

Summary of Data Sources for Stock Assessments for the Species in the Nearshore Fisheries Management Plan (NFMP)

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Table of Contents

Scope and structure of report	1
Table 1: Ranking of species by data richness	2
Descriptions of data sources	3
Table 2: Summary of data by data source	10
Individual species reports and data summary tables	
Black rockfish (<i>Sebastes melanops</i>)	12
Black and yellow rockfish (<i>Sebastes chrysomelas</i>)	16
Blue rockfish (<i>Sebastes mystinus</i>)	20
Brown rockfish (<i>Sebastes auriculatus</i>)	24
Cabezón (<i>Scorpaenichthys marmoratus</i>)	28
Calico rockfish (<i>Sebastes dalli</i>)	32
China rockfish (<i>Sebastes nebulosus</i>)	35
Copper rockfish (<i>Sebastes caurinus</i>)	39
Gopher rockfish (<i>Sebastes carnatus</i>)	42
Grass rockfish (<i>Sebastes rastrelliger</i>)	46
Kelp greenling (<i>Hexagrammos decagrammus</i>)	50
Kelp rockfish (<i>Sebastes atrovirens</i>)	53
Monkeyface prickleback eel (<i>Cebidichthys violaceus</i>)	57
Olive rockfish (<i>Sebastes serranoides</i>)	60
Quillback rockfish (<i>Sebastes maliger</i>)	63
Rock greenling (<i>Hexagrammos lagocephalus</i>)	66
Scorpionfish (<i>Scorpaena guttata</i>)	68
Sheephead (<i>Semicossyphus pulcher</i>)	71
Treefish (<i>Sebastes serriceps</i>)	74

Scope and structure of report

The purpose of this report is to summarize the data sources that are available for the 19 nearshore species identified in the Nearshore Fisheries Management Plan (NFMP), to provide a means for the California Fish and Game to determine which species have enough data to assess and where more data need to be collected. This list may not be comprehensive, and species that range outside of California are not fully represented in these data sets.

Data described in this report are summarized by data source and species. Summaries of data sources include the types of information included in the data set, years covered by the data set, whether the data are fishery dependent or independent, geographic coverage of the data, how data are available, who to contact to get the data, number of species in the data set, and additional comments related to the data set or accessibility to data.

Summary of data coverage by species begin with a description of the species, most taken directly from California's Living Marine Resources (Leet et al 2001). A data table follows that includes year coverage by database, whether the data are fishery dependent or independent, and any comments on the data within a database such as very few data points in a given year, inconsistencies in common or scientific names, and other information pertaining to the given species. Inconsistencies in names occur with some frequency, and in searching for data, a stock assessment team should be aware of this.

We have ranked the species in terms of data richness. Those species in the category “strongest” have the most and highest quality data amongst these fishes. These are likely the first candidates for stock assessments. Those in the “weakest” category have very little data to support a stock assessment, and those in the “intermediate” category are just that, intermediate. Typically, the fishes in both the “strongest” and “intermediate” category have long (> 20 years), continuous time series of fishery dependent data and significant quantities of length data. Those in the “strongest” category are distinguished by having the longest time series’ and more length data.

Table 1. Ranking of species as “strongest” to “weakest” candidates for stock assessments based on abundance of data.

Data Quality Rankings by Species		
Strongest	Intermediate	Weakest
Black rockfish	Treefish	Rock Greenling
Blue rockfish	Brown rockfish	Calico Rockfish
China rockfish	Quillback rockfish	Monkeyface Eel
Copper rockfish	Olive rockfish	Black & Yellow rockfish
Kelp Greenling	Kelp rockfish	Grass rockfish
Sheephead*	Gopher rockfish	
Cabazon*		
Scorpionfish*		

* species already assessed or undergoing assessment.

Data source descriptions for stock assessments of species identified in the NFMP

Nineteen species fall under the regulations of California's Nearshore Fisheries Management Plan (NFMP): black rockfish (*Sebastes melanops*), black-and-yellow rockfish (*Sebastes chrysomelas*), blue rockfish (*Sebastes mystinus*), brown rockfish (*Sebastes auriculatus*), cabezon (*Scorpaenichthys marmoratus*), calico rockfish (*Sebastes dallii*), California scorpionfish (*Scorpaena guttata*), California sheephead (*Semicossyphus pulcher*), China rockfish (*Sebastes nebulosus*), copper rockfish (*Sebastes caurinus*), gopher rockfish (*Sebastes carnatus*), grass rockfish (*Sebastes rastrelliger*), kelp greenling (*Hexagrammos decagrammus*), kelp rockfish (*Sebastes atrovirens*), monkeyface prickleback or monkeyface eel (*Cebidichthys violaceus*), olive rockfish (*Sebastes serranoides*), rock greenling (*Hexagrammos lagocephalus*), and quillback rockfish (*Sebastes maliger*).

At this time, two stock assessments have been performed (cabezon and California sheephead), and one is in progress (California scorpionfish). Additionally, black rockfish has undergone stock assessments by the National Marine Fisheries Service (NMFS), and data are being assembled for black-and-yellow rockfish and gopher rockfish by NMFS.

The data available are primarily fisheries dependent. However, all fisheries are well represented in both landings and lengths data. Many of the data-bases provide landings by gear and/or port, primarily in the commercial sector for recent years. The limited time frame is not a huge concern however, because most of the nearshore fisheries initially began as hook and line fisheries. The fisheries independent data are more sparse, and one

of the key fisheries independent surveys, California Cooperative Oceanic Fisheries Investigations (CalCOFI), often does not capture nearshore species or does not identify larvae down to species.

A number of the nearshore species extend beyond California borders. Data for Oregon and Washington are fairly easy to acquire, data from Mexico are quite a bit more difficult. There are no data-sets in this report that include landings from Mexico. Some of the commercial data-sets include fish caught in Mexico but landed in California however, the existence of these data are not consistent throughout data sets. A summary of Department Fishery-Dependent Monitoring and Fishery-Independent Assessment of Nearshore Commercial and Recreational Fisheries can be found at:

http://www.dfg.ca.gov/mrd/nfmp/pdfs/appendix_j.pdf

Fishery Dependent Data Sources

These sources provide information on the number of participants in the fishery, types of gear used, sizes and pounds (numbers of fish) landed at each port, the value of the fishery, recruitment of young into the fishery, age composition, fishing mortality, and catch per unit effort (CPUE).

Commercial Landings:

The Department of Fish and Game has compiled commercial landing records since 1916. The principal source of this information has been landing receipts, or “fish tickets.” Between 1929 and 1986, the Department summarized records of commercial landings in issues of the Fish Bulletin. Each source below comes from these initial landing receipts.

1. **CFIS** – California Fisheries Information System (1980-2003)
 - a. This program extracts commercial landings straight from the recorded and edited landing receipts submitted to DFG.
 - b. By year, by port, all gears included

2. **PacFIN** – Pacific Coast Fisheries Information Network (1981-2003)
 - a. Provides commercial landings information which enables agencies and industries to track commercial fish catches by area, and to manage and plan more effectively.
<http://www.psmfc.org/pacfin/>
 - b. By year, by port, all gears included
 - c. The Biological Statistics Data-base (BSD) contains maturity, length, weight, and sex data

3. **CALCOM** – California Cooperative Survey (1978-2002)
 - a. This data is the product of the California Cooperative Survey, a joint effort of the DFG, NMFS, and PSMFC. The purpose of the survey is to collect, process, and disseminate commercial market sample data on California's groundfish fishery.
 - b. Expansions from landing receipts.
 - c. Lengths from dockside sampling.
 - d. By year, by port, all gears included

4. **Archive Market Data** - (1981-2003)

- a. Commercial Length information by gear.
- b. Documentation available on sampling methods.

Recreational Landings:

Monitoring nearshore recreational fishing has focused on collecting information on four modes of fishing: party/charter or Commercial Passenger Fishing Vessels (CPFV's), private/rental boats, beach/bank, and man-made structures (i.e. piers). Three principal monitoring programs are the Marine Recreational Fisheries Statistics Survey (MRFSS), which is incorporated into RecFIN in California, Oregon, and Washington, CPFV logbooks, and onboard CPFV sampling. Today, California is in the process of implementing a new sampling program, the California Recreational Fisheries Survey (CRFS).

1. **RecFIN** – Recreational Fishery Information Network

- a. The Recreational Fishery Information Network is designed to integrate state and federal marine recreational fishery sampling efforts (from MRFSS) into a single database to provide important biological, social, and economic data for Pacific coast recreational fishery biologists, managers and anglers.
- b. <http://www.psmfc.org/recfin/>

- c. Complete database includes 1980-2003, with no information available in 1990-1992.
- d. Catch, length and CPUE information available.

2. **CPFV Logbooks**

- a. Since 1936, CPFV operators have been required to submit records (logbooks) to the Department for each day of fishing. For each log entry, the vessel operator must list the number of anglers and number of hours fished, fishing location by Department fishing block (10x10 nm), port of departure, type and number of fish caught, and number of discards.
- b. Complete logbook database available, 1980-2003.

3. **CPFV Onboard Surveys**

- a. Between 1984 and 1998, the Department conducted two onboard sampling programs of CPFV's. Each survey collected information on catch composition, amount, size, and bycatch for selected passengers at each location fished.
- b. CPFV fishing trips in Southern California (1984-1989) for catch information by general fishing areas
- c. CPFV rockfish and lingcod trips from Crescent City to Point Conception (1987-1998) on more site-specific catch information
- d. Used for in-season fisheries management and to supplement MRFSS data

4. **CCRS- California Conservation Rockfish Survey (1977-1985)**

- a. conducted by CDFG annually from CPFV sampling

- b. length and count information by gear
5. **CenCAL** – Length data from Spearfishing Tournaments Landings (1958-2003)
- a. The Department of Fish and Game have collected information on nearshore species, such as size frequency, from spearfish meets held on the central coast.
6. **Party boat and skiff data**-Landings and lengths from private boats and party boats
- a. Data from central California only available digital. Rest of the state is in process of digitizing.
 - b. Data divided into two sets for each data type; 1958-1972 and 1979-1986
 - c. Data also divided into length frequency and species composition for each year set and each boat type
7. **LA Times Phone Survey**-Call in survey conducted by the LA Times (1959-2003)
- a. Contains CPUE, reported landings, and port data

Fishery Independent Data Sources

These sources provide data on abundance and population structure, as well as CPUE data for the entire population, rather than just the portion of the population available to the fishery

1. **CalCOFI** - <http://www.calcofi.org/>-The California Cooperative Oceanic Fisheries Investigations (CalCOFI) are a unique partnership of the California Department of Fish and Game, the NOAA Fisheries Service and the Scripps Institution of Oceanography. Since 1949, CalCOFI has organized cruises to measure the physical and chemical properties of the California Current System and census populations of organisms from phytoplankton to avifauna. This sampling program was developed in

response to the crash of the California sardine fishery (see Smith 1994 for a history of the development of CalCOFI). On each cruise a grid of 66 stations off Southern California is occupied. At each station a whole suite of physical and chemical measurements are made to characterize the environment and map the distribution and abundance of phytoplankton, zooplankton and fish eggs and larvae. Very few nearshore species occur in these data.

2. **CDFG Diver Survey**-Surveys at Stillwater Cove were conducted over one year for CDFG. These data include length and sex data, but CPUE could also be extrapolated because dive start and stop time are included.
3. **Trawl Surveys**-NMFS conducts fisheries independent trawl surveys, primarily on the shelf. Nearshore species however, are not expected to show up very often.

Leet, W.S., C. M. Dewees, R. Klingbeil and E. J. Larson eds. (2001), California's Living Marine Resources: A Status Report. California Department of Fish and Game.

Smith, T.D. Scaling Fisheries: the science of measuring the effects of fishing, 1855-1955. Cambridge University Press, New York, New York, USA.

Table 2. Summary of data sources available for the 19 nearshore species named in the NFMP

Data Source	Data Type	Years		Data Origin	Area where data collected	Data Availability	Data Source Contact	Number of Nearshore Species Included	Comments
		Start	End						
Archive Market Data	landings	1996	2003	Fishery dependent Commercial	Primarily central and southern California	Electronic	Valerie Taylor (CDFG) or Steve Wertz swertz@dfg.ca.gov	4	Pretty sparse for the four species during the years available.
	gear								
	weight								
	sex								
	length								
Recfin	individual length	1980	2003	Fishery dependent recreational	Washington, Oregon and California	Electronic, web-based www.recfin.org	Wade Van Buskirk (PSMFC)	19	Many species sporatically represented. Data missing from 1990-1992, CPUE calculation changes during this time.
	discards								
	port								
	landings-recreational								
	CPUE								
CalCOM	landings by gear	1978	2003	Fishery dependent commercial	California	Electronic	Brenda Erwin (CDFG)	17	Varied sex and maturity data. Length data not as complete as landings data
	length comps by gear								
	weight								
	maturity								
	sex								
	port								
CDFG Diver Survey	individual length	2002	2002	Fishery independent	Stillwater Cove, Carmel, CA	Electronic	Paulo Serpa (CDFG)	15	All dives took place during 1 year, but on different dates, with different divers.
	sex (for some species)								
	CPUE (fish/diver/time)								
CenCal-Spear fishing tourney	CPUE (fish/diver/time)	1958	2003	Fishery dependent recreational	Central California	Electronic	Dave VenTresca (CDFG) dventresca@dfg.ca.gov	14	Spear fishing tournament data
	Landings								
	individual lengths								
PacFIN-Biological Data Systems	length	1981	2004	Fishery dependent recreational	CA, OR, WA	Electronic	Will Daspit (PSMFC) http://www.psmfc.org/pacfin/bds.html	19	Mostly northern California. Almost no Washington data
	weight								
	sex								
	maturity								
CRFS-see MRFSS				Fishery dependent recreational				NA	This is a California data base that replaces MRFS as of 2004
MRFSS-See RecFin				Fishery dependent recreational				NA	All MRFSS data added to Recfin
PacFIN-Washington, Oregon and California (W-O-C) Catch Reports	fish ticket-based landings	1981	2004	Fishery dependent commercial	CA, OR, WA	Electronic http://www.psmfc.org/pacfin/index.html	Gerry Kobylinski Gkobylin@dfg.ca.gov 916-323-1456	4	No comprehensive data base or search for the data bases available. Rockfish exist as a single market category in the W-O-C data bases .
	logbook data								
	landings by gear								
CPFV Onboard Data /CA CPFV Observer	lengths	1984	1989	Fishery dependent recreational	Santa Barbara to San Diego	Electronic 88data.mdb	Paulo Serpa (CDFG) pserpa@dfg.ca.gov (831) 649-7143	18	This one is called 86-88, even though it has more years
	discards								
	landings by port								
CPFV Onboard Data /CA CPFV Observer	samples by port	1987	1998	Fishery dependent recreational	California, North of Point Conception	Electronic CPFV-Onboard.mdb	Deb Wilson-Vandenberg (CDFG) dwilsonv@dfg.ca.gov	17	These data are called both observer and onboard data, and according to Meisha Key at CDFG, they are the same
	CPUE								
	weight								
	length								
	discards								
CPFV Onboard Data /CA CPFV Observer	samples by port and block	1975	1989	Fishery dependent recreational	Southern California	Electronic	Paulo Serpa (CDFG) pserpa@dfg.ca.gov (831) 649-7143	18	Data gap exists between 1979 and 1985. Data base is password protected.
	length								
	discards								
	cpue								
CA CPFV Logbook (1980 - Present)	cpue	1980	2003	Fishery dependent recreational	California	Electronic	Wendy Dunlap (CDFG) wdunlap@dfg.ca.gov	18	Structure and content of database varies by year, to the point where the database can be difficult to use.
	discards								
	depth								
	port/block								
CA CPFV Logbook (1936-39 & 1947-69)	descriptive summary info	1936	1969	Fishery dependent recreational	California	Hard copy	Kevin Hill (SWFSC-La Jolla) Kevin.Hill@noaa.gov	NA	Report can be downloaded from http://repositories.cdlib.org/sio/reference/99-19/
CCRS (California Conservation Rockfish Survey)	landings by gear	1977	1985	Fishery dependent recreational	Pedros Pt., San Mateo County to Avila, SLO County	Electronic in Access, rest of state available hard copy	Howatt King hking@dfg.ca.gov	14	Also a species comp data base, looks identical except species comp doesn't have lengths
	lengths by gear								
Cal. Living Mar. Resc.	Commercial landings	1916	1999	Fishery dependent both recreational and commercial	California	PDF or book, taken from RecFin, CPFV, CalComm and More	Available on line http://www.dfg.ca.gov/mrd/stat-us/	4	Mix of a number of different data sources. All recreational either CPFV or Recfin, not sure where commercial data from.
	Rec. landings (see recfin for detail)	1947	1999					19	

Table 2 cont'd

ISK (Intercept Skiff data -- private skiff)-Lengths	Lengths	1979	1986	Fishery dependent recreational	Pedros Pt., San Mateo County to Avila, SLO County	Electronic in Access, rest of state available hard copy	Howatt King hking@dfg.ca.gov	14	Sex data very sparse. May already be contained in historic MRFSS. Associated species composition database
	Sex								
	Port								
IPB (Intercept Party Boat Data)-Lengths	Lengths	1979	1986	Fishery dependent recreational	Pedros Pt., San Mateo County to Avila, SLO County	Electronic in Access, rest of state available hard copy	Howatt King hking@dfg.ca.gov	15	Sex data very sparse. May already be contained in MRFSS historic data. Associated species composition database.
	Sex								
	Port								
Party Boat Bottomfish-Lengths	Lengths	1959	1972	Fishery dependent recreational	Pedros Pt., San Mateo County to Avila, SLO County	Electronic in Access, rest of state available hard copy	Howatt King hking@dfg.ca.gov	14	Related to ISK and IPB data bases, but part of earlier coverage. Associated species composition database.
	Sex								
	Port								
Skiff-Lengths	Lengths	1958	1972	Fishery dependent recreational	Pedros Pt., San Mateo County to Avila, SLO County	Electronic in Access, rest of state available hard copy	Howatt King hking@dfg.ca.gov	14	Related to ISK and IPB data bases, but part of earlier coverage. Associated species composition database. Other than blue rockfish, data only in 59, 60, & 66
	Sex								
	Port								
CFIS	landings by gear	1980	2004	Fishery dependent commercial	California	Electronic	Robert Leos (CDFG) RLeos@dfg.ca.gov	17	Data are only accessible through a CDFG employee. Data base uses market categories that aren't necessarily "clean" meaning that multiple rockfish species may be grouped into one category
	landings by block								
	landings by port								
LA Times Phone Survey	CPUE	1959	2003	Fishery dependent recreational	Southern California	Electronic	http://swfscdata.nmfs.noaa.gov/latimes/queries/default.htm	15	Data are from phone calls made to the LA times, not a random sampling of all landings. Rockfish are lumped and survey participants ID their own fish.
	landings								
	port								
AFSC Triennial Trawl Shelf Survey	biomass indices			Fishery independent	California, Oregon, and Washington	Electronic	Mark Wilkins (AFSC - Seattle)	NA	Some nearshore species show up in these survey, but occurrence is infrequent. Early surveys discarded many nearshore species without recording them.
NWFSC Trawl Slope/Shelf Survey	lengths								
	ages								
	maturity								
	individual weights								
	sex								
CA Midwater Juvenile Rockfish Survey	recruitment index			Fishery independent	CA	Summarized form, Electronic	Steve Ralston (SWFSC - Santa Cruz) Steve.Ralston@noaa.gov	NA	Data are available, but analysis requires otolith data. NMFS will summarize data as requested. Project description at: http://www.mbnms-simon.org/sections/fisheries/project_info.php?pid=100118&sec=f
	age								
	mortality								
	size								
CalCOFI Data	spawning biomass index	1951	2000	Fishery independent	CA, some Mexico	Currently in the CalCOFI reports, to be available on the web in April '05	Richard Charter (SWFSC - La Jolla) Richard.Charter@noaa.gov 858-546-7157	5; Scorpionfish, Kelp greenling, Sheephead, Rock greenling, Cabezon	Only a few nearshore species occur, most are identified down to family only. We were not able to attain year by year larval data. Oceanographic data from: http://www.calcofi.org/newhome/data/database/database.htm
Groundfish tagging study	adult survey	2002	2004	Fishery independent	California	Electronic	Ed Roberts (CDFG) 562.342.7199 eroberts@dfg.ca.gov	13	Data cover just over 15 months
	length								
Observer Data	Pikitch Discard Rate			Fishery independent			John Wallace (NWFSC - Seattle)		Unable to acquire data
	EDCP Discard Rate								
	NWFSC Discard Rate								
	NWFSC Discarded Indiv Lengths								
	NORPAC at-sea bycatch data								
P. Whiting Shoreside Observer	Bycatch			Fishery independent					Unable to acquire data
	Lengths								
WA Ocean Sampling Program	landings			Fishery independent			Farron Wallace (WDFW)		Unable to acquire data
	effort								
	cpue								
	lengths								
	individual weights								
OR Ocean Boat Sampling	landings			Fishery independent			Nick Wilsman, Mark Feeman mark.feeman@oregonstate.edu, Don Bodenmiller		Unable to acquire data
	effort								
	cpue								
	lengths								
	individual weights								
Power-plant Impingement	recruitment index			Fishery independent					Unable to acquire data
YOY juvenile rockfish	recruitment index			Fishery independent	Morro Bay-Newport OR		Susan McBride (SeaGrant)		Unable to acquire data

Black Rockfish

History of the Fishery

Black rockfish (*Sebastes melanops*), also known as black snapper and black bass, are a minor to moderate component of nearshore commercial and recreational fisheries, with increasing importance from the San Francisco area northward. The Eureka area accounts for 80 percent to 90 percent of all commercial landings in the "black rockfish" market category (which may contain other species, most commonly blue rockfish). Annual statewide landings in the 1990s ranged from 189,000 to 277,000 pounds, except in 1993 when only 86,000 pounds were landed. Landings from port areas south of San Francisco have never comprised more than 10 percent of total landings in the market category. In the San Francisco port area, "black rockfish" landings increased fifteen-fold from 1989 to 1992. The majority of black rockfish in commercial fisheries are landed dead but a small portion are now landed live in the recently expanded live fish fishery, primarily from Morro Bay north to Fort Bragg. They are also taken incidentally in the commercial salmon troll fishery. Black rockfish also comprise minor to significant proportions of other market categories, in particular "blue rockfish," "small rockfish," and "unspecified rockfish."

Black rockfish are an important recreational species, particularly in northern California. Long-term monitoring of the recreational skiff fishery in the Eureka/Crescent City area showed them as the most frequently taken species every year in the 1990s; in 1997, for example, black rockfish comprised 58 percent of the observed catch. During the period from 1981 through 1986, the Marine Recreational Fisheries Statistical Survey (MRFSS) showed that in Humboldt and Del Norte Counties (northern California), black rockfish comprised from 15 to 31 percent annually of the estimated total marine recreational catch for all fishing modes combined. South of the Eureka area, black rockfish gradually decrease in importance in the recreational catch and are infrequently observed south of Santa Cruz. They are often among the top 10 species observed annually in commercial passenger fishing



Black Rockfish, *Sebastes melanops*
Credit: DFG

vessel (CPFV) catches from Fort Bragg south to the San Francisco/Princeton area. Black rockfish also are important to divers. In a 1972 survey in northern and central California, black rockfish comprised approximately eight percent of all fish taken by divers, and were primarily taken in northern California.

A six- to seven-fold increase in estimated annual landings of black rockfish in the recreational fishery occurred between 1957 through 1961 and 1979 through 1986, which reflects a substantial increase in fishing effort between the two periods. Since then, estimated total recreational catch has been variable and has not continued to increase steadily. During the 1990s, the annual estimated take of black rockfish in the recreational fishery was fairly similar to that of the commercial fishery.

In 1992, DFG initiated a voluntary catch-and-release program in recreational and commercial fisheries for black rockfish less than 14 inches in total length in response to concerns over the lack of larger fish in sampled recreational catches, particularly in the San Francisco/Half Moon Bay area. The program was unsuccessful in the primary target area (Bodega Bay to Santa Cruz) and was not continued due to two factors: 1) increased recruitment of sub-adult fish to the fishery (*i.e.*, recreational anglers were unwilling to return a substantial portion of their catch to the water); and 2) perceived competition for the same resource from non-cooperative fishermen.

Status of Biological Knowledge

Black rockfish range from Amchitka Island, Alaska to Santa Monica Bay in southern California, but are uncommon south of Santa Cruz. They frequently occur in loose schools ten to twenty feet above shallow (to 120 feet) rocky reefs, but may also be observed as individuals resting on rocky bottom, or schooling in midwater over deeper (to 240 feet) reefs. They may attain a maximum length of 25.5 inches in California, although individuals over 20 inches are rarely observed today. Average size observed in commercial and recreational fisheries now is 14 to 15 inches in northern California and 11 to 13 inches in central California.

Black rockfish have a relatively fast growth rate. First year growth is usually 3.5 to 4.0 inches. Most individuals become available to the fishery by the time they have reached three to four years of age and are approximately 10 to 11.5 inches. They are larger at equal age than blue rockfish; four-to-seven-year old black rockfish may average from 11.5 to 13.8 inches, while blue rockfish range from 10 to 12 inches within that age range. By age five, growth rate of female black rockfish surpasses that of males, and

by age 15, female black rockfish may average 2.4 inches longer than males.

At six years, or about 14 inches, half of all males are sexually mature. At seven to eight years, or about 16 inches, half of all females are sexually mature.

