Managing Data-Poor Fisheries: Case Studies, Models & Solutions 1:247–256, 2010

ISBN number 978-1-888691-23-8

[Article]

Review of the Use of California Commercial Fisheries Landings and Recreational Catch Data in Stock Assessments

Janet Mason
Environmental Fisheries Division,
Southwest Fisheries Science Center,
1352 Lighthouse Avenue, Pacific Grove, CA 93950
Janet.Mason@noaa.gov

Abstract. Current stock assessment models require extensive sets of data. In addition to many life history parameters, they rely on time series of catch from fisheries to calculate total removals and to estimate historic biomass levels. Recent assessments have constructed catch series for various recreational, and commercial fisheries. California commercial landings are stored in several databases, which differ in time period, spatial coverage and spatial resolution. Information on type of fishing and an estimation of species composition from port sampling programs are available in more recent data. The longest series of California marine recreational data is the Commercial Passenger Fishing Vessel (CPFV) logbook series, but it groups all rockfish together. The Marine Recreational Fisheries Statistical Survey, which began in 1980, surveys all types of marine recreational fisheries in northern and Southern California for catch disposition, effort, species size and weight. To create estimates for CPFV rockfish species catch before 1980, several sources of data must be integrated and assumptions made about similarity of species composition from different eras. A coordinated reconstruction of catch of groundfish species has recently been developed. Historic data on gear and landings by fishing block have been incorporated to refine the commercial catch estimates. Recreational catch reconstruction is in progress for rockfish species based on CPFV data by block, various sampling programs and ratios of effort by recreational fishing mode.

Stock assessments are preformed to evaluate the health and sustainability of federally managed fish populations in the United States and California is also assessing fish populations for management. Federal and California State management call for a sustainable fishery and the reduction of harvest when a stock falls below a specified percentage of its unfished biomass. For federally managed fisheries 25 percent of the unfished stock is the overfished threshold, but 40 percent is the level at which the fishing rate starts to be reduced. For fisheries managed by the state of California, 60 percent of unfished biomass is the level at which harvest rates will be reduced. Calculating the current and historic biomass is done with models requiring diverse and complex parameters. There is pressure on both state and federal levels to evaluate many more stocks and set catch limits for them.

Do we have the data needed to assess many more stocks? This paper will review the catch data used in recent groundfish stock assessments. The currently used models require time series of fisheries landings (sometimes from recreational as well as commercial fisheries), preferably by area, and use cohort analysis based on ages or length frequencies for cases in which no ages are available. They require life history parameters including age, length and weight data to calculate mortality, maturity and fecundity. Fishery-independent survey data are used to provide indications of change in relative abundance that is not confounded by catch regulations and to monitor spatial distribution and density of fish in areas not sampled by the fisheries. The models require an estimation of gear selectivity for the survey data. I review the use of historical commercial and recreational catch data in recent assessments to address issues of the length of available data series, consistency of data, spatial considerations, and changes in species composition of market categories.

Commercial Landings Databases

California commercial fish and shellfish landings are reported to the California Department of Fish and Game (CDFG) by fish buyers and processors on landings receipts. From 1928 through 1976, CDFG published a monthly summary of California landings, grouped by six port areas, and as monthly and annual landings by port in their Fish Bulletin series (Oliphant et al. 1990). Summary tables of statewide annual total landings by market category were compiled and published from 1916 to 1968 (Heimann and Carlisle 1970), but did not contain port or monthly information. Weights were recorded just as landed. These were round weights for most species, but dressed weights for those landed dressed such as salmon *(Oncorhynchus* spp.*)* and sablefish *(Anoplopoma fimbria*). The published tables separated landings caught in waters off California from those caught north or south of the state through 1976. This allowed separation of the local and distant water fisheries for tuna (*Thunnus* spp.*),* California barracuda (*Sphyraena argentea*), Pacific bonito (*Sarda chiliensis*), giant seabass (*Stereolepis gigas*),

white seabass (*Cynoscion noblis*) and California yellowtail (*Seriola dorsalis*). Similar tables were published in California's Living Marine Resources (Frey 1971; Leet et al. 1992), but the most recent version of this report (Leet 2001) did not separate landings caught beyond the state boundaries.

There are several different databases that contain the California commercial landings information for different time periods (Table 1). The longest time series, 1928 to 2002, was developed by the Environmental Research Division (ERD) of Southwest Fisheries Science Center (SWFSC), National Marine Fisheries Service (NMFS) and monthly data are available online at http://www.pfeg.noaa.gov/products/las.html. For this database we used the monthly Fish Bulletin tables through 1976, similar unpublished tables obtained from CDFG marine statistical division for 1977 to 1980 and landings from California waters from the Pacific Fisheries Information Network (PacFIN) database from 1981. The PacFIN database is the nation's first regional fisheries data network, and it contains commercial landings by area provided by California, Oregon and Washington since 1981 (http://www.psmfc.org/pacfin/). PacFIN converts all weights to round weights, but to avoid an abrupt change in the ERD time series we converted back to dressed weight for salmon and sablefish. Our goal was to look at the variation in species landings and location off California, so we removed landings from other areas when they could be identified. This includes most of the yellowfin tuna fishery because it occurred south of California, so only landings caught off California remain (Mason 2004). The grouping of species into market categories by fish buyers changed over time in the tables published by CDFG. For example, species of soles, Dover *(Microstomus pacificus),* English *(Parophrys vetulus)*, petrale *(Eopsetta jordani),* rex *(Errex sachirus)* and sand *(Psettichthys melanostictus)*, were grouped together in the published monthly totals until 1955, although annual totals were provided by species by Heimann and Carlisle (1970). In this database we provide two time series using monthly totals: the group name available for the longest time (i.e., all soles all years) and the individual species when they became available by month. Documentation of name changes is available on the website.

