2016 CALIFORNIA LEGISLATIVE FISHERIES FORUM

Annual Marine Fisheries Report

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Executive Summary

Management and protection of California's vast and complex marine ecosystems and fisheries is one of the primary missions of the Department of Fish and Wildlife (Department). It involves a complicated process of coordination and collaboration among multiple entities, including the State Legislature, the Fish and Game Commission (Commission), the Pacific Fishery Management Council, the Federal Government and the Department. Within the Department, the Marine Region with its 146 permanent and 95 temporary positions focuses on the approximately 145 species with a history of active management. Included in this multitude of fish and invertebrates is a subset of species which consistently accounts for high recreational and commercial catch volumes and economic values. California's ocean fisheries can be grouped into two broad categories: finfish (including Pacific salmon, groundfishes, coastal pelagic fishes, and highly migratory fishes) and invertebrates. Invertebrate fisheries have been growing in importance worldwide and are now California's most important fisheries by both volume and value. Since 1980 there has been about a 170% increase in the value of marine invertebrate fisheries in California. This trend in the expansion of California invertebrate fisheries follows global fishery trends. In the eastern Pacific Ocean, there has been a 400% increase in the landings of invertebrate fisheries from 1950 to 2011[1].

State ocean management policy is guided by the landmark twin marine conservation acts, the Marine Life Management Act (MLMA) and the Marine Life Protection Act (MLPA), the former focuses on sustainable use, conservation (including habitat protection), rebuilding depressed stocks, preventing overfishing, and establishing a scientific foundation for management decisions; while the MLPA establishes a network of marine protected areas to conserve the integrity of our marine ecosystems. Federal fisheries management is guided by the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Fishery management plans (FMPs) are a fundamental mechanism for implementing management policies of the MLMA and MSA.

In addition to government entities, the Department seeks to broaden and deepen its capability in managing these important resources by working directly with fishermen, academic research scientists from California's public and private universities and Sea Grant, as well as non-governmental organizations (NGOs). Eight FMPs have been adopted pursuant to the MLMA and MSA, which in combination encompass well over 100 different species. The Department is also nearing completion of a spiny lobster FMP, a multi-year collaborative process, expected to be presented for final consideration by the Commission in early 2016. In addition, the Department in 2014 initiated the development of a northern red abalone FMP, starting the process with numerous public outreach efforts, including workshops and on-line surveys to obtain guidance on goals and objectives for the FMP.

[1] Rogers-Bennett, L. and C I. Juhasz. 2014. The rise of invertebrate fisheries and the fishing down of marine food webs in California. Calif Fish & Game, 100(2):218-233.

In an ongoing effort to prioritize Department staff resources in accordance with the needs of California's fishery resources, §7073 of the Fish and Game Code requires a Master Plan to serve as a roadmap for the development of FMPs, specifying the process and resources needed to prepare, adopt, and implement FMPs for sport and commercial marine fisheries managed by the state. The first Master Plan was completed in 2001, with a comprehensive update slated to be completed in 2017. Among other things, this updated Master Plan will help us determine which of the fisheries currently managed without an FMP should be next in line for FMP development. In the interim, many other fisheries are actively managed without an FMP, and in those cases the same standards of sustainability, conservation, and science-based information are applied.

This report focuses on reporting catch and economic fishery statistics for the calendar year 2014, since at the time of writing, 2015 statistics were incomplete.

- **In 2014, statewide commercial landings totaled 358 million pounds worth $235 million to fishermen. In 2013, 363 million pounds of finfish and shellfish were landed in California ports worth $256 million to fishermen[2]. Market squid accounted for the state's largest fishery landings with 228 million pounds valued at $72.4 million ex-vessel, while Dungeness crabbers landed 18.4 million pounds, valued at $66.8 million. The price of spiny lobster soared to over $19 per pound ex-vessel and with 951,000 pounds landed, the lobster catch was valued at $18.2 million. Chinook salmon was another top ranked fishery, with 2.2 million pounds landed, valued at $12.1 million.**

- **Marine recreational fishing activities support approximately 12,000 full- and part-time jobs in California, and contribute $2.2 billion to the California economy annually[3].**

- **Total shellfish production in 2014 reached a total of 1.8 million pounds, all species combined. This resulted in a value of $23.8 million. Compared to 2013, this was a 1% decrease in production, all species combined.**

Some highlights in marine resources management during 2014 include:

- **California Recreational Fisheries Survey (CRFS) samplers interviewed over 68,000 angling parties about their fishing activities. Samplers examined and identified about 245,000 fish, and measured nearly 132,000 fish.**
- **Staff reviewed over 500 environmental documents; submitted over 70 comment letters and permits**

[2] California Fisheries Information System, CDFW, 2015

[3] National Marine Fisheries Survey. 2013. Fisheries Economics of the United States, 2012. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-128. 175 p. http://www.st.nmfs.noaa.gov/economics/publications/feus/fisheries_economics_2012

- **Distributed over 28,000 MPA guides and 17,000 MPA brochures**
- **Entered over 65,000 commercial landing receipts into databases**
- **In conjunction with partner agency staff, determined age and origin of approximately 45,000 salmon taken in sport and commercial fisheries**
- **Publication of Special Marine Issue of California Fish and Game – 9 peer reviewed articles**
- **Prepared eleven regulatory packages considered by the Fish and Game Commission**
- **Processed 391 Scientific Collecting Permit applications and issued 350 permits**
- **Logged over 2,600 staff hours attending Pacific Fishery Management Council (PFMC) meetings**

California is home to the largest scientifically designed network of Marine Protected Areas (MPAs) in the United States. This year, the Department is updating the 2008 Master Plan for Marine Protected Areas. The updated 2015 Master Plan is a guidance document that shifts the focus from designing and siting California's MPA network to setting a statewide framework for MPA management.

In January 2014 the Department initiated expeditions utilizing remotely operated vehicles (ROV) to explore deep water habitats in each of the four Marine Protected Area regions, north, north central, central and south coast. These quantitative surveys occur both inside and outside California's MPAs, at locations previously identified using bathymetric data collected by the California Seafloor Mapping project (CSMP). Within these index sites the project characterizes ecological conditions by quantifying and describing the abundance and distribution of fish and invertebrate species.

- **ROV surveys completed in 2014 collected video and still imagery from 81 distinct sites. Twenty MPAs were visited including eleven state marine reserves (SMRs) and nine state marine conservation areas (SMCAs), two of which are designated as no-take.**

- **Over 200 kilometers of video strip transects were performed resulting in 108 hours of video. Along these transects over 15,000 high resolution still images were captured. This imagery is being processed for habitat classification, species identification, and spatial referencing.**

California fisheries, along with the entire west coast, face a myriad of challenges going forward, including rising ocean temperatures, acidification and new and harmful algal blooms and disease agents. Coupled with such issues as marine mammal gear entanglement and endangered species bycatch in trawl fisheries, these developments threaten the stability and longevity of our coastal fishing communities.

2015 was an especially challenging year as reported whale entanglement events increased significantly in central and southern California waters, sea star wasting disease continued to wipe out nearly all sea stars in coastal waters from Washington to Mexico, and a harmful neurotoxin called domoic acid, produced by a massive bloom of marine diatoms extending along all three coastal states, threatened the economically important Dungeness and rock crab fisheries. On top of all of these issues, Department marine staff found themselves in the middle of a devastating oil spill along the Santa Barbara mainland, and had to drop everything and help design and implement a sampling plan to assess the extent of the damage to the valuable marine resources and habitats in that area. The Department's dedicated management and staff work diligently every day to meet challenges like these for the people of California.

The fisheries reports that follow provide background information for selected California recreational and commercial fisheries, as well as landing information and updates through 2014.

Fisheries Reports

PACIFIC SALMON

The Pacific Fishery Management Council's (Council) Salmon Fishery Management Plan (FMP) was developed in 1977 and was the first FMP implemented by this entity. Each year, the Council develops management measures that establish fishing areas, season dates, harvest quotas, legal fishing gear, minimum size lengths, and possession and landing restrictions for salmon fisheries in federal waters off California, Oregon, and Washington. These measures must meet the goals of the FMP that address spawning escapement needs, allow for freshwater fisheries, allow for Federally-recognized Tribal fishery rights, and meet the needs of salmon species listed under the federal Endangered Species Act (ESA). Of the five species of Pacific salmon found on the West Coast, Chinook and coho are most frequently encountered off California; however, the retention of coho salmon has been prohibited in all California fisheries since 1993.

Reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act and federal guidelines on Annual Catch Limits and Accountability Measures required changes to the Salmon FMP in 2011. Amendment 16 to the Salmon FMP features an updated science-based conservation objective for Klamath River fall Chinook (KRFC), guidelines for establishing ocean fisheries during periods of very low salmon abundance, and provides clear definitions of reference points to be used by the Council to

determine the status (e.g., overfished, rebuilt) of specific salmon stocks. The new requirements of the FMP were implemented in 2012.

The ESA requires that the National Marine Fisheries Service (NMFS) assess the impact of ocean fisheries on listed salmon populations and develop standards that avoid the likelihood of jeopardizing their continued existence. Sacramento River winter Chinook (SRWC), Central Valley spring Chinook, California Coastal Chinook (CC-Chinook), and all California coho salmon stocks are listed under federal and state ESAs. Consequently, the California Fish and Game Commission, the Council, and the NMFS have developed management objectives to reduce fishery impacts on these stocks.

Since the late 1980's, California ocean salmon fisheries have been constrained to reduce impacts on ESA-listed SRWC. Endangered SRWC are incidentally harvested in ocean salmon fisheries, primarily by sport anglers fishing south of Point Arena (Mendocino County) that are targeting more abundant Central Valley stocks. In April 2010, the NMFS issued an updated Biological Opinion (BO) with the conclusion that ocean salmon fisheries continue to jeopardize the continued existence of this depressed stock in spite of fishing area closures and size limit restrictions. A new requirement of the 2010 BO was to develop methods to quantify impacts of fisheries on SRWC and assess potential impacts of proposed fisheries. As a result, new analytical tools were developed and approved by the Council for use in fishery management; however, the available data suggests that downward trends in SRWC cannot be readily explained by ocean harvest, especially since California fisheries were completely closed in 2008 and 2009. In 2012, the NMFS introduced a maximum ocean fishery impact rate on SRWC based on current population status in addition to fishing area closures and minimum size limit restrictions. In 2014, the maximum ocean impact rate on SRWC was 15.4%. Management strategies in place to protect SRWC are considered sufficient by the NMFS to also protect ESA-threatened Central Valley spring Chinook.

