**Fishery-at-a-Glance:** White Seabass

**Scientific Name:** *Atractoscion nobilis*

**Range:** White Seabass range from Magdalena Bay, Mexico to Point Conception, California. During warmer years, individuals have been caught as far north as Juneau, Alaska. They are also found in the northern Gulf of California.

**Habitat:** Young White Seabass inhabit the open coast and are closely associated with small drifting debris and algae in shallow areas just outside the surf zone. Juveniles move into protected bays around 2 years old, utilizing eelgrass for cover and forage. Adults occupy a wide range of habitats including kelp beds, reefs, offshore banks, and the open ocean.

**Size (length and weight):** White Seabass grow quickly during the first 8 years, after which growth rates decrease considerably. Fish that are of legal size are estimated to be around 3 years old and weigh 8 pounds. The maximum size is more than 80 pounds and more than 4 feet in length, while an average fish from the commercial fishery is typically between 20 and 40 pounds.

**Life span:** White Seabass likely do not live beyond 30 years. The oldest White Seabass caught was 28 years old.

**Reproduction:** To spawn, multiple males fertilize the eggs of a gravid female as gametes are broadcast into the water column. White Seabass spawning occurs near shore from March through September, peaking in late spring to early summer.

**Prey:** White Seabass feed on a variety of pelagic fish and invertebrate species including Northern Anchovy, Jack Mackerel, Pacific Mackerel, Pacific Sardine, and Market Squid, and pelagic red crabs when available.

**Predators:** Other fish, sharks, and sea lions are known to prey on White Seabass.

**Fishery:** Both commercial and recreational fishermen target white Seabass.

**Area fished:** Commercial and recreational catches of White Seabass are concentrated along the coast from Point Conception to the U.S and Mexico border and around the Channel Islands. Although the frequency of White Seabass caught north of Point Conception has increased, these landings still represent less than 20% of the total annual California catch.

**Fishing season:** The recreational fishery is open year-round but occurs primarily March through September. The daily bag limit is three fish, except from March 15 through June 15 when the daily bag limit is one fish south of Point Conception. The commercial fishery is closed between Point Conception and the U.S. and Mexico border from March

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15 to June 15, except one fish may be taken, possessed, or sold by a vessel each day if taken incidental to gill and trammel net fishing operations.

**Fishing gear:** White Seabass are primarily taken with set and drift gill net (commercial) and hook and line (commercial and recreational).

**Market(s):** White Seabass is sold fresh and frozen as fillets predominantly to local restaurants and specialty fish markets. White Seabass is not exported. Mexico is the only foreign source of White Seabass, making up about 75% of White Seabass sold in the U.S.

**Current stock status:** Estimated female spawning biomass in 2015 was 627 tons or 27% of unfished levels. This value is below the Pacific Fishery Management Council biomass target depletion of 40% but above the minimum stock size threshold of 25% for groundfish.

**Management:** This fishery is managed under the White Seabass Fishery Management Plan, which includes a provision for annual monitoring and assessment of the White Seabass fisheries. The annual review includes fishery-dependent data and fishery-independent data, if available, as well as documented changes within the social and economic structure of the recreational and commercial industries that utilize the White Seabass resource within California. The review also includes information, if available, on the harvest of White Seabass from Mexican waters and other relevant data.

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# 1 The Species

## 1.1 Natural History

### *1.1.1 Species Description*

The White Seabass, *Atractoscion nobilis*, is the largest croaker species in California waters (Thomas 1968). White Seabass have an elongated body, large mouth, and a raised ridge along the length of its belly. Adults are bluish to gray dorsally with dark speckling and silver to white colored ventrally. It has a black spot on the inner base of its pectoral fins. Young White Seabass have several dark vertical bars on the side (Figure 1-1). White Seabass have been recorded to 5.2 feet (ft) (1.6 meters (m)) Total Length (TL) and 93 pounds (lb) (42 kilograms (kg)); however, individuals larger than 60 lb (27 kg) are rarely observed (Thomas 1968) (Figure 1-2).

Figure 1-1. Photo of juvenile White Seabass (Photo Credit: Scott Aalbers, PIER).

Figure 1-2. Photo of adult White Seabass (Photo Credit: Scott Aalbers, PIER).

*1.1.2 Range, Distribution, and Movement*

White Seabass primarily range from Magdalena Bay, Mexico to Point Conception, California. However, during warm water events, individuals have been caught as far north as Juneau, Alaska (Miller and Lea 1972; Vojkovich and Reed 1983) (Figure 1-3). They are also found in the northern Gulf of California.

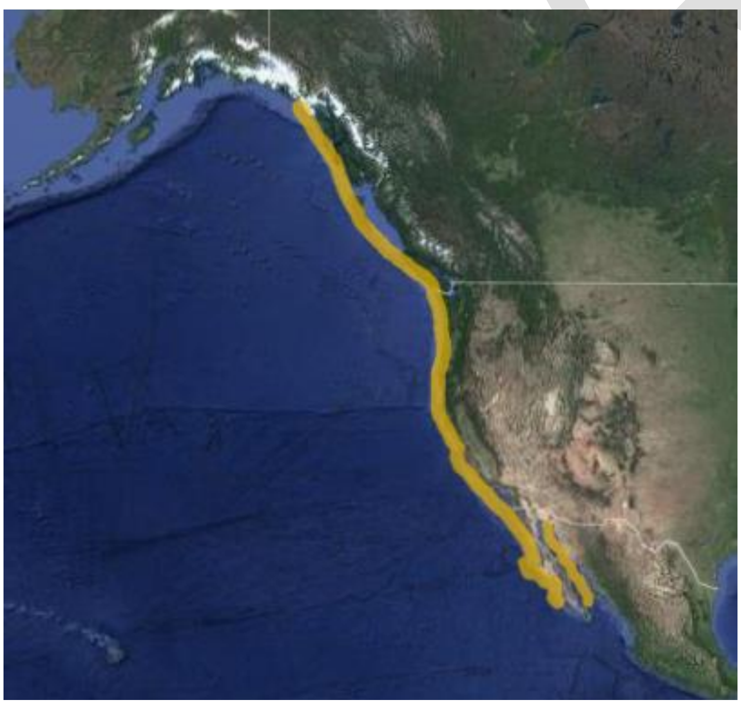

Figure 1-3. Range of White Seabass.

White Seabass that are found off the coasts of California and Baja Mexico are thought to be a single breeding population, with the center of their distribution occurring off central Baja California, Mexico (Moser et al. 1983; Vojkovich and Reed 1983). White Seabass move throughout the Southern California Bight and along the coast of California. As Sea Surface Temperatures (SST) increase during the late summer months in the Southern California Bight, White Seabass migrate above Point Aguello in a northwesterly direction along the California coastline (Aalbers and Sepulveda 2015). Within the water column, White Seabass occur across a broad temperature range (46 to 75 degree, Fahrenheit (°F) (8 to 24 degree, Celsius (°C)) but spend more than half their time within a relatively narrow thermal gradient, between 55° and 61°F (13° and 16°C) (Aalbers and Sepulveda 2015). As water temperatures increase during the spring and summer months, the vertical distribution of White Seabass shifts toward the surface, increasing the vulnerability of White Seabass to fishing during their spawning season (Aalbers and Sepulveda 2015).

### *1.1.3 Reproduction, Fecundity, and Spawning Season*

The White Seabass is an egg-laying group spawner, where multiple males fertilize the eggs of a gravid female as gametes are broadcast into the water column. Spawning occurs near shore from March through September, peaking in late spring to early summer (Moser et al. 1983; Donohoe 1997; Aalbers 2008). White Seabass larvae have been found between Santa Rosa Island, California and Magdelena Bay from April through August (Moser et al. 1983), indicating that spawning activity occurs throughout the southern extent of their range.

White Seabass utilize visual, tactile, and sonic cues to communicate their reproductive state. Gravid females are identifiable during courtship and spawning by shifts in behavior and the development of dark bars across the dorsal region (Aalbers and Drawbridge 2008). Male White Seabass produce five distinct sounds: single and multiple repetitive series of pulses, separated in time by a fixed and often constant interval, during courtship, drumrolls and thuds during spawning, booms during yawning, and burst swimming.

