Part I

REPORTS, REVIEW, AND PUBLICATIONS

REPORT OF THE CALCOFI COMMITTEE 2009

NOAA HIGHLIGHTS

CalCOFI Cruises

The beginning of the field season for CalCOFI's 60th year saw the remnants of a weak La Niña condition which became ENSO-neutral by May of 2009. Neutral conditions were short lived as a weak El Niño system developed by July and persisted throughout the remainder of 2009. The 2009 field season saw the successful completion of the standard quarterly surveys and the Pacific sardine (*Sardinops sagax*) biomass survey using a total of four research vessels but also was noted for several milestones.

The field season of 2009 will be remembered for the final research cruise of the NOAA Ship *David Starr Jordan*. Due to budget constraints, the *Jordan* was placed on limited operational status during 2008 which kept her in San Diego but sitting idle at the Nimitz Marine Facility. By early 2009 it was decided that the ship would be moved up to Seattle, Washington, for storage until a decommissioning date was determined. The spring CalCOFI/sardine biomass survey was scheduled to go out on the NOAA ship *Miller Freeman* but due to major mechanical problems during the ship's dry dock period the *Freeman* was unable to fulfill its obligations. In order to complete a spring CalCOFI survey, the *Jordan* was reactivated one last time in March 2009 for her final cruise. The *David Starr Jordan* was built by the Christy Corporation in Sturgeon Bay, Wisconsin, and launched in 1964 for the U.S. Bureau of Commercial Fisheries which later became a part of NOAA as the National Marine Fisheries Service. Since her commissioning in 1966 in San Diego, the *Jordan* has covered over 1.5 million nautical miles. Many of those miles were earned during CalCOFI surveys so it seems fitting that the *Jordan* completed her long and successful life with one last CalCOFI survey. The *Jordan* now sits up in Lake Washington in Washington State, and is scheduled to be decommissioned in early August 2010.

The Ship Operations group at the Southwest Fisheries Science Center said goodbye to Ron Dotson as he headed off into retirement starting in 2010. Ron caps off an illustrious 39-year career with the Federal Government which began back in 1970 with the Bureau of Commercial Fisheries. Ron was hired on to the original albacore group by Ron Lynn while he was still a student at San Diego State University. Ron played a vital part in the early albacore studies as well as the development of the early aerial spotter surveys and has been a mainstay within the CalCOFI program. Prior to Ron's departure he was tasked with one last responsibility: to develop and implement a marine mammal excluder device to be installed in the Nordic 264 mid-water trawls used extensively by the Division for adult sardine assessments. With the help of many people within NMFS and the fishing industry, Ron was able to pull together a successful, working system that was used throughout the 2009 field season without incident (this process published in NOAA Tech. Memo. 455). Ron will surely be missed but we wish him only the best in his well earned retirement.

Figure 1. NOAA Ship *David Starr Jordan*

Over the course of the 2009 calendar year a total of five individual surveys (the four standard CalCOFI surveys and one Daily Egg Production Method survey) were completed using four different vessels: SIO's R/V *New Horizon*, the NOAA Ship *David Starr Jordan*, the NOAA Ship *McArthur II*, and the chartered fishing vessel F/V *Frosti*. Throughout these combined surveys a total of 656 Bongo samples, 318 Pairovet tows, 261 Manta tows, 404 CTD casts, and 1,127 CUFES samples were collected. In addition, 59 surface trawls were

conducted netting approximately 377 kilograms of adult and juvenile Pacific sardine for the annual spawning biomass estimate.

CalCOFI Ichthyoplankton Update

The continuing SWFSC Ichthyoplankton Ecology group projects to update larval fish identifications to current standards from 1951 to the present, and to identify eggs of Pacific whiting (hake) and jack and Pacific mackerels collected in the CalCOFI bongo net samples are now complete from 1987 to the present for the eggs and 1967 to the present for the larvae.

Since 1997 we have identified market squid paralarvae in all CalCOFI samples (since 1981 for surface samples), and other cephalopod paralarvae from time to time in some samples. Beginning in 2008 we are now identifying all cephalopod paralarvae in all samples and including them in the ichthyoplankton database. The presence or absence of jumbo squid paralarvae has been of particular interest in recent years; ommastrephid paralarvae are rare in CalCOFI collections and although most are too small to identify below the level of family with any certainty, the few larger specimens appear to be *Ommastrephes* rather than *Dosidicus*.