Since 2000, California ocean salmon fisheries have also been constrained to reduce impacts on ESA-listed CC-Chinook. This threatened stock includes all coastal Chinook populations between, and including, Redwood Creek (Humboldt County) and the Russian River (Sonoma County). No hatchery component exists for this stock and genetic stock identification data is limited, thereby making it difficult to assess total ocean harvest rates. Furthermore, spawning escapement data is lacking and the limited data available do not allow for estimation of abundance nor provide an applicable index of abundance. Inadequate ocean fishery and spawner data have precluded development of a CC-Chinook specific management strategy, requiring the use of age-4 KRFC as a proxy. The NMFS 2000 BO designated a maximum forecasted ocean harvest rate of 17% on age-4 KRFC, which was later reduced to 16% in 2002 based on data from a new KRFC cohort reconstruction model.

In 2007, a Constant Fractional Marking program was initiated in California to increase the mark and coded-wire tag (CWT) rate of hatchery produced fall

Chinook. Each release group is tagged representatively with at least 25% of all fall Chinook releases being adipose fin-clipped and implanted with a microscopic (≤1 mm) CWT. This CWT is imprinted with a unique code that provides release information such as hatchery of origin, brood year, release location, and release strategy (e.g., bay net pens, direct bay release, direct river release). The primary goal of this program is to estimate in a statistically valid manner the relative contribution of hatchery production to harvest and escapement, and to evaluate release strategies being employed throughout California. In 2014, nearly 20,000 CWTs were collected from the California commercial and recreational ocean salmon fisheries. Hatchery-origin Chinook comprised approximately 59% of the commercial harvest and 69% of the recreational harvest. Of those hatchery-origin Chinook, Sacramento River fall Chinook contributed over 80% to ocean salmon fisheries, with the remainder comprised of other Central Valley and Klamath-Trinity stocks, as well as a very small contribution of Oregon and Washington stocks.

Spawning escapement, in conjunction with harvest data is used to predict the ocean abundance of Klamath River and Sacramento River fall Chinook available to ocean salmon fisheries. Spawning escapement of both stocks in 2013 resulted in ocean abundance forecasts that allowed for commercial and recreational fishery seasons in 2014. Fisheries in 2014 were primarily constrained by restrictions to protect ESA-listed stocks.

In 2014, commercial salmon fisheries were allowed from May through October, with variable open dates within management areas to meet the NMFS guidance and FMP conservation objectives. The ocean area between the Oregon/California border and Humboldt South Jetty (Klamath Management Zone) had a small quota during September.

- **Statewide commercial landings (number of Chinook) and total fishing effort (boat-days fished) decreased in 2014 compared to 2013. The commercial fleet landed 1,100 tons of dressed Chinook (166,500 fish) during 14,200 boat-days fished in 2014; compared to 1,900 tons of dressed Chinook (297,600 fish) during 17,300 boat-days fished in 2013. Ex-vessel prices for dressed salmon averaged $5.54 per pound and the nominal ex-vessel value of the commercial salmon fishery was over $12.3 million in 2014.**

The 2014 recreational season also satisfied the NMFS ESA consultation standards and FMP management objectives for relevant Chinook stocks. Restrictions to protect ESA-listed SRWC primarily affected the recreational fishery, and included a larger minimum size limit (24 inches total length) through June in areas between Point Arena and Pigeon Point, and for the entire season south of Pigeon Point. The number of Chinook landed and fishing effort in the 2014 California recreational decreased compared to 2013.

- **Recreational anglers landed approximately 74,700 Chinook during 120,300 angler-trips in 2014 compared to 116,100 Chinook landed during 147,300 angler-trips in 2013.**

The Fishery Economic Assessment Model (FEAM) estimated that California personal income impacts for the 2014 ocean salmon fishery exceeded $31 million, with approximately $20 million from the commercial fishery and $11 million from the recreational fishery. This is a decrease from the 2013 FEAM estimate that was in excess of $52 million, with approximately $39 million from the commercial fishery and $13 million from the recreational fishery.

For more information on the 2015 ocean salmon season, please visit the California Department of Fish and Wildlife website at https://www.wildlife.ca.gov/Fishing/Ocean/Regulations/Salmon or the Pacific Fishery Management Council website at http://www.pcouncil.org/salmon/current-season-management.

GROUNDFISH FISHERIES

Approximately 92 species of bottom-dwelling marine fishes are included in the federal Groundfish Fisheries Management Plan (GFMP) implemented by the Pacific Fishery Management Council (Council) in 1982. Since then, these species have been managed under the joint jurisdiction of the state and federal government. Species and species complexes managed under the GFMP include all rockfishes (about 60 species), sablefish, thornyheads, lingcod, Dover sole and selected other flatfishes (not including California or Pacific halibut), Pacific whiting, and some sharks and skates. Federally designated "overfished" groundfish species including bocaccio, canary, cowcod and yelloweye rockfishes are protected with very low catch limits (bycatch only) while stocks rebuild. Low bycatch limits also constrain recreational and commercial fishing opportunities for healthy fish stocks found in association with the overfished species. New assessment results in 2013 indicated that several overfished species are rebuilding on-track or ahead of schedule. Seventeen species included in the GFMP are also included in California's Nearshore Fishery Management Plan.

The commercial fishery is generally regulated by a combination of allowable fishing depths, trip limits, permit and gear restrictions, and season adjustments to prevent landings from exceeding catch limits. Beginning in 2011, an Individual Quota system was implemented for managing the commercial trawl fishery for federal groundfish (see the Trawl Individual Quota section below). The recreational fishery is regulated using daily bag limits, seasons, area closures, size limits, gear, and depth restrictions.

- **2014 commercial groundfish landings for all gears in California totaled 14.8 million pounds (6,715 metric tons) with an ex-vessel value of approximately $19.6 million.**
- **2014 recreational groundfish catch in California totaled 3.9 million pounds (1,774 metric tons).**

Depth-based Rockfish Conservation Areas (RCAs) implemented in 2003 continue to be used to protect rebuilding overfished species by closing their primary depth range to groundfish fishing. The RCA closures are expected to remain in place until overfished stocks are rebuilt or a better management approach is adopted. The RCA depth boundaries have been modified to accommodate healthy fisheries as much as possible, and change throughout the year to increase or restrict access as needed. However, fishing on healthy stocks remains constrained.

Trawl Individual Quota Program

In 2011, a new program was implemented for the West Coast Groundfish Trawl fleet which changed how fish are harvested in California. The Trawl Individual Quota (TIQ) program was developed over several years with input from state and federal governments, non-governmental organizations, fishing communities and the public. Under the TIQ program, limited entry trawl permits are allocated quota shares and corresponding quota pounds for target groundfish species and species complexes based upon past fishery participation. Quota pounds are assigned to a vessel, and may be leased to individuals/entities for use. The TIQ program encompasses 21 species and three species complexes and allows for the use of non-trawl gears making it one of the most complex programs of its kind in the nation.

As with any new program, it can be difficult to fully understand and evaluate fishery trends in the early years after implementation. However, preliminary data suggest though that this program is having positive benefits. Since transitioning to the new program, there has already been a substantial reduction in bycatch of overfished species compared to years prior to TIQ and increased utilization of target species.

One of the anticipated results of the TIQ is that fleet capacity will be reduced as less efficient vessels leave the fishery. This trend has not yet occurred in California and vessel participation has remained constant since program implementation. This trend may change in future since quota shares can be sold as of 2014 and fishermen can leave the fishery, though data regarding sales or attrition are not yet available.

In 2014, a total of 11.2 million pounds were landed in California under the TIQ program, a decrease of 0.2 million pounds compared to 2013. Ex-vessel value increased by $1.2 million dollars in 2014 to $9.5 million dollars. Although TIQ landings comprise the majority of commercial groundfish landings in California by volume (11.2 million pounds out of 14.8 million pounds), they account for less than half (48%) of the overall value ($9.5 million out of $19.6 million).

Given the complexity of this program, not all program elements could be completed in time to meet the January 2011 implementation deadline. Therefore, the Pacific Fishery Management Council initiated a series of ongoing trailing regulatory actions to address outstanding components, emerging issues and program enhancements. As a result, fishery management resources continue to be required to analyze and complete the TIQ program[4]. Given the number of trailing actions needed to address those issues which have been identified, it is unlikely that workload requirements will decrease in the foreseeable future. In fact workload may increase as the program continues to evolve and further enhancements are identified.

In 2014, the Pacific Fishery Management Council developed a regulatory framework to allow for the use of electronic monitoring (i.e., video cameras) in lieu of the current 100% human observer requirement on all trips. This framework was developed because some fishery participants experienced difficulty securing observers in a timely or consistent manner. The electronic monitoring program was developed over three years and is expected to reduce overall operating costs while still achieving overall program monitoring goals.

For more information on the TIQ program, go to the Pacific Fishery Management Council's website:
http://www.pcouncil.org/groundfish/fishery-management-plan/fmp-amendment-20/

For more information on groundfish, go to the Department's Marine Region website:
https://www.wildlife.ca.gov/Conservation/Marine/Groundfish

Essential Fish Habitat

In 2010, the Pacific Fishery Management Council initiated a review of the Pacific Coast groundfish essential fish habitat (EFH). Groundfish EFH is defined as generally between the shore line out to depths of 3,500 m as well as seamounts in depths greater than 3,500 meters. EFH also includes Habitats of Particular concern such as estuaries, canopy kelp, seagrass, and rocky reefs.

The EFH review consists of summarizing the results of information that is new since the last groundfish EFH review in 2006 (Phase I), considering changes to EFH and soliciting public proposals to consider changes to groundfish EFH (Phase II), and implementing appropriate management changes to revise EFH (Phase III). In March 2014, Phase I of the review was completed. Phase II is now underway and eight public proposals were submitted to the Pacific Fishery Management Council which include a number of changes to EFH. Phase II is

[4] Once implemented, the TIQ program was expected to be self-sustaining and require less input to address management issues in the long term. This would allow fishery managers to focus future resources on other fishery sectors which were largely ignored during TIQ program development. Given the number of ongoing trailing actions to address various components of the TIQ program, the anticipated long term workload savings will likely not materialize.

expected to move slowly given the number and complexity of proposed changes contained in the public proposals.

Federal Legislation

In 2003, Congress authorized a $46 million buyback program to address overcapitalization in the groundfish trawl fishery. The buyback program permanently removed 91 vessels and 239 fishing permits from the groundfish trawl fishery and associated fisheries of the coasts of California, Oregon and Washington, with the loan being repaid by fishermen remaining in the fishery. In December 2014, Congress signed into law the REFI Act (HR 2646) which lowers the interest rate on the 2003 Federal groundfish trawl buyback loan. In 2003, the interest rate was 6.7 percent; it has now been lowered to the current Treasury rate (which is lower), and the loan term was extended to 45 years. The total annual savings to the fleet (120 active vessels coastwide) is estimated at over $1 million per year.