Batch fecundity (the number of eggs released by one female at a single time) ranges from 0.76 million to 1.5 million eggs and varies as a function of female body weight (CDFG 2002). Although it has been reported that White Seabass spawn more than once per season, the number of spawns per female and the spawning intervals for individual females are unknown (Aalbers and Drawbridge 2008). White Seabass produce relatively large eggs, averaging 0.04 inches (in) (1.27 millimeters (mm)) in diameter (Moser et al. 1983). Fertilized eggs are buoyant and drift with the ocean surface currents for 2 days before hatching into planktonic larvae that disperse for approximately 30 days and settle out in algae and small drifting debris in shallow areas just outside the surf zone at a size of 0.27 to 0.39 in (7.0 to 10.0 mm) (Moser et al. 1983; Allen and Franklin 1988, 1992).

### *1.1.4 Natural Mortality*

Determining the natural mortality 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.

Natural mortality rates in fish are well known to be size-dependent, with natural mortality rates declining and leveling off as fish age (CASG 2017). There are several estimates of natural mortality for White Seabass ranging from 0.080 to 0.303 (Thomas 1968; Dayton and MacCall 1992; Valero and Waterhouse 2016). Thomas (1968) calculated a natural mortality rate of 0.303 for fish caught in commercial gill nets. Dayton and MacCall (1992) calculated a natural mortality rate of 0.080 for White Seabass from both the recreational and commercial fisheries. Valero and Waterhouse (2016) relied on otolith (hard, calcium carbonate structures located directly behind the brain of bony fishes) age datasets from Hubbs-SeaWorld Research Institute (HSWRI) (sex specific), CDFG (2002) and Romo-Curiel (2015) to estimate natural mortality based on methods described by Hamel (2015) and Then (2015). For females, they estimated a natural mortality rate of 0.225 and for males a natural mortality rate of 0.360 (Table 1-1).

Table 1-1. Natural mortality estimates of White Seabass.

| **Natural mortality estimates** | | | **Reference** |
|---|---|---|---|
| ***Both Sexes*** | ***Females*** | ***Males*** | |
| 0.303 | — | — | Thomas (1968) |
| 0.08 | — | — | Dayton and MacCall (1992) |
| N/A | 0.225 | 0.36 | Valero and Waterhouse (2016), HSWRI otolith data |
| 0.2 | — | — | Valero and Waterhouse (2016), otlith data (CDFG 2002) |
| 0.193 | — | — | Valero and Waterhouse (2016), otolith data (Romo-Curiel 2015) |

### *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. White Seabass can reach lengths of more than 4 ft (1.3 m) and weight of more than 90 lb (36 kg) (Young 1973). An average fish landed in the commercial fishery is typically between 20 (9 kg) and 40 lb (18 kg).

White Seabass grow quickly during the first 8 years (yr) of life after which growth rates decrease considerably (Figure 1-4) (Romo-Curiel et al. 2015). White Seabass

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growth rates also vary in relation to water temperature, with faster growth during warm periods. Williams et al. (2007) found that growth rates of juvenile White Seabass (1 to 4 yr of age) were positively correlated with higher SST that are characteristic of El Niño Southern Oscillation (ENSO) conditions. Romo-Curiel et al. (2015) also found that White Seabass reared in southern Baja California grow at a faster rate in the first year of life, most likely because of the warmer water temperatures of the region.

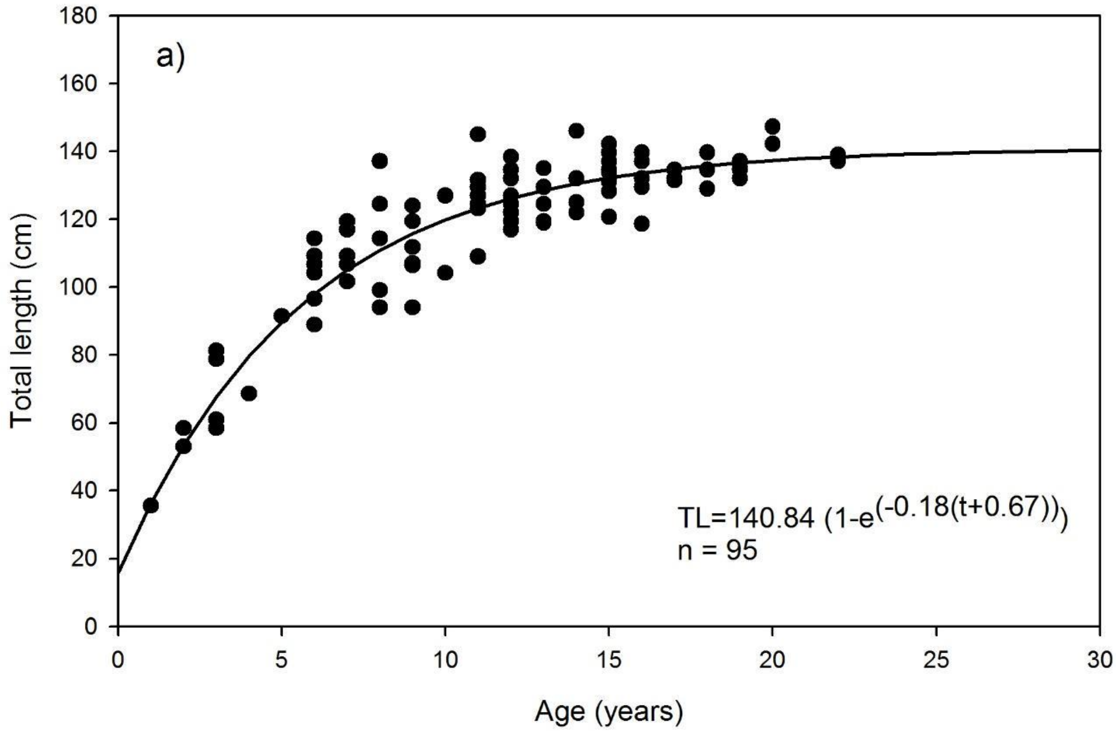


Figure 1-4. White Seabass growth as estimated from age-length data sampled between 2009 and 2012. The data were fitted with the von Bertalanffy growth model $L_t = L_\infty(1 - e^{-k(t-t_0)})$, were $L_\infty$ is mean asymptotic Total Length (centimeters (cm)), K is the growth coefficient ($yr^{-1}$), t is age (yr) and $t_0$ is the theoretical age at zero length). Note that a single dot could denote several overlapping data points and n is sample size (Reproduced from Romo-Curiel et al. 2015).

### *1.1.6 Size and Age at Maturity*

Information on the size and age of maturity for White Seabass is limited. The only published study on White Seabass maturity is by Clark (1930), who found that 50% of the males over 24 in (600 mm) TL were mature; whereas females began maturing at 24 in (600 mm) TL with 50% of females not yet mature at 27.5 in (700.0 mm) TL. Both sexes are mature by 31.5 in (800.0 mm) TL. Although no fish were aged in Clark (1930), the sizes suggest that males mature at age 2 yr and females at age 3 yr (Fig. 1-2).

## 1.2 Population Status and Dynamics

### *1.2.1 Abundance Estimates*

Historically, White Seabass were abundant enough to support commercial and recreational fisheries as far north as San Francisco Bay, but as oceanographic conditions changed and the various segments of the fishery grew, there was a steady decline in availability and catch. By the late 1970s, stock abundance and fisheries catches had declined to historically low levels, and the bulk of the resource was situated off southern California and northern Baja California, Mexico. During the 1980s, the stock began recovering naturally and increased dramatically in the 1990s because of strong recruitment. However, recruitment returned to much lower levels in the 2000s. As a result, stock abundance and fisheries catch began to decline during the late 2000s.

The first full stock assessment of the White Seabass wild stock was completed in 2016 (Valero and Waterhouse 2016). The stock assessment was conducted using an integrated, statistical, age-structured model. The model estimated female spawning biomass in 2015 at 627 ton (569 metric ton (mt) (Figure 1-5) and that the population was at 27% of unfished levels. This value is below the Pacific Fishery Management Council (PFMC) biomass target depletion of 40% but above the Minimum Stock Size Threshold (MSST) of 25% for groundfish. PFMC policy is to declare a stock overfished if current spawning biomass falls at or below 25% of the unexploited biomass.

