the abundance, distribution, migration, availability, spawning, growth, food requirements, etc., of skipjack tuna, and even more information about the regions of the ocean which it inhabits. These two sets of knowledge, however, have not been systematically related to each other except in a few special cases or in limited geographic regions. A systematic effort is required to identify the environmental factors which most significantly influence the skipjack tuna's availability and its response as a population to fishing mortality.

This study proposes to analyze available time series data on apparent abundance, distribution, and other population parameters of skipjack tuna critically related to major oceanographic and meteorologic parameters within the habitat range of this species. In this way we hope to determine whether there are significant statistical correlations or clearcut coincidences between significant individual events (e.g., El Niño) in both the fisheries and the environment, either locally or on an ocean-wide basis.

To the extent permitted by the available data, it should be possible to isolate those factors in the environment which significantly correlate with fluctuations in skipjack tuna population parameters and to rank these in order of probable importance.

The framework of the investigation will consist of explicit conceptual models of the energetics and life history of the skipjack tuna, and corresponding conceptual models of the tropical and subtropical ocean and atmosphere, such as Bjerknes' model.

Once assembled, the available data can be related to data from various world skipjack tuna fisheries by statistical correlation, by comparison of unique events, or combinations of events and parameters, with results leading to informed, well-founded predictive models.

LIFE STUDIES: TUNA AND TUNALIKE FISHES

Principal Investigator: Dr. William H. Neill

In the tuna fisheries of the Pacific, the major biological problem is prediction of the distribution and abundance of the resource. While fishery and oceanographic data collected over the years have improved our understanding of fish distribution and environmental conditions, the mechanisms of such distribution and production are unknown and require a concerted effort to measure directly the responses of tunas to environmental factors. This program sets forth a list of achievements and aims for fiscal years 1974, 1975, and 1976 which, by 1976, will have contributed sufficient information to allow

the development of a preliminary model for distribution and production of skipjack tuna in the Pacific Ocean.

The initial modeling effort will center on distributional responses to temperature, particularly temperature preference. Measurements accomplished or planned to contribute to this include those of routine metabolism and lower lethal oxygen concentrations, spontaneous swimming activity as a function of temperature, temperature discrimination thresholds, and the measurement of rates of heat exchange. Experimental animals are both the skipjack tuna and the kawakawa, handled by an experienced research team. Prime beneficiaries of these studies will be the government units charged with management of tuna resources, and the commercial tuna fishing industry.

A major endeavor contributing toward the successful development of the distribution and production model will be the development and construction of an apparatus for measuring preferred temperatures of tunas. A tuna's direction of swimming (clockwise, counterclockwise) in a doughnut-shaped tank will control the direction of temperature change; swimming speed will control rate of temperature change. The preferred temperature of the fish can be determined from the record of tank temperature through time.

Laboratory experiments are to be designed and scheduled to maximize the rate of information growth for the modeling effort.

FY 1979 is the target date for the completion of a predictive model for the distribution and production of skipjack tuna in the Pacific Ocean. The model will simulate time/space changes in skipjack tuna numbers and biomass on the basis of the skipjack tuna's behavioral and physiological responses to the time/space distribution of oceanographic conditions.

RECREATIONAL FISHERIES

Principal Investigator: Heeny S. H. Yuen

Many of the species sought by recreational fishermen in the central and eastern Pacific such as the billfishes (Istiophoridae and Xiphiidae), the dolphin, Coryphaena hippurus, and the wahoo, Acanthocybium solandri, are also taken commercially both intentionally and incidentally. It is unlikely that the saltwater recreational anglers can seriously affect the stocks of the species they seek, but the combined pressure of commercial and sport fisheries most assuredly can.

Among the marine species most important to sport and commercial fishing interests are the billfishes. Ecologically they are similar to the tunas; unlike tunas, they are poorly known biologically. Even less is known of the dolphin and wahoo. All aspects of the biology of these species need to be studied for rational utilization of the resources with consideration given to all user groups.

Research needs include (1) the conduct of life studies research directed toward specific problems of the fisheries; (2) development and maintenance of the data base and data management techniques needed

to manage the resources; (3) conduct of life studies research in direct support of international negotiations.

Research activities to be accomplished during fiscal years 1974, 1975, and 1976 are (1) the analysis of records of Pacific longline fisheries on catch, effort, and distribution; (2) studies of spawning, age determination, and growth; (3) a study of short-term movements of billfishes off the west coast of the island of Hawaii utilizing known tracking techniques, together with (4) the collection of coordinated environmental measurements.

Information on distribution, ecology, yield levels, movements, and biology of billfishes, dolphin, and wahoo in the Indo-Pacific region will be the products of the program. This information will provide a factual base for utilization decisions in the areas of allocation of fishery quotas, resource management, and international negotiations.

