

May 1995



Director's Report to the **46th** Tuna Conference

On Tuna &
Tuna-Related Activities at the
Southwest Fisheries Science Center
for the Period May 1, 1994
to April 30, 1995

Administrative Report
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National Marine Fisheries Service
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DIRECTOR'S REPORT TO THE 46TH TUNA CONFERENCE ON TUNA AND TUNA-RELATED ACTIVITIES AT THE SOUTHWEST FISHERIES SCIENCE CENTER FOR THE PERIOD MAY 1, 1994, TO APRIL 30, 1995

This report describes research at the Southwest Fisheries Science Center (SWFSC) relating to tuna, billfish and other large pelagic fishes and protected species associated with their fisheries. The work was conducted from May 1994 through April 1995 by staff at the Center's La Jolla Laboratory in California and Honolulu Laboratory in Hawaii. It is not meant to be a comprehensive account, but rather an informal summary of research highlights and relevant papers published since last year's Tuna Conference in May.

Since May 1994, much of the Center's fishery research focused on supporting the needs of the Western Pacific Regional Fisheries Management Council (WPRFMC), international working groups and committees, and NMFS' Southwest Region and Headquarters. The research is designed to meet the information needs of fishery managers both in the long and short term, and includes stock assessment and basic biological research to improve the scientific basis for effective management; socio-economic research for analyzing management alternatives, especially for limited entry regimes; biological and technological research to eliminate or minimize interactions between fisheries and protected species; and mathematical modeling to improve our understanding of fishery interactions and fish movements, and to help predict some of the consequences of management actions.

The following are selected activity highlights:

HAWAII TUNA/MARLIN HOOKING STUDY

A research cruise was completed by the Honolulu Laboratory in July 1994 using hook timers and time-depth recorders to study the habitat utilization, hooking longevity, and gear vulnerability of blue marlin and yellowfin tuna. The objective was to quantify the effects of gear configuration and vertical temperature and oxygen profiles on longline catch-per-unit effort data

Director's Report to the 46th Tuna Conference

used for stock assessment. Results gleaned from the study suggest methods for modifying fishing gear to avoid catching some species, such as marlin, and indicate which species are most affected by hooking mortality — information relevant to potential non-retention regulations.

2ND FAO MEETING ON TUNA FISHERIES INTERACTIONS

Center staff scientists participated in the 2nd Food and Agricultural Organization (FAO) meeting of the United Nations Expert Consultation on the Interaction of Pacific Tuna Fisheries in Shimizu, Japan, January 23 - February 1, 1995. SWFSC researchers contributed six papers entitled "Time Series Analysis on Hawaii Tuna Fisheries: Do Local Catches Affect Local Abundance?" by X. He and C. Boggs; "Unresolved Problems and Questions from the First FAO Consultation on Interactions of Pacific Tuna Fisheries," by C. Boggs; "Western Pacific Yellowfin Tuna Research Group — Findings on Tuna Fisheries Interactions," by G. Sakagawa; "Types of Tuna Fisheries Interactions," by P. Kleiber; "Formulation of a Model for Studying Interactions of Yellowfin Tuna Fisheries in the Western Pacific," by P. Kleiber; and "Atlantic Yellowfin Interactions," by A. Fonteneau and P. Kleiber. At the consultation, participants conducted a comprehensive review of fishery interaction problems and made recommendations for research to address these problems. Also at the consultation, SWFSC staff, collaborating with staff from the Pelagic Fisheries Research Program, University of Hawaii, demonstrated computer software useful for analyzing and assessing fisheries interactions. These programs were used to "paint" numerical maps of seasonally and spatially variable fish movement, fish recruitment, and fishing effort by various fleets. In this way, participants at the consultation could create hypothetical interaction scenarios and quickly view the consequences of such scenarios with respect to fishery interaction.

JIMAR PROJECTS AT THE HONOLULU LABORATORY

During the year, the Southwest Fisheries Science Center made good progress on grant projects awarded under the University of Hawaii's (UH) Tuna and Billfish Pelagic Fisheries Research Program (PFRP) to principal investigators at the Honolulu Laboratory. These grants are funded by a competitive process through the NOAA-UH Joint Institute for Marine and Atmospheric Research (JIMAR).