The ERD California landings database has been used to evaluate shifts in species dominance in California fisheries more than 74 years, revealing the increasing importance of invertebrates including sea urchins and squid in the 1990s and later (Mason 2004). It was used in several stock assessments as the series dates back to 1928: scorpionfish (*Scorpaena guttata*) (Maunder et al. 2004), cabezon (*Scorpaenicthys marmoratus*) (Cope and Punt 2005), cowcod (*Sebastes levis*) (Dick et al. 2007) and blue rockfish (*S. mystinus*) (Key et al. 2008).

A database of commercial landings by market category dating back to 1969 called CMASTER is maintained by CDFG as part of their Commercial Fisheries Information System. It contains information not found in the monthly summary data — such as the type of fishing gear, value of the landings and the fishing location block number. The block numbers are a system of boxes ten minutes of latitude by ten minutes of longitude developed by CDFG in the 1930s used to identify fishing areas off California. There is some skepticism about the accuracy of the recorded locations to the level

TABLE 1.—Data sources for California commercial fishery catch reconstructions. Time period, location, type of information and reference or database.

Commercial Landings	
1928–2002	CA monthly landings by port region (ERD) (Mason 2004)
1925–1957	CA Trawl catch by fishing block (CALCOM)
1931–1968	CA Fishing block summary of landings (CALCOM)
1954–1963	CA Trawl landings by port (Nitsos 1965)
1951–1968	CA Landings receipts, gear (digitizing from paper) (CALCOM)
1969+	CA landings receipts digitized, gear (CDFG CMASTER)
1978+	CA Commercial groundfish with port samples (CALCOM)
1916–1977	CA Reconstructed commercial landings (CALCOM)
Commercial Rockfish Species Composition	
1937	Monterey, setline fishery (Phillips 1939)
1957–1958	Morro Bay, trawl (Onboard samples) (Heimann and Miller 1960)
1960	Monterey Bay, trawl (Onboard samples) by depth (Heimann 1963)
1962–1963	Trawl Rockfish, port samples (Nitsos 1965)
1978+	N. CA, CCS port samples (CALCOM)
1983+	S. CA, CCS port samples (CALCOM)

of individual blocks, since they were often recorded by the fish buyer rather than by the vessel operator, but blocks can be aggregated to provide general areas of fishing effort.

Market categories containing more than one species pose a particular problem for tracking landings of rockfish species. Minimal sorting of rockfish species into several market categories was often based on price and size, which mixed abundant and less-abundant species together in the landings records. The market categories declared on landing receipts and the species in them have changed over time and vary by region (Pearson et al. 2008). Regular sampling of commercial groundfish landings for species composition and biological information began in 1978 through the California Cooperative Survey (CCS), a joint effort of the CDFG, the NMFS and the Pacific States Marine Fisheries Commission (PSMFC). The Fisheries Ecology Division of SWFSC, NMFS, applies the species composition from the groundfish samples collected at ports to the market categories of the California landings by port, gear and quarter of the year to create the CALCOM database (California Commercial Landings Database). It contains data from samples dating back to 1978 (Pearson and Erwin 1997). Beginning in 1981, the landings with species derived from port sampling from all the West Coast states are complied into the PacFIN database (managed by PSMFC).

A data recovery project by NMFS has recently been digitizing California data from paper and microfiche copies of CDFG reports to enhance the CALCOM database. Monthly landings summaries by fishing block and market category from 1931 to 1968 will extend spatial resolution available after 1968 in the CDFG (CMASTER) database to the earlier period. Monthly trawl log summary reports provide the summarized landings of the trawl fleet by market category and fishing block for 1926–1957. These two data sets can be used to separate the monthly trawl and nontrawl catch by fishing block. Copies of individual landings receipts on microfiche from 1951 to 1968 were also recovered and will take time to digitize. These will provide specific vessel and gear information for landings that was only available in CMASTER for later years. These newly recovered data sets are already being used to reconstruct historic rockfish landings for stock assessments.

Commercial Rockfish Landings

Time series of commercial rockfish landings before 1978 have been reconstructed for use in recent stock assessments. There are only a few studies that provide information on the mix of rockfish species in the landings before 1978. Different assessments have used different sources of sample information and applied them over different time periods.

Retrospective analyses must consider changes in fishing techniques over time that have affected the species composition and the volume of the rockfish landings. Through the early 1940s rockfish were caught with bottom-set longlines and vertical drop lines statewide. The earliest rockfish species composition data came from the Monterey setline fishery (Phillips 1939). Paranzella trawl gear used in Central California in this era caught flatfish, but very little rockfish (Clark 1936). Major changes in region, depth and composition of rockfish catches occurred the 1940s with the introduction of balloon trawls that caught rockfish above the bottom to meet the wartime demand for frozen fillets (Phillips 1958). Balloon otter trawls were fished first in the Eureka area starting in 1944, in Monterey and San Francisco areas in the early 1950s and near Morro Bay in 1955. Trawling was prohibited south of Santa Barbara County from 1913 until 1968, and remained rare after 1968 (Phillips 1958; Pearson et al. 2008). Southern California rockfish landings from setlines peaked in 1926. Rockfish species composition from the early Southern California setline fishery was not documented.

Only a few studies document the species composition of early trawl rockfish landings beyond listing the top five species: bocaccio (*Sebastes paucispinis*), chilipepper (*S. goodei*), canary (*S. pinniger*), vermillion (*S. miniatus*) and black rockfish (*S. melanops*) (Phillips 1958). There were three studies that sampled the species composition from the trawl fishery before 1978, one in the Morro Bay area (Heimann and Miller 1960), one in the Monterey Bay area (Heimann 1963) and one statewide in 1962–1963 (Nitsos 1965) (Table 1). The California Cooperative Survey (CCS) began port samples in 1978 in central and Northern California and focused first on trawl caught rockfish. Samples of other gears were gradually added and sampling began in Southern California in 1983. The species ratio of market categories sampled by CCS was applied to seasonal port area landings by CALCOM for use in stock assessments. CALCOM has applied species ratios from port samples from 1978 to 1980 to earlier trawl rockfish landings from 1969 to 1977. This species reconstruction was used in many assessments including the blue rockfish (Key et al. 2008), yelloweye (*S. ruberrimus*) (Wallace et al. 2006) and cowcod stock assessments (Dick et al. 2007).