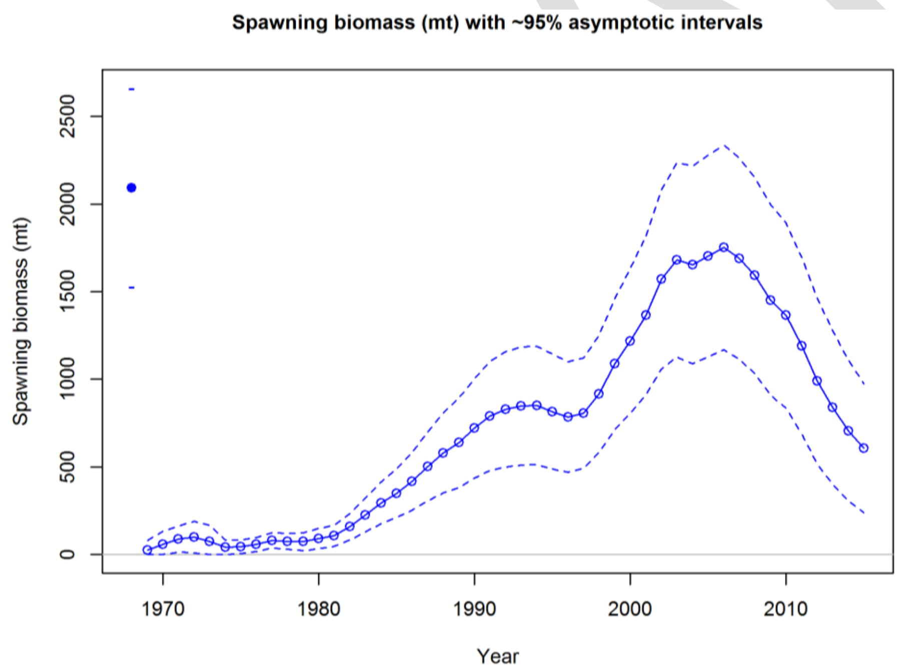


Figure 1-5. Time series of estimated female spawning biomass with 95% asymptotic confidence intervals. The blue dot before the start of the time series is the estimated equilibrium virgin unfished female spawning biomass with 95% asymptotic confidence interval (Reproduced from Valero and Waterhouse 2016).

### *1.2.2 Age Structure of the Population*

White Seabass comprise an important commercial and recreational resource in California, but the age structure of the population is uncertain. There have been several studies on White Seabass growth, based on length frequency, scale, and otolith analyses of fish sampled mainly in southern California (Clark 1930; Thomas 1968; Donohoe 1997; Williams et al. 2007; Hervas et al. 2010; Romo-Curiel et al. 2015). Length-at-age and length-at-weight relationships have been calculated for White Seabass but need to be verified by additional age and growth studies.

## 1.3 Habitat

Young of the Year (YOY) (age 0) White Seabass, ranging in length from 0.25 to 2.25 in (6.0 to 57.0 mm), inhabit the open coast at depths of 12 to 30 ft (4 to 9 m). YOY are closely associated with small drifting debris and algae in shallow areas just outside the surf zone (Allen and Franklin 1988, 1992). By age 2 yr, some have moved into protected bays and are found in association with eelgrass beds and kelp habitats (CDFG 2002). Larger juveniles are caught off piers, jetties, and in kelp beds. Adult White Seabass school over rocky substrate in or near large kelp beds. They are also found several miles offshore in schools swimming at or near the surface, particularly during the spring and summer months (Skogsberg 1939; Squire 1972; Aalbers and Sepulveda 2015).

## 1.4 Ecosystem Role

White Seabass are large, mobile, substratum predatory fish that primarily inhabit the coastal waters of southern California and Baja California, Mexico. White Seabass have a high affinity for warm water and spikes in yearly recruitment coincide with ENSO events (CDFG 2002). However, both giant kelp (Edwards 2004) and eel grass (Rasmussen 1977), which provide important habitat to White Seabass and their prey, are adversely affected by water temperature increases. Therefore, trends in warming oceanic conditions may be beneficial to White Seabass in the short term but deleterious in the long term due to habitat loss.

### *1.4.1 Associated Species*

White Seabass have no known associated species. However, they are often caught with other migratory species that have similar diets, such as Pacific Bonito (*Sarda lineolate*) and California Yellowtail (*Seriola lalandei*). It is not known how these species interact with White Seabass, or how the removal of White Seabass from the ecosystem would affect these relationships (CDFG 2002).

### *1.4.2 Predator-prey Interactions*

White Seabass are known to be opportunistic feeders on a variety of pelagic fish and invertebrate species including Northern Anchovy (*Engraulis mordax*), Jack Mackerel (*Trachurus symmetricus*), Pacific Mackerel (*Scomber japonicus),* Pacific

Sardine (*Sardinops sagax*), as well as Market Squid (*Loligo opalescens*), other small fishes, and pelagic red crabs when available. The White Seabass annual review process reviews the commercial landings and biomass trends for Northern Anchovy, Jack Mackerel, Pacific Mackerel, Pacific Sardine, and Market Squid and notes any adverse or significant changes in the availability of these species (www.wildlife.ca.gov/Conservation/Marine/WSFMP). As prey, White Seabass are eaten by other fish, sharks, and California Sea Lions (*Zalophus californianus*).

## 1.5 Effects of Changing Oceanic Conditions

The distribution of White Seabass and success of the commercial and recreational fisheries in California waters appear to be strongly influenced by environmental conditions. During warm water periods, White Seabass are difficult to find due to their migratory behavior. During these periods they may move father north and west in search of squid, which are much less available during warm conditions, or they may move north off the coast towards their preferred temperature range. Both the average recreational and commercial fisheries landings generally decrease during warm water periods and increase during cooler water periods (Figure 1-6) (Figure 1-7). There appears to be no consistent correlation between White Seabass catch and strong to very strong El-Niño events (e.g., 1957-1958, 1965-1966, 1972-1973, 1982-1983, 1997-1998, and 2015-2016). Interestingly, the average White Seabass catches are much greater at the beginning of a cool water period and then tend to decline significantly thereafter.

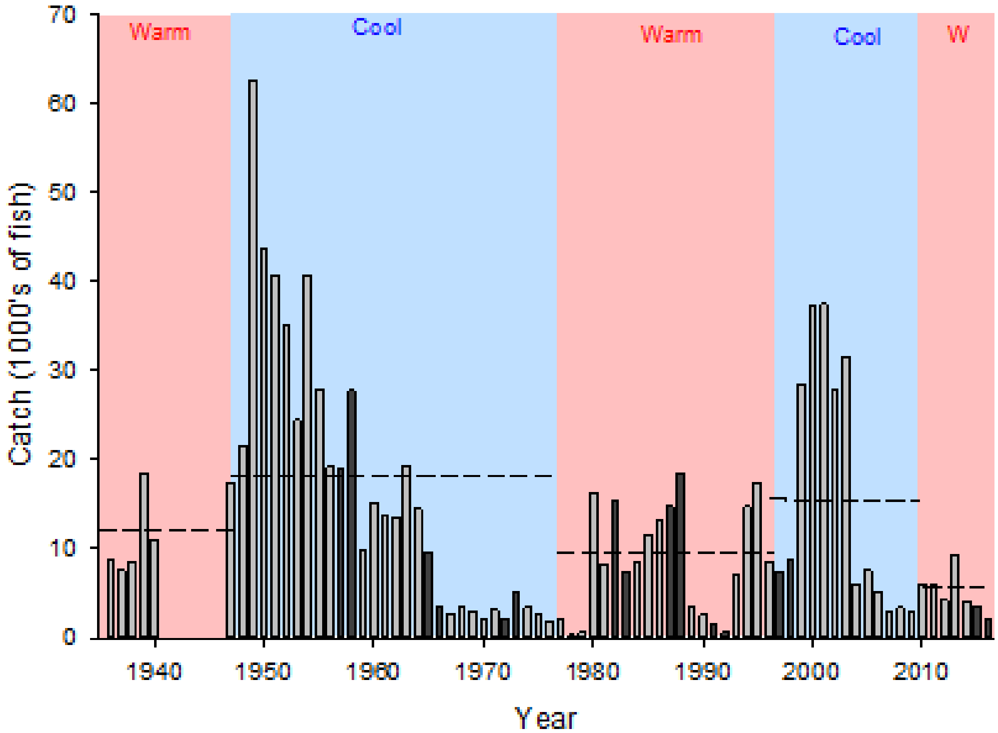

Figure 1-6. Historical recreational catch of White Seabass with PDO trends from 1936 to 2016. Dashed line represents the average number of fish caught per year for that time-period. Dark gray bars denote strong to very strong El Niño years (CDFW Marine Log System (MLS); Recreational Fisheries Information Network (RecFIN)).