A time series analysis was conducted by scientists of the Hawaii Catch and Effort Analysis (HICEA) project. Scientists addressed the question of whether local tuna catches ever reach levels high enough to depress local tuna catch rates. Time series of total catch in the Hawaii Exclusive Economic Zone from 1962 to 1992 showed no general pattern of negative effects on the catch-per-unit effort (CPUE) for bigeye or yellowfin tuna. The predominant significant findings were that positive relationships exist between catch and CPUE at the monthly resolution and zero lag, for both species and all fisheries. This analysis represents a preliminary product from an ongoing investigation of multiple factors affecting CPUE indices from Hawaii fisheries. Researchers of the HICEA project have also identified long-term participants in the longline, troll, and handline fisheries and grouped such fishermen according to similarities in their catch composition (by species). Indices of CPUE for fishermen from these groupings are less variable and reflect more similar temporal patterns between fishing gears than CPUE indices from each fishery as a whole.

Work began on a Hawaii Fleet Industry & Vessel Economics (HIFIVE) project during the year. A detailed economic survey of the Hawaii-based domestic longline fishery was conducted that concentrated on economic costs and motivations in fishing, as well as the ownership structure of the industry. In addition, a separate survey was conducted on the value and sale of longline permits. The cost data are now being

Director's Report to the 46th Tuna Conference

compiled with revenue data to create cost-earnings profiles for major segments of the fleet. Two primary economic models are anticipated at this stage: a production model and an institutional model. Preliminary results are expected at the time of the Tuna conference. Second year funding for the HIFIVE project was approved. This will expand the economic studies to include the costs, earnings, and motivations of the Hawaii small-scale commercial troll and handline fisheries. This component of the project will begin in mid-1995 with results in mid-1996.

Another research project with JIMAR PFRP funding began at the Honolulu Laboratory in December 1994. The project will incorporate environmental information into a fishery performance model for swordfish in the central North Pacific. Sea-surface temperature gradients are expected to be important to the dynamics of swordfish distribution and gear vulnerability, and understanding such factors will improve interpretation of swordfish catch-per-unit effort data used in evaluating management alternatives for the domestic longline fishery.

Honolulu Laboratory scientists also collaborated with UH principal investigators in two other PFRP-funded projects. In one of these projects, scientists are examining the utility of satellite altimetry and ocean color data to identify environmental features and quantify environmental variability that may impact the distribution and abundance of marine resources (fish and protected species) in the central North Pacific. The other project is concerned with modeling yellowfin tuna movements and fisheries around the Hawaiian Archipelago in order to design a tagging program sufficient to answer WPRFMC questions regarding interactions between Hawaii pelagic fisheries.

1994 HIGH-SEAS NORTH PACIFIC ALBACORE OBSERVER PROGRAM

The SWFSC has placed scientific observers on cooperative U.S. albacore troll vessels oper-

ating in the North Pacific since 1990. This effort is designed to obtain catch, effort and length frequency data and information on fishery interaction. During the 1994 season, four observers collected fishery data during a total of 252 fishing days. Over 150 metric tons (t) of albacore were landed during the four trips, and 10,701 albacore were measured and examined for evidence of encounters with other types of fishing gear.

This season marks the first time vessels with observers traveled as far west as 173° E, near the Emperor Sea Mounts. Catches there were very good and at times exceeded 1,000 fish per day. Albacore were taken in three size modes and averaged 75 cm fork length (FL). Albacore caught east of the international date line consisted of the same three size modes, but had a lower percentage of large fish. These albacore averaged 69 cm FL overall. As the fleet continued east from the mid-Pacific region, fishing continued good on 6-7 kg (14 to 16 lb) fish. Coastal vessels also reported good fishing within 100 nautical miles of the coast. Of the 10,701 albacore examined for net marks, only 1% showed any indication of damage, and 89% of those were considered old, healed wounds from previous seasons.

U.S. albacore fleet catch from 1977 to 1993 averaged 6,300 t and had not exceeded 5,000 t since 1985. The catch for the 1994 season exceeded 10,000 t for the first time in over a decade. The good catches and large fish found west of the date line encouraged fishermen — many of whom are planning to fish the Emperor Sea Mount area early in the 1995 season.

1992-93 SOUTH PACIFIC ALBACORE FISHERY

Statistics on the 1992-93 U.S. South Pacific albacore fishery were also analyzed during the year by SWFSC staff. During the 1992-93 season, the fishery was centered approximately 1,600 nm east of New Zealand, between 150° W and 160° W. It began in December 1992 and

Director's Report to the 46th Tuna Conference

ended in April 1993. Participation in the fishery decreased from 55 vessels during the 1991-92 season to 47 vessels during the 1992-93 season. The decreased participation was due, in part, to concerns about the adverse effects of the El Niño on fish availability. Total landings for the 1992-93 season decreased to 1,028 t from 3,016 t landed in the 1991-92 season. Catch rates for the 1992-93 South Pacific season similarly declined to 38 fish per day, compared with an average catch rate of 54 fish per day for the 1991-92 season. The average size of fish caught during the 1992-93 season was 5.9 kg while the average size of albacore caught during the 1991-92 season was 7.6 kg.