The blue rockfish assessment (Key et al. 2008) relied heavily on the studies of trawl and sport rockfish species composition in the Morro Bay area (Heimann and Miller 1960) and the Monterey Bay area (Heimann 1963). These studies showed blue rockfish, the dominant species in the sport fishery, were not caught by the trawl fisheries. The recovered trawl summaries from CDFG annual reports for 1936–1956 allowed calculation of the percent of total rockfish caught by trawlers

back to 1934, before the balloon trawl era in California. The ratio of blue rockfish from Phillips' setline study was then applied to nontrawl rockfish landings by port to estimate historic commercial landings back to 1916 in the blue rockfish assessment

Black rockfish are caught in trawl, hook-and-line and recreational fisheries in Northern California. Regional differences in trawl rockfish composition from 1962 to 1963 (Nitsos 1965) were used to estimate trawl landings of black rockfish from 1954 to 1963 in the 2003 stock assessment (Ralston and Dick 2003). Species composition in 1973 of trawl-caught shelf rockfish by port area in California (Gunderson et al. 1974) was used to estimate trawl landings of black rockfish for the next period from 1969 to 1973, and landings of black rockfish were interpolated from zero in 1945 to the 1954 estimate. The 2007 black rockfish assessment (Sampson 2007) created a different historical reconstruction, starting in 1916 and estimating nontrawl total rockfish landings for 1927 to 1955 from the U.S. Fishery Statistics series. There was no information found on the ratio of black rockfish in the early nontrawl fishery, so the ratio by area from 1992 to 1999 nontrawl port samples was applied to the nontrawl rockfish landings back to 1927. The average ratio from the declining 1980–2006 trawl fishery was applied to the historic trawl landings. These estimates were considered imprecise but the best available to create a range of plausible values.

In Southern California, reconstruction of landings of individual rockfish species is hampered by a lack of species composition information. The hook-and-line and set net fisheries for rockfish in Southern California were not sampled for rockfish species by the California Cooperative Survey until 1983. The 1983–1985 samples were only recently found, revealing a large decline in the early 1980s in the percentage of cowcod caught by the hook-and-line fleet in Southern California. In cowcod assessments, differences in the available data and assumptions in reconstruction have produced different estimates of unfished spawning biomass and current depletion for cowcod (Piner et al. 2005; Dick et al. 2007).

Spatial resolution of catch data is useful in interpreting the pattern of species depletion. For some species, such as blackgill rockfish (*S. melanostomus*) assessed by Butler et al. (1998), fishing pressure serially depleted the species as fishermen moved from one rocky reef to another, but the regional CPUE did not reveal declines in the population (Yoklavich et al. 2007). Spatial resolution will be improved by the recently recovered historic monthly landings summaries for 1931–1968 by block number added to CALCOM.

New interest in localized fishery management will require estimates of harvestable biomass by management area, or indices of depletion rates by area. The recovered block data will improve estimates of historic removals by area.

Recreational Catch

Recreational ocean fishing includes several fishing modes that catch different species and have received different amounts of sampling. Boats that take paying passengers fishing submit logbooks recording the number of passengers, time fished, catch and location by block number. Several different surveys have also measured the length and species composition and interviewed anglers from these boats. Sampling of other recreational modes, shore, piers, and rental or private boats was rare until the 1980s. Recreational catches are a significant proportion of the removals for some recently assessed species and the historical data sets give some indication of the amount caught by these fisheries.

The longest series of recreational catch and catch per angler effort (CPUE) comes from Commercial Passenger Fishing Vessel (CPFV) logbooks. This information has been important in several recent stock assessments, including scorpionfish (Maunder et al. 2004), yelloweye rockfish (Methot et al. 2002), black rockfish (Ralston and Dick 2003), cabezon (Cope and Punt, 2005), and blue rockfish (Key et al. 2008). These draw on the database of CPFV logbook information compiled by Hill and Schneider (1999) to provide a long time series (from 1936 for Southern California and from 1957 for Northern California) of catch and effort by fishing block for most species, except rockfish.

The earliest sampling program of CPFV catch to look at rockfish species composition was the Northern California Marine Sportfish Survey conducted from 1957 to 1972 (Table 2). Sampling was most extensive from 1957 to 1961 when funds were available for intensive sampling of all recreational modes from Avila to Crescent City (Miller and Gotshall 1965). The survey was reduced to Central California for 1966 (Miller and Odemar 1968). Sampling of species composition from CPFVs and private or rental boats in Central California continued through 1972 and is important for identifying the rockfish species that make up most of the catch in this area. This survey distinguished trolling trips that caught salmon, from bottomfishing trips that caught primarily rockfish, and expanded species composition separately to the effort recorded in CPFV logbooks for the two categories of fishing trips. The data from Monterey to Santa Cruz CPFVs and private and rental boats has been entered into a database (Mason 1995), but data from other ports remains to be entered from paper records.

Four other programs sampled recreational catch and effort from CPFVs between 1974 and 1998, two in Southern California and two to the north. In Southern California sampling was conducted onboard CPFVs

from 1975 to 1978 that identified and measured the species caught and recorded the angler effort by depth and fishing block (Collins and Crooke unpublished MS, Love et al. 1985). A similar CPFV sampling program from 1985 to 1989 used a different location system (Ally et al. 1991). In Central California, fishing from CPFVs was sampled mostly from the dock in 1978–1985 by the California Cooperative Survey, which collected species composition, lengths and otoliths for ageing (Mason 1998); this data is available from CALCOM. The longest series of onboard sampling of rockfish and lingcod by CPFV anglers was conducted by CDFG in central and Northern California from 1987 to 1998 (Reilly et al. 1998). It contains location specific catch information in addition to species, lengths and discarded catch. Overlapping with three of these surveys was the CPFV component of the Marine Recreational Fisheries Statistical Survey (MRFSS).

