

Part I

## REPORTS, REVIEW, AND PUBLICATIONS

### REPORT OF THE CALCOFI COMMITTEE

#### NOAA HIGHLIGHTS

##### CalCOFI Cruises

The CalCOFI program completed its fifty-eighth year with four successful quarterly cruises. All four cruises were manned by personnel from both the NOAA Fisheries Southwest Fisheries Science Center (SWFSC) and Scripps Institution of Oceanography (SIO). The fall 2007 cruise was conducted on the SIO RV *New Horizon* and covered the southern lines of the CalCOFI pattern. The winter and spring 2007 cruises were conducted on the NOAA RV *David Starr Jordan*. The *Jordan* covered lines 93 to line 60 just north of San Francisco. The summer 2007 cruise was on the SIO RV *New Horizon*, and covered the standard CalCOFI pattern.

Standard CalCOFI protocols were followed during the four quarterly cruises. Over the year a total of 288 bongo tows, 266 manta tows, 212 paironet tows, and 301 CTD casts were conducted. In addition to the usual CTD casts and net tows, measurements were collected on a variety of other parameters including, but not limited to, primary productivity, salinity, dissolved oxygen, acoustics, and weather. Both seabird and marine mammal observers also collected data on each cruise.

##### California Current Ecosystem Surveys

In 2008 the Fisheries Resources Division of the Southwest Fisheries Science Center plans on conducting two coast-wide California Current Ecosystem (CCE) Surveys. The first is scheduled to run 24 March–1 May 2008 using the NOAA RVs *David Starr Jordan* and *Miller Freeman*. The goals of the survey are to: (1) conduct continuous underway sampling of surface waters; (2) record current profiles throughout the duration of the cruise with the Acoustic Doppler Current Profiler; (3) continue an ongoing assessment of pelagic fish stocks between La Jolla and San Francisco, California; (4) collect information on sardine reproductive parameters, spatial distribution of size, age, and abundance of sardine, and acoustics ground truth information using trawling; (5) monitor environmental conditions within the CCE survey area; (6) make continuous observations of sea birds and marine mammals when possible; and (7) record continuous acoustic targets obtained with a multi-frequency Simrad EK-60 scientific sounder.

The *David Starr Jordan* will conduct operations in the Southern California Bight in San Diego and stations from Point Conception north to San Francisco, California. The *Miller Freeman* will synoptically conduct similar operations over the northern section of the CCE, in Port Townsend, Washington, and south to San Francisco. An additional California Current Ecosystem survey will be conducted in July 2008.

##### CalCOFI Ichthyoplankton Update

The SWFSC Ichthyoplankton Ecology group made progress on a multi-year project to update larval fish identifications to current standards from 1951 to the present, which will ultimately provide taxonomic consistency throughout the CalCOFI ichthyoplankton time series. The group updated samples collected during the first nine months of 1969 and from 1972 to the present. In addition, the group has begun re-identifying fish eggs collected in the CalCOFI bongo net samples, and is adding the count data for eggs of Pacific whiting (hake, *Merluccius productus*) and jack (*Trachurus symmetricus*) and Pacific mackerels (*Scomber australasicus*) to the database. Re-identifications have been completed for samples collected from 1992 to the present and the group will continue to work back through the time series.

During 2007 larval fish abundance continued to decline from the 2005 peak, to about 59% of the 2006 average abundance, and 30% of the 2005 average abundance. Northern anchovy (*Engraulis mordax*) larvae, the most abundant species collected in 2005 and 2006, declined precipitously in 2007 to about 16% of its 2006 abundance and 2% of its 2005 level. Pacific sardine (*Sardinops sagax*), on the other hand, increased in 2007 to about 15% above its 2006 abundance, although still well below its most recent peak (in 2005) of larval abundance. Ichthyoplankton data suggested that peak Pacific sardine spawning began to shift southward from central California in 2005, and this trend appears to have continued through 2007.

##### Review of Rockfish

SWFSC houses a collection of over 20,000 groundfish tissue samples, which includes virtually all extant rockfish species. These samples have enabled the completion of a comprehensive and robust phylogenetic hy-

pothesis for the genus *Sebastes* (Hyde and Vetter 2007). With at least 65 rockfish species found along the west coast of North America, this genus has presented numerous long-standing problems for identification and management. This work allowed: (1) major revisions to previous subgeneric classifications based on morphology; (2) assignment of approximate timing of speciation events; (3) evaluation of patterns of species evolution; and (4) the discovery of two “cryptic” species (Hyde and Vetter 2007; Hyde et al. 2008).

By using a combination of seven mitochondrial and two nuclear genes, the authors were able to develop a phylogeny of virtually all extant rockfish species including Asian, north Atlantic, and southern hemisphere forms. The results provide for the first time an unequivocal method of identifying ichthyoplankton and other field samples and forensic identification of market samples. An additional result is that rockfishes can now be assigned to meaningful sub-generic lineages that allow managers to group species under management according to shared life-history characteristics such as time of spawning and essential fish habitat requirements.