We are working cooperatively with Ron Burton's group at SIO, who are developing a system for molecular identification of ichthyoplankton in the California Current Ecosystem with the ultimate aim of providing near real-time identifications of the 100 most common taxa. When developed, this method should be especially useful for fish eggs collected with the CUFES, particularly for taxa whose eggs are difficult to distinguish during early developmental stages, such as Pacific hake and Pacific mackerel, or white seabass and California barracuda.

PaCOOS—Pacific Coast Ocean Observing System

In 2009 the focus for PaCOOS was to continue to serve biological data via the internet as well as increase survey coverage in support of the California Current (CC) ecological observing system. Data access and data interoperability underlie ecological forecasts and integrated ecosystem assessments in the California Current. Collaboration and partnerships within NOAA and between NOAA and academic scientists remains the primary means of developing these forecasts and assessments.

Data management activities in 2009 centered on merging and access to the historical CalCOFI biological and physical data housed at the Southwest Fisheries Science Center and the Scripps Institution of Oceanography, respectively. In addition, PaCOOS hosted a zooplankton data management meeting of researchers and data managers along the California Current. A summary will be available on the PaCOOS website. The final activity to highlight is the quarterly reporting of climate and ecosystem science and management activities in the California Current that started as a pilot project in 2008. The quarterlies are now a regular feature of the program and can also be accessed on the PaCOOS website.

The 2010 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. Two assessments to highlight are: 1) the second annual ecosystem status report that was included in the Coastal Pelagic Stock Assessment and Fisheries Evaluation (SAFE) document for the Pacific Fisheries Management Council; and 2) a second module for the California Current Integrated Ecosystem Assessment developed by the Farallon Institute and funded by the NOAA IOOS Program.

Other Surveys Conducted in the California Current

Lines 60 and 67. MBARI, NPS, and UCSC scientists continue to occupy Line 67 off Monterey and Line 60 off San Francisco with NOAA and MBARI funding. A consistent suite of samples has now been collected quarterly along Line 67 since 1997, and nearshore since 1989. In recent years this shipboard work has been augmented by mooring, AUV, and glider programs. The focus has been on: 1) seasonal/interannual/decadal temporal variations; and 2) Monterey Bay/upwelling system/California Current spatial variations. The data document California Current and Upwelling System dynamics over several ENSO cycles as well as a decadal to multidecadal shift.

In 2009, the retirement of the NOAA Ship *David Starr Jordan* left the winter and spring occupations of Line 67 in peril. The winter occupation was salvaged by an occupation aboard the MBARI vessel *Western Flyer* (s109). MBARI and UCSC personnel collected nutrient, phytoplankton and zooplankton samples during summer cruise aboard the NOAA Ship *McArthur II* (0907-s209) as part of the annual coast-wide sardine survey. Finally a fall cruise out to 67–155 (500 km from shore) was made aboard the MBARI vessel *Western Flyer* (s309). Data from the three cruises have been processed and quality-controlled, and are available both in the MBARI Biological Oceanography database and online. 2009 was a near-normal year, although with a strong spring upwelling season, and the effects of the 2009–10 El Niño are not obvious (temperature, salt, chlorophyll, primary production). MBARI moorings seem to have detected the first arrival of El Niño as a thermocline anomaly in mid-October. As analysis and publication proceed, the 2009 work will enable data-based exploration of: 1) the 2009–

10 El Niño; 2) the putative decadal shift to cool conditions after 1998; and 3) secular climate change.

Trinidad Head Line. NOAA's National Marine Fisheries Service, Southwest Fisheries Science Center and Humboldt State University continue collaborative ocean observing efforts off northern California. 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. Standard sampling protocols include CTD casts to a maximum depth of 150 m, collection of zooplankton samples by oblique bongo tows (505 um to formalin and 335 um mesh to EtOH) from a maximum depth of 100 m and vertical 0.5 m ring net tows from a maximum depth of 100 m (200 um mesh to formalin). These observations are being augmented by CTD data and ring net samples collected at the first five stations during research cruises lead by Dr. Jeff Abell (HSU, Oceanography) to quantify ocean acidity and other hydrographic and chemical parameters under a grant funded through the Ocean Protection Council. All cruises in 2009 and into 2010 were conducted aboard Humboldt State University's R/V *Coral Sea*. Sampling of offshore stations occurs after dark, but sampling over the shelf is conducted during daylight hours.