The federal MRFSS was the most extensive marine recreational fishing survey. In California it sampled several fishing modes (CPFV, private or rental boats (PRB), shore, and manmade structures) statewide from 1980 to 2003 (Holliday 1984). It is lacking data from 1990 to 1992 when sampling was not funded. The MRFSS data are available through the Recreational Fisheries Information Network (RecFIN) maintained by the PSMFC (http://www.recfin.org/). The field component of the MRFSS program was an intercept survey in which samplers interviewed fishers, and identified, measured and weighed their recreational catch. Catch disposition was recorded by species, indicating fish discarded alive and dead as well as those retained. The second component was a telephone survey of residents of counties near the coast that was used to expand the sampled catch and effort to the entire fishery. The accuracy of the telephone survey, and therefore of the data expansion, have been points of concern with this survey.

In 2004 the California Recreational Fisheries Survey (CRFS) replaced the MRFSS in California; CFRS data and procedures are also available through RecFIN. It uses an intercept survey and a telephone survey of licensed recreational fishers (instead of county residents) to expand the sampled catch and effort to total effort. It also monitors CPFV logbook submission with a phone survey of CPFV operators to provide catch estimates more quickly for in-season management adjustments.

Other modes of marine recreational fishing (shore, pier, private and rental boat) were rarely sampled before the MRFSS, but these surveys provide an important estimate of catch and species composition by area and fishing mode in earlier years. All modes of recreational ocean fishing were sampled in the Northern California Marine Sportfish Survey between 1957 and 1961 (Miller and Gotshall 1965), sampling of private and rental boats in Central California continued through 1972. The Southern California Marine Sportfishing Survey sampled piers and jetties in 1963 (Pinkas et al. 1967) private boats in 1964 and shoreline fishing (including bays) in 1965–1966 (Pinkas et al. 1968). These surveys included an airplane census of shore fishing effort, but the Southern California surveys did not identify rockfish to species.

Results from the Northern California sportfish survey were compared to those from MRFSS from 1980 to 1986 by Karpov et al. (1995). They noted an increase in effort on both private and CPFV boats and a corresponding increase in the total recreational catch of rockfish, but a decrease in the average weight and number of rockfish per angler. The 1957 to 1961 sportfish survey was used to extend the recreational catch series for the 2003 black rockfish assessment (Ralston and Dick 2003) and the blue rockfish assessment (Key et al. 2008).

These surveys of various fishing modes provided data for the reconstruction of catches in the cabezon assessment. Ratios of catch in the 1960s from CPFV to shore and private boat fishing from the sportfish surveys showed higher catches of cabezon in the shore and PRB modes in Northern California, but higher catches from CPFVs in Southern California. These data were used along with the MRFSS data, which show an increased catch of cabezon from man-made structures, shore and PRB fishing modes in Southern California in the 1980s, to reconstruct the cabezon catch in 2005 (Cope and Punt 2005).

Private boats were also surveyed in Southern California in 1975–1976 (Wine and Hoban 1976), as cited by Butler et al. (1999) in the first cowcod assessment.

Three different series of CPFV catch from Southern California were compared by Butler et al. (1999) in the cowcod assessment. Cowcod were not indicated separately from other rockfish in the CPFV logbooks before 1964, and since then they are optionally reported as cowcod or may be included in the rockfish category. Although logbooks are required for all CPFVs the compliance rate varies, and therefore underestimates the actual catch. The fisheries resource division of SWFSC created another database of CPFV catches reported by sportfishing operators in the *Los Angeles Times* newspaper back to 1959 (http://swfscdata.nmfs.noaa.gov/LaTimes/Default.asp). They found the catch of cowcod in the MRFSS survey averaged 4.2 times the reported logbook catch and 1.3 times the catch reported in the *Los Angeles Times*. They expanded their logbook and *Los Angeles Times* series using these ratios to cover years not available from the MRFSS survey for the 1999 cowcod assessment.

Indices of Abundance

Recreational CPUE has been used as an indicator of abundance for species with significant recreational catch. Recent assessments for yelloweye rockfish (Methot et al. 2002) cowcod (Butler et al. 1999; Piner et al. 2005; Dick et al. 2007), blue rockfish (Key et al. 2008), and bocaccio (MacCall 2003) have relied heavily on recreational CPUE as an index of changes in abundance. Recreational fishing trips from a port can target a variety of species and the likelihood of catching a particular species will vary with location, fishing technique and season. These assessments used different techniques to select relevant fishing trips; 1) the presence of rockfish on a trip was used to exclude salmon fishing trips in the yelloweye assessment (Methot et al. 2002); 2) a general linear model was used to select trips based on the catch of species co-occurring with black rockfish (Sampson 2007) or to weight trips by the probability of catch (Ralston and Dick, 2003); and 3) the fishing area and season were used for selection of trips that could catch cowcod (Piner et al. 2005).

The first two techniques do not consider changes that might influence the likelihood of catching a particular species such as fishing depth or location. Changes in the catch composition in the Monterey Bay area in the 1970s and 1980s did indicate a shift from shallow to deepwater fishing by CPFVs from 1982 to 1985 (Mason 1995). The onboard sampling programs (Table 2) contain the specific location and depth of fishing that could be used to identify locations where a species was caught (Sullivan 1995). Individual trips sometimes go to multiple locations where they catch different species, which can only be distinguished by onboard sampling. The 2007 black rockfish assessment used onboard CPFV data to select only trips to locations where black rockfish were caught repeatedly; it produced a higher CPUE index than other series (Sampson 2007). The CPUE index can also be affected by changes in fishing regulations that limit the catch of species. This is a problem for the analysis of overfished species — such as bocaccio, yelloweye rockfish and cowcod — whose retention is now prohibited.