### **PaCOOS—Pacific Coast Ocean Observing System**

In 2007 the focus for PaCOOS was to improve data access and interoperability and to develop new products for supporting the California Current (CC) ecological observing system. Data management activities centered on access of NOAA’s West Coast biological and physical data in partnership with academics. With funds from the NOAA IOOS Program, three data portals were updated with QA/QC’d data and were made accessible from the PaCOOS website ([www.pacoos.org](http://www.pacoos.org)) as well as through the following home servers:

1. NOAA Habitat data: <http://tomcat.coas.oregonstate.edu/>;
2. NOAA Pelagic data: <http://oceanwatch.pfeg.noaa.gov/PaCOOS/>; and
3. National Marine Sanctuary physical data: <http://portal.ncddc.noaa.gov/wco/>.

Through leveraging of PaCOOS funds with the CalCOFI and the California Current Ecosystem Long-Term Ecological Research (CCE LTER) Programs SIO, the historical CalCOFI physical and biological data are being made web accessible. The physical data are already available and the biological data will be available in 2008–09 (<http://oceaninformatics.ucsd.edu/datazoo/>).

Data access and data interoperability underlie the primary products of PaCOOS, ecological forecasts and assessments in the California Current. The recent closure of the California salmon fishery and the discussions at the Pacific Fisheries Management Council (PFMC) of how ocean conditions influence salmon demonstrate

a growing need for ocean observing data and ecological forecasts.

Collaboration and partnerships within NOAA and between NOAA and academic scientists are the primary means of developing the next generation of ecosystem forecasts and assessments. Within NOAA, the Northwest Fisheries Science Center and SWFSC and the National Weather Service Climate Prediction Center are developing a pilot forecast to use wind field projections from existing atmospheric models in order to predict the timing and duration of the spring transition along the coasts of Washington, Oregon, and northern California. More information can be found at: <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/upwelling/mainupwelling.html>. The SWFSC and SIO are developing a second ecological forecast with funds from the NOAA IOOS Program. This project utilizes existing SIO climate model outputs (temperature, salinity with depth, sea-surface height, and currents) to project West Coast Pacific sardine larvae distribution and abundance to improve NOAA Fisheries’ annual coastal pelagic sardine stock assessment required by the PFMC.

The 2008 plans for PaCOOS include continued coordination with the Regional Associations on joint proposal development with an emphasis on data management, ecological forecasting and assessment, and increasing ocean observing data when opportunities arise.

### **CalCOFI Conference**

The SWFSC Fisheries Resources Division hosted the CalCOFI Conference 26–28 November 2007 at Hubbs-SeaWorld Research Institute, San Diego, California. The symposium of the conference was “Jumbo squid invasions in the Eastern Pacific Ocean.” The conference was well-attended with 130 participants from around the world.

As there were overlapping participants, the 8th Tri-National Sardine Forum was held immediately following the CalCOFI Conference, 29–30 November, also at Hubbs-SeaWorld Research Institute. The Forum provided an opportunity to exchange information regarding Pacific sardine issues among the fishing industry and scientists, government and academia from Mexico, the U.S., and Canada. The Forum was attended by 90 representatives from the SWFSC, NWFSC, PFMC, SIO, the States of California and Oregon, the Canadian Department of Fisheries and Oceans, the Ministry of Environment, Province of B.C., and several members from Mexico’s CICESE and CICIMAR from Ensenada and La Paz. Industry was well represented from all three countries.

### **Other Surveys Conducted in the California Current**

**Lines 60 and 67** With NOAA funding, Monterey Bay Aquarium Research Institute (MBARI), National

Park Service (NPS), and University of California, Santa Cruz (UCSC) scientists continue to participate in CalCOFI shipboard occupations of Line 67 off Monterey and Line 60 off San Francisco, California. A suite of samples has consistently been collected quarterly along Line 67 since 1997. The focus has been on onshore/offshore and interannual variations, and the data document California Current and upwelling system dynamics over several El Niño–Southern Oscillation cycles as well as a probable shift in the Pacific Decadal Oscillation.

In 2007, MBARI and UCSC personnel collected nutrient, phytoplankton, and zooplankton samples during winter and spring cruises aboard the NOAA RV *David Starr Jordan* (lines 0701 and 0704). MBARI, NPS, and UCSC personnel conducted summer and fall cruises aboard the NOAA RVs *MacArthur II* (June) and *David Starr Jordan* (November). These data have been processed and quality-controlled, and are available both in the MBARI Biological Oceanography database and online. Briefly, 2007 was colder, saltier, and had higher chlorophyll concentrations than the mean. As analysis and publication proceed, the 2007 data should be especially interesting concerning: (a) the mid-latitude teleconnections and expression of the 2007–08 La Niña; and (b) the 2007 collapse of the northern and central California Chinook salmon (*Oncorhynchus tshawytscha*) fishery.