Here we report hydrographic and chemical data for Station TH02 (41°3.50'N, 124°16.00'W). Observations found warmer, fresher water along the coast during late 2009 and early 2010, consistent with the timing of El Niño effects in the California Current. This pattern is also apparent at other stations along the Trinidad Head Line and reflects substantial onshore transport associated with numerous strong storm systems. Warming in summer 2009 contrasted starkly with the cool conditions observed the previous year. Evidence of renewed upwelling is apparent moving into spring 2010, and cruises scheduled in June 2010 were prevented by severe northerly winds that presumably drove intense upwelling going into early summer 2010.

Shark Surveys. The SWFSC's shark research group is responsible for collecting 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 off the U.S. West Coast 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 by NOAA Fisheries to collect data on the three species is fisheries independent surveys. These surveys provide catch data that allow us to track trends in abundance. 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 August 2009, the SWFSC conducted its sixteenth juvenile mako and blue shark survey since 1994. Working aboard F/V *Southern Horizon*, the team of scientists and volunteers fished a total of 5,575 hooks during 27 daytime sets inside seven focal areas within the Southern California Bight. Average water temperature during the 2009 survey was the second highest on record, although in only three other years were survey sets conducted during the month of August (1995, 1996, and 1997) when surface temperatures tend to be warmer. From the catch data, the index of relative abundance for juvenile sharks, defined as catch per 100 hook-hours, was calculated for the seven target survey areas. Survey catch totaled 100 shortfin makos, 67 blue sharks, 31 pelagic rays (*Pteroplatytrygon violacea*), and seven opah (*Lampris guttatus*). Nearly all of the sharks caught were injected with OTC for age and growth studies, tagged with conventional tags, and released. In addition, satellite tags were deployed on 14 mako sharks and 10 blue sharks. The nominal survey catch rate for makos was 0.453 per 100 hook-hours and for blue sharks was 0.314 per 100 hook-hours. The nominal CPUE for blue sharks dropped substantially from 2008 and was the second lowest in the survey's history. There is a declining trend in nominal CPUE for both species over the time series of the survey.

In September 2009, the SWFSC conducted its fifth thresher shark nursery area survey in the Southern California Bight. The team worked aboard the F/V *Outer Banks* and fished fifty longline sets in relatively shallow nearshore waters from Point Conception to the Mexico border. Over the 18-day cruise, shark catch included 216 common thresher, 11 soupfin (*Galeorhinus galeus*), seven shortfin mako, three spiny dogfish (*Squalus acanthias*), one leopard (*Triakis semifasciata*), and one Pacific angel (*Squatina californica*) shark. The average nominal catch rate by set was 2.13 per 100 hook-hours for common thresher sharks. This is down from 2008 when the catch rate was 3.32 per 100 hook-hours. The distribution of common threshers is very patchy and areas of high abundance are not consistent across years. In all years, a large percentage of the catch has been neonates, which were found in all areas surveyed. In addition to providing important information on abundance and distributions, the thresher shark pre-recruit survey enhances other ongoing research at the SWFSC, including age and growth, feeding, and habitat utilization studies. Two hundred and six sharks were tagged with conventional tags; 190 sharks were marked with OTC for age validation studies; 212

DNA samples were collected. In addition, colleagues from Scripps Institute of Oceanography tagged 17 neonate common thresher sharks with mini PSATs to study their movement patterns.

West Coast Midwater Trawl Survey. The twenty-eighth annual west coast midwater trawl survey was conducted during the peak of the upwelling season from May 1 through June 12, 2010. This coast-wide survey represents a major geographical expansion of the traditional SWFSC Fisheries Ecology Division's pelagic juvenile rockfish survey, which was conducted in the central California region between Carmel and Bodega Bay from 1983 through 2003. A total of 136 midwater trawls and 235 CTD casts, as well as zooplankton samples, seabird and mammal observations, and continuous underway data collections were conducted during this year's cruise. The survey targets pelagic juvenile rockfish for fisheries oceanography studies and for developing indices of year class strength for stock assessments, however the focus of the survey has expanded to an ecosystem survey focusing on the productivity of the forage assemblage in recent years.