1993 NORTH PACIFIC ALBACORE FISHERY

During the past year, the SWFSC also assembled information on the results of the 1993 U.S. North Pacific albacore fishery. The fishery began in May 1993 north of Midway Island and ended in November 1993. Approximately 650 troll vessels participated in the fishery. Vessels fishing in the offshore areas near the international date line, and northeast of Hawaii, gradually moved east as the season progressed. The two areas of highest catch were between 40° N and 45° N, 145° W to 155° W, and off the coasts of Washington and Oregon from 42° N to 47° N, west to 128° W. Total albacore landings for the 1993 North Pacific season increased to 6,254 t from 4,572 t landed in 1992. However, catch rates declined from 54 fish per day in 1992 to 38 fish per day in 1993. The average weight of albacore caught during the 1993 North Pacific season was 6.8 kg compared to an average weight of 5.4 kg for fish caught during the 1992 North Pacific season.

ALBACORE AGE AND GROWTH

A contract study at the Honolulu Laboratory was completed on North Pacific albacore age

and growth which, combined with a previous SWFSC study, will enable improved stock assessments using age-structured models. Fish were aged using daily increments on otoliths. In a previous study conducted at the La Jolla Lab, otoliths from immature albacore caught by U.S. troll vessels had been read using light microscopy, and the daily frequency of increment formation had been validated for immature albacore. In the recent Honolulu Lab study, these otoliths were re-examined using both light microscopy and scanning electron microscopy (SEM), and the sample was extended to include, for the first time, otoliths from adult albacore caught in the Hawaii longline fishery. From this study, growth models were developed for male and female albacore encompassing the entire exploited size range.

INTERNATIONAL SWORDFISH SYMPOSIUM

An International Symposium on Pacific Swordfish was held December 11 to 14, 1994, in Ensenada, Mexico. The event was hosted by CICESE (Centro Investigación Científica y de Educación Superior de Ensenada, the graduate University in Ensenada). SWFSC scientists were involved in two ways: assisting in organizing the event as members of the event steering committee, and preparing and presenting scientific papers related to swordfish. The objective of the symposium was to provide a forum for the exchange of information on the recent developments regarding fisheries, markets, and biological research on swordfish from the Pacific Ocean, and to promote international scientific collaboration. Over 25 papers were presented at the symposium dealing with trends in fisheries, trends in markets, population dynamics and biology of swordfish. The final output of the symposium will be the publication of the papers (peer reviewed) in a single volume. Contributions by SWFSC staff included "Broadbill Swordfish in the Eastern North Pacific," by D. Holts and O. Sosa-Nishizaki; "Central Pacific Swordfish Status report," by R. Skillman; "California

Harpoon Fishery for Swordfish," by A. Coan Jr., M. Vojkovich, and D. Prescott; "The Hawaiian Longline Fishery for Swordfish," by R. Ito, R. Dollar, and K. Kawamoto; "Catch and Bycatch in the California Drift-Net Swordfish Fishery: 1990-1994," by F. Julian and D. Hólts; "Supply of Swordfish for the United States Consumer Market," by G. Sakagawa; "Accounting for Effects of Targeting on Longline CPUE for Swordfish with the Use of General Additive Models," by P. Kleiber and N. Bartoo; "On Protecting the Reproductive Value of Swordfish and Other Billfishes," by D. Au; "Sex Composition and Maturity of Swordfish Caught in the Driftnet Fishery Along the Coast of California and Oregon, 1990-1993 and Baja California, 1992-1993," by D. Ramon and R. Castro-Longoria; "Spatio-temporal Dynamics of Broadbill Swordfish Landings in the Hawaii-based North Pacific Pelagic Longline Fishery," by G. DiNardo and W. Kwok; and "Aging of North Pacific Swordfish Using Hard Parts," by J. Uchiyama, R. Skillman and J. D. Sampaga.

The symposium was open to anyone and considerable interest was shown by scientists, commercial interests, and government administrators in the international community. It was attended by more than 70 participants from six countries around the Pacific Rim.