**Trinidad Head Line** An ocean observing effort (PaCOOS) has recently been established by NOAA Fisheries in cooperation with Humboldt State University. Data are collected at roughly monthly intervals along the Trinidad Head line, which consists of six stations along a transect extending approximately 27 nm due west from Trinidad Head. At each station, a CTD cast to 150 m (or as limited by bathymetry) is performed to collect data on temperature (T), salinity (S), dissolved oxygen (DO), fluorescence, and transmissivity, and plankton are sampled by: (1) an oblique tow from a maximum depth of 100 m with a 70 cm bongo frame fitted with dyed 505  $\mu\text{m}$  and 335  $\mu\text{m}$  mesh nets; and (2) a vertical haul of a PairoVET frame fitted with 153  $\mu\text{m}$  mesh from a maximum depth of 70 m. Flowthrough instruments are used to sample near-surface T, S, fluorescence, and turbidity continuously along the ship's track. Since November 2007, all operations have been conducted at night. Cruises for which data are reported here are CS0704 (5 April), CS0706 (29 June), CS0711 (8–9 November), CS0712 (11–12 December), CS0802 (17–18 February), and CS0803 (5–6 March).

Observations along the Trinidad Head line (41°3.50'N) from spring 2007 through winter 2008 complement the regional patterns reported above, but also reflect the forcing by upwelling- or downwelling-favorable winds that immediately preceded each cruise and the variation in coastal freshwater input. Observations during spring 2007

captured a dominant signal of persistent upwelling, modified by a relaxation downwelling that coincided with sampling (CS0704). Conditions in June 2007 (CS0607) indicated relatively weak upwelling and mixing, and strong stratification in the upper 50 m along the entire transect. Conditions in November 2007 indicated the effects of persistent downwelling. In contrast, conditions during the 2007–08 winter and early spring were marked by shoaling of cooler, saltier water towards the coast. Both patterns are consistent with the trends in the monthly upwelling index between 39°N and 42°N.

**COAST07** The SWFSC Advanced Survey Technology (AST) and In-Situ Survey groups have made operational a Collaborative Optically-Assisted Acoustic Survey Technique (COAST) to survey rockfish and evaluate their biotic and abiotic requirements for habitat. The COAST can provide estimates of biomass and dispersion by species throughout the Southern California Bight (SCB), with moderate sampling effort. The techniques were developed in 2003–04 on the Commercial Passenger Fishing Vessel (CPFV) *Outer Limits*, and were applied throughout the Southern California Bight (SCB) in 2004–05 and 2007 (COAST07), largely from the NOAA RV *David Starr Jordan*. The COAST will provide a time-series of data for improving rockfish stock assessments. Efforts are underway to also apply the COAST to rockfish off central California.

Throughout COAST07, acoustical volume backscattering strengths (Sv; dB re 1 m) and in-situ target strengths (TS; dB 1 m<sup>2</sup>) were measured continuously by four Simrad EK60 echo sounders configured with 38, 70, 120, and 200 kHz hull-mounted transducers. Then, video and high-resolution still images of the rockfish were collected using cameras deployed on a remotely operated vehicle (ROV). In each of 42 sites surveyed, a three-dimensional seafloor was visualized by interpolating the bottom detections from the 38 kHz echo sounder to render a surface. Empirical relationships between the multi-frequency Sv were used to remotely identify and separate the scatterer taxa (i.e., large fish, small fish, and zooplankton). Signals from the rockfish were thus extracted from the echograms and their distributions were overlaid on the rendering of the seafloor. Using these geographically-referenced files to navigate the ROV, optical images were obtained to characterize the fish species and their sizes, and also to validate acoustical seabed classifications. At the conclusion of each survey segment or day, a CTD was deployed in the area to profile the temperature, salinity, and sound speed within each survey location.

Additional optical surveys were conducted during December 2007 through April 2008, with the aid of partners in the sportfishing industry, to fill in missing data at a few sites. The goals were to examine the species

compositions and length distributions of bocaccio (*Sebastes paucispinis*), cowcod (*S. levis*), vermilion (*S. miniatus*), and bank rockfish (*S. rufus*) at all sites. Manuscripts detailing the methods and results of the COAST04/05 and COAST07 surveys are in preparation.

The AST and In-Situ Survey groups are currently analyzing the COAST07 survey data and planning surveys of the rockfish off Central California using the COAST. Tentative plans include COAST surveys of rockfishes around the Farallons and Cordell Bank. The groups are also working to improve COAST through better characterizations of habitat by species; quantification of the acoustic blind zone; improved length distributions by species; quantification of fish reactions to the ROV by species; improved models of TS by species, length, depth, and frequency; and quantification of total survey error by species.