The survey has in recent years spanned the entire U.S. west coast, by pooling effort between the SWFSC survey and a cooperative survey by the NWFSC and the Pacific Whiting Conservation Cooperative (PWCC). The expanded survey has been conducted using two vessels, usually the NOAA Ship *David Starr Jordan* (SWFSC) and the F/V *Excalibur* (NWFSC/PWCC). However, last year the SWFSC portion of the survey was conducted on the NOAA Ship *Miller Freeman*, and this year's survey was conducted on a chartered research vessel, the F/V *Frosti*. Moreover, the NWFSC/PWCC portion of the survey was not conducted in 2010, thus data for 2010 span only the region covered by the SWFSC survey, from San Diego, CA (lat. 32°42'N) to Delgada, CA (39°50'N). Future surveys are anticipated to take place on the new NOAA Ship *Bell M. Shimada*, and the use of this suite of new ships will necessitate future inter-vessel calibrations to maintain the integrity of the time series.

Sampling is focused on young-of-the-year (YOY) groundfish, particularly rockfishes (*Sebastes* spp.), Pacific whiting (*Merluccius productus*), lingcod (*Ophiodon elongatus*), rex sole (*Glyptocephalus zachirus*), and sanddabs (*Citharichthys* spp.). Data are used in stock assessments for several of these species. In addition, a wide variety of other epipelagic micronekton are captured and enumerated, including krill (*Euphausia pacifica* and *Thysanoessa spinifera*), market squid (*Loligo opalescens*), lanternfishes (*Diaphus theta*, *Tarletonbeania crenularis*, *Stenobrachius leucopsarus*, *Lampanyctus* spp.), northern anchovy (*Engraulis mordax*), and Pacific sardine (*Sardinops sagax*). The entire assemblage is analyzed to develop indicators of ecosystem state and productivity, which relates the productivity of higher trophic level species that forage on much or all of this assemblage. As with the 2009 data, results from this year continue to represent a return to cool, high productivity conditions similar to the 1999 to 2003 period for many groups, while others are at moderate levels that approximate long term mean conditions.

Ongoing efforts also include focused research on krill, which are being done in collaboration with the Farallon Institute for Advanced Ecosystem Research (FIAER). These efforts have focused on developing a geographic atlas of krill abundance and hotspots using both net and hydroacoustic data, and currently a decade of krill abundance data representing 28,000 nautical miles of transects have been processed. These data will be used to develop dynamic habitat models for higher trophic level predators in the California Current, including seabirds and salmon. Additional information on these data and efforts are reported in the State of the California Current report in this volume.

SIO HIGHLIGHTS

Four CalCOFI cruises went out over the last 12 months. The standard CalCOFI measurements were made on all 4 cruises; however, the number of depths sampled had to be reduced during the spring 2010 cruise since the ship, NOAA's *Miller Freeman*, could not handle the weight of the 24 bottle CalCOFI CTD rosette. Instead a 12-place rosette had to be used. The limited number of bunks on *Miller Freeman* forced us to leave the Marine Mammal group ashore during the spring 2010 cruise and curtail efforts of the California Current Ecosystem Long-Term Ecosystem Research (CCE-LTER) group as well. However, these two ancillary programs were able to carry out their work on the other three cruises, giving us estimates of the abundance of marine mammals in the region and a much more detailed look at the structure of the pelagic ecosystem. Along with measurements of total inorganic carbon, alkalinity and sea surface pCO2, measurements of sea surface pH were made for the first time on the fall 2009 cruise by Todd Martz. These measurements will be made on future cruises using funds provided by the CCE-LTER program. This spring the CCE-LTER program received very encouraging news from NSF that it is to be continued for the next 6 years. Over this time period measurements of the inorganic carbon system and fluorescence-based measurements of phytoplankton community structure and physiological status will be integrated into the CalCOFI program.

The most interesting oceanographic event during 2009–10 was the El Niño which was followed closely by NOAA and SIO scientists. Preliminary analyses of the CalCOFI data suggest that effects of the El Niño on the Southern California Bight were limited to changing

stratification which did not have dramatic impacts on mixed layer hydrographic properties or phytoplankton or zooplankton biomass. Similar to previous years, the timing and strength of the upwelling off Pt. Conception was the most significant control on phytoplankton biomass. It appears that we will be heading for La Niña conditions. It will be interesting to compare the 2007–08 La Niña period, which was not preceded by strong El Niño conditions, with the upcoming conditions.

