Fishery-at-a-Glance: California Sheephead (Sheephead)

Scientific Name: *Semicossyphus pulcher*

Range: Sheephead range from the Gulf of California to Monterey Bay, California, although they are uncommon north of Point Conception.

Habitat: Both adult and juvenile Sheephead primarily reside in kelp forest and rocky reef habitats.

Size (length and weight): Male Sheephead can grow up to a length of three feet (91 centimeters) and weigh over 36 pounds (16 kilograms).

Life span: The oldest Sheephead ever reported was a male at 53 years.

Reproduction: As protogynous hermaphrodites, all Sheephead begin life as females, and older, larger females can develop into males. They are batch spawners, releasing eggs and sperm into the water column multiple times during their spawning season from July to September.

Prey: Sheephead are generalist carnivores whose diet shifts throughout their growth. Juveniles primarily consume small invertebrates like tube-dwelling polychaetes, bryozoans and brittle stars, and adults shift to consuming larger mobile invertebrates like sea urchins.

Predators: Predators of adult Sheephead include Giant Sea Bass, Soupfin Sharks and California Sea Lions.

Fishery: Sheephead support both a popular recreational and a commercial fishery in southern California.

Area fished: Sheephead are fished primarily south of Point Conception (Santa Barbara County) in nearshore waters around the offshore islands and along the mainland shore over rocky reefs and in kelp forests.

Fishing season: Recreational anglers can fish for Sheephead from March 1through December 31 onboard boats south of Point Conception and May 1 through December 31 between Pigeon Point and Point Conception. Recreational divers and shore-based anglers can fish for Sheephead year round. The commercial fishing season for Sheephead has a 2-month closure from March 1 through April 30.

Fishing gear: The primary recreational fishing gear is hook and line, as well as spear. The primary fishing gears used to target Sheephead in the commercial live fish fishery are traps and line gear including: stick gear, set longline, rod and reel, as well as dip net gear usually used while diving.

Market(s): Sheephead are primarily landed commercially in the live fish fishery and sold to restaurants.

Current stock status: At this time, Sheephead landings appear to be stable and populations appear to benefit from restricted fishing in Marine Protected Areas.

Management: Sheephead are currently managed with seasonal closures, minimum bag and size limits, as well as a Total Allowable Catch for both the recreational and commercial fisheries. The available information suggests there are currently no management issues, as Sheephead populations and landings appear to be stable.

1 The Species

1.1 Natural History

1.1.1 Species Description

California Sheephead (Sheephead) (*Semicossyphus pulcher*) are one of the most common temperate wrasse species in the Labridae family in southern California. Wrasses are primarily found in tropical waters, although in addition to Sheephead there are two other temperate wrasse species found in California, Señorita (*Oxyjulis californica*) and Rock Wrasse (*Halichoeres semicinctus*). Sheephead are easily distinguished from the other wrasse species by their large size, color pattern and protruding canine-like teeth. Sheephead are sexually dimorphic and male, female and young-of-the-year individuals are easily distinguishable. Males have a black head and tail divided by a reddish color along their middle. Both sexes have a white chin, although females are uniformly reddish-pink in color. The young-of-the-year are bright reddish-orange with a white stripe along their lateral line and large black spots on their rear dorsal and upper caudal fins (Figure 1-1). Coloration and morphology alone is not sufficient to determine the sex of individuals, as transitioning or recently transitioned males can appear female with uniform coloration, but possess male gonads (Loke-Smith et al. 2010).

Figure 1-1. Images of California Sheephead life stages a) juvenile, b) female and, c) male (Photo Credit: Miranda Haggerty, CDFW).

1.1.2 Range, Distribution, and Movement

Sheephead range from the Gulf of California to Monterey Bay, California, but are uncommon north of Point Conception (Figure 1-2). They are considered resident species on the reefs they reside. Tagging studies show Sheephead have small home ranges and high site fidelity (Topping et al. 2005, 2006). On average, Sheephead home range is approximately 600 square meters (m^2) (6,458 square feet (ft^2)), but this can vary seasonally with individuals moving more during warmer water temperatures. Gender may also drive some differences seen in Sheephead movement. For instance, terminal phase males expand their home ranges and move wider distances during spawning compared to initial phase females (Lindholm et al. 2010). Although this movement behavior is different to what was observed in an earlier study off Catalina Island, where terminal phase males occupied small territories approximately 20 meters

(m) (66 feet (ft)) along a reef during spawning season compared to females who moved between various males' spawning territories (Adreani et al. 2004). These differences seen in movement behavior suggest like other life history characteristics of Sheephead, their movement may change with differing local environmental conditions and population parameters.

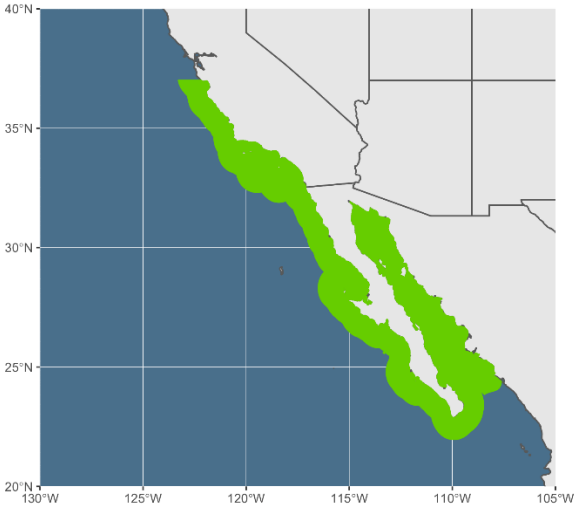

Figure 1-2. Range of California Sheephead.

1.1.3 Reproduction, Fecundity, and Spawning Season

Sheephead are protogynous hermaphrodites, meaning they all begin life as females and older, larger females can develop into males. The largest female in a group will commonly change sex in response to the removal of the dominant male. Although transformation does not always occur, changing to male depends on the sex ratio of a population and the size of available males (Warner 1975; Cowen 1990). Sheephead are batch spawners, with females releasing eggs almost daily during their spawning season from July to September (Adreani et al. 2004). Fecundity increases with increasing length and ovary mass, indicating the importance of large females for the reproductive potential of Sheephead populations (Loke-Smith et al. 2012). The average number of eggs spawned daily varies between studies from 12,000 to 296,000 (Warner 1975; Jirsa et al. 2007; Loke-Smith et al. 2012). The Gonadosomatic Index (GSI) (an index of relative gonad size compared to body weight, an estimate of reproductive allocation) of mature females has been estimated to range between about 2 to 7%, with higher GSI being attributed to populations of Sheephead that consume a higher proportion of mobile invertebrates like sea urchins (Hamilton et al. 2011).

After spawning occurs, fertilized eggs enter the plankton as pelagic larvae for 34 to 78 days. Most Sheephead larvae settle at approximately 37 days, but some are slower growing and continue as pelagic larvae for another month until they reach settlement size between 0.5 and 0.6 inches (in) (13.0 to 16.0 millimeters (mm)). Once larvae settle onto shallow reefs, continued growth of young-of-the-year individuals is not affected by their size or age at settlement (Cowen 1991).

1.1.4 Natural Mortality

Determining the natural mortality (M) of marine species is important for understanding the health and productivity of their stocks. Natural mortality results from all causes of death not attributable to fishing such as old age, disease, predation or environmental stress. Natural mortality is generally expressed as a rate that indicates the percentage of the population dying in a year. Fish with high natural mortality rates must replace themselves more often and thus tend to be more productive. Natural mortality along with fishing mortality result in the total mortality operating on the fish stock.

The oldest Sheephead ever reported was a male at 53 years (yr) (Warner 1975). Although this is most likely uncommon, since a size at age study using dorsal spines found fish were 21 yr old at most (Cowen 1990). Determining the natural mortality (M) of fish is important in understanding the health and productivity of their stocks. Natural mortality of a fish results from all causes of death not attributable to fishing such as old age, disease, predation, environmental stress. Natural mortality is generally expressed as a rate that indicates the percentage of the population dying in a year. Fish with high natural mortality rates must replace themselves more often and thus tend to be more productive. Natural mortality, along with fishing mortality, result in the total mortality operating on the fish stock. A large proportion of the uncertainty in the 2004 stock assessment is due to the uncertainty in the estimate of natural mortality, as estimates of biomass and recruitment are highly dependent on this value. Estimating natural mortality is difficult and often relies on evaluation of life history traits. The natural mortality of Sheephead has been estimated between M=0.2 and 0.35 using age and growth parameters, $L\infty$ and K, maximum length and the relative growth rate of an individual, described in detail below (Alonzo et al. 2004.)

1.1.5 Individual Growth

Individual growth of marine species can be quite variable, not only among different groups of species but also within the same species. Growth is often very rapid in young fish and invertebrates, but slows as adults approach their maximum size. The von Bertalanffy Growth Model is most often used in fisheries management, but other growth functions may also be appropriate.

Male Sheephead can grow up to a length of 3 ft (91 centimeters (cm)) and weigh over 36 pounds (lb) (79 kilograms (kg)). Female Sheephead grow to an average of 14.5 in (37.0 cm) in length before changing sex to male. However, there is record of a female aged at 30 yr that weighed 18.3 lb (8.3 kg) with an unknown length (Fitch and Lavenberg 1971). Individual growth of fishes is quite variable, not only among different groups of species, but also within the same species. Growth is often very rapid in young fish and invertebrates, but slows as adults approach their maximum size. The von Bertalanffy Growth Model is most often used in fisheries management, but other growth functions may also be appropriate. Alonzo et al. 2004 conducted a stock assessment that used four different methods for fitting growth parameters to predict observed growth data. Growth parameters for Sheephead have been calculated for both sexes combined by fitting data to a von Bertalanffy Growth Model:

$$L_t = L_\infty(1 - e^{-k(t-t_0)}$$

where L_t = length at age, L_∞ = maximum asymptotic length, k = relative growth rate, t = age of fish, and t_0 = theoretical age at time when length is zero. The values of those calculated parameters are: L_∞ = 467.7, k=0.182, t_0 =0. The relationship between weight and length for Sheephead (both sexes combined) has also been modeled using the exponential equation:

$$W_L = \alpha L^\beta$$

where W is the weight in grams, L is the length in centimeters, and α and β are estimated parameters. The parameters for Sheephead are estimated at α =0.00000002952 and β =2.9066 (Recreational Fisheries Information Network (RecFIN)).

1.1.6 Size and Age at Maturity

Sheephead reach maturity at approximately 4 yr of age, and a total length of about 10 in (25 cm) (Warner 1975). However, there is a wide range of individual variation among different populations (Cowen 1990; Caselle et al. 2011). Transitioning to male typically occurs at approximately 7 to 8 yr or 14.5 in (37 cm) in length, but it can occur in Sheephead as young as 4 yr or 9 in (22 cm) (Warner 1975; Cowen 1990). The average size at maturity and age at sex change has been seen to decrease in Sheephead populations surrounding the Channel Islands (Hamilton et al. 2007, 2011). This decrease in size is suggested to be from increased fishing pressure, as populations of Sheephead in Mexico where fishing pressure has remained low over time exhibit no change in size structure or shift in maturity or sex change (Hamilton et al. 2007).

1.2 Population Status and Dynamics

Although a formal stock assessment for Sheephead has not been conducted since 2004, only three years after regulations were put in place, Sheephead appear to have benefited from the regulations. At this time, Sheephead landings appear to be stable (see section 1.2.1), and populations also appear to benefit from restricted fishing in Marine Protected Areas (MPA).

1.2.1 Abundance Estimates

A stock assessment that estimated the Spawning Potential Ratio (SPR) of mature Sheephead was approximately 20% of the unfished biomass level (Alonzo et al. 2004). Female biomass in isolation was estimated to be impacted much less, with female SPR estimated at 80% of the unfished level (Alonzo et al. 2004). It is important to note that most of the biological data used in the 2004 stock assessment was

collected before the effects of the size and catch limits set between 1999 and 2001 could be observed, and should be updated to reflect current landings. Additionally since the 2004 stock assessment, research has indicated high variability in life history parameters between Sheephead populations across southern California, and abundance estimates may vary greatly depending on each population's exposure to varying fishing pressures and environmental conditions.

Little is known about historical abundances of Sheephead before commercial fishing began, although a recent study using zooarchaeological records suggests Sheephead stocks may have thrived more than 10,000 yr ago and prehistoric stock size has decreased by approximately 14.6% compared to Sheephead today (Braje et al. 2017). Research has shown Sheephead display biogeographic patterns of abundance with densities highest in the southern portion of their range (Cowen 1985; Hamilton et al. 2007; Caselle et al. 2011;). Densities are also different between island and mainland locations, with an average of 2.84 ± 0.33 fish per 80 cubic meter (m^3) (2,825 ft^3) at offshore islands and 1.84 ± 0.27 fish per 80 m^3 (2,825 ft^3) along the mainland (Caselle et al. 2011).

1.2.2 Age Structure of the Population

The current age structure of retained recreational catch of Sheephead was determined by length data that was converted to ages (Figure 1-3) (RecFIN). The implementation of the minimum size limit in 2001 is reflected in the shift in the age structure of the catch with decreasing proportion of fish under 6 yr of age. Since 2001, the majority of the catch has been fish from 7 to 14 yr of age, totaling 88%. As Sheephead mature near 4 yr of age, this means the majority of the fished population reproduced a minimum of three times. Each of the ten age classes are represented in the catch every year, which suggests a healthy population has existed without any years of recruitment failure.

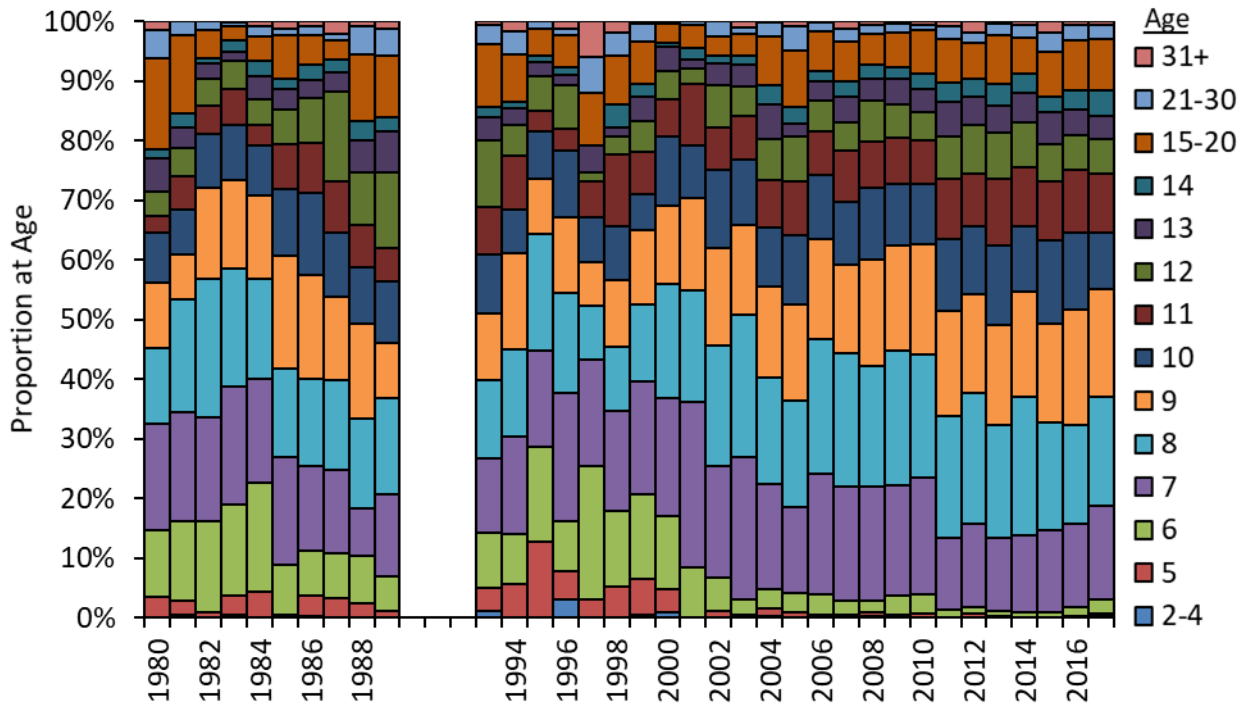

Figure 1-3. Age structure of recreational California Sheephead catch from 1980 to 2017. Age classes were converted from length data of retained catch from all fishing modes. All fish older than 15 yr and younger than 5 yr are represented in summed categories (no data collected from 1990 to 1992) (RecFIN).