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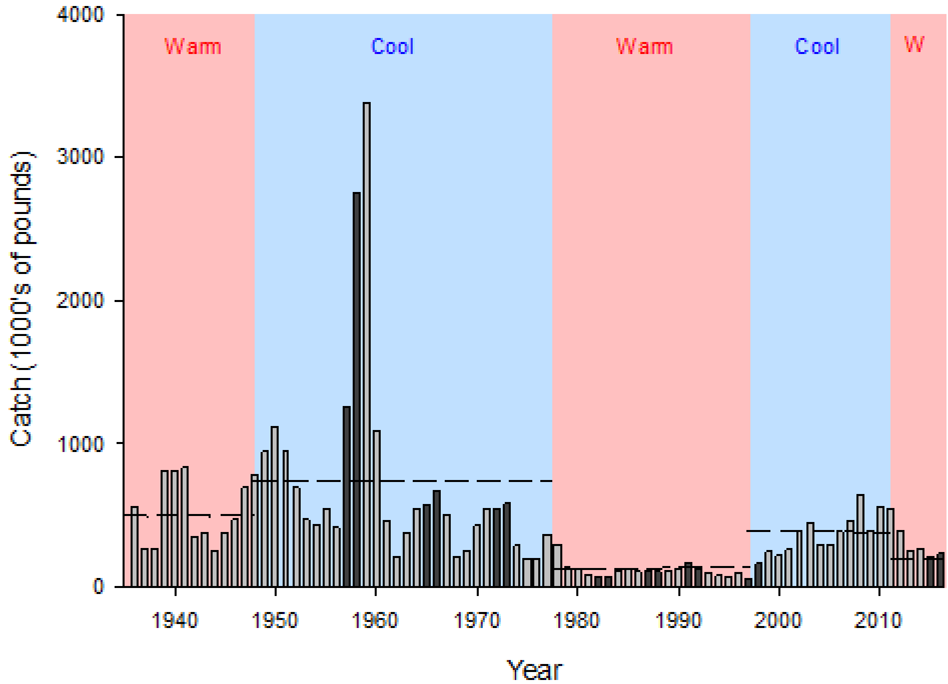


Figure 1-7. Historical commercial catch of White Seabass with PDO trends from 1936 to 2016. Dashed line represents the average number of fish caught per year for that time period. Dark gray bars denote strong to very strong El Niño years. Commercial catch data from 1936 to 1964 (Collyer 1949; Thomas 1968); Commercial catch data from 1965 to 2016 (CDFW Commercial Fisheries Information System (CFIS)).

White Seabass growth rates can also vary annually relative to temperature as noted in section 1.5. Williams et al. (2007) found that growth rates of juvenile White Seabass were positively correlated with higher SST that are characteristic of El Niño conditions. However, it is unclear if warm water periods of longer duration would have the same positive effect on juvenile growth or if juvenile growth would be adversely affected by lower primary production caused by lower nutrient levels, lower concentrations of oxygen, and stress from increased metabolism.

ENSO events can also affect White Seabass habitat. Juvenile and adult White Seabass are associated with eelgrass and kelp beds, which tend to be adversely affected by anomalously warm water (Rasmussen 1977 and Edwards 2004). The reduction or loss of kelp habitat potentially impacts White Seabass by reducing shelter and prey.

## 2 The Fishery

### 2.1 Location of the Fishery

White Seabass have been fished off the coast of California for at least 130 yr. In the early years, most of the catch was landed in the San Francisco area (Skogsberg 1939). By the 1920s, the majority of the catch (more than 80%) was being landed in southern California, and this is still the case today (Figure 2-1). It is unknown whether this shift in the White Seabass fishery range is due to changes in population density along the California coast, the effects of fishing, or changing oceanic conditions (CDFG 2002).

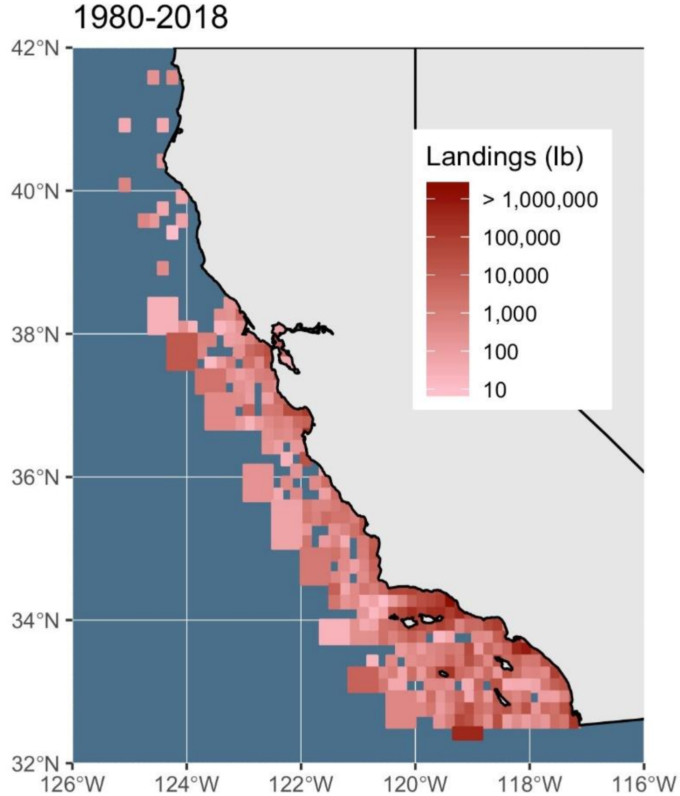


Figure 2-1. Map of commercial fishery landings by block from 1980 through 2018 (CDFW MLDS).

During the middle of the 1900s, the recreational fishery was concentrated between San Pedro and San Diego. Over time, as more recreational fishermen became interested in White Seabass, fishing activity expanded northwestward along the coast to Santa Barbara and out to the northern Channel Islands. Since these areas had been used by commercial fishermen, user conflicts increased. In the mid 1990s, implementation of the southern California nearshore gill net ban caused a shift in commercial fishing activity. The San Pedro/Huntington Flats area became less important as effort was focused at San Miguel, Santa Rosa, and Santa Cruz islands and along the mainland from Goleta northward (Figure 2-2). Increased regulation on the use of various commercial gears has created large areas along the mainland coast and offshore islands that have become de facto commercial fishing closures. Due to these changes, recreational fishermen have had better access to White Seabass than previously (CDFG 2002).

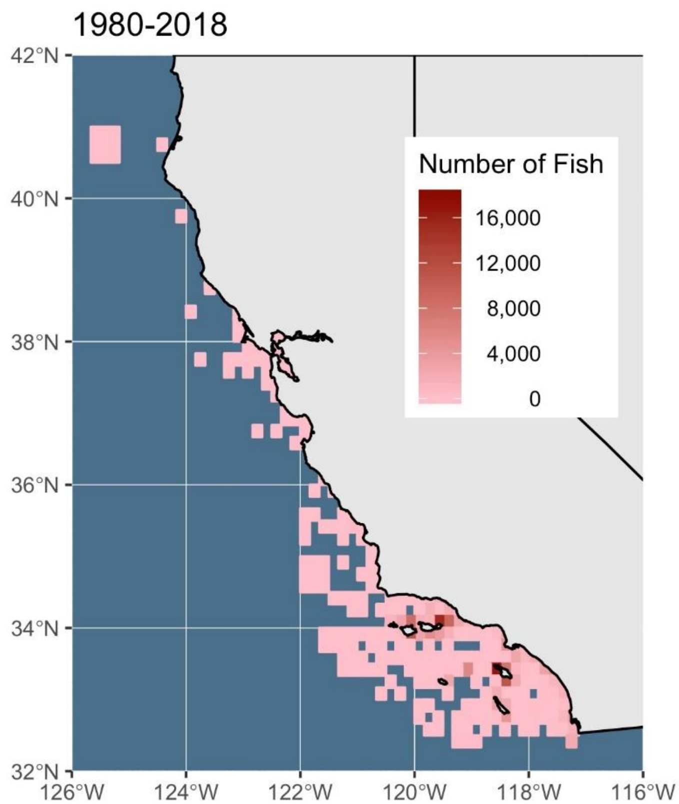


Figure 2-2. Map of recreational fishery landings by block from 1980 through 2018. (CDFW MLS).