**Shark Surveys** The SWFSC's shark research group collects data to support the management of blue (*Prionace glauca*), shortfin mako (*Isurus oxyrinchus*), and common thresher sharks (*Alopias vulpinus*), all of which are common in the Southern California Bight and taken in regional fisheries, primarily as juveniles. Common thresher and mako sharks have the greatest commercial value and are also targeted by sport fishers. Although the blue shark has little market importance in the United States, it is a leading bycatch species in a number of U.S. fisheries and is targeted in Mexico. One of the primary methods used to collect data on the three species are fisheries-independent surveys. These surveys provide catch data that allow trends in abundance to be tracked. Use of fisheries data alone for estimating population status is complicated by changes in regulations, fishing methods, and areas over time. The surveys also provide the opportunity to deploy conventional and electronic tags, obtain biological samples, and conduct studies on age and growth.

In June and July of 2007, the SWFSC conducted its fourteenth juvenile shark survey since 1994. Working aboard the NOAA RV *David Starr Jordan*, a total of 5,759 hooks at 28 sampling stations in seven main areas in the Southern California Bight were fished. The survey catch totaled 112 makos, 139 blue sharks, 14 pelagic rays (*Pteroplatytrygon violacea*), and 1 ocean sunfish (*Mola mola*). Of these, 12 mako sharks, 4 blue sharks, and the sunfish were tagged with satellite tags and most were conventionally tagged and injected with oxytetracycline (OTC). From catch data, the index of relative abundance for juvenile sharks, defined as catch per 100 hook hours, was calculated for seven target survey areas. The overall survey catch rate was 0.556 per 100 hook hours for mako and 0.666 per 100 hook hours for blue sharks. The CPUE for mako sharks has increased slightly since 2003, however, there is a declining trend in CPUE for both species over the time series of the survey.

In September of 2007, the SWFSC team worked with the CPFV *Outer Banks* to sample common thresher sharks in the California Bight from Point Conception to the Mexico border. Forty-nine longline sets were made in relatively shallow nearshore waters. Over the 18-day cruise, 137 common thresher sharks, 2 shovelnose guitarfish (*Rhinobatos productus*), 2 soupfin sharks (*Galeorhinus galeus*), 1 leopard shark (*Triakis semifasciata*), and 1 bat ray (*Myliobatis californica*) were caught. Roughly 65% of the threshers caught were young-of-the-year (<100 cm FL). Nearly all of the threshers caught were injected with OTC for age and growth studies, tagged with conventional tags, and released. In addition, satellite tags were deployed on four thresher sharks.

**Ocean Salmon Ecology** A cruise was conducted on the NOAA RV *David Starr Jordan* (DS-07-05) 10–20 August 2007 to investigate the ocean ecology of juvenile salmon. The objectives of the cruise were to: (1) determine the growth, feeding, energy status, and spatial distribution of juvenile salmonids in the coastal ocean off northern California and southern Oregon; (2) analyze the relationship between oceanographic conditions and features and salmon dynamics; (3) quantify and describe the coastal pelagic fish and macroinvertebrate community; and (4) collect jumbo squid, *Dosidicus gigas*, for trophic analysis. Trawl stations were located between the Golden Gate and Cape Blanco in 50 m to 150 m water depths. At each trawl station a suite of operations were conducted, including a CTD cast to record temperature, salinity, chlorophyll fluorescence, photosynthetically available radiation, and transmissivity; water samples by Niskin bottle at 1 m and the chlorophyll maximum depth for discrete chlorophyll analysis; an oblique Bongo net tow to collect zooplankton; a Manta net tow to collect neuston, and a 20–30 min tow with a 264 Nordic rope trawl fished at the surface at 3–4 knots. All stations were trawled during daylight. Horizontal temperature, salinity, and chlorophyll concentrations were recorded continuously, day and night, with a SCS thermosalinometer and a Turner SCUFA fluorometer. At night, CTD drops were performed in a grid design to cover the shelf area where trawls were conducted. Also, during the night at deep stations (>200 m) hook-and-line fishing for jumbo squid was performed. In all, 29 trawl stations and 87 CTD stations were completed.

At 3 m depth, temperature ranged from 9.6°C to 18.5°C with highest temperatures on the southern Oregon coast. Salinity varied little during the cruise, ranging from 32.74 psu to 33.96 psu. Surface chlorophyll was highest in the Gulf of the Farallones and lowest between Point Reyes and Cape Mendocino.

A total of 110 juvenile salmon and 15 adults were captured in 29 trawl sets. The majority were caught in a few sets between Cape Mendocino and Trinidad

Head. Preliminary analysis indicates most of the juvenile salmon were coho based on pyloric caecae counts, but the discrimination between coho (*Oncorhynchus kisutch*) and Chinook juveniles at this stage (~200–300 mm fork length) is difficult. Final species counts await genetic analysis. Twenty-one juvenile steelhead (*Oncorhynchus mykiss*) were also collected, as were 27 jumbo squid.