1.3 Habitat

Both adult and juvenile Sheephead primarily reside in kelp forest and rocky reef habitats, and they are highly associated with the structure of these habitats. Newly settled juveniles are most commonly found on reefs with high relief, and they are commonly found in areas with protective ledges leading out to open habitat for refuge and foraging (Andrews and Anderson 2004). Adult Sheephead are found in higher densities on connected or continuous reefs compared to isolated reefs (Sievers et al. 2016). Although adult Sheephead may forage up to 65 to 100 ft (20 to 30 m) away from these structures during the day, they return to the reef for refuge at sunset, where they are often found resting under rocks and crevices until daylight (Love 2011).

1.4 Ecosystem Role

It has been suggested that Sheephead play an important ecosystem role in the maintenance of kelp forest habitat through the regulation of urchin populations (Cowen 1983; Hobson and Chess 1986; Hamilton and Caselle 2015; Selden et al. 2017). At high densities, both red (*Mesocentrotus franciscanus*) and purple (*Strongylocentrotus purpuratus*) urchins can overgraze giant kelp and other macroalgae, converting the structural habitat into a deforested area overrun by sea urchins. This occurrence is termed an urchin barren (Estes and Duggins 1995; Graham 2004). The presence of large Sheephead consuming urchins may prevent kelp forests from becoming urchin

barrens. This is a vital ecosystem role as over 200 species of fishes, invertebrates and mammals rely on kelp forests for structural habitat in southern California alone (Foster and Schiel 1985). The presence of Sheephead may also benefit the kelp forest community by removing parasites as juvenile Sheephead have been observed to engage in cleaning behaviors, removing and consuming parasites from the skin of associated fishes (Coyer 1980; Allen et al. 2006).

1.4.1 Associated Species

The species most highly associated with Sheephead comprise the complex of southern ranging kelp and rocky reef associated species including Blacksmith (*Chromis punctipinnis*), Halfmoon (*Medialuna californiensis*), Garibaldi (*Hypsypops rubicundus*), Opaleye (*Girella nigricans*), Treefish (*Sebastes serriceps*) and Giant Sea Bass (*Stereolepis gigas*) (Allen et al. 2006).

1.4.2 Predator-prey Interactions

Sheephead are generalist carnivores whose diet shifts throughout their growth. They consume small invertebrates like polychaetes, bryozoans and brittle stars in the juvenile stage and then shifting to larger mobile invertebrates like sea urchins as they increase in size (Cowen 1983). Shifts in prey consumption can also be seen between Sheephead populations across southern California depending on Sheephead size and prey availability (Hamilton et al. 2011). Sheephead feeding on red and purple sea urchins may play an important role in regulating urchin densities with larger males exerting top down control on urchin populations (Cowen 1983; Hobson and Chess 1986; Hamilton and Caselle 2015). Feeding trials show Sheephead smaller than 8 in (20 cm) do not consume urchins, and larger Sheephead consume disproportionally more and larger urchins (Selden et al. 2017). Additionally as urchin size increases Sheephead must be larger for successful predation. For large urchins from 2.0 to 2.8 in (5.1 to 7.1 cm) test diameter, only Sheephead over 18 in (46 cm) were successful in more than half of predation attempts, whereas Sheephead less than 11 in (28 cm) were only successful in 10% of their attacks (Selden et al. 2017). The importance of larger Sheephead to regulate urchin populations has also been observed in a Sheephead population surrounding San Nicolas Island, when their size structure recovery caused changes in their diet from small, sessile invertebrates to invertebrates like urchins (Hamilton et al. 2014). These studies demonstrate the role of Sheephead controlling urchin populations relies on large individuals rather than an abundance of small individuals. MPAs may aid in Sheephead regulating urchin densities, as multiple studies have shown a higher biomass of large Sheephead inside reserves corresponding with increased urchin mortalities rates (Froeschke et al. 2006; Caselle et al. 2011; Hamilton and Caselle 2015; Selden et al. 2017). Although recent observations demonstrate smaller females, from 9 to 12 in (23 to 30 cm), can actually use rocks as anvils to break open large urchins that are too big to be crushed by their mouths alone (Dunn 2016).

Predators of adult Sheephead include Giant Sea Bass, Soupfin Sharks (*Galeorhinus galeus*) and California Sea Lions (*Zalophus californianus*) (Allen et al. 2006). Juveniles are most likely consumed by larger kelp forest fishes found in the same kelp forest and rocky reef habitats.

1.5 Effects of Changing Oceanic Conditions

Oceanic changes due to climatic events impacting water temperature and nutrient availability such as El Niño Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO) and the North Pacific Gyre Oscillation (NPGO) can have profound effects on fishes and fisheries. There may be long-term positive responses by Sheephead populations migrating into warm water regimes, as their northern range to Monterey Bay is likely a relatively modern phenomenon as increasing warming events may increase the range of larval dispersal and survivorship (Cowen 1986; Braje et al. 2017). With increasing climatic events the Sheephead's range may continue to expand or the center of the population in southern California may shift northward.

2 The Fishery

2.1 Location of the Fishery

Sheephead are fished primarily south of Point Conception (Santa Barbara County) in nearshore waters around the offshore islands and along the mainland shore over reefs and in kelp with over 95% of the landings occurring in this area (Figure 2-1). Landings of Sheephead occur north of Point Conception where they are bycatch in the nearshore fishery, with two-thirds of the landings being 10 lb (4.5 kg) or less.

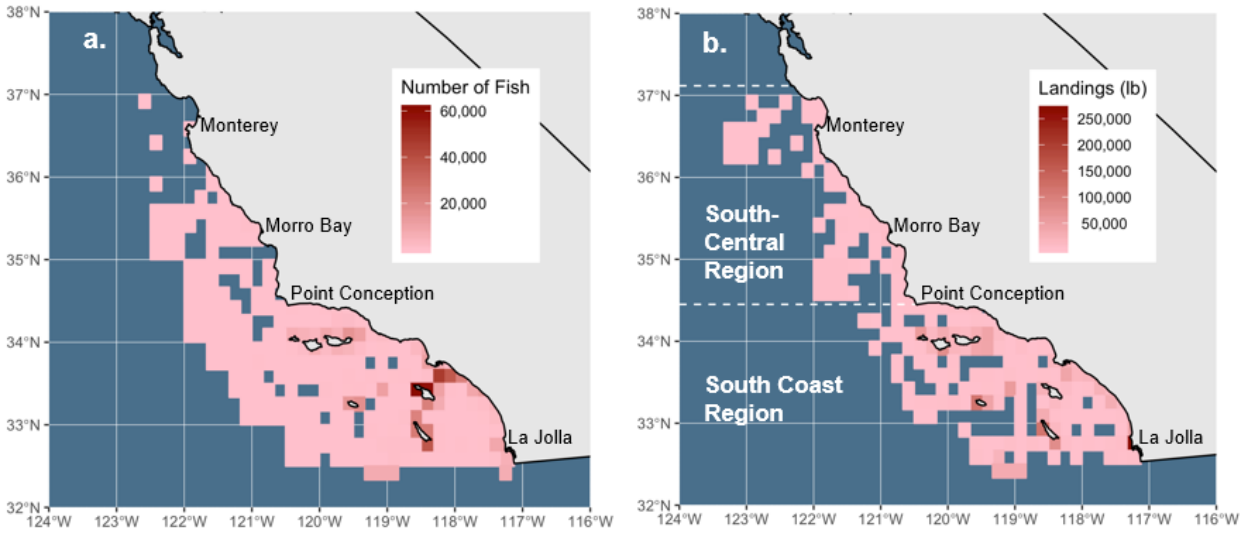

Figure 2-1. Maps showing location of a) recreational Sheephead catch and b) commercial Sheephead landings, 1999 to 2017. The commercial graph also shows the NFP regions where Sheephead occur (Commercial Passenger Fishing Vessel (CPFV) Logs and CDFW Marine Landings Database System (MLDS)).

2.2 Fishing Effort

2.2.1 Number of Vessels and Participants Over Time

In 1996, due to concerns about the growing live fish trap fishery in southern California, the Legislature established a nontransferable Finfish Trap Permit for the take of finfish south of Point Arguello (Santa Barbara County). In 1996, 288 Finfish Trap Permits were sold.

Concerns about the coast-wide growing live fish fishery led to the Nearshore Fisheries Management Act (NFMA) of 1998 (FGC §8585 et. seq.) that was part of the MLMA (FGC §7055 et. seq.). The NFMA established the Nearshore Fishery Permit (NFP) for the take of Cabezon, Sheephead, California Scorpionfish, Greenlings (*Hexagrammos* spp.), and Black-and-Yellow (*Sebastes chrysomelas*), China (*Sebastes nebulosus*), Gopher (*Sebastes carnatus*), Grass (*Sebastes rastrelliger*) and Kelp (*Sebastes atrovirens*) Rockfishes, with 1,127 permits issued in 1999. Additionally, 158 Finfish Trap Permits were sold in 1999 (CDFW).

In 2000, the Commission adopted an annual permit renewal requirement capping participation at 1,007 NFPs statewide (146 Finfish Trap Permits) (CDFW). Then in 2001 the Commission adopted a minimum landings requirement of 100 lb (45 kg) from 1994 to 1999, reducing the number of NFPs to 746 (123 Finfish trap permits) (CDFW).

Finally in 2003, the Commission adopted a restricted access program that capped the number of NFPs at 220 coast wide and made them regional, with 75 and 77 NFPs in the South-Central Coast and South Coast Regions, respectively (CDFW). Approximately 97% of Sheephead are caught in the South Coast Region, with the remainder coming from the South-Central Coast Region where they are caught incidentally. A nearshore trap endorsement was established as part of the restricted access program in 2003, and as a result the Finfish Trap Permit was no longer required (§150.03, Title 14, CCR). Since 2003, the number of NFPs has declined to 141 statewide in 2018, with 51 in the South-Central and 50 in the South Coast Regions. The decline in permits is primarily due to a two-for-one permit transfer system that changed to one-for-one or to nonrenewal on April 1, 2018 (§150, Title 14, CCR).

The live fish fishery began around 1987 (McKee 1993) and as it grew, so did the number of Sheephead fishers, peaking at 455 in 1996 (Figure 2-2). The number of participants dropped to less than 100 after the restricted access program was established in 2003, and has averaged 60 participants since 2010 (CDFW). Approximately half the South Coast Region NFP holders target Sheephead, accounting for 95% of the landings.

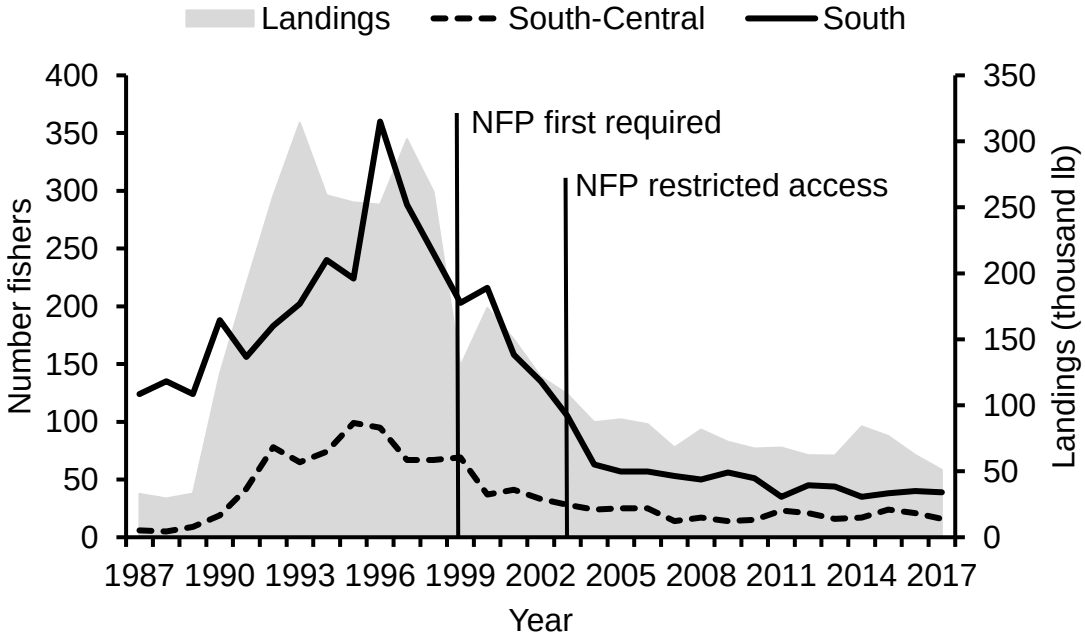

Figure 2-2. Number of fishers by region (left axis: lines) and total landings (right axis: bars) in the commercial Sheephead fishery, 1987 to 2017 (CDFW MLDS).

Vessels in the commercial Sheephead fishery vary from small kayaks and skiffs to trap vessels capable of fishing out at the offshore islands. Vessel size ranges from 13

to 56 ft (4 to 17 m), according to Department vessel license records (note that vessels without engines (e.g., kayaks) are not licensed). Larger vessels have one or more live wells onboard with recirculating sea water to keep the fish alive. Smaller vessels may have a live well, although many just have a basket or trap hung over the side to keep the fish alive.

2.2.2 Type, Amount, and Selectivity of Gear

NFP holders targeting Sheephead can use hook and line gear, including: rod and reel, set longline, stick gear, as well as dip net gear, which is usually used while diving. Fishers targeting nearshore species using hook and line gear are limited to 150 hooks with no more than 15 hooks per line when operating within 1 mi (1.6 km) of the mainland shore (§150.17, Title 14, CCR). Stick gear is a popular gear that uses a piece of rebar for weight and has a groundline attached to the rebar with one-hook gangions attached to the ground line (Figure 2-3), and it is buoyed at one or both ends. Fishers tend to put out several pieces of stick gear, and closely tend their gear, checking the lines for fish every few hours.

Figure 2-3. Image of stick gear with four hooks attached to a ground line along a piece of rebar with buoy attached used in the Sheephead fishery. (Photo credit: CDFW).

NFP holders with a nearshore trap endorsement can also use trap gear to take Sheephead and other NFP species. Fishers targeting Sheephead or other nearshore species are limited to 50 traps within state waters or 3.0 mi (5 km) along the mainland shore. Additionally, finfish traps have a minimum mesh size of 2.0 by 2.0 in (5 by 5 cm) and can only be fished during daylight hours (FGC §9001.7).

The preferred bait type in Sheephead traps is: crustaceans (rock crabs (*Cancer* spp.) or spider crabs (*Loxorhynchus* spp.)) or mollusks (mussels (*Mytilus* spp.)) or Market squid (*Doryteuthis opalescens*) (McKee 1993). Live fish trap fishers are not allowed to use Spiny Lobster (*Panulirus interruptus*) or Dungeness crab (*Cancer magister*) as bait, and the use of rock crabs requires the fisher have a rock crab permit (FGC §9001.7). Fishers using trap gear also tend to closely monitor their gear, checking traps every few hours. The reason for closely monitoring their gear, be it stick gear or

traps, is to ensure healthy, live fish for market; the longer fish are hooked or captured in traps the more stressed they become and the more likely that predators can harm the fish.

Before the advent of the live fish fishery in the late 1980s, Sheephead were caught primarily with gill net gear. As the demand for live fish increased, fishers switched to trap and hook and line gear (Figure 2-4). The Marine Resources Protection Act of 1990 prohibited the use of gill net gear in waters less than 70 fathoms (fm) (128 m) or 1.0 mi (1.6 km) around the Channel Islands and within 3 nautical miles (8 km) of the mainland shore from Point Arguello to the U.S. and Mexico border (FGC §8610.2), phasing in these restrictions between 1991 and 1994. This pushed gill net gear into deeper waters resulting in the decline in the use of gill nets to take Sheephead. The restricted access program began in 2003, which further limited gear to trap, hook and line and dip net, used while diving (§150 and 150.03, Title 14, CCR). Since 2003, 82% of the Sheephead were caught with traps, 17% with hook and line gear, and 1% with dip nets. Less than 1% were caught with gill net or trawl gear by those with a Nearshore Fishery Bycatch Permit (NFBP), which allows small amounts of incidentally caught NFP species with trawl or gill net gear (§150.05, Title 14, CCR). NFBP holders are limited to 25 or 50 lb (11 or 23 kg) per day of nearshore species, including Sheephead, in the South-Central and South Coast Regions, respectively, in addition to state and federal bimonthly trip limits.