## 2.2 Fishing Effort

### *2.2.1 Number of Vessels and Participants Over Time*

The commercial fishery for White Seabass has largely been composed of a small group of fishermen who target White Seabass with set gill nets, drift gill nets, and hook and line gear with the remaining catches landed incidentally in other fisheries. In the 1980s and 1990s, an average of 141 vessels (ranges from 91 to 199 vessels) participated annually in the White Seabass fishery; however, only about 20 vessels participated in the directed fishery, landing 80% of the annual catch. Since the mid 1980s, the number of vessels using set and drift gill net vessels has decreased, while the number of hook and line vessels has experienced a five-fold increase between 1980 and 2000. Since 2000, the number of vessels that have participated in the fishery has fluctuated considerably, with a minimum of 95 vessels participating in 2005, and a maximum of 257 vessels in 2012 (Figure 2-3). In the 2016-2017 season, there was a 32% decrease in the number of vessels participating in the fishery from the previous two seasons. Most of the fluctuation seen in the number of vessels occurs in the northern California commercial hook and line fishery. White Seabass migrating northward due to warmer water temperatures can lead to a marked increase in participation in the fishery in areas such as Monterey. Changes in market conditions, buyers entering or leaving the market, and the amount of fish entering the market from Mexico can also greatly affect the ex-vessel value and, subsequently the number of participants in the fishery.

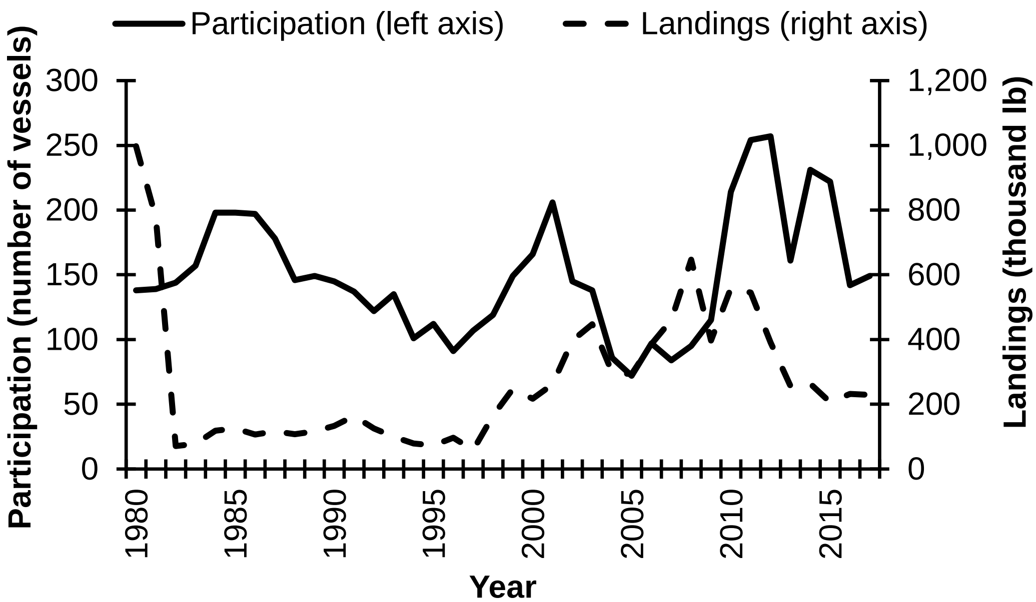


Figure 2-3. White Seabass commercial fishery participation (number of vessels) and landings (thousand lb), 1980 to 2017 (CDFW CFIS).

The size of gill net vessels has not changed significantly over time. Most boats range from 29 to 40 ft (9 to 12 m) in length and are crewed by a skipper working alone or with at least one deckhand. Gill nets are a type of passive entangling net that are attached to buoys at the surface and either staked to the bottom (set gill net) or allowed to drift with the currents (drift gill net). Both set and drift gill nets hang like a wall vertically in the water and entangle fish by the gills as they try to swim through the mesh (Figure 2-4). The amount of time nets are in the water depends on the availability of White Seabass, weather conditions, and presence of marine mammals. Most drift gill nets along the mainland shore are set just prior to sunset and pulled 2 or 3 hours later. At the Channel Islands, drift gill nets may be set for up to 12 hours. Set gill nets remain in the water for about 16 hours. In the hook and line sector, vessels ranging in size from 20 to 45 ft (6 to 14 m) are used, and will either drift or anchor within or adjacent to kelp beds when targeting White Seabass.

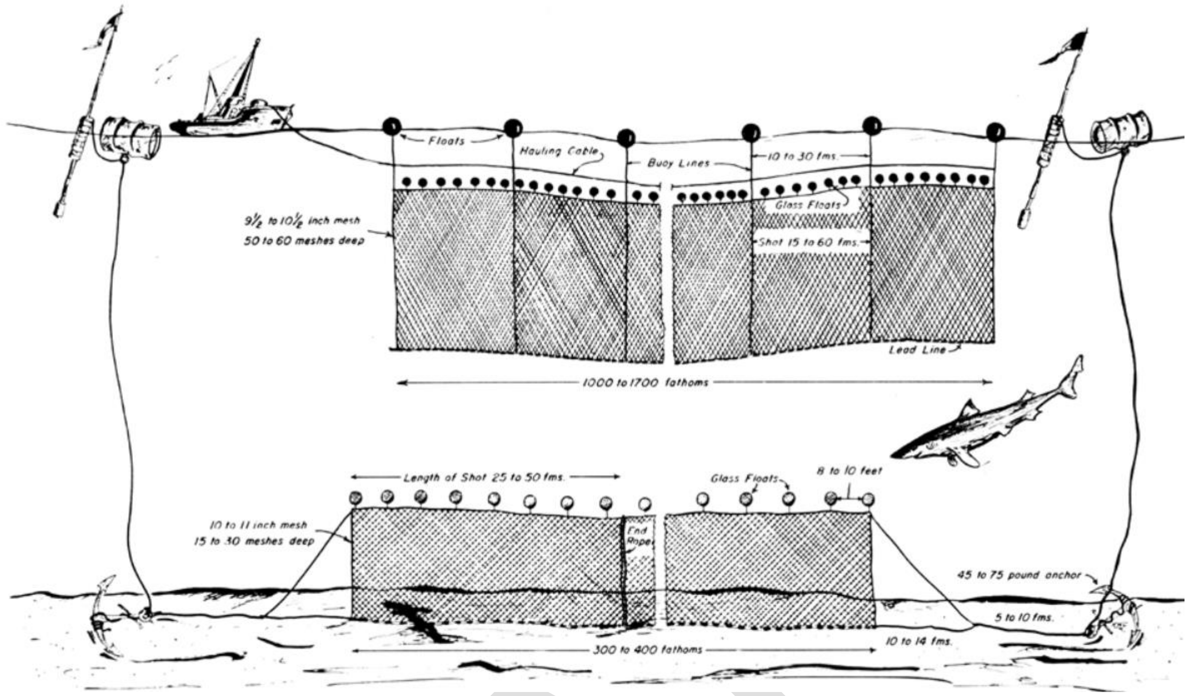

Figure 2-4. Diagram of a drift gill net (top) and set gill net (bottom) (Reproduced from Roedel and Ripley 1950- Drawing by Keith W. Cox).

There is limited information on the number of participants in the recreational fishery. Marine recreational anglers fishing south of Pt. Arguello are required to purchase an Ocean Enhancement Validation with their sport license; therefore, the number of validations sold per year indicates the number of marine anglers in southern California. However, both the number of marine anglers for the entire state of California and the number of fishermen targeting White Seabass is unknown. In 2018, there were 264,593 OREHP stamps sold, while the number of recreational fishing licenses sold totaled 1,776,989.

Vessel efficiency is thought to have increased over time, aided by advances in marine vessel electronic technology. These innovations have improved the ability of vessels to locate White Seabass.

### *2.2.2 Type, Amount, and Selectivity of Gear*

White Seabass are caught by multiple gear types in both the recreational and commercial fisheries. These are described in the sections below.

#### *Recreational*

White Seabass are most often fished by recreational fishers using hook and line gear using live bait in relatively shallow water, but are also taken with a fast-trolled spoon, artificial squid, or bone jig. Hook and line anglers can fish for White Seabass from shore, including beaches and man-made structures, such as jetties and piers, private or rental boats, and charter or party boats (Commercial Passenger Fishing



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Vessels (CPFV)). Live squid appear to be the best and most commonly used White Seabass bait, but large anchovies and medium sized sardines are also effective live bait. Scuba and free divers using spear guns also take White Seabass, though this sector is thought to be relatively small.