COASTAL PELAGIC FISHERIES

California Market Squid

In 2014, market squid *(Loligo (Doryteuthis) opalescens)* continued to dominate commercial landings of marine species in California, contributing about 64% of the total tonnage and 30% of total ex-vessel value of all species landed. Landings of market squid in 2014 decreased 2% compared to 2013 landings, from 104,370 t to 102,516 t. Ex-vessel value in 2014 decreased 3% compared to 2013, from $73.7 million to $71.8 million.

- **California fish businesses exported 89,240 t of market squid to 40 countries for a value of $114 million in 2014 (http://www.st.nmfs.noaa.gov/commercial-fisheries/foreign-trade/). The majority (86%) was shipped to just 3 countries but most (73% of the total amount) went to China.**

For the fifth season in a row, since the inception of the Market Squid Fishery Management Plan in 2005, market squid landings were projected to reach the seasonal catch limit of 107,048 t. By November 18, 2014, 97.2% of the catch limit had been landed. On this date, the seine sector of the squid fleet made a voluntary decision to stop fishing so that the remaining portion of the catch limit could be set aside for the brail sector. Neither the brail nor seine sector of the commercial fleet made directed landings of market squid after November 18, 2014 and the 2014/15 season ended without reaching the seasonal catch limit.

Commercial fishing for market squid is limited by fishery control rules set forth in the Market Squid Fishery Management Plan. Vessels are required to have a permit to commercially fish for market squid. In 2014, there were 75 market squid vessel (purse seine), 34 light boat (attracting), and 44 brail (or dip net) permits issued. Of the 75 vessel permits issued, 64 vessels were active in the fishery with 52 vessels contributing 95% of the landings. Of the 44 brail permits issued, 11 brail vessels landed squid. Other fishery control rules include a seasonal catch limit that starts April 1 and ends March 31 of the following year, weekend closures, spatial closures, and lighting restrictions.

The geographic distribution of market squid landings in 2014 is particularly interesting. Although the fishery has its historical origins in Monterey Bay, it had been dominated by southern California landings in recent years. Landings north of Point Conception have increased since 2010 and increased sharply in 2014. This sharp increase, paired with a sharp decrease in landings south of Point Conception, meant the fishery was no longer dominated by southern California in 2014. The Department's Commercial Fisheries Information System (CFIS) contains landing data back to 1980 and contains no record of directed squid landings north of the San Francisco Bay prior to 2014.

- **The 2014/15 season represents the first time in recent history that directed fishing for market squid has resulted in landings to the port of Eureka. A shift in oceanic conditions, such as sea surface temperature (SST), may have attributed to this northward shift of landings.**

Market squid live less than a year and have been found in nearshore waters of the eastern Pacific Ocean from Baja California to the Gulf of Alaska. The population appears to fluctuate widely in abundance in response to short-term oceanographic events, like the El Niño Southern Oscillation. Ecologically, they are considered important as forage for other species, including predatory fishes, marine mammals, and seabirds.

A live bait fishery exists for market squid, largely to supply recreational fishing in southern California. The live bait fishery is a low-volume, high-value endeavor, as recreational anglers are willing to pay up to $60 for a "scoop" of live squid, which averages 10 lbs. As a comparison, the average price paid to the commercial fleet in 2014 was $0.32 per pound.

Coastal Pelagic Finfish

Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), and northern anchovy (*Engraulis mordax*) form a finfish complex known as coastal pelagic species (CPS). These species are jointly managed by the Pacific Fishery Management Council (Council) and the National Marine Fisheries Service (NMFS) under the Coastal Pelagic Species Fisheries Management Plan (CPS FMP). In 2014, total commercial landings for these species equaled 24,483 t with a combined ex-vessel revenue of over $4.9

million. When compared to landings in 2013, this represents an 11.1% and 15.3% increase in volume and value, respectively. For the first time since 1982, the northern anchovy fishery ranked as the largest by volume among these four species in 2014, comprising 42.9% of the total volume and 32.4% of the total value.

Pacific Sardine. The Pacific sardine fishery is composed of three subpopulations, northern, southern, and Gulf of California. While the fishery ranges from Baja California, Mexico, north to British Columbia, Canada, the majority of landings have occurred in southern California and northern Baja California since the 1980s. Landings of sardine have steadily increased in the Pacific Northwest and Canada since the recent expansion of the sardine fishery in 1999; however, there were no landings in Canada in 2014. Combined landings of Pacific sardine for California, Oregon, and Washington totaled 23,271.8 t, a 63.6% decrease from the 63,891.3 t landed in 2013.

The US Pacific sardine harvest guideline (HG) for each calendar year is determined from the previous year's stock biomass estimate of the northern sub-population (of ≥1-year-old fish on 1 July) in US and Mexican waters. The recommended HG for 2014-15 season was 28,646 t based on a biomass estimate of 369,506 t (a 44% decrease from the 2013 biomass estimate of 659,539 t). The Pacific sardine HG was apportioned coast-wide through the year with a 40% allocation of the annual HG from 1 July through 14 September, 25% (plus any portion not harvested) allocated from 15 September through 31 December, and the last 35% (plus any portion not harvested from the first two allocations) released on 1 January. Landings above the HG would be constrained by an incidental catch rate of 45% by weight when landed with other CPS with an additional 500 tons per allocation set aside for incidental catch.

In November 2013, the start date of the 12 month Pacific sardine fishery was changed from 1 January to 1 July; this changed the fishing season from one based on a calendar year (1 January–31 December) management cycle to a fishing season (1 July–30 June) cycle. This change better aligned the timing of the research and science required for annual stock assessments with the annual management schedule. A one-time interim harvest period from 1 January 2014 through 30 June 2014 was established with an allocation of 5,446 t to allow targeted fishing to continue during the transition to the new management cycle.

In 2014, the US West Coast fisheries harvested a large portion (81.2%) of the HG. The 2014 interim period (1 Jan-30 Jun) lasted almost the entire allocation period, 175 days. The first allocation period for the 2014-15 season (1 Jul-14 Sep) lasted 23 days. The second period (15 Sep- 31 Dec) lasted only 5 days. A decrease in the biomass and harvest guideline in 2014 largely contributed to the general decrease in US commercial landings of Pacific sardine.

- **California commercial landings of Pacific sardine come from the northern subpopulation. This fishery in California has long been one**

of the largest in the state. In 2014, it was the fourth largest in volume and twelfth largest in value, landing 7,768.0 t and generating an ex-vessel revenue of $2 million.

This was a 9.8% increase from 2013 (7,074 t). Commercial landings of sardine averaged 39,979 t over the fourteen year period from 2001–14. Nearly all (98.6%) of California's 2014 sardine catch was landed in Los Angeles (18.4%, 1,430.0 t) and Monterey (80.2%, 6,233.0 t) port areas. California exported 6,497.1 t of sardine product worth over $6.2 million. Twenty-six countries received sardine product from California; Japan and Australia received the majority at 25.6% and 9.9%, respectively.

Oregon landings appeared to be leveling off since 2008; they experienced a large jump in 2012 and decreased in 2013 and 2014. Landings of Pacific sardine totaled 7,788.5.4 t, a 70.4% decrease from 2013 (26,288.4 t). In 2013, Oregon exported 88 t of sardine product to 1 country (Malaysia) worth $113,021.

Washington landings of Pacific sardine totaled 7,783.8 t in 2014, a decrease of 74.4% from 2013 (30,457.1 t). They exported 16,614.6 t of sardine product to 20 countries, totaling $15.8 million in revenue.

The recreational Pacific sardine catch as sampled from the California Recreational Fisheries Survey (CRFS) was 12.6 t (127,321 fish). The majority (94.8%) of the fish landed were from manmade structures, such as piers. The tonnage and number of fish decreased from 2013, 83.6 % and 82.6% decreases respectively.

Pacific Mackerel. In 2014, 5,420 t of Pacific mackerel were landed in California generating over $1.2 million in ex-vessel revenue, and making it California's fifth largest volume fishery. This is a 32.8% decrease in volume and a 19.3% increase in ex-vessel revenue from 2013. Monterey area ports landed 243.4 t while landing nearly no Pacific mackerel in 2013. A shift in oceanic conditions, such as sea surface temperature, may have attributed to Pacific mackerel landings shifting northward.

Industry exported 2,994.5 t of mackerel product, valued at $2.6 million, mainly for human consumption, to 20 countries. The Philippines (1,074.3 t) and Egypt (447.5 t) received over 50% of this product.

Oregon reported landing 1,172.3 t of Pacific mackerel in 2014, with an ex-vessel revenue of $324,624. This is a 167% increase from the 2013 catch of 439.3 t. No exports were reported for Oregon.

Washington reported landing 544.6 t of Pacific mackerel in 2014, with an ex-vessel revenue of $155,337. There were no landings of Pacific mackerel in 2013. No exports were reported for Washington. They exported 1,341.7 t of mackerel

product, valued at $1.9 million, mainly for human consumption, to 15 countries. Ghana (247.3 t) and Malaysia (190.2 t) received over 50% of this product.

At the start of the 2014–15 season, which runs from 1 July to 30 June the following year, the PMFC set the HG at 29,170 t, including a 5,000 t set-aside for incidental landings in other fisheries. Landings above the HG would be constrained by an incidental catch rate of 45% by weight when landed with other CPS.

The 2014 recreational Pacific mackerel catch as sampled from CRFS was 285.4 t (1,743,740 fish), a 79.3% increase (93.1% by number of fish) from 2013. The majority (49.5%, 863,230 fish) of fish landed were from manmade structures; 43.1% of fish were landed on commercial passenger fishing vessels (CPFVs).

Jack Mackerel. Jack mackerel has long been the smallest of the federal CPS finfish fisheries. It is a monitored species under the CPS FMP. Jack mackerel represented 3.2% of the total landings of the CPD finfish fisheries in California for 2014. Landings of jack mackerel totaled 784.4 t in 2014, with an ex-vessel revenue of $148,947 for California. Oregon reported landing 800.4 t of jack mackerel, with an ex-vessel revenue of $146,577. This is a 549.7% increase from the 2013 catch of 123.2 t. Washington reported landing 242.7 t of jack mackerel in 2014, with an ex-vessel revenue of $59,210. This is an increase of over 204.9% from the 2013 catch of 79.6 t.

The 2014 recreational jack mackerel catch as sampled from CRFS was 8.6 t (56,091 fish), a 101.7% increase (152.6% by fish) from 2013. A total of 31,224 fish were landed on manmade structures.

