

Part I

REPORTS, REVIEWS, AND PUBLICATIONS

REPORT OF THE CALCOFI COMMITTEE 2012

CDFG HIGHLIGHTS

The California Department of Fish and Game changed its name to California Department of Fish and Wildlife (CDFW) at the end of 2012. The Marine Region said good-bye and thank you to our former regional manager, Marija Vojkovich, after years of dedication and service and welcomed our interim region manager, Paul Hamdorf. In 2013, the Marine Region will have a new regional manager. Dale Sweetnam jumped ship from CDFW to NOAA Fisheries and so we wish him well in his new position and thank him for his hard work as editor of the status of the fishery reports for CalCOFI. Dianna Porzio of CDFW has taken over this role as well as assisting with hosting the CalCOFI symposium in 2012 and working with contracts. We said farewell to Emily Jones, our DFG scientific aid who helped sort invertebrate larvae in the CalCOFI samples, bolstering what we know about the distribution and density of lobster phyllosoma larvae and Dungeness crab megalopae; both species managed by the state. The CalCOFI lobster phyllosoma data in combination with Dr. Johnson's historic phyllosoma data was used by Drs Koslow, Rogers-Bennett, and Neilson in a paper quantifying the influence of oceanographic conditions on lobster recruitment, which was published in CalCOFI Reports.

CalCOFI 2012 Symposium: Harmful Algal Blooms

The CDFW hosted the 2012 CalCOFI conference at Asilomar in California. The symposium of the conference focused on Harmful Algal Blooms (HABs) in the California Current. HABs can have serious impacts on not only on human health but the health of marine populations. There is also some evidence that HABs may be expanding in geographic scope as well as severity. This symposium explored the state of the art in HAB work in the California Current Ecosystem as well as explored ways to incorporate collecting data useful for the study of HABs into the CalCOFI program.

Marine Regulatory Changes

In 2012, the California Fish and Game Commission undertook rule-making actions that addressed marine

and anadromous species. The Commission adopted changes to commercial or sportfishing regulations that include ocean and inland salmon, greenling, groundfish, saltwater basses, herring, and abalone.

Sportfishing regulation changes: <http://www.fgc.ca.gov/regulations/2012/index.aspx#sf>.

Marine Life Protection Act

California completed planning for a revised network of marine protected areas (MPAs) in 2012 that now stretches along the entire coast including offshore islands. California's system of MPAs is the largest scientifically based network in the contiguous U.S., comprised of 124 protected areas covering approximately 852 square miles or 16 percent of coastal state waters (approximately nine percent of which is in no-take MPAs). The Department assigned staff to support outreach for California's network of MPAs and to build awareness of boundaries and regulations, facilitate compliance, support enforcement actions, and understanding of the significance and purpose of MPAs. The Department, in partnership with the California MPA Monitoring Enterprise (a program of the Ocean Science Trust), began long-term planning for the five-year review of baseline monitoring results from the central coast MPAs. In 2012, MPA baseline monitoring data collection for the north-central coast MPAs was completed and data analyses started. The south coast MPA baseline monitoring program completed its first year of data collection. In the north, baseline monitoring planning has begun for the north coast MPAs.

Ocean Protection Council (OPC)

The OPC provided a grant (\$990,000) to support the creation of a spiny lobster fishery management plan for California. Funds have been used to contract for an independent peer review of the lobster stock assessment, a facilitation group to run the advisory committee meetings, an economic report on the commercial and recreational lobster fisheries, the creation of a management strategy model for the California lobster, creation of an electronic lobster log for commercial fishermen, and outreach materials for recreational lobster fishermen. A draft lobster FMP will be ready for scientific and

public review early next year. OPC work continued on the California Sustainable Seafood Initiative, which is a voluntary seafood certification and marketing program. OPC is working in conjunction with the Ocean Science Trust to conduct rapid fisheries assessments to identify which fisheries may be eligible for the program.