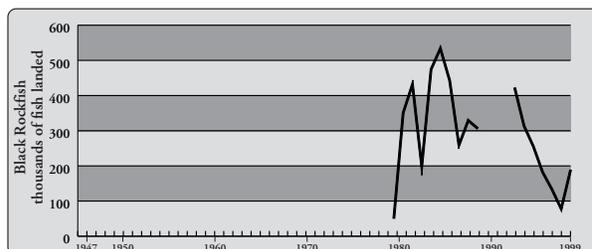
As with all members of the genus *Sebastes*, fertilization and development of embryos takes place within the female's body. Black rockfish mating generally occurs between September and November. Females store the sperm until their eggs mature in December or January, at which time the eggs are fertilized by the stored sperm. The larvae develop within thirty days, at which time black eyespots become visible to the naked eye. The eyed larvae are released into the water from late January to May, peaking in February off of California.

Larvae may remain in the ocean's surface waters for three to six months where they are dispersed by currents, advection, and upwelling. They begin to reappear as young-of-the-year (YOY) in shallow, nearshore waters by May, but the major recruitment event usually occurs from July to August. YOY black rockfish generally recruit to the shallower portions of kelp beds (15- to 40-foot depth) as well as semi-protected sandy areas of the coast. As newly settled YOY (approximately 1.5 inches) they most closely resemble yellowtail rockfish YOY. As they grow, YOY black rockfish more closely resemble YOY blue rockfish in pigmentation but lack the mottling on the sides, which are a uniform tan to light brown. As juveniles and adults, black rockfish are frequently mistaken for blue rockfish. The best characteristics that separate black from blue rockfish are a wide, unmottled, light blue-gray area along the lateral line, a relatively large mouth, the shape of the anal fin, and black speckling in the dorsal fin.

Although black rockfish may occur with blue rockfish, particularly in central and northern California, they are not considered to be competitors because their diets share little in common. Juvenile and adult black rockfish primarily consume crab megalopae, amphipods, isopods, and other fishes, including YOY rockfishes.

Major predation occurs on all rockfishes from the moment of larval release throughout the first year by a variety of fishes and invertebrates, as well as marine birds. Larger black rockfish are preyed upon by lingcod and marine mammals such as sea lions.

Black rockfish are commonly associated with other nearshore fish species, particularly other rockfishes. A statistical technique, cluster analysis, was used to partition CPFV catch data from 1987 to 1992 in the Monterey area based on the frequency of occurrence of species in the sampled catch. Interestingly, no other schooling rockfish was closely associated statistically with black rockfish, but three benthic species (gopher, China, and brown rock-



Recreational Catch 1947-1999, Black Rockfish

Data Source: RecFin data base for all gear types; data not available for 1990-1992

fishes) showed an affinity to the same habitat and depth range as black rockfish. It is commonly known among fishermen that black rockfish in central California are characterized by localized areas of relatively high abundance in the nearshore area.

The DFG has conducted limited tagging studies on juvenile and adult black rockfishes. Between 1978 and 1985, 89 black rockfish were tagged in central California. Four tags were returned from fish which had been at liberty from 18 to 552 days; all fish were recaptured in the same areas where they were released.

Status of the Population

Although no fishery-independent population estimates have ever been made of black rockfish stocks in California, substantial information exists on relative abundance and length frequency from fishery-dependent surveys. Data from the 1981-1986 MRFSS survey showed a 23 percent decline in the average weight of black rockfish taken compared with fish harvested from 1958 through 1961.

Onboard observations from CPFVs in the San Francisco area documented a significant change in the length frequency of the sampled catch from 1989 to 1990. During that period, the occurrence of larger adult black rockfish (greater than 15 inches) declined precipitously. This occurred during a time when nearshore commercial hook-and-line fishing effort and landings were expanding, as mentioned previously. Mean length in the sampled catch from the San Francisco area declined from 14.3 inches in 1988-1989 to 12.1 inches in 1990-1991, and has ranged from 11.4 to 12.6 inches annually from 1993 to 1998. This is well below the average length at 50 percent sexual maturity. Since 1993, all other CPFV port areas from Fort Bragg south to Morro Bay have yielded similar low mean lengths.

Results from commercial fishery sampling are consistent with the above. For example, 296 black rockfish sampled from the Morro Bay area commercial nearshore fishery from 1993 to 1997 averaged 12.2 inches. Coincident with

these observed declines in mean length were increased harvest rates (catch per angler hour) observed in the CPFV fishery in central California, particularly from 1994 to 1997. Thus, the observed decline in mean length is partially related to stronger recruitment, and, in spite of increased fishing effort on black rockfish in recent decades, localized populations of adults still must be present in California to provide this recruitment.

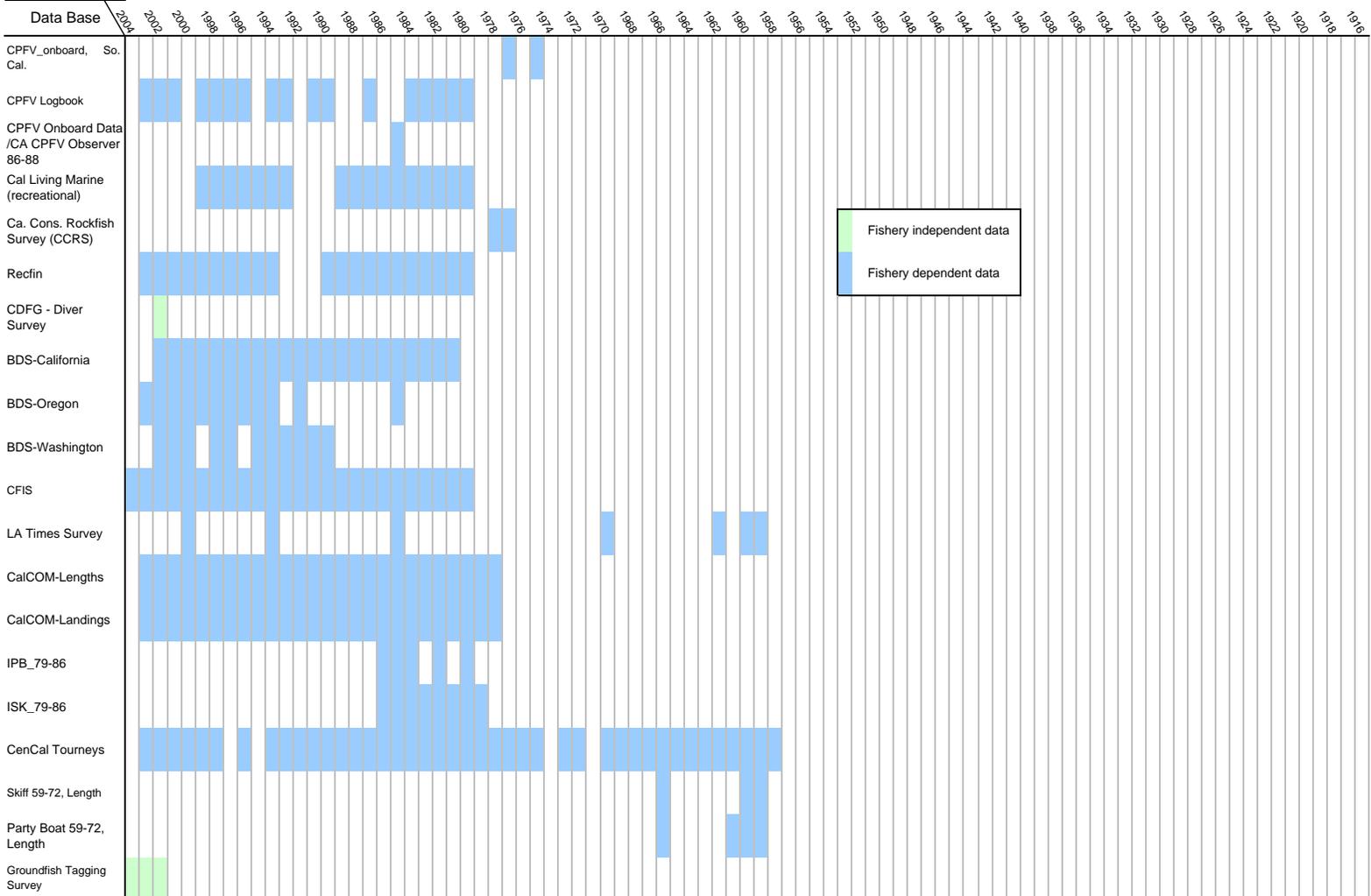
Paul Reilly

California Department of Fish and Game

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Data Coverage for Black Rockfish



Fishery independent data
 Fishery dependent data

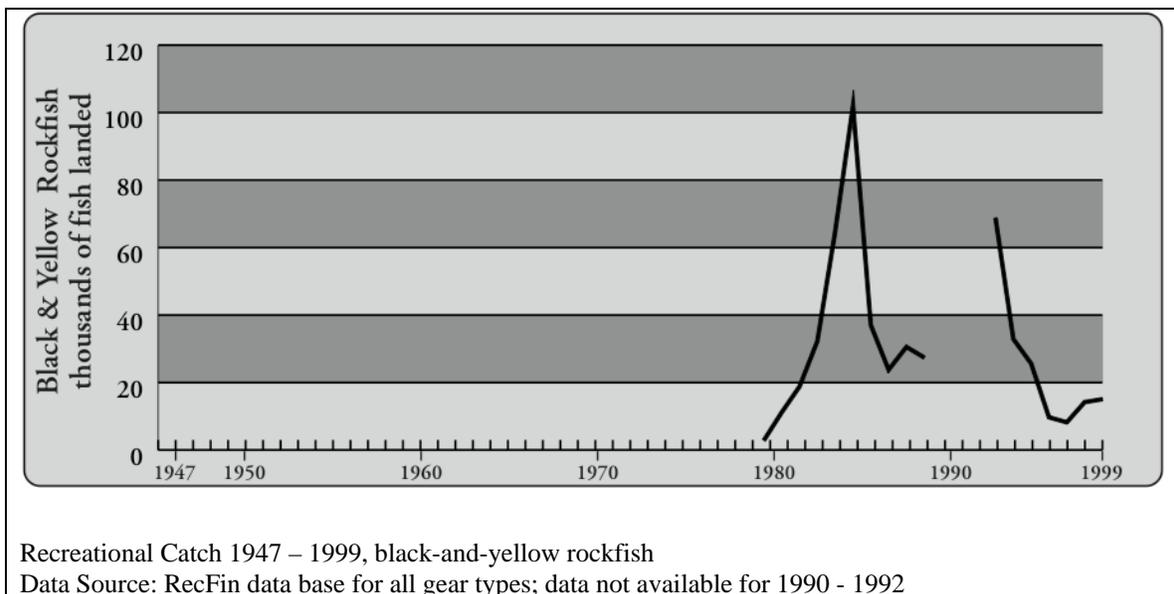
Notes: CPFV Onboard Data /CA CPF only two measurements
 CCRS 20 measurements in '77 and 5 in '78
 Recfin length data available '80 to '94 only
 CDFG - Diver Survey CPUE and length, no sex data
 BDS-California length and maturity, some age, no weight
 BDS-Oregon Length and maturity, some age and some weight
 BDS-Washington length, some age, some maturity and no weight
 CalCOM gear information
 CFIS Black and blue rockfish also lumped

Black-and-yellow Rockfish

Black-and-yellow rockfish (*Sebastes chrysomelas*) is very closely related to gopher rockfish (*Sebastes carnatus*), and though they are morphologically distinct, there is some confusion over whether they are one species or two. The two species are very similar ecologically, but are found at different depth ranges: black-and-yellows are found above 18 meters while gophers live below 12 meters and up to 80 meters deep.

History of the Fishery

Black-and-yellow rockfish have been a minor component of recreational and commercial rockfish fisheries. They are most frequently caught by anglers fishing from private boats rather than by anglers fishing from CPFVs (commercial passenger fishing vessels) or from shore. However, the proportion of the catch taken by commercial (versus recreational) fishers rose from about 18% in the 1980s to about 60% in the 1990s.



Gopher and black-and-yellow rockfishes are frequently classified wrongly: 34.4% of the black-and-yellow market category are gopher rockfish and the gopher group contains only up to 61% gopher rockfish. While species misidentification does occur, fish are often grouped by price rather than by species complicating specific landing estimates.

The live fish market demand is mainly for fish in the one to two pound size range, this is above the size of sexual maturity, although in the development of the fishery all fish were kept regardless of size. Due to concerns over the harvest of immature fish the Marine Life Management Act of 1998 implemented minimum commercial size limits for black-and-yellow rockfish. The shallow, nearshore nature of this fishery renders it very weather dependent. Poor weather, combined with lower overall allowable catches, implementation of minimum size limits, and a lack of a market north of Bodega Bay resulted in reduced catches from 1997 to 1999.

Black-and-yellow rockfish also have important non-consumptive uses. Colorful and accessible they are frequently observed and photographed by divers. In addition, individuals are taken for the aquarium trade.

Status of Biological Knowledge

Black-and-yellow rockfish are reasonably well studied. They are not abundant north of Sonoma County, and range south to central Baja California, though they are now uncommon south of Point Conception. Black-and-yellow rockfish have been found from in intertidal waters and up to 37 meters deep, however they are most commonly found above 18 meters depth.

Black-and-yellow rockfish reach a maximum size of about 39 centimeters, they may live as long as 30 years, but individuals older than 20 are rare. Individuals are smaller off of southern California, rarely exceeding 20 centimeters. They reproduce once per breeding season, parturation occurs between January and July in California, and peaks in March.

Black-and-yellow rockfish are territorial, they defend areas up to 10 –12 square meters. They occupy rocky habitat at the base of kelp beds. aLargely nocturnal, they spend daytime hours in holes and crevices, emerging at dusk to eat.

Available data suggest that diets of juvenile fish include primarily crustacean zooplanktors such as barnacle cyprids. Adult diets include invertebrates such as cephalopods, gatropods, opiuroids (brittle stars) and polychaetes. Small fish consumed by

these rockfish include juvenile rockfish (mainly blue rockfish), sculpins, juvenile surfperch, kelpfishes, and plainfin midshipman.

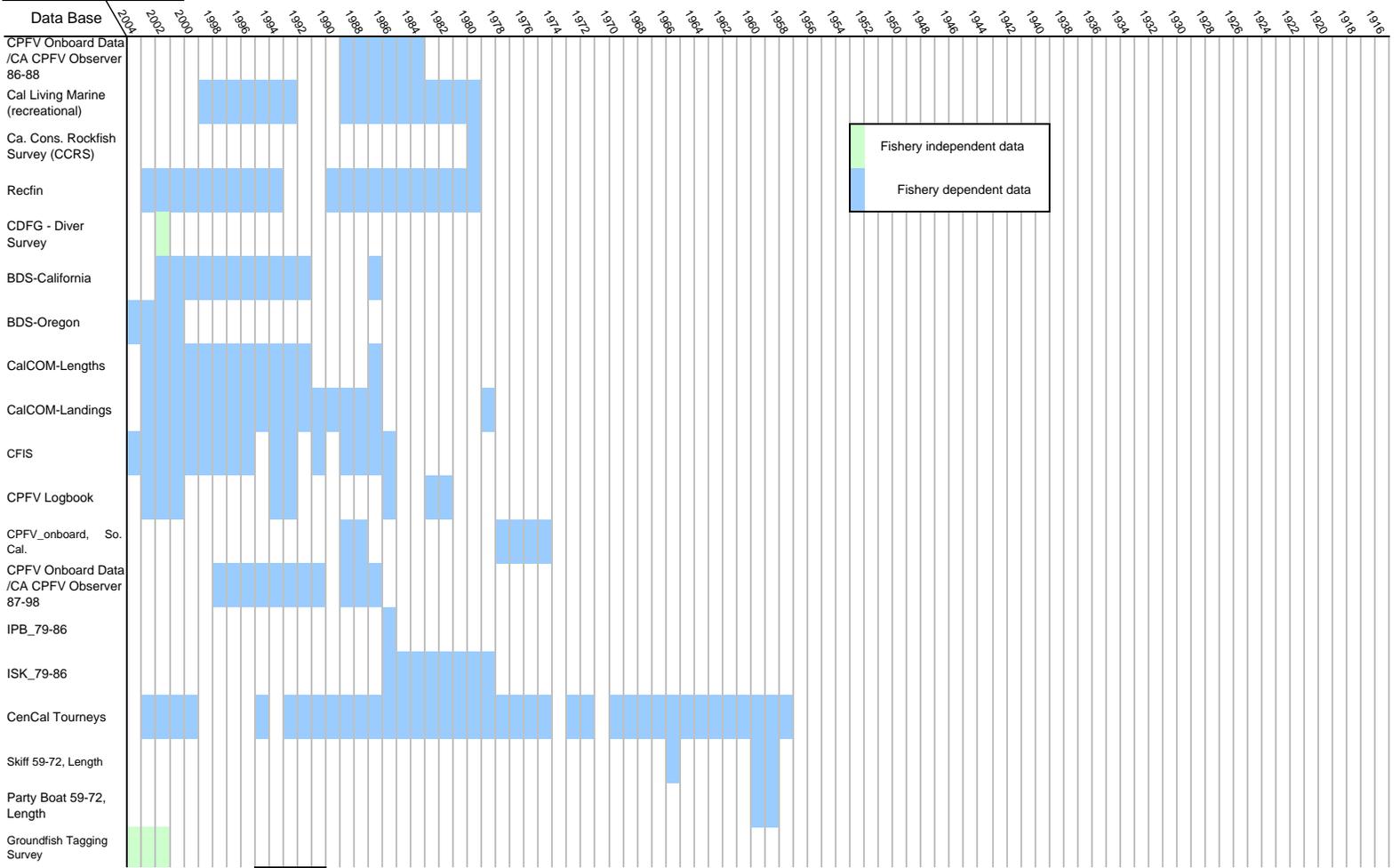
Status of Populations

While there have been several studies of local abundance in black-and-yellow rockfish, there is no comprehensive assessment of their population. The population is probably subject to local depression in abundance and average size where diving, skiff fishing, party boat activity, or commercial fishing is concentrated. The low fecundity, restricted habitats and limited movements of this species make them vulnerable to local fishing pressure. Statewide, the limited geographic ranges and restricted habitats suggest that they have small populations in comparison to more widespread species that have traditionally been the target of commercial fishing. The limited depth distribution of black-and-yellow rockfish means that all of the spawning population is vulnerable to fishing and probably few natural refugia exist. Infrequent years of good recruitment increase the danger of removing too many spawners, even with limited fishing pressure.

Adapted from California Living Marine Resources Status Report “Other Nearshore Rockfishes” by Ralph J. Larson (San Francisco State University) and Deborah A. Wilson-Vandenberg (California Department of Fish and Game)

Data Coverage for Black & Yellow Rockfish

Black & Yellow Rockfish



Fishery independent data
Fishery dependent data

Notes: CCRS two measurements
 Recfin length data available
 CDFG - Diver Survey CPUE and length, no sex data
 BDS-California length, no age, no maturity, no weight
 BDS-Oregon length and weight, no age, no maturity
 CalCOM gear information
 CPFV Onboard Data length, weight, cpue, and by-block landings

Blue Rockfish

History of the Fishery

The blue rockfish (*Sebastes mystinus*), also known as bluefish, blue perch, blue bass, priestfish, and reef bass, is most commonly caught from the northern Channel Islands (in the Southern California Bight) to the Oregon border. Although only a small portion of blue rockfish landings is from the commercial fishery, those landings have increased in the past decade. During the 1987-1989 period, landings in the "blue rockfish" market category (which may include other morphologically similar rockfishes) averaged 25,670 pounds; in 1998 landings were approximately 92,000 pounds. Based on market sampling in the Morro Bay area, total landings of the species blue rockfish are significantly greater than those of the market category "blue rockfish." For example, in 1998 in this port area, estimated total landings for the species were 19,300 pounds, yet total reported landings for the market category were only 2,100 pounds. The former estimate is based on the percentage of blue rockfish in various sampled market categories and the total landed weight of all market categories. Blue rockfish are often landed as "unspecified rockfish" or "group small rockfish," both frequently used market categories.

Blue rockfish have become a minor component of the live fish fishery, which developed during the 1990s in California. For example, in the Morro Bay area during the 1996-1998 period, less than one percent of the live fish landings were blue rockfish, and about four times as many blue rockfish were landed dead than alive. In 1998, the ex-vessel value of all fish landed statewide in the "blue rockfish" market category was \$57,700.

The blue rockfish is one of the most important recreational species in California. It is usually the most frequently caught rockfish north of Point Conception for anglers fishing from skiffs and Commercial Passenger Fishing Vessels (CPFVs). It is also an important species for skin and scuba divers using spears, and is occasionally caught by shore anglers fishing in rocky subtidal areas. In a 1981-1986 survey of sport fish taken between the southern boundary of San Luis Obispo County and Oregon, an estimated 800,000 blue rockfish were harvested annually - more than any other species. This represents a doubling of the estimated annual harvest from a similar survey conducted in 1957-1961.

In every complete year sampled by the department, from 1988 through 1998, blue rockfish has been among the three most frequently observed species caught on CPFVs in every major port area from Morro Bay to Fort Bragg. Based on the Department of Fish and Game's (DFG) onboard observations and log book summaries, estimated annual take of blue rockfish by CPFV anglers ranged from 199,000 to 546,000 fish for the period 1988 to 1995 and

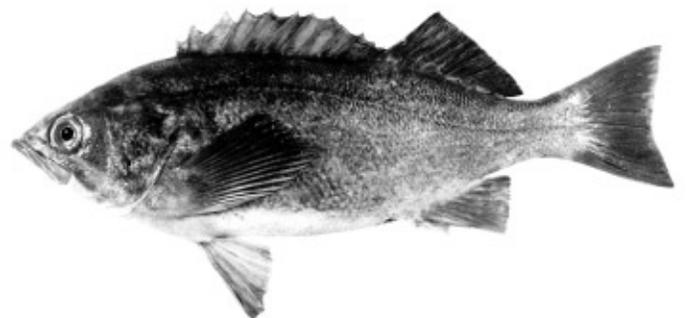
averaged 335,000 fish. This species truly has been the bread and butter of the nearshore recreational angler in northern and central California.

In a survey of divers conducted in 1972 in northern and central California, blue rockfish ranked second in importance to lingcod with 10.5 percent of all fish landed and was the most common rockfish taken, comprising 29.6 percent of all rockfishes. Preliminary data from a 1999 survey of Monterey Bay area divers revealed that blue rockfish was the fourth most abundant species harvested, after California halibut, kelp rockfish, and lingcod.

For more than 25 years, the recreational harvest of rockfish was limited to 15 fish per day, with 15 blue rockfish allowed within that limit. Effective January 1, 2000, the bag limit was reduced to 10 rockfish overall, with 10 blue rockfish allowed within that limit. The National Marine Fisheries Service considers the blue rockfish a "nearshore species." Effective January 1, 2000, very restrictive limits on the commercial harvest of nearshore rockfishes have been imposed by the National Marine Fisheries Service upon recommendation of the Pacific Fishery Management Council. In addition, the DFG now requires a special permit for the commercial harvest of nearshore fishes, and it is likely that a restricted access program will be developed for the nearshore commercial finfish fishery in California.

Status of Biological Knowledge

Blue rockfish range from the Bering Sea to Punta Baja, Baja California, and from surface waters to a maximum depth of 300 feet. They are less common south of the northern Channel Islands and north of Eureka, California. They are a medium-sized species among all rockfishes; the largest known specimen was 21 inches, although individuals exceeding 15 inches are uncommon in central and southern California. Average size in California recreational fisheries today is 11 to 13 inches. In central and southern California, larger blue rockfish are now common only in areas distant from fishing ports or in larger kelp beds which are practical to fish only from the edges.



Blue Rockfish, *Sebastes mystinus*
Credit: DFG

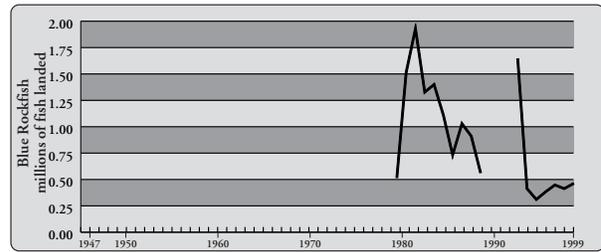
Rockfishes in general are considered to be slow-growing fishes. However, blue rockfish are among the faster growing rockfishes. First year growth may vary from 3.0 to 4.5 inches (central California average about 4.25 inches), and after two years blues may reach six inches. An occasional two- or three-year old blue rockfish may be caught by anglers, but most do not recruit to the sport and commercial fisheries until four to seven years of age when they range from eight to 10 inches. Females grow at a slightly faster rate than males. Maximum age is about 24 years.

Age at first spawning is protracted for both sexes. Only about 10 percent spawn for the first time at three years of age. At five years, or about 10 to 10.5 inches, half of all males are sexually mature. At six years, or about 11 inches, half of all females have spawned.

In males, the gonads increase in size from May to July, but in females the eggs begin maturing from July to October. Males transfer sperm to the females in October, but the embryos do not begin to develop until December when the eggs are fertilized by the stored sperm. Embryos develop within the female and hatch immediately upon being released into the water; larval release usually peaks in mid-January. Larvae live in the surface waters for four to five months, where they may be carried many miles by ocean currents. Young-of-the-year (YOY) blue rockfish begin to appear in the kelp canopy and shallow rocky areas by late April or early May when they are about 1.2 to 1.4 inches in length. However, they are not considered fully recruited each year until July due to the variability in the planktonic period. As YOY, they are mottled reddish-blue in color upon settlement and may appear in massive swarms in certain years in inshore areas, especially in kelp beds.

After more than two decades of estimating relative abundance of blue rockfish in central California, DFG biologists have shown a positive statistical correlation with blue rockfish recruitment and annual upwelling index. Continuing research is directed towards the mechanisms by which YOY rockfish recruit to nearshore areas, and the relationship between spawning areas and recruitment areas, as influenced by current patterns and oceanographic events.

