

Part I

REPORTS, REVIEW, AND PUBLICATIONS

REPORT OF THE CALCOFI COMMITTEE

Scientists from the California Department of Fish and Game (CDFG), the Southwest Fisheries Science Center of the National Marine Fisheries Service (NMFS), and the Scripps Institution of Oceanography, University of California, San Diego (UCSD), have collaborated for 46 years in the longest-running large-scale study ever undertaken in the ocean. This study was begun in order to understand the causes of changes in population, over time, of commercially important fishes in California's coastal waters. When the study began, the Pacific sardine was by far the most significant species of economic concern to the State of California. Because its population changes were thought to be caused by a diversity of atmospheric, oceanic, and biological variables, a wide array of measurements in the California Current region were begun and have been continued to this day. This long time series of data allows not only a better understanding of the flux of fish populations, but also lays the foundation for understanding interdecadal and secular change in the seas.

Two symposia were held at the 1995 California Cooperative Oceanic Fisheries Investigations (CalCOFI) Conference. The first concerned interdecadal trends in the physics, chemistry, and biology of the California Current region, and was inspired by discoveries published in *Science* magazine by UCSD scientists Dean Roemmich and John McGowan (*Science* 267:1324-1326; 1995). The symposium dealt with time-series data from the California Current and other regions of the Pacific Basin that may help us understand these trends. In preparation for the symposium, a meeting was organized by UCSD scientist Thomas Hayward to discuss the possible changes in sampling and field research strategy that are implied by Roemmich and McGowan's discoveries. The results of that meeting are published at the beginning of the symposium in this volume.

During 1994, scientists of the Instituto Nacional de la Pesca of the Government of Mexico, the NMFS, and CDFG carried out a successful daily egg production method (DEPM) survey to estimate the spawning biomass of the recovering sardine population. A special Sardine Symposium was held at the CalCOFI meeting to discuss the results. One objective of the collaborative research project was to produce a set of peer-reviewed

papers. This volume of *CalCOFI Reports* contains nine scientific papers dealing with the DEPM survey, its results, and sardine population dynamics. The survey and papers represent significant advances in the biological understanding of and survey techniques for Pacific sardine.

A hull-mounted continuous egg sampler was tested by NMFS scientists during the first two CalCOFI cruises of 1996. This remarkable device, developed by UCSD scientist David Checkley and colleagues at UCSD's Scripps Institution of Oceanography, allows continuous sampling of ichthyoplankton in the top four meters of the water column while a ship is under way at nine knots. Sardine and anchovy egg catches from the pump were strongly correlated with egg catches in nets towed vertically from 80-m depth to the water surface, and with oceanographic features. The continuous egg sampler may become a routine feature during CalCOFI cruises, and is expected to be used in DEPM surveys as well.

Substantial advances were made by National Oceanographic and Atmospheric Administration and NMFS scientists in a joint project to develop an airborne lidar (laser-based) survey instrument for assessing coastal pelagic fishes. Direct measurements of the reflectivity of fish schools were obtained, and both lidar and sonar data from hundreds of schools were collected for comparison, and published in a report. The next step, to be carried out with scientists of the CDFG during 1997, will test an airplane-mounted lidar unit for rapid surveys over large areas.

During 1995, NMFS initiated a new research program dealing with the reproductive biology and early life history of Pacific whiting. In 1995, cruises were carried out to map physical structure and circulation. Objectives were to: 1) try an adaptive sampling strategy for whiting eggs and larvae (whiting eggs and larvae are extremely patchy in the ocean and hard to survey); 2) measure larval growth rates; 3) compare the distribution of larvae to the distribution of their food; 4) describe the physical structure of larval habitat and the effects of ocean circulation on larval distribution; and 5) measure the size of patches of larvae in the ocean. During 1996, the adaptive approach for sampling whiting eggs and larvae was evaluated on the basis of data from cruises during 1995. Results indicate that considerable increases

in precision are possible, but they are complicated by some additional bias.

CDFG's wetfish port sampling program was modified in 1995 to simplify data collection. Other changes may be initiated in order to reduce sampling effort and to accommodate staff reductions.

Pacific mackerel biomass in 1995 was estimated by CDFG scientists to be 56,000 metric tons, consistent with a long-term stock decline apparent since the mid-1980s. A fishery-independent abundance index used in the mackerel assessment model was larval density in the Southern California Bight, calculated from CalCOFI's plankton database. Since the Southern California Bight is at the northern fringe of the mackerel spawning grounds, there was concern that spawning indices derived from it may be insensitive to changes in mackerel abundance at low levels of biomass. Therefore, a mackerel spawning (plankton) survey off Baja California was planned for 1996, in order to obtain data centered in traditional spawning grounds. We hypothesize that these new data will improve the precision of annual mackerel stock assessment. Plankton survey data from Mexican waters should offer additional contributions to sardine assessment work, and to anchovy investigations, and should complement the proposed Inter-American Institute for the Investigation of Global Change (the IAI includes scientists of sixteen American maritime nations).

The total sardine biomass (age 1+) increased dramatically from 1983 to 1995. The July 1, 1995, biomass was estimated to be 353,000 short tons, and CDFG scientists recommended a 1996 sardine quota of 35,000 short tons. To determine the 1996 sardine quota and build consistency for implementing the draft Coastal Pelagic Species-Fishery Management Plan (FMP), the harvest formula selected as the preferred option in the FMP was used. That formula had undergone extensive scientific and user-group review as part of the Pacific Fishery Management Council's adoption process and had the endorsement of the fishing industry, the scientific community, NMFS, and CDFG. Unfortunately, NMFS declined to implement the FMP, and pelagic fishery management remains with CDFG.

In 1995, CDFG scientists conducted a sardine spawning survey off northern and central California during August (3-25). The study was designed to detect the presence and estimate the abundance of sardine eggs in an area from Cape Mendocino to the Channel Islands, and extending from the coastline out to CalCOFI station 90 (approximately 180-200 miles from shore). A total of 480 plankton tows were made during the survey, using CalVET nets deployed from the CDFG RV *Mako*. Of 480 stations sampled with PairoVET net tows, only three contained sardine eggs. The three positive sta-

tions were all in the vicinity of Monterey Bay. The scientists concluded that the cruise was too late in the season, despite evidence in the literature that suggested a summer spawning peak (*CalCOFI Atlas* No. 31; and Watson, *CalCOFI Reports* Vol. 33).

Additional research from RV *Mako* during 1995 included a larval hake survey by NMFS scientist Paul Smith; hooking mortality studies for salmon and lingcod; abalone withering foot studies; and shark longline tagging studies.

In early 1996, NMFS scientist Geoff Moser and colleagues at the Southwest Fisheries Science Center completed work on a new CalCOFI Atlas. Together with the CalCOFI Committee and the Allen Press, they have published *CalCOFI Atlas 33*, a definitive identification guide for fish eggs and larvae in the California Current. The guide includes over 1,500 pages, describes about 500 species in 125 families, and represents six years of intensive work by Southwest Fisheries Science Center staff, with cosponsorship of the U.S. Minerals Management Service. The identification guide will serve for decades as a key reference for scientists all over the world, and is available from the Allen Press.

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Portions of *CalCOFI Reports* (Table of Contents, Committee Report, Fisheries Review, and State of the California Current), as well as extensive data archives, maps of cruises, animations, operational calendars, and general information, are available online at <http://www-mrlg.ucsd.edu/calcofi.html>.

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