Coastal Pelagic Species

CDFW conducted a collaborative Pacific sardine survey with the California Wetfish Producers Association as a fishery-independent index of abundance for the Southern California Bight. The Pacific Fisheries Management Council reduced the harvest guideline for Pacific sardine, which was set at just under 109,450 MT based on a biomass estimate of 988,385. For the third year in a row, the commercial market squid fishery was projected to reach the seasonal catch limit of 107,049.6 MT before the season's end. During the 2012–13 season the fishery was closed early on November 21, and catch totaled 99,573 MT. The past three years have seen favorable oceanographic conditions with very high squid landings well above the 20-year average (70,500 MT) and the fishery reached its harvest guideline before the end of the season each year.

Aquaculture and Bay Management

The project completed its annual assessment of the San Francisco Bay commercial Pacific herring fishery for the 2012–13 season. The spawning biomass estimate for the 2012–13 season is 79,500 MT, well above the historical average (1979–80 season to the present) of 52,000 MT. This is the fourth consecutive year of increased biomass since the historic low during the 2008–09 season of 4,800 MT. Since the fishery reopened during the 2010–11 season, harvest targets for Pacific herring have been set at five percent or below as a conservation safeguard to allow continued recovery. This allows 95 percent of the spawning stock to be available as forage for a variety of species dependent on Pacific herring.

Invertebrate Fisheries Management

The CDFW's Marine Region Invertebrate Project abalone staff presented papers on southern California abalone recovery. The papers describe translocation studies of pink (*Haliotis corrugata*) and green (*H. fulgens*) abalones for recovery and assessing recovery of pink abalone by incorporating aggregation into a matrix model, and are now published in the *Journal of Shellfish Research* (Vol. 32). The Invertebrate Project's northern California abalone staff initiated the regulation change process for the northern California recreational abalone fishery. Proposed changes were intended to maintain a healthy fishery, based on declines in survey densities at Abalone Recovery and Management Plan (ARMP) key fishery

index sites. The Department initiated the development of a spiny lobster fishery management plan. A Lobster advisory committee was appointed representing commercial and recreational fishermen, marine scientists, non-consumptive stakeholders, environmental organizations, and a federal fisheries agency. Implementing regulations for the new commercial Dungeness crab trap limit program were developed with the cooperation of the Dungeness crab task force in 2012. The new regulations will require fishermen to affix tags to their specific tier allotment of crab trap buoys starting with the 2013 crab season.

Ocean Salmon

In 2012, California ocean salmon fisheries were less constrained by conservation objectives used to protect stocks than in recent years. Commercial salmon fisheries were open for a season total of 375 days, the most fishing opportunity since 2004. Total commercial landings exceeded 214,800 Chinook salmon (1,150 MT), caught in 14,400 days fished. Average nominal ex-vessel price was \$11.40/kg (\$5.17/lb), with an ex-vessel value of over \$13 million. Recreational fishing opportunity also increased, for a season total of 754 days. In 2012, nearly 122,900 Chinook were landed in 146,500 angler-days.

Groundfish

The Groundfish Project prepared documents for modifications to federal regulations for the 2013–14 recreational fishery. Modifications included an increased sub-bag limit and removal of the minimum size limit for bocaccio rockfish, retention of shelf rockfish while fishing inside the Cowcod Conservation Areas during the open season for groundfish in depths shallower than 20 fathoms, and extending the Mendocino Groundfish Management Area season length through Labor Day. A 50-fathom depth restriction was also implemented in the Southern Groundfish Management Area. In addition, documents were prepared to inform fishery managers on the increased catch of Pacific halibut in the recreational fishery, and the abundance and distribution of Pacific halibut in California waters.

California Recreational Fisheries Survey

The California Recreational Fisheries Survey (CRFS) and the Recreational Fisheries Data Project continued to successfully transition California's saltwater sport angler intercept survey to a Department-staffed program. In 2012, the projects jointly developed web-based data entry and estimation programs for the commercial passenger fishing vessel (CPFV), and primary private/rental boat (PR1) fishing modes. Staff entered CPFV and PR1 data, and produced estimates of total catch and effort. Following the 2011 review of CRFS sampling methods

and estimation procedures by NOAA Fisheries' Marine Recreational Information Program consultants, project staff worked towards improving the survey designs for the recreational fisheries at man-made structures and secondary private/rental boat sites.