NOAA conducted a formal review of the CalCOFI program, March 2–4, 2010, led by Dr. Stephen Murawski. The external review committee was chaired by Dr. Anne Hollowed (NOAA, Alaska Fisheries Science Center, Seattle) and consisted of Drs. Enrique Curchitser (Rutgers University), Robert Cowen (Rosenstiel School of Marine and Atmospheric Science, Miami), Anthony Richardson (CSIRO and University of Queensland, Australia), and Michael Sinclair (Bedford Institute of Oceanography, Canada). The review was very positive about the program and its strong scientific legacy, stating that the CalCOFI program has been very responsive to the mission to provide a scientific understanding of human impacts and the influence of variability and climate change on the living marine resources of the California Current. Its overall recommendation was that the core CalCOFI Program should be continued for the foreseeable future. The review also made a number of specific recommendations:

- A review paper or book should be prepared to document the major scientific advances that stemmed from CalCOFI monitoring and research.
- A workshop should be convened to thoroughly assess the strengths and weaknesses of each of the three survey methods: aerial surveys, acoustic surveys and the DEPM. The Panel was skeptical that an acoustic survey could be conducted without trawl validation of targets. It therefore recommended that additional work should be conducted to confirm that cameras and 3-dimensional imaging provide accurate depictions of the length composition of the aggregation.
- If acoustics become part of the assessment tool box, then the assumption that target–strength to length relationships for Atlantic stocks are suitable for Pacific sardine and northern anchovy should be evaluated.
- The stock assessment authors should examine the relationship between sardine size at age and indices of prey availability, and the species composition of the diet relative to available prey.
- The historical data should be used to assess the most parsimonious sampling grid that would minimize ship time, while preserving the data needed to monitor climate impacts on the CCS.
- Some funds should be secured that could be devoted annually to high priority research projects. This could take the form of graduate student stipends, or research fellowships.
- To formally align the mission of CalCOFI with the shifting priorities of the three partner agencies, the Panel recommends that the Mission Statement for the CalCOFI program be modified.
- If the mission statement is broadened to encompass ecosystems, the title (not the acronym) should be revisited.
- A CalCOFI Scientific Steering Committee (SSC) should be formed to provide strategic direction to the program.
- The core CalCOFI surveys should be considered a part of the national backbone of oceanographic sampling.
- The new stock assessment expert/ecosystem modeling at SIO should play an important role in facilitating a link between resource managers the developing science of ecosystem assessment.
- When considering the plausible range of management alternatives for IEAs, CalCOFI scientists can inform analysts who are developing technical interaction models that track how the existing or planned management constraints would limit the range of management actions.
- Analysts responsible for gathering the information for the IEA should carefully consider the content and timeframes necessary for an adequate assessment.
- Dedicated funds should be identified to maintain and modernize the database.
- Dedicated funds should be identified to support research focused on applied science that would be useful in stock assessments or ecosystem assessments.
- Ancillary sampling programs should be encouraged because these programs provide added value to the CalCOFI surveys by addressing issues of spatial aggregation and seasonality.
- SIO should consider offering a course on ecosystem monitoring and assessment.
- Once a model is transitioned from research to use in routine operational activities, funding and staffing for this activity should be external from core CalCOFI program.

The CalCOFI Committee is reviewing the recommendations and considering how best to adopt them.

With funding from the California Conservancy Ocean Protection Council, several related projects are nearing completion. The Scripps and NOAA CalCOFI databases have been merged and are now available on the web. Phyllosoma of the California spiny lobster have been removed from the summer CalCOFI cruises, and the data will be used to develop a management plan for the fishery. Ichthyoplankton data for the coastal region have been combined from several sources, including

CalCOFI, NOAA, Los Angeles County Museum, and Tenera. Multivariate analyses were carried out to examine onshore-offshore and alongshore variability. Consistent with other studies, Pt. Conception was found to be a major biogeographic break point. A distinct nearshore assemblage was also found inshore of approximately 25 m depth. These results will be used in planning monitoring strategies for marine protected areas in the region.

CDFG HIGHLIGHTS

The California Department of Fish and Game's Marine Region was established in 1999. At that time two major pieces of legislation were passed by the Legislature that guide work within the region. The first is the Marine Life Management Act (MLMA), which mandates that fisheries management will focus on sustainability, taking an ecosystem perspective and be science-based. The second is the Marine Life Protection Act (MLPA) which directs the state to redesign its system of Marine Protected Areas (MPAs) to function as a network to protect marine life and habitats.