The intended primary beneficiary of this program is the sport fisherman. The ultimate benefit, of course, will be the preservation of these species for full utilization by all interests.

ASSESSMENT AND DEVELOPMENT OF INSULAR FISHERY RESOURCES

Principal Investigator: For the current year the input will be provided by the Director's Office; some staff will be borrowed from on-going program personnel.

The objectives of this program are to identify and assess the principal fishery resources of the insular waters of tropical oceans, and to determine their maximum sustainable yield. Successful accomplishment of program objectives will result in optimal utilization of the insular fishery resources by the peoples of Hawaii, American Samoa, Guam, and the Trust Territory of the Pacific Islands. Most of the current protein needs of these people of direct concern to the U.S. as well as millions of other island inhabitants scattered throughout the Pacific Ocean are being met by imports of non-fishery products. The seas, especially the outer reef zones, are capable of providing much more protein. There is a need, however, to survey and assess these insular resources for optimal utilization by the island communities.

This program at present is in the "preliminary planning" stage. Approval of the proposal will lead first to the development of a "prospectus" by the staff of the Honolulu Laboratory, a document that will provide the rationale and background for the program. This document will be completed by the end of fiscal year 1974 and be followed by a detailed presentation of the full-scale program. Field work will begin with a preliminary assessment of the insular resources of the Leeward Island chain of the Hawaiian Archipelago, highly desirable because it is an area of essentially virgin conditions and also because of its proximity to Honolulu.

Since the scope of research envisioned for this study goes beyond the present capabilities of the Honolulu Laboratory, the presentation

will include contributions of interested research groups. The State of Hawaii in a recent updating of Hawaii and the Sea, 1969 reconfirmed the priority need to survey and assess the marine fishery resources of the Leeward Islands. Preliminary contacts have been made with representatives of the Hawaii State Division of Fish and Game and the University of Hawaii. Both have agreed that the study of the Leeward Island chain should and could be a joint undertaking.

The task will then be extended to include accumulation and dissemination of information covering the assessment, development, and management of insular resources of island territories of U.S. concern; and will be terminated when the principal resources of commercial value have been identified, assessed, and their fisheries developed.

Senior Staff Members of Southwest Fisheries Center Honolulu Laboratory



RICHARD S. SHOMURA

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Born 1928. M.S. (Zoology), University of Hawaii, Honolulu, 1961. Joined NMFS Honolulu Laboratory, 1950-70; Southwest Region, 1970-71; Tiburon Fisheries Laboratory, 1971-73; Honolulu Laboratory, 1973.

AFFILIATIONS: American Fisheries Society, American Institute of Biological Sciences, American Institute of Fishery Research Biologists, American Museum of Natural History, American Society of Ichthyologists and Herpetologists, Ecological Society of America, Hawaiian Academy of Science. Member, Governor's Advisory Commission on Natural Area Reserve System.

FIELD: Ecology of marine fishes.

HONORS: Special Act Award, 1955; Quality Increase, 1966; BCF Honolulu Laboratory Nominee for Hawaii Federal Executive of the Year, 1966; Superior Performance Award, 1967.

PUBLICATIONS, 1950-73: Published, 31; in press 2.



RICHARD A. BARKLEY

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AFFILIATIONS: Affiliate Graduate Faculty of the University of Hawaii, American Association for the Advancement of Science, American Chemical Society, American Geophysical Union, Hawaiian Academy of Science, Society of Sigma Xi. Member, Board of Editors, Journal of Marine Research, 1969-74; member, Board of Editors, Pacific Science, 1967-70.

FIELD: Theoretical and actual distributions of temperature, salinity, and other properties of the ocean. The characteristics of boundary layers, particularly island wake systems, and their influence on the nearby ocean.

HONORS: Superior Performance Award, 1964; BCF Honolulu Laboratory Nominee for Hawaii Federal Executive of the Year, 1968; Special Achievement Award, 1968; BCF Honolulu Laboratory Nomination for Arthur S. Fleming Award, 1968; Nomination for Fisheries Publication Award of the Wildlife Society, 1969; Meritorious Service Award of Department of the Interior, 1970.

PUBLICATIONS, 1961-73: Published, 12; in preparation, 2.



ROGER E. GREEN

**Leader, Baitfishes and Bait Fishery Development
(Fishery Biologist, Research)**

Born 1928. M.S., Stanford University, Stanford, 1958. Joined NMFS Southwest Fisheries Center, La Jolla Laboratory staff, 1962-71; Tiburon Fisheries Laboratory staff, 1971-73; Honolulu Laboratory staff, 1974.