If recreational CPUE is used, there is a need to verify the relationship of the CPUE to changes in stock abundance. The CPUE from large areas can hide declines in local populations of sedentary species when boats change fishing locations to maintain high CPUE (Yoklavich 2007). A study by Love (1980) showed differences in size of olive rockfish between heavily fished and lightly fished locations in the same port area. Tracking CPUE over time at specific locations from onboard sampling might reveal local variance in CPUE.

Fishery independent surveys for abundance would greatly help these stock assessments. A program of recurrent sampling to monitor groundfish abundance began in 1977 with the triennial NMFS groundfish trawl survey, which also samples adult size and age. Unfortunately nearshore species are not often caught in the groundfish trawl surveys. Black rockfish, blue rockfish and cabezon are generally in shallower water than surveyed and yelloweye rockfish are in rockier untrawlable areas.

Other historical indices of recruitment have been used in a few stock assessments. The California Cooperative Fisheries Investigations (CalCOFI) egg and larval surveys developed in 1950 primarily for coastal pelagic species, has expanded their historic analysis to many other species off the Southern California coast (Moser et al. 2001) and was used in assessments of cowcod (Butler et al. 1999; Piner et al. 2005) and cabezon (Cope and Punt 2005). Larval rockfish are collected by CalCOFI tows, but have not all been identified to species; some identifications were limited to the Southern California area.

TABLE 2.—Data sources for California recreational catch reconstructions. Time period, location, type of information and reference or database.

Recreational Catch and Effort	
1936–1997	All CA, CPFV Logbook, effort by block (Hill and Schneider 1999)
1958–1961	N. CA, Effort boat, shore, pier, dive (Miller and Gotshall 1965)
1962–1967	S. CA, Effort boat, pier, shore (Pinkas et al. 1967)
1929–1980	CA Recreational Rockfish Catch Reconstruction (CALCOM)
Recreational Species Composition	
1957–1958	Morro Bay, CPFV (Heimann and Miller 1960)
1958–1961	N. CA, CPFV, boat, shore, pier, dive (Miller and Gotshall 1965)
1962–1964	1966–72 Central CA, CPFV and boat (Miller and Gotshall 1965)
1966	Central CA, CPFV, boat, pier, shore, (Miller and Odemar 1968)
1962–1967	S. CA, boat, pier, shore (not RF species) (Pinkas et al. 1967)
1975–1976	S. CA Private boat (Wine and Hoban 1976)
1975–1978	S. CA, Onboard CPFV (CDFG reports, Collins and Crooke unpub. MS)
1985–1989	S. CA, Onboard CPFV with location and habitat, (Ally et al. 1991)
1987–1998	Central CA, CPFV Onboard with location and depth (Reilly et al. 1998)
1980–1989	1993–2003 CA, MRFSS, CPFV, boat, shore, pier (Karpov et al. 1995)

Two other long time series of fishery independent data for Southern California have been used in stock assessments. One is the Southern California power plant impingement studies (1972–2002) used in the 2005 assessment of cabezon (Cope and Punt 2005). The other is a series of benthic trawls conducted by Southern California sanitation departments as far back as 1970. Four of these trawl series were combined to create an index of abundance in the scorpionfish assessment (Maunder et al. 2004). The increased recruitment indicated in recent years by these surveys had a strong influence on the estimated current biomass, which may be influenced by changes in environmental conditions.

Cabezon provides an example of a complicated catch reconstruction integrating both commercial and recreational fisheries using some of these indices. The catch was primarily recreational through the 1980s, but it came less from the well-monitored CPFV fishery than from other modes. The second cabezon assessment by Cope and Punt (2005) reconstructed recreational catch and CPUE in three steps. Historical CPFV catch was reconstructed from MRFSS from 1980 to 2004 and from the CPFV logbook database from 1947 to 1979 (Hill and Schneider 1999). Data for other fishing modes prior to 1980 were estimated based on catch ratios of CPFV to shore and other boat catch from the 1960s (Miller and Gotshall 1965; Pinkas et al. 1968). The average weight for each fishing mode was used to convert from numbers of fish to catch weight. Commercial landings for cabezon (from CalCOM) exceeded recreational landings from 1995 to 2002 as the live fishery increased. Landings from 1930 to 1977 were taken from ERD California landings database and the Santa Barbara area landings were divided to match the division of Northern and Southern California substocks. Data from tables in Fish Bulletin 149 (Heimann and Carlisle 1970) extended the data back to 1916. Size composition was available from these data sources from 1975 and later, but ageing structures was not collected. CalCOFI larval tows and power plant impingement series were inspected for recruitment events. Without ages or length by sex information, the identification of recruitment variability is difficult. High variability in CPUE trends between port areas implies regional variations in recruitment. Low correlation between a fishery independent adult (SCUBA) survey and the CPUE in the same area (Morro Bay) reveals the difficulty in confirming the observed trends with the available data.

California Rockfish Catch Reconstruction Project

The council that manages U.S. West Coast groundfish (PFMC) requested an effort in 2008 to create a catch reconstruction for use in groundfish stock assessments. Creating an optimal reconstruction of rockfish landings that could be used in all the assessments would standardize this part of the process and facilitate new assessments for the data-poor species. The Fisheries Ecology Division of SWFSC has taken the lead on developing this reconstruction as part of their CALCOM database. They recently recovered several CDFG historic data sets on microfiche and were getting them digitized. These include monthly trawl log summaries with trawl effort and catch by fishing block from 1925 to 1957, and block summaries with market category landings by block (but no gear information) from 1931 to 1968. Landing receipts from 1951 to 1968 were also obtained from CDFG and will provide fishing gear information for the landings by market category, but will require more time to digitize. Extensive error checking and crosschecking was done to correct for the poor readability of some of the microfiche. These data sets were used to calculate ratios of landings by gear by area and market category from proximal years to complete a time series of estimated rockfish landings by market category and area and gear from 1916 to 1968. Rockfish market categories were broken down to species based on gear and area using the earliest available port sampled data (1978–1984). The reconstruction procedures differ in specific time periods and are well documented in the report by Ralston et al. (2009). More refinements are planned to add seasonal variation in species composition when monthly block data and more landings receipts are digitized.