Fisheries Independent Assessment Project

Amendments to the management of saltwater bass (barred sand bass, kelp bass, and spotted sand bass) fisheries were presented to the Fish and Game Commission. A combination of increased exploitation rates and cooler oceanographic conditions in the early 2000s led to depressed populations of saltwater bass in southern California. These declines, coupled with constituent input, lead the Commission to adopt an increase in the minimum size limit and a reduction in the bag limit in November 2012. Staff will continue to monitor fishery-dependent and independent data for the basses to assess the effectiveness of the new regulations. In addition, a collaboration between the Santa Monica Bay Restoration Commission and CDFW resulted in the successful use of an ultrasound machine to non-lethally identify the sex of California halibut, potentially identifying this as a monitoring tool for future studies.

Northern and Central California Finfish Research and Management Project

Ongoing project work included with sampling, research, and monitoring tasks such as: ageing of thin sections of halibut otoliths and whole surfperch otoliths; sampling and monitoring commercial halibut, hagfish, and white seabass fisheries; sampling and monitoring recreational halibut fisheries and fishing tournaments; conducting life-history studies of surfperch using fishery-independent hook-and-line sampling; and estimating recreational beach fishery effort through instantaneous angler counts in Monterey County. The project supervisor represents the Department at the Monterey Bay National Marine Sanctuary Advisory Council.

New project work included the following: determination of maturity and fecundity for central coast California halibut, obtaining sublegal-sized halibut using fishery-independent beach seines for maturity studies, estimating age of neonatal redbait surfperch otoliths, reviewing sportfishing regulatory proposals from the public submitted to the Fish and Game Commission, completing a guide for CRFS samplers to determine sex of surfperch, applying a Spawning Potential Ratio model to surfperch populations, completing draft chapters for a future halibut Fishery Management Plan, representing the Department on the Strategic Wildlife Action Plan revision and update, investigating incidental take of great white sharks in commercial gill net fisheries, and representing the Marine Region on a Depart-

ment sturgeon task force. Staff completed halibut and surfperch status of fishery reports, a CalCOFI halibut fishery review, and an annual Sport Fish Restoration Act Progress Report.

NOAA HIGHLIGHTS

CalCOFI Ichthyoplankton Update

During the past year the SWFSC Ichthyoplankton Ecology group faced moving the laboratory and sample archive into the new SWFSC building after having occupied the same laboratory space in the old building for 49 years. This grand effort was simultaneously managed with processing current CalCOFI, spring sardine, and SaKe survey plankton samples and spending considerable time at sea. In addition, the group managed to continue their project to retroactively update identifications of fish eggs and larvae to current standards. Identification of Pacific whiting (hake) and jack and Pacific mackerel eggs collected in the CalCOFI oblique net samples are now complete from 1981 to the present.

Much of the laboratory effort focused on the ethanol-preserved bongo net samples (which can be used for genetic analyses) collected during Cowcod Conservation Area and CalCOFI surveys. Staff continued their collaboration with Ron Burton and his students at SIO on the development of a high-throughput system for molecular identification of ichthyoplankton; with the ultimate aim to provide accurate, near real-time identifications of fish eggs, many of which can be difficult or impossible to identify to species using traditional morphological characters. This method should ultimately enable scientists to accurately identify eggs of several taxa of sport or commercial fishery value such as Pacific hake, Pacific mackerel, white seabass, and California barracuda; and will be applied to ethanol-preserved CalCOFI samples to develop a time series for eggs from 1997 to the present. During the past year staff finished sorting eggs and larvae from ethanol-preserved samples from winter cruises in 2004 and 2011, adding these years to the list of completed ethanol-preserved samples from 1998, 1999, 2002–05, and 2011. The ichthyoplankton lab continues to seek funds to hire a technician to sort all of the ethanol-preserved samples, and have submitted a proposal to NOAA's Fisheries and the Environment (FATE) program requesting one year of funding for a full-time technician that will focus exclusively on the ethanol samples. The lab has also gained a master's student from University of San Diego who will be working with rockfish larvae from the ethanol-preserved samples for his thesis.