*Commercial*

Historically, commercial fishermen used gill nets, hook and line, trawl nets, and roundhaul gear such as lampara and purse seine nets to take White Seabass. Lampara and purse seine nets were used in the early years of the fishery until it became unprofitable (Whitehead 1930). The two types of gill nets used are set nets and drift gill nets with 6 to 7 in (152 to 178 mm) mesh (stretched mesh, knot to knot). In the late 1970s and 1980s, set nets were the principle gear used to take White Seabass in California waters while drift gill nets were used primarily in Mexican waters (Vojkovich and Reed 1983). In the mid 1990s, drift gill nets played a larger role in the California fishery than set nets.

The other principle gear used in the commercial fishery is hook and line. In the early years of the fishery, handlines were used to take White Seabass (Skogsberg 1925). As technology changed, fishing with rod and reel and live bait became more prevalent (Skogsberg 1939). Today, rod and reel and longlines are the two types of hook and line gear used. Commercial rod and reel gear is similar to that used by the recreational industry, consisting of monofilament line with two hooks and either live squid or sardine as bait. Set longlines are also used and consist of a buoy and vertical line attached to an anchor and mainline, which can vary in length. Along the mainline are equidistant, snap-on gangions with hooks. The mainline is monofilament and is taken on and off the boat by means of a reel. This gear is typically fished over sandy substrate and the duration of the set is the amount of time it takes to set and retrieve the gear (CDFG 2002). It takes at least two people to work longline gear.

*Selectivity of the Gear*

There is limited information on selectivity for the different gears that catch White Seabass. In general, the recreational fishery catches mostly smaller, younger, and potentially immature individuals, whereas the commercial fishery lands relatively larger, older fish (Figure 2-5). Anglers fishing from CPFVs and private vessels typically catch many undersized fish and relatively few large fish, and those fishing from piers and jetties catch undersized fish almost exclusively. The exception to this is the spear fishing sector of the recreational fishery, which tends to target larger fish, though this may be seasonal. From September through February, when there is a bag limit of three White Seabass per day, there may be increased take of sublegal White Seabass, but when the bag limit is reduced to one White Seabass per day from March 15 to June 15, spear fishers may tend to target only larger fish (CDFG 2002).

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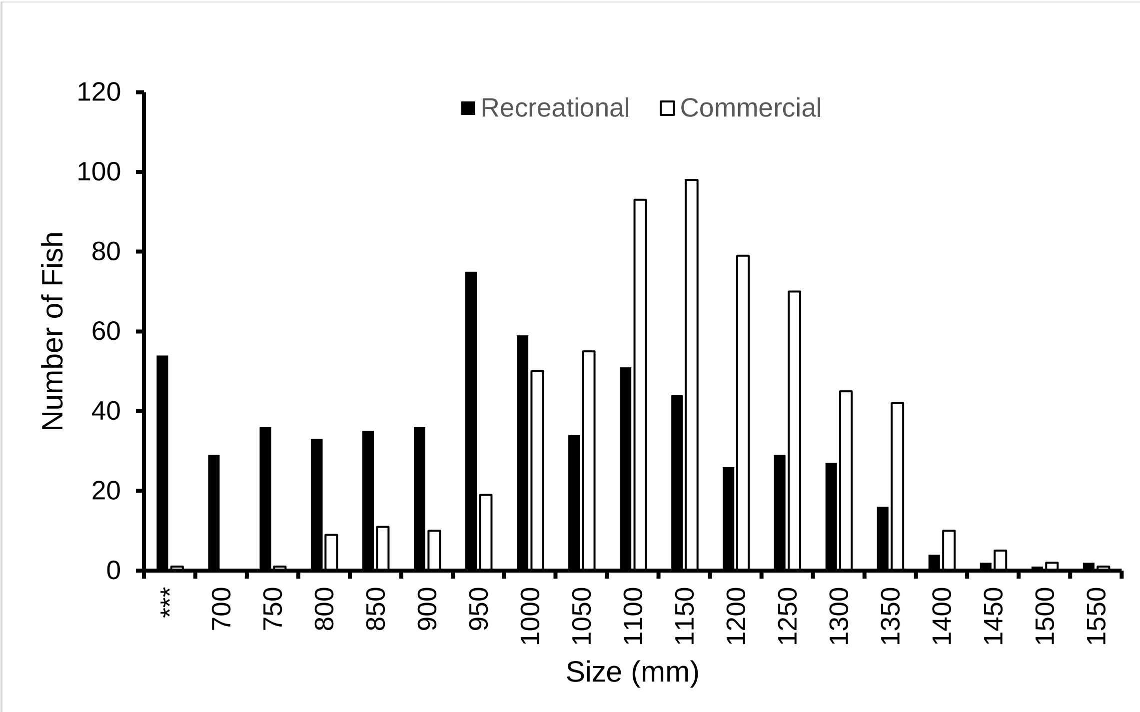


Figure 2-5. Recreational and commercial White Seabass sampled length frequencies, 2013-2014 through 2016-2017 (RecFIN (Recreational data); CDFW White Seabass sampling program (commercial data)).

Taking smaller fish may have a negative effect on the overall abundance of the population by removing individuals that have not yet spawned. Smaller White Seabass may also be more susceptible to injury and mortality as a result of catching, handling, and release. Since White Seabass have just reached sexual maturity at their minimum legal size limit of 28.0 in (71.1 cm), this take of undersized fish may have contributed to lower population sizes in recent years (CDFG 2002).

## 2.3 Landings in the Recreational and Commercial Sectors

White Seabass landing records date back to 1889 (Figure 2-6). This section discusses the historical landings in the commercial and recreational sectors of the White Seabass fishery. The following sections describe how landings have changed in both the recreational fishery and the commercial fishery since 1980.

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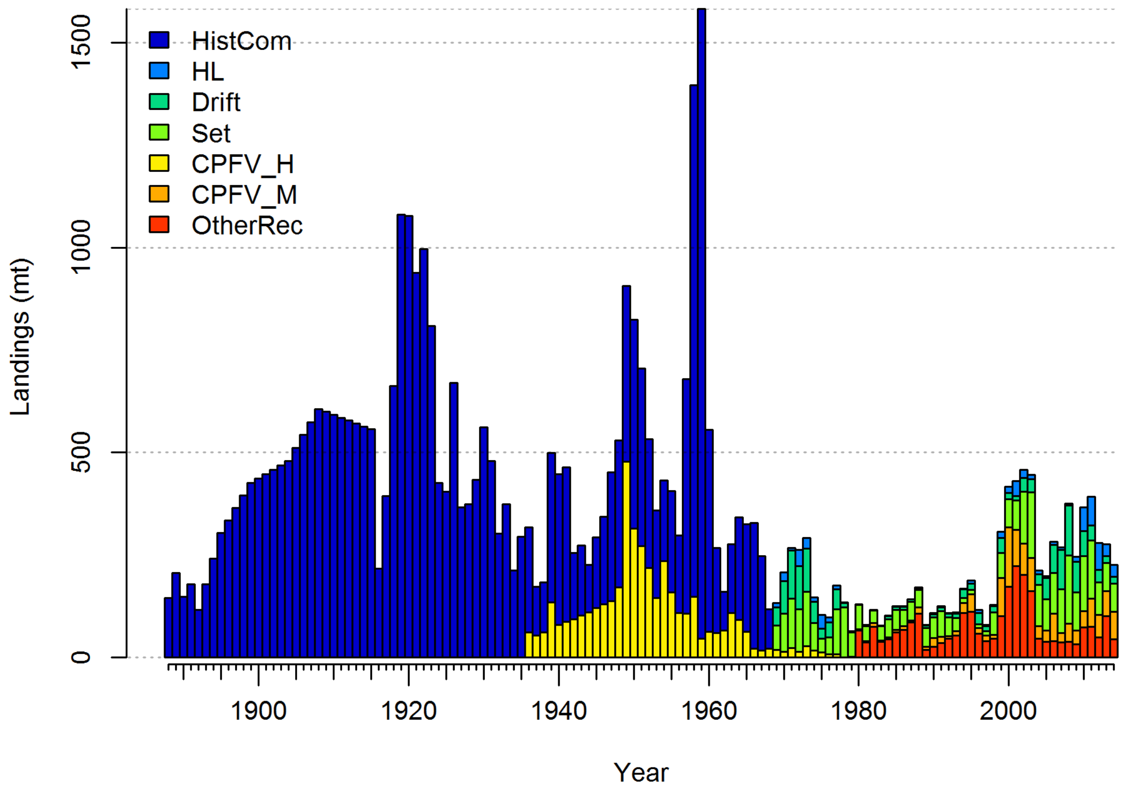


Figure 2-6. Total landings (mt) between 1889 and 2014 by fleet. Fleets include Commercial Historical (HistCom), Hook-and-Line (HL), Drift Gill net (Drift), Set Gill net (Set), Historic Commercial Passenger Fishing Vessel (CPFV_H), Modern Commercial Passenger Fishing Vessel (CPFV_M), Other Recreational (OtherRec) (Reproduced from Valero and Waterhouse 2016).