**West Coast Midwater Trawl Survey** The seventh annual West Coast midwater trawl survey was completed in 2007 from 4 May–17 June. This coast-wide survey represents a major geographical expansion of the SWFSC Fisheries Ecology Division's pelagic juvenile rockfish survey, which historically was fielded in the central California region between Carmel and Bodega Bay. Now the survey spans the entire U.S. west coast and in 2007 extended from San Diego, California (lat. 32°42'N), to Cape Alava, Washington (lat. 48°06'N). The expansion of the survey has been accomplished by a latitudinal extension of trawling by the NOAA RV *David Starr Jordan* to encompass the region between San Diego and Point Delgada (lat. 40°00'N), and by coordination with the NWFSC's pre-recruit Pacific whiting midwater trawl survey aboard the FV *Excalibur*, which samples from Monterey (lat. 36°30'N) to Cape Alava. In 2007 the two vessels completed a total of 182 and 152 midwater trawls, respectively, including 21 paired trawls wherein the ships sampled side-by-side to calibrate the two surveys. The NWFSC survey has been conducted cooperatively with the Pacific Whiting Conservation Cooperative since 2001. In addition to the biological data collected during the combined survey, a variety of physical data were gathered aboard the *David Starr Jordan*, including 268 CTD casts (with fluorometry) and continuous underway sampling of temperature, salinity, fluorescence, ADCP, and hydroacoustic data.

In 2007 the coast-wide abundance of young-of-the-year (YOY) rockfish (*Sebastes* spp.) was quite low (13 fish/trawl), being well below the 2001–07 long-term mean of 25 fish/trawl. Only squarespot rockfish (*S. hopkinsi*) was encountered in above average quantities and catches of that species were limited in its distribution to the Southern California Bight. Abundances of young-of-the-year hake were also down and, other than a single large tow at San Clemente Island, were largely limited in their distribution to the region between Monterey Bay and Cape Mendocino.

## SIO HIGHLIGHTS

Scripps Institution of Oceanography participated on all four CalCOFI cruises. While the spring and summer cruises suffered from rough weather and some stations were not surveyed, these cruises were a success overall. The ISUS nitrate sensor, mounted on the CTD, has by

now become an integral part of the system and produces reliable data; these, however, do not match the accuracy of those generated using chemical analyses for nitrate. The CCE-LTER group participated on all four cruises and augmented CalCOFI sampling with measurements aimed at characterizing biogeochemical cycling and lower trophic-level community structure in more detail. The marine mammal program participated on all four cruises as well, using visual observers and acoustic methods to enumerate the abundance of marine mammals on stations and along the cruise tracks. The seabird program, due to funding restrictions, was not able to participate on all cruises; however the important ones for that program, winter (January) and summer (July), were covered in 2007.

Observations made over the last year showed that the basin-wide La Niña conditions significantly affected the California Current System. Southward coastal winds were anomalously strong and, as a consequence, upwelling was stronger than normal. Mixed-layer temperatures and nutricline depths were below long-term averages and mixed-layer concentrations of nitrate were elevated during the last year. However, concentrations of chlorophyll *a* and rates of primary production were not significantly affected by these changes in water-column structure and chemistry. Zooplankton displacement volumes were similar to values observed during previous years. The discrepancy between changes in water-column structure and chemistry and biological responses may well be due to differential responses of different areas of our study domain, a topic we are pursuing currently.

The most important results for the seabird program include the following climate-change-related observations: (1) continuing low abundance, in comparison with the late 1980s and early 1990s, of trans-hemispheric migrants in the California Current including Sooty (and some Short-tailed, *Puffinus tenuirostris*) Shearwaters (*Puffinus griseus*); and (2) a recent and continuing increase in the at-sea abundance of Cassin's Auklet (*Ptychoramphus aleuticus*), an obligate krill-feeding planktivore, which started in July of 2005 and persisted in July 2006 and July 2007.

Ashore-data processing progresses on schedule. We have begun to make the CTD data publicly available and have reprocessed these for past cruises. We began to use CTD data instead of interpolated data at standard levels, thus increasing the accuracy of the interpolations. We are now in the process of merging CalCOFI hydrographic data and CCE-LTER data, using the DataZoo software developed by the CCE-LTER group.