Northern Anchovy. Composed of three stocks, southern, central and northern, landings of northern anchovy in California have been reported since the early 1900s. Northern anchovies are only occasionally landed in Oregon and Washington (primarily used for live bait). The California fishery is harvested from the central stock, which ranges from San Francisco to northern Baja California. Currently, northern anchovy are a monitored species under the CPS FMP. Studies of scale deposits on the sea floor suggest that their abundance has historically been quite large. Now used for animal food, live bait, and human consumption, anchovy was used mainly in a reduction industry to produce oil and fish meal in the 1900s. From the 1900s to the late 1970s, northern anchovy was a major component of California's commercial CPS fisheries. During periods of low sardine abundance, anchovy landings have increased, hitting a peak in the mid-1970s at over 100,000 t. However, commercial landings of northern anchovy have remained relatively low since the 1980s due to market constraints. Presently, landings of northern anchovy are modest, averaging 7,877 t per year over the last 14 years.

Landings of northern anchovy in California for 2014 were 10,511 t with an ex-vessel revenue of greater than $1.6 million. When compared to landings in 2013, this represents a 75.0 % and 49.9% increase in volume and value, respectively.

Nearly all (98.7%; 10,378.8 t) of California's 2014 northern anchovy catch was landed in the Monterey port area. Exports of northern anchovy product from California totaled 416 t for an export value of over $1.5 million. Seven countries received anchovy product from California; Australia received the majority at 77.0%.

In 2014, Oregon and Washington reported no landings of anchovy. Oregon did not report any anchovy exports in 2014. Washington exported 1.9 t of anchovy product to Canada, totaling $13,336 in revenue. The 2014 recreational northern anchovy catch as sampled from CRFS was 4.1 t (227,759 fish), a 25.1% decrease (50.1% by fish) from 2013. The majority (91.6%) of the fish landed were from manmade structures, and 6.5% of fish were landed from CPFVs.

PACIFIC HERRING

Fishing effort for Pacific herring (*Clupea pallasi*) in 2014 continued at reduced levels when compared to historic landings for California. San Francisco Bay was the only active fishery during this reporting year. There has been no commercial fishing effort in Tomales Bay since 2007, Humboldt Bay since 2005, and Crescent City Harbor since 2002. During the 2014 sac roe season (January 2014–March 2014), the San Francisco Bay fleet landed 2,901.2 t, an increase over the 2013 landings (2,115.6 t) (Fig. 1) and 93% of the 3,122.5 t quota.

The forecast base price for roe herring is a good indicator of the economic status of the fishery and determines whether fishermen will participate in the fishery. Ex-vessel prices for roe herring are set using a base price with an additional roe percentage point bonus. The base price is set per short ton of roe herring with a minimum roe percentage of 10%. Roe herring that are landed which exceed the minimum roe recovery level are given a bonus for each percentage point exceeding 10%. Ex-vessel prices in the herring sac roe fishery can vary greatly based on roe recovery rates. The 2014 base price for roe herring with 10% or greater roe recovery was $200 per short ton landed, with an additional $20 paid for each percentage point above the 10% baseline. The average roe count for the 2014 season was 13.4% resulting in an ex-vessel value of $268 per short ton. Due to a decrease in base price, the statewide ex-vessel value of the herring sac roe fishery fell from $1,702,360 in 2013 to $857,064 in 2014

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The San Francisco Bay herring-eggs-on-kelp (HEOK) fishery landed 0 t during the 2014 season, however the fishery was active during the 2013 season, landing 35.7 t of HEOK product. Price paid for HEOK typically ranges from $8-22 per pound depending on the quality of the product.

During the 2014 season, the Department conducted spawn deposition surveys in San Francisco Bay to estimate the spawning biomass of the herring stock. The

spawning biomass estimate for San Francisco Bay was 54,999 t, a 23.8% decrease over the previous season's estimate of 72,130 t. However, 2014 was the fifth consecutive year of increased biomass since the historic low in the 2009-10 season of 4,394 t and was above the long term average biomass for San Francisco Bay (1979-2014) of 47,445.8 t. There were no spawning biomass estimates conducted in Tomales Bay, Humboldt Bay, or Crescent City for 2014.

The commercial herring fishery is closely regulated through a catch-quota system to provide for adequate protection of this important forage species. The Department conducts annual assessments of the spawning herring population in San Francisco Bay as part of its ongoing monitoring and management of the fishery. The Department also examines age structure, growth, general condition and biological aspects of the catch. These data serve as the basis for establishing fishing quotas for the following season. The quota range is based on the determination of the Department's assessment of the stock status, utilizing the best science available. This includes, but is not limited to, recent fishery-independent field surveys, commercial catch and age composition analysis, and environmental data. Quota recommendations for San Francisco Bay are primarily based on the most recent assessments by the Department of the size of the spawning population in San Francisco Bay. The recommendation also takes into account additional data collected each season, including ocean and bay conditions, growth rates of herring, strength of individual year-classes, and predicted size of incoming year-classes (*i.e.*, recruitment).

In response to poor recruitment, indication of population stress, and/or unfavorable oceanographic conditions, harvest targets in recent years have been set at or below 10%. The San Francisco Bay fishery was closed during the 2009-10 season for the first time ever to allow for stock recovery following a record low biomass estimate of 4,394 t. After the one year closure, harvest targets have been set at precautionary levels of approximately 5%. Since the 2004-05 season, harvest targets have allowed over 96% of the spawning biomass to return to the ocean after spawning in the bay. Based on accepted fishery management principles, these harvest targets are conservative and represent a precautionary approach to safeguard the population as forage and to provide a robust reproductive base to allow for stock rebuilding during years of low recruitment or abundance.

TRUE SMELTS

The family Osmeridae is comprised of approximately 11 genera and 30 species. These "true smelts" are small, soft-rayed, schooling fishes with an adipose fin and are found in marine, estuarine, and freshwater habitats in the Northern Hemisphere. They range from Pt. Arguello, California to the Gulf of Alaska. The related family Atherinopsidae (silversides) includes jacksmelt, topsmelt, and grunion. Members of the true smelts occurring in California waters are delta smelt (*Hyposmesus transpacificus*), eulachon (*Thaleichthys pacificus*), longfin

smelt (*Sprinichus thaleichthys*), night smelt (*Sprinchus starksi*), surf smelt (*Hypomesus pretiosus*), whitebait smelt (*Allosmerus elongatus*) and a non-native, the Wakasagi (*Hypomesus nipponenisis*).

Historically, most of California's Osmerids contributed to sport, commercial, and tribal fisheries; however, only surf and night smelt support these fisheries today. Surf and night smelt, though small in size, are a popular local food fish. Surf smelt are typically headed, gutted, and pan fried due to their relative large size while night smelt are fried whole - "fries with eyes" flavor. Surf and night smelt are also sold by fish wholesalers to aquariums as food for fish, birds, and mammals. Anglers use Osmerids for bait targeting a range of gamefish including striped bass, California halibut, rockfish, lingcod, and redtail surfperch.

Most commercial and recreational Osmerid fishermen use A-frame dip nets and/or cast nets (Hawaiian throw nets). Two-person beach seines ("jump nets") were also popular and are currently legal gear but the use of beach seines has waned recently in favor of cast nets by recreational fishermen targeting surf smelt. Cast nets are most effective when thrown at visible schools of fish. Fishermen wait until they spot surf smelt appearing in the wash and immediately throw their nets at schooling fish. Cast nets are also readily available, relatively inexpensive, and with practice can be effective.

A-frame dip nets are still used for targeting night smelt throughout their range. The webbing, approximately 3/8" measured stretched, is sized to minimize gilling the catch. The net frame is placed seaward into the substrate then the net is tilted up and the catch is tumbled down the throat of the net into the bag. A-frame nets which are handmade have become increasingly difficult to source with ageing of fishery participants but are still widely used.

Commercial landing records for all Osmerid and Atherinopsid species from 1916 through 1969 were recorded as "smelt" and "whitebait smelt." "Smelt" was comprised of surf smelt, but may have also included silversides - jacksmelt, topsmelt, and grunion depending on the individual fish buyer and region. "Whitebait smelt" was primarily night smelt and similarly sized but less abundant Osmerids including whitebait, longfin smelt, and delta smelt. After 1969, the "smelt" category was replaced by the "true smelt" and "silversides" market categories to capture Osmerids and Atherinopsids, respectively. True smelt included all Osmerids except whitebait and night smelt; however it is important to note that whitebait was the only Osmerid market category pre-printed on receipt books provided to fish buyers to record catch. Therefore, it appears likely that whitebait included other Osmerid species including surf smelt and night smelt. Market categories were created for silversides (unspecified Atherinopsids), jacksmelt, topsmelt, and grunion), night smelt, and surf smelt.

Over time, true smelt and whitebait landings steadily declined as the use of night smelt and surf smelt market categories on fish receipts increased. The decline in true smelt and whitebait landings is attributed to phasing out these market categories as receipt books were replaced rather than changes in species

abundances. Use of night smelt and surf smelt market categories was initiated in 1970. In 2014, the true smelt market category composed less than 0.07 percent of the total Osmerid landings and whitebait landings dropped to zero. Currently, receipt books have pre-printed categories for night smelt and surf smelt as well as jacksmelt.

From 1977 to 2014 the combined commercial catch of the Osmerid market categories, primarily night smelt and surf smelt, ranged from 102.5 metric tons (t) in 2005 to 941.4 t per year in 1996. Ex-vessel value of the landings ranged from $43,500 in 1971 to $608,000 in 1995.

- **In 2014, night smelt landings totaled 138.5 t with an ex-vessel value of $169,000; surf smelt landings totaled 102.2 t with an ex-vessel value of $157,000. Fish processors paid an average of $0.62 and $0.58 for night smelt and surf smelt per pound, respectively, in 2014.**

Commercial landings of night surf and surf smelt indicate peaks in April-May and June-July, respectively. Night smelt begin spawning in late winter while surf smelt begin appearing in the spring. Both species are found on the same beaches but are fished at different times of the day – surf smelt also are called “day fish” or “day smelt” and are caught typically during daylight hours while night smelt are fished at dusk. Landings of both species are often caught on the same fishing trip. Over 97 percent of the 2014 statewide commercial Osmerid harvest was landed in Eureka with the remainder landed in the ports of Crescent City, San Francisco, and Half Moon Bay. Landings reported from Santa Barbara and Newport Beach as Osmerids may be Atherinopsids.