Feeding habits vary considerably depending upon life history stage, depth, and locality. Larval and YOY blue rockfish consume primarily planktonic crustacea. Adult fishes in deeper water feed almost entirely on macroplankton consisting of tunicates (salps), scyphozoids (gonadal material of jellyfish), and crustaceans. In shallow areas and kelp beds, blue rockfish feed on the same types of macroplankton as those in deeper water, but they also feed on algae, small fishes, hydroids, and crustaceans, including amphipods and crab larvae.



Recreational Catch 1947-1999, Blue Rockfish

Data Source: RecFin data base for all gear types; data not available for 1990-1992

During their first few months on nearshore reefs, larval and YOY blue rockfish are preyed upon by most large piscivorous fishes. As adults, their predators include lingcod, harbor seals, sea lions, and, occasionally, larger rockfishes, especially bocaccio.

Adult blue rockfish are common in kelp beds, where food is plentiful and the kelp provides protection from predators, but they also occur on deeper rocky reefs between 100 and 300 feet deep. In kelp beds they form loose to compact aggregations. Under dense kelp canopies, they will sometimes form columns at least 30 wide and 80 feet deep and may be extremely compact. In deeper waters, they form aggregations that may extend from the surface to the bottom, but they are usually at or below mid-depth.

Blue rockfish are commonly associated with other nearshore fish species, particularly other rockfishes. A statistical technique, cluster analysis, was used to partition CPFV catch data from 1987 to 1992 in the Monterey area based on the frequency of occurrence of species in the sampled catch. In a broad area along the entire Monterey Peninsula extending out to 240 feet deep, blue rockfish were the predominant species and were in close association with olive, yellowtail, starry, and rosy rockfishes. This statistical relationship has been supported with observations using scuba and submersibles.

The DFG has conducted marking studies on all size ranges of blue rockfish from 1.8 to 18 inches. A population study using freeze branding as a marking technique resulted in more than 80,000 recently-settled blue rockfish being marked in a five-week period. These fish showed very little movement from an isolated reef 100 x 150 feet and, in fact, showed very little movement from one part of the reef to another.

Tagging studies of adult blue rockfish indicate they do not migrate laterally along the coast. Between 1978 and 1985, over 1500 blue rockfish were tagged and released in central California waters by DFG biologists. Eighteen tags were subsequently returned, with the fish being at liberty from 11 to 502 days; all were recaptured in the same locations where they were tagged. The longest recorded movement of a blue rockfish from any tagging study was 15 miles. While these studies show adult blue rockfish

populations are more or less discrete at each fishing port, it is not known how much larval drift occurs between fishing areas.

Status of the Population

Although no fishery-independent population estimates have ever been made of blue rockfish stocks, it appears that they have withstood considerable fishing pressure over the last four decades and continue to be healthy, at least north of Point Conception. There is evidence of a decline in blue rockfish stocks off southern California since the 1970s. There is a well-documented difference in the population structure between northern and central California stocks. Northern stocks are generally characterized by a wider size range of adults, a higher proportion of adults greater than 15 inches and a correspondingly greater mean length, less variability in annual recruitment, and most likely a higher growth rate. These attributes are likely a result of a combination of greater fishing pressure and a greater influence of anomalous oceanic conditions such as El Niño events in central California. Greater variability in annual recruitment results in occasional strong year classes which cause strong length-frequency modes in the sampled catch; this occurred four times in recreational fishery samples obtained from 1959 to 1983 in central California. It is believed that the last exceptionally strong year class of blue rockfish in central California occurred in 1988, which is cause for concern. However, a relatively strong year class also was observed in 1999. In 1993, when the majority of the 1988 year class had become available to recreational anglers, mean lengths in the sampled catch declined substantially in central California. For example, mean length of blue rockfish sampled from Monterey area CPFVs declined from 11.9 inches in 1992 to 11.0 inches in 1993. In heavily fished and well-sampled populations of rockfishes, changes in annual mean length from one year to the next are commonly less than 0.5 inches.

The total number of blue rockfish caught in recreational fisheries increased substantially from the late 1950s to the mid-1980s, concurrent with increased effort. However in the past 15 years recreational fishing effort has been variable but has not shown a consistent increase; the recreational catch of blue rockfish has shown the same pattern. However, increased commercial fishing in the nearshore area during the same period has put additional stress on blue rockfish populations. Fishery managers have increased monitoring efforts for this keystone species of nearshore ecosystems.

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References

See black rockfish reference list.

Brown Rockfish

History of the Fishery

Brown rockfish (*Sebastes auriculatus*), commonly referred to as bolina by fishermen and markets, have long been an important component of the marine recreational fishery and a relatively minor but important component of the nearshore commercial fishery in California, especially north of Point Conception. In the commercial fishery freshly caught whole brown rockfish are sold either dead or alive in the fresh fish markets. Brown rockfish have not been reported separately from other rockfishes in catch statistics, but comprise the majority of the market grouping called bolina, which also includes other similar-looking rockfish species, such as copper or quill-back rockfish, that are sold at the same price. In samples obtained from 1999 landings, brown rockfish comprised 70 percent by weight of the bolina category. Brown rockfish are also mixed into other market categories, such as the red rockfish group (19 percent by weight in 1999 landings). Commercial catches were made in the past with hook-and-line gear and, to a lesser extent, gillnets until gillnets were excluded from state waters in 1991. Today, brown rockfish are primarily taken with hook-and-line gear, which includes mainly rod-and-reel and horizontal longline gear, along with some vertical longline (stick) and troll longline gear. In most port areas of the state, the majority of bolina group catch is made by rod-and-reel, although, in the San Francisco area, the longline fleet accounts for over 70 percent of bolina taken. The species is targeted directly in both nearshore and offshore ocean environments. In the San Francisco area, the brown rockfish was estimated to be the third most common rockfish species landed by weight in the hook-and-line commercial fishery through the 1990s. The 1999 and 2000 catch estimates suggest that they are now equal to line-caught landings of chilipepper and the two are the most common species in nearshore catches. Since the early 1990s, the brown



Brown Rockfish, *Sebastes auriculatus*
Credit: DFG

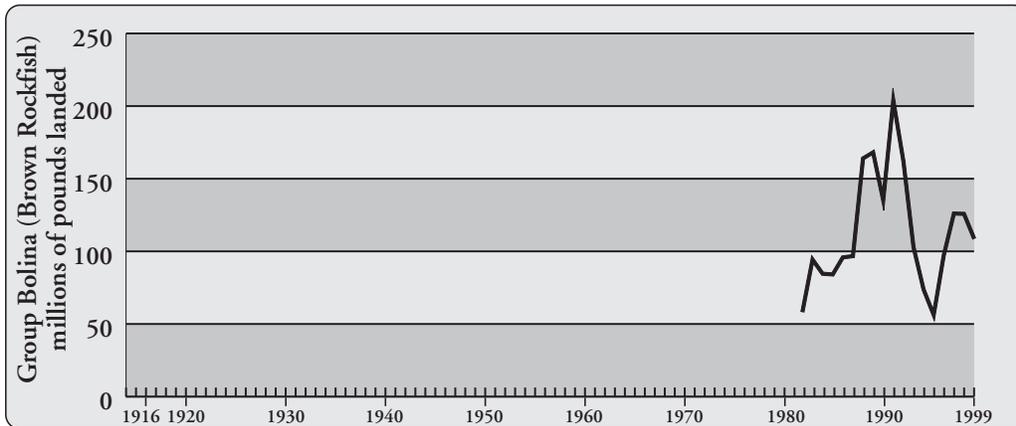
rockfish has been the most common rockfish species sold live in San Francisco markets and comprised nearly 50 percent of the live rockfish catch in 1999.

The number of vessels landing brown rockfish peaked in the early 1990s, when over 250 hook-and-line vessels made an average of over 1,300 landings per year statewide, usually ranging from 60 to just over 100 pounds per landing. Total landings of brown rockfish peaked in 1991, decreased through the mid-1990s, and increased again during the late 1990s coincident with an increasingly active nearshore premium and live fish fishery. Though landings have fluctuated over the last two decades, the value of the catch has continued to increase, particularly during the last decade, as rockfish quotas have been reduced and demand has continued to remain high. Markets in areas such as San Francisco (especially those in Chinatown) sell their brown rockfish whole and preferably live. Dead-landed fish obtain an ex-vessel price of \$1 to \$2 per pound, whereas live brown rockfish have demanded an ex-vessel price from \$2 to \$4 per pound. With the recent management-related reductions in supply, prices have increased to over \$6 to \$8 per pound at times in 1999 and 2000.

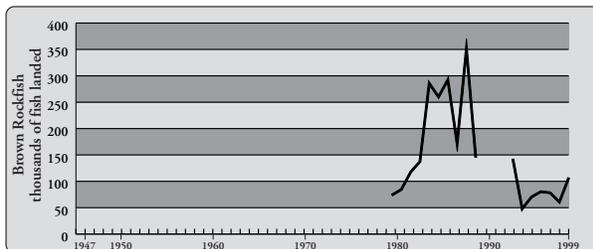
Sport anglers regularly catch brown rockfish with rod-and-reel either from the shore, commercial passenger fishing vessels (CPFVs), or private/rental boats (PRBs), especially in nearshore reef habitats (depths of less than 175 feet). Brown rockfish are most common in sport catches near San Francisco. In a sport fish survey conducted from 1980 through 1986, brown rockfish were among the top five species of rockfish caught and composed up to 6.6 percent of the estimated sport catch. Inside San Francisco Bay, they are the most common sport-caught rockfish species. Although catches south of Point Conception are lower, brown rockfish have comprised up to one percent of rockfish take and have remained among the top 15 species of rockfish caught during the last 20 years. These represent a seven-fold increase by number in statewide take relative to a 1958 to 1961 survey of recreational fishing. Substantial increases in take have occurred in all modes of fishing, especially by shore fishing, pier fishing, and PRBs.

Status of Biological Knowledge

Brown rockfish are found along the Pacific Coast of North America from the northern Gulf of Alaska to central Baja California. They live in shallow subtidal waters and bays, and have been found at depths of just over 400 feet, although they most commonly reside above 175 feet. Brown rockfish are typically found associated with sand-rock interfaces and rocky bottoms of artificial and natural reefs. In shallow waters, they may be found in small aggregations associated with rocky areas and kelp



Commercial Landings 1916-1999, Brown Rockfish
Group Bolina (Brown) rockfish landings were aggregated as rockfish prior to 1979. DFG market sampling indicates that 75 percent of the Group Bolina rockfish market category is made up of brown rockfish, the remaining 25 percent consists primarily of widow rockfish. Data Source: DFG Catch Bulletins and commercial landing receipts.



Recreational Catch 1947-1999, Brown Rockfish
Data Source: RecFin data base for all gear types; data not available for 1990-1992

beds, whereas they stay near the rocky bottom when in deeper waters. The sub-adults migrate into both high and low relief reefs and are strongly residential to their home sites.

Distinguishing characteristics of brown rockfish include orange-brown or dark brown mottling, especially on the back, and a prominent dark brown blotch on the gill cover. Little sexual dimorphism is evident between male and female brown rockfish in relation to growth or maturity rates. Recent studies found maturity as early as three years, and 100 percent maturity at six years, or roughly 12.2 inches total length (TL). Half of the population was mature at 3.9 and 4.2 years of age, measuring 9.8 and 10.4 inches TL in males and females, respectively. Brown rockfish grow to a maximum size of 22 inches, and live less than 25 years. This is a relatively short life span compared with most offshore rockfish species, though many nearshore rockfish species have a similar or shorter lifespan.

As with all members of the genus *Sebastes*, brown rockfish are ovoviviparous. A 12-inch TL female may produce approximately 42,500 eggs, while an 18-inch TL female may produce as many as 266,000 eggs. Peaks in larval release occur in the pelagic environment in both December-January and May-June. Larvae live in the upper zoo-

plankton layer for approximately a month before metamorphosing into pelagic juveniles as part of the plankton and micronekton, and subsequently settling out into shallow nearshore waters. Although brown rockfish reproduce on the open coast, young-of-the-year fish commonly migrate into bays and estuaries for use as nursery habitat, which is an uncommon practice for rockfish species. They may remain in the bay around rubble, piers and other structures in areas of higher salinity for one to two years before returning to the open coast.

Brown rockfish feed on increasingly larger prey as they grow. They shift from small crustaceans, amphipods, and copepods as juveniles, to an adult diet of crabs and fish. Little is known about predation on brown rockfish, but it is thought to be similar to that of other nearshore rockfish species: Most predation on the brown rockfish presumably occurs during the larval and juvenile stages, with less predation occurring on the adults.

Status of the Population

While there have been studies of local abundance in certain coastal areas and within bays, the population size and structure of this species has not been comprehensively assessed. Evidence of stress on brown rockfish stocks in California exists, however, and some relative changes in the population have been identified. Commercial and recreational catches have steadily increased during the last 40 years, while the average length and weight of brown rockfish in landings have declined. When recreational statistics collected during the last 20 years were compared to results from a 1958 through 1961 recreational survey, brown rockfish showed a 49 percent decrease in average weight per fish over 30 years. Mean length of brown rockfish obtained from CPFVs and PRBs in northern California declined by 18 percent and 21 percent respectively over 40 years. In southern California, mean

length in the CPFV catches declined by 31 percent during the same period. In relation to the length at which 50 percent of males and females are mature, recreational landings data indicate that from 1958 to 1961, most brown rockfish taken had reached sexual maturity. By the 1980s, however, few fish taken from shore or from the bays, and about half taken from PRBs were sexually mature. Lengths of brown rockfish sampled from commercial landings during the last decade also reflect that half of the fish were at or below the size at which 50 percent of the population is sexually mature, and few larger adult fish are being landed compared to historic values. The decline in size of fish in these fisheries does not seem to be associated with incoming year classes, but instead with a depletion of larger adults due to fishing pressure. Although nearly half of the fish landed statewide are adults that can replenish the population, there are now few large adults above the length of the median-sized fish recorded in the 1958 through 1961 survey. The brown rockfish has been identified as a species vulnerable to severe localized depletions in other geographic areas; in Washington state, the Puget Sound stock of brown rockfish was recommended for listing as a threatened species in 1999.

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History of the Fishery

Evidence exists for subsistence use of cabezon (*Scorpaenichthys marmoratus*) by prehistoric native Americans along the central California coast. Cabezon represented five percent of the fish remains taken from exposed rocky coastal archaeological sites.

As game fish, cabezon are prized by sport divers for edibility, size, and ease of capture. The recreational take aboard commercial passenger fishing vessels (CPFVs) does not comprise a large proportion of the catch, but those that are taken are usually of a good size, averaging around 3.5 pounds. In central California, cabezon generally account for less than one percent of observed annual CPFV catches. Recreational landings data are available from 1980 to 1999 for CPFV and private boat anglers as well as shore and pier anglers from the National Marine Fisheries Service Recreational Fisheries Information Network (RecFIN). RecFIN data from 1982 to 1999, for all four modes of recreational fishing showed a 40 percent decline in average annual landings between the 1982 through 1989 and 1993 through 1999 periods, from 122 to 74 tons. Data from RecFIN also suggest that cabezon are more common in catches north of Point Conception and more frequently caught by anglers fishing on private boats and from shore than on CPFVs.

Cabezon were taken incidentally in commercial catches by boats fishing for rockfish using hook-and-line or gillnets until 1992. From 1916 to 1992, commercial landings only exceeded 30,000 pounds in 1951 and again from 1979 to 1982, when reported landings reached 62,614 pounds. Development of the live/premium fishery in the late 1980s resulted in increasing commercial catches of many species occupying the nearshore environment in and around kelp beds. The commercial catch of cabezon started increasing in 1992 with the expansion of marketing live fish to markets and restaurants in California's Asian communities. Most of the initial increase in landings was from the Morro Bay area, but by 1995, landings in most central and northern California ports had increased dramatically. Sampled catches from the Morro Bay area from 1995 to 1998 suggested a large proportion of landings were immature fish.

Commercial landings continued to increase through 1998 with over 373,000 pounds reported, then declined slightly in 1999 but remained over 300,000 pounds. Live fish are taken primarily by trap and hook-and-line gear. About 90 percent of the catch is landed live. Markets demanded top quality live fish, and fishermen received premium prices for their catches evidenced by the increase in average price per pound from \$0.85 in 1990 to \$3.30 in 1998. The estimated value of reported landings in 1998 was \$1,231,700.

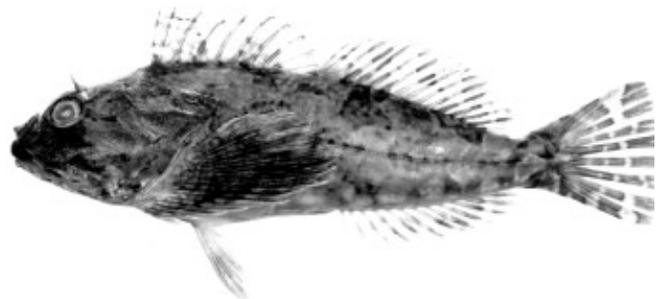
Concerns over the increased harvesting of nearshore species and potential impacts on fished populations led to passage of legislation known as the Marine Life Management Act of 1998 (MLMA) which was enacted in January of 1999. Within the MLMA, minimum commercial size limits were implemented for several nearshore species including a 14-inch size limit for cabezon. Implementation of the size limit may have been responsible for the decline in landings between 1998 and 1999.

Status of Biological Knowledge

The cabezon is the largest member of the cottid family. In Spanish, *cabezon* means bigheaded or stubborn and, proportionally, the massive head is definitely the largest feature of this fish. The specific name *marmoratus* refers to the marbled or mottled appearance of the body, which can be reddish, greenish, or bronze. Generally the belly is a pale turquoise or white, and there are no scales on the body.

Populations range along the eastern Pacific coast from Point Abreojos, Baja California to Sitka, Alaska. They are found on hard bottoms in shallow water from intertidal pools to depths of 250 feet. Fish frequent subtidal habitats in or around rocky reef areas and in kelp beds.

Cabezon may reach an age in excess of 20 years. The largest recorded size is 39 inches in length and over 25 pounds. Limited information available on age at sexual maturity in published literature suggests that in central California males begin to mature in their third year and all are mature by their fourth year. Average size of males in their fourth year is 17 inches. Some females begin to mature in their fourth year between 16 and 20 inches in length, and all females are sexually mature by the sixth year when they are 19 to 23 inches in length. These data collected from 1950-1951 suggest a size of female 50 percent maturity greater than 16 inches. Unpublished DFG data collected in the Morro Bay area from 1996 to 1999 indicates that half of females are mature at 14 inches.



Cabezon, *Scorpaenichthys marmoratus*
Credit: DFG

In California, spawning commences in late October, peaks in January and continues until March, whereas in Washington, the spawning season begins in November and extends to September with a peak in March and April. There is some evidence that females may spawn more than once in a season. Females spawn their eggs on subtidal, algae-free rocky surfaces, which can be horizontal or vertical in orientation. Up to 152,000 eggs can be expected from a large female (30 inches, 23 pounds). Masses of the pale green or reddish eggs are up to 18 inches in diameter and up to two to four inches thick. As the eggs develop they change to an olive green color.

There have been several reports on the toxicity of cabezon roe. In the 1950s, the well-known ichthyologist Carl Hubbs published a personal account of eating cabezon roe. As part of an ongoing search for another caviar, Hubbs and his wife consumed the roe and flesh of a cabezon for dinner. Four hours later they "... awoke in misery ... and were violently ill throughout the rest of the night." Laboratory evidence indicates that the roe is lethal to mice, rats, and guinea pigs. Anecdotal information on egg masses exposed at low tide suggests they are not preyed upon by natural predators such as raccoons, mink, or birds. Observations of captive cabezon have documented a female eating her own eggs with no resulting ill effects.

Males fertilize the eggs after spawning by the female, and the male guards the nest. Apparently the same nest sites are used from year to year. Fish are very protective of the nests for the two to three weeks it takes the eggs to develop and hatch.

Pelagic juveniles are silvery when small, spending their first three to four months in the open ocean feeding on tiny crustaceans and other zooplankton. At a size of about 1.5 inches, juveniles leave the open water and assume a demersal existence. They appear in kelp canopies, tide pools, and other shallow rocky habitats such as breakwaters from April to June in California.

Cabezon can be aptly described as "lie-in-wait" predators. Their mottled coloration lets them blend in with the surroundings, as they lie motionless to wait for their next meal. With large, robust pectoral fins set low on the body and a powerful tail, they quickly lunge after unwary prey, engulfing it in their large mouth.

Their diet consists mainly of crustaceans, although large and small cabezon have different diets. Adult fish eat crabs, small lobsters, mollusks (abalone, squid, octopus), small fish (including rockfishes), and fish eggs. Small juveniles depend mainly on amphipods, shrimp, crabs, and other small crustaceans.

Juveniles are eaten by rockfishes and larger cabezon, as well as by lingcod and other sculpins. Large cabezon may be preyed upon by harbor seals or sea lions.

Cabezon normally occur nearshore, except as larvae. Usually solitary, juveniles and adults are common on rocky bottom areas with dense algal growth. They are often in the vicinity of kelp beds, jetties, isolated rocky reefs or pinnacles, and in shallow tide pools.

Most of their time is spent lying in holes, on reefs, in pools, or on kelp blades beneath the canopy. As fish get older and larger they tend to migrate to deeper water. In shallower water, they migrate in and out with the tide to feed. Their habit of lying motionless makes them an easy target for sport divers.

Status of the Population

Limited information is available on population biology or changes in biomass over time. Recent increases in commercial fishing pressure on cabezon have intensified efforts to learn more about their life history characteristics, population biology, and to assess stock size. Recreational landings have declined concurrent with the increase in commercial fishing efforts and reported commercial landings. As fishing effort increases, it is likely that populations living in heavily utilized areas will decline further.

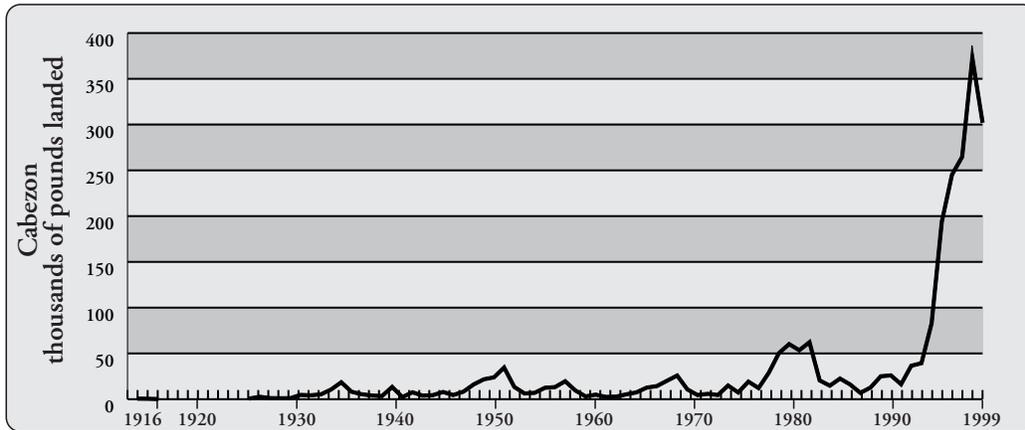
Management Considerations

See the Management Considerations Appendix A for further information.

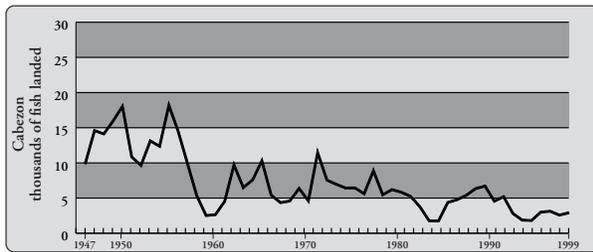
Deborah Wilson-Vandenberg and Robert Hardy
California Department of Fish and Game

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Commercial Landings 1916-1999, Cabezon
 Data Source: DFG Catch Bulletins and commercial landing receipts.