Commercial White Seabass landings have fluctuated dramatically over the years (Figure 2-6). Landings were moderate during the late 1800s but grew between 1889 and 1915. By 1904, more than 1 million lb (454 mt) were landed annually. Declining catches in the late 1920s and early 1930s prompted a series of commercial regulations including closed seasons, bag limits, gear restrictions and minimum size limits (Skogsberg 1939). During the 1930s and 1940s, commercial landings ranged from 250,000 to 900,000 lb (113 to 408 mt). The greatest peak in commercial landings occurred during the warm water year of 1959, when more than 3 million lb (1361 mt) were taken. Between 1959 and 1965, commercial landings dropped sharply, and remained below 600,000 lb (272 mt).

Prior to the mid 1930s no data was collected on recreational landings. Since that time annual recreational catches of White Seabass have fluctuated considerably over the years, with much of the recreational catch occurring aboard CPFVs (Figure 2-6). According to CPFV logs, the bulk of White Seabass landed recreationally in California are caught in federal waters, with a small percentage caught in Mexican waters. Historical records show that at the peak of the recreational fishery for White Seabass (1947 to 1959), anglers on CPFVs landed an average of 373,100 lb (169 mt) per year.

This was followed by a steady decline in the average annual catch: 125,200 lb (57 mt) during the 1960s, and 41,100 lb (19 mt) in the 1970s (CDFG 2002).

### *2.3.1 Recreational*

Large recreational catches of White Seabass take place only occasionally, at irregular intervals, and at scattered localities. From the 1950s to 1970s, higher catches were seen in nearshore coastal areas off the southern California mainland. In contrast, throughout the 1980s and 1990s, the highest catches were recorded off the Channel Islands (CDFG 2002). In the 1980s and early 1990s annual catches were low, with an average of 52,000 lb (24 mt) (Figure 2-7). Recreational catches increased in the mid 1990s through the mid 2000s, peaking at more than 650,000 lb (295 mt) in 2000 (Figure 2-6). This can be attributed to increases in both the availability of White Seabass and in fishing effort (CDFG 2002). Since the mid 2000s the recreational catches of White Seabass have been moderate at an average of 192,000 lb (87 mt) and fairly stable.

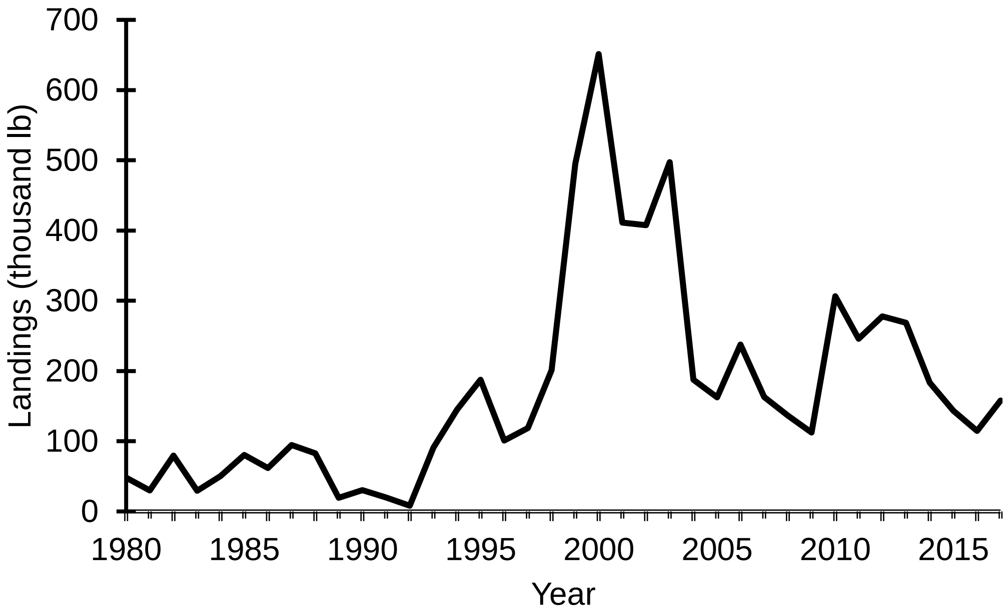


Figure 2-7. White Seabass recreational fishery landings (thousand lb), 1980 to 2017 (CDFW MLS; RecFIN).

### *2.3.2 Commercial*

In the 1980s and 1990s regulatory changes affected commercial landings. In 1982, Mexican waters were closed to U.S. fishermen, and as a result catches declined sharply (91%) between 1981 and 1982 (Figure 2-8). In 1990, California Proposition 132 banned the use of gill nets in state waters south of Point Conception and became effective January 1, 1994. This also contributed to the decline in commercial White Seabass landings and catches remained low until the late 1990s. After that period, catches steadily increased, peaking in the 2007-2008 season. This increase in catch has been primarily attributed to an increase in the abundance of White Seabass (Valero and Waterhouse 2016).

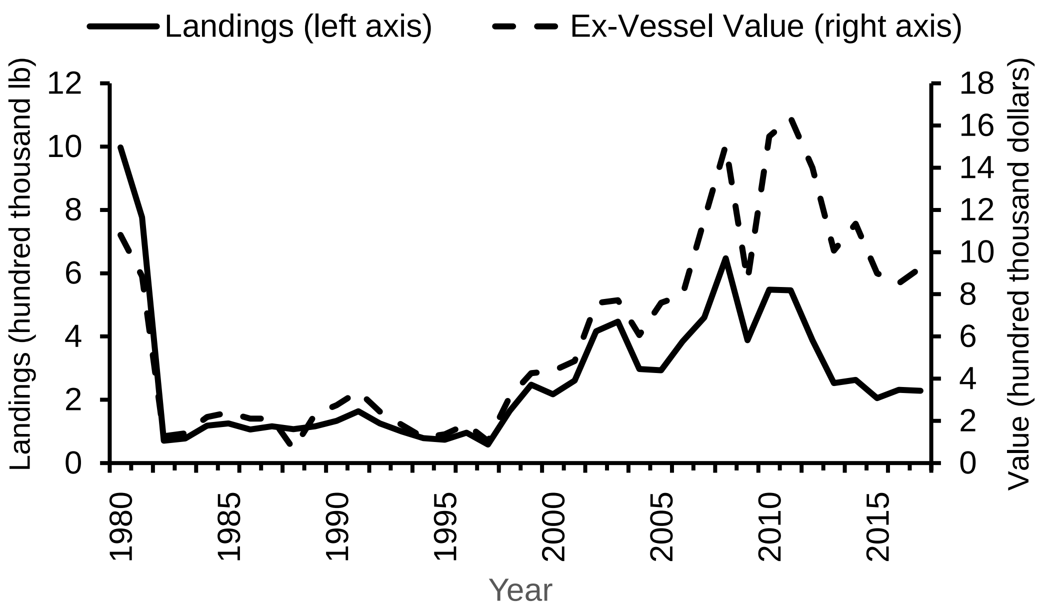


Figure 2-8. White Seabass commercial fishery landings (hundred thousand lb) and value (hundred thousand dollars), 1980 to 2017 (CDFW CFIS).

## 2.4 Social and Economic Factors Related to the Fishery

The commercial and recreational fisheries for White Seabass in California produce a ripple effect in the California economy. Money generated in these industries stimulates further economic growth throughout the state of California in the form of jobs, income and output. The following sections provide additional information on the socio-economic factors related to each sector.

### *Recreational Socio-economic Factors*

White Seabass is an important sport fish that, along with other marine sport fish, has become more popular with recreational anglers every year (CDFG 2002). This species has a special allure for anglers, likely due to its potential size, eating quality, and elusive nature.

The amount of money spent in the pursuit of White Seabass contributes to the growth of the recreational fishing industry and California's economy through various local businesses and other indirect, fishing related expenditures. There is limited socio-economic information available for the recreational White Seabass fishery, but there is some general information on the spending of recreational anglers. In 2011, the total economic contribution of saltwater recreational anglers in California was roughly $2.8 billion (Lovell et al. 2013). Saltwater anglers spend substantial amounts of money on

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fishing related items such as boat maintenance, fishing licenses, and fishing gear, as well as trip related expenditures such as food, gasoline, parking, lodging, and tickets for CPFV trips. In 2011, anglers in California spent nearly $122 million on CPFV trip related expenses (31% of all trip related expenditures), while private and rental boat trip related expenses totaled about $78 million (about 20% of all trip related expenditures). Anglers who fished from shore in California spent close to $188 million on trip related expenses (about 48% of all marine angler trip expenditures).