The Gordon and Betty Moore Foundation funded a joint SIO-SWFSC project to develop an acoustics capacity for future CalCOFI cruises and related studies of

the California Current ecosystem. A five-frequency (18, 38, 70, 120, and 200 kHz) Simrad EK-60 system was purchased and hull-mounted on the RV *New Horizon* in May 2008. A portable pole-mounted four-frequency (38, 70, 120, and 200 kHz) system will be fabricated for use on other vessels. The first anticipated deployment of the portable system will be on the CCE-LTER cruise in October 2008, when it will be used to assess the distribution and biomass of the midwater micro-nekton and its role in carbon sequestration in the California Current, a study led by an SIO Ph.D. candidate. A single-warp, Japanese-designed midwater trawl with a 5 m<sup>2</sup> mouth opening is being built to ground-truth the acoustics, and funds are being requested for two additional sea days on Scripps' CalCOFI cruises in 2009 to utilize the new acoustic and trawl sampling capability. The aim of this new sampling will be to examine the ecology of mid to higher trophic levels in the California Current, as the basis for ecosystem-based fishery management. Specific objectives are to assess the biomass and distribution of micro-nekton, krill, juvenile, and forage fishes in relation to hydrographic features in the California Current, and to sample and assess the ecology of the late larvae and juveniles of key fish species in relation to oceanographic conditions.

Funding was received from the California Coastal Conservancy in March 2008 for a two-year project. The project has four objectives: (1) to describe the ichthyoplankton assemblages of nearshore coastal habitats, based on recent and historical CalCOFI samples and past nearshore ichthyoplankton studies; (2) to develop indices of stock size and recruitment for the California spiny lobster (*Panulirus interruptus*), based on phyllosoma abundance from historical CalCOFI samples; (3) to assess the potential impacts of climate variability and climate change on the phyllosoma; and (4) to develop a central, publicly available database for the CalCOFI program, combining available ichthyoplankton, larval invertebrate, and hydrographic data held at SIO and the SWFSC.

Scientists from SIO, Oregon State University, the SWFSC and NWFSC, and other institutions jointly submitted a proposal to a new NSF/NOAA funded program for the Comparative Analysis of Marine Ecosystem Organization (CAMEO). If funded, the project will compare ecosystem organization and the response to climate forcing in the northern and southern California Current, focusing on krill and the recruitment dynamics of sardine, anchovy, and hake. The project would bring together time series, including CalCOFI, from northern and southern sectors of the California Current, initiate pilot field studies that would build on CalCOFI and other regional time-series studies, and develop biophysical modeling of the region, with the aim of enhancing ecosystem-based management of key fisheries.

## CDFG HIGHLIGHTS

### Marine Regulatory Changes

The Fish and Game Commission adopted significant changes to its mandatory reporting and tagging programs for recreational fishermen late in 2007. Beginning in 2008, report cards are required for all fishermen, including children, pier fisherman, and on free fishing days. Report cards serve to provide information on catch and fishing activity (effort), and improve compliance with existing bag limits and other rules. For species of high commercial value, report cards can also help reduce the potential for illegal take and commercialization. The California Department of Fish and Game (the Department or CDFG) has report card requirements only for species of particular importance or concern. Before the new regulations were adopted, report cards were required for steelhead, salmon, sturgeon, and abalone fishing. The new regulations add a card requirement for spiny lobster, and a requirement that any abalone taken in the recreational fishery must be tagged and recorded on the card.

For the first time, the Pacific Fishery Management Council recommended regulations to constrain recreational tuna fishing off California, in response to declines in stocks. NOAA Fisheries adopted a bag limit of 10 albacore (*Thunnus alalunga*) for federal waters south of a line drawn at Point Conception, and a 25-fish bag limit for waters north of that line. The Fish and Game Commission adopted similar rules for state waters.

CDFG Marine Region staff assisted the Department's Oil Spill Response Program in the assessments of the impact of the container ship MV *Cosco Busan* oil spill. A spill on 8 November 2007 in San Francisco Bay resulted in a temporary closure of recreational and commercial fisheries within the bay and from Point Reyes Light south to San Pedro Point. To determine the health risks of consuming bay-area marine life, CDFG Marine Region staff collected close to 1,000 crabs, mussels, herring, and surfperch from a variety of locations and depths both inside and outside the spill zone for laboratory testing. Testing results showed that fish and shellfish (with the exception of mussels found in two bay locations) from the spill area were safe to eat. Therefore, San Francisco Bay-area fisheries were reopened on 29 November 2007. A natural resources damage assessment study will be conducted during the 2007–08 herring (*Clupea pallasii*) spawning season within the bay to determine if lingering contaminants from the spill are negatively impacting herring eggs and larvae. For more information go to [http://www.dfg.ca.gov/ospr/spill/incidents/cosco\\_busan/cosco\\_busan.html](http://www.dfg.ca.gov/ospr/spill/incidents/cosco_busan/cosco_busan.html) in Nov. 2007.

## Aquaculture and Bay Management

The Aquaculture and Bay Management Project (ABMP) completed the California Pacific Herring Commercial Fishing Regulations Supplemental Environmental Document (SED) for the 2007–08 season. The SED included the herring spawning biomass estimates, spawning population, and commercial catch assessment. In addition, the SED included the results of sub-aquatic vegetation surveys in key herring spawning areas for San Francisco Bay for the 2006–07 season. The spawning biomass estimate for San Francisco Bay of 10,935 tons (including catch) for the 2006–07 season is the lowest recorded estimate in the history of the roe herring fishery (1978–79 to present) and a 92% decrease over last season's estimate of 145,054 tons.

