

2010 PICES POMA Award Nomination
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Nomination: California Co-operative Oceanic Fisheries Investigations (CalCOFI)

Since 1949, hydrographic and biological data of the California Current System have been collected by the California Co-operative Oceanic Fisheries Investigations (CalCOFI). CalCOFI is arguably the finest oceanographic time series in the world. The data and information products collected by this program spans 60 years and over that period CalCOFI has become a cardinal time series in oceanography, germane to documenting and understanding long-term change in the ocean and climate in the eastern North Pacific Ocean and the California Current Ecosystem. CalCOFI is synonymous with excellence in ocean monitoring.

The Marine Research Committee, the precursor of CalCOFI, was created in 1949 to investigate the ecological aspects of the collapse of the Pacific sardine (*Sardinops sagax*) off California. The present CalCOFI Committee was created in 1957. In 1949, the sardine catch fell to less than one quarter of its peak and the northern anchovy (*Engraulis mordax*) catch was minimal. The objective of CalCOFI, from its genesis, was to understand, using observations at sea, the physics, chemistry, and biology of the ecosystem of which Pacific sardine is a part. In the ensuing years, the catch of Pacific sardine continued to decline and, eventually, a moratorium on its capture was instituted. Recently, the sardine has returned and fishing begun. The northern anchovy catch was maximal when sardine was not fished and, in recent years, has declined in abundance, although not to prior levels. In general, the populations of sardine and anchovy off California continue to wax and wane, with no clear understanding of the cause. Therefore, to date, the original mission of CalCOFI remains. That is, to understand the population dynamics of the Pacific sardine in the context of its associated ecosystem.

Today the focus of CalCOFI has shifted to include the study of the marine environment off the coast of California, the management of its living resources, and monitoring the indicators of climate change. CalCOFI conducts quarterly cruises off southern and central California, collecting a suite of hydrographic and biological data on station and underway. Data collected at depths down to 500 m include: temperature, salinity, oxygen, phosphate, silicate, nitrate and nitrite, chlorophyll a (discrete [*in vitro*] and profiled [*in vivo*]), transmissometer, PAR, C14 primary productivity, phytoplankton biodiversity, zooplankton biomass and biodiversity (bongo net collection, displacement volume), and species of fish eggs and larvae (CalVET and bongo net collections). Ancillary data collected include continuous underway sea surface and meteorological measurements (SCIMS), Acoustic Doppler Current Profiler (ADCP) data (currents and zooplankton backscatter), the Continuous Underway Fish Egg Sampler (CUFES, winter and spring; species of fish eggs), trace metals, sediments, MOCNESS net sampling, bio-optics (on station, vertical profiles of optical properties, potentially useful for estimation of primary productivity), phytoplankton pigment analysis in particulate matter and plankton collected on station, Optical Plankton Counter deployed on station in a bongo net, to assess vertical and size distribution of the zooplankton, pCO₂ air-sea interface, and atmospheric measurements. Marine mammal and sea bird visual surveys are conducted during transits between stations as well as marine mammal acoustics recording.

Annual CalCOFI biological-oceanographic surveys have been conducted since 1951, accumulating a vast wealth of data on the biology, chemistry, and physics of the California Current. Ichthyoplankton has always been a key part of this program. The CalCOFI database includes information on the distributions and

abundances of larvae of approximately 800 fish taxa collected during the nearly 60-year time series (e.g., CalCOFI Atlases 31-35). The original CalCOFI study area extended from the Oregon and California border to southern Baja California Sur, Mexico during 1951-1984, then was restricted to southern California until 1997 when sampling resumed off central California during winter and/or spring cruises to better assess Pacific sardine egg and larval abundance. The CalCOFI ichthyofauna includes representatives from the coastal Oregonian, San Diegan, and Panamic zoogeographic provinces, as well as oceanic taxa of Subarctic-transitional, Central, and Eastern Tropical Pacific water mass affinity. In 2004, the CalCOFI surveys became part of the Long Term Ecological Research ecological studies network as a site to understand the pelagic ecosystem of the California Current. The CCE-LTER project expanded CalCOFI goals and, with additional seawater sample analyses and vertical net tows, broadened the scope of the 60 year timeseries. LTER also conducts seasonal process cruises in the CalCOFI grid and operate autonomous gliders along lines 80 and 90.

The initial partners, in 1949, included the U.S. Bureau of Commercial Fisheries (now NOAA), the California Department of Fish and Game (CDF&G), Scripps Institution of Oceanography (SIO), and the California Academy of Science. The latter was dropped in 1957. The current CalCOFI Committee has one member from each of NOAA, CDF&G, and SIO. The Committee advises its respective organizations on participation in and coordinates the quarterly CalCOFI cruises, annual meeting, and publications, including CalCOFI Reports, Data Reports, and Atlases. CalCOFI hosts an annual conference, publishes a scientific journal and quarterly hydrographic data reports for each cruise while maintaining a publicly accessible data server. CalCOFI hydrographic and plankton data are distributed to the community for use without restriction. Unless otherwise noted, these data can be considered to be final data which have been evaluated using CalCOFI data quality control procedures. Methods for data collection and processing are summarized in cruise data reports introduction. Annual CalCOFI Reports and bi-annual data reports are available at the UCSD/SIO libraries or contact the data manager for publication availability. The CalCOFI data (1949 to present) are permanently archived at the U.S. National Oceanographic Data Center.

CalCOFI is unique in comparison with other organizations responsible for oceanographic time series. This is due, in part, to its combination of basic and applied disciplines, including oceanographers, fisheries scientists, managers, and enforcers.

The value of CalCOFI in the context of long-term change is apparent in the global mean surface air temperature (GMSAT) measured from 1850 to present and predicted by the IPCC, (Intergovernmental Panel on Climate Change) to 2050. Between 1850 and 1950, GMSAT increased ca. 0.2 °C. In the first 50 years of CalCOFI (1950-2000), GMSAT increased ca. 0.6 °C. In the next 50 years, GMSAT is predicted to increase a further 1.5 °C. Uncertainty exists for these predictions and the concurrent ocean changes. With its core serving as a baseline, CalCOFI measurements over the next 50 years will be invaluable in documenting and understanding long-term change.

The accomplishments of CalCOFI are numerous. From the scientific perspective, these are perhaps best manifest in the prodigious peer-reviewed papers by PhD students, postgraduate researchers, and research scientists having participated in or used CalCOFI data. There is a rich history of graduate student participation in CalCOFI which speaks to the contributions made in the areas of training and capacity building.