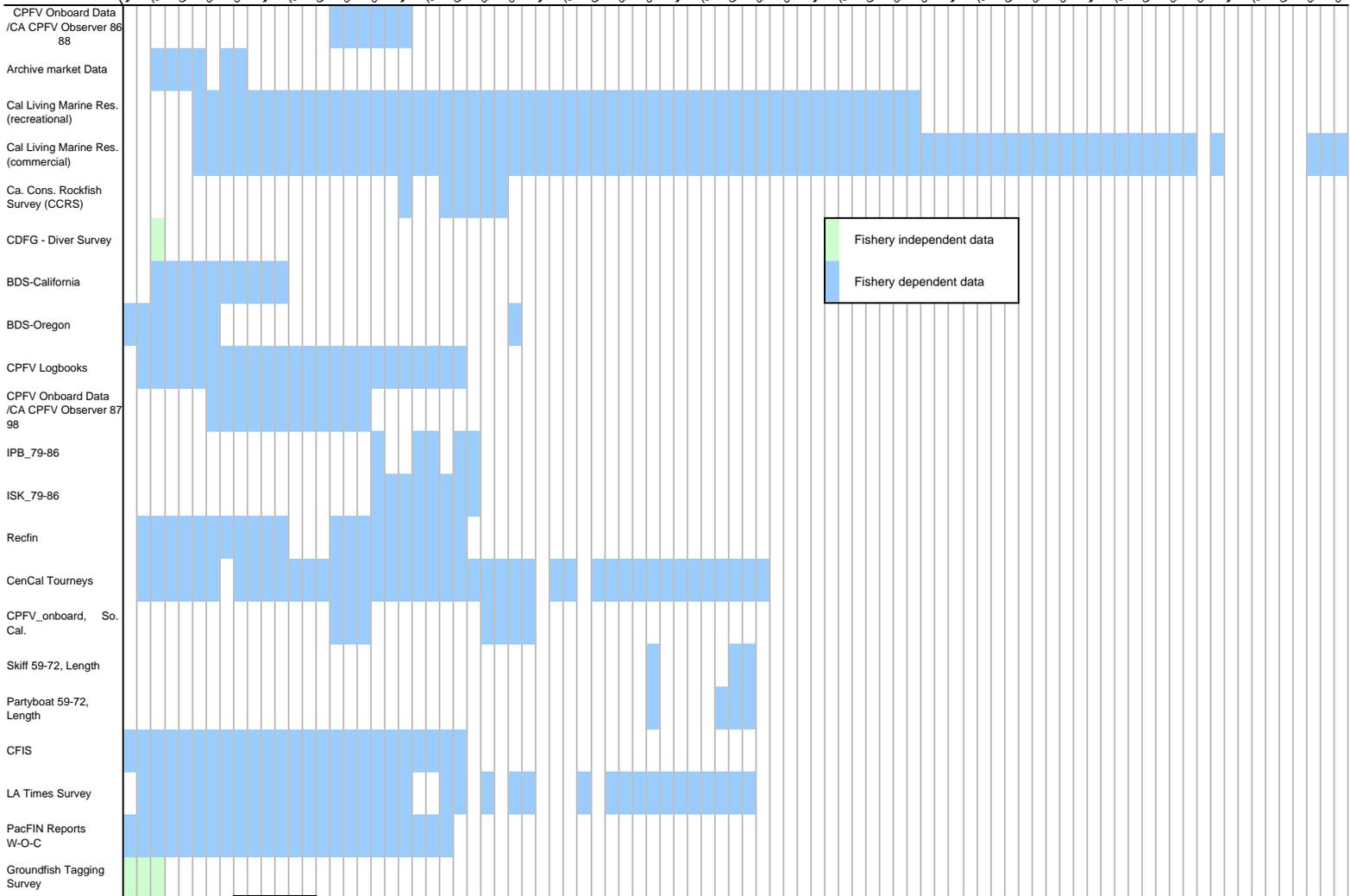
Recreational Catch 1947-1999, Cabezon

CPFV = commercial passenger fishing vessel (party boat); Recreational catch as reported by CPFV logbooks, logbooks not reported prior to 1947.

Data Coverage for Cabezon

Cabezon

Data Base



Fishery independent data
 Fishery dependent data

Notes: Archive market Data length data available
 CDFG - Diver Survey 33 length measurements, CPUE data, no sex data
 BDS-California length, no age, some maturity, no weight
 BDS-Oregon length, no age, one maturity measure, some weight
 PacFIN Reports W-O-C Data also listed as nominal cabezon
 CPFV Onboard Data /CA CPFV Observer 87,98 length, weight, cpue, and by-block landings

Calico Rockfish

History of the Fishery

Calico rockfish (*Sebastes dalli*) are taken in the southern and central California sport fisheries for nearshore rockfishes. During the 1980s, the estimated annual calico rockfish sport catch averaged 8,900 fish with a high of 21,000 fish taken in 1985. An onboard study of the southern California commercial passenger fishing vessel (CPFV) or partyboat fishery from 1985 through 1987, ranked calico rockfish among the top 20 species taken during two of the three years surveyed. The same study also showed that CPFV anglers discarded large numbers of calico rockfish at sea each year in a practice commonly known as "high grading." In high grading, only the largest fish were retained by anglers as part of their bag limits, and the smaller fish were selectively discarded. For calico rockfish, the estimated number of discards on CPFVs exceeded the number of calico rockfish that were kept by anglers each year. This illegal practice has been widespread at times in the past and has been difficult to curtail. A more recent estimate of annual California sport catches of calico rockfish averaged 5,700 fish per year between 1993 and 1999, with a high of 8,000 calico rockfish caught in 1995 and in 1998.

Calico rockfish comprise a very minor portion of the state's commercial catch. Their small size and scattered distribution probably preclude them from being targeted. Calico rockfish, however, may be one of several small rockfish species, including squarespot, honeycomb, halfbanded and starry rockfishes, that are caught and subsequently discarded at sea as an unmarketable bycatch in nearshore hook-and-line, trap, or trawl fisheries. The quantity of calico rockfish bycatch in these fisheries is currently undetermined.

Status of Biological Knowledge

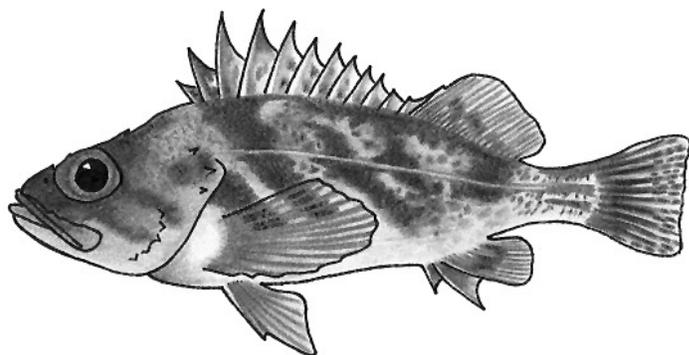
Calico rockfish range from Sebastian Viscaïno Bay, Baja California to San Francisco within a depth range of 60 to 840 feet. They are small, colorful rockfish that inhabit nearshore areas of southern and central California. Calico rockfish are distinguished by having a greenish yellow background color overlaid with dark-brown oblique bars on the side, and a black spot on the edge of the gill cover. Juvenile calico rockfish are found in areas of soft sand-silt sediment, and on artificial reefs. Adults inhabit rocky shelf areas where there is a mud-rock or sand-mud interface with fine sediments. They are usually associated with structures that provide vertical relief and sheltered habitat, including artificial reefs. The main diet of calico rockfish is pelagic crustaceans, including calanoid copepods. They are preyed upon by larger rockfish species, lingcod, cabezon, and salmon. Sea birds, sharks, and dol-

phins have also been known to feed on juvenile and adult calico rockfish.

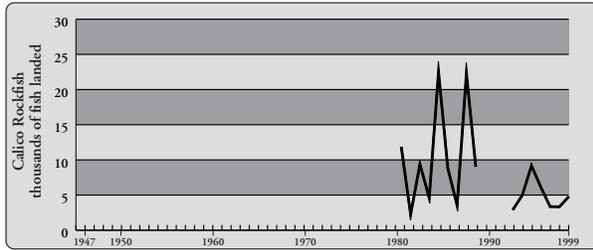
Calico rockfish up to 10 inches long and 1.25 pounds in weight have been measured. They have been aged to between 11 and 12 years. Male calico rockfish first become sexually mature at age seven and females reach sexual maturity at age nine. Spawning occurs in southern California between January and May, with peak spawning activity occurring in February. Fertilized eggs are present in November and December. The range of fecundity observed for calico rockfish was 1,700 to 18,000 eggs per female. The pelagic larval stage lasts from one to two months, and the post-larvae then settle out of the plankton between 0.08 and 0.1 inches in length.

Status of the Population

There are currently no estimates of abundance for calico rockfish in California. There were more calico rockfish landed annually by sport anglers in the 1980s than in the 1990s, which may have been a reflection of the abundance of that species during two strong El Niño events that occurred in the 1980s. Whether the reduced calico rockfish catch during the 1990s was a result of changing oceanic conditions or was due to actual depletion of calico rockfish stocks by sport and commercial fisheries is not known. Because of the relatively small size of adult calico rockfish, they are not usually targeted by either sport or commercial fishermen but are caught incidentally when other finfish species are targeted. Calico rockfish appear as bycatch in prawn trawls and other nearshore fisheries in southern California and are caught by sport anglers on CPFVs and private boats when they are fishing for other, larger benthic species.



Calico Rockfish, *Sebastes dalli*
Credit: L. Sinclair, Miller and Lea



Recreational Catch 1947-1999, Calico Rockfish

Data Source: RecFin data base for all gear types; data not available for 1980 & 1990-1992

Management Considerations

See the Management Considerations Appendix A for further information.

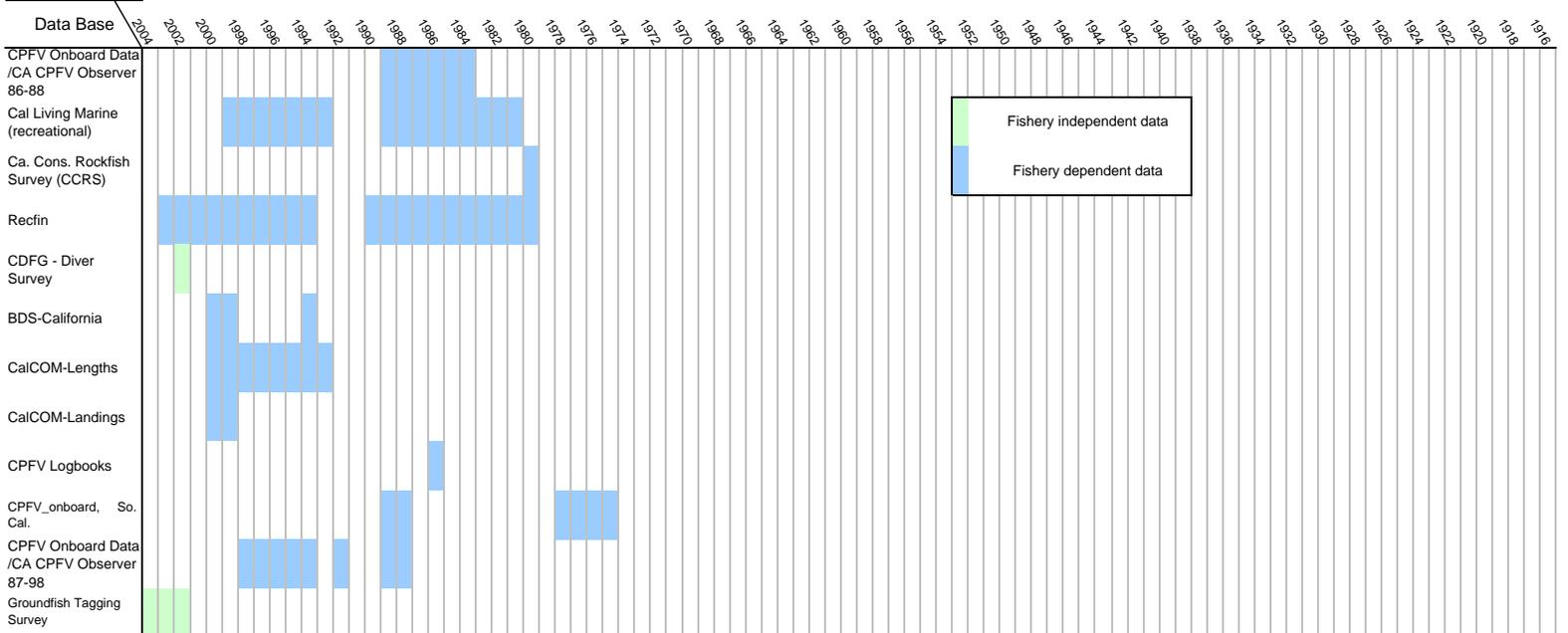
David Ono

California Department of Fish and Game

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Data Coverage for Calico Rockfish

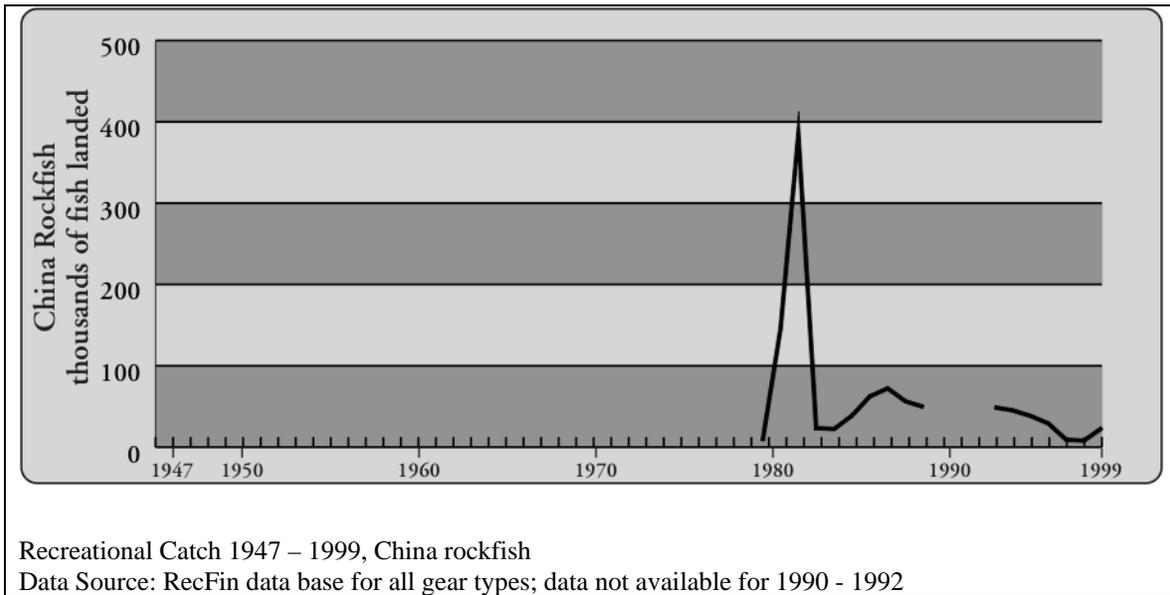


Notes: Recfin some length data available
 CDFG - Diver Survey CPUE, no length or sex data
 BDS-California Length, no age, no maturity, no weight
 CalCOM gear information
 CPFV Onboard Data
 /CA CPFV Observer 87- few data points, length, weight, cpue, and by-block landings
 98

China Rockfish

History of the Fishery

China rockfish have been a minor component of recreational and commercial rockfish fisheries. They are most frequently caught by anglers fishing from private boats rather than by anglers fishing from CPFVs (commercial passenger fishing vessels) or from shore. However, the proportion of the catch taken by commercial (versus recreational) fishers rose from about 25% in the 1980s to about 50% in the 1990s.



Development of the live/premium fishery in the late 1980s resulted in increasing commercial catches of many species occupying the nearshore environment in and around kelp beds, including China rockfish. Live fish are taken primarily by line gear and pot and trap gear, but other gear types are used. The fishery serves mainly Asian-American markets that demand top quality (live) fish. Fishermen receive premium prices for their catches ranging from \$2 to \$10 per pound in 1998. China rockfish often fetch higher prices than other rockfishes in the live fish market because of their extraordinary coloring. These nearshore fish are caught primarily north of Point Conception. Annual total landings by species are difficult to determine due to the inexact nature of recording landings; market categories are often comprised of multiple species.

The live fish market demand is mainly for fish in the one to two pound size range, above the mean size at sexual maturity, although in the development of the fishery all fish were kept regardless of size. Due to concerns over the harvest of immature fish the Marine Life Management Act of 1998 implemented minimum commercial size for China rockfish. The shallow, nearshore nature of this fishery renders it very weather dependent. Poor weather, combined with lower overall allowable catches, implementation of minimum size limits, and a lack of a market north of Bodega Bay resulted in reduced catches from 1997 to 1999.

China rockfish are also important in non-consumptive uses: colorful and accessible, they are frequently observed and photographed by divers. In addition, individuals are taken for the aquarium trade.

Status of Biological Knowledge

China rockfish are not well studied and very little is known about their early life history. China rockfish are abundant in Washington, British Columbia, and southeastern Alaska, and present, but less abundant south into California. Chinas are quite rare south of Point Conception, and seem to inhabit progressively deeper water in the southern part of its range. Ranges of many rockfish species have changed in the last 15 to 20 years, probably related to oceanic warming after 1977, but no documentation exists on changes in the range of China rockfish.

China rockfish live to be at least 79 years old, they reach a maximum size of about 45 centimeters. In the southern part of the range, parturition occurs between January and June, peaking in January. Larvae are released later in Alaska: from April to August, peaking in May.

China rockfish are territorial, and likely defend territories about of about 10 meters square. They are commonly found between 3 and 128 meters depth.

Available data suggest that diets of juvenile fish include primarily crustacean zooplanktors such as barnacle cyprids. Crustaceans and small fish are common diet items for adults. China rockfish also consume ophiuroids and a variety of mollusks including

cephalopods, gastropods, chitons, and nudibranchs. Small fish consumed by these rockfish include juvenile rockfish (mainly blue rockfish), sculpins, juvenile surfperch, kelpfishes, and plainfin midshipman

Status of Populations

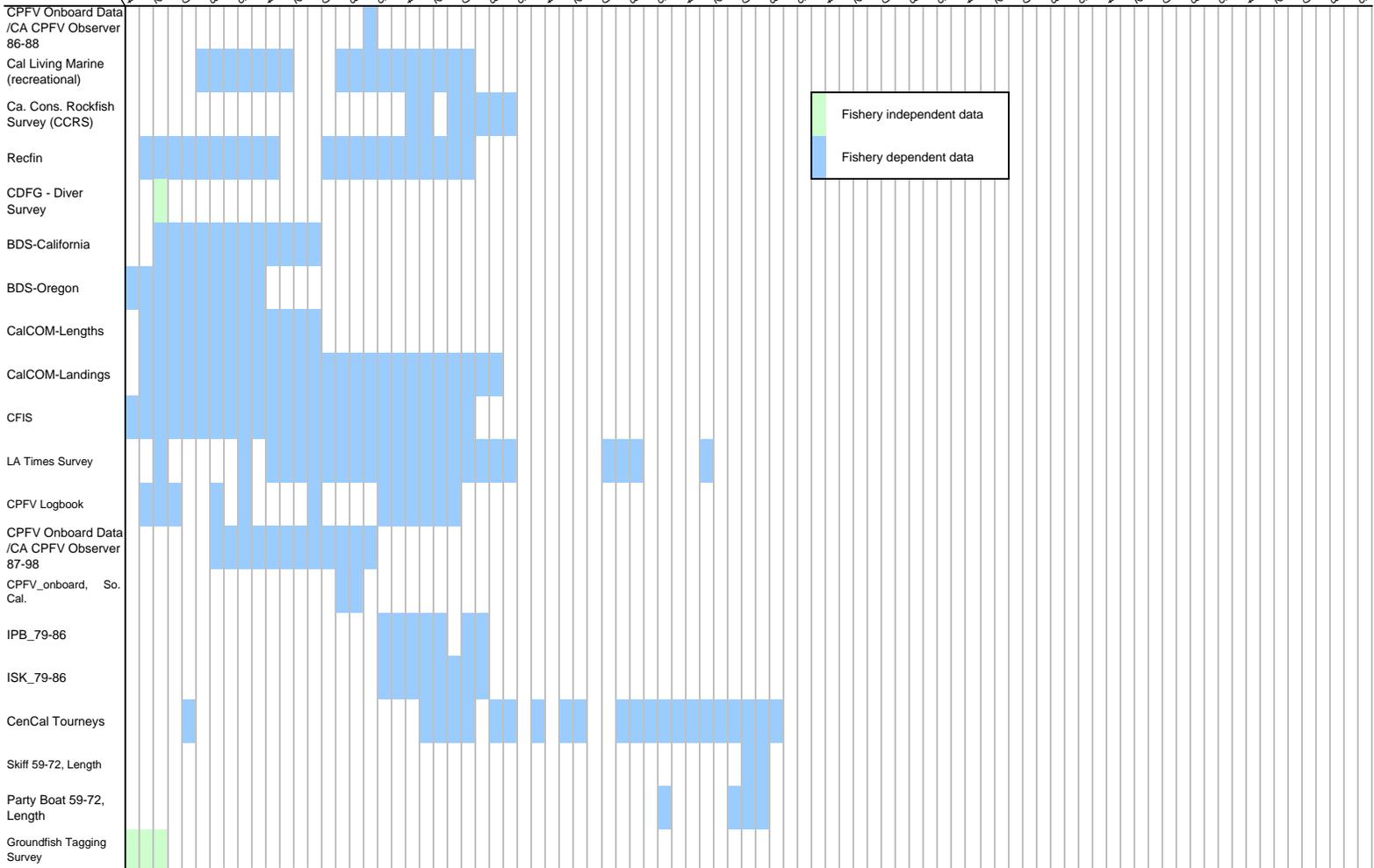
There is no comprehensive assessment of China rockfish populations. They are probably subject to local depression in abundance and average size where diving, skiff fishing, party boat activity, or commercial fishing is concentrated. The low fecundity, restricted habitats and limited movements of this species makes them vulnerable to local fishing pressure. Statewide, the limited geographic ranges and restricted habitats of this species suggest that they have small populations in comparison to more widespread species that have traditionally been the target of commercial fishing. The limited depth distribution of China rockfish means that all of the spawning population is vulnerable to fishing and probably few natural refugia exist. Infrequent years of good recruitment increase the danger of removing too many spawners, even with limited fishing pressure.

Adapted from California Living Marine Resources Status Report “Other Nearshore Rockfishes” by Ralph J. Larson (San Francisco State University) and Deborah A. Wilson-Vandenberg (California Department of Fish and Game)

Data Coverage for China Rockfish

China Rockfish

Data Base



Fishery independent data
Fishery dependent data

Notes: CPFV Onboard Data /CA only two measurements
 CCRS very sparse
 Recfin length data available
 CDFG - Diver Survey CPUE, no sex data, only one length measurement
 BDS-California length, no age, one maturity measurement, and no weight
 BDS-Oregon length, some maturity, no age, some weight
 CalCOM gear information
 CPFV Onboard Data /CA length, weight, cpue, and by-block landings

Copper Rockfish

History of the Fishery

The copper rockfish (*Sebastes caurinus*) is a highly variable species in terms of coloration, and due to this characteristic it has been known by several names, depending to some degree upon locality. These include copper rockfish, whitebelly rockfish, gopher, white gopher, and bolina (this name is most commonly applied to the brown rockfish). Copper rockfish is most widely used and is the recommended vernacular name. Historically, copper rockfish was considered a common nearshore species.

Over the past 20 years, copper rockfish have become a less frequent component of the nearshore environment. Commercially, copper rockfish are landed in a number of market categories including copper rockfish as well as red, bolina, and gopher rockfish groups. It is sold as fillets by the market names rockfish or red rockfish and often whole as red rockcod; it is considered an excellent food fish. Copper rockfish is one of the species taken in the live-fish fishery. They have been an important component of the recreational catch in both skiff and commercial passenger fishing vessel fisheries, especially off central and northern California. Due to its relatively large size, known to reach 22.9 inches in length, copper rockfish has been considered one of the premium species in the recreational angler's catch and a prime target for the sport diver.

Status of Biological Knowledge

The copper rockfish was one of the first species of rockfishes to be described from the Pacific Coast, having been scientifically named in 1845 by John Richardson from Sitka, Alaska. For many years, the copper and whitebelly rockfish were considered as separate species but morphological and biochemical analyses in the 1980s have shown these two nominal forms to be conspecific, a highly variable-colored but genetically unique species. The copper rockfish is broadly distributed geographically, known from the Gulf of Alaska to off central Baja California, Mexico. It also has a broad bathymetric distribution, known to occur from the shallow subtidal to 600 feet.

As with all rockfishes, coppers are viviparous and highly fecund. A 13.4-inch female is capable of producing 215,000 ova and an 18.5-inch fish of producing 640,000 ova. The largest individuals may well produce over one million larvae. The larvae are released during winter months (Jan.-March). Young-of-the-year copper rockfish are pelagic and recruit into the nearshore environment at about 0.8 to 1.0 inch during April and May off central California. The newly recruited copper rockfish initially associate with canopy-forming kelps such as *Macrocystis*, *Cystoseira*, and *Nereocystis*. After several months, and at about 1.6 inches, the juveniles settle to the bottom on

rocky reef as well as sandy areas and are referred to as benthic juveniles. Copper rockfish in the early juvenile stage are morphologically similar to two closely related species, gopher rockfish and black-and-yellow rockfish, and the three species at this life stage are extremely difficult to distinguish. Upon settling, color patterns and morphological characteristics develop and the three species become separable.

Copper rockfish are an important component of the nearshore rocky reef system and are frequently encountered by scuba divers in this environment. Submersible observations of the biotic community off the Big Sur coast revealed copper rockfish between depths of 70 and 325 feet. The majority of sightings were of individual (solitary) fish occurring over rocky reef or boulder fields and most frequently in areas of high relief. Occasionally, an individual was observed over sand. Coppers are considered epibenthic, normally occurring slightly above the substrate.

Tagging studies indicate that copper rockfish, for the most part, show little movement once they have settled to the bottom. Movement of up to one mile has been noted but the majority of tagged and recaptured copper rockfish are from the locality where they were originally taken. This life history characteristic makes species with high site fidelity susceptible to local depletion. In areas close to fishing ports and higher rates of utilization, fewer and smaller copper rockfish are caught.

Copper rockfish reach sexual maturity at about 11.6 inches total length (TL) for females and 14.6 inches TL for males. This is at about five years of age for females and seven years for males. Size and age for copper rockfish from off central California for the first five years are as follows: age zero, 3.6 inches TL; age one, 3.7 to 5.9 inches TL; age two, 4.2 to 9.4 inches TL; age three, 7.0 to 11.5 inches TL, and age four, 8.9 to 13.2 inches TL. There appears to be no significant difference in the growth rates between sexes.



Copper Rockfish, (*Sebastes caurinus*) and a sea anemone
Credit: CA Sea Grant Extension Program

Off central California, copper rockfish have been aged to 28 years for a 22.1-inch individual. Copper rockfish from Puget Sound have been aged to 34 years.