A standard reconstruction of recreational catches for the CPFV fishery for 1928–1980 is in the early stages of development in CALCOM (Ralston et al. 2009). Total rockfish catch is based on historic logbook records by fishing block, adjusted to account for incomplete logbook submission. A stratified approach to species composition is used to estimate the catch from the CPFV samples that indicate fishing block. The species ratio of the top five rockfish species, which differ for Northern and for Southern California, is calculated from the 75 fishing blocks sampled by onboard observers that account for 95 percent of the historic CPFV catch. Other rockfish species are grouped into their assemblages (nearshore, shallow, nearshore deep, minor shelf and minor slope rockfish), and the proportion of each assemblage is estimated by block. Species composition for these assemblages is calculated by coastal region and applied to the blocks. The logbook records of total rockfish catch are used to calculate the total catch by species. This will be an important data set for species that are primarily caught by the recreational fisheries. This CPFV reconstruction may also prove useful for selecting areas for calculation of time series of catch-per-unit effort from this fleet as regional management is explored.

The reconstruction of the historic catch of rockfish species from the other recreational fishing modes is

also underway. Fishing effort and species composition of catch from private boats, shore and manmade structures is available from MRFSS since 1980; however there is no long time series of effort as there was for the CPFV reconstruction. The 1957–1961 sportfish survey gave a reference point for Northern California total rockfish and effort by fishing mode, and provided rockfish species composition by mode. Species specific linear interpolation connected data from this period to the MRFSS data of the early 1980s. Rockfish were less important in these modes in Southern California in the 1960s and rockfish species composition was not collected in the surveys (Pinkas et al. 1967), so the species ratios from the early 1980s were used to project back to the total rockfish catch from the 1960s.

These catch reconstructions addressed rockfish landings because rockfish landings have been confounded by mixed-species market categories. The overfished status of some of the rockfish species makes estimates of their historic biomass essential for rebuilding plans. Reconstruction of both commercial and recreational catch histories is important for many of the nearshore species that are caught in both the nontrawl and recreational fisheries.

Summary

Groundfish from the U.S. West Coast may fall into the category of data-poor fisheries from a lack of species identification in both the commercial and recreational landings. Commercial market categories combined many rockfish species and were not sampled for species composition until 1978. Nearshore species that were caught in recreational fishing modes other than CPFV have very little information available until 1980. Some of these species have become important in the commercial live fishery and have required stock assessments. Many different catch reconstructions have been created for individual species stock assessments using different data sources and covering different time periods.

A coordinated reconstruction of groundfish landings began in 2008 at the request of PFMC. The California commercial catch reconstruction benefits from recently digitized summaries of historic catch by fishing location divided into trawl and nontrawl categories. It used stratified port sampling by gear type from 1979 to 1984 to estimate rockfish species landings starting in 1916. A similar reconstruction of recreational rockfish catch is based on the CPFV logbook series, and various sampling programs for species composition and relative effort by fishing mode. These reconstructions will provide consistent landings estimates for groundfish management.

References

Ally, J. R., D. S. Ono, R. B. Read and M. Wallace. 1991. Status of major southern California sport fish species with management recommendations, based on analysis of catch and size composition data collected on board commercial passenger fishing vessels from 1985 through 1987. Marine Resources Division Admin. Rep. No. 90-2. California Department of Fish and Game: Sacramento. 375 pp.

Butler, J. L., L. D. Jacobson and J. T. Barnes. 1998. Stock assessment for blackgill rockfish. Pacific Fishery Management Council: Portland, OR. 93 pp.

Butler, J. L., L. D. Jacobson, J. T. Barnes, H. G. Moser and R. Collins. 1999. Stock assessment of cowcod. Pacific Fishery Management Council: Portland, OR. 85 pp.

Clark, G. H. 1936. The California trawl fishery and its conservation. California Department of Fish and Game. 22:13-26.

Collins, R. A. and S. J. Crooke. An evaluation of the commercial passenger fishing vessel record system and the results of sampling the southern California catch for species and size composition, 1975–78. Unpublished MS. 147 pp.

Cope, J. M., K. Piner, C. V. Minte-Vera and A. E. Punt. 2003. Status and future prospects of Cabezon (*Scorpaenicthys marmoratus*) as assessed in 2003. Pacific Fishery Management Council: Portland, OR. 147 pp.

Cope, J. M. and A. E. Punt. 2005. Status of cabezon (*Scorpaenicthys marmoratus*) in California waters as assessed in 2005. Pacific Fishery Management Council: Portland, OR. 190 pp.

Dick, E. J., S. Ralston and D. Pearson. 2007. Status of cowcod, *Sebastes levis*, in the Southern California Bight. Pacific Fishery Management Council: Portland, OR. 101 pp.

Frey, H. W. 1971. California's living marine resources and their utilization. California Department of Fish and Game: Sacramento. 148 pp.

Gunderson, D. R., J. Robinson and T. Jow. 1974. Importance and species composition of continental shelf rockfish landed by United States trawlers. Report submitted to International N. Pacific Fisheries Commission by the U.S. National Section. 4 pp.

Heimann, R. F. G. and D. J. Miller. 1960. The Morro Bay otter trawl and partyboat fisheries August, 1957 to September, 1958. California Department of Fish and Game. 46:35-67.

Heimann, R. F. G. 1963. Trawling in the Monterey Bay area, with special reference to catch composition. California Department of Fish and Game. 49:152-173.

Heimann, R. F. G. and J. G. Carlisle, Jr. 1970. The California marine fish catch for 1968 and historical review 1916–1968. California Department of Fish and Game. 149:47-70.

Hill, K. H. and N. Schneider. 1999. Historical logbook databases from California's commercial passenger fishing vessel (partyboat) fishery, 1936–1997. SIO Reference Series No. 99-19. Scripps Institution of Oceanography/ University of California: San Diego. 65 pp.