California's 2006 Budget Act appropriated $8 million to the California Ocean Protection Council (OPC) for the implementation of the MLMA and MLPA. An additional $2 million was appropriated to DFG to fulfill these same goals. The OPC-DFG Joint Work Plan was developed focusing on collecting, analyzing, and applying data essential to the implementation of the MLMA and the MLPA. Work plan projects focus on three activities and will end in 2010: 1) improving methods and collection of fishery-dependent and fishery-independent data; 2) monitoring to inform the management of MPAs; and 3) equipment improvements to ensure capacity to collect and manage data.

This funding helped to develop a joint research program to quantify the presence of larval spiny lobsters in CalCOFI samples. Lobster phyllosoma larvae were quantified from 1948 to the present. Dr. Martin Johnson began this work sorting lobster larvae in the samples for two decades. Drs. Koslow and Rogers-Bennett will work to: 1) identify patterns in larval abundance with oceanographic indexes; 2) identify trends relative to commercial catch of adult lobsters; and 3) work to incorporate these data into stock assessment modeling efforts in DFG.

Severe budget problems have impacted work within the Marine Region in 2009 requiring travel restrictions and limited hiring. Due to the state budget crisis Governor Schwarzeneggar froze state contracts temporarily and issued Executive Order S-13-09 which put DFG employees on unpaid furlough and closed offices statewide for the first, second, and third Friday of each month. Further reductions in salaries and other cuts are anticipated for 2010.

Marine Life Protection Act Project

As the lead agency in the state for the MLPA, the Department is responsible for Marine Protected Area planning, designing, and management. A Memorandum of Understanding established in 2004 created a unique public-private partnership among the following entities: the Department, the California Natural Resources Agency, and the Resources Legacy Fund Foundation. This partnership, known as the MLPA Initiative, continues to implement public policy through a series of regional planning processes. Each planning process includes input from a broad-based Regional Stakeholder Group, scientific advice from the Master Plan Science Advisory Team (SAT), and oversight and policy advice by a Blue Ribbon Task Force (BRTF). The final decision-making body for each planning process is the California Fish and Game Commission (Commission).

Two of five regional MLPA planning processes have been completed thus far. MPAs in the first planning region—the central coast study region spanning state waters from Point Conception (Santa Barbara County) to Pigeon Point (San Mateo County)—became effective in September 2007. MPAs in the second planning region, the north central coast study region (encompassing state waters from Pigeon Point [San Mateo County] to Alder Creek [Mendocino County]), were implemented in May 2010.

The south coast study region, which extends from Point Conception (Santa Barbara County) to the U.S./Mexico border, is the third region to undergo the planning process. Planning for this region commenced in June 2008 and the BRTF forwarded their integrated preferred alternative (IPA) as well as all South Coast Regional Stakeholder Group proposals to the Commission in December 2009. The Commission directed the Department to prepare the regulatory package including CEQA process using the IPA as their preferred alternative. Regulations are expected to be adopted in late 2010.

The fourth planning region, the north coast study region, which spans state waters from Alder Creek (Mendocino County) to the California/Oregon border, began in July 2009 with a series of informational public workshops. As was done in past study regions, the North Coast Regional Stakeholder Group will be developing alternative MPA proposals for the north coast study region. The SAT, Department, and California Department of Parks and Recreation (State Parks) will evaluate these proposals relative to how well they meet scientific guidelines developed by the SAT and follow Department and State Parks feasibility criteria, as well as the proposals' ability to meet the MLPA goals and objectives. An iterative MPA proposal process will continue through August 2010 that will be forwarded to the Commission at the end of 2010.

The San Francisco Bay study region is the last of the study regions to undergo the planning process and is set to commence in late 2010. See http://www.dfg.ca.gov/mlpa for more information.

Ocean Salmon

In April 2009, the Pacific Fishery Management Council (Council) and the California Fish and Game Commission (Commission) closed all commercial and severely limited recreational ocean salmon fishing, to protect Sacramento River Fall Chinook (SRFC). The 2009 10-day recreational fishery (August 29 through September 7, 2009) occurred in the coastal waters north of Horse Mountain to the California/Oregon border. The 10-day season was designed to target relatively abundant Klamath River fall Chinook, while minimizing impacts on recovering SRFC. The 2009 recreational ocean salmon fishery landed 672 Chinook salmon in 5,359 angler-days. In 2009, only 39,530 SRFC adults returned to spawn in the Central Valley, the lowest return on record. A total of 9,216 jacks (age-2 fish) returned. Based on these data the Council and the Commission will allow recreational and limited commercial fisheries in 2010. The fisheries result in a projected spawner escapement of 180,003 SRFC adults, which satisfies both the 2010 NMFS guidance and the Councils guidance to target 180,000 adult spawners.