Copper rockfish feed on a wide variety of prey items. Crustaceans form a major part of their diet; these include *Cancer* crabs, kelp crabs, and shrimps. Squid of the genus *Loligo* and octopuses are also important food items. Fishes, which include young-of-the-year rockfishes, cusk-eels, eelpouts, and sculpins are important forage for larger individuals. Juvenile copper rockfish feed primarily on planktonic crustaceans.

Hybridization of copper rockfish with brown rockfish has been suspected in Puget Sound, but this has not been noted from anywhere else within their range.

Status of the Population

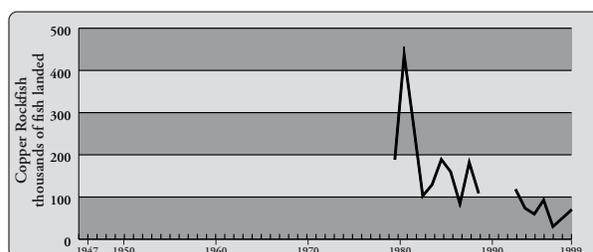
There has been no stock assessment of this species in California. However, there is compelling evidence that copper rockfish populations have severely declined in many areas and large individuals are noticeably less common than in past decades. Due to their solitary nature, high habitat specificity, and the size they can enter the fishery (as juveniles), the copper rockfish is a prime candidate for local depletion.

Robert N. Lea

California Department of Fish and Game

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Recreational Catch 1947-1999, Copper Rockfish

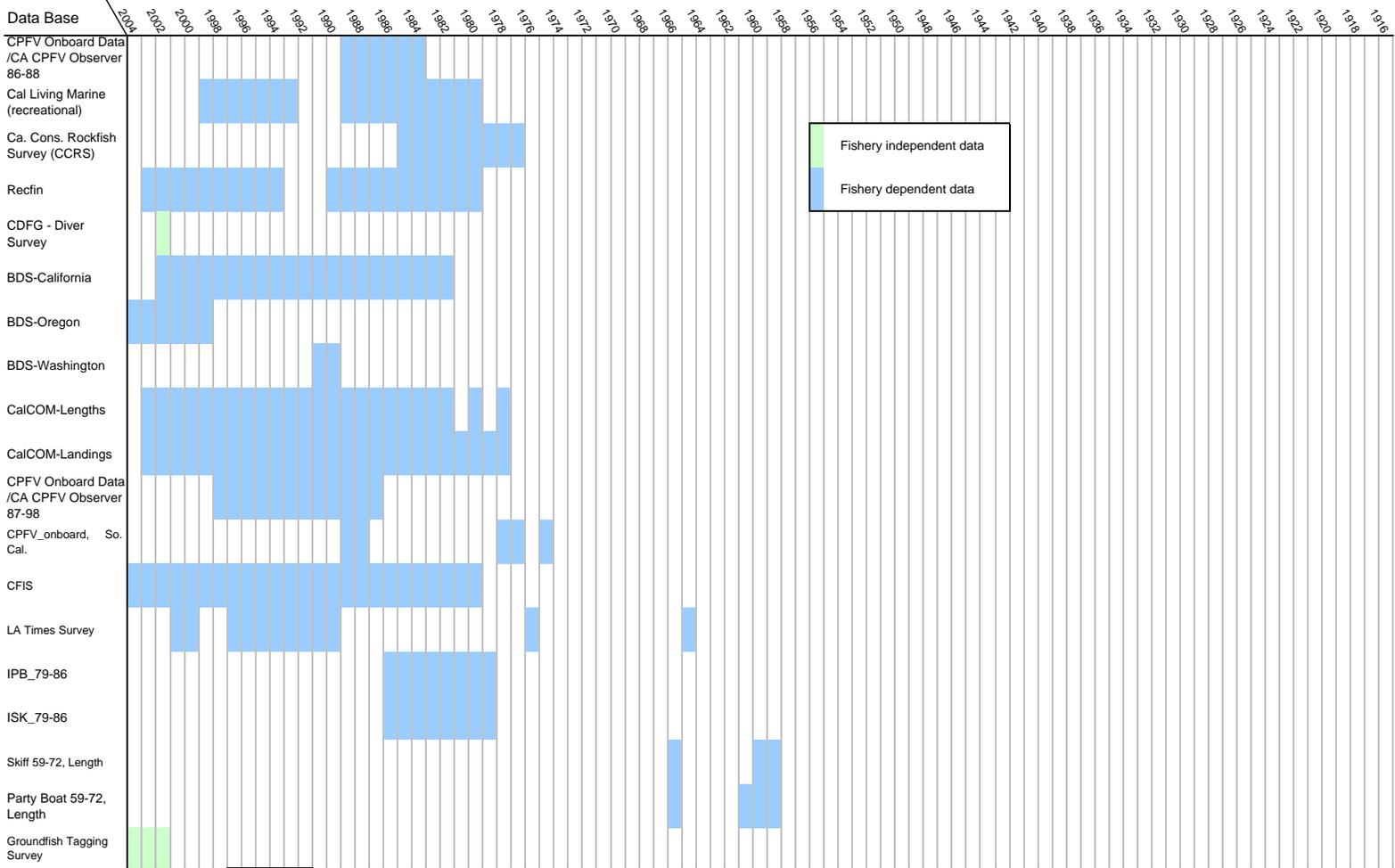
Data Source: RecFin data base for all gear types; data not available for 1990-1992

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Data Coverage for Copper Rockfish

Copper Rockfish



Fishery independent data
 Fishery dependent data

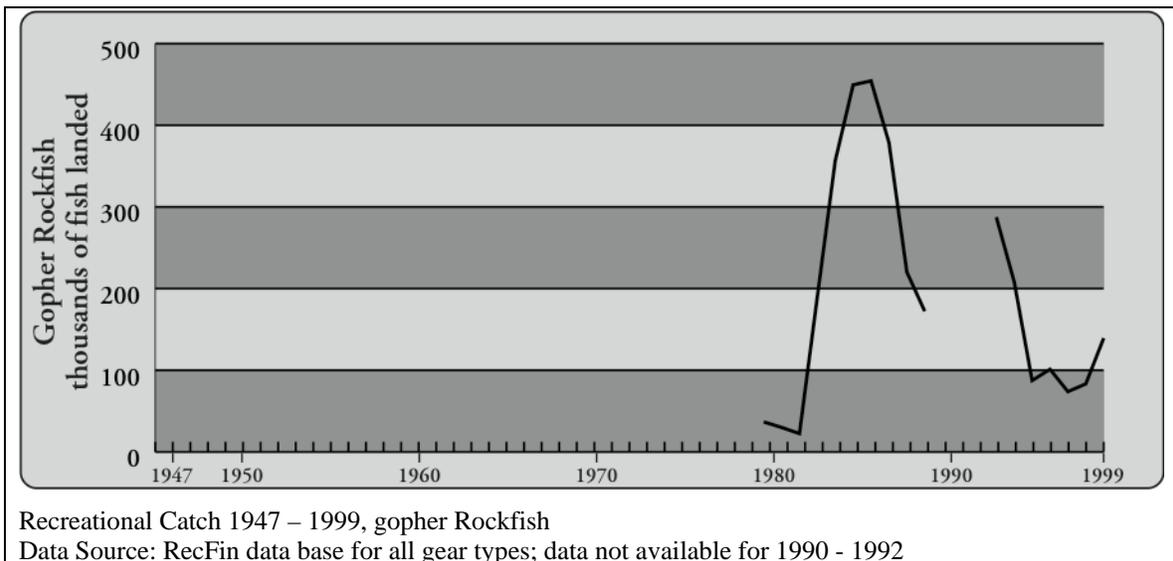
Notes: Recfin length data available
 CDFG - Diver Survey CPUE and length, no sex data
 BDS-California length, no age, some maturity, no weight
 BDS-Oregon length, one maturity measurement, no age, no weight
 BDS-Washington length, no age, no maturity, no weight
 CalCOM Gear information
 CPFV Onboard Data /CA length, weight, cpue, and by-block landings
 IPB_79-86 most of this data is for blue, copper and olive rockfish

Gopher Rockfish

Gopher rockfish (*Sebastes carnatus*) is very closely related to black-and-yellow rockfish (*Sebastes chrysomelas*), and though they are morphologically distinct in coloring, they may be the same species. The two species are very similar ecologically, but depth ranges differ: black-and-yellows are found above 18 meters while gophers live below 12 meters and up to 80 meters deep. Fishermen sometimes use the name gopher cod to describe gopher rockfish.

History of the Fishery

Gopher rockfish comprise a significant portion of recreational landings, and were common enough in commercial landings to have a market category prior to 1994. Landings primarily occur north of Point Conception. Private and rental boats dominate the recreational catch throughout the state. Observations from CPFVs (commercial passenger fishing vessels) in the Morro Bay area report 13% of total landings per year as



Gopher rockfish. The proportion of the catch taken by commercial (*versus* recreational) fishers rose from about 20% in the 1980s to about 40% in the 1990s. This is due both to increases in commercial catches and declines in recreational catches. A review of MRFSS (marine recreational fishery statistics survey) catch data from 1980 to 1999 indicate declining recreational catches of gopher rockfish since the late 1980s. At the same time, development of the live and premium fishery in the late 1980s resulted in

increased commercial catches of many nearshore species, including gopher rockfish. Live fish are taken primarily by line gear and pot and trap gear, but other gear types are used. The fishery serves mainly Asian-American markets that demand top quality (live) fish. Fishermen receive premium prices for their catches ranging from \$2 to \$10 per pound in 1998.

Annual total landings by species are difficult to determine due to the inexact nature of recording landings. For example, sampled market categories from the Morro Bay area from 1993 to 1998 revealed a wide range of placement of gopher in both specific (single species) and nonspecific (gopher group) market categories. The most common classification error of gopher rockfish seems to occur between gopher and black-and-yellow rockfish, 34.4% of the black-and-yellow market category are actually gopher rockfish. The gopher group only contains as much as 61% gopher rockfish. Price, rather than species, often determines grouping, complicating landing estimates for specific species. Based on DFG CMASTER summaries of gopher rockfish, grass rockfish, and the gopher group, reported landings peaked at 31,225 pounds (\$35,740 value) in 1994, 109,003 pounds (\$506,670) in 1995 and 221,018 pounds (\$521,163) in 1996.

The live fish market demand is mainly for fish in the one to two pound size range. This is above the mean size at sexual maturity, although in the development of the fishery all fish were kept regardless of size. Due to concerns over the harvest of immature fish the Marine Life Management Act of 1998 implemented minimum commercial size limits for gopher rockfish. Poor weather, which severely limited fishing time, combined with lower overall allowable catches, implementation of minimum size limits, and a lack of a market north of Bodega Bay resulted in reduced catches from 1997 to 1999.

Gopher rockfish are also important in non-consumptive uses. Colorful and accessible, gopher rockfish are frequently observed and photographed by divers. In addition, individuals are taken for the aquarium trade.

Status of Biological Knowledge

Gopher rockfish are reasonably well studied. They are not abundant north of Sonoma County, and range south to central Baja California. Gopher rockfish have been found

from as shallow as intertidal waters to 80 meters deep, however they are most common below about 12 meters depth.

Gopher rockfish reach a maximum size of about 42.5 centimeters, and may live as long as 30 years, but individuals older than 20 are rare. They reproduce once per breeding season. Parturation occurs between January and July in California, and peaks in March.

Gopher rockfish are territorial, defending areas up to 10 –12 square meters. They occupy rocky habitat at the base of kelp beds. Largely nocturnal, they spend daytime hours in holes and crevices, emerging at dusk to eat.

Available data suggest that diets of juvenile gopher rockfish include, primarily, crustacean zooplanktors such as barnacle cyprids. Adult diets include invertebrates such as cephalopods, gastropods, opiuroids (brittle stars) and polychaetes. Small fish consumed by gopher rockfish include juvenile rockfish (mainly blue rockfish), sculpins, juvenile surfperch, kelpfishes, and plainfin midshipman.

Status of Populations

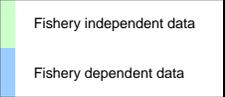
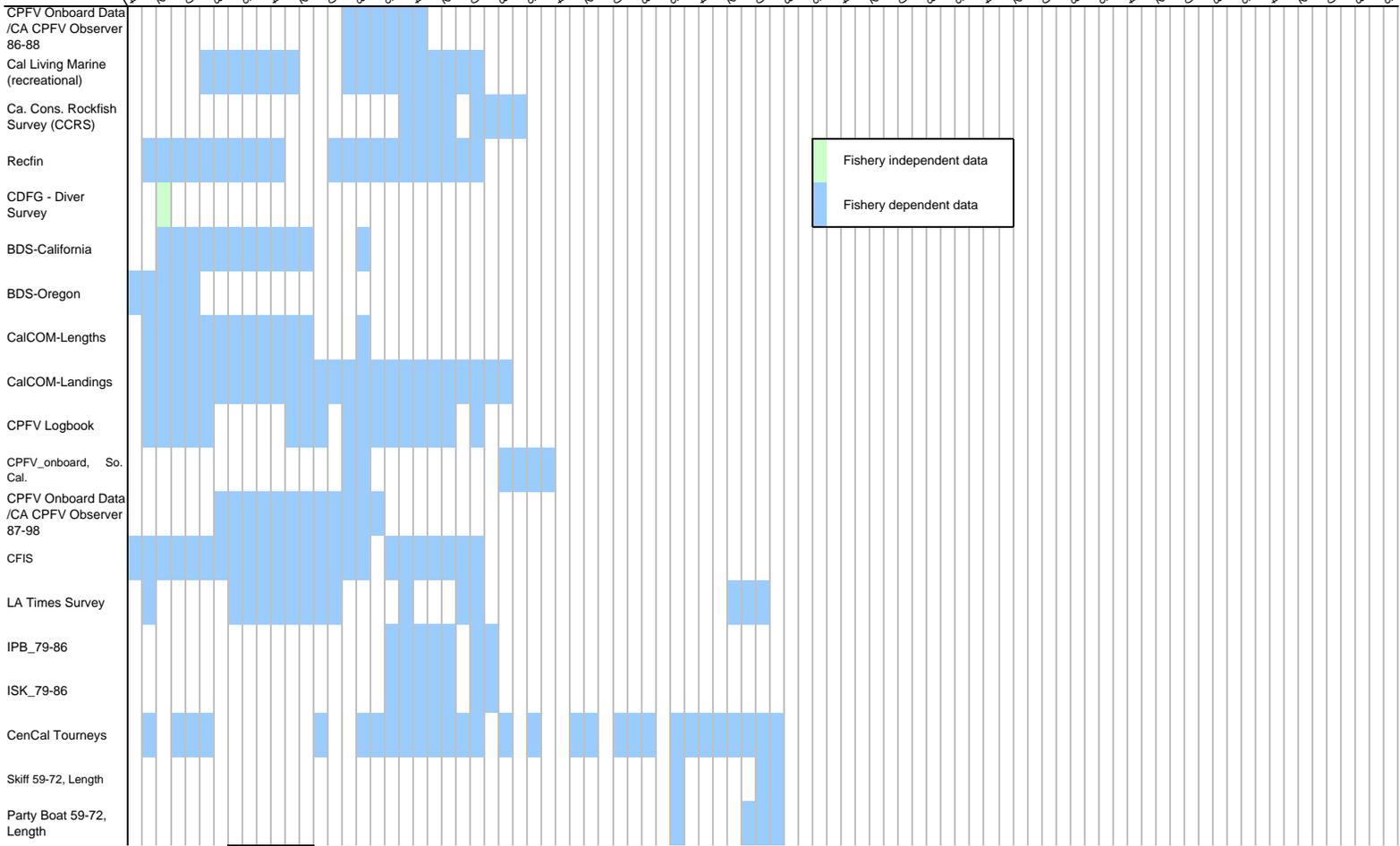
While there have been several studies of local abundance in gopher rockfish, there is no comprehensive assessment of their population. They are probably subject to local depression in abundance and average size where diving, skiff fishing, party boat activity, or commercial fishing is concentrated. The low fecundity, restricted habitats and limited movements of this species make them vulnerable to local fishing pressure. Statewide, the limited geographic ranges and restricted habitats suggest that they have small populations in comparison to more widespread species that have traditionally been the target of commercial fishing. Gopher rockfish have a limited depth distribution so that all of the spawning population is vulnerable to fishing and most likely few natural refugia exist. Infrequent years of good recruitment increase the danger of removing too many spawners, even with limited fishing pressure.

Adapted from California Living Marine Resources Status Report “Other Nearshore Rockfishes” by Ralph J. Larson (San Francisco State University) and Deborah A. Wilson-Vandenberg (California Department of Fish and Game)

Data Coverage for Gopher Rockfish

Gopher Rockfish

Data Base

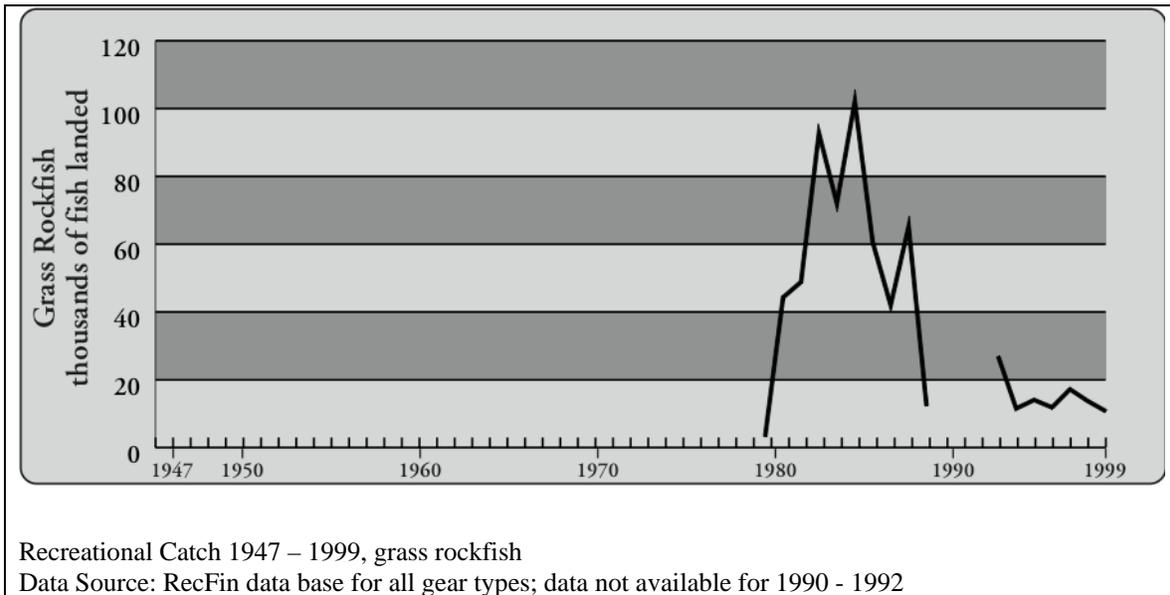


Notes: CCRS very sparse
 Recfin Length data available
 CDFG - Diver Survey CPUE and length, no sex data
 BDS-California Length, one maturity measurement, no age, no weight
 BDS-Oregon length, no age, one maturity measurement, and some weight
 CalCOM Gear information
 CPFV Onboard Data /CA C length, weight, cpue, and by-block landings

Grass Rockfish

History of the Fishery

Grass rockfish constitute only a minor component of recreational and commercial rockfish fisheries. They are most frequently caught by anglers fishing from private boats rather than by anglers fishing from CPFVs (commercial passenger fishing vessels) or from shore. However, the proportion of the catch taken by commercial (versus recreational) fishers rose from about 1% in the 1980s to about 80% in the 1990s.



Development of the live/premium fishery in the late 1980s resulted in increasing commercial catches of many species occupying the nearshore environment in and around kelp beds, including Grass rockfish. Live fish are taken primarily by line gear and pot and trap gear, but other gear types are used. The fishery serves mainly Asian-American markets that demand top quality (live) fish. Fishermen receive premium prices for their catches ranging from \$2 to \$10 per pound in 1998. Grass rockfish are caught primarily north of Point Conception. Annual total landings by species are difficult to determine due to the inexact nature of recording landings: market categories are often comprised of multiple species.

Grass rockfish appeared most frequently in nine other market categories than their own. While species misidentification does occur, fish are often grouped by price rather than by species complicating specific landing estimates. Based on DRG CMASTER summaries of reported landings, landings of gopher and grass rockfish and the gopher group peaked at 31,225 pounds (\$35,740 value) in 1994, 109,003 pounds (\$506,670) in 1995 and 221,018 pounds (\$521,163) in 1996.

The live fish market demand is mainly for fish in the one to two pound size range, above the mean size at sexual maturity, although in the development of the fishery all fish were kept regardless of size. Due to concerns over the taking of immature fish the Marine Life Management Act of 1998 implemented minimum commercial size for grass rockfish. The shallow, nearshore nature of this fishery renders it very weather dependent. Poor weather, combined with lower overall allowable catches, implementation of minimum size limits, and a lack of a market north of Bodega Bay resulted in reduced catches from 1997 to 1999.

Grass rockfish are also important in non-consumptive uses: colorful and accessible, they are frequently observed and photographed by divers. In addition, individuals are taken for the aquarium trade.

Status of Biological Knowledge

Grass rockfish are relatively well studied. The geographical range of the grass rockfish extends throughout California and into southern Oregon, but its habitat is restricted to rocky areas shallower than about 20 feet. The ranges for many rockfish species have changed in the last 15 to 20 year, probably related to oceanic warming after 1977, but nothing has been documented about changes in the range for grass rockfish.

Grass rockfish can live to at least 23 years old, they reach a maximum size of about 56 centimeters and larvae are released between January and March, with a peak in January.

Grass rockfish are one of the shallowest dwelling of the rockfish, often found in tidal or subtidal waters as deep as 46 meters. They are usually found over rock bottom where caves and crevices are common, they are probably nocturnal.

Available data suggest that diets of juvenile fish include primarily crustacean zooplanktors such as barnacle cyprids. Overall adult diets are more varied. Crustaceans and small fish are common diet items for adult fish. Small fish consumed by these rockfish include juvenile rockfish (mainly blue rockfish), sculpins, juvenile surfperch, kelpfishes, and plainfin midshipman.

Status of Populations

There is no comprehensive assessment of grass rockfish populations. They are probably subject to local depression in abundance and average size where diving, skiff fishing, party boat activity, or commercial fishing is concentrated. The low fecundity, restricted habitats and limited movements of this species makes them vulnerable to local fishing pressure. Statewide, the limited geographic ranges and restricted habitats of this species suggest that they have small populations in comparison to more widespread species that have traditionally been the target of commercial fishing. The limited depth distribution of grass rockfish means that all of the spawning population is vulnerable to fishing and probably few natural refugia exist. Infrequent years of good recruitment increase the danger of removing too many spawners, even with limited fishing pressure.

Adapted from California Living Marine Resources Status Report “Other Nearshore Rockfishes” by Ralph J. Larson (San Francisco State University) and Deborah A. Wilson-Vandenberg (California Department of Fish and Game)

Kelp Greenling

History of the Fishery

Kelp greenling (*Hexagrammos decagrammus*) are fished primarily for sport. The commercial fishery has historically been based largely on catch incidental to the lingcod or nearshore rockfish fisheries, although their importance in the commercial catch has increased since 1997 with the emergence of a nearshore "live" fish fishery. Because of their abundance in nearshore rocky areas, they are frequently caught by people fishing from shore or small boats and are a common target for spear fishermen underwater. Sport fishing surveys made from 1958 to 1961 showed that kelp greenling were the most frequent catch of shore fishermen north of San Francisco, where in some areas they made up more than 30 percent of the total catch. In California, during those years, an average of 54,000 kelp greenling were caught by hook-and-line fishermen and another 2,000 by spear fishermen. In later surveys conducted from 1980 to 1999, the estimated sport catch averaged 106,650 fish per year, with 103,000 of those taken between Monterey County and the Oregon border. It should be noted that the two sport fishing surveys used different sampling designs, so results may not be comparable. By comparison, the commercial catch reported from 1981 to 1999 averaged about 8,500 fish per year. This average is somewhat exaggerated by exceptionally large numbers of fish landed commercially in recent years by the nearshore live fish fishery mentioned above. From 1981 to 1996 average commercial catch was only around 5,500 fish per year, while from 1997 to 1999 that average increased to 27,400 fish per year. Until recently most of these fish were sold in the fresh-fish market, although now many are sold live to restaurants. Though fillets from kelp greenling are not as large as those from their more popular relative, the lingcod, texture and taste are comparable.

Status of Biological Knowledge

Kelp greenling range from San Diego to the Aleutian Islands, but are common only north of Morro Bay. Here they are one of the most conspicuous fishes in rocky nearshore habitats occurring often in and around kelp beds. The male and female look so different that they were first described as separate species. The body color is variable in both sexes, ranging from light gray to brown. Males, however, have large irregular blue patches anteriorly, while females are uniformly covered with smaller dark spots.

These solitary fish are common at depths between 10 and 60 feet, and range down to 150 feet. Sport catches indicate that larger fish live in deeper water. For example, fish caught at 80 to 100 feet range from 12 to 18 inches

long while those caught at 20 to 40 feet tend to be eight to 13 inches long. Kelp greenling grow faster than most nearshore fishes during their first three years. After the third year, growth slows, especially in males (as it does in lingcod), so that by the fifth or sixth year males are smaller than females. The maximum reported age and size is 16 years and 21 inches. At age three, males average 10.6 inches and females 9.1 inches. By age five, the males average 12.6 inches while females are 14.7 inches. Ten-year-olds average 15.5 and 16.4 inches, respectively. These data are from Puget Sound, Washington.

The reproductive behavior of greenling is similar to that of the lingcod. Females are mature by their fourth year and spawn adhesive egg masses on the sea bed and encrusting biota within the territories of courting males. In Puget Sound, females deposit egg masses that range from golf-ball to tennis-ball size, with an average of about 4,000 eggs per cluster. Females are batch spawners, capable of producing multiple clutches of eggs per spawning season. Males fertilize the eggs and guard the nests until larvae about one third of an inch long emerge four to five weeks later. Often, males guard more than one egg mass at a time, each possibly produced by a different female. Studies done in British Columbia and California showed some nests did contain egg masses from multiple females. Hatching occurs from December through February in northern California and gets progressively earlier to the north, November through January in Puget Sound and August through September in Alaska. Larvae and early juveniles feed on small copepods and spend about one year in the pelagic environment before entering the nearshore benthic community.

After they settle in the nearshore environment, kelp greenling have flexible food habits. During most of the year, they consume a variety of prey that are consistently available in the habitat, including crabs, amphipods, polychaetes and ascidians. There are brief periods when organisms such as juvenile fishes or herring spawn become exceptionally abundant, and kelp greenling shift their food habits to take advantage of these opportunities.



Kelp Greenling, *Hexagrammos decagrammus*
Credit: DFG

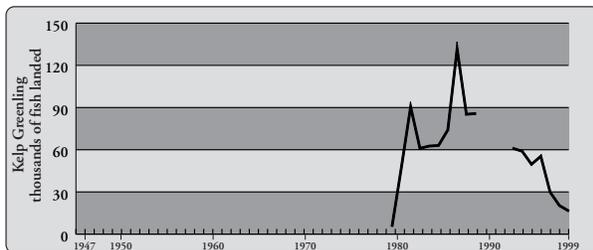
The primary predators of adult greenling are lingcod and harbor seals. As juveniles they are probably prey to many nearshore predators.

Status of the Population

There are no estimates of abundance for kelp greenling in California. The yearly sport catch remained relatively constant during the first ten years (1980-1989) it was surveyed, but has declined steadily from 1993 to 1999. Since decline in catch is one symptom of overfishing, this may be an indication that current levels of fishing are having adverse effects on the population, although no population data are available at present to confirm this. Spear fishermen could overfish local populations, however, because they can select individual targets, and greenling are particularly vulnerable to spears when guarding their nests. Also, although commercial catch has been traditionally very low compared to recreational catch, the increased fishing pressure in recent years by the nearshore live fish fishery could have a much broader impact on the kelp greenling population in California.

Dan Howard
National Marine Fisheries Service

Revised by:
Kelly R. Silberberg
National Marine Fisheries Service



Recreational Catch 1947-1999, Kelp Greenling
Data Source: RecFin data base for all gear types; data not available for 1990-1992

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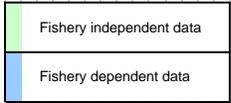
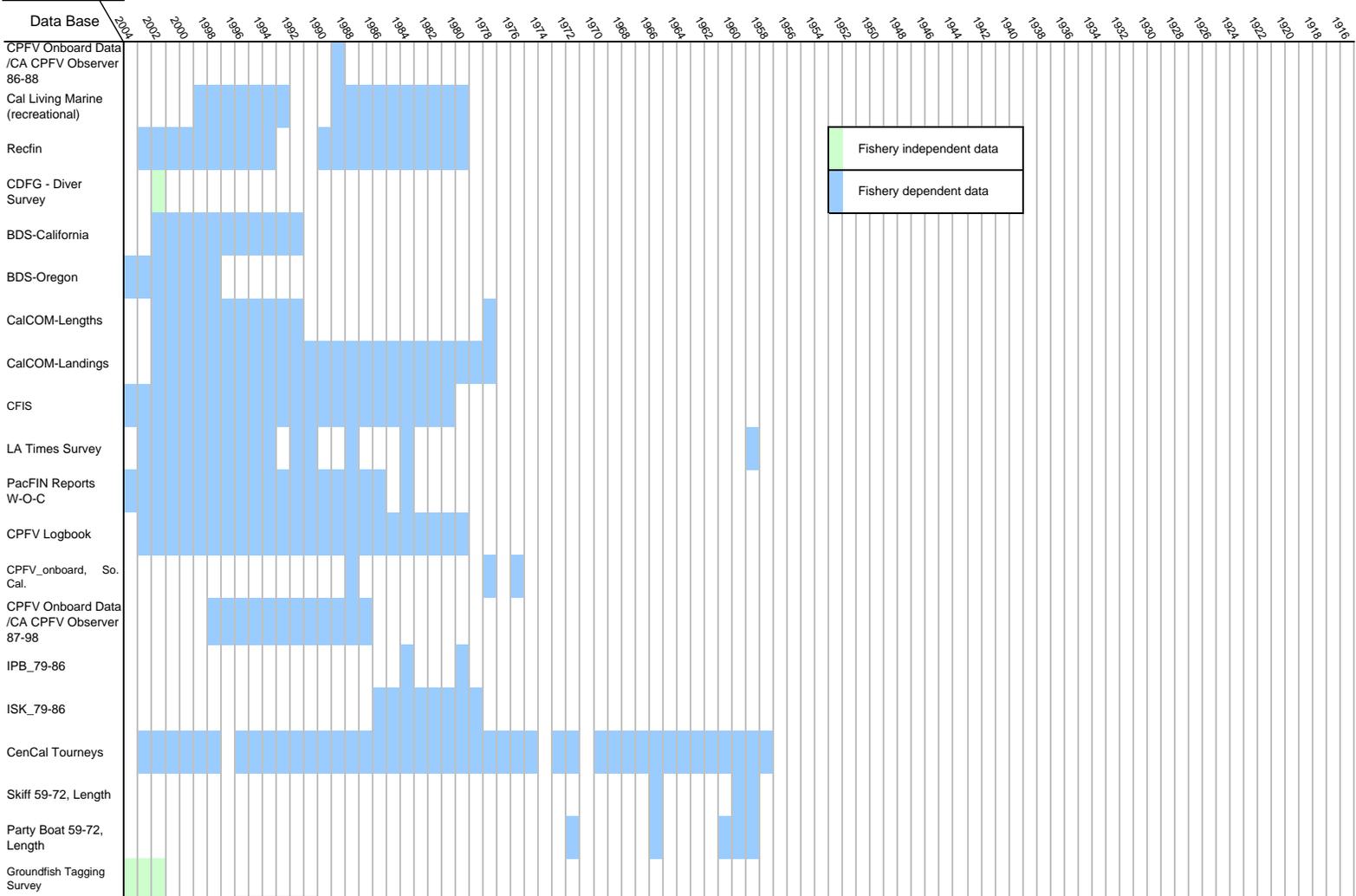
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Data Coverage for Kelp Greenling

Data Base



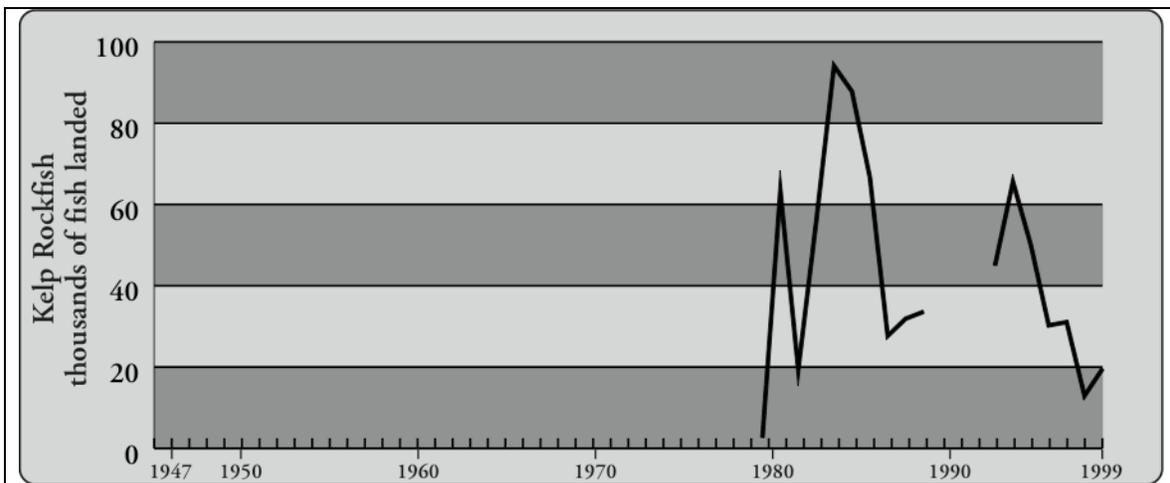
Notes:

- CPFV Onboard Data /CA CPFV only one observation
- Recfin length data available
- CDFG - Diver Survey CPUE, length and sex
- BDS-California length, no age, no maturity, no weight
- BDS-Oregon length, no age, one maturity, some weight
- CalCOM gear information
- Groundfish tagging survey includes sex at length data
- PacFIN Reports W-O-C kelp greenling listed as nominal greenling
- CPFV Onboard Data /CA CPFV length, weight, cpue, and by-block landings

Kelp Rockfish

History of the Fishery

Kelp rockfish have been a minor component of recreational and commercial rockfish fisheries. They are most frequently caught by anglers fishing from private boats rather than by anglers fishing from CPFVs (commercial passenger fishing vessels) or from shore. However, the proportion of the catch taken by commercial (versus recreational) fishers rose from about 2% in the 1980s to about 22% in the 1990s.



Recreational Catch 1947 – 1999, Kelp Rockfish

Data Source: RecFin data base for all gear types; data not available for 1990 - 1992

Development of the live/premium fishery in the late 1980s resulted in increasing commercial catches of many species occupying the nearshore environment in and around kelp beds, including kelp rockfish. Live fish are taken primarily by line gear and pot and trap gear, but other gear types are used. The fishery serves mainly Asian-American markets that demand top quality (live) fish. Fishermen receive premium prices for their catches ranging from \$2 to \$10 per pound in 1998. These nearshore fish are caught primarily north of Point Conception. Annual total landings by species are difficult to determine due to the inexact nature of recording landings: market categories are often comprised of multiple species.

The live fish market demand is mainly for fish in the one to two pound size range this size is above the size of sexual maturity, although in the development of the fishery all

fish were kept regardless of size. Due to concerns over the harvest of immature fish the Marine Life Management Act of 1998 implemented minimum commercial size for kelp rockfish. The shallow, nearshore nature of this fishery renders it very weather dependent. Poor weather, combined with lower overall allowable catches, implementation of minimum size limits, and a lack of a market north of Bodega Bay resulted in reduced catches from 1997 to 1999.

Status of Biological Knowledge

Kelp rockfish are relatively well studied. Kelp rockfish are not abundant north of Sonoma County and range south to the region of Point Eugenia, Baja California. Kelp rockfish occur almost exclusively in kelp forests, they are found as deep as 18 – 24 meters, the lower depths of giant-kelp habitat. While they do sometimes aggregate and move large distances, primarily they occupy a home range with about a 2 meter radius.

Kelp rockfish live as long as 25 years, and reach a maximum size of about 42.5 centimeters. They release larvae from February through June, with the peak reproduction in May.

Available data suggest that diets of juvenile fish include primarily crustacean zooplanktors such as barnacle cyprids. Overall adult diets are more varied. Crustaceans and small fish are common diet as well as cephalopods, gastropods, polychaetes, and tunicates. Small fish consumed by these rockfish include juvenile rockfish (mainly blue rockfish), sculpins, juvenile surfperch, kelpfishes, and plainfin midshipman.

Status of Populations

There is no comprehensive assessment of kelp rockfish populations. They are probably subject to local depression in abundance and average size where diving, skiff fishing, party boat activity, or commercial fishing is concentrated. The low fecundity, restricted habitats and limited movements of this species makes them vulnerable to local fishing pressure. Statewide, the limited geographic ranges and restricted habitats of this species suggest that they have small populations in comparison to more widespread species that have traditionally been the target of commercial fishing. The limited depth distribution of kelp rockfish means that all of the spawning population is vulnerable to fishing and

probably few natural refugia exist. Infrequent years of good recruitment increase the danger of removing too many spawners, even with limited fishing pressure.

Adapted from California Living Marine Resources Status Report “Other Nearshore Rockfishes” by Ralph J. Larson (San Francisco State University) and Deborah A. Wilson-Vandenberg (California Department of Fish and Game)

Monkeyface Prickleback

History of the Fishery

The monkeyface prickleback (*Cebidichthys violaceus*) is a nearshore fish that is a minor component of the recreational and commercial catch. It is frequently referred to as monkeyface eel and blenny eel due to its eel-like appearance. However, it is more closely related to bass-like fishes (Perciformes) than to true eels. It is a member of the prickleback family, Stichaeidae, of which 17 species occur in California. Its elongate body shape is an adaptation for living in cracks, crevices, and under boulders, primarily in the intertidal zone. Monkeyface prickleback have been found in coastal Indian middens of California along with cabezon and rockfishes and were undoubtedly exploited as a food resource in historic and prehistoric times.

A specialized recreational fishery by shore anglers fishing in rocky intertidal and shallow subtidal habitat exists for this species. The most common fishing method is "poke poling," which normally consists of fishing with a long bamboo pole, a short piece of wire, and a baited hook. The bait is placed in front of or in holes or crevices in the rock. Skin and scuba divers also spear them.

The monkeyface prickleback did not rank among the top fifteen species observed in either beach/bank or jetty/breakwater fishing categories in a 1980 through 1986 Marine Recreational Fisheries Statistics Survey (MRFSS) in California. The most recent (1999) MRFSS total catch estimate for northern California from all recreational fishing categories was 2,000 fish; however, the standard error of the estimate was much higher than the estimate.

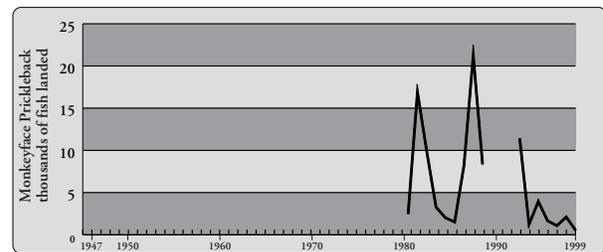
Commercial landing records in California date from 1928. Catch since then can best be described as of minor significance. Since 1991, annual landings have ranged from 12 to 935 pounds, primarily from the port areas of San Francisco and Santa Barbara. However, catch statistics may include California moray, rock prickleback, wolf-eel, and other eel-like fishes or true eels.

Status of Biological Knowledge

The monkeyface prickleback ranges along the Pacific coast from San Quentin Bay, Baja California, Mexico to central Oregon. It is most common off central California from San Luis Obispo County to Sonoma County, and is uncommon south of Point Conception. They normally occur in the intertidal zone with a depth range extending from the high intertidal to a reported depth of 80 feet. Typical habitat for monkeyface prickleback includes rocky intertidal areas with ample crevices, boulders, and

algal cover, including high and low tide pools, jetties and breakwaters, and shallow subtidal areas, particularly rocky reefs and kelp beds. Juveniles are particularly adapted for living in the high intertidal zone. The species is capable of living out of water under algae for extended periods and has air-breathing capacity. It is considered to be a residential species, moving short distances from crevices or under rocks to foraging sites. It appears to occupy a small home range of several meters and is primarily active during periods of a flooding tide.

The coloration of the species is a uniform light brown to dark green, often with several rust-colored blotches on the sides of the body. Two dark stripes radiate behind the eye. Adults have a lumpy ridge on top of the head. The coloration of both sexes is similar.



Recreational Catch 1947-1999, Monkeyface Prickleback

Data Source: RecFin data base for all gear types; data not available for 1990-1992

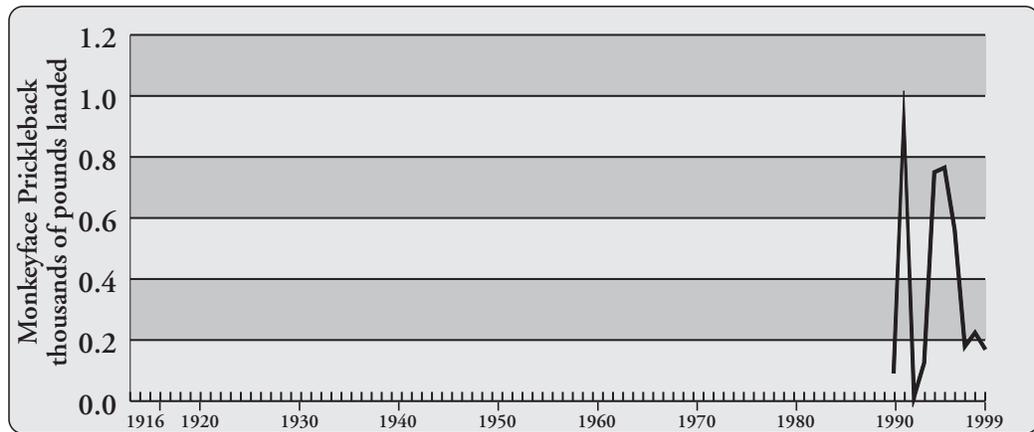
Monkeyface prickleback grow slowly, particularly after the first few years of life. A 12-inch fish is approximately three years old, while a 24-inch fish will be 15 to 17 years old. Monkeyface prickleback have been aged to 18 years using the otolith and opercular bone, but the largest specimens have not been aged. The maximum reported size is 30 inches in total length; 18 to 24 inch individuals are not uncommon.

Information available on age at sexual maturity suggests that both sexes begin to mature in their third or fourth year at a total length range of 11.0 to 14.2 inches, while 50 percent maturity occurs at approximately 15.4 inches at five years of age. Fertilization is internal and spawning activity occurs from January to May, with the peak spawning period from February to April. Females are oviparous, depositing their eggs on subtidal, rocky surfaces. Fecundity is known to range from 17,500 eggs for a 16-inch, seven-year old fish to 46,000 eggs for a 24-inch, 11-year-old fish, with smaller fish producing fewer eggs. Nest guarding behavior has been observed but it is unclear



Monkeyface Prickleback, *Cebidichthys violaceus*
Credit: PSMFC

**Commercial Landings
1916-1999,
Monkeyface Prickleback**
No commercial landing are
reported for monkeyface
prickleback prior to 1990. Data
Source: DFG Catch Bulletins and
commercial landing receipts.



if the female, male, or both sexes guard the egg mass. Larval length at hatching is unknown; larvae begin to settle out of the plankton at 0.7 to 0.9 inches.

The diet of monkeyface prickleback shifts from carnivorous to herbivorous with an increase in size. As early juveniles, up to 3.1 inches, prey items are predominantly zooplankton and include copepods, amphipods, isopods, mysids, and polychaetes. At approximately three inches, they then become almost exclusively herbivorous. Over sixty species of algae have been recorded as food items. Despite this wide array, they appear to feed selectively on eight to 10 species of red and green algae, mostly in the genera *Ulva*, *Porphyra*, *Mazzaella*, *Microcladia*, and *Mastocarpus*. Adults appear to prefer annual red and green algae to perennial red algae. This preference is determined to some degree by ocean season and availability.

Predators of monkeyface prickleback include piscivorous birds, such as great egrets and red-breasted mergansers, and fishes such as cabezon and grass rockfish. Predation is primarily on the earlier life stages of this species; large juveniles and adult fish most likely evade or outgrow these predators.

Other intertidal boulder and crevice-dwelling eel-like fishes, such as the rock and black pricklebacks and pen-point and rockweed gunnels, are possible competitors with monkeyface prickleback for space and food resources.

Status of the Population

No information is available on the status of stocks of monkeyface prickleback. The primary source of fishing mortality is from recreational poke polers and commercial anglers fishing from shore or the shallow subtidal, with a lesser number taken spearfishing by free and scuba divers. Historically, both recreational and commercial landings are considered to be low.

Management Considerations

See the Management Considerations Appendix A for further information.

Robert N. Lea and Paul N. Reilly
California Department of Fish and Game

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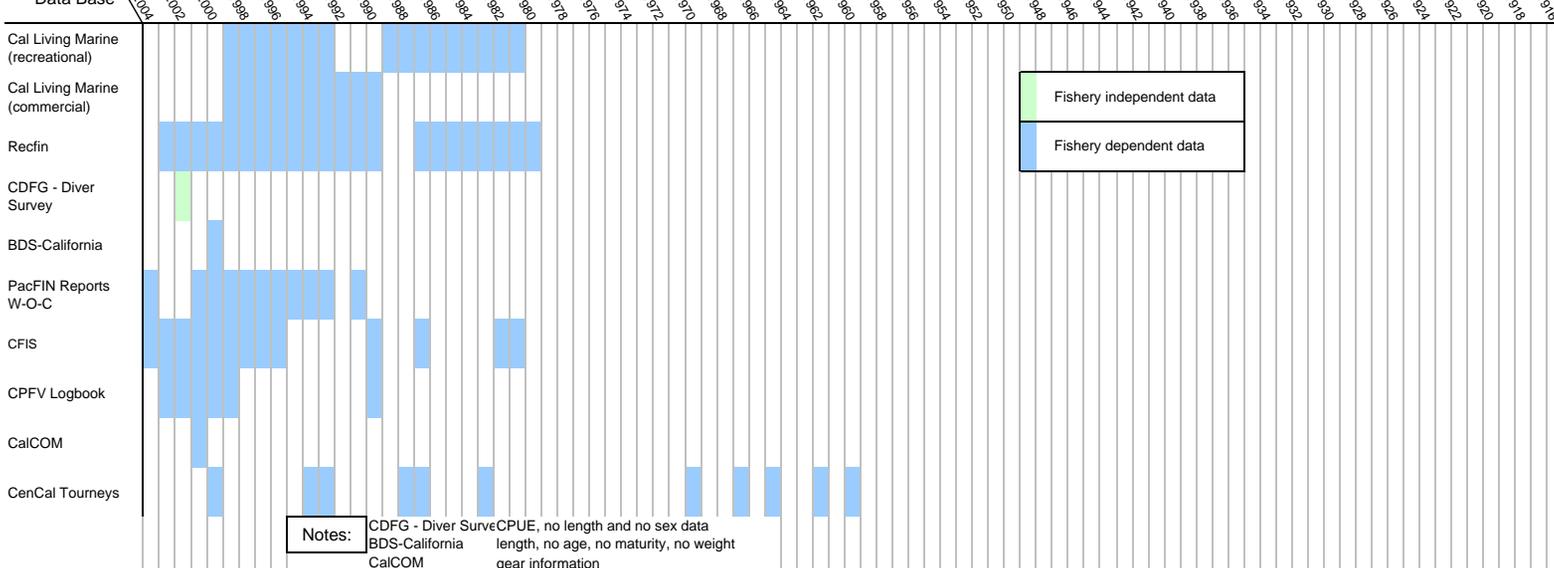
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Data Coverage for Monkeyface Eel

Monkeyface Eel

Data Base



Fishery independent data
 Fishery dependent data

Notes: CDFG - Diver Survey CPUE, no length and no sex data
 BDS-California length, no age, no maturity, no weight
 CalCOM gear information

Olive Rockfish

History of the Fishery

Olive rockfish (*Sebastes serranoides*) form a minor part of the commercial fishery in central and southern California, where they are primarily taken by hook-and-line. A relatively small number find their way into the live fish fishery. Historically, olive rockfish have been common in the recreational fishery as far north as Fort Bragg and were particularly important from central California to the northern Channel Islands. As late as the 1980s, olives were a very important recreational species throughout much of southern California. However, a combination of overfishing and poor juvenile survival brought about by changes in oceanographic conditions led to a steep decline (83 percent) in southern California party vessel catches between 1980 and 1996. In addition, while they were still commonly taken in the central California recreational catch, olive rockfish also declined there in the late 1990s.

Status of Biological Knowledge

Olive rockfish are streamlined fish with almost no head spines. Their body color is dark brown or dark green-brown on the back and light browns or green-brown on sides. There are a series of light blotches on the back. The fins range from olive to bright yellow, and olives are often mistaken for yellowtail rockfish. Olive rockfish are somewhat drabber in appearance, and yellowtail rockfish have red-brown flecking on the scales. They reach a maximum length of two feet.

Olive rockfish occur from southern Oregon to Islas San Benitos (central Baja California) from barely subtidal waters to 570 feet (the latter based on a trawl specimen collected by the Southern California Coastal Water Research Project). They are common from about Cape Mendocino to Santa Barbara and around the Northern Channel Islands from surface waters to about 396 feet. Olives appear to be uncommon off much of both southern California and Baja California.



Olive Rockfish, *Sebastes serranoides*
Credit: DFG

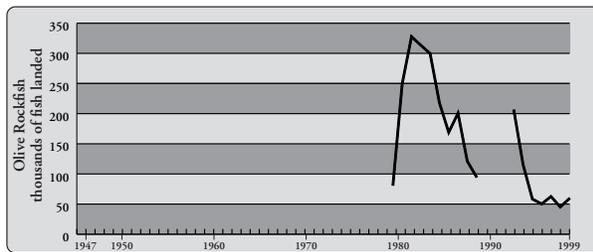
From April to September, young-of-the-year olive rockfish, around 1.2 to 1.6 inches long, settle out of the plankton to kelp beds, oil platforms, surfgrass and other structures at depths as shallow as 10 feet. During the day, young fish aggregate in the water column, occasionally with blue and black rockfish. They spend the night near or on the bottom, sheltering under algae or among rocks. Young olives also are found under drifting kelp mats. Olives about 2.5 inches long become more active at night, but it is not clear whether adult olives are nocturnal. They do feed commonly on octopuses, which are more available at night. Sub-adult and adult olives live over high relief reefs, as well as around the midwaters of oil platforms. In shallow waters, they are found throughout the water column and occasionally rest on the bottom. They form small to moderate-sized schools and a few often are mixed with blue rockfish schools. From tagging studies, most olive rockfish move relatively little; a maximum movement of 20 miles has been reported.

Olive rockfish live at least 25 years. Females grow larger, and, beginning at maturation, tend to be longer at a given age. Males reach maximum length earlier. Throughout California, males mature at a somewhat smaller size and a slightly greater age than females, however the difference is not large. Off central California, a few fish were mature at 10.6 to 11.2 inches (three years), 50 percent were mature at 12.9 to 13.7 inches (five years), and all were mature by 15.2 inches (eight years). Females release larvae once a year from December through March, peaking in January. Females produce between 30,000 to 490,000 eggs per season. Small juveniles are planktivorous, feeding on copepods, gammarid amphipods, cladocerans, euphausiids, other crustaceans and fish larvae. As they grow, their diet shifts to fishes, such as juvenile rockfishes, squids, octopuses, isopods, polychaete worms and krill.

Status of the Population

There has been no stock assessment of this species. However, there is clear evidence that olive rockfish have declined in abundance south of Pt. Conception.

Milton Love
University of California, Santa Barbara



Recreational Catch 1947-1999, Olive Rockfish

Data Source: RecFin data base for all gear types; data not available for 1990-1992

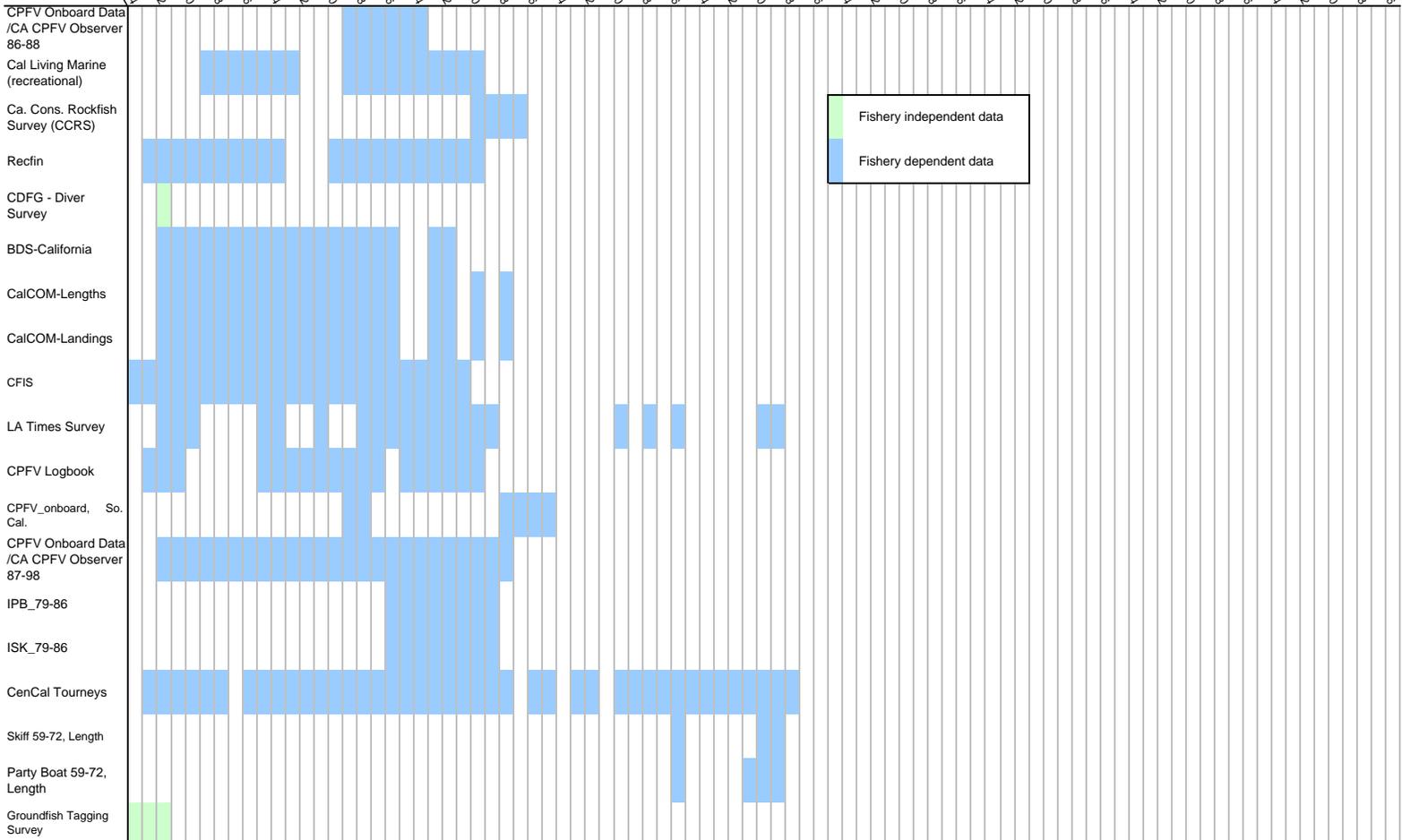
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Data Coverage for Olive Rockfish

Olive Rockfish

Data Base



Fishery independent data
Fishery dependent data

Notes: Recfin Length data available
 CDFG - Diver Survey CPUE and length, no sex data
 BDS-California Length, some maturity, no age, no weight
 CalCOM Gear information
 CPFV Onboard Data / length, weight, cpue, and by-block landings
 IPB_79-86 most of this data is for blue, copper and olive rockfish

Quillback Rockfish

History of the Fishery

Quillback rockfish (*Sebastes maliger*) are a minor component of the commercial passenger fishing vessel (CPFV) fishery and in general are only observed from the ports of Monterey northward. Only in the Eureka area does this species rank among the 10 most frequently observed benthic sport fishes caught by CPFV anglers. In the Fort Bragg area, quillback rockfish ranked between 13 and 17 among benthic sport fishes caught by CPFV anglers, and their importance in the fishery diminishes with decreasing latitude. A survey of all recreational sport fishing modes from 1981 to 1986 indicated an average annual harvest of approximately 9,000 fish.

Commercial landings of the "quillback rockfish" market category are significant only from the San Francisco area northward. However, historical landings are difficult to determine because of the low frequency of quillback rockfish and confused identification with other similar species. Statewide landings in this market category in 1999 comprised less than 0.3 percent of all rockfishes. Since 1992, this market category has not been used every year and when used, may have consisted of several different species.

Status of Biological Knowledge

The quillback rockfish was first described by Jordan and Gilbert in 1880. Also referred to as orange-spotted, yellow-back, or stickleback rockfish, it is part of central and northern California's nearshore benthic assemblage.

Quillback rockfish are relatively small, and are of "stout" morphology; a characteristic common among nearshore *Sebastes* found in close association with the bottom. They are usually orange-brown to black in color with a yellow or orange pale area between the eye and pectoral fin. This pale area is also present as a saddle on the first few dorsal spines and as speckling on the mid-dorsal surface. A characteristic that helps distinguish this species from similar species is its long dorsal spines and deeply notched forward dorsal fin membranes. Copper rockfish and other nearshore shallow dwelling rockfish also have deeply notched first dorsals but not so much as quillback.

Quillback rockfish are known from the Gulf of Alaska to Anacapa Passage in southern California, and are considered common between southeast Alaska and northern California. They are found from near the surface to a depth of 900 feet and can be common at depths of several hundred feet.

Like other *Sebastes* of shallow, benthic habit, individual quillback rockfish are not known to range far. Tagging studies in central California and Washington have shown

quillback to be residential (no movement) or to show movement of less than six miles. They have also demonstrated homing ability and day-night movement patterns.

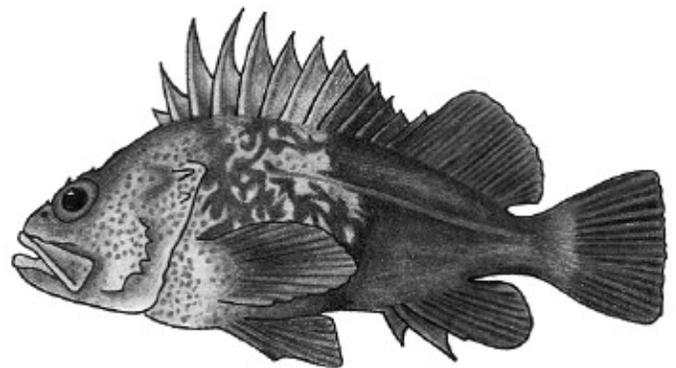
In California, quillback rockfish have been aged to 15 years, but are known to live longer, as they have been aged to 76 years in Canada. Quillback can grow to 24 inches, and growth rates differ along its range. In California, size for a 12-year-old quillback is approximately 7.1 inches. Size at first maturity for males is 8.7 inches (four years), and for females is 10.2 inches (six years). In California, size at 50 percent maturity for males and females was found to be the same as for first maturity.

As with all *Sebastes*, quillback have internal fertilization and produce live young. In California, mating takes place in the late winter and early spring, with birth occurring from April through July. After roughly one to two months in the plankton (0.7 to 2.8 inches), they begin to settle near shore.

As planktonic larvae and after they settle, quillback rockfish feed on other planktonic animals and eggs. As adults they feed on a variety of prey such as crustaceans, especially shrimps; small fish, including rockfishes and flatfishes; clams; marine worms; and fish eggs.

Quillback rockfish larvae are subject to predation by jellyfish and arrow worms. As juveniles, they are preyed upon by fishes, including larger rockfishes, lingcod, cabezon and salmon. Various marine birds and pinnipeds eat juvenile quillback as well. Adults are also subject to predation by larger fishes including some sharks, as well as sea lions, seals, and possibly, river otters.

Juveniles inhabit very nearshore bottom areas and are found over both low and high rocky substrate. They are sometimes found among sponges and algae that provide shelter. Adults are most often found in deeper water and are solitary reef-dwellers living in close association with the bottom. They are often seen perched on rocks or taking shelter in crevices and holes. Adults have also been noted to retreat to eelgrass beds at night. Quillback



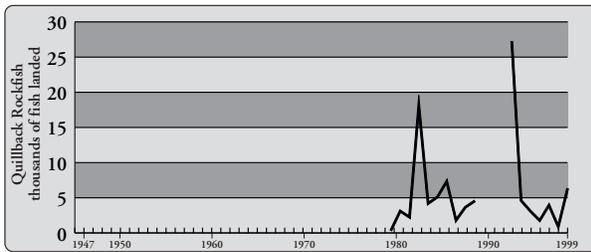
Quillback Rockfish, *Sebastes maliger*
Credit: L. Sinclair
Miller and Lea

are also associated with the rock-sand interface, but are rarely seen in the open away from suitable cover.

Status of the Population

While no stock assessment has been done for quillback rockfish in California, length-frequency data exist on their occurrence in the recreational fishery in northern and central California, as well as in the commercial fishery from the same region. Between the late 1980s and mid-1990s, quillback rockfish experienced increased take by the commercial fishery as the market demand for premium, live fish increased, yet no significant trend was noted in the average size of fish. Fishing pressure has relaxed somewhat in recent years because of restrictions placed on the fishery. Concern over sustainability of the commercial and recreational nearshore fishery has made this species of particular interest to managers.

David A. Osorio and Richard Klingbeil
California Department of Fish and Game



Recreational Catch 1947-1999, Quillback Rockfish

Data Source: RecFin data base for all gear types; data not available for 1990-1992

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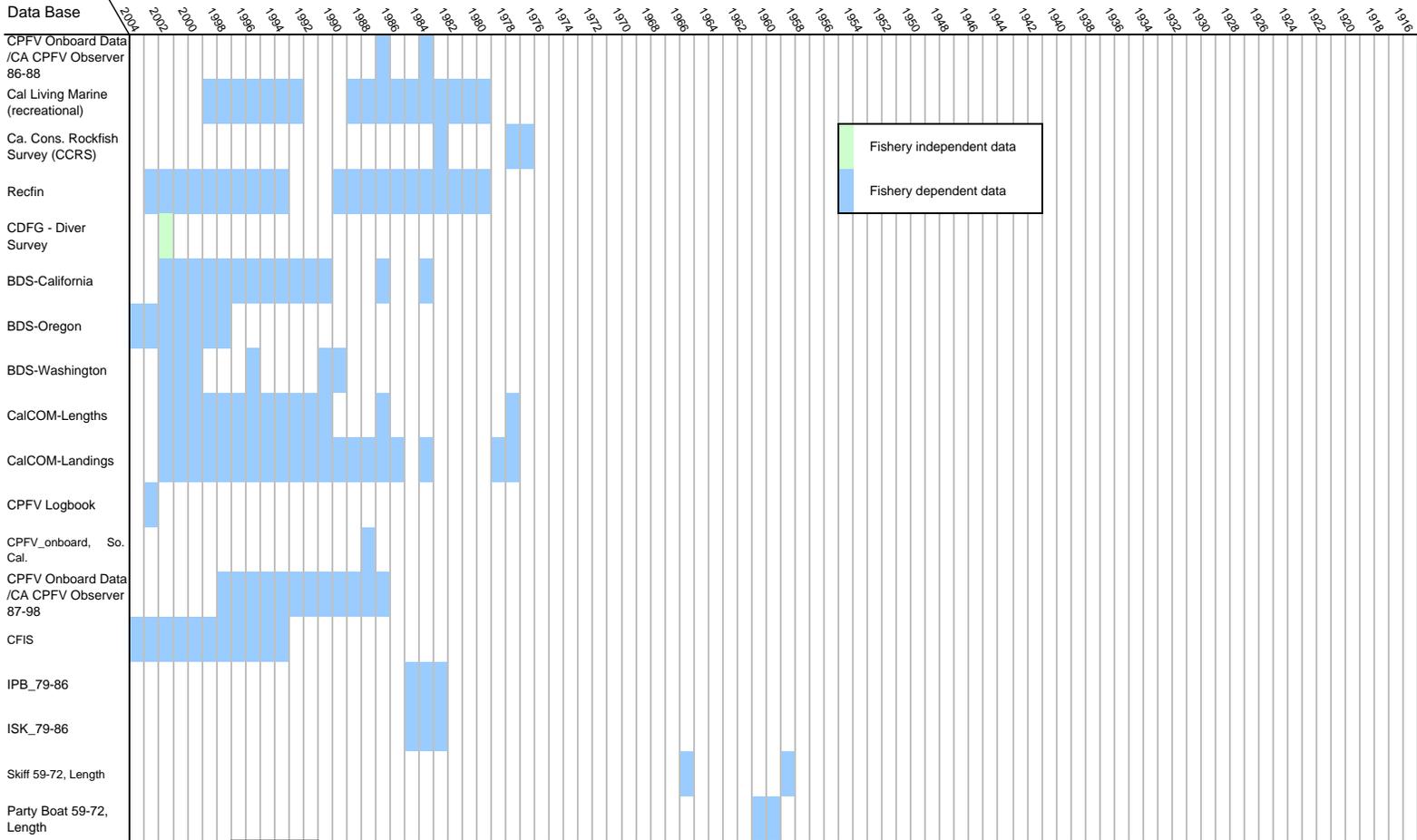
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Data Coverage for Quillback Rockfish

Quillback Rockfish



Fishery independent data
Fishery dependent data

Notes: CPFV Onboard Data /CA Only 3 data points
 Recfin Length data available
 CDFG - Diver Survey CPUE, no length or sex data
 BDS-California Length, some maturity, no age, no weight
 BDS-Oregon length, no age, one maturity measurement, and no weight
 BDS-Washington Length, no age, no maturity, no weight
 CalCOM Gear information
 CPFV Onboard Data /CA Length, weight, cpue, and by-block landings
 IPB_79-86 few data points
 ISK_79-86 few data points

Rock Greenling

The rock greenling is in the family Hexagrammidae and is closely related to the kelp greenling, both taxonomically and morphologically. It is reddish-brown with darker mottling and often has large bright-red blotches on the sides. The inside of the mouth is bluish.

Little is known about rock greenling. There are no estimates of abundance for rock greenling and little is known about their natural history. Juveniles and adults frequent subtidal habitats in or around rocky reef areas and under kelp beds. Based on co-occurrence with adult and juvenile rock greenling, demersal fishes associated with kelp beds and reef structure likely to compete with rock greenling for food and space would include lingcod, cabezon, kelp greenling, and rockfish species such as grass, China, quillback, copper, and vermilion.

Rock greenlings have been aged to a maximum of 8 yr for males and 11 yr for females. Total lengths corresponding to these male and female ages were 11.9 inches total length (TL) and 22.4 in. TL, respectively. The rock greenling ranges from the Bering Sea to Point Conception, but also occurs in the western Pacific Ocean south to Japan. In California, this species is infrequently observed south of San Francisco. Little is known about their stock structure. Similar to kelp greenling, adults are territorial.

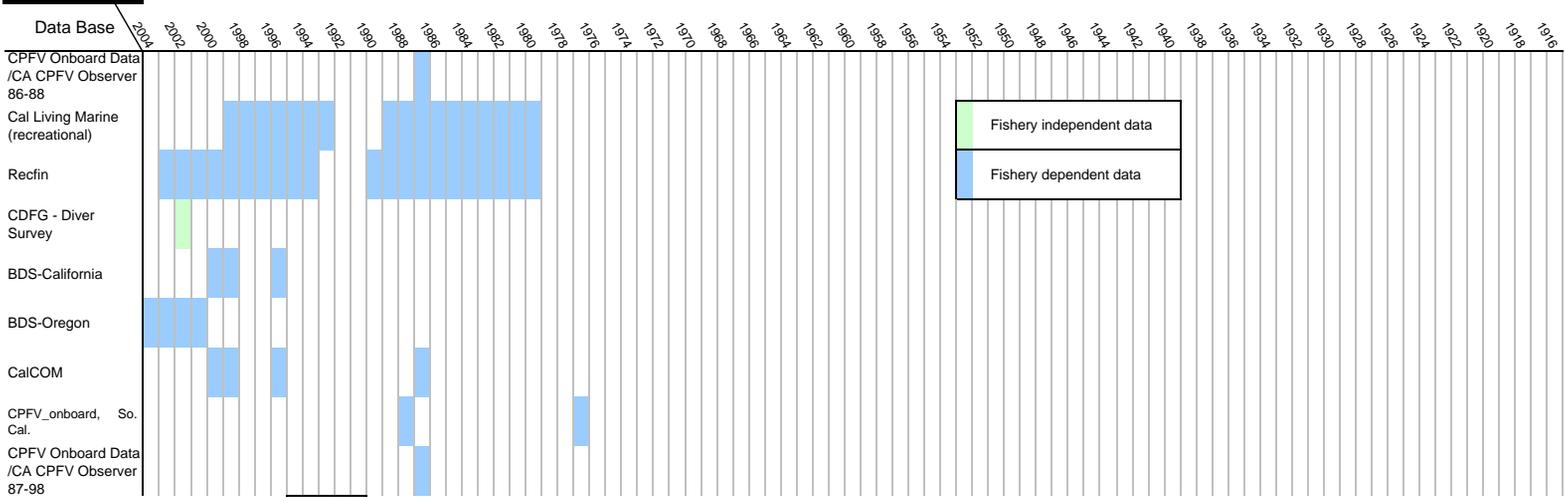
No maturity data are available from California. However, data from the western Pacific Ocean indicate that approximately one half of all male and female rock greenlings are sexually mature at age 3-4 and a length of 11.4 to 13.8 inches. In the Aleutian Islands, the spawning season extends from June through August. Females are oviparous, or egg-laying. Nest guarding by rock greenling has not been documented.

Adapted from California Department of Fish and Game nearshore finfish profiles

<http://www.dfg.ca.gov/mrd/rockfish/rockgreenling.html>

Data Coverage for Rock Greenling

Rock Greenling



Fishery independent data
Fishery dependent data

Notes:

Recfin	length data available
CDFG - Diver Survey	CPUE, three length measurements and two sex measurements
BDS-California	length, no age, no maturity, no weight
BDS-Oregon	length and weight, no age, no maturity
CalCOM	gear information
CPFV Onboard Data /CA CPFV Observer 87-98	length, weight, cpue, and by-block landings
Recfin	length data available
CDFG - Diver Survey	CPUE, three length measurements and two sex measurements
BDS-California	length, no age, no maturity, no weight
BDS-Oregon	length and weight, no age, no maturity
CPFV_onboard So. Cal	incorrect species name listed

California Scorpionfish

History of the Fishery

The California scorpionfish (*Scorpaena guttata*) is a valuable commercial fish in southern California. For many years, the fishery experienced a long decline, with peak catches of 223,000 pounds in 1925 and fluctuating catches thereafter. However, the rise of the live fish fishery in the 1990s led to the fishery's resurgence, as this species' bright red color and hardness after capture has made it a favorite target. Today, about 85 percent of the commercial California scorpionfish catch goes to the live fish fishery. Catches in 1998 totaled about 75,000 pounds valued at \$175,000. Most fish are taken in traps or by hook-and-line.

California scorpionfish are a moderately important part of the sport fishery in southern California. They are taken primarily from party boats and private vessels, and occasionally from piers and jetties, mostly from Point Mugu southward.

Status of Biological Knowledge

California scorpionfish are easily distinguished from most other California fishes. They are a relatively heavy-bodied species, with strong head and fin spines, ranging in color from red to brown, often with purple blotches and always covered with dark spots. They reach a length of 17 inches.

California scorpionfish live from tide-pool depths to about 600 feet (usually in about 20-450 feet) from Santa Cruz to southern Baja California, and in the northern part of the Gulf of California. Preferring warmer water, the species is common as far north as Santa Barbara. While they are most abundant on hard bottom (such as rocky reefs, sewer pipes and wrecks), they are also found on sand.

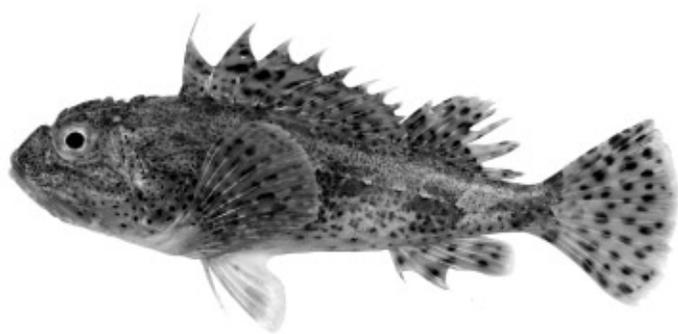
California scorpionfish grow to 17 inches and some live at least 21 years. After four years of age, females grow faster than males and reach a larger size. Although a few

fish mature at six inches (one year), over 50 percent are mature by seven inches (two years) and all reproduce by nine inches (four years). Spawning occurs from April to August, peaking in June and July. Scorpionfish are oviparous, have external fertilization, and females produce eggs imbedded in the gelatinous walls of hollow, pear-shaped "egg-balloons." These paired structures, each five to 10 inches long, are joined at their small ends. The walls of these "balloons" are about 0.1 inch thick, transparent or greenish in color, and contain a single layer of eggs. Each egg is about .05 inch in diameter. The egg masses float near the surface and the eggs hatch within five days. Very young fish live in shallow water, hidden away in habitats with dense algae and bottom-encrusting organisms. Small crabs are probably the most important food of California scorpionfish, although other items, such as small fishes, octopuses, shrimps and even pebbles are sometimes eaten. These animals are primarily nocturnal and feed at night. Octopuses prey on small individuals. California scorpionfish make extensive spawning migrations in late spring and early summer, when most adults move to 12 to 360 foot depths, forming large spawning aggregations on or near the bottom. During spawning, these aggregations rise up off the bottom, sometimes approaching the surface. Spawning occurs in the same areas year after year, and it is likely that the same fish return repeatedly to the same spawning ground. When spawning ends, the aggregations disperse and many (though not all) of the fish move into shallower waters.

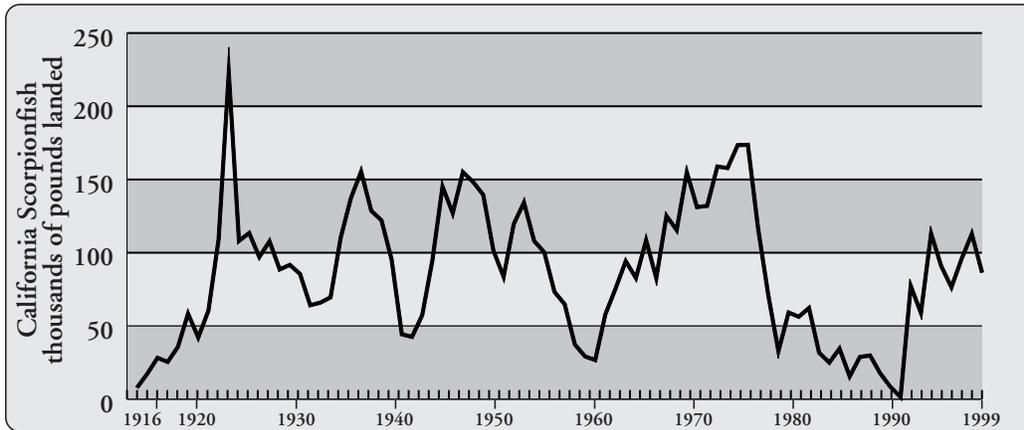
The sharp spines on the dorsal, anal and pelvic fins are poisonous. The toxin is produced in glands that lie at the base of each spine and run up to the tip through a groove. A wound, although painful, is seldom fatal, and bathing the wound in hot water can reduce the pain. The heat alters the toxin's structure making it harmless. One should be careful not to make the water so hot as to damage tissue.

Status of the Population

No population estimates exist for California scorpionfish. However, data from trawl studies conducted by the Los Angeles County Sanitation Districts, Southern California Coastal Water Research Project and the Orange County Sanitation District from 1974-1993 show that there are substantial short-term fluctuations in California scorpionfish abundance within the Southern California Bight.