Holliday, M. C., D. G. Deuel and W. M. Scogin. 1984. Marine Recreational Fisheries Statistical Survey, Pacific Coast, 1979–1980. Current Fishery Statistics Number 8321. U.S. Department of Commerce: Washington, D.C. 224 pp.

Karpov, K. A., D. P. Albin and W. H. Van Buskirk. 1995. The marine recreational fishery in northern and central California: A historical comparison (1958–86), status of stocks(1980–86), and effects of changes in the California current. Fish Bulletin 176. California Department of Fish and Game: Sacramento. 192 pp.

Key, M., A. D., MacCall, J. Field, D. Aseltine-Neilson and K. Lynn. 2008. The 2007 Assessment of blue rockfish (*Sebastes mystinus*) in California. Available at: http://www.dfg.ca.gov/marine/bluerockfish/index.asp.

Leet, W. S., C. M. Dewees and C. W. Haugen (editors). 1992. California's living marine resources and their utilization. USCGEP-91-12. California Sea Grant: La Jolla, CA. 257 pp.

Leet, W. S., C. M. Dewees, R. Klingbeil and E. J. Larson (editors). 2001. California's living marine resources, a status report. University of California ANR Publication SG01-11. 592 pp.

Love, M. S., B. Axell, P. Morris, R. Collins and A. Brooks. 1987. Life history and fishery of the California scorpionfish, *Scorpaena guttata*, within the Southern California Bight. Fishery Bulletin. 85:99-116.

Love, M. S. 1980. Isolation of olive rockfish, *Sebastes serranoides*, populations off southern California. Fishery Bulletin. 77:975-983

Love, M. S., W. Westphal and R. A. Collins. 1985. Distributional patterns of fishes captured aboard commercial passenger fishing vessels along the northern Channel Island, California. Fishery Bulletin. 83:243-251.

Love, M. S., J. E. Cassell and W. Van Buskirk. 1998. A Severe decline in the commercial passenger fishing vessel rockfish (*Sebastes* spp.) catch in the Southern California Bight, 1980–1996. California Cooperative Fisheries Investigations Reports. 39:180-195.

MacCall, A. D. 2003. The status of bocaccio off California in 2003. Pacific Fisheries Management Council: Portland, OR. 61 pp.

Mason, J. E. 1995. Species trends in sport fisheries, Monterey Bay, Calif., 1959–1986. Marine Fisheries Review. 57:1-16.

Mason, J. E. 1998. Declining rockfish lengths in the Monterey Bay, California, recreational fishery, 1959–1994. Marine Fisheries Review. 60:15-28.

Mason, J. E., 2004. Historical patterns from 74 years of commercial landings from California waters. California Cooperative Fisheries Investigations Reports 45:180-190.

Maunder, M. N., J. T. Barnes, D. Aseltine-Neilson and A. D. MacCall. 2004. The status of California Scorpionfish (*Scorpaena guttata*) off Southern California in 2004. Pacific Fishery Management Council: Portland, OR. 132 pp.

Methot, R., F. Wallace and K. Piner. 2002. Status of Yelloweye rockfish off the U.S. west coast in 2002. Pacific Fishery Management Council: Portland, OR. 77 pp.

Miller, D. J. and D. Gotshall. 1965. Ocean sportfish catch and effort from Oregon to Point Arguello, California–July 1, 1957 to June 30, 1961. Fish Bulletin 130. California Department of Fish and Game: Sacramento. 135 pp.

Miller, D. J. and M. W. Odemar. 1968. Ocean sportfish catch and effort from the Golden Gate to Yankee Point, Monterey California for the year 1966. Marine Resources Operations Ref. 68-15. California Department of Fish and Game: Sacramento. 70 pp.

Moser, H. G., R. L. Charter, P. E. Smith, D. A. Ambrose, W. Watson, S. R. Charter and E. M. Sandknop. 2001. Distributional Atlas of fish larvae and eggs in the Southern California Bight region: 1951–1998. California Cooperative Fisheries Investigations Atlas No. 34. 166 pp.

Nitsos, R. J. 1965. Species composition of rockfish (family Scorpaenidae) landed by California otter trawl vessels. 1962–1963, Pages 55–60 in 16th and 17th Annual reports of the Pacific Marine Fisheries Commission for the years 1963 and 1964. Pacific Marine Fisheries Commission: Portland, OR.

Oliphant, M. P., P. A. Gregory, B. J. Ingle and R. Madrid. 1990. California marine fish landings for 1977–1986. Fish Bulletin 173. California Department of Fish and Game: Sacramento. 52 pp.

Pearson, D. E. and B. Erwin. 1997. Documentation of California's commercial market sampling data entry and expansion programs. NOAA Tech Memo. NMFS-SWFSC-240. U.S. Department of Commerce: Washington, D.C. 62 pp.

Pearson, D. E., B. Erwin and M. Key. 2008. Reliability of California's groundfish estimates from 1969–2006. NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-431. U.S. Department of Commerce: Washington, D.C. 113 pp.

Phillips, J. B. 1939. The rockfish of the Monterey wholesale fish markets. California Department of Fish and Game. 25:214-225.

Phillips, J. B. 1958. Rockfish review. Pages 7-25 in the marine fish catch for the years 1955–1956 with rockfish review. Fish Bulletin 105. California Department of Fish and Game: Sacramento.

Piner, K., E. J. Dick and J. Field. 2005. Stock status of cowcod in the Southern California Bight and future prospects. Pacific Fishery Management Council: Portland, OR. 107 pp.

Pinkas, L., J. C. Thomas and J. A. Hanson. 1967. Marine sportfishing survey of southern California piers and jetties 1963. California Department of Fish and Game: Sacramento. 53:88-104.

Pinkas, L., M. S. Oliphant and C. W. Haugen. 1968. Southern California marine sportfishing survey: private boats 1964; shoreline, 1965–66. Fish Bulletin 143. California Department of Fish and Game: Sacramento. 42 pp.