To enhance understanding of how ichthyoplankton respond to environmental variability throughout the

California Current system, staff analyzed CalCOFI data together with ichthyoplankton and environmental data collected in Oregon between 1997 and 2011 by Oregon State University and the NWFSC. In collaboration with Toby Auth and Ric Brodeur from Oregon, staff prepared a manuscript currently under revision for the journal *Marine Ecology Progress Series*. This manuscript shows fluctuations in larval abundances of taxa common to both regions were not coherent between regions during that time, and that these fluctuations were well explained by environmental variability (measured as water depth, temperature, and salinity) off Oregon but not off southern California. A similar study using CalCOFI data together with IMECOCAL data is underway, in collaboration with Martín Hernández-Rivas and co-workers from CICIMAR. These studies should help inform NOAA's California Current Integrated Ecosystem Assessment program.

Staff also prepared a manuscript in collaboration with Sam McClatchie that evaluates how ichthyoplankton distributions have changed within the CalCOFI sampling frame over the past three decades. This work shows that the center of sardine spawning has shifted further offshore in recent years; the results of which have broad implications for the understanding of how the fish assemblage in the California Current system respond to climate change.

The highlight of the year was the group's move into the new ichthyoplankton laboratory and sample archive room, both great improvements over the old facility. The new lab features 12 microscope workstations, each with an adjustable snorkel and data portals, additional countertop work spaces with data portals, three computer workstations, a zooscan station, and separate hoods and sinks on opposite sides of the lab for processing ethanol- and formalin-preserved samples. The Ahlstrom library is housed along the west wall of the laboratory, and the reference collection is housed on high density shelving in an adjacent room. The sample archive is in a large, H3-rated controlled environment room equipped with high density shelving, a halon fire suppression system, and explosion-proof lighting.

Yet another benefit of the new SWFSC building is the state-of-the-art Pacific Room, which will act as the site for the 2013 CalCOFI conference from December 9–11 and mark the first CalCOFI conference to be held on SWFSC grounds. Unlike conference rooms of the previous SWFSC building, the Pacific Room boasts a 200 person capacity, allowing for larger conferences previously relocated to other NOAA sites. This provides an exceptional benefit for multinational interactions during larger functions, such as CalCOFI, as SWFSC's Mexican counterparts have greater access to San Diego than sites to the north.

Spring Coastal Pelagic Species Cruise

The spring Coastal Pelagic Species (CPS) cruise relies on a 25 ship charter plus a 25–30 day commitment of NOAA vessel time, of which the first 14–17 days are typically the spring CalCOFI cruise. Observations from CalCOFI including acoustics and CUFES often guide adaptive sampling for the daily egg production method (DEPM) and the acoustic trawl method (ATM). The spring CPS cruise carries out of suite of CalCOFI measurements along with acoustics, trawling, and adaptive sampling of eggs and larvae to provide total and spawning biomass estimates for CPS stock assessments. This year's spring CPS survey began badly in the second week of April 2013. Acoustic calibration on *Ocean Starr* took place dockside on April 9 as planned; however, departure was delayed as a result of mechanical problems, including the winch metering and failure of the general/fire/man overboard/abandon ship alarm systems. The net effect of these problems was a loss of three and a half days of survey time. The lost time was shared with the following rockfish cruise, meaning that both cruises lost a day and a half of survey time. Weather was windy and rough both in the Southern California Bight and off the central coast during much of the survey. Numbers of sardine eggs were low but with a concentration of eggs on the central coast. *Shimada* made better progress than the *Ocean Starr*, despite an erratic cruise track brought on by poor weather. *Ocean Starr* leg 1 ended on Friday April 19 in Port San Luis, much to the relief of some of the staff aboard.