Historical recreational landings data on Osmerids is extremely limited. An estimated 181 t of unspecified smelt were taken in 1958 based on the results of a Department recreational fishing survey. Subsequent recreational estimates estimates ranged from 5 t in 2000 to 199 t in 1984 for surf smelt. Night smelt recreational landing estimates have been sporadic. Recent estimates are unavailable due to safety concerns and logistical issues related to night time data collection and assignment of the Osmerids as a low priority species. Results of the previous estimates ranged from 0.01 t in 1982 to 16 t in 1980. Recreational estimates of annual surf smelt take have varied widely, most likely because this species is rarely encountered in the Department’s recreational fishery surveys.

PACIFIC HAGFISH

The Pacific hagfish, *Eptatretus stoutii,* is a member of the Myxinidae (hagfishes) family. Members of this family have a row of mucous-producing “slime” glands along each side of the body. When agitated, hagfish will produce a protein-based mucous that, when mixed with water, produces a thick, viscous slime. This behavior is the reason hagfish are commonly called “slime eel”.

Pacific hagfish are the target of a statewide fishery. Prior to 1982, hagfish were not landed or targeted by California fishermen and were considered a nuisance due to their tendency to eat bait or destroy catches such as netted sharks and hooked deep-water rockfish. Hagfish can burrow into a fish that has been trapped or long-lined-hooked on the bottom, eat the internal organs and, if time allows, the rest of the fish. For fishermen that do not target hagfish, this behavior continues to cause loss within some deep water trap and hook-and-line fisheries.

During the early 1980's, the Korean fishery for two related hagfish species was receiving heavy fishing pressure; the hagfish were being pursued for food and an "eel skin" leather trade. In the mid 1980's, due to fishery depletion, Korean hagfish processors began to look for outside sources of hagfish. By late 1987, Korean processors began to solicit California fishermen, mostly from the San Francisco and Monterey port areas, to target hagfish. After one year of fishing, eight vessels had landed 690,000 pounds. Captured hagfish were treated with MS222 (fish anesthetic), frozen, and shipped to Korea for processing. Korean processing laws allowed for the use of treated hagfish for their skins, with the meat discarded. Commercial interest and catch surged to a high of 2.6 million pounds in 1989. By 1990, landings increased to 5.0 million pounds. However, during the 1990 season, Korean demand waned due to imperfections and bite marks on California-caught hagfish skins and began buying hagfish from British Columbia fishermen. Demand for California-caught hagfish continued to drop. Between 1992 and 2004, annual landings ranged from zero to 404,000 pounds and averaged 68,000 pounds.

More recently, Korean importers became interested in California-caught hagfish for their human food market, resulting in a landings increase in 2007 to 1.7 million pounds at an average price of $0.78 per pound. In 2008, landings reached 1.8 million pounds, the most recent high, with an average price of $0.95 per pound. Since 2007, effort and landings by California commercial fishermen has been relatively consistent.

Currently the species is sought for human consumption in Asia, mostly in South Korea. California hagfish are caught and sold live to local fish receivers. These receivers export the live hagfish directly to the purchasing Asian market.

- **In 2014, 31 vessels landed 1.4 million pounds for an ex-vessel value of $1.09 million. Port complexes of landing (with percent of landings) include Eureka (41%), Morro Bay (29%), San Francisco (17%), Los Angeles (6%), and San Diego (6%).**

Export value, demand, and participation rate is subject to many variables, such as competing fisheries (foreign and domestic hagfish fisheries), bait supply, and buyer demands.

Little is known about the status or biomass of Pacific hagfish stocks. Based on landings from the first surge of fishing activity from 1989 to 1991 and the consistency of landings since 2007, the biomass must be large. The Northern-

Central California Finfish Research and Management Project monitors changes in the average size of landed hagfish by sampling hagfish from the ports of Morro Bay and Eureka. Due to the physical impossibility of accurately measuring hagfish in a live condition, staff employs a count-per-pound method to monitor changes in average size of harvested hagfish. While Korean importers desire larger hagfish, they may utilize hagfish of all sizes. In 2014, staff counted 8,379 hagfish for an average count-per-pound of 4.21 at Morro Bay. Eureka staff counted 3,345 hagfish for an average count of 4.43. Randomly selected hagfish from sampled landings are retained for maturity and length data.

For more information on Pacific hagfish, go to the Northern-Central California Finfish Research and Management Project website:
https://www.wildlife.ca.gov/Conservation/Marine/NCCFRMP

DUNGENESS CRAB

Dungeness crab seasonal landings have been characterized as cyclical, with several years of increasing poundage preceded and followed by several years of declining catch. The most recently completed season of landings, 2013-14, continued a declining trend from a streak of record breaking seasons in 2010-11 and 2011-12. The 2013-14 crab season brought in state-wide landings of 17.2 million pounds, valued at $60.2 million to the fishermen. The high value overall was in part due to the increasing average price per pound over the course of the season at $3.50, compared to $2.85 the previous season. Dungeness crab was California's most valuable fishery in ex-vessel value for the 2013 calendar year at $89.1 million resulting from this high average price and high landings from the previous 2012-13 season (24.4 million pounds).

There are two management areas separated at the Sonoma/Mendocino county line, and historically the northern management area contributes to the majority of landings state-wide, which occurred during the 2012-13 season when landings in the north contributed 68% of the total. However, for the 2013-14 season, 61% of landings were derived from ports between Bodega Bay and Morro Bay. This area has experienced a recent shift in higher than average landings for the past four seasons and set a record for the area in 2010-11 of 19.1 million pounds, three times higher than the 20-year average of 5.3 million pounds. Landings in the southern portion of the central management area, Santa Cruz to Morro Bay, set a record for the area during the 2013-14 season of 1.6 million pounds, landings surpassed one million pounds for the first time during the prior season of 2012-13.

- **Dungeness crab was among California's most valued fisheries for 2014. Landings for the 2014 calendar year totaled 18.2 million pounds with an ex-vessel value of $70.0 million.**

This current 2014-15 season marks the 100th year the Department has tracked landings data for this fishery and estimates for the current season of 2014-15 are preliminary through March 2015. A total of 14.5 million pounds have been

landed valued at $53.6 million, and similar to last season, the central management area accounts for the majority of the total at over 11.5 million pounds. Although this current season's landings are trending somewhat lower than the prior season, total ex-vessel value will probably remain high since fishermen are receiving a consistently high average price at the start of the season of $3.50 per pound compared to the $2.97 that was received during the same time period last season.

The Dungeness crab fishery is one of the few remaining state-managed commercial fisheries in California managed by the Legislature rather than the Commission. Management is based on the "3-S principles" – sex, size, and season. Only male crabs over six and one quarter inches wide may be retained in the commercial fishery. The fishery also utilizes open and closed seasons intended to avoid fishing during molting and mating times. The two management areas also have slightly different fishing seasons, while the fishery opens earlier in the central area on November 15 and ends June 30, the season in the northern area may open December 1, dependent on crab quality testing and extends until July 15. The earlier opening in the central area lures many northern boats south and can lead to intense fishing pressure and crowded fishing grounds.

Commencing with the 1995-96 season the state legislature authorized an industry-funded pre-season crab quality test that evaluates crab condition and whether or not crabs are ready for harvest on the target opening date. The testing protocol is decided upon by the Tri-State Dungeness Crab Committee, a cooperative effort between state managers and commercial fishers from Washington, Oregon and California and all three states then mutually agree on whether to delay the opening of the season in order to let the crabs accumulate more body meat weight according to test results. When there is a season delay, fair start statutes are in place to alleviate fishing pressure by preventing a vessel that began fishing elsewhere at the start of the season from fishing for 30 days in the delayed area.

Legislation restricted access to commercial Dungeness crab fishing permits beginning in 1995. A limited entry permit system was then enacted by the legislature with the provision that most permits are transferable. Currently, there are about 566 permits, with only about 450 active during this past season. However, there is concern among some fishermen that an increase in the use of the latent permits could cause over-fishing and worsen overcrowding on crab fishing grounds.

- **The trap limit program, created by SB 369 (Evans), began with the 2013-14 season whereby each Dungeness crab vessel permit (permit) in the fishery is subject to a cap on the number of traps it can fish.**

- **Permits are organized into one of seven tiers according to landings made during a five-season window period and those with the highest**

landings were placed in the first tier, set at a maximum of 500 traps, while those with the lowest landings were placed in the last tier, set at 175 traps.

Permitholders are required to purchase biennial trap limit permits and department-issued buoy tags for each trap in their tier, failure to do so would invalidate their permit, and potentially remove latent permits from the fishery. Fishermen still observed over-crowded fishing grounds, and trap limits did not seem to affect the "derby style" nature at the start of the season when 80% of the landings occur during the first 6-8 weeks from the season opener. From a fishery management perspective, trap limits will be a useful tool in tracking effort within trap tiers. Lastly, permitholders were also able to submit appeals of their initial trap tier assignments until March 31, 2014. As of February 2015, most of these appeal proceedings have taken place and 15 upward appeals have been granted.

In 2008, legislation created the Dungeness Crab Task Force (task force), an advisory group comprised of Dungeness crab fishers from the primary fishing ports in the state, members from the Department, and non-governmental organizations. The task force was reinstated with SB 369 in 2012 and one of their many objectives is to evaluate the trap limit program. Task force meetings were held in April and October 2014 and the recommendations that were formally voted on at these meetings were included in the initial report to the Joint Committee on Fisheries and Aquaculture this past January 2015. A final report of recommendations is due on January 15, 2017 and two more task force meetings will be scheduled prior to this due date. The inclusion of District 10 (the central management area) in the Tri-State testing protocol remains a contentious issue among the task force representatives and no formal recommendations were included in the initial report. Further evaluation of the trap limit program continues as the fishing industry undergoes another fishing season with trap limits in place.

California Dungeness crab Task Force Initial Recommendations Report:
http://www.opc.ca.gov/webmaster/ftp/project_pages/dctf/DCTF_ReportJan2015_Final_012015.pdf

For more information, go to the Department's Marine Region website:
https://www.wildlife.ca.gov/Conservation/Marine/Invertebrates/Commercial-Management

Dungeness Crab Trap Limit Program Information website:
https://www.wildlife.ca.gov/Conservation/Marine/Invertebrates/Commercial-Management#28670866-dungeness-crab-trap-limit-program

MONITORING MARINE PROTECTED AREAS WITH REMOTELY OPERATED VEHICLE (ROV)

In January 2014 the Department initiated ROV expeditions to explore deep water habitats in each of the four Marine Protected Area regions, north, north central, central and south coast. These quantitative surveys occur both inside and outside California's MPAs, at locations previously identified using bathymetric data collected by the California Seafloor Mapping project (CSMP). Within these index sites the project characterizes ecological conditions by quantifying and describing the abundance and distribution of fish and invertebrate species. For these expeditions the Department is contracting with its longtime partner Marine Applied Research and Exploration (MARE) who is providing the *ROV Beagle* as well as extensive operational and data processing expertise.