AFFILIATIONS: San Francisco Bay and Estuarine Association, American Fisheries Society.

FIELD: Tuna fisheries and gear development.

HONORS: Incentive Award, 1966, 1973; Quality Increase, 1969.

PUBLICATIONS, 1962-73: Published, 9; in preparation, 3.



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AFFILIATIONS: Affiliate Graduate Faculty of the University of Hawaii, American Fisheries Society, American Institute of Biological Sciences, American Institute of Fishery Research Biologists, Society of Sigma Xi.

FIELD: Ecology, behavior, and physiology of fishes.

HONORS: Phi Eta Sigma, 1962; Phi Beta Kappa, 1964; National Science Foundation (NSF) Undergraduate Research Participant, 1964-65; NSF Cooperative Graduate Fellow, 1965-67; NMFS Honolulu Laboratory Nominee for Outstanding Young Federal Employee of the Year, 1973.

PUBLICATIONS, 1971-73: Published, 2; in press, 3; in preparation, 2.



TAMIO OTSU

Chief, Tuna Assessment and Development Investigations (Supv. Fishery Biologist, Research)

Born 1923. B.A. (Zoology), University of Hawaii, Honolulu, 1950. Joined NMFS Honolulu Laboratory staff, 1950.

AFFILIATIONS: American Fisheries Society, American Institute of Fishery Research Biologists, Hawaiian Academy of Science, International Oceanographic Foundation. Member, Working Party on Tuna Tagging, Food and Agriculture Organization of the United Nations; alternate member, Advisory Committee on Invertebrates and Aquatic Vertebrates, Board of Agriculture, State of Hawaii.

FIELD: Ecology of marine fishes of the Pacific Ocean.

HONORS: Bronze Star; Superior Performance Award, 1962; Outstanding Performance Award, 1969; BCF Honolulu Laboratory Nominee for Federal Manager of the Year, 1970.

PUBLICATIONS, 1950-73: Published, 34. Translations (from the Japanese), 28.



ROBERT A. SKILLMAN

Leader, Fishery Analysis Program (Fishery Biologist, Research)

Born 1941. Ph. D. (Zoology with studies in population ecology, population genetics, and biomathematics), University of California, Davis, 1969. Joined NMFS Honolulu Laboratory staff, 1969.

AFFILIATIONS: American Fisheries Society, Ecological Society of America, Hawaiian Academy of Science.

FIELD: Biomathematics, population ecology, population dynamics, ecology.

PUBLICATIONS, 1969-73: In press, 1; in preparation, 1.



PAUL J. STRUHSAKER

Leader, Purse Seine Fishery Development (Fishery Biologist, Research)

Born 1935. Ph. D. (Zoology), University of Hawaii, Honolulu, 1973. Joined NMFS Southeast Fisheries Center staff, 1959-65; Honolulu Laboratory staff, 1969.

AFFILIATIONS: American Society of Ichthyologists and Herpetologists, Hawaiian Academy of Science, Society of Systematic Zoologists. Research Associate, Bernice P. Bishop Museum.

FIELD: Fisheries development; ecology and systematics of marine fishes.

HONORS: Tri-Beta, Undergraduate Biology Honorary Society.

PUBLICATIONS, 1959-65, 1969-73: Published, 13; in press, 5; in preparation, 11.



HEENY S. H. YUEN

Leader, Recreational Fisheries (Fishery Biologist, Research)

Born 1926. M.S. (Fishery Biology), University of Hawaii, Honolulu, 1954. Joined NMFS Honolulu Laboratory staff, 1950.

AFFILIATIONS: American Association for the Advancement of Science, American Fisheries Society, American Institute of Biological Sciences, American Institute of Fishery Research Biologists, American Museum of Natural History, Hawaiian

Academy of Science, Society of Sigma Xi.

FIELD: Fishery biology.

PUBLICATIONS, 1950-73: Published, 17; in press, 1.



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AFFILIATION: Hawaiian Academy of Science.

FIELD: Oceanographic and biological data processing administration; technical editing and public information.

HONORS: Phi Beta Kappa, 1943; Superior Performance Award, 1961; BCF Honolulu Laboratory Nominee for Outstanding Woman Federal Employee of the Year, 1967.

PUBLICATION, 1950-73: Published, 1.



EDWIN K. W. LEE

Administrative Officer

Born 1926. B.S., University of California, Berkeley, 1949. Joined NMFS Honolulu Laboratory staff, 1966.

AFFILIATIONS: American Society for Public Administration, Honolulu Federal Employees Federal Credit Union, Honolulu-Pacific Federal Executive Board, Waiialae-Iki Community Association.

FIELD: Public administration.

HONORS: Superior Performance Award, 1967.