Fishery-Independent and ROV Assessment Project

In 2009, Project staff, the Pacific States Marine Fisheries Commission (PSMFC), and partners continued Remotely Operated Vehicle (ROV) deep water quantitative surveys within and adjacent to the northern Channel Islands Marine Protected Areas. From 2005–2008, 7 of 11 finfishes that are targeted by fishermen had significantly higher densities in the reserves relative to outside fished areas. Project staff, PSMFC, and the National Park Service conducted the first year of exploratory ROV surveys in the North Central Coast Study Region at Tomales Point, Point Reyes Headlands, and Duxbury Reef. Project staff and PSMFC conducted the third year of ROV surveys in the Central Coast Study Region within and adjacent to MPAs from Monterey Bay to Point Buchon. For more information see http://www.dfg.ca.gov/marine/fir/dss.asp.

Project staff developed regression equations to evaluate vertical parameters as predictors of fish length. Due to a fish's continuous lateral flexion while swimming and angle to the viewer, its length is often difficult to estimate from videos. In many cases, vertical morphometric parameters such as depth at mid-orbit and depth at anal fin origin may be measured more accurately than horizontal parameters. Relationships between each vertical parameter and fork length were strongly correlated ($r > 0.973$) for kelp greenling (*Hexagrammos decagrammus*), lingcod (*Ophiodon elongatus*), blue rockfish (*S. mystinus*), black rockfish (*S. melanops*), and combined rockfish species ($r > 0.947$).

Kelp canopy aerial survey data were collected along the north coast from Pigeon Pt. to Alder Creek near Pt. Arena in the fall of 2009. In this region the surface area of both Nereocystis and Macrocystis kelp canopy was high at 7.7 km^2 with 2009 being the third highest in the eight-year record compared with the low in 2005 of 2.3 km^2, and an average of 5.3 km^2. Data are available on the DFG web site, http://www.dfg.ca.gov/marine/gis/naturalresource.asp, including metadata that describes methods and areas surveyed by year.

Invertebrate Fisheries Management Project

Invertebrate Project biologists completed a number of significant projects and reports in 2009, and continued progress on numerous ongoing activities. Lobster study biologists began catch and effort based modeling in 2009, initiated at a December 2009 spiny lobster stock assessment workshop at UCSB. First season (2008–09) lobster recreational fishery report card results have been processed and will be integrated into the stock assessment along with 2009–10 catch and effort estimates as they become available. Lobsters use eelgrass and rocky habitat in San Diego Bay, where commercial fishing is prohibited, making the bay a potential *de facto* reserve that may buffer San Diego's lobster population from declines. Project staff continued a joint study with San Diego State on lobster movement patterns within San Diego Bay in 2009. The size of the lobster population in the bay, and movement rates of lobsters between bay and coastal habitats are two goals of this research. In addition, a collaborative program using commercial lobster fishermen to collect biological and CPUE data from their catches was initiated.

The abalone project, divided into northern and southern California components, continued stock assessment work in both regions. Southern California staff continued the San Miguel Island Red Abalone Cooperative Tagging Study with quarterly monitoring beginning January 2009: onsite monitoring is conducted over a period of 1–2 days of diving using the R/V *Garibaldi* or R/V *Irish Lord*, in cooperation with California Abalone Association boats. The Pink/Green Abalone Translocation/Aggregation Study begun in 2008 includes monitoring of study sites for one year. Study sites for green abalone are at Catalina Island and pink abalone sites are at San Clemente Island. This study is funded in part by NOAA. The northern California abalone staff biologists completed revisions to the draft northern California abalone triennial status of the fishery report to the Fish

and Game Commission. Ongoing field work consisted of assessing three index stations and the abalone recruitment modules.

Project staff participated in the Dungeness Crab Task Force, a committee formed to discuss commercial crab management and make recommendations to the state by January 2010. Dungeness crab megalopae trapping continued in Humboldt Bay in an effort to establish a predictive population abundance index, complementing similar research in Bodega Bay begun in 2007, and coastal Oregon. Gaper clam and razor clam fisheries in Humboldt County were assessed by both creel census and transect surveys using methods developed earlier by Department biologists and researchers from Humboldt State.