The near real-time sardine habitat model and overlaid CPS density and eggs from April 13 shows that there were considerable areas of favorable potential sardine spawning habit where no sardine eggs were found this year. Trawl catches yielded low numbers of sardine (which are needed for interpretation of both the DEPM and acoustic biomass estimates). *Shimada* leg 2 of the spring CPS cruise ended on April 30 in San Francisco, and leg 2 of *Ocean Starr* ended on May 4 in San Diego. Staff from *Shimada* ended the cruise with a successful outreach event arranged with the Exploratorium in San Francisco.

The spring ATM portion of the survey was conducted from NOAA FSV *Bell M. Shimada* and chartered FV *Ocean Starr*. The survey totalled ~2,000 nmi of track-line spanning over ~50,000 nmi² and the distribution of the northern stock of sardine predicted by a model of potential sardine habitat. Small catches of large sardine spanned the latitudinal extent of the survey, but they were mostly far offshore, north of Point Conception, whereas Pacific and jack mackerel were predominantly found to the south. The acoustic backscatter attributed to CPS was generally very low. The largest CPS backscatter was located towards the western ends of a couple of transects.

Summer Sardine and Hake Acoustic-Trawl Surveys (SaKe)

During the summer, the SWFSC conducted an acoustic trawl method based survey for small pelagic fish (henceforth referred to as CPS); e.g., Pacific sardine (*Sardinops sagax*), jack (*Trachurus symmetricus*) and Pacific mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*). For this summer survey sampling is combined with survey personnel and survey objectives of the Northwest Fisheries Science Center to develop an acoustic-trawl based measure of hake abundance. This year the combined sardine-hake survey (SaKe) surveyed the near-shore extending to just beyond the shelf-slope break spanning from San Diego to northern Vancouver Island (VI), Canada. The ATM uses ship-based, multiple-frequency echosounders to map the distributions of CPS; and trawl catches to apportion the echo energy to species and convert those values to animal densities. During daylight, from sunrise to sunset, multifrequency echosounders (38, 70, 120, and 200 kHz) were used to sample acoustic backscatter from CPS and hake. During nighttime, surface trawls were used to identify the proportions of CPS and their lengths. The data were combined to estimate density-weighted fish-length distributions. This procedure resulted in maps of fish densities and estimates of their biomasses, by species and lengths (presented elsewhere).

The summer ATM survey was conducted solely from *Shimada*, over approximately 80 days during June–August. The survey totaled ~4,000 nmi of trackline spanning over ~45,000 nmi² and the expected distribution of the northern stock of sardine. North of Point Conception, transects were spaced 10 nmi, generally, extending from 40 to 1500 m depths, to at least 35 nmi offshore. During the summer survey, the habitat in the Southern California Bight was unsuitable for the northern stock of sardine. Some large sardine were caught far offshore between San Francisco and Humboldt, California, and nearshore between central Oregon (OR) and central Washington (WA). Anchovy were the only small pelagic fish caught south of Monterey Bay. Larval anchovy were caught offshore, just south of the Columbia River. Only a few mackerels were caught throughout the survey. Herring and smelt (family Osmeridae) were relatively abundant, however, with catches spanning from southern OR to the northern end of Vancouver Island. CPS backscatter was highest in the areas where sardine were caught (near San Francisco and between central OR and central WA), and nearshore off Vancouver Island, where herring were caught. This was the second year that a SaKe cruise has been conducted and refinements continue to be made.

SIO HIGHLIGHTS

Four quarterly CalCOFI cruises occurred on the RV *New Horizon* (NH), RV *Bell M. Shimada* (SH), and RV *Ocean Starr* (OS) in 2012: 1202NH (January 27–February 13), 1203SH (March 27–April 7), 1207OS (July 9–26), and 1210NH (October 19–November 5). Ancillary programs included measurement of carbon dioxide and related variables, in collaboration with the Pacific Marine Environmental Lab (NOAA) and Andrew Dickson (SIO); visual and acoustic observations of marine mammals, led by John Hildebrand (SIO); and seabird observations, led by Bill Sydeman (Farallon Institute for Advanced Ecosystem Research). CalCOFI continued to be augmented significantly by the California Current Ecosystem Long-Term Ecological Research (CCE-LLTER) program led by Mark Ohman (SIO) and funded by NSF, including routine sampling and observations of lower trophic levels and, led by Tony Koslow (SIO), of micronekton. Most data from these cruises have been rapidly made available on the Scripps CalCOFI, CCE-LLTER, NOAA SWFSC, and CDF&G Web sites. More than 35 publications by SIO and other university scientists in 2012 were based on CalCOFI results. Selected papers are mentioned below.