Ralston, S. and E. J. Dick. 2003. The status of black rockfish (*Sebastes melanops*) off Oregon and northern California in 2003. Pacific Fishery Management Council: Portland, OR. 75 pp.

Ralston, S., D. Pearson, J. Field and M. Key. 2009. Documentation of the California catch reconstruction project. Pacific Fishery Management Council: Portland, OR.

Reilly, P. N., D. Wilson-Vandenberg, C. E. Wilson and K. Mayer. 1998. Onboard Sampling of the rockfish and lingcod commercial passenger fishing vessel industry in northern and central California, January through December 1995. Marine Region Administrative Report 98-1. California Department of Fish and Game: Sacramento. 110 pp.

Sampson, D. B. 2007. The status of black rockfish off Oregon and California in 2007. Pacific Fishery Management Council: Portland, OR. 236 pp.

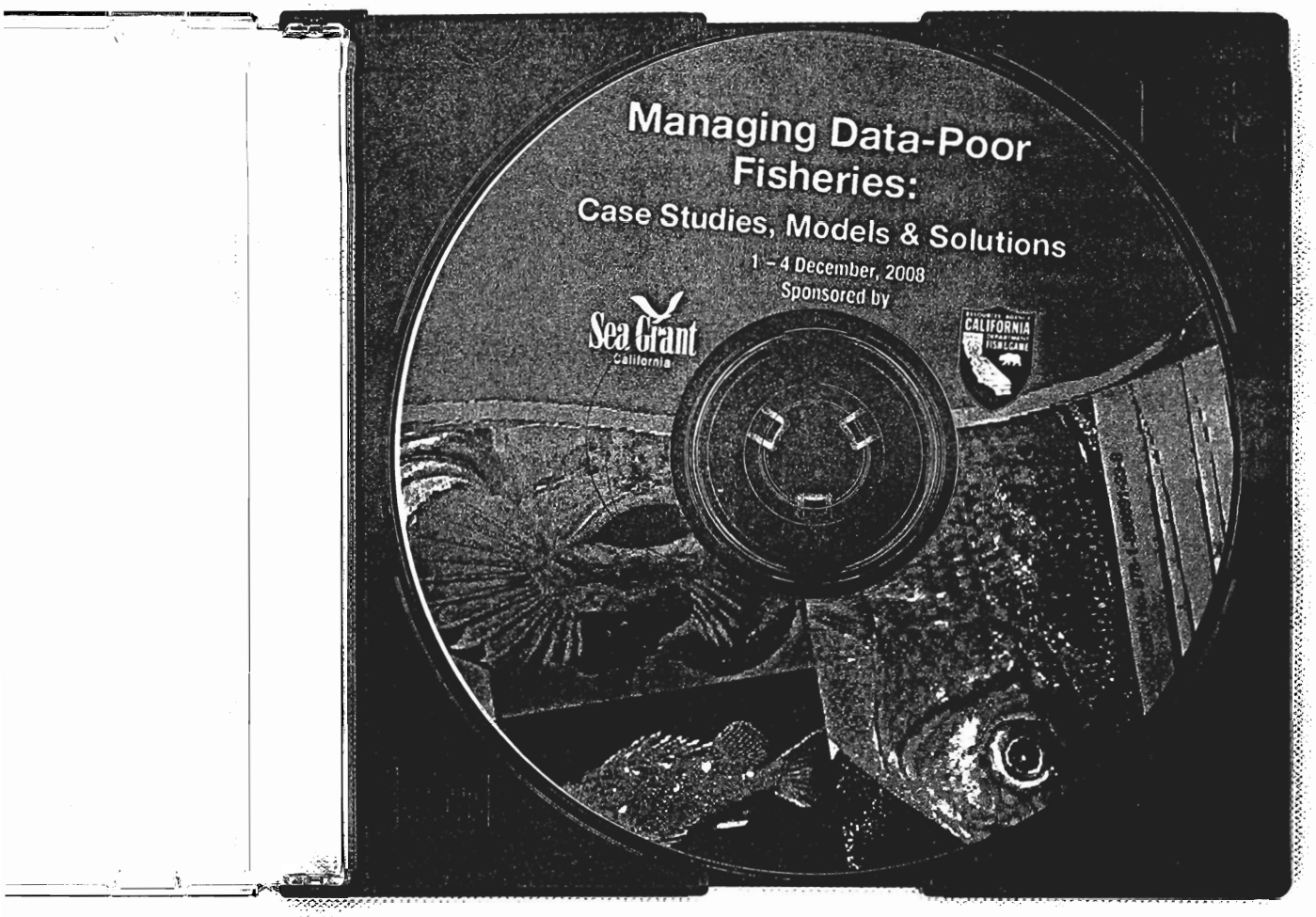
Sullivan, C. M. 1995. Grouping of fishing locations using similarities in species composition for the Monterey Bay area commercial passenger fishing vessel fishery,

1987–1992. Marine Resources Technical Report No. 59. California Department of Fish and Game: Sacramento. 37 pp.

Wallace, F., T. Tsou, T. Jagielo and Y. W. Cheng. 2006. Status of yelloweye rockfish off the U.S. west coast in 2006. In: Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council: Portland, OR. 141 pp.

Wine, V. and T. Hoban. 1976. Southern California independent sport fishing sampling survey annual report–July 1975–June 30, 1976. Marine Resources Division Admin. Rep. No. 76-4. California Department of Fish and Game: Sacramento. 299 pp.

Yoklavich, M. M., M. S. Love and K. A. Forney. 2007. A fishery-independent assessment of an overfished rockfish stock, cowcod (*Sebastes levis*), using direct observations from an occupied submersible. Canadian Journal of Fisheries and Aquatic Sciences. 64:1795-1804.


Managing Data-Poor Fisheries:
Case Studies, Models & Solutions
1 – 4 December, 2008
Sponsored by
Sea Grant
California
CALIFORNIA