Figure 1. The *ROV Beagle* being launched off Campus Point State Marine Conservation Area.

Three deployments were successfully completed in 2014 beginning a three year statewide survey. In January 2014, surveys were completed between Point Conception and Santa Barbara with additional survey sites at Ancapa and Santa Cruz Islands. In June 2014, the second deployment surveyed the remainder of the south coast region from Point Dume to San Diego including sites at Santa Barbara and Catalina Islands. In September and October 2014, a third deployment surveyed deep habitat within the north coast MPA region from Crescent City to Albion (Mendocino County). Throughout all 2014 ROV surveys, additional sites outside MPAs were also visited. These sites allow the Department to further expand on ROV data for habitat characterization and species distributions, while also providing reference sites to allow comparisons to MPA sites over time (Figure 2).

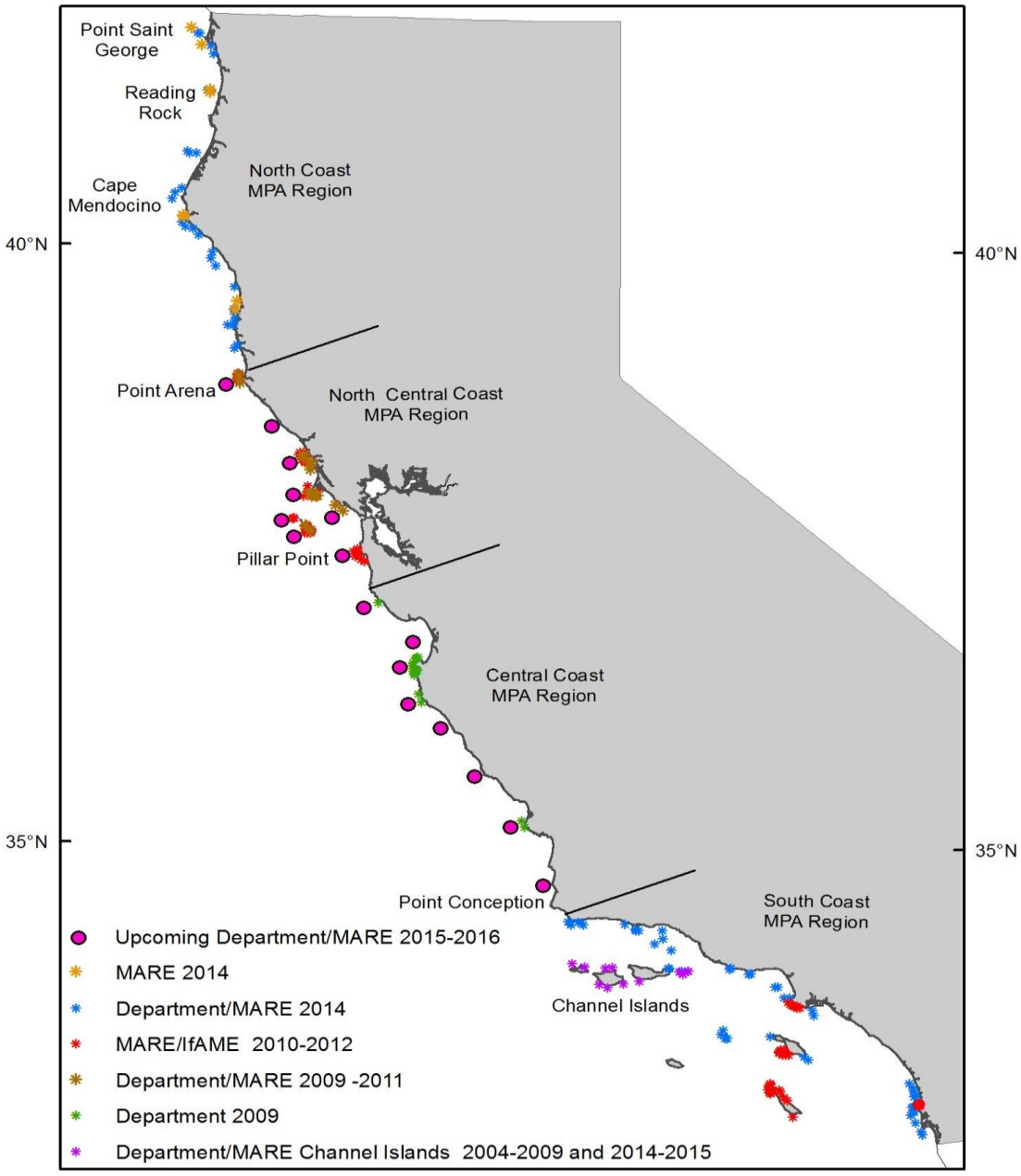


Figure 2. Map of ROV survey areas visited during 2014, historic survey sites (Department, MARE, and IfAME), and sites planned for 2015-2016.

Surveys completed in 2014 collected video and still imagery from 81 distinct sites. Twenty MPAs were visited including eleven state marine reserves (SMRs) and nine state marine conservation areas (SMCAs), two of which are designated as no-take. Over 200 kilometers of video strip transects were performed

resulting in 108 hours of video. Along these transects over 15,000 high resolution still images were captured.
The first two deployments of 2014 revealed interesting features of southern California MPAs. In Point Conception SMR, areas that were thought to be rocky habitat (as characterized by the CSMP) were found to be natural tar deposits (Figure 3d). Subsequent examination of the ROV imagery and bathymetric maps indicate that these tar deposits (also called tar mounds or tar volcanoes) may cover over three square kilometers of seafloor within and near the SMR. Scattered throughout these tar mounds small areas of less viscous tar were observed oozing from the seafloor along with bubbles of methane gas. Fish and invertebrates were less abundant in and around these deposits and biodiversity appears to be lower compared to nearby sites with rocky habitat.

Dense aggregations of rockfish, predominantly vermillion, copper, and flag rockfish (*Sebastes miniatus*, *S. carinus*, and *S. rubrivinctus,* respectively), were observed at several locations inside and outside of Campus Point SMCA and Point Conception SMR (Figure 3a). We suspect that these aggregations may be spawning related as multiple fish were observed with bulging abdomens which may indicate gravid females.

An undocumented bed of geoduck clams (*Panopea generosa*) was discovered inside Naples SMCA. Using the location identified by the ROV, Department divers later confirmed this by collecting geoducks from the area and other nearby areas. A handful of locations in southern California waters were known to have beds of subtidal geoduck clams and recent explorations by Department divers continue to find more locations. This bed is one of the first documented on the mainland coast and appears to extend deeper (>40 meters) and contains densities higher than beds observed in other areas.

A portion of the first southern California deployment was focused on exploring areas of sea cucumber trawl grounds to examine densities and habitat of the giant red sea cucumber (*Parastichopus californicus)* in areas where there is high fishery effort. Giant red sea cucumbers were observed in high densities in Campus Point SMCA and in deep areas of Anacapa SMR. Densities in the deeper (90-120m) trawled areas were lower than in the mainland sites and deep (40-80m) portions of Anacapa. Rocky habitats in shallower waters of Anacapa Island sites were also surveyed for the warty sea cucumber, *P. parvimensis* (Figure 3b), which is the target of a commercial dive fishery. Warty sea cucumbers were found in high densities in the shallower (10-40m) areas of the Anacapa Island SMR and SMCA. These surveys documented sea cucumber densities during the winter period which is generally a period of very low catch rates for the trawl and dive fisheries. These surveys are the first to try to document seasonal changes of abundance in deep areas (40-100m) of MPAs where abundance is not affected by fishing. Distribution and abundance data collected on these commercially fished sea cucumbers is providing much needed information that will aid the Department's management of these expanding and valuable fisheries.