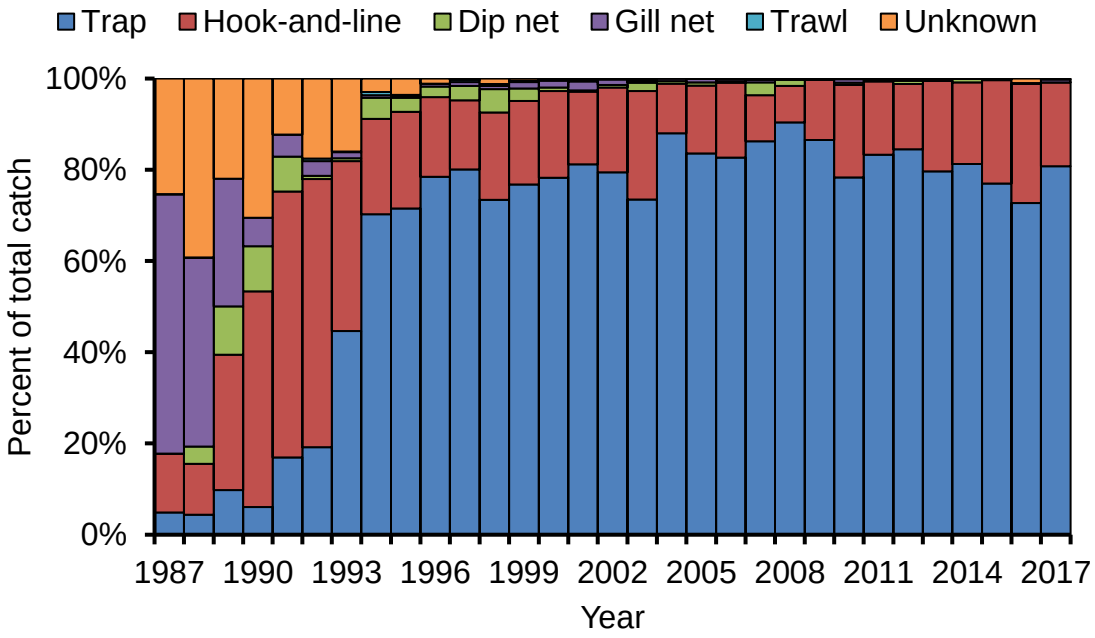

Figure 2-4. Proportion of commercial Sheephead landings by gear type, 1987 to 2017 (CDFW MLDS).

There have been two commercial sampling programs collecting information on Sheephead. The first is a Department sampling program from 1993 through 2005 that collected biological data (e.g., length, weight, sex, maturity and otoliths) for several species, including Sheephead. The second is a Pacific States Marine Fisheries

Commission (PSMFC) commercial sampling program from 1980 to present collecting biological data (e.g., length, weight, sex, maturity and otoliths) for groundfish (primary focus) and Sheephead (California Cooperative Commercial Groundfish Survey Sampling Manual). It should be noted that weight data for line-caught Sheephead was sparse in the Department dataset (n=5) and nonexistent in the PSMFC data set; therefore, it was not used in any analyses. Analysis of weight and length frequencies from both sampling programs reveals that the majority of Sheephead in the commercial trap fishery were from 1.0 to 2.0 lb (0.5 to 1.0 kg) and from 13 to 16 in (33 to 41 cm) Total Length (TL) (Figure 2-5 and 2-6). Sheephead caught in fish traps have a fairly narrow size range because fish traps have semi-rigid entrance funnels that limit the maximum size of fish that can swim into the traps, and escape ports that allow smaller fish to escape. However, hook and line gear are less selective, as seen in the much wider distribution of lengths of fish sampled in both commercial sampling programs (Figure 2-6). In 1999 the minimum size limit was 12 in (31 cm) TL (FGC §8588), which was changed in 2000, to 13 in (33 cm) TL where it remains (§150.16, Title 14, CCR). While the length frequency graph (Figure 2-4) shows many fish below the minimum length threshold, most of these fish were caught prior to 1999 before size limitation regulations existed.

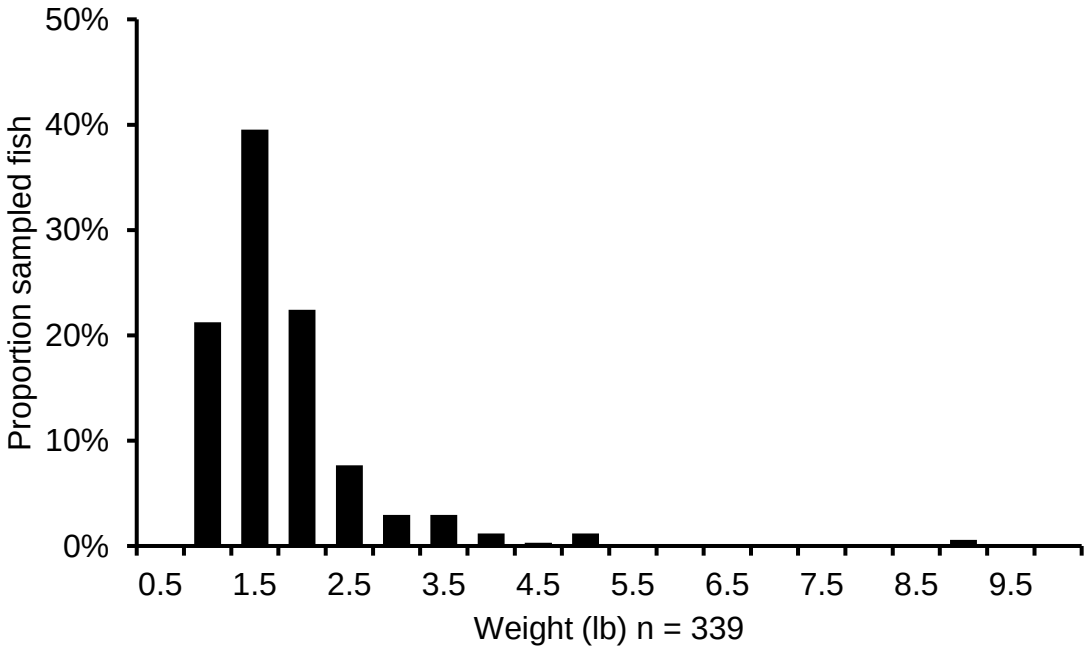

Figure 2-5. Commercial Sheephead weight-frequency for trap gear, 1993 to 2005 (CDFW port sampling program).

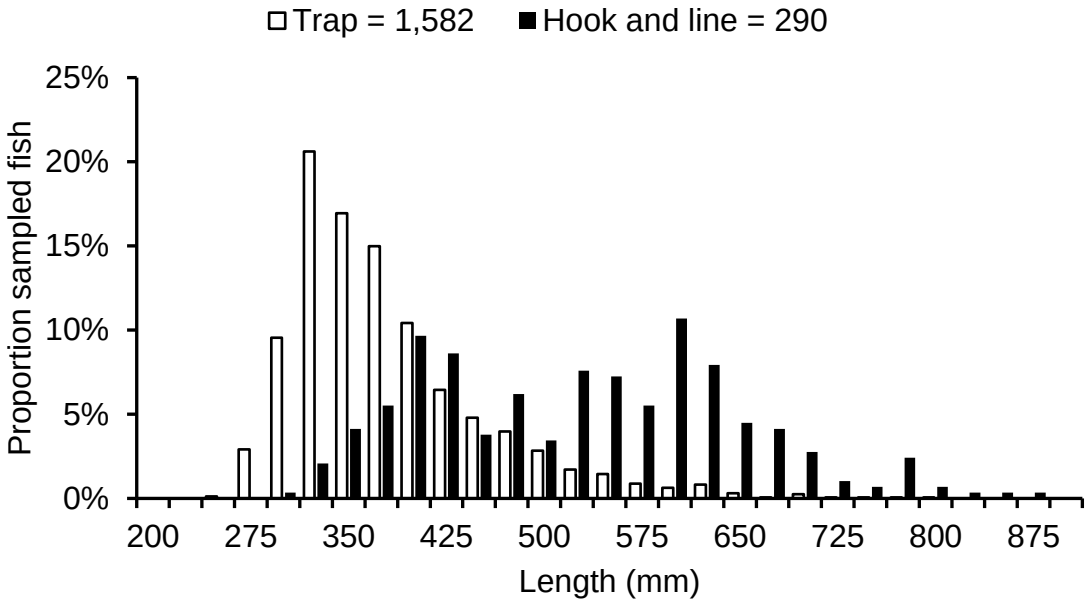

Figure 2-6. Commercial Sheephead length frequencies for trap versus line gear, 1993 to 2017 (CDFW port sampling program and PSMFC sampling program).

2.3 Landings in the Recreational and Commercial Sectors

2.3.1 Recreational

Recreational anglers catch Sheephead by hook and line and spearfishing. Catch data for the recreational fishery are provided by three sources: (1) the Marine Recreational Fisheries Statistical Survey (MRFSS) estimates for 1980 to 2003, (2) California Recreational Fisheries Survey (CRFS) estimates for 2005 to 2017 from the RecFIN website, and (3) CPFV logbooks within the Department's Marine Logs System database (MLS). Estimates from MRFSS and CRFS are not directly comparable due to differences in methodology, and are discussed separately (See section 4.2.1 for more details on these datasets).

From 1980 to 2003, recreational Sheephead catch was variable ranging from just over 100,000 lb (45,400 kg) in 1995 to almost 500,000 lb (226,800 kg) in 1986, averaging 230,000 lb (104,300 kg) annually (RecFIN) (Figure 2-7). Overall, catches were higher in the 1980s compared to later years. The majority (97%) of Sheephead were caught from vessels (private/rental boats and Commercial Passenger Fishing Vessel (CPFVs) (Figure 2-7). Private and rental boats account for over 60% of the vessel-based Sheephead catch, with CPFVs accounting for the remainder.

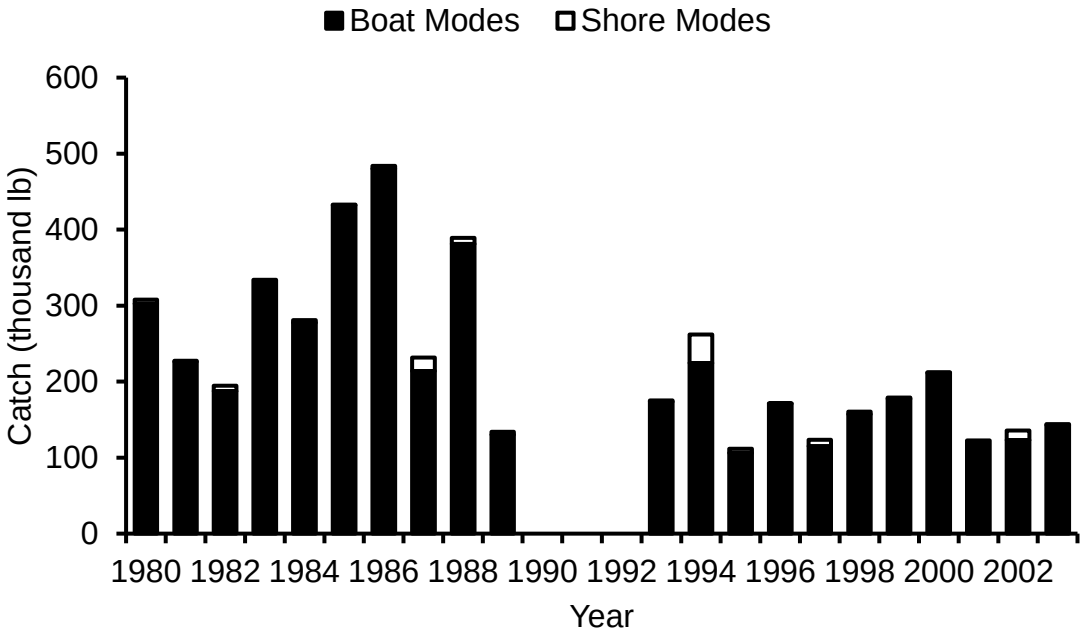

Figure 2-7. Recreational Sheephead catch, 1980 to 2003 (RecFIN).

From 2005 to 2017, recreational Sheephead catch was variable, with a slightly increasing trend (RecFIN) (Figure 2-8). The majority of Sheephead catch (average 89% annually) was taken in the boat modes (private/rental and CPFV), with smaller amounts taken in the shore modes (beach/bank and man-made) (Figure 2-8). The catch from private/rental and CPFVs was evenly split.

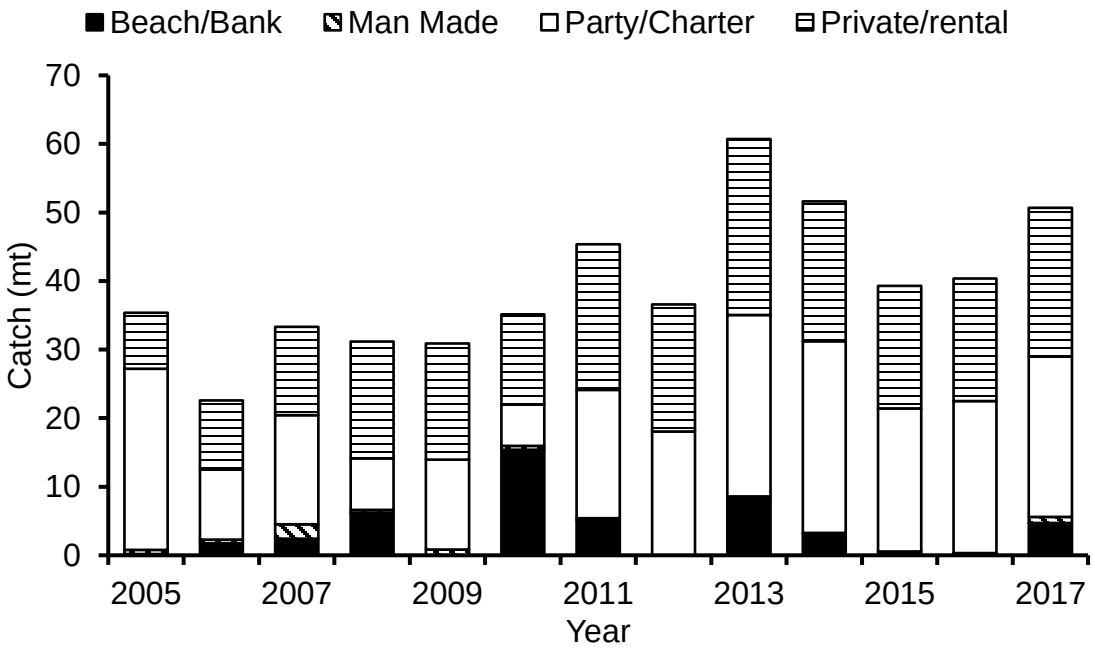

Figure 2-8. Recreational Sheephead catch in metric tons, 2005 to 2017 (RecFIN).

Looking at just CPFV landings through time, the fishery began to take off in popularity in the late 1960s and peaked in 1983 at just under 70,000 Sheephead landed (Figure 2-9). After dropping in the late 1980s to under 40,000 Sheephead, CPFV landings have fluctuated around 20,000 to 40,000 Sheephead landed each year.

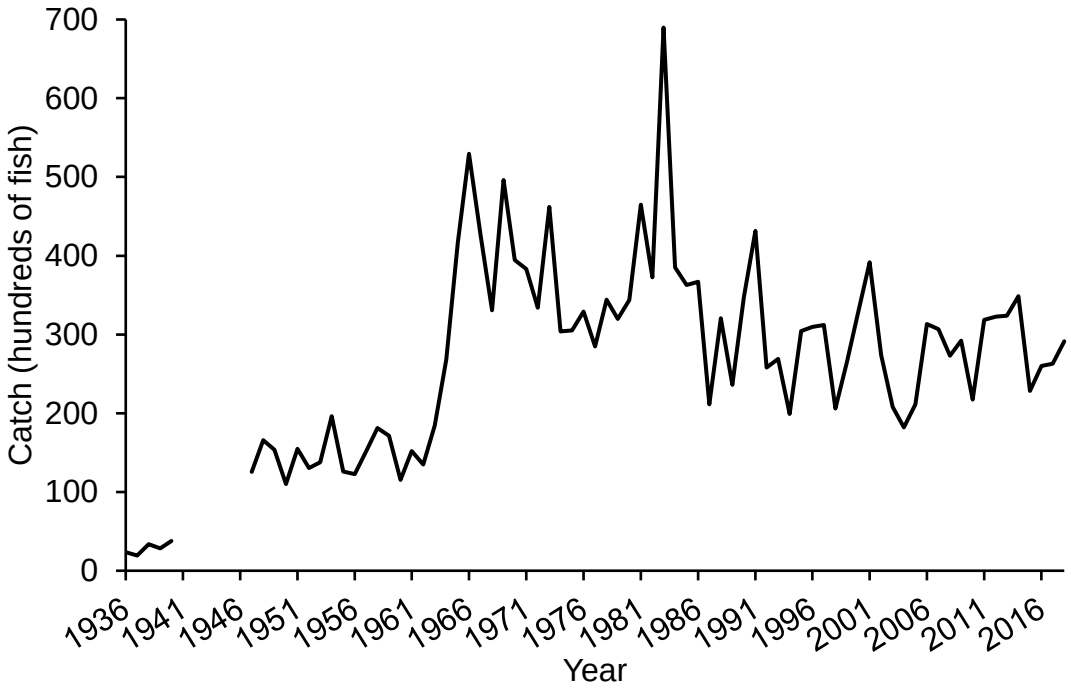

Figure 2-9. Historical (Hill and Schneider 1999; no data collected from 1941 to 1945) and current (CDFW MLS) recreational landings of California Sheephead in hundreds of fish kept off CPFVs from 1936 to 2018.