DOLPHIN-SAFE RESEARCH

During the past year, the Dolphin-Safe Research Program at the SWFSC's La Jolla Laboratory began implementing the research program outlined by the planning workshop held in March 1994. Contracts were awarded to various researchers, primarily from the military sector, to characterize the physical environment of the eastern tropical Pacific Ocean (ETP) and the target signatures of large yellowfin tuna under three detection modes: acoustic, optical, and radar. In addition to these contracts, the Dolphin-Safe Program cooperated with the SWFSC's Coastal Division in a multi-dimen-

sional field survey testing various types of optical detection devices, including both the Light Detecting and Ranging (LIDAR) device tested last year by the Dolphin-Safe Program aboard a commercial purse-seiner's helicopter, and a passive imaging device being developed by a commercial organization under a Small Business Innovative Research grant awarded in response to the Dolphin-Safe Program's bid solicitation the previous year. Results from experiments with both the LIDAR and the passive imaging devices were promising enough that additional research is planned for the coming year.

In addition to these activities, Dolphin-Safe Program personnel completed the workshop report from last year's research planning workshop and a report summarizing Fish Aggregating Device (FAD) research at the SWC during 1989-1994. Personnel from the Inter-American Tropical Tuna Commission (IATTC) and the Dolphin-Safe Program personnel completed a cooperative project funded by the Dolphin-Safe Program in 1992, correlating environmental characteristics in the ETP with capture of medium and large yellowfin tuna not associated with dolphins. Captures were found to correlate strongly with relatively narrow ranges of surface water temperatures, a result that will help tuna fishermen to target greater quantities of dolphin-safe (unassociated) tuna in the ETP. Work continues on a second IATTC project funded by the Dolphin-Safe Program, to investigate diets of top predators in the ETP. Completion of this second project is expected in August 1995.

WEST COAST SHARK PLANNING WORKSHOP

A workshop was held at the SWFSC, August 30 and 31, 1994, to develop a cooperative scientific program to provide accurate stock assessment information for pelagic sharks fished along the west coast of the United States and Mexico. The workshop was attended by 20 participants from the Center, California Department of Fish and Game, Mexico and the Cali-

Director's Report to the 46th Tuna Conference

formia State University system. The first day was spent reviewing current research being conducted by the various groups while a planning session was held on the second day.

Sixty-two specific research activities, in 12 research categories, were identified by the participants as necessary to perform accurate stock assessment. Three key pelagic sharks (blue, shortfin mako and common thresher) were identified as requiring immediate research focus.

DEVELOPMENT OF SHARK CPUE INDEX OF ABUNDANCE

A cooperative experiment to develop and evaluate a catch-per-unit-effort (CPUE) index for pelagic sharks (shortfin mako, common thresher, and blue shark) in the waters off southern California was initiated and is being conducted by the SWFSC and the Calif. Dept. of Fish and Game (CDFG). The research is being conducted because of limited fisheries data from which catch and effort indices can be used to determine relative abundance.

Commercial landings of the three primary pelagic shark species from both the driftnet fishery and the mako shark longline fishery (now terminated) have decreased substantially from highs in the mid- to late-1980s. Changing goals and an increasing number of regulations governing these fisheries have resulted in wide swings in both catch and the distribution of fishing effort. This in turn has hampered attempts to determine abundance. The aim of this research is to provide a reliable index of shark abundance in the southern California Bight.

Three cruises were completed in 1994, with the last one being completed in October 1994. The first and third cruises were conducted aboard the CDFG research vessel *Mako*, and the second cruise was conducted aboard the NOAA vessel *David Starr Jordan*. The three cruises logged a total of 47 fishing sets in 31 days within the Southern California Bight. Fish-

ing effort totaled 6,094 hooks deployed within the research period. Catch totaled 432 blue sharks, 1 common thresher shark, 215 shortfin mako sharks, and at least 114 pelagic rays. Catches varied between 0 to 7.0 mako sharks per 100 hooks. Although final analysis is pending, the proportion of catch of mako sharks was considered consistent with previous data.

Healthy fish were tagged with CDFG spaghetti tags and released alive. Tagged and released fish totaled 1 common thresher shark, 149 shortfin mako sharks, and 399 blue sharks.

PACIFIC NORTHERN BLUEFIN TUNA

Also during the year, a SWFSC study was completed on the Pacific-wide dynamics of northern bluefin tuna. The study revealed decadal variation in the proportion of juvenile bluefin making trans-Pacific migrations from the western Pacific to the eastern Pacific. Periods of reduced migration occurred when a key prey of bluefin, the Japanese sardine, was abundant in the western Pacific. Increased bluefin migration occurred when sardines were relatively scarce. SWFSC scientists predict that if the current trend of declining abundance of Japanese sardine continues, the proportion of bluefin migrating out of the western Pacific should increase, leading to increased catches of northern bluefin off Hawaii, California, and Mexico.

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Director's Report to the 46th Tuna Conference

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