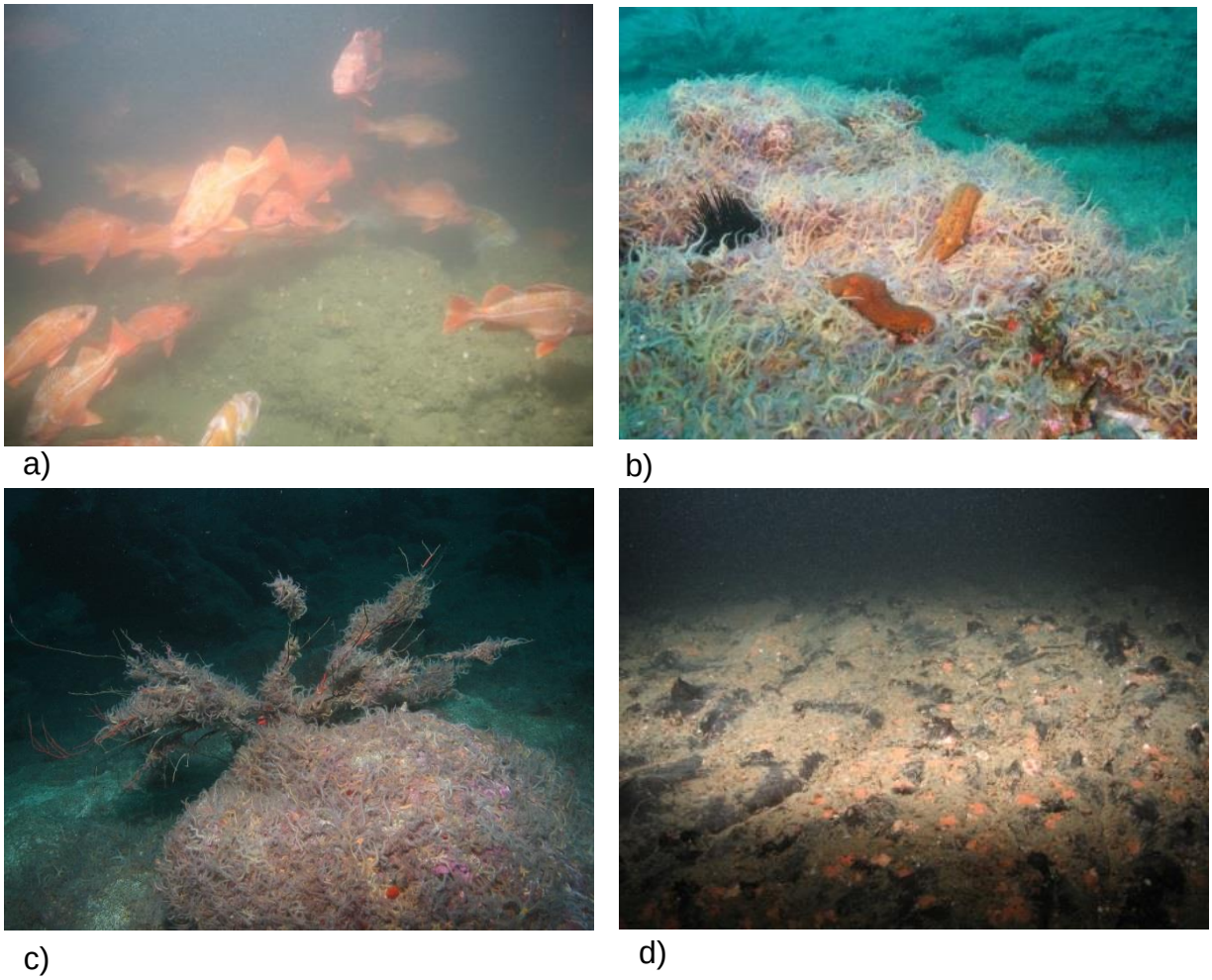
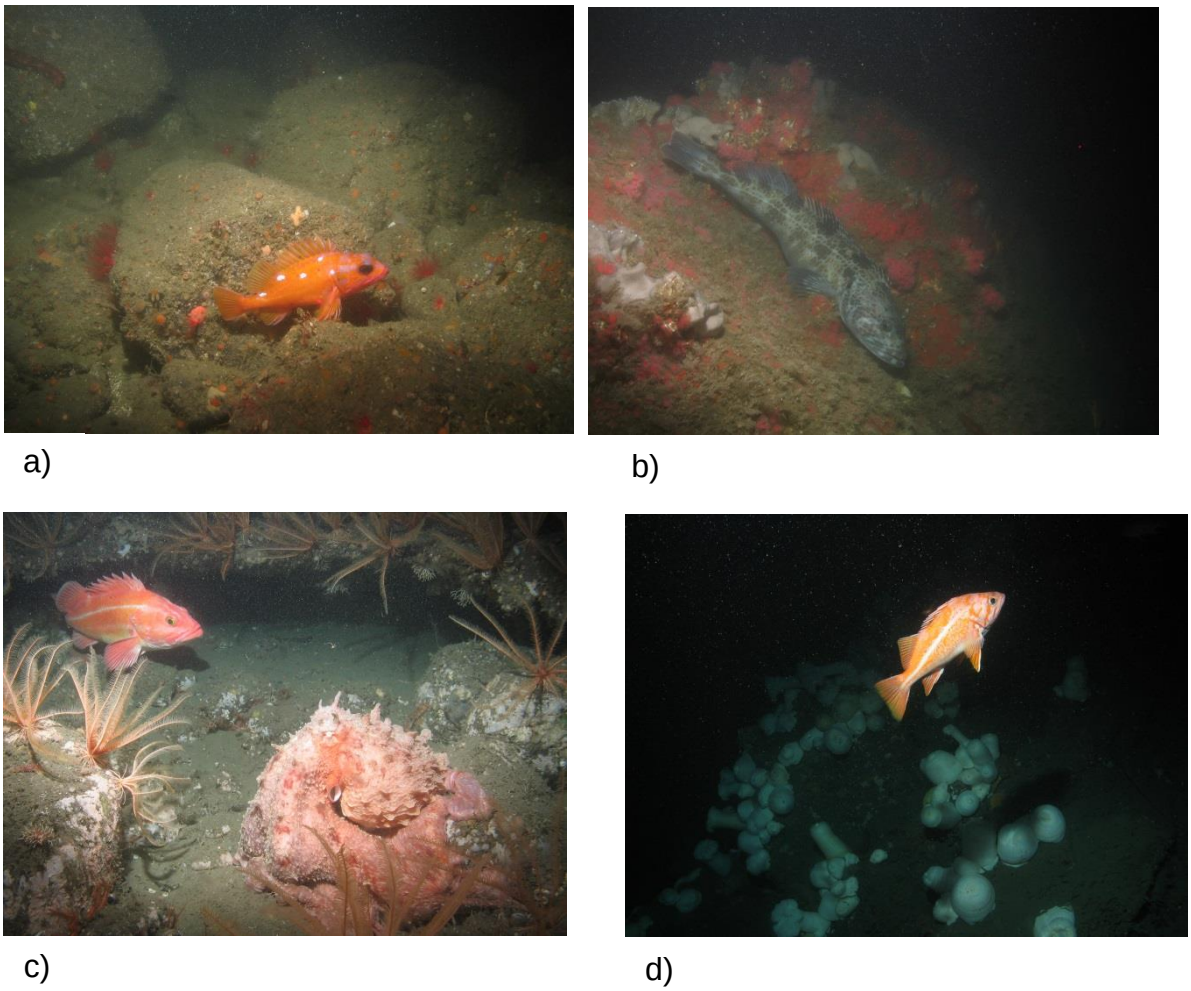


Figure 3. Selected photos taken during surveys of the South Coast MPA region. a) Vermilion and copper rockfish (*Sebastes miniatus, S. caurinus*) aggregations at Campus Point SMCA, b) warty sea cucumbers (*Parastichopus parvimensis*) at Anacapa Island SMR, c) brittle stars and dying gorgonian coral at Anacapa SMR, and d) natural tar deposits at Point Conception SMR.

Rockfish abundance and size was greater in north coast areas than southern California. Juvenile and adult lingcod were abundant in both north and south surveys although increased size and abundance was evident in the north (Figure 4b). Patchy distributions of fish were observed with some areas surprisingly devoid of common species. This patchiness was most common in areas with large expansive low relief rocky reef areas. The north coast's complex and dynamic habitats that are swept by strong ocean currents, large waves, and receive increased sedimentation from rivers, may be influencing these patchy distributions. For example, greater fish abundance and more invertebrates were observed on the northern side of Reading Rock offshore of Orick, CA (Figure 4b). Inside Reading Rock SMR, on the south side of the actual sea stack, very few fish and sparse invertebrate growth was observed in rocky habitats covered with fine sediment (Figure 4a). River mouths adjacent to Reading Rock (Klamath River and Redwood Creek) deposit large volumes of sediment during winter

storms into the surrounding waters. Local winds and currents may be washing away this sediment from the north side of Reading rock creating the differences observed. Similar areas of sediment impacted reefs were observed at sites around Pt. Saint George Reef and Crescent City.



a) b) c) d)

Figure 4. Selected photos taken during surveys of the North Coast MPA region. a) Rosy rockfish (*Sebastes rosaceus*) in sediment impacted rocky habitat of Reading Rock SMR, b) Lingcod (*Ophiodon elongates*) in rocky habitat less impacted by sediment outside of Reading Rock SMR, c) Yelloweye rockfish (*Sebastes ruberrimus*) and Giant Pacific Octopus (*Enteroctopus dofleini*) at Sea Lion Gulch SMR, and d) a Canary rockfish (Sebastes pinniger) at Sea Lion Gulch SMR.

The Department's efforts compliment other deep water ROV survey efforts in California waters using the same or similar equipment and methods. Researchers at MARE and Institute for Applied Marine Ecology (IfAME) at California State University Monterey Bay collaborated to examine the deep habitats of several MPAs as part of the baseline monitoring projects in the north central (2010-2011) and south coast (2011-2012) MPA regions. The current Department survey builds off these surveys and fills in data gaps by visiting

MPAs and outside reference areas that have not been surveyed, as well as revisiting some MARE/IfAME sites.

In the south coast, Department surveys coincided with a MARE led project focused on revisiting the Channel Islands sites previously surveyed from 2004-2009. These surveys are looking for potential ecological changes that arose 10 years after MPA implementation. Similarly, in 2014 the Department combined its statewide survey project with MAREs north coast MPA baseline project. During this four week long joint research cruise aboard the *R/V Miss Linda,* MARE and the Department each visited four MPAs completing 52 km and 58km of transects, respectively . Additionally, the Department surveyed another seven locations within the region, focusing on prominent rocky habitat areas. This collaborative partnership provided much greater coverage of deep water habitats than was possible in any of the previous regional baseline monitoring programs.

In 2015 and 2016 researchers will revisit MPAs in the north central coast MPA region where both MARE/IfAME and the Department surveyed in 2009-2011. Similarly, researchers will revisit sites in the central coast region, originally surveyed by the Department in 2007-2009, and fill in data gaps while visiting additional MPAs and reference sites that were not part of the first surveys. When complete this effort will result in unprecedented coverage of nearshore deep water habitats across the entire coastline of California (Figure 2).

After completion of data processing and summary analysis, technical reports of each ROV deployment will be made available. Each report will summarize the abundance of fish and invertebrates, and will provide a characterization of habitats and stereographic sizing of select fish species. An in-depth analysis of the statewide dataset by Department scientists may include investigations on distributions of management species inside and outside MPAs, size structure of select fish species, descriptions of unexplored deep water habitats, and other findings that emerge from this extensive dataset. Particular attention has been placed on directing survey effort both inside and outside MPAs, and in rockfish conservation areas, where rocky habitats important to the overfished Yelloweye and Canary rockfish (*Sebastes ruberrimus* and *S. pinniger*) are found (Figure 4c and 4d).

Analysis of survey data will examine distribution, habitat preference, and size structure of these protected species. Analyses will also focus on areas within the north coast region where frequent encounters of these protected species by recreational anglers impose restrictive fishing seasons, depth restrictions and catch limits. Department scientists are also exploring collaborative partnerships to analyze the extensive data set that will result from these surveys. The datasets will be made available to researchers, and will likely provide opportunities to study many species of fish and invertebrates in relationship to MPA effectiveness and fishery management.

OCEAN MANAGEMENT AND DATA PROGRAM

California Recreational Fisheries Survey

Marine finfish in California's bays, estuaries and coastal and offshore waters are diverse and comprise one of the nation's largest and most heavily used sport fishery resources.

- **In 2014, recreational finfish anglers took about 4.3 million fishing trips in California's marine waters and landed more than 8.4 million fish.**

- **Marine recreational fishing activities support approximately 12,000 full- and part-time jobs in California, and contribute $2.2 billion to the California economy annually[5].**

The California Recreational Fisheries Survey (CRFS) was initiated in 2004 to provide the data needed to sustainably manage recreational finfish fisheries. Invertebrate sport fisheries estimates are not performed by CRFS due to federal funding constraints, so the Department employs other methods to track those activities. CRFS collects essential fishery information for all marine recreational finfish fisheries managed by the state as required by the Marine Life Management Act. State and federal managers use the data to track catch and make in-season responses if catches are projected to be higher or lower than expected before the end of the fishery year. Managers examine catch rates, average fish lengths and weights, and other fishery information collected by CRFS to monitor changes in the fisheries. Managers also use the data to help determine if catch and season limits need to be adjusted.