Climate control of wind-forced upwelling in the southern California Current system was investigated by statistical analysis of observations (Macias et al. 2012a,b). The North Pacific Gyre Oscillation was shown to be an important modulator of upwelling in this region (Chenillat et al. 2012). CalCOFI data were used in a study of the effects of internal waves on the surf zone (Wong et al. 2012).

Nutrient and oxygen dynamics in the North Pacific, and their relation to climate and upwelling, were the subject of several papers (Deutsch and Weber 2012; Send and Nam 2012; and Pierce et al. 2012). Long-term variability of the species composition of the phytoplankton of the CalCOFI region was characterized by Venrick 2012. Bargu et al. 2012 suggest that domoic acid in toxic *Pseudo-nitzschia* may have caused a seabird frenzy that “eventually led [Alfred] Hitchcock to make his film [The Birds].” Two papers used satellite images of sea surface temperature and color (due to chlorophyll *a*) to document patterns of phytoplankton abundance in time and space (Kahru et al. 2012a,b).

Zooplankton collections were analyzed for nitrogen isotopes (Ohman et al. 2012) and to compute mortality rates (Ohman 2012). Time series of the abundance of phyllosoma larvae of spiny lobster (*Panulirus interruptus*) were studied and will be useful in its management (Koslow et al. 2012). Molecular methods were developed to identify eggs of fish in CalCOFI collections (Gleason and Burton 2012). CalCOFI data were used

to study the spawning habitat of bocaccio (*Sebastes paucispinis*) within and around a marine reserve (Hitchman et al. 2012). On a larger scale, the spatial structure of ichthyoplankton assemblages was described for the central and southern California Current regions (Suntsov et al. 2012). Seabird hotspots (Suryan et al. 2012) and seabird relation to climate change (Sydeman et al. 2012) used CalCOFI observations.

A process study of fronts in the southern California Current system by the CCE-LTER program (Landry et al. 2012) made use of CalCOFI data. One paper focused on the use of inverse models of plankton trophic flows (Stukel et al. 2012). A study of the use of nonlinear time series analysis to infer about causation in complex systems (Sugihara et al. 2012) included CalCOFI results, with implications for understanding the dynamics of marine ecosystems and contributing to fisheries management.

Finally, Scripps CalCOFI leadership changed in 2013. Tony Koslow stepped down as Director of Scripps CalCOFI and was replaced by Dave Checkley on 1 July 2013. Tony directed Scripps CalCOFI from 2007 to 2013. During that time, despite fiscal challenges, CalCOFI thrived and was enhanced due to the efforts of Tony and colleagues at SIO, NOAA, CDF&G, and the CCE LTER program. Tony was instrumental in developing a scientific acoustic-trawl program ancillary to CalCOFI and the analysis of market squid paralarvae and spiny lobster phyllosoma in CalCOFI collections. Collectively, those efforts have valuably enhanced our understanding of midwater micronekton, market squid, and spiny lobster in the CalCOFI region, with implications for management. They also contributed to PhD research at Scripps. In 2012, the North Pacific Marine Science Organization, PICES, presented its Ocean Monitoring Service (POMA) Award to CalCOFI. Tony and Steven Bograd (PMEL, NOAA) accepted the POMA award on behalf of CalCOFI from PICES at its annual meeting in Hiroshima, Japan. Scripps expresses its appreciation to Tony for his leadership of Scripps CalCOFI.

The CalCOFI Committee

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