## Invertebrate Fisheries

The Invertebrate Project added several new staff in 2007, allowing an increase in resource assessment capabilities. A lobster team was created and has embarked on several assessment efforts including a sport lobster trap efficiency comparison study and a night-time sport lobster creel survey. Red abalone (*Haliotis rufescens*) recruitment and aggregation indices are being developed. In northern California, new staff have begun assessing Dungeness crab (*Cancer magister*) megalopae abundances in light traps in Bodega and Humboldt Bays. In addition, surveys began in 2007 of recreational clammers on Humboldt Bay and Clam Beach in Humboldt County to continue collecting historic catch and effort data. In southern California, cooperative abalone stock assessments were conducted for the second year around San Miguel Island using fishing industry divers trained in dive transect techniques as well as Department and Kelp Forest Monitoring divers. Furthermore, there is a process underway examining the potential for a fishery of red abalone at San Miguel Island.

## Groundfish Highlights

In 2007, management measures for state and federally managed groundfish species were similar to 2006 in California recreational and commercial fisheries, with a few exceptions. In September, the California Fish and Game Commission took emergency action to conform state regulations to match federal action that closed the recreational fishery in the Northern and North-Central Management Areas on 1 October; this action was taken due to higher-than-expected catches of canary (*Sebastes pinniger*) and yelloweye (*Sebastes ruberrimus*) rockfish, both federally-designated "overfished" species. Commercial fisheries for California sheephead (*Semicossyphus pulcher*) and greenling (*Hexxagrammos* spp.) were closed early due to concerns that allocations would be exceeded. In addition, cabezon (*Scorpaenichthys marmoratus*) trip limits

were lowered in the fall to maintain the season through the end of the year.

A new stock assessment of blue rockfish (*Sebastes mystinus*) was conducted in California waters and it was not determined to be "overfished" as defined by the Nearshore Fishery Management Plan. The stock's biomass was estimated to be above the "overfished" threshold of 30% but below 50% of the unfished biomass. The results of this assessment will be used to develop nearshore fishery regulations for the 2009–10 management season.

## Recreational Fisheries

The California Recreational Fisheries Survey (CRFS) began in January 2004 to provide catch and effort estimates for marine recreational finfish fisheries. This is the updated version of the marine recreational finfish fisheries statistical survey (MRFSS) which started in 1980. The CRFS generates monthly estimates of total recreational catch for four modes of fishing (beach/bank and shore, piers and jetties, commercial passenger fishing vessels, and private vessels launched from public launch ramps) for six geographic districts along California's 1,000 plus miles of coast. These data are used by state and federal regulators to craft regulations protecting fish stocks and provide recreational fishing opportunities.

The CRFS includes field sampling and telephone surveys. In 2007, approximately 45 samplers worked to gather the field data. The CRFS samplers interviewed more than 98,000 anglers at 414 sites, and examined almost 194,000 fish. The licensed angler telephone survey completed almost 26,000 interviews in 2007 which is comparable to the number completed in 2006.

A review of the first three years of CRFS data was undertaken in 2007 to improve the analyses and estimation procedures. This resulted in changes to the number of trip types, the district boundaries, and effort estimation procedures. In 2008, the CRFS program will begin to conduct studies to verify the estimates of effort for night fishing and for boats that depart from and return to private marinas. For more information: <http://www.dfg.ca.gov/marine/crfs.asp>

## State Finfish Management Project

In 2007, a comprehensive description of the California Halibut Trawl Grounds (CHTG) fishery was prepared for the Commission. Commencing 1 April 2008, approximately 73 square nautical miles within the CHTG located in state waters off of Ventura and Santa Barbara Counties are proposed to be closed (Fish and Game Code [FGC] §8495). The Fish and Game Commission has the authority to reverse the pending closures if fishery performance criteria listed in FGC §8495 for this fishery are met. Sampling began in the commercial California halibut fishery in central California for basic

length, weight, sex, and age-composition data. Sublegal halibut were tagged and released. These data along with similar data from previous efforts in southern California will be used in a planned stock assessment for California halibut (*Paralichthys californicus*).

In 2007, a recreational beach fishery study began in central and southern California counties examining the barred surfperch (*Amphistichus argenteus*). The program uses a series of “progressive angler surveys,” recording instantaneous angler counts at major beach fishing locations on random days. Recommendations will be made to the CFRS sampling program regarding beach and bank fishing modes to improve total catch and effort estimates.

In 2007, the California commercial hagfish fishery (primarily *Eptatretus stoutii*) experienced a resurgence in directed catch after a 17-year hiatus; landing in excess of 1 million lbs for the first time since 1990. In response the Project is tracking fishery landings statewide, and sampling the fishery for size composition since this is one of the last open access fisheries in the state.