California Scorpionfish, *Scorpaena guttata*
Credit: DFG



Commercial Landings 1916-1999, California Scorpionfish
Data Source: DFG Catch Bulletins and commercial landing receipts.

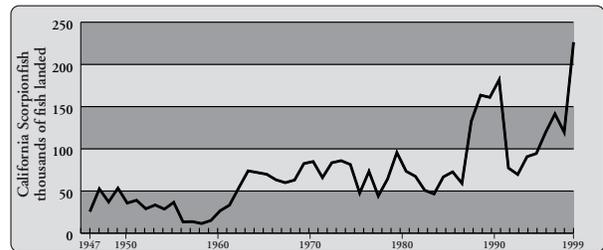
Management Considerations

See the Management Considerations Appendix A for further information.

Milton Love
University of California, Santa Barbara

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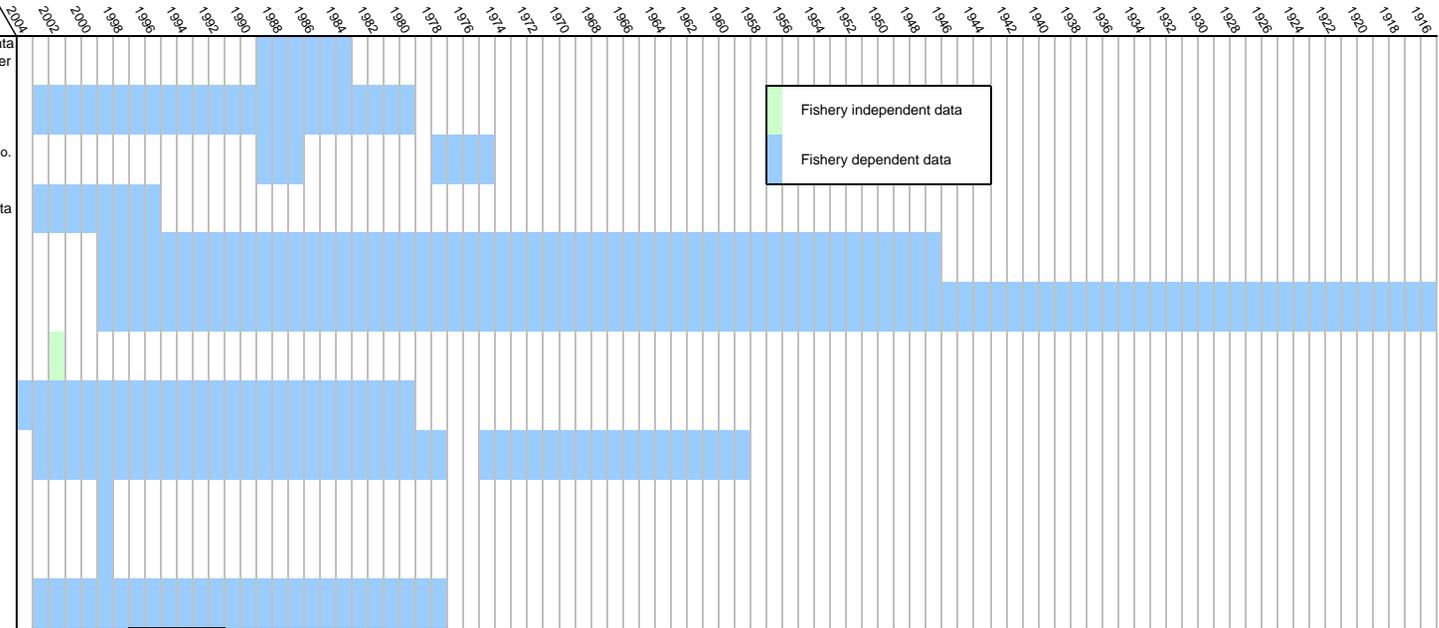
Recreational Catch 1947-1999, California Scorpionfish
CPFV = commercial passenger fishing vessel (Party Boat); Recreational catch as reported by CPFV logbooks, logbooks not reported prior to 1947.

Data Coverage for Scorpionfish

Scorpionfish

Data Base

- CPFV Onboard Data /CA CPFV Observer 86-88
- CPFV Logbook
- CPFV_onboard, So. Cal.
- Archive market Data
- Cal Living Marine (recreational)
- Cal Living Marine (commercial)
- CDFG - Diver Survey
- CFIS
- LA Times Survey
- BDS-California
- CalCOM-Lengths
- CalCOM-Landings



Notes: Archive market Data length data available
 CDFG - Diver Survey CPUE, no length and no sex data
 BDS-California length, no age, no maturity, no weight
 CalCOM gear information

California Sheephead

History of the Fishery

Although the commercial catch of California sheephead (*Semicossyphus pulcher*) dates back to the late 1800s, a renewed interest in this fishery has developed only recently. Today, it is exploited by sport divers, anglers, and especially by a growing live fish commercial industry.

In the late 1800s, Chinese fishermen took large quantities of sheephead for drying and salting. Since that time, except for brief periods, sheephead was not a targeted species until the 1980s. In the recently developed live fish fishery, the fish are trapped and taken live to supply Asian seafood restaurants. Because small fish, usually females, are easier to keep alive in small aquaria, prereproductive individuals have often been taken. A recent minimal size limit of 12 inches should reduce this possibility.

The largest commercial catches of California sheephead were from 1927 to 1931, peaking in 1928 at more than 370,000 pounds. During and shortly after World War II (1943-1947), the sheephead catch increased from 50,000 to 267,000 pounds, probably because of easy availability close to port. Since the 1940s and until the late 1980s, the average annual landing has been about 10,000 pounds and the price of this catch was under \$0.10 per pound. During the 1980s, the price and catch increased slightly until the live fish market began in the late 1980s. The price of live fish has reached as high as \$9 per pound. Between 1989 and 1990, the catch quadrupled and reached a peak in 1997 of 366,000 pounds and a market value of \$840,176. During 1994 to 1999, the live catch varied between 87.8 percent and 73.7 percent of the total sheephead landings. The catch has decreased from 1997 to 1999, but the market value has remained high.

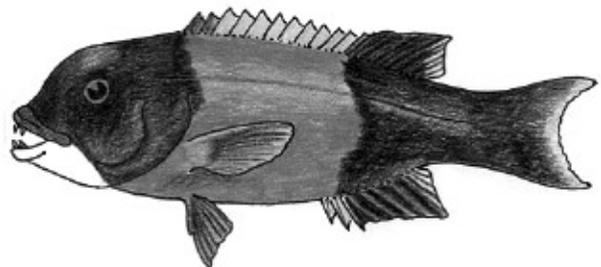
The estimated recreational catch of sheephead between 1983 and 1986 averaged 312,400 pounds with a maximum estimate of 448,800 pounds for 1986. Commercial passenger fishing vessel data from 1947 to 1998 indicate an average take of 28,030 fish per year with a maximum in 1983 of about 69,000 fish. Using an average weight of two pounds per fish (a low estimate) the sport catch, except in the cited maximal periods, often exceeds the commercial catch. During the 1930s, sheephead were considered "junk fish" by most recreational anglers and were not kept because of their soft flesh. However, the large size, fine flavor, and use as a lobster substitute in salads and other recipes has more recently made them a preferred and even targeted species by anglers and divers.

Status of Biological Knowledge

The California sheephead and two other common Southern California species, the rock wrasse and the senorita are members of the mostly tropical, worldwide wrasse

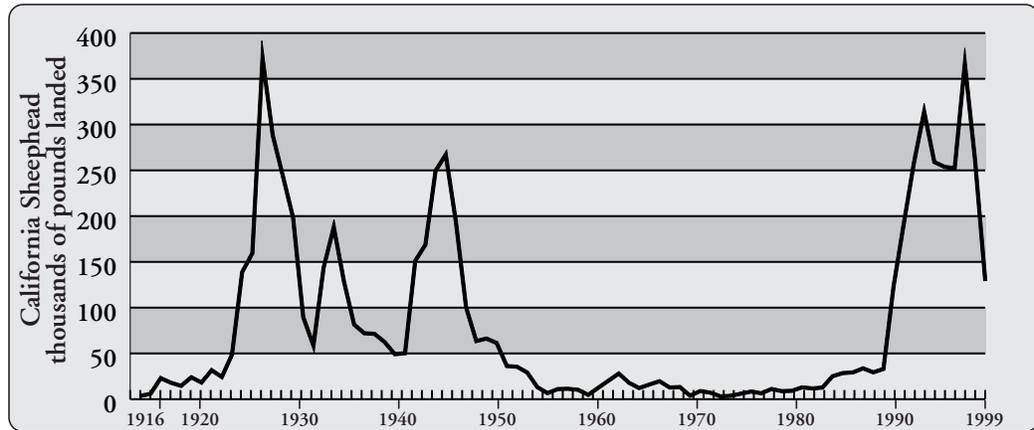
family Labridae. All have protruding canine-like jaw teeth and large cycloid scales. The sheephead is easily distinguished from the others by its color pattern, greater body depth, and large size. Males have a black head and tail separated by a reddish middle section. The chin is white in both sexes but females are uniformly pinkish. Young-of-the-year are bright reddish orange with a lateral longitudinal white stripe and large black spots at the rear of the dorsal fin and upper caudal. Although the sheephead ranges from Monterey Bay, California to the Gulf of California, it is not common north of Point Conception. It is a protogynous hermaphrodite, beginning life as a female with older, larger females developing into secondary males. Female sexual maturity may occur in three to six years and fishes may remain female for up to fifteen years. Timing of the transformation to males involves population sex ratio as well as size of available males and sometimes does not occur at all.

Males have been aged at around 50 years, and can achieve a length of three feet and a weight exceeding 36 pounds. As growth rates are higher and mortality lower at the northern end of the range, the sexual transformation occurs later there and the males are larger. Batch spawning occurs between July and September, and estimates of yolky oocytes present in the ovary vary from 36,000 to 296,000 for fish from eight to 15 inches. Larval drift ranges from 34 to 78 days with two settlement patterns. Most larvae settle at about 37 days, but some slow their growth at this time and may continue as pelagic larvae for another month. Settlement size remains between 0.5 and 0.6 inches. The sheephead has a broad diet with crabs, barnacles, mollusks, urchins, polychaetes and even bryozoa occasionally dominant. There appears to be no evidence of its preference for abalone and lobster as cited in earlier literature. Because of its large size of adult males, there are few known predators. The sheephead is a rocky reef, kelp bed species found to depths of 280 feet. Adults are usually solitary, but sometimes are seen in large schools, perhaps associated with spawning aggregations.



California Sheephead (male), *Semicossyphus pulcher*
L. Sinclair
Miller & Lea

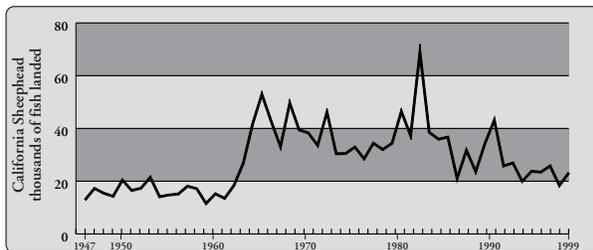
**Commercial Landings
1916-1999,
California Sheephead**
Data Source: DFG Catch
Bulletins and commercial
landing receipts.



They are considered resident species and no systematic movements have been described.

Status of the Population

There has been no ongoing analysis of the status of the California sheephead. Long-term studies at two localities in southern California, Palos Verdes Point and the King Harbor breakwater, have shown that the species was not abundant in the cool period of the early 1970s. The population increased at both sites with the onset of the little El Niño of 1977-1978. At King Harbor, the population peaked in 1978, decreased through the end of the great El Niño of 1982-1983, and remained low until the early 1990s when it again reached a large size (1994 and 1998). With the exception of 1982-1983 El Niño, the population seems to increase during El Niño conditions and this is reflected in increased recruitment. At Palos Verdes, the population peaked in 1981, then declined until 1983, but has remained relatively stable since. At maximum, the density of sheephead at the Palos Verdes kelp bed was three times that of the King Harbor breakwater. There is no evidence from these very limited data that the population is threatened by existing fishery practices. The projected decrease in landings during 1999 may reflect the imposition of a minimum size limit.



Recreational Catch 1947-1999, California Sheephead

CPFV = commercial passenger fishing vessel (party boat); Recreational catch as reported by CPFV logbooks, logbooks not reported prior to 1947.

Management Considerations

See the Management Considerations Appendix A for further information.

John Stephens

Occidental College-retired

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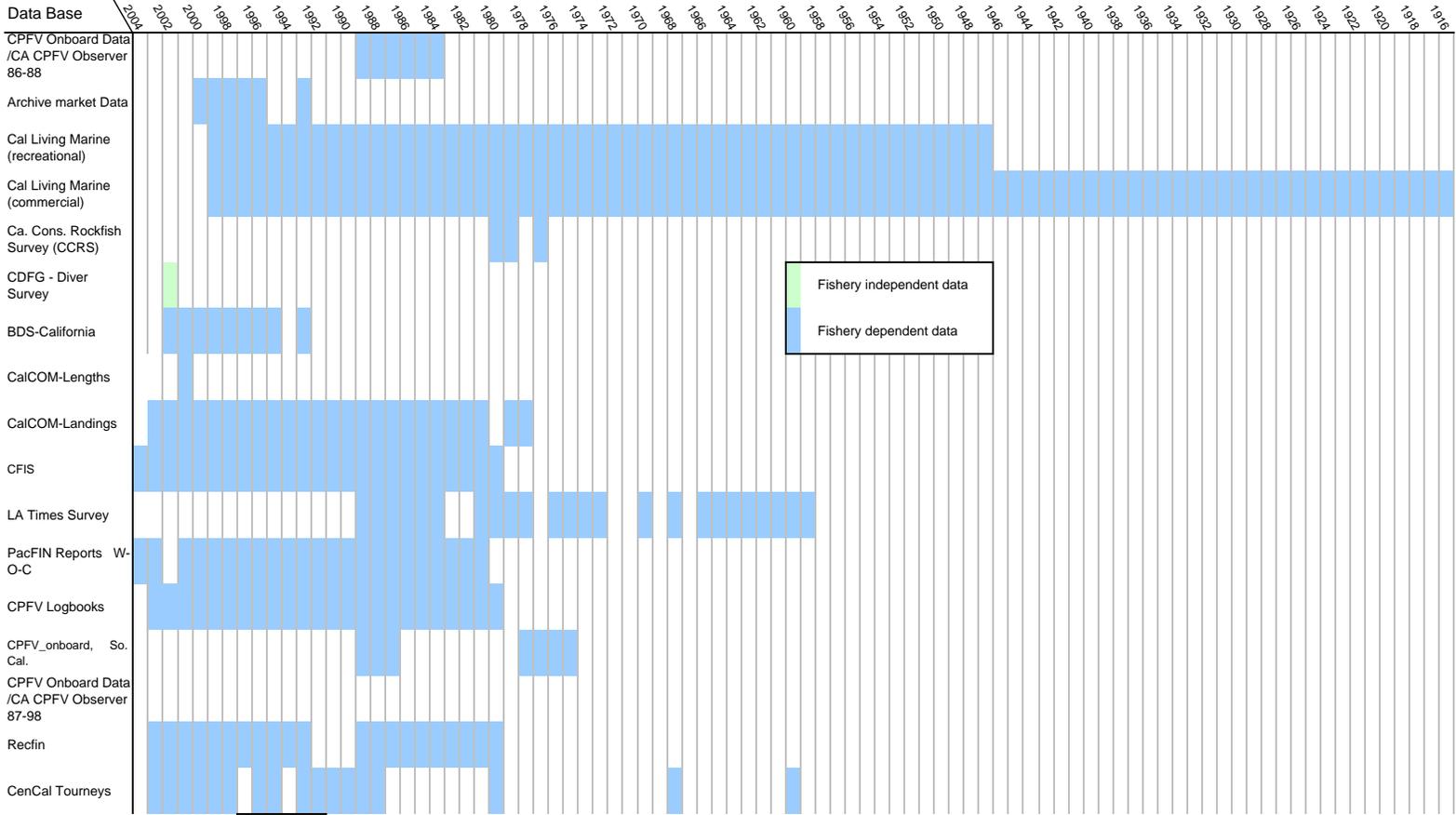
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Data Coverage for Sheephead

Sheephead



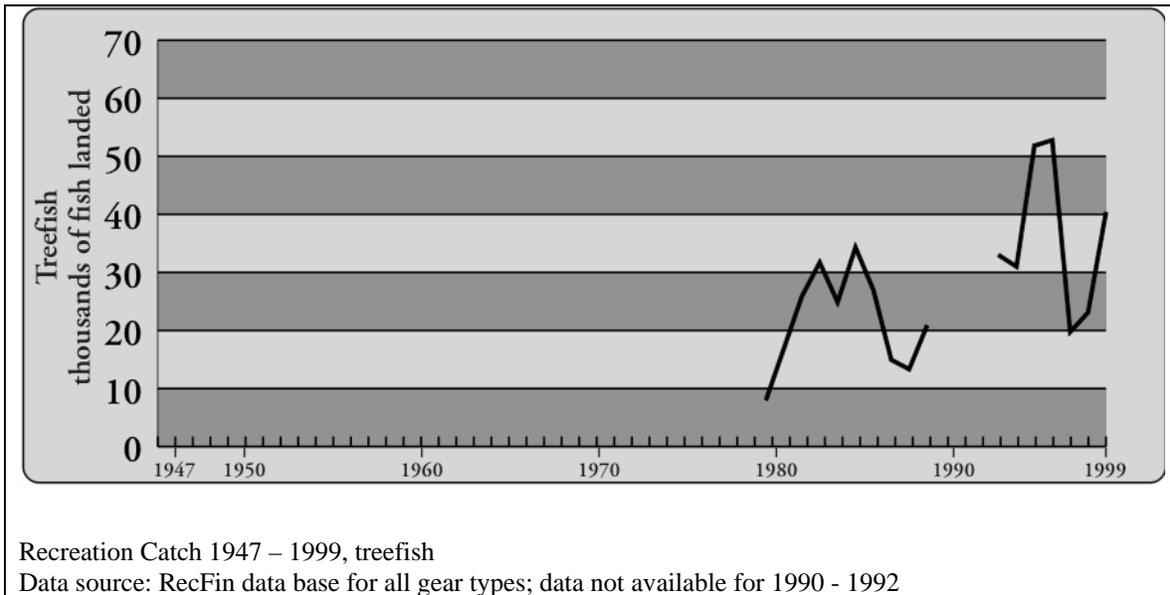
Fishery independent data
 Fishery dependent data

Notes: Archive market Data length data available for '93 and '96 through '03
 BDS-California Length, no age, no maturity, some weight
 CPFV Onboard Data /CA Cfew data points, length, weight, cpue, and by-block landings

Treefish

History of the Fishery

Treefish have been a minor component of recreational and commercial rockfish fisheries. They are most frequently caught by anglers fishing from private boats rather than by anglers fishing from CPFVs (commercial passenger fishing vessels) or from shore. However, the proportion of the catch taken by commercial (versus recreational) fishers rose from about 1% in the 1980s to about 5% in the 1990s.



Development of the live/premium fishery in the late 1980s resulted in increasing commercial catches of many species occupying the nearshore environment in and around kelp beds, including treefish. Live fish are taken primarily by line gear and pot and trap gear, but other gear types are used. The fishery serves mainly Asian-american markets that demand top quality (live) fish. Fishermen receive premium prices for their catches ranging from \$2 to \$10 per pound in 1998. These nearshore fish are caught primarily north of Point Conception. Annual total landings by species are difficult to determine due to the inexact nature of recording landings: market categories are often comprised of multiple species.

The live fish market demand is mainly for fish in the one to two pound size range this size is above the size of sexual maturity, although in the development of the fishery all fish were kept regardless of size. The shallow, nearshore nature of this fishery renders it very weather dependent. Poor weather, combined with lower overall allowable catches, implementation of minimum size limits, and a lack of a market north of Bodega Bay resulted in reduced catches from 1997 to 1999.

Treefish are also important in non-consumptive uses: colorful and accessible, they are frequently observed and photographed by divers. In addition, individuals are taken for the aquarium trade.

Status of Biological Knowledge

Little is known about treefish. They are most common in depths of less than 100 feet on rocky reefs, and are largely restricted to the region south of Point Conception. However, abundance of Treefish seems to have increased in the Monterey area since the 1980s. These changes in distribution seem to be related to ocean warming that began in 1977.

Treefish can live as long as 23 years, and get as large as 41 centimeters. They release larvae from June – July (at least). Treefish are probably nocturnal, occupying caves and crevices. Information on diet of treefish is limited.

Status of Populations

There is no comprehensive assessment of treefish populations. They are probably subject to local depression in abundance and average size where diving, skiff fishing, party boat activity, or commercial fishing is concentrated. The low fecundity, restricted habitats and limited movements of this species makes them vulnerable to local fishing pressure.

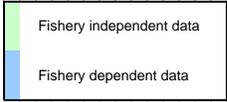
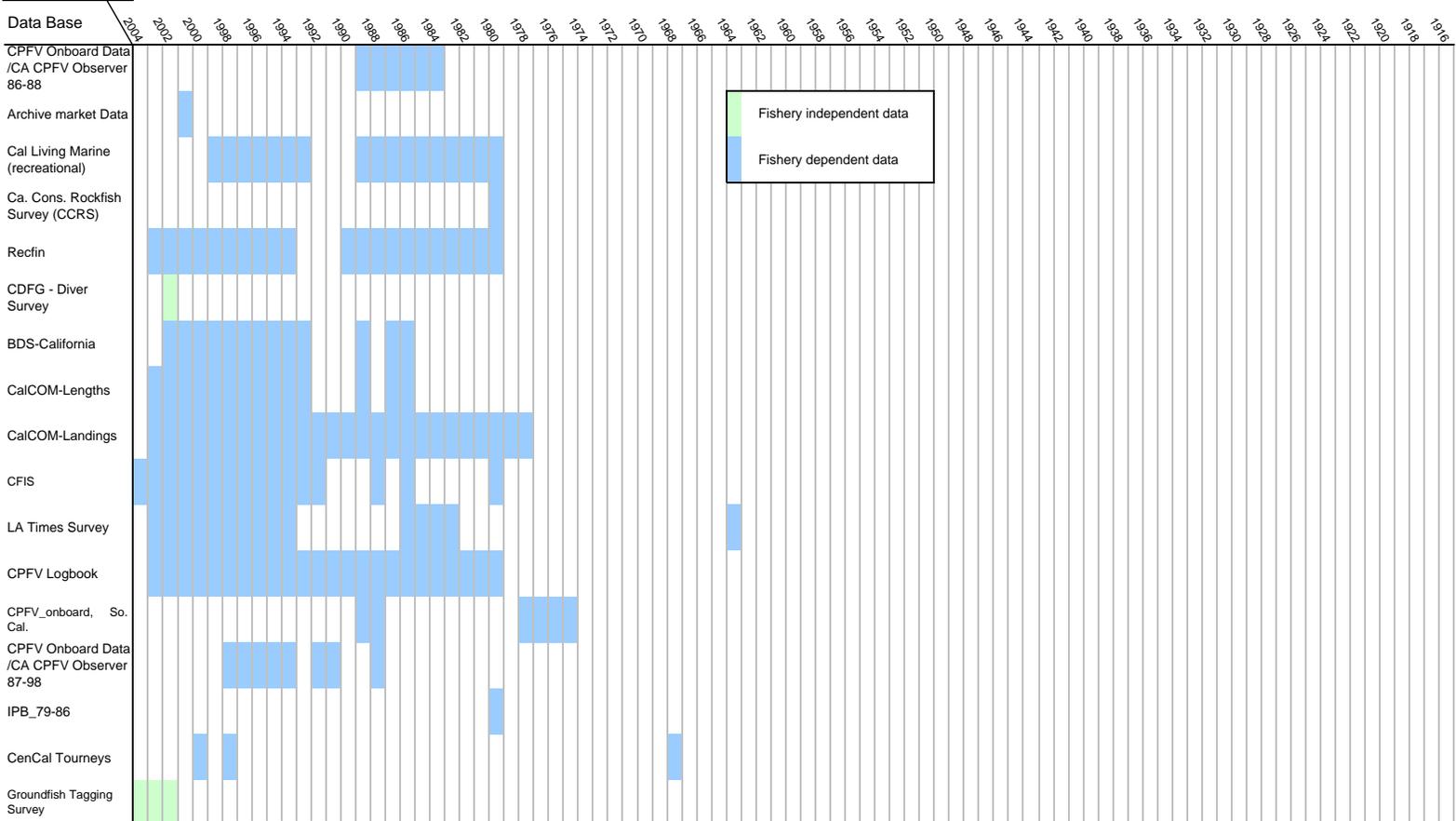
Statewide, the limited geographic ranges and restricted habitats of this species suggest that they have small populations in comparison to more widespread species that have traditionally been the target of commercial fishing. The limited depth distribution of treefish means that all of the spawning population is vulnerable to fishing and probably

few natural refugia exist. Infrequent years of good recruitment increase the danger of removing too many spawners, even with limited fishing pressure.

Adapted from California Living Marine Resources Status Report “Other Nearshore Rockfishes” by Ralph J. Larson (San Francisco State University) and Deborah A. Wilson-Vandenberg (California Department of Fish and Game)

Data Coverage for Treefish

Data Base



Notes: CCRS one measurement
 Recfin Length data available except '82 - '84
 CDFG - Diver Survey CPUE and length, no sex data
 BDS-California Length, no age, no maturity, no weight
 CalCOM Gear information
 CPFV Onboard Data /CA Cfew data points, length, weight, cpue, and by-block landings
 IPB_79-86 one data point