The field sampling is conducted during daylight hours at publicly-accessible sites. Samplers intercept anglers upon the completion of fishing trips at beaches, piers, jetties, onboard commercial passenger fishing vessels (CPFVs), and at public launch ramps. Samplers ask anglers questions about their fishing activities, examine their catch to determine the numbers and kinds of fish kept, and weigh and measure the catch. At the public launch ramp sites, anglers who fished aboard private skiffs are asked to provide fishing location, depth information and usage of descending devices. In addition, samplers ride aboard CPFVs and record fishing location, depth, species kept and species released at each stop or drift in the CPFV trip. Additional fishing effort information is obtained from a telephone survey of licensed anglers to estimate effort and catch not captured in the intercept survey and from fishing logs submitted by CPFV operators. The field sampling, angler telephone survey, CPFV fishing activity logs, and sport fishing license sales data are combined to make monthly estimates of total catch

[5] National Marine Fisheries Survey. 2013. Fisheries Economics of the United States, 2012. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-F/SPO-128. 175 p. http://www.st.nmfs.noaa.gov/economics/publications/feus/fisheries_economics_2012

and effort (number of fishing trips) by species for six geographical districts along the California coast.

- **In 2014, CRFS samplers interviewed over 68,000 angling parties about their fishing activities. Samplers examined and identified about 245,000 fish, and measured nearly 132,000 fish. The telephone survey completed more than 26,000 interviews with licensed anglers about their fishing effort.**

About 71 percent of the fishing effort occurred in southern California (counties from San Diego to Santa Barbara) in 2014. Much of this area is highly urbanized and has many harbors, marinas and launch ramps utilized by anglers fishing from boats. It also has many piers, jetties and beaches for shore based anglers. In addition, the weather and sea conditions are conducive to year-round fishing. By number, the most commonly caught fish in this region are tunas and mackerels, sea basses, rockfishes, surfperches and flatfishes. By weight, rockfishes and California scorpionfish slightly dominated the catch in southern California; followed by yellowtail, tunas, mackerels, kelp and sand basses, surfperches and flatfishes such as California halibut and Pacific sanddab.

About 29 percent of the fishing trips took place in central and northern California (counties from San Luis Obispo to Del Norte including the counties surrounding San Francisco Bay). Northern California fisheries are constrained seasonally by inclement weather and ocean conditions, severely limiting effort during winter months and affecting available fishing days during the peak summer months. Rockfishes and salmon are major fisheries in this region with rockfishes dominating the catch in terms of numbers of fish caught and total weight of the catch. Other commonly caught fishes in order of total weight include; Lingcod, surfperches, California halibut, other flatfishes such as Pacific sanddab, striped bass, sharks and rays and cabezon.

The composition of the catch varies by the mode of fishing. Fish commonly caught on both private boats and CPFVs include: rockfishes, kelp and sand basses, salmon and flatfishes such as California halibut and sanddabs. Anglers fishing from man-made structures such as piers and jetties frequently catch sardine, herrings, mackerels and surfperches while the catches at beach sites are dominated by surfperches.

More information on the CRFS program can be found on the Department's Marine Region website: https://www.wildlife.ca.gov/Conservation/Marine/CRFS

MARINE AQUACULTURE

The Fish and Game Commission and the Department have the authority to regulate and manage certain aspects of commercial marine aquaculture on state tidelands and in state waters.

- **The Department currently manages 17 state water bottom leases for marine aquaculture, totaling 909 acres. Additional marine aquaculture operations occur on granted or privately owned tidelands, adding an additional 3,950 acres for a state-wide total of 4,860 acres of water bottoms utilized for marine aquaculture.**

There are also marine aquaculture facilities established on privately owned uplands along the California coastline. The Department's management authority also includes the registration of aquaculture facilities and species cultured within the state; the detection, control, and eradication of disease in aquaculture facilities, and the permitting and licensing of aquaculture-related activities, such as stocking, broodstock collection, and importation.

California's commercial marine aquaculture industry consists of the production of five oyster species, clams, mussels, and abalone. The Pacific oyster (*Crassostrea gigas*) originally from Japan is the principal species cultured on the West Coast. The kumamoto oyster (*Crassostrea sikamea*) also from Japan is the second most popular species grown in California estuaries. The Eastern oyster (*Crassostrea virginica*) grown on the Atlantic and Gulf coasts of North America accounts for most U.S. oyster landings, but is just a small percentage of the oyster production in California. Two species of the genus *Ostrea* are cultivated to a lesser extent. The European flat oyster (*Ostrea edulis*) leads in production for this genus, while the Olympia oyster (*Ostrea lurida*) indigenous to the Pacific coast, has been the least important. Currently, the Manila clam (*Venerupis philippinarum)* is the only clam species grown commercially in California. Most mussel production in the state comes from naturally set Mediterranean mussel or bay mussel seed (*Mytilus galloprovincialis and M. trossulus, respectively*). However, some growers acquire Mediterranean mussel seed from west coast hatcheries, the same species that is cultured in Spain and most of Europe. Red abalone (*Haliotis rufescens*) is the mainstay of the commercial abalone industry, grown in either land-based tanks or in cages suspended in the water column.

Shellfish aquaculture is currently centered in eight areas along the coastline, Humboldt Bay, Tomales Bay, Santa Cruz, Monterey Bay, San Luis Obispo, Morro Bay, Santa Barbara and Agua Hedionda Lagoon.

- **Total shellfish production in 2014 (January through December) reached a total of 820.37 metric tons (t) all species combined. This resulted in a value of $23.8 million. Compared to 2013, this was a 1% decrease in production, all species combined.**

- **The culture of Pacific oysters represented the largest production for the industry, resulting in 61% of the total production, and 58% of the total value in 2014.**

Oysters

The first commercial oyster beds were established in San Francisco Bay about 1851 when mature native (Olympia) oysters were shipped form Shoalwater Bay, Washington (Willapa Bay) and later from other bays in the Pacific Northwest and Mexico. Market demand for a larger half-shell product stimulated experiments in transporting the Eastern oyster form the Atlantic states to the West Coast. Cool summer water temperatures, however, prevented successful natural reproduction of the Eastern oyster. Soon after completion of the transcontinental railroad in 1869, shipments of Eastern oyster seed were made and transplanted in San Francisco Bay for further growth, marking the beginning of actual oyster raising in California. However, with California's population and industrial growth came a degradation of water quality in San Francisco Bay and by 1939 the last of the San Francisco Bay oysters were commercially harvested.

Throughout the 1930s, the commercial oyster industry and the Department began conducting experimental plantings using the Pacific oyster in Tomales Bay, Elkhorn Slough, Drakes Estero, Bodega Lagoon, and Morro, Newport, and San Francisco bays. Several Pacific oyster plantings proved successful, demonstrating that imported Pacific oyster seed could be grown commercially in California. Oyster culture is now centered in four major growing areas: Humboldt Bay, Tomales Bay, Morro Bay, and Agua Hedionda Lagoon. Oysters were previously grown in Drakes Estero, but as of December, 2014, the commercial operations in that location have been closed. However, production data for that growing area is included in this report.

In 2014 oyster production for the state totaled approximately 586.05 t, worth $18.3 million. This was a 13% decrease in production compared to 2013 (679.83 t). Commercial harvest of oysters averaged 512.14 t over the ten-year period from 2005-2014. In 2014, Drakes Estero was the leading producer of oysters in California, representing 34% of the total oyster production, all species combined. The estero produced 201.01 t of Pacific oysters, the highest production on record for this area since 1971, with a value of $5.6 million. Pacific oyster production in Tomales Bay reached 168.59 t, $4.7 million in 2014, a 6% decrease from the previous year's harvest (158.97 t). Kumamoto oyster production in Tomales Bay increased slightly to 1.48 t, compared to last year's production of 0.32 t, resulting in $74,900. In addition, Tomales Bay harvested small amounts of Eastern oysters, 0.61 t, totaling $30,900. Humboldt Bay was close behind in Pacific oyster production with 111.98 t, valued at approximately $3.1 million. Humboldt continues to be the leading producer of kumamoto oysters in the state, with 85.1

t in 2014, the high production on record, reaching a value of $4.3 million. Pacific oysters are currently the only species of shellfish grown in Morro Bay and totaled 17.25 t, valued at $479,800 for 2014, a decrease of 8% compared to 2013 (18.72 t). Agua Hedionda Lagoon also cultivates Pacific oysters; however, data was unavailable in time for preparation of this report.

Clams

The Manila clam was unintentionally introduced to the West Coast with import of Pacific oyster seed in the 1930s, and has since become an important species to the aquaculture industry in California. The culture of clams in California began in 1981, but production levels were relatively low until the mid-1990s. While British Columbia and Washington are the largest commercial producers of adult Manila clams, Humboldt Bay, California is the leading supplier of clam seed worldwide. In 2014, Tomales Bay and Drakes Estero were the only growing areas in California to produce adult Manila clams with 11.07 t and 2.62 t, respectively, totaling $150,900 combined.

Mussels

Experiments in culturing wild mussel seed stock and in developing hatchery and growout methods in the 1980s have greatly increased the importance of commercial mussel production, particularly the Mediterranean mussel, which occurs primarily in southern and south-central California. A related species, the bay mussel, occurs in northern California and hybrids of the two species are commonly found between Cape Mendocino and Monterey Bay. Tomales Bay, Santa Barbara, and Agua Hedionda Lagoon are the primary growing areas of mussels in California. Santa Barbara produced 73.27 t, $484,600 and Tomales Bay produced 10.78 t, $71,300, an increase for both areas compared to the previous year (32.58 t and 9.24 t, respectively). Data for mussel production in Agua Hedionda Lagoon was not available in time for preparation of this report.

Abalone

The Department led pioneering research to mass cultivate abalone in California at its Granite Canyon laboratory near Carmel about 45 years ago. Since then commercial abalone production peaked in 1997. However, participation in the industry has declined since that time, due in part to disease impacts. Interest in abalone aquaculture remains high, prompted in part by the closure of the commercial abalone fishery in 1997. Presently, the commercial culture of red abalone occurs in four main coastal areas: Santa Cruz area, Monterey Bay, Santa Barbara and the San Luis Obispo areas. There is a high market demand and price for growing the farmed product and production had been steadily increasing since the decline, with 2014 reaching a high of 136.59 t. This is a 50% increase compared to last year's production of 90.71 t and approaches $4.5 million in value for the industry.