### **Marine Project Reviews**

Marine Project Review staff reviewed and evaluated proposed projects that have the potential to affect marine resources, habitats, and water quality, especially as they relate to threatened and endangered species and essential fish habitats. During 2007–08, some of these projects included liquefied natural gas projects, oil platform decommissioning projects, state and federal marine aquaculture programs, the Federal Energy Regulatory Commission’s Wave Energy permitting process, as well as desalination projects in both northern and southern California.

### **Fishery-Independent SCUBA Assessment Project**

In 2007, CDFG created a new Fishery-Independent SCUBA Assessment Project. Using SCUBA-based methods, the staff of this project conducts surveys of fish and invertebrates in nearshore subtidal habitats, inside and outside Marine Park Areas (MPAs). This project, in partnership with other agencies and academic institutions, is a collaborative research and monitoring program. In southern California, the project is collecting data on surfperch and other nearshore sandy beach fishes through beach seining and mark-recapture efforts. Data are being collected on the movement patterns of barred sand bass (*Paralabrax nebulifer*), particularly in relation to their spawning behavior. In central California, the abundance, mortality, and movement patterns of rocky reef fishes listed in CDFG’s Nearshore Fishery Management Plan is being investigated. In addition, data are being collected to estimate age, growth, and maturity of kelp greenling.

### **ROV and Kelp Surveys**

CDFG, along with the Pacific States Marine Fisheries Commission and its partners, have been using a Remotely Operated Vehicle (ROV) to quantitatively survey deep subtidal habitats. The Department has been conducting ROV surveys within and adjacent to the Channel Islands Marine Protected Areas since 2003. This effort was expanded in 2007 when the Department conducted the first annual surveys in the Central Coast Marine Protected Areas from Monterey Peninsula to Point Lobos. Recent work is focused on developing the ability to measure fishes using paired lasers.

During 2007 the CDFG completed the sixth annual coast-wide survey of California’s kelp beds. The results of ongoing aerial assessments through 2006 are now available to GIS users on the Department’s website at: [http://ftp.dfg.ca.gov/Public/R7\\_MR/Natural\\_Resources/Kelp/](http://ftp.dfg.ca.gov/Public/R7_MR/Natural_Resources/Kelp/)

### **Marine Life Protection Act**

The Marine Life Protection Act is being implemented in five planning regions which encompass the California coastline and is expected to be completed by 2011. The first planning region, along the central coast from Pigeon Point in San Mateo County south to Point Conception in Santa Barbara County, was completed in April 2007, when the California Fish and Game Commission adopted 29 MPAs. These 29 MPAs represent approximately 204 square miles (or approximately 18 percent) of state waters, with 85 square miles designated as no-take state marine reserves, and became effective in September 2007. The second planning region process commenced in summer of 2007, in the north-central coast region, from Pigeon Point to Alder Creek, near Point Arena, Mendocino County. A Blue Ribbon Task Force, appointed by the Secretary for Resources, will make its recommendation for a preferred proposal to the Fish and Game Commission in May 2008. The Commission’s formal public process will commence at that time. See [www.dfg.ca.gov/mlpa](http://www.dfg.ca.gov/mlpa) for more information.

### **Ocean Salmon Project**

In April 2008, the California Fish and Game Commission voted unanimously to prohibit commercial and recreational salmon fishing in state ocean waters, which extend three miles off the coast. This followed a federal ban imposed by the Pacific Fishery Management Council which applies to U.S. waters extending from three to 200 miles off the coasts of California and Oregon. The Commission took this unprecedented action based on sharp declines in runs of fall-run Sacramento Chinook salmon.

In 2007, ocean salmon fisheries in California were less constrained than 2006 due to a forecasted increase in the ocean abundance of Klamath River fall Chinook;

however, these forecasts did not materialize as Chinook landings in the California recreational and commercial fisheries were the lowest and second lowest, respectively, on record since monitoring began in the 1960s. These low numbers were due primarily to a scarcity of Central Valley salmon stocks in California waters. In 2007, the salmon program sampled over 53,000 salmon in the ocean fisheries and processed 6,200 Coded Wire Tags from adipose fin-clipped salmon collected in the ocean and inland salmon fisheries, Department hatcheries, and Central Valley spawning ground surveys.

### **Ocean Protection Council**

In 2007, the Ocean Protection Council, in partnership with the Marine Region of the California Department of Fish and Game, earmarked funds for projects and equipment upgrades for the next three years. A series of projects have been identified ranging from larval invertebrate and fish assessments, fish trapping, SCUBA surveys and MLPA baseline surveys, as well as socio-

economic studies. A total of \$6.7 million has been allocated for these projects. An additional \$0.7 million is slated for data analysis including fishery landings e-tickets and commercial logbooks database upgrades. Furthermore, \$0.45 million will target program support and staff training as well as infrastructure upgrades for vessels, ROV, and SCUBA equipment.

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