California Recreational Fisheries Survey

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 uses field and telephone sampling to generate monthly estimates of total recreational finfish catch for four modes of fishing (private and rental boats, beaches and banks, man-made structures such as piers, and commercial passenger fishing vessels) for six geographic districts along California's 1,000 plus miles of coast. In 2009, approximately 40 samplers worked statewide to gather the field data. The CRFS samplers interviewed more than 66,000 anglers at more than 400 sites, and examined almost 207,000 fish. The licensed angler telephone survey completed almost 26,000 interviews.

In 2009, CRFS completed two pilot studies to improve the current methods of determining catch and effort for anglers who depart from marinas, mooring, and docks that CRFS field samplers cannot access (i.e., private-access). A Marina Study used field-based counts of the number of returning recreational fishing boats at seven southern California marinas to generate monthly estimates of private-access fishing effort. Those estimates were compared to estimates currently generated from the licensed angler telephone survey and a report has been drafted. In general the Marina Study verified the relative accuracy of the telephone survey's estimates of angler effort, however, the Marina Study's estimates tended to be more precise in months of low fishing effort. A Saltwater Angler Logbook Study used more than 1,000 volunteers representing publicly accessible boat sites and private-access sites to compare catch and discard rates by species between the two populations. The data analysis and report writing are in progress. The comparisons will provide a better understanding of the similarities and differences and can be used to refine the current methods. For more information: http://www.dfg.ca.gov/marine/crfs.asp.

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 2009–10 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 2008–09 season. Despite improved oceanic conditions reported for 2008, the spawning population exhibited further decline to a new historic low. The spawning biomass estimate for the 2008–09 season is 4,844 tons, less than ten percent of the historic average (1978–79 season to present) of 49,428 tons. The estimate is a 57 percent decrease from the previous season's estimate of 11,183 tons.

Coastal Pelagics: Sardine and Squid

The Pacific sardine, *Sardinops sagax*, fishery existed from the early 1900s, crashed in the 1940s, and saw resurgence in the late 1980s. In 2009, sardine was California's second largest fishery by volume and sixth in ex-vessel value. Statewide landings in 2009 were 82.8 million pounds (37,543 metric tons) with an ex-vessel value of approximately $5.6 million. This was a 35 percent decrease in volume from 2008, in which landings were estimated at 127.4 million pounds (57,803 metric tons) with an ex-vessel value of approximately $7.6 million.

In 2009, the coastwide harvest guideline (HG), as adopted by the Pacific Fishery Management Council (PFMC), was completely taken. This is the second time since its resurgence that the sardine HG had been achieved. In November 2008, the Council adopted a total HG of 66,932 metric tons for the 2009 Pacific sardine fishery, which extends from California to Washington. The behavior of the fishery in 2009 was characteristic of a "derby" style fishery, leading to a temporally shortened directed fishery. The directed Pacific sardine fishery was officially closed by NOAA Fisheries on September 23, 2008.

In November 2009, the Council adopted a HG of 72,039 metric tons for the 2010 Pacific sardine fishery based on a biomass estimate of 702,024 metric tons and the harvest control rule in the Coastal Pelagic Species Fishery Management Plan. This HG also incorporates a set-aside allocated for dedicated Pacific sardine research consisting of a coast-wide aerial survey with accompanying point sets during closed periods.

The California commercial market squid fishery in 2009 was the largest volume fishery and most valuable

fishery in the state. Statewide, over 200 million pounds (93,371 metric tons) of market squid were landed in 2009 with an ex-vessel value of $56.4 million. In 2008, the fishery landed 84 million pounds (38,100 metric tons) and was worth $26.4 million. From 1999 to 2008, the market squid fishery averaged $20.7 million in value and 142.7 million pounds (64,730 metric tons) in landings. The average price per pound decreased from $0.31 in 2008 to $0.28 in 2009.

The presence of market squid is strongly correlated with environmental factors, such as water temperature and nutrient availability. Although the majority of landings usually occur in southern California, landings in Monterey have been considerably lower since 2005. The decline in squid landings have been attributed to the cyclical nature of the market squid population and changes in environmental conditions.

Market squid is a federally monitored species and a state managed fishery. In 2005, the California Fish and Game Commission adopted the Market Squid Fishery Management Plan (MSFMP), which implemented a series of fishery control rules. A harvest guideline of 236 million pounds (107,048 metric tons) for each fishing season (April 1 through March 31 of the following year) was enacted along with weekend closures, gear closure areas to protect squid spawning a light boat wattage restriction, and shielding requirements as well as a limited entry program.

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