*Commercial Socio-economic Factors*

Public demand and fish businesses also influence fishing effort. Because of consumer demand, White Seabass has always commanded relatively high prices for whole dressed (gutted) fish, and between 2010 and 2016, the average price per pound has been $4 or higher (Table 2-1). At the beginning of the season, a premium price is paid for White Seabass; however, if availability is high, the price can drop later in the season. This flooding of the market results in fishermen reducing the number of days they target White Seabass or shifting to another species (California Halibut (*Paralichthys californicus*), Swordfish (*Xiphias gladius*), etc.). Total ex-vessel value of the fishery has tracked landings, and between 2006 and 2017 has averaged over $1 million annually (Figure 2-6).

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Table 2-1. White Seabass price per pound, 2005-2006 through 2016-2017.

| Season | Average Ex-vessel Price per Pound |
|---|---|
| 2005-2006 | $3.00 |
| 2006-2007 | $3.00 |
| 2007-2008 | $3.50 |
| 2008-2009 | $3.50 |
| 2009-2010 | $3.50 |
| 2010-2011 | $4.00 |
| 2011-2012 | $4.00 |
| 2012-2013 | $5.00 |
| 2013-2014 | $5.50 |
| 2014-2015 | $4.00 |
| 2015-2016 | $4.00 |
| 2016-2017 | $4.00 |

Over the last two decades, commercial fishermen have sold their catch to fish businesses distributed along the coast from San Diego to Eureka. Market prices are affected by such factors as the availability of White Seabass, competition from foreign markets, and consumer demand. The majority of fish businesses that receive White Seabass are located in southern California. Only a small number of these businesses purchase 2.5 ton (2.3 mt) or more annually. Fish businesses may influence fishing effort through the importation of White Seabass from Mexico. Imports from Mexico cost less than White Seabass caught in California, and if White Seabass caught in Mexico is readily available, markets will not buy fish from local fishermen unless there is a special need for local fresh-caught fish.

There are five major port areas associated with California's commercial White Seabass fishing industry in southern California: Santa Barbara, Ventura, Oxnard, San Pedro (Los Angeles), and San Diego. Collectively, these five major port areas account for 89% of the total landings from 2013 through 2017. The remaining 11% of landings were largely made at ports in the San Luis Obispo, Monterey, and San Francisco areas (Figure 2-9).

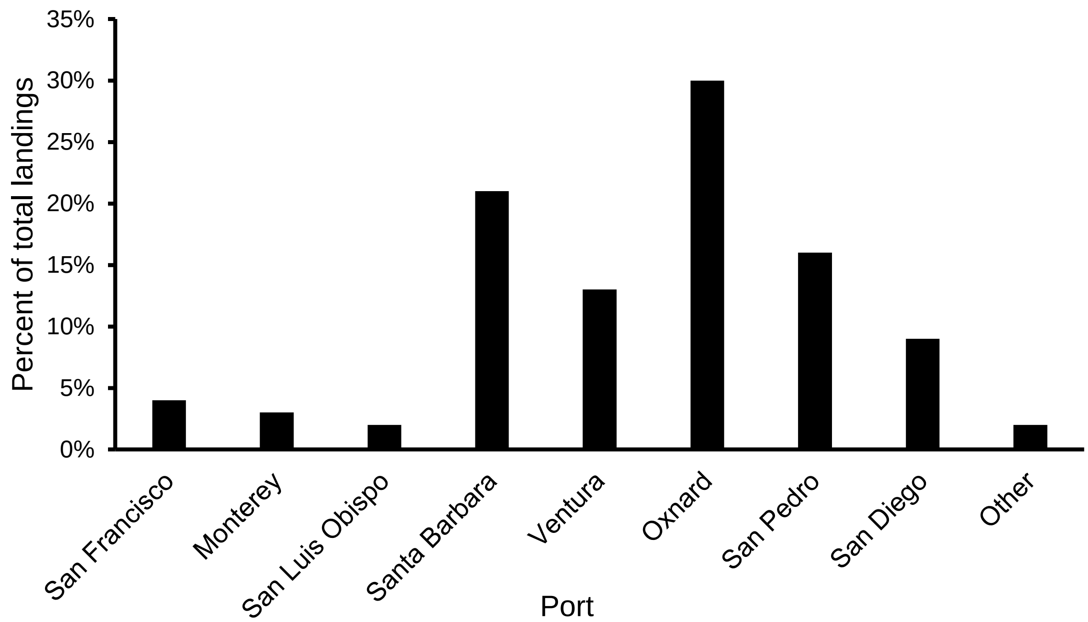


Figure 2-9. White Seabass percentage of total commercial landings by port, 2013 to 2017 (CDFW CFIS).

*Non-consumptive Use*

Non-consumptive use of the fishery includes activities of scuba and skin divers, such as underwater photography and wildlife viewing. Although data are unavailable for the entire southern California area, socio-economic data related to diving activities in the Channel Islands Marine Sanctuary (CINMS) and surrounding offshore area from Point Sal to Point Mugu have been collected, and suggest that these areas contribute to California's tourism economy in part due to opportunities to see large fish such as White Seabass (Leeworthy 2000). CINMS and the surrounding area is a popular diving location and contains prime habitat for White Seabass.

# 3 Management

## 3.1 Past and Current Management Measures

*Commercial Fishery*

Declining White Seabass landings in the late 1920s and during most of the 1930s led to a series of regulations designed to stabilize the catch (Young 1973). The first of these regulations was instituted in 1931, aimed primarily at the commercial fishery (Figure 3-1). The first regulations enacted were a commercial fishing closure during May and June and a commercial minimum size limit of 28 in (711 mm) (Fish and Game Code (FGC) §8383.5). The main purposes of these restrictions were to protect White Seabass during spawning, and to provide for spawning opportunities, at least twice, before the fish were caught (Skogsberg 1939). Through the 1930s, purse seine, roundhaul nets, and gill nets were the primary gear types in the commercial fishery. The use of purse seine and other roundhaul nets to take White Seabass in waters off California was prohibited in 1940 due to their effectiveness of targeting aggregations of White Seabass at night (FCG §8623(a)) (Skogsberg 1939; Vojkovich and Reed 1983); however, their use in Mexican waters was still allowed and fishermen could transit through California waters with purse seine-caught fish under a Department-issued permit. In 1982, the Mexican government enacted a Foreign Fishery Act that closed Mexico's waters to the U.S. and all other foreign countries. In addition to the prohibition of purse seine and other roundhaul nets, a minimum gill net mesh size of 3.5 in (89.0 mm) was also established in 1941. The gill net mesh size was increased to a minimum of 6.0 in (152.0 mm) in 1988 (FGC §8623(d)). Six years later continued concern over White Seabass and other commercial stocks, as well as high levels of bycatch in associated coastal fisheries, led to the Marine Resources Protection Act of 1990 (Article XB, California Constitution). The Marine Resources Protection Act of 1990 banned the use of gill and trammel nets in state waters along the mainland shore south of Point Arguello, Santa Barbara County, and 1 mile (mi) offshore or within 70 fathoms (fm) (128 m) around the Channel Islands mainland (Article XB, California Constitution; FGC §8610.4). In 2002, the Commission banned the use of gill nets within 60 fm (110 m) from Point Reyes, Marin County to Point Arguello (§104.1, Title 14, CCR).

*Recreational Fishery*

In 1913, the Anglers License Act made it a misdemeanor for any person over 18 years of age to take, catch, or kill any "game fish" for any purpose other than profit, without first purchasing a license. For purposes of the Act, "game fishes" did not include White Seabass, but it was added to the list of "game fish" in 1937 (Figure 3-2). The addition of White Seabass to the list meant that all persons catching White Seabass for sport had to have a sport fishing license. This change meant the size limit and season closure regulations instituted prior to 1937 also applied to sport take.

In 1949, the sport bag limit for White Seabass was set at ten fish per day, with not more than five White Seabass less than 28 in (711 mm) in length. In 1957, the allowance for undersized fish was reduced to two fish per day. In 1971, the allowance for undersized fish was abolished; however, it was reestablished in 1973 when the possession of one White Seabass shorter than 28 in (711 mm) was allowed. In 1978, it once again became illