Part I

REPORTS, REVIEW, AND PUBLICATIONS

REPORT OF THE CALCOFI COMMITTEE

The California Cooperative Oceanic Fisheries Investigations were begun in 1949 to answer the question, of great concern to the fishing industry and, therefore, the legislature: "Where have all the sardines gone, and what will bring them back?" The underlying question for population biologists was and is: "What are the causes of long-term, large-scale variation in population size of pelagic fish stocks?"

The labor for this research undertaking was divided between the California Department of Fish and Game, the Southwest Fisheries Science Center (NMFS/NOAA), and the Scripps Institution of Oceanography (UCSD). Each agency has contributed ships and scientific personnel to this project, so that the emerging understanding of the fishery oceanography of the California Current ecosystem is the product of dozens of principal investigators and hundreds of researchers over the decades. The knowledge gained in trying to understand what happened to one species has enlarged our understanding of the ecology and population dynamics of hundreds of species, in the waters of the Californias and throughout the world.

One of the greatest impediments to understanding change has been the lack of data on appropriate temporal and spatial scales. CalCOFI addresses that paucity of data in a number of ways. From studies of the deposition of fish scales in undisturbed marine sediments, we have begun to understand the time ranges of natural variations of pelagic fish populations, and how those variations relate to physical phenomena such as warming or cooling trends. Such studies, covering the last 2000 years, are being continued by Timothy Baumgartner of Mexico's Centro de Investigaciones Científicas y de Educación Superior de Ensenada, and Andrew Soutar of the Scripps Institution of Oceanography (SIO). Baumgartner and his student Diego Holmgren-Urba present a paper in this volume describing the population sizes of pelagic species in the Gulf of California during the past 250 years. One of their discoveries is that sardine populations seem to undergo natural fluctuations on the order of 50 to 100 years. Data from the Guaymas and Santa Barbara basins are being compared to other long time series, such as tree ring data. These comparisons may help explain the physical phenomena that cause biological responses in the sea.

Data collected by California Department of Fish and Game (CDFG), NMFS, and SIO personnel have shown that the Pacific sardine population in California coastal waters has increased during the past decade. Indeed, colleagues from the Pacific Biological Station at Nanaimo report that they captured sardines, ranging in age from 1 to 8 years, along the British Columbia coast from June through October 1992. These data may offer cause for optimism, but a new model, which used catch and age data from the United States and Mexico, and information from CalCOFI surveys and aerial spotters, suggests that the population has leveled off at between 100,000 and 220,000 metric tons (MT). This is relatively small when compared to the 2,000,000-MT biomass upon which the California sardine fishery was established near the turn of the century, and the estimated 5,000,000 MT in the sixth century A.D.

These data were presented at the fourth annual sardine management workshop, convened by the CDFG and involving state, federal, industrial, and Mexican federal biologists. As a result of these data, the U.S. harvest limit for 1993 was set at 22,000 MT, slightly lower than last year.

A team of federal and state scientists continued their work on a federal fishery management plan for coastal pelagic species (anchovy, sardine, Pacific mackerel, and jack mackerel) under the auspices of the Pacific Fishery Management Council. The team completed the fishery description, developed options for a license limitation program and an experimental offshore fishery, and began developing harvest strategies and definitions of overfishing. Relations between temperature and the recruitment and productivity of sardines continue to be studied. A newly developed high-speed trawl should make it possible for NMFS and CDFG to sample adult sardines and jack mackerel for stock assessment from their research vessels, and may make it practical to

use the daily egg-production method to estimate sardine biomass.

Scientists at NMFS completed new life-table models for anchovy, sardine, and Dover sole. These models yield new insights into the importance of different life stages in the recruitment process and of population growth rates. In addition, a new biomass estimation model was developed for the northern anchovy. This model is simpler than past models because it does not require age-structured information.

Researchers at NMFS continued studying the ecology of groundfish that inhabit the continental slope: Dover sole, sablefish, and long- and shortspine thornyheads. The work included field studies on recruitment processes; verification of the growth of Dover sole larvae and the determination that they live in the plankton for up to two years; initial sequencing of the mitochondrial DNA of these species for purposes of studying larval dispersion; and studies of Dover sole's physiological adaptations to the oxygen minimum zone.

Scientists from NMFS, CDFG, and Moss Landing Marine Laboratories have been investigating the distribution, abundance, age, and growth of pelagic juvenile rockfish relative to thermal fronts in Monterey Bay. Early results suggest that the juvenile fish are associated with areas of colder water.

Researchers in the NMFS climate project BURNM used immunoassay techniques to identify UV-induced damage in field-caught anchovy larvae. This work verifies earlier findings, based only on laboratory work, that atmospheric ozone levels are damaging the DNA of anchovy larvae.

Electronic and computer-facilitated data acquisition and processing continue to advance on the quarterly CalCOFI survey cruises of NOAA ship *David Starr Jordan* and the University of California ship *New Horizon*. A complete transition to a CTD rosette system for hydrographic sampling and measurement is anticipated by mid-1993.

As of this writing, warm-water phenomena are obvious in the California Current for a second consecutive year. For 20 of the past 21 months, the sea height at Scripps Pier in La Jolla has been higher than the 89-year mean sea height. The May 1993 sea height at La Jolla tied the May 1992 sea height for the highest May on record at La Jolla. In April, scientists on the quarterly CalCOFI survey cruise measured water temperatures on sections perpendicular to the California Current off Southern California, and found that waters even deeper than 50 m were anomalously warm by as much as 2°C. Pelagic red crabs (*Pleuroncodes*) have been abundant in the Southern California Bight in the first quarter of this year.

Investigators not normally associated with the CalCOFI program have joined CalCOFI survey cruises to test new techniques or collect data to supplement the customary data suite. Researchers often find that their data become more valuable when collected simultaneously with variables for which a very long (44-year) time series already exists, because it is possible to determine whether or not the conditions at the time of sampling are typical. These non-CalCOFI researchers can also reach desirable sampling sites without great cost in ship transit time, and have the help of a highly trained and competent CalCOFI technical team.

Izadore Barrett served as director of the Southwest Fisheries Science Center and as a member of the CalCOFI Committee from 1977 to 1992, when he retired from federal service. Iz was a strong supporter of CalCOFI's mission and helped the program remain current by periodically reevaluating its direction and accomplishments. Iz was instrumental, in 1987, in formalizing CalCOFI's longstanding relations with Mexican scientists into a cooperative fisheries research agreement with Mexico, called MEXUS-Pacifico. Iz served as cochair of MEXUS-Pacifico from its inception until his retirement. The Committee will miss his presence, his thoughtfulness, and his dry wit.

The Committee is pleased to announce the publication, in March of this year, of CalCOFI Atlas 31, *Distributional Atlas of Fish Larvae and Eggs in the California Current Region: Taxa with 1000 or More Total Larvae, 1951 through 1984*, by H. G. Moser, R. L. Charter, P. E. Smith, D. A. Ambrose, S. R. Charter, C. A. Meyer, E. M. Sandknop, and W. Watson. This atlas of the distributions of 110 fish taxa will be followed, in about a year, by another atlas describing the distributions of taxa with fewer than 1000 larvae collected between 1951 and 1984.

The CalCOFI Committee thanks the officers and crews of the fishing vessel *Good News*, the state of California vessel *Mako*, the NOAA ship *David Starr Jordan*, and the University of California ship *New Horizon* for their contribution to the success of the CalCOFI program. The Committee and the coordinator further thank all those who served as reviewers for this volume of *CalCOFI Reports*: Mark Abbott, Tom Barnes, Dudley Chelton, Tom Clark, Ed DeMartini, Bob Francis, John Govoni, Phillip Hastings, Dennis Hedgecock, Larry Jacobson, Tony Koslow, Nancy Lo, Ron Lynn, Alex MacCall, Rick Methot, Dick Parrish, Rick Prager, Paul Smith, Dan Ware, and Gary Winans; as well as the editor of *CalCOFI Reports*, Julie Olfe, and the Spanish-language editor, Jesús Pineda.