Two-thirds of recreational anglers caught Sheephead while targeting “bottomfish” which includes rockfish (Figure 2-10); the CRFS survey does not have a Sheephead target species category. Sheephead are managed in concert with Rockfish, Cabezon and Greenlings, (RCG) having the same season and depth restrictions since 2004 (§28.26, Title 14, CCR). Ranking of Sheephead catch has fluctuated from 2005 to 2017 (Figure 2-11). It can be seen that Sheephead landings rank higher when solely looking at catch from private/rental boats, as that is where the majority of their landings come from. Private/rental Sheephead rankings have climbed since ranking 21st in 2005 to a high of 6th in 2011, and have remained fairly steady from 2012 to 2017 at an average of 10th.

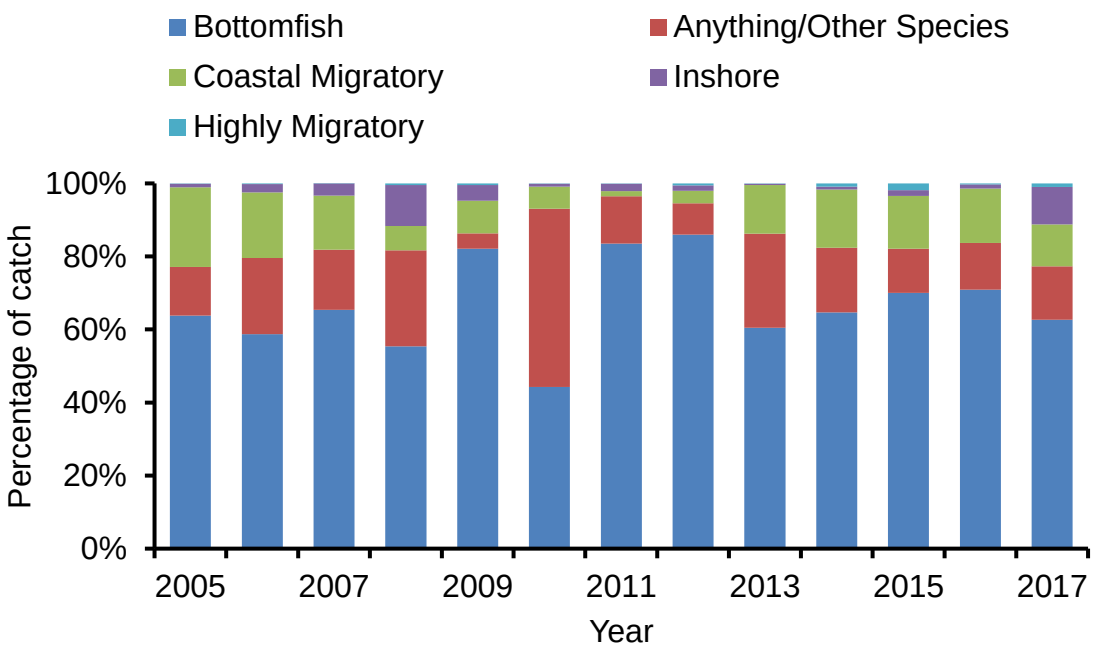

Figure 2-10. Recreational Sheephead catch by target species group, 2005 to 2017 (RecFIN).

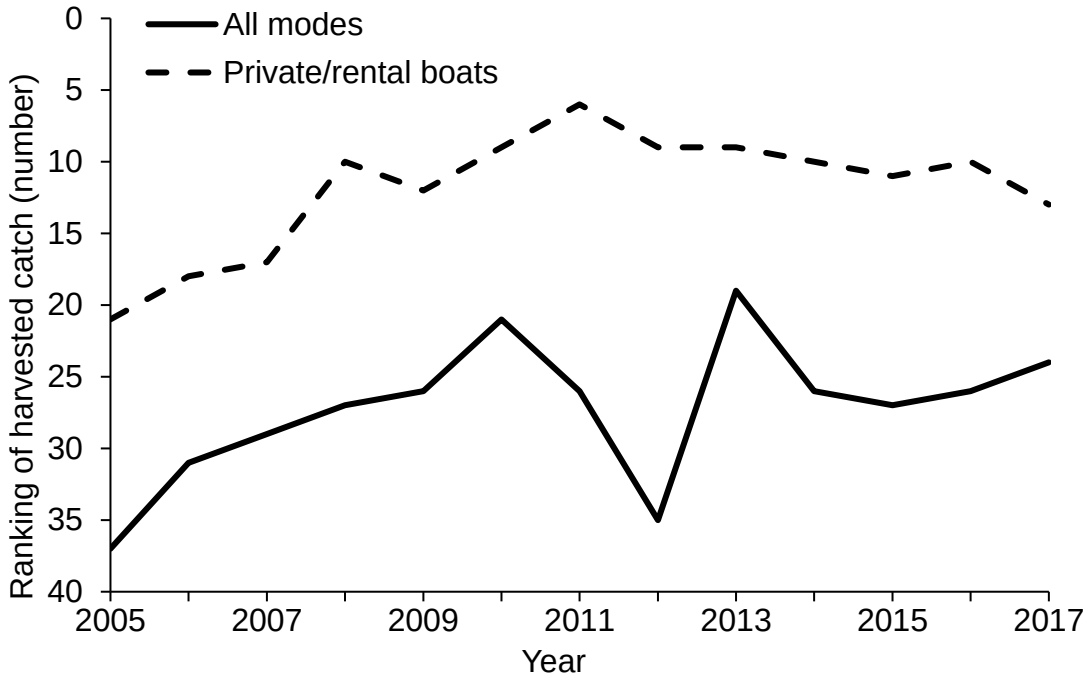

Figure 2-11 Ranking of California Sheephead relative to other finfish species in southern California from 2005 to 2017 based on RecFIN estimates of retained catch. Solid line represents rankings for all fishing modes, dashed line represents rankings for private/rental boats only (RecFIN).

2.3.2 Commercial

In the late 1800s, Chinese fishers took large quantities of Sheephead for drying and salting (Stephens 2001). The largest commercial catches of Sheephead were from 1927 to 1931, peaking in 1928 at more than 370,000 lb (168,000 kg). During and shortly after World War II (1943 to 1948), the Sheephead catch increased from 50,000 to 267,000 lb (23,000 to 121,000 kg) (Figure 2-12). Since the post-war peak, Sheephead landings were quite low throughout the 1970s, gradually increasing in the 1980s (Figure 2-12).

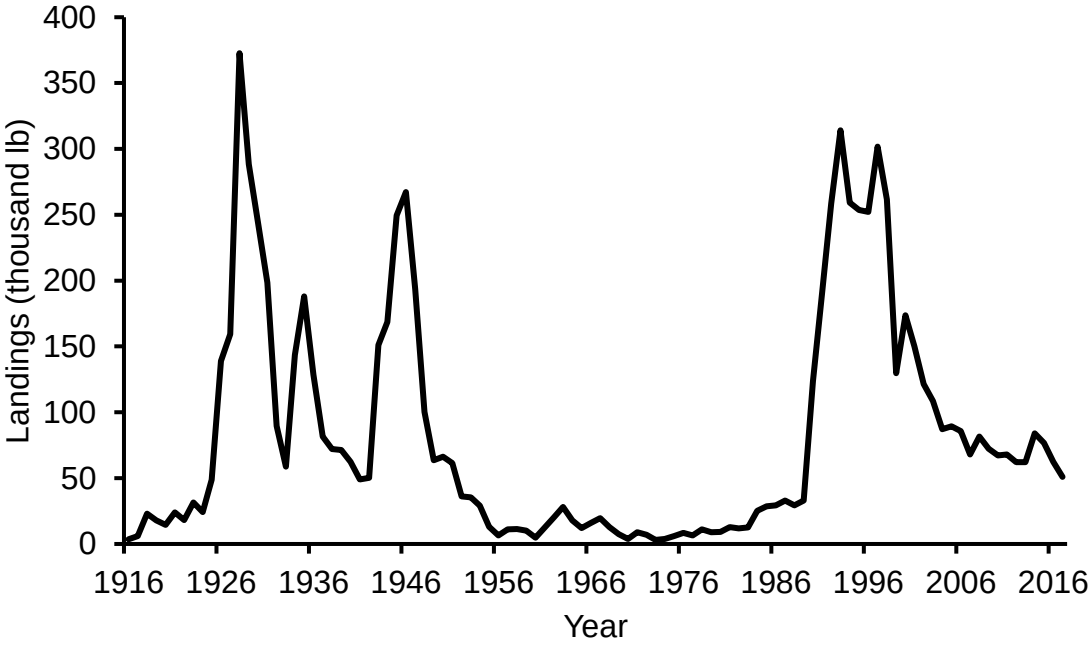

Figure 2-12. Commercial Sheephead landings, 1916 to 2017 (CDFG Fish Bulletins and MLDS).

The live fish fishery began in 1988 to supply fish mainly to California's Asian communities (McKee 1995). Live fish species including Sheephead, nearshore rockfishes (*Sebastes* spp.), California scorpionfish (*Scorpaena guttata*), Lingcod (*Ophidion elongatus*) and Cabezon (*Scorpaenichthys marmoratus*) are popular as they can withstand the rigors of capture and transport (McKee 1993). Due to its distribution, Sheephead are caught primarily south of Point Conception in the nearshore fishery's South Coast Region (ranges from Point Conception to the U.S. and Mexico border) (Figure 2-13 and 2-14). Incidental Sheephead landings occur above Point Conception to just north on Monterey Bay in the South-Central Coast Region (ranges from Point Año Nuevo (San Mateo County) to Point Conception) (Figure 2-13 and 2-14).

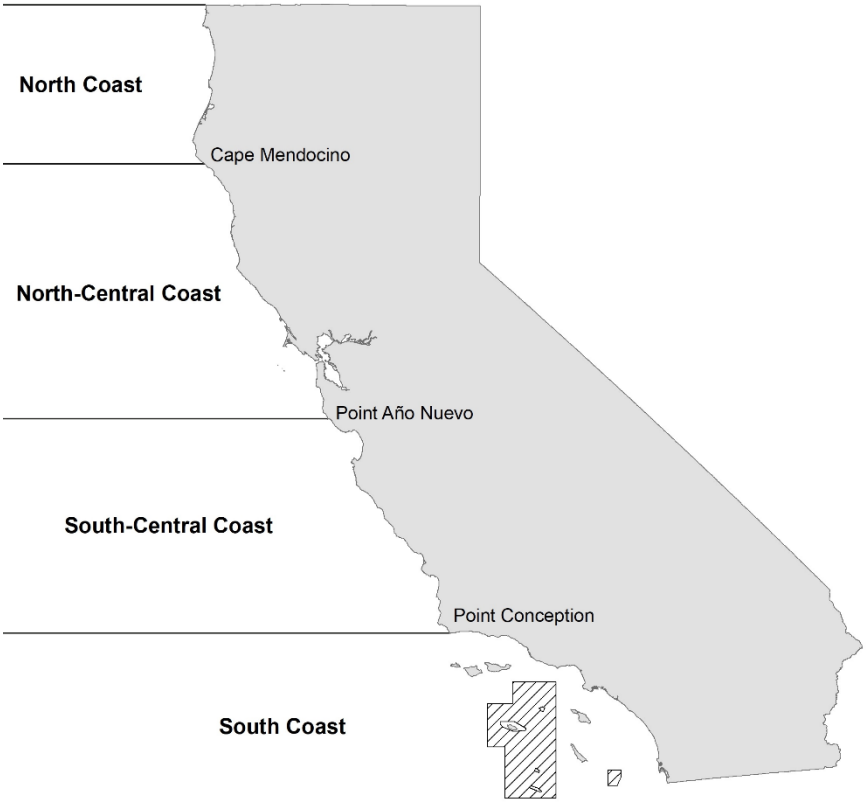

Figure 2-13. California's Nearshore Fishery Permit regions with Cowcod Conservation Areas (boxes with diagonal lines). (CDFW).

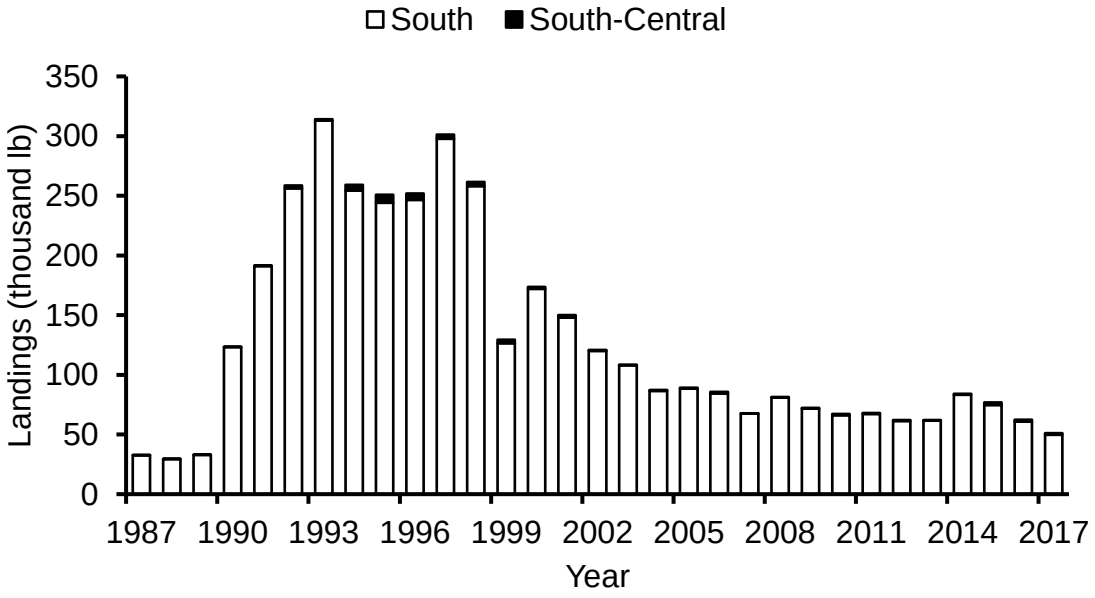

Figure 2-14. Commercial Sheephead landings by region, 1987 to 2017 (CDFW MLDS).

As the live fishery developed, Sheephead landings rose quickly peaking in 1993 at 314,000 (143,000 kg), with a maximum ex-vessel value of $835,000 in 1997, before decreasing (Figure 2-15). The advent of the Nearshore Fishery Permit NFP, first required in 1999 (FGC §8587), limited the number of participants and contributed to the decline in landings. The establishment of the nearshore restricted access program in 2003 further limited participation in this fishery (§150, Title 14, CCR) (see section 3.1 for more information on the NFP and the restricted access program).

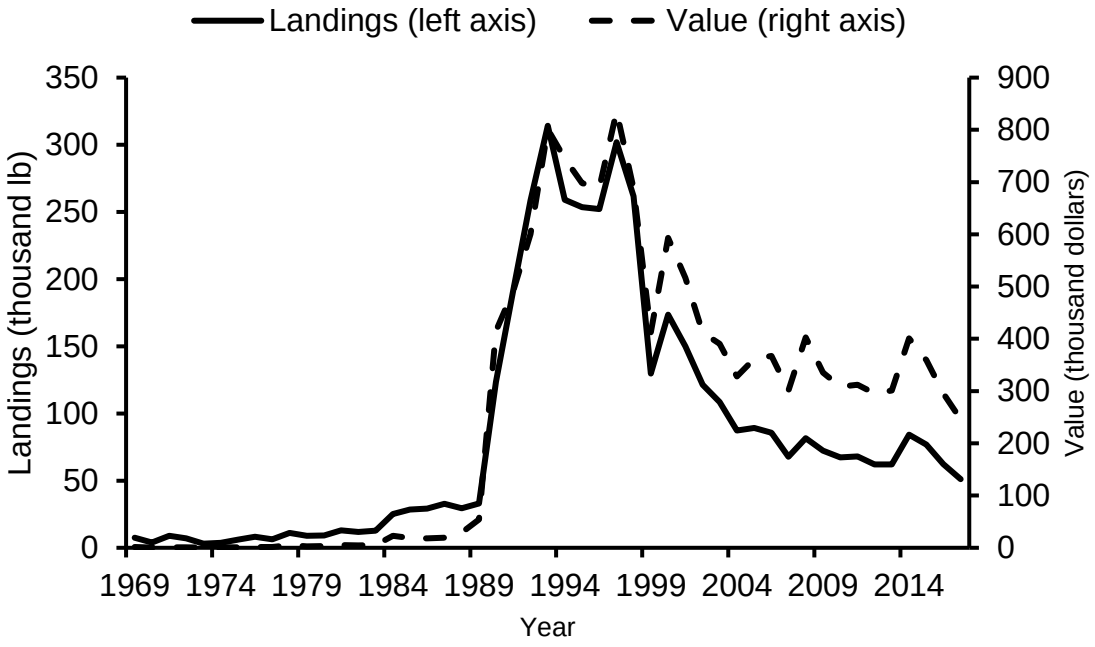

Figure 2-15. Commercial Sheephead landings and value, 1969 to 2017 (CDFG Fish Bulletins and MLDS).

While the live fish fishery began in the late 1980s, the Department did not begin capturing information on the landing receipts about whether the fish were landed live until 1994. In 1994, live Sheephead landings accounted for 78% of the total, increasing to 88% by 1997, and to more than 90% by 1990 (Figure 2-16). Since 2003, at least 98% of the Sheephead landings have been live fish.

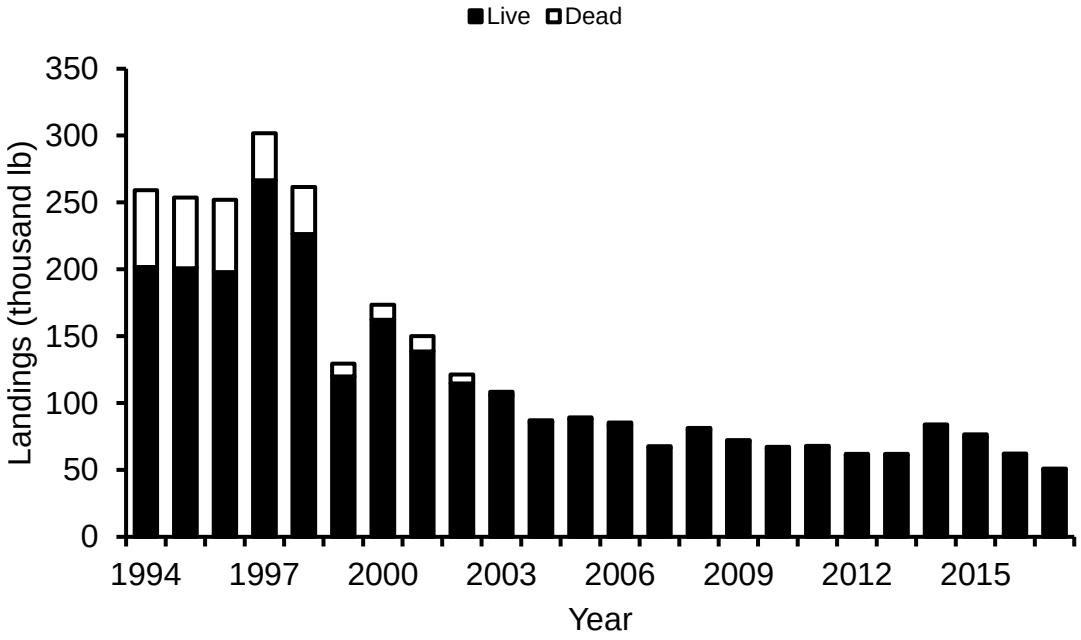

Figure 2-16. Commercial Sheephead landings, live versus dead, 1994 to 2017 (CDFW MLDS).

2.4 Social and Economic Factors Related to the Fishery

California's live fish fishery began in the mid-1980s in the port of Morro Bay area, which includes Port San Luis, and later spread north and south (CDFG 2002). The live fish fishery quickly spread to the Los Angeles and Morro Bay port complexes, and expanded out from there. Live fish fishers in the Los Angeles and San Diego port complexes targeted Sheephead, California Scorpionfish, and a few nearshore rockfish species, while in the Morro Bay port complex targeted Cabezon, Greenlings and some nearshore rockfish species. Both Sheephead and Scorpionfish are hardy and they can survive the transfer and storage process well. While live fish fishers continue to target Sheephead, Scorpionfish and nearshore rockfishes, Sheephead is the species with the highest landings south of Point Conception.

Sheephead are landed primarily in the ports of Santa Barbara/Ventura, San Diego, and Los Angeles/Orange counties (Figure 2-17). In the Morro Bay port area, only small amounts (1%) of Sheephead are caught incidental to other live fish activity. Sheephead and other live species landed in Morro Bay port area are destined for restaurants in the San Francisco Bay area. Live fish, including Sheephead, landed in the South Coast Region are sold to restaurants in local Asian communities.

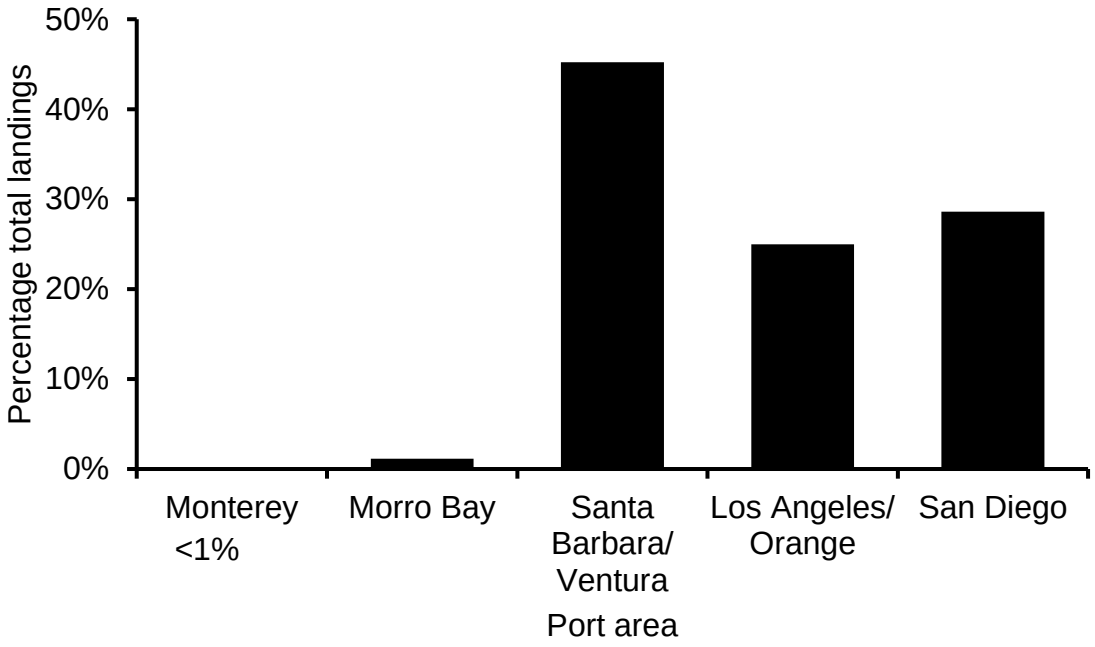

Figure 2-17. Commercial Sheephead landings by port area, 1980 to 2017 (CDFW MLDS).

A premium has always been paid for live fish, including Sheephead, and has increased over time. In 1994 the most common price paid for live fish was $2.00 per pound, twice the price of fresh (dead) fish (Figure 2-18) (CDFW). The price for live Sheephead was the same in both the South-Central (Monterey and Morro Bay port complexes) and South Coast (Santa Barbara/Ventura, Los Angeles/Orange, and San Diego port complexes) regions until 2002 when the price jumped to $4.00 per pound in the South Coast Region, while it remained at $2.50 in the South-Central Coast Region (CDFW). Over time the ex-vessel price offered for live Sheephead continued to increase, with fishers in the South Coast Region given a higher price per pound (Figure 2-18). In 2017, the most common ex-vessel price for live Sheephead was $3.50 per pound in the South-Central Coast Region and $5.50 in the South Coast Region (CDFW). While the price paid for live Sheephead has increased over time, the price paid for fresh fish has risen more slowly going from $1.00 per pound in 1994 to $1.75 in 2017 in the South Coast Region. In the South-Central Coast Region, the price paid for fresh fish is also lower, and in some years they had no value (2007, 2008, 2013 through 2017) (Figure 2-18). Note that Sheephead landings of no value were very small, less than 20 lb (9 kg) per year from 2013 to 2017 and were likely taken home for personal use.

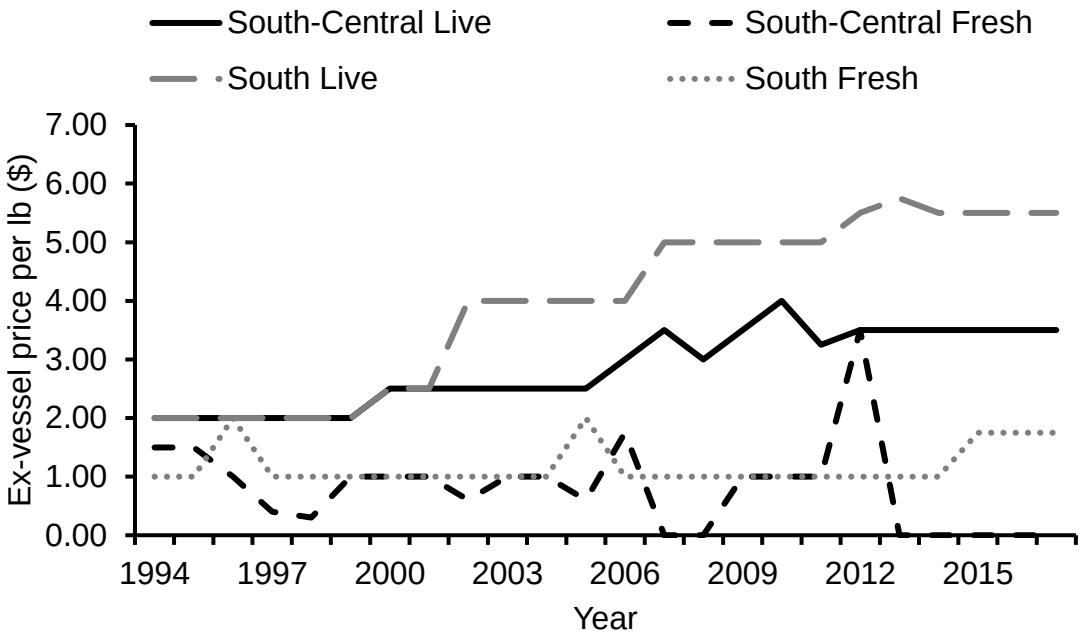

Figure 2-18. Most common ex-vessel price paid for live and fresh (dead) Sheephead in the South-Central and South Coast Regions, 1994 to 2017 (CDFW MLDS).

Marine recreational fishing in general supports the economy through the contributions of various local businesses and other indirect, fishing related expenditures. The total economic contribution generated for California in 2011 was roughly $2.8 billion and 10,000 jobs (Lovell et al. 2013). An official socioeconomic analysis has never been completed for Sheephead; however, recreational fishing is a popular pastime that spans generations and Sheephead are one of the most popular sport fish in southern California, especially for anglers fishing off private/rental boats. Sheephead has fluctuated around the top ten species caught on private/rental boats since 2011 (Figure 2-11). The distribution of landings can provide information on which areas in California are most likely to benefit. In 2017, all of the Sheephead catch from CPFVs was landed in southern California, with the majority, 48%, from Los Angeles County (Figure 2-19).

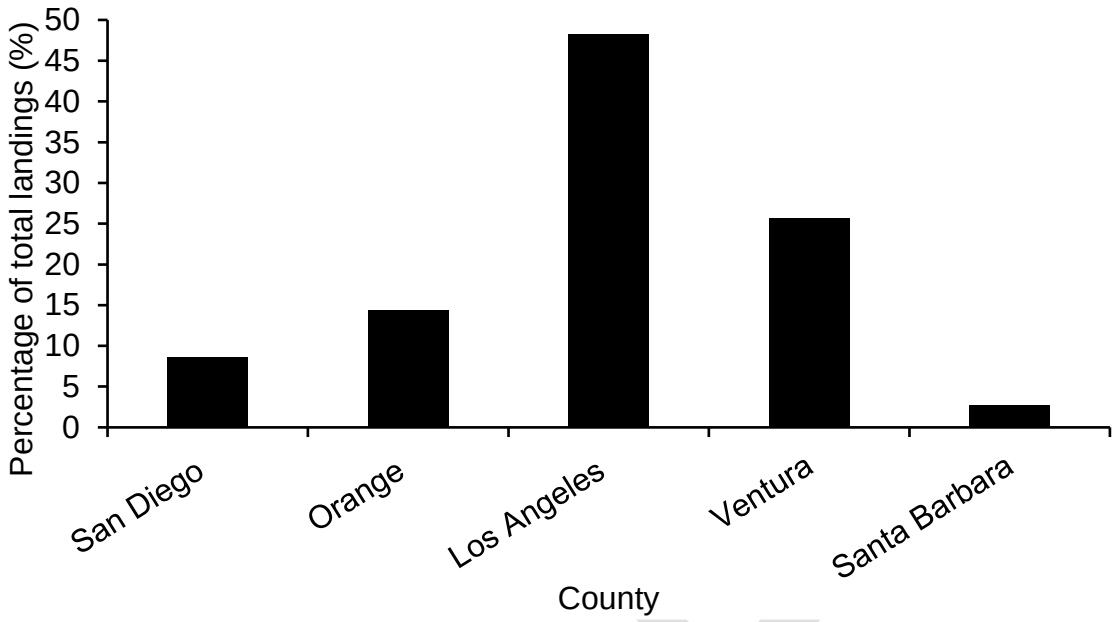

Figure 2-19. Percentage of total Sheephead landed on CPFVs by county in 2017 (CDFW MLS).

3 Management

3.1 Past and Current Management Measures

Prior to 1999, all that was required to fish commercially for Sheephead was a commercial fishing license, and if using trap gear, a general trap permit. In 1996, a nontransferable Finfish Trap Permit was established for the take of finfish south of Point Arguello (Santa Barbara County). The permit was accompanied by a trap limit of 50 traps within state waters along the mainland shore, regulations limiting fishing to daylight hours, and creation of a minimum mesh size of 2 by 2 in (5 by 5 cm) (FGC §9001.5, §9001.7). In 1996, 288 Finfish Trap Permits were sold.

In 1998, the legislature enacted both the NFMA and MLMA. The MLMA delegated more responsibility to the Commission and the Department for ocean fisheries management and established sustainability as the primary goal. The MLMA also recognized the economic and cultural importance of recreational and commercial fisheries, emphasized constituent involvement, required use of the best available science, and advocated for management via fishery management plans (FGC §7055 et. seq.). In addition, the MLMA specifically mandated development of a fishery management plan by 2001 for the evolving and expanding nearshore fishery. The NFMA identified ten nearshore species (Sheephead, California Scorpionfish, Cabezon, Greenlings (Kelp and Rock), and Black-and-Yellow, China, Gopher, Grass and Kelp Rockfishes) that required an NFP for commercial take of nearshore species. It also granted the Commission the authority to regulate nearshore fish stocks and fisheries, set minimum size limits for nearshore species, and identified funding for developing the Nearshore Fisheries Management Plan (NFMP) (FGC §8585 et. seq).

Initially, the NFP was a statewide, nonrestrictive permit (no annual renewal requirement) with no gear limitations, although a Finfish Trap Permit was still required in southern California. In 2000, the Commission adopted interim regulations for the NFP, changing it to a restrictive permit (annual renewal required), and added a moratorium on new permits along with a control date (December 31, 1999) for a future restricted access program (Wilson-Vandenberg et al. 2014). In 2001, the Commission added a landing requirement of 100 lb (45 kg) from January 1,1994 to December 31,1999 and set a control date (October 20, 2000) for future gear endorsements that reduced the number of permits issued from 1,127 in 1999 to 505 in 2002 (Wilson-Vandenberg et al. 2014). Along with the decline in NFPs, the number of Finfish Trap Permits reduced from 158 in 1999 to 112 in 2002.

In 2002, the Commission adopted the NFMP for 19 species, including Sheephead (Wilson-Vandenberg et al. 2014). The NFMP contains five main management measures to sustainably manage the nearshore fishery, which are: (1) fishery control rules, (2) regional management, (3) allocation, (4) restricted access, and (5) MPAs. The NFMP also includes sections on research needs, species life histories, history of the fisheries, and implementation of the NFMP (Wilson-Vandenberg et al. 2014).

In 2003, the Commission adopted a regional restricted access program for the NFP species in accordance with the Commission's policy on restricted access commercial fisheries (Commission 1999). The permits were established in accordance

with the regional approach taken by the Commission when the NFMP was adopted. Regional management grew out of concern that some species could be subject localized depletion if catch was concentrated in a few areas (Wilson-Vandenberg et al. 2014). The NFP restricted access program was considered a first step in developing regional management for the nearshore fishery, while the Commission and the Department worked toward being able to manage all aspects of the nearshore fishery on a regional basis. While not all Sheephead management is regional in nature, (e.g., Total Allowable Catch (TACs), and bag and trip limits are statewide), regional monitoring (recreational and commercial) and the Sheephead stock assessment both take a regional approach (Wilson-Vandenberg et al. 2014).

Part of the nearshore restricted access program included a regional nearshore trap endorsement, and exemption from the Finfish Trap Permit requirement. In 2003, 46 South Coast nearshore trap endorsements and 24 South-Central nearshore trap endorsements were issued. The Legislature repealed the Finfish Trap Permit in 2004, but kept the regulations pertaining to number of traps, minimum mesh size, and fishing hours in place. Over time that has been reduced to 33 and 19 nearshore trap endorsements in 2018, respectively (Table 3-1).

Table 3-1. Number of permits used to take California Sheephead at key management points (CDFW License Statistics).

Key Point	Permit	1996	1999	2003	2018
Finfish Trap Permit established					
	Finfish Trap Permit	288	158	--	--
Statewide Nearshore Fishery Permit established					
	NFP (statewide)	--	1164	220	141
Nearshore Restricted Access Program established; Finfish Trap Permit no longer required.					
	South-Central NFP	--	--	75	51
	South-Central Trap	--	--	24	19
	South NFP	--	--	77	50
	South Trap	--	--	46	33
	NFBP	--	--	26	10

There are four different regions with separate NFPs and capacity goals, and fishermen can only fish in the region listed on their NFP (Figure 2-12). Additionally, permits can only transfer within the region they are assigned. Originally, two NFPs were required for transfer into the fishery, but the Commission reduced that to just one in 2018 due to difficulties in finding two permits and the overall reduction in permits since 2003 (§150, Title 14, CCR). The capacity goal for transferable NFPs in each region is 14, nine, 20 and 18 for the North Coast, North-Central Coast, South-Central Coast and South Coast regions, respectively. The capacity goal for nontransferable NFPs is zero.

An NFBP was adopted at the same time (2003) as the nearshore restricted access program, for the incidental take of the ten shallow nearshore species with trawl or gill net gear only (§150.05, Title 14, CCR). The purpose of this permit was to allow fishermen who had been using these gear types to continue to take nearshore species while phasing out the use of these gears. There were concerns that both trawl and gill

net were non-selective gear that could take large portions of the TAC, which is the amount of fish that can be sustainably harvested in a year, and that the fish would be landed dead. Since the TAC for these species was quite low in 2003, one of the objectives of the nearshore restricted access program was to preserve the live fish component of the fishery, which offered a much higher ex-vessel price per pound. To ensure that NFBP holders did not target nearshore species, the Commission adopted daily trip limits in addition to the state and federal bimonthly trip limits already established. In 2003, 97 individuals qualified for a NFBP but only 26 permits were issued. By 2018, the number of NFBPs was reduced 60% to just ten permits (Table 3-1). NFMP holders account for less than 1% of the total shallow nearshore species landings each year.

3.1.1 Overview and Rationale for the Current Management Framework

The NFMP species are managed both at both state and federal levels (Commission and PFMC, respectively). Sheephead is one of three species in the NFMP that is solely state managed; (Rock Greenling (*Hexagrammos lagocephalus*) and Monkeyface Prickleback (*Cebidichthys violaceus*) are the other two). The remaining 16 species are all managed by the PFMC as part of the federal Pacific Coast Groundfish FMP, although Cabezon and Kelp Greenling are not actively managed. This led to the Commission adopting regulations for Cabezon, Sheephead and Greenlings (CGS) in 2001, and aligning recreational and commercial Sheephead regulations with federal nearshore rockfishes in 2002 (Alonzo et al. 2004). Aligning CGS with federal rockfish seasons prevents bycatch that could occur when CGS is open and nearshore rockfish is closed, or vice versa. Today the 19 NFMP species are effectively co-managed by the Commission and PFMC with the Department providing recommendations on setting state and federal harvest limits (e.g., TACs (state) and annual catch limits (federal)), conducting in-season monitoring for Sheephead and other nearshore species, conducting or participating in stock assessments for NFMP species, modifying trip or bag limits, and closing fishery sectors when the TAC is reached (Wilson-Vandenberg et al. 2014).

Sheephead have been managed since 2002 with a statewide TAC that was set at 50% of recent catches, and allocated between the recreational to commercial fisheries. A regional fishing permit (NFP) with trap endorsement limits participation in the commercial fishery. Minimum size limits allow the fish to live long enough to reproduce for one or more seasons before reaching a size at which they can be legally retained. Seasonal closures spread effort throughout the year and may provide time for Sheephead to spawn unmolested. MPAs and other closed areas (e.g., CCAs, RCAs) may provide additional protection for Sheephead from fishing effort.

A stock assessment for Sheephead was conducted in 2004; however, it was not used for management. Most of the biological data used in the assessment came from before the fisheries boom in the 1990s and recent limitations in the fisheries (e.g., NFP, trip and bag limits, size limits) (Loke-Smith 2013). Although the stock assessment results suggested a need to reduce catch, it was decided to not reduce the TAC, but to continue monitoring the recreational and commercial fisheries, collecting biological data to better evaluate the effects of recent management changes to the stock. Additionally,

the Department engaged with university researchers, asking their assistance in expanding life history information to fill some of the gaps in the assessment. A review of Sheephead catch from 2003 to 2017 show that catches have been fairly steady since 2003 and have not exceeded the TAC (Figure 3-1).

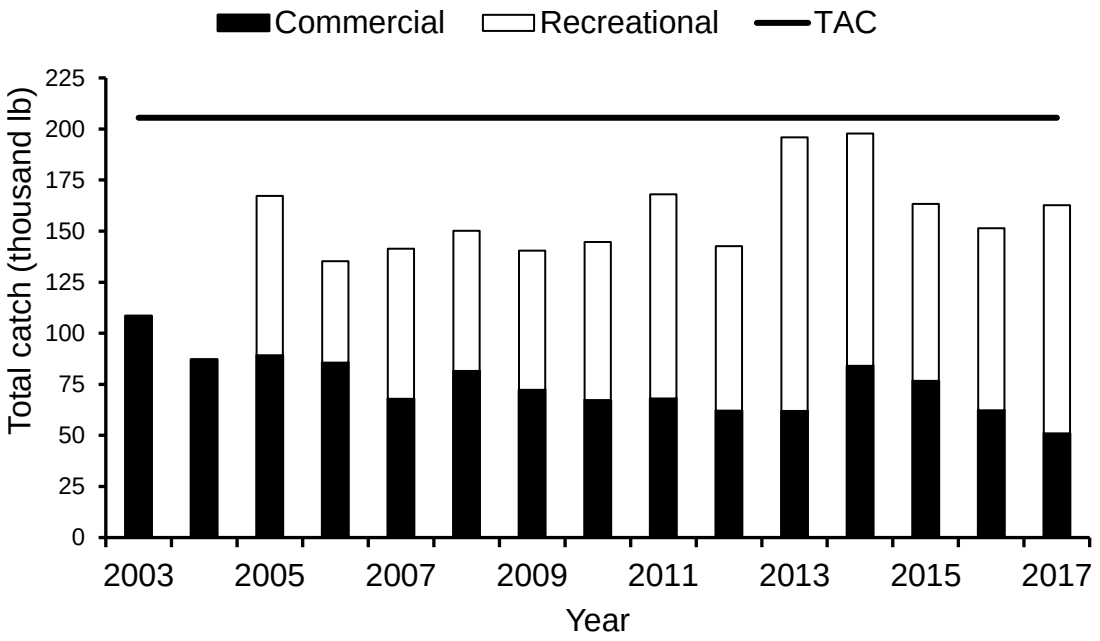

Figure 3-1. Total catch of Sheephead (commercial and recreational) vs. the Total Allowable Catch (TAC). Note: 2003 and 2004 RecFIN data are not available. (CDFW MLDS and RecFIN).

3.1.1.1 Criteria to Identify When Fisheries Are Overfished or Subject to Overfishing, and Measures to Rebuild

The fishery control rules in the NFMP incorporate different approaches to meet its objectives by integrating Essential Fishery Information (EFI) into the level of precaution used in setting the TAC. The framework for the fishery control rule includes three stages, depending on the level of EFI available (Wilson-Vandenberg et al. 2014).

The NFMP Stage III (data-rich) category supports ecosystem-based management, including incorporation of the effect of marine reserves and other environmental factors (Wilson-Vandenberg et al. 2014). The Stage II (data moderate) category in the NFMP applies a 60 to 20 fishery control rule which means if a stock's current spawning biomass is estimated to be at or above 60% of its unfished biomass (B_0) then its status is considered to be "healthy". Once the stock's unfished biomass is below this 60% (i.e. depletion), the status of the stock is in a "precautionary" zone and the catch must be reduced below the default ($F_{50\%}$) fishing rate, along a line to zero catch at 20% of B_0. A stock would be considered overfished if the biomass estimate fell below 30% of B_0. In addition to a required decrease in the Sheephead TAC, spatial and temporal closures can be used to stop overfishing and help to rebuild the stock. In data-poor (Stage I) situations, the proxy for Maximum Sustainable Yield (MSY) was based on

the historical average catch during a time period when there is no indication of a decline in abundance and a proxy for TAC was then set at 50% of the proxy MSY, according to Restrepo et al. (1998) (CDFG 2002).

Initially Sheephead was considered data poor (Stage I) and the TAC for Sheephead was determined by using recreational and commercial landing data from 1983 to 1989 and from 1993 to 1999 and reduced 50% following the fishery control rules of the NFMP (CDFG 2002). The timeframe of 1983 to 1989 was chosen because the period had higher recreational catch, while the later period of 1993 to 1999 had higher commercial catch, and regulations were largely unchanged. The years from 1990 to 1992 were not considered because no recreational data were available during that time period. This resulted in an allocation ratio between the recreational and commercial sectors of 63:37 for Sheephead.

Sheephead is now considered data moderate (Stage II) (Wilson-Vandenberg et al. 2014) with the 14 years since the last assessment yielding a number of papers on various life history traits for Sheephead, and a long time series of fishery-dependent data (landings and biological data) post-2002 regulations. There are no points of concern or other criteria within the NFMP that would require the Department to take management action should they be met, unlike the White Seabass Fishery Management Plan. However, the Department continues monitoring the recreational and commercial catch of Sheephead and collecting biological data from both fisheries. If any changes in catch and/or size of fish caught by one or more fishery sectors are detected, the Department would then look at its current management strategy to see if changes are warranted.

3.1.1.2 Past and Current Stakeholder Involvement

Increased constituent involvement in the management process was mandated in the MLMA (1999). The Department established the Nearshore Advisory Committee (NAC) to guide the Department and the Commission in developing the NFMP and nearshore restricted access program early in the process. The NAC was comprised of 20 individuals representing both recreational and commercial fisheries, as well as environmental and academic interests. The NAC began holding 2 day meetings beginning in January 2001 to consider a broad array of management measures, and they continued to hold additional meetings throughout 2001 and into 2002. The Commission also held six public meetings in 2001 and 2002 to solicit public comment on the proposed regulations to implement the NFMP.

The NFMP called for the development of regional advisory committees, and although formal committees were never developed, steps were taken by the Department to more formally involve constituents in the management process such as the establishment of a statewide Groundfish Task Force comprised of recreational, commercial and environmental members (CDFG 2006). The Groundfish Task Force, provided input on trip limits, bag limits, and season structure for both recreational and commercial fisheries for both Commission and Pacific Fishery Management Council (PFMC) processes. The Department also developed a mailing list of interested parties who receive notice of proposed regulation changes, relevant press releases, and the Marine Management Newsletter (CDFG 2006).

3.1.2 Target Species

3.1.2.1 Limitations on Fishing for Target Species

3.1.2.1.1 Catch

In 2002, the Sheephead TAC was set at 205,500 lb (93,200 kg) and allocated 130,300 lb (59,100 kg) to the recreational fishery and 75,200 lb (34,100 kg) to the commercial fishery. The commercial fishery closed early in the season most years from 2003 to 2008 due to attaining its allocation, with the last closure in 2008. The recreational fishery was last closed in 2003 for attaining its allocation. In 2013, the recreational fishery again exceeded its allocation, but due to the commercial sector being well within its allocation no action was taken to close the recreational fishery early. Even though one sector or the other has exceeded their allocation, the total take of Sheephead has not exceeded the overall TAC (Figure 3-2).

The recreational bag limit for Sheephead was ten fish per day until 2001 when the Commission adopted a recreational bag limit of five fish in 2001 along with a 12.0 in (30.5 cm) minimum size limit (§28.26, Title 14, CCR) as part of the interim regulations while the NFMP was being drafted.

The commercial fishery has bimonthly trip limits for Sheephead (Table 3-2), which have remained unchanged since established in 2001. Although there are trip limits for a six bimonthly trip limit periods, March to April have been closed since 2005 in line with federal closures for NFP rockfishes (§150.06, Title 14, CCR).

Table 3-2. Commercial Sheephead trip limit (§150.06, Title 14, CCR).

Period	Trip limit (lb)
January-February	2,000
March-April	2,400
May-June	2,400
July-August	2,400
September-October	2,400
November-December	2,400

In 2003, the Commission established a NFBP for the take of the ten NFP species, including Sheephead, with trawl or gill net gear (§150.05, Title 14, CCR). These NFBP holders are required to follow the bimonthly trip limits, and in addition there is a regional daily trip limit for all ten NFP species combined, as follows: South Coast Region: 50 lb (22 kg) per day, South-Central Coast Region: 25 lb (11 kg) per day, and 0 pounds per day in the North-Central Coast and North Coast Regions.

3.1.2.1.2 Effort

The commercial Sheephead fishery is restricted access requiring fishers to obtain a regional NFP, and if they are using traps, a Nearshore Fishery Trap Endorsement (§150.03, Title 14, CCR). There is a NFBP that allows for the take of Sheephead and other NFP species with trawl or gill net gear. Bimonthly trip limits, discussed above, along with a 2 month seasonal closure (March and April) spread out

the fishing effort during the year. The TAC and allocation for recreational and commercial fisheries helps to keep overfishing from occurring.

3.1.2.1.3 Gear

The commercial Sheephead trap fishery has specific restrictions, "(d) During the period from one hour after sunset to one hour before sunrise, finfish traps that are left in the water shall be unbaited with the door secured open. If, for reasons beyond the control of the permittee, all trap doors cannot be secured open prior to one hour after sunset, the permittee shall immediately notify the Department. (e) Pop–ups shall not be used on buoy lines attached to finfish traps, and shall not be possessed aboard a vessel when taking finfish under a general trap permit. (f) Trap destruction devices used on finfish traps shall conform to the current regulatory requirements for those devices pursuant to §9003 and as adopted by the Commission. (g) No finfish traps shall be set within 750 feet of any pier, breakwall, or jetty in District 6, 7, 17, 18, 19, 19A, 19B, 20, 20A, 20B, or 21. (h) No more than 50 finfish traps may be used in state waters along the mainland shore. (i) The mesh of any finfish trap used pursuant to this section shall measure not less than two inches by two inches." (FGC §9001.7). The commercial hook-and-line fishery which includes Sheephead, has various restrictions including being limited to 150 hooks with no more than 15 hooks per line within 1.0 mi (1.6 km) of the shore (FGC §9027, §9027.5; §150.17, Title 14, CCR).

3.1.2.1.4 Time

The recreational fishing season for Sheephead, first established in 2000, is managed the same as for Rockfish, Cabezon and Greenlings (RCG) Complex) because these species are frequently caught together. For the Southern Groundfish Management Area where most Sheephead fishing occurs, §27.45, Title 14, CCR lists the following season and depth constraints:

"(1) January 1 through the last day in February: Closed.

(2) March 1 through December 31: Take of all species is prohibited seaward of a line approximating the 75-fathom depth contour along the mainland coast and along islands and offshore seamounts. The 75-fathom depth contour is defined by straight lines connecting the set of 75-fathom waypoints as adopted in Federal regulations (50 CFR Part 660, Subpart C)." Other seasonal and depth constraints for Sheephead by Groundfish Management Area can be found in CCR Title 14 §27.20 through §27.50 or in the current California Ocean Sport Fishing Regulations booklet.

The commercial fishing season for Sheephead is open most of the year, with a 2-month closure March 1 through April 30. This season structure is also the same as nearshore Rockfishes, Cabezon and Greenlings. The 2 month closure was established to coincide with a time when many of the nearshore species are spawning. For Sheephead, the 2 month closure does not coincide with the peak spawning period of July to September (Adreani et al. 2004).

3.1.2.1.5 Sex

There are no restrictions on the take of Sheephead by sex.

3.1.2.1.6 Size

In 1999, the Legislature established a minimum size limit for Sheephead of 12 in (30 cm) TL that applied to both recreational and commercial fisheries. In 2000, the Commission adopted regulations that changed the commercial minimum size limit to 13 in (33 cm) TL (§150.16, Title 14, CCR)), but left the recreational size limit unchanged (§28.26, Title 14, CCR). Live fish buyers prefer smaller, 1.0 to 2.0 lb (0.5 to 0.9 kg) Sheephead, so the price can be lower for larger live fish.

3.1.2.1.7 Area

Sheephead can be caught anywhere in California, but are caught primarily in nearshore waters along the mainland and offshore islands from Point Conception to the U.S. and Mexico border. As mentioned above, Sheephead are included in regulations for the RCG Complex within five Groundfish Management Areas (Figure 3-2). These areas are described in §27.25 through 27.45, Title 14, CCR. Since most Sheephead fishing occurs in southern California, only the Southern Groundfish Management area is described here from CCR §27.45, Title 14, CCR "(a) The Southern Groundfish Management Area means ocean waters between 34° 27' N. lat. (at Point Conception, Santa Barbara County) and the U.S./Mexico border. The Cowcod Conservation Areas are special closure areas within the Southern Groundfish Management Area." See §27.50, Title 14, CCR or the current California Sport Fishing Regulations booklet for specific coordinates for the Cowcod Conservation Area.

Both the recreational and commercial fisheries have depth restrictions, called California Rockfish Conservation Areas (CRCAs) that are designed to limit the catch of overfished Rockfish species (e.g., Canary and Yelloweye Rockfish [*Sebastes pinniger* and *S. ruberrimus*]). In addition to the depth-based CRCAs, the Cowcod Conservation Areas (CCAs), are designed to protect overfished Cowcod (*Sebastes levis*) (Figure 3-2), which have also limited where Sheephead can be taken. The depth of the RCAs vary along the coast, and they have also varied over time. While the CRCAs and CCAs were designed primarily for rockfish fisheries, they apply to Sheephead as well because Sheephead are frequently caught with rockfish and using the same gear. From §27.51, Title 14, CCR "California Rockfish Conservation Area (CRCA) means the ocean waters that are closed to recreational groundfish fishing at specified times, or closed in specified depths or areas. CRCAs serve to minimize interaction with particular species of overfished groundfish that cannot be selectively avoided and thus must be protected from overharvest by closing times, depths or areas to recreational fishing for federal groundfish and associated species managed by California. See Section 27.20."

"(a) In the CRCA, take and possession is prohibited for federally-managed groundfish species as defined in Section 1.91, California sheephead, ocean whitefish, and all greenlings of the genus Hexagrammos."

Figure 3-2. Groundfish Management Areas includes Sheephead. (California Ocean Sport Fishing Regulations, 2019 to 2020).

3.1.2.1.8 Marine Protected Areas

Pursuant to the mandates of the Marine Life Protection Act (Fish and Game Code §2850), the Department redesigned and expanded a network of regional MPAs in state waters from 2004 to 2012. The resulting network increased total MPA coverage from 2.7% to 16.1% of state waters. Along with the MPAs created in 2002 for waters surrounding the Santa Barbara Channel Islands, California now has a statewide scientifically-based ecologically connected network of 124 MPAs. The MPAs contain a wide variety of habitats and depth ranges, including habitat that is appropriate for Sheephead (Table 3-3).

The NFMP considered MPAs as one of the five main management measures of nearshore species, including Sheephead (CDFG 2002). Comparing fish densities between fished to unfished areas was considered a key approach for management of NFMP species, and a possible alternative to data-intensive full stock assessments for each species (CDFG 2002). Although this particular management approach could not be used immediately because the Department was just starting the process for establishing MPAs, the NMFP set up guidelines for their use in management. These

guidelines included setting aside 10 to 20% of appropriate habitat for NFMP species from fishing pressure – dependent on the level and success of management outside the MPAs. A key role of MPAs in the NFMP was to preserve nearshore habitat and ecosystems, and act as "reference reserves" – areas that could be temporally compared to similar fished areas as a means to evaluate stock health (Wilson-Vandenberg et al. 2014). The NFMP objectives relative to the use and role of MPAs included the following (Wilson-Vandenberg et al. 2014; CDFG 2002):

- Ensure that MPAs met the goal of conservation of nearshore fish communities
- Maximize successful larval transport of the fish by spacing MPAs as a network with sufficient connectivity
- Size MPAs appropriately to protect a portion of spawning adults sufficient to sustain the overall stocks for species that were largely residential and had home ranges on the order of a couple of miles
- Encompass a variety of habitats that were replicated in other MPAs along the coast

A statewide series of MPAs has been established in (2012), and efforts are underway to monitor them. Unfortunately, the primary focus of monitoring these MPAs is not nearshore management, but for their own future management (MPA Monitoring Enterprise 2011). In 2011, the Department hosted a workshop to begin investigating how MPAs could be used in fisheries management and which fisheries might benefit the most (Wertz et al. 2011). Results of monitoring California's MPAs so far have shown some limited benefits to NFMP species, such as Sheephead, within MPAs, although not on a scale relevant to fisheries management (California Ocean Science Trust and CDFW 2013).

Table 3-3. Percentage of estimated appropriate habitat for Sheephead in MPAs.

Habitat type	**Average % habitat type protected by MPA**
Hard substrate 0 to 30 m (low and high relief)	18.8
Kelp beds	19.8

3.1.2.2 Description of and Rationale for Any Restricted Access Approach

In the late 1990s, the commercial fishery was significantly over-capitalized and it was recognized that limiting participation in the fishery was necessary to keep catches within TACs. Development of the nearshore restricted access program was a step-wise process that began with the Legislature's establishment of a nonrestrictive NFP (no annual renewal requirement) in 1999 for the take of ten species, including Sheephead (FGC §8587). In 2000, the Commission adopted regulations for the NFP, making it a restrictive permit (annual renewal required), and adding a moratorium on permits along with a control date for a future restricted access program (FGC §8587). In 2001, the

Commission added a landing requirement to renew a NFP and set a control date for future gear endorsements (§150.03, Title 14, CCR).

The development of the nearshore restricted access program that includes fishing for Sheephead, began in 2001 by researching different programs and conducting small group meetings in ports throughout the state to learn about the nearshore fishery. The results of these small group meetings revealed that participants wanted a fishery that limited participation to prevent overfishing, but that allowed both full and part-time participants in the fishery, while giving preference to those who land their fish live.

In 2003, the Commission adopted a regional restricted access program for the NFP species in accordance with the Commission's policy on restricted access commercial fisheries (Commission 1999). The permits were regional in accordance with the regional management approach, another of the five main management measures of the NMFP. The NFP restricted access program was considered a first step in developing regional management for the nearshore fishery, while the Commission and the Department worked toward being able to manage all aspects of the nearshore fishery on a regional basis (Wilson-Vandenberg et al. 2014).

The nearshore live fish fishery is a low volume, high value fishery with both full and part-time participants, using regular fishing vessels to small skiffs and kayaks. The NFP restricted access program goal was developed with guidance from the NAC and constituents, including those at the 2001 small group port meetings. Since the nearshore live fish fishery was well developed in the South Coast and South-Central Coast Regions, the qualifying criteria used for initial restricted access NFP qualification in 2003 was a combination of multiple years of participation (3 yr with 500 lb (227 kg) per year, from 1994 to 1999), recent participation (one landing after the control date of December 31, 1999) and an average price per pound ($2.00 for 1994 to 1999 landings).

In addition to these qualifying criteria regional capacity goals were set for each NFP region. The capacity goal was based on the average landings of all ten NFP species for each fisher from 1994 to 1999 that were ranked from highest to lowest and summed until the regional TAC was reached. Since only statewide TACs had been developed, the same method of using average catch from 1983 to 1989 and from 1993 to 1999 and reducing it by 50% was used to develop regional TACs. As a result, the capacity goal in the South Coast and South-Central Coast Regions is 18 and 20 permits, respectively.

The nearshore restricted access program also limited the types of gear used in the fishery to gear that could successfully land these species alive. Both trawl and gill net gear landings are mostly comprised of dead fish, except for trawl-caught California Scorpionfish. Additionally, separate regulations had pushed these gears further offshore, primarily outside state waters and in deeper depths than most nearshore species.

The nearshore restricted access program also established the NFBP for the take of NFP species, including Sheephead, with trawl and gill net gear. This NFBP was established in 2003 at the same time as the restricted access program that limited gear to hook and line gear, traps, and dip nets (§150, 150.03, Title 14, CCR). The NFBP has daily trip limits for NFP species (combined) of 25 lb (11 kg) in the South-Central region and 50 lb (23 kg) in the South Coast Region in addition to state and federal bimonthly trip limits.

3.1.3 Bycatch

3.1.3.1 Amount and Type of Bycatch (Including Discards)

The Fish and Game Code (FGC §90.5) defines bycatch as “fish or other marine life that are taken in a fishery but which are not the target of the fishery.” Bycatch includes “discards,” defined as “fish that are taken in a fishery but are not retained because they are of an undesirable species, size, sex, or quality, or because they are required by law not to be retained” (FGC §91). The term “Bycatch” may include fish that, while not the target species, and are desirable and are thus retained as incidental catch, and does not always indicate a negative impact.

There are no logbooks required for commercial nearshore fishermen, and there is therefore little information regarding discards, other than information from a Department fishery-independent study in 1992. This study looked at the trap fishery in southern California targeting Sheephead, California Scorpionfish, California Moray Eel, Cabezon, and nearshore rockfishes. Trapping operations were patterned after techniques used by commercial fishers, with both daytime (84% of sets) and nighttime sets (16%). Daytime sets were comprised of 34% of target species, with the rest being bycatch. Nighttime sets were comprised of just 19% of target species, with very small amounts of Sheephead. Non-target finfish included Kelp Bass (*Paralabrax clathratus*) and Sand Bass (*Paralabrax nebulifer*), rock wrasse (*Halichoeres* spp.), some surfperch (*Amphistichus* spp.), and other shallow water fishes. Non-target invertebrates included whelks, Spiny Lobster, sea stars, sea urchins and rock crabs. The results of this study led to regulation changes for finfish trapping in 1996, such as a limitation on the number of traps, minimum mesh size, and most importantly, allowing fishing only during daylight hours. As discussed above, in 2003 the nearshore restricted access program also limited the number of fishers allowed to use trap gear. Thus it would be difficult to use this study to infer bycatch levels in the fishery today. This fishery independent study was not designed to infer bycatch, so this remains an informational gap.

The Department’s (1992) trap study noted that few fish and invertebrates were brought up dead or damaged in the traps. The fact that most fishers tend to frequently service their traps (usually every few hours) should result in low discard mortality.

There are no documented instances of whale entanglements in the nearshore trap fishery. The likelihood of entanglement is reduced by the fact that finfish traps are fished in nearshore shallow waters and on a single groundline, as opposed to single traps attached to individual buoys in deeper waters offshore. National Oceanic and Atmospheric Administration (NOAA) Fisheries-Office of Protected Resources classifies CA nearshore live fish trap/hook and line fishery as Category III with no known marine mammal interactions (NOAA Fisheries 2018).

To assess the most commonly caught species with Sheephead while recreational fishing, all trips where at least one Sheephead was caught were analyzed. This eliminates offshore fishing trips that solely target pelagic species; however, it is not possible to avoid trips where effort is split between multiple habitats, and both nearshore and offshore species are landed on the same trip. The most common species caught in 2017 on private/rental boat and party/charter boat trips where Sheephead was caught included Ocean Whitefish (*Caulolatilus princeps*), Copper Rockfish (*Sebastes*

caurinus), Vermilion Rockfish (*Sebastes miniatus*), Blue Rockfish (*Sebastes mystinus*) and Kelp Bass (*Paralabrax clathratus*) (Table 3-4). Although Sheephead were caught on 100% of these trips, they are often not the most abundant species. These other species may be primary targets or secondary targets by anglers that may, or may not, be targeting Sheephead. Note that most of these species are also associated with Sheephead habitat (see section 1.4.1). All species listed in Table 3-4 have state or federal management measures in place.

Table 3-4. Number caught and percent of trips (frequency of occurrence) for the top ten most abundant species kept on sampled private/rental and party/charter trips (n=1,270) where at least one California Sheephead was also caught in 2017 (RecFIN).

Species	Number Caught	Percent of Trips	Number of Sheephead caught on associated trips
Ocean Whitefish	2915	47	986
California Sheephead	**2405**	**100**	**2405**
Copper Rockfish	978	23	535
Vermilion Rockfish	806	22	422
Blue Rockfish	700	15	259
Kelp Bass	512	39	501
Bocaccio Rockfish	326	11	226
Pacific (chub) Mackerel	306	13	120
Starry Rockfish	276	12	245
Halfmoon	220	6	199
Blacksmith	115	5	112

Catching any species whose take is prohibited is of special concern. Of the species that are prohibited from recreational take, Giant Sea Bass, Cowcod (*Sebastes levis*), and Garibaldi (*Hypsypops rubicundus*) have been recorded as caught and discarded on private rental and party/charter trips in 2017 where at least one Sheephead was also caught (Table 3-5). The reported numbers and frequency of these occurrences are extremely low; however, it is worth noting that Giant Sea Bass was listed as critically endangered by the International Union for Conservation of Nature in 1996 and has protected status in California. Giant Sea Bass bycatch does not seem to be a resource concern at this time as their populations appear to be increasing (House et al. 2016). Due to considerable outreach over the years, anglers are aware of their protected status and the importance of handling them carefully and releasing immediately.

Table 3-5. Species prohibited from recreational take that were caught on private/rental and party/charter trips along with California Sheephead in 2017 (RecFIN).

Species	Number caught	Percent of trips
Giant Sea Bass	13	0.44
Cowcod	2	0.09
Garibaldi	19	0.35

3.1.3.2 Assessment of Sustainability and Measures to Reduce Unacceptable Levels of Bycatch

The number of NFP trap endorsements coupled with the limits on traps, limits the amount of effort along the mainland shore. Additionally, fishers set their gear in shallow nearshore waters and closely monitor the traps, pulling them frequently in order to capture live fish in good condition, which should further limit the bycatch of non-target species, and allow non-target species to be returned to the water in good condition. While there are no direct bycatch measures, the nature of the live fishery, and a goal of participants, to land live fish in a good condition mitigates bycatch frequency driven by economics of the per pound price. Additionally most of the known species of bycatch have their own state or federal management measures in place.

3.1.4 Habitat

3.1.4.1 Description of Threats

As all life stages of Sheephead reside in kelp forest and rocky reefs, they are primarily impacted by the threats to these habitats. Pollution from runoff and wastewater discharge can have negative impacts on kelp forest habitats, but less than the impacts observed for bays and estuaries as environmental conditions play a larger role in kelp ecosystem health (Schiff et al. 2000). Climate change, invasive species, and the predicted increased variability in the cool and warm water regimes may also have detrimental effects on the health of nearshore kelp forest ecosystems (Caselle et al. 2017; Provost et al. 2017). These variables may also have large impacts on sea urchins and other hard-shelled invertebrates – Sheephead's primary source of prey. At this time the Department has no direct measures in place to address any of these threats. The recreational hook and line, and spear fisheries for Sheephead are very low impact gear types with no known adverse effects on habitat. Some impact to marine invertebrates associated with rocky reefs can result from anchoring of vessels or fishing gear snagging on structure or organisms; however, this is also likely minimal so measures to minimize them have not been developed.

3.1.4.2 Measures to Minimize Any Adverse Effects on Habitat Caused by Fishing

The main measures to limit adverse effects on habitat has been the implementation of limits on the number of traps allowed along with the number of fishers authorized to use trap gear. Since 1996, fishers have been limited to 50 traps in state waters along the mainland shore and a special permit is required (FGC §9001.7, §150.03, Title 14, CCR). Even though there are no trap limits outside 3 mi (5 km) or around the offshore islands, Sheephead fishers are limited by how many traps that they can service every few hours to ensure product quality. Additionally, from 1996 through 2003, a Finfish Trap Permit was required limiting the number of fishers allowed to use traps in southern California with around 316 permits issued in 1996 (CDFW).

3.2 Requirements for Person or Vessel Permits and Reasonable Fees

Commercial Fishery

The ability to commercially fish for Sheephead requires a commercial fishing license and regional NFP, which allows the fisher to use hook and line gear (e.g., stick gear, set longline, rod and reel) and dip nets, usually while diving. To use trap gear requires a general trap permit and a regional nearshore fishery trap endorsement. In addition, Sheephead receivers also require a license; the type of license depends on the activities of that business. The fees associated with each of these are shown in Table 3-4. The most current license options, fees and other information for the commercial fishery may be accessed at the Department website.

Table 3-6. List of commercial license and permit fees related to the California Sheephead Fishery April 1, 2019 to March 31, 2020. Note that fees associated with fish business licensing are based on a calendar year, January to December. (Accessed June 21, 2019. https://www.wildlife.ca.gov/Licensing/Commercial/Descriptions).

Permit	Fee (U.S. dollars)	Description
Commercial Boat Registration (Resident)	$379.00	Required for any resident owner or operator for any vessel operated in public waters in connection with fishing operations for profit in this State; or which, for profit, permits persons to sport fish.
Commercial Boat Registration (Nonresident)	$1,122.00	Required for any nonresident owner or operator for any vessel operated in public waters in connection with fishing operations for profit in this state; or which, for profit, permits persons to sport fish.
Nearshore Fishery Permit	$751.25	Required for any person using hook and line to take, possess aboard a vessel, or land black-and-yellow rockfish, gopher rockfish, kelp rockfish, California scorpionfish, greenlings of the genus Hexagrammos, China rockfish, grass rockfish, California sheephead, and cabezon, for one of four regional management areas, as described in Section 52.04, Title 14, of the California Code of Regulations.
Nearshore Fishery Bycatch Nontransferable	$305.25	Required for any person using trawl or entangling nets to take, possess aboard a vessel or land black-and-yellow rockfish, cabezon, California sheephead, California scorpionfish, China rockfish, gopher rockfish, grass rockfish, greenlings of the genus Hexagrammos, or kelp rockfish. Permits become null and void upon death of permit holder.
Nearshore Fishery Trap Endorsement	$75.00	Required for any person using traps to take, possess aboard a vessel, or land Black–and–Yellow Rockfish, Gopher Rockfish, Kelp Rockfish, California Scorpionfish,

		Greenlings (*Hexagrammos* spp.), China Rockfish, Grass Rockfish, Sheephead, and Cabezon .
Trap Permit (General)	$54.08	Required for any person who uses traps to take finfish, mollusks, or crustaceans for profit except spiny lobster and Dungeness crab, as defined in FGC §9001.
Fish Receiver's License	$798.25	Any person who purchases or receives fish for commercial purposes from a commercial fisherman not licensed as a fish receiver must obtain a Fish Receiver's License.
Fisherman's Retail License	$101.97	A commercial fisherman is required to have this license only if he/she sells all or a portion of his/her catch to ultimate consumers.

Some of the costs associated with management of the fishery by the Department are borne by the fishermen, fish receivers, and processors. In addition to licensing fees, fish businesses in California must pay a landing tax for all fish purchased. Landing tax rates are set in Fish and Game Code §8051. The current rate for Sheephead is $0.0333. In 2017, California fish businesses collectively paid $1,700 in landing taxes for Sheephead.

Recreational Fishery

Unless recreationally fishing off a public pier, all anglers 16 yr-old or older are required to purchase a fishing license to fish for Sheephead. Anglers fishing south of Point Arguello must also have an ocean enhancement validation. Captains operating their vessels as CPFVs or private charters must purchase a permit. In 2019, the cost of an annual resident sport fishing license is $49.94, and an ocean enhancement validation is $5.66 (Table 3-5). The most current license options, fees, and other information for recreational fishing may be accessed at the Department website.

Table 3-7. Annual sport fishing license fees from January 1 to December 31, 2019. (Accessed June 21, 2019. https://www.wildlife.ca.gov/Licensing/Fishing).

License	Fee	Description
Commercial Passenger Fishing Vessel License	$367.25	Required for any boat from which persons are allowed to sport fish for a fee.
Resident Sport Fishing	$49.94	Required for any resident 16 years of age or older to fish.
Recreational Non-resident Sport Fishing	$134.74	Required for any non-resident 16 years of age or older to fish.
Recreation Ocean Enhancement Validation	$5.66	Required to fish in ocean waters south of Point Arguello (Santa Barbara County). An Ocean Enhancement Validation is not required when fishing under the authority of a One or Two-Day Sport Fishing License.
Reduced-Fee Sport Fishing License – Disabled Veteran	$7.47 at CDFW offices. $7.82 from	Available for any resident or non-resident honorably discharged disabled veteran with a 50 percent or greater service-connected disability. After you prequalify for your first Disabled Veteran

	license agents	Reduced-Fee Sport Fishing License, you can purchase disabled veteran licenses anywhere licenses are sold.
Reduced-Fee Sport Fishing License – Recovering Service Member	$7.47	Available for any recovering service member of the US military. The Recovering Service Member Reduced-Fee Sport Fishing License is only available at CDFW License Sales Offices.
Reduced-Fee Sport Fishing License – Low Income Senior	$7.47	Available for low income California residents, 65 years of age and older, who meet the specified annual income requirements. The Reduced-Fee Sport Fishing License for Low Income Seniors in only available at CDFW License Sales Offices.

4 Monitoring and Essential Fishery Information

4.1 Description of Relevant Essential Fishery Information

FGC §93 defines EFI as “information about fish life history and habitat requirements; the status and trends of fish populations, fishing effort, and catch levels; fishery effects on age structure and on other marine living resources and users, and any other information related to the biology of a fish species or to taking in the fishery that is necessary to permit fisheries to be managed according to the requirements of this code.” There are many studies on life history EFI for Sheephead as described in Section 1, including age and growth, reproduction, and movement. This section summarizes the EFI that is routinely collected and used to monitor the health of the stock and ecosystem. The Department relies on a combination of fishery-dependent and fishery-independent sources to monitor the status of the Sheephead fishery.

4.2 Past and Ongoing Monitoring of the Fishery

4.2.1 Fishery-dependent Data Collection

Fishery-dependent data provides an excellent way to monitor fishing effort, catch levels, and the size structure of retained Sheephead. Recreational fishery data are reported in the form of CPFV logbooks and are also collected from all fishing modes by CRFS staff. Beginning in 1935, CPFV operators were required to keep daily catch logs and submit them to the Department on a monthly basis. These data were collected continuously to present day, except for the years during World War II (1941 to 1946) when most CPFVs were not fishing (Hill and Schneider 1999). Logbook data have always included the date of fishing, port code, boat name, Department fishing block, angler effort and the number of fish kept by species, and after 1994 included discarded fish, bait type and sea surface temperature.

All modes of recreational fishing were surveyed by MRFSS for estimates of catch and effort between 19780 and 2003, except for 1990 to 1992 when there was no funding. The PSMFC conducted these surveys with both federal and state funding. A combination of dockside surveys, CPFV sampling and phone interviews were used to generate the estimates. In January 2004, the Department implemented its own sampling survey, CRFS, to replace the MRFSS surveys using similar methods.

All commercial fish buyers are required to submit landing receipts, which are housed in the Department’s MLDS. Landing receipts record by species the weight of the fishes landed, the condition and use of the fish, price paid to the fishermen, date the fish were landed, type of gear used, port of landing and the fishing block location where the fish were harvested. Commercial landing receipts, CPFV logbooks, and CRFS data collected by the Department continue to contribute valuable estimates of catch and effort that help staff monitor the status of Sheephead (Loke-Smith 2013).

The PSMFC groundfish samplers have conducted standardized biological sampling for the commercial groundfish fishery in California since 1980, and also collect samples of Sheephead when they are encountered at local fish markets. Sampling includes randomly removing fish from the tote until approximately 50.0 lb (22.7 kg) of fish are in the sample basket – this is called a cluster. Individual fish in the cluster are

then examined for fork length, weight, sex, maturity and otoliths are taken for ageing. Some fish buyers do not want the samplers to sample live fish for fear they may be damaged, so many times the samplers only get length and sex information. In addition to the biological data, catch information from the landing receipt are also recorded. There are no logbooks for either trap fishers or hook and line fishers taking Sheephead or other nearshore species resulting in a lack of data on effort. These data are all used to monitor trends and can be used in future stock assessments.

4.2.2 Fishery-independent Data Collection

Fishery-independent data on Sheephead are primarily from long-term monitoring studies looking at entire species assemblages associated with kelp forest and rocky reefs where Sheephead are one of the common species. The National Park Service (NPS) has conducted a Channel Islands Kelp Forest Monitoring program throughout the northern Channel Islands since 1985 (Davis 1988). The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) has conducted a kelp forest monitoring program at over 100 locations across California since 1999. PISCO has published a multitude of studies assessing how fishing pressure may impact the age, growth and sex change of various localized populations of Sheephead, as well as variations in diet and Sheephead abundances inside and outside of MPAs, many of which are discussed in section 1. The trends seen from long-term monitoring studies can be used to corroborate trends observed in the landings. These types of fishery-independent datasets can also be used in combination with fishery dependent data in stock assessments and models used to forecast long-term trends. Additionally these studies aid in informing the health of populations inside MPAs, which aids in understanding the sustainability of Sheephead populations.

5 Future Management Needs and Directions

5.1 Identification of Information Gaps

A multitude of previous studies provide EFI for Sheephead (see section 1). Fishery-dependent data collected by the Department provides an excellent way to monitor fishing effort, catch levels, and the size structure of retained Sheephead. However, additional fishery-independent data are essential for effectively monitoring the population. Trends in fishery-dependent data do not encompass all life stages of the species, and the data can be biased towards specific locations more heavily targeted by fishers.

Fishery-independent data can provide a more comprehensive, less-biased assessment of relative abundance because sampling can be standardized, information on all life stages can be collected, and abundances can be assessed inside and outside of MPAs. Although EFI on Sheephead age, growth, and reproductive parameters already exist, there are still knowledge gaps that could aid in informing the sustainable management of the fishery (Table 5-1).

Table 5-1. Informational needs for California Sheephead and their priority for management.

Type of information	Priority for management	How essential fishery information would support future management
Bycatch associated with the nearshore trap fishery	High	Quantifies the level of bycatch and condition of discarded catch from the nearshore trap fishery, which would aid in understanding the sustainability of the Sheephead commercial fishery.
Immediate and long term post-release mortality	Medium	Quantifying discard mortality, both long-term and upon immediate release is necessary for a more accurate estimate of overall fishing mortality.
Updated estimate of natural mortality	Medium	Natural mortality estimates are used in the calculation of total mortality. Estimated total mortality rates are utilized in stock assessments and when modeling forward projections of the fishery.
Estimate of amount of money the fishery contributes to California's economy	Low	This information would be the goal of a socioeconomic analysis that would be useful when assessing how changes in the fishery impact the economy.
Amount of catch attributed to research take (annually)	Low	Quantifying this type of catch will contribute to the annual estimate of the total number of removals from the population.

5.2 Research and Monitoring

5.2.1 Potential Strategies to Fill Information Gaps

Department staff continue to utilize CPFV logbooks, CRFS data and commercial landing receipts to monitor trends in both the recreational and commercial fisheries. The Department also continues to search for and incorporate any relevant results from other fishery-dependent or fishery-independent studies conducted by outside agencies. Opportunities to collaborate with Tribes, outside researchers, non-governmental organizations, recreational and commercial interests, and other stakeholders will be pursued and considered whenever possible. As mentioned above studies on bycatch, discard mortality and natural mortality will all aid in understanding the sustainability of the Sheephead fishery. This may require a combination of efforts led by the Department and independent researchers through various grants or other funding sources. Studies could include an observer program on the nearshore trap fishery to quantify the level and condition of discarded catch. Additionally, an estimate of long-term discard mortality would be useful to the Department to understand whether restrictive size limits result in increased mortality of sublegal size classes. Research efforts like these may be particularly well suited for graduate studies at local universities.

5.2.2 Opportunities for Collaborative Fisheries Research

The Department has collaborated in the past and will continue to work with outside entities such as academic organizations, NGOs, citizen scientists, and both commercial and recreational fishery participants to help fill information gaps related to the management of state fisheries. The Department will also reach out to outside persons and agencies when appropriate while conducting or seeking new fisheries research required for the management of each fishery.

Several of the information gaps identified above (Table 5.1) are potential areas for collaboration. In particular, a study on bycatch associated with the nearshore trap fishery or quantifying discard mortality would be good subjects for collaborative studies, potentially involving both fishers and academic entities.

5.3 Opportunities for Future Management Changes

This section is intended to provide information on changes to the management of the fishery that may be appropriate, but does not represent a formal commitment by the Department to address those recommendations. ESRs are one of several tools designed to assist the Department in prioritizing efforts and the need for management changes in each fishery will be assessed in light of the current management system, risk posed to the stock and ecosystem, needs of other fisheries, existing and emerging priorities, as well as the availability of capacity and resources.

There have been multiple suggestions from stakeholders for management change including increasing the minimum size limit, decreasing the bag limit, implementing a slot limit and changing regulations at a localized scale to take into account geographic differences in changing life history traits. However, there is no apparent need for management change for Sheephead at this time, as populations

appear to benefit from restricted fishing in MPAs, catch is managed through a TAC and landings appear to be stable. The Department will continue to monitor fishery dependent and independent data to detect any changes to the Sheephead fishery and will work with stakeholders and the Commission on any future changes.

5.4 Climate Readiness

To incorporate climate readiness into the management of the Sheephead fishery it is important to increase the Department's understanding of the possible impacts of climate variability. California's coastal waters are already subject to high variability due to episodic events such as ENSO, PDO, and NPGO. Climate change may bring further uncertainty to these trends, with potential implications for ecosystem function and fishery sustainability in coastal areas. To manage Sheephead populations effectively under climate change, it will be important to take a proactive approach to management.

Climate change that results in warmer ocean temperatures could have both positive and negative effects on Sheephead populations. There may be long-term positive responses in Sheephead populations to warm water regimes, as their northern range to Monterey Bay is likely a relatively modern phenomenon as increasing ENSO events may increase the range of larval dispersal and survivorship (Braje et al. 2017). With increasing climatic events, the Sheephead's range may continue to expand, or the center of the population in southern California may shift northward.

Continued fishery-independent, long-term monitoring surveys as conducted by PISCO and the NPS is important for detecting potential changes in populations and species assemblages from shifting climatic variables (See section 4.2.2 for explanation of these surveys). However, warmer ocean temperatures can also result in loss of kelp forest habitat (Wernberg et al. 2010), which could have a negative effect on Sheephead survival and/or recruitment. Increased storm frequency and coastal runoff may have negative impacts on kelp forest habitats, which can affect entire community assemblages (Byrnes et al. 2011). Ocean acidification may also have a negative impact on prey availability for Sheephead, especially for sea urchins and other hard-shelled invertebrates that would be directly affected, which Sheephead preferentially consume. Protecting the health of key habitats for Sheephead and other kelp forest and rocky reef fishes is a priority for climate readiness. This might involve protection of spawning grounds, removal and monitoring for invasive species, and regulation of coastal runoff. Finally, increased monitoring of environmental variables, fish abundance, and distribution from all available data sources will be important to anticipate change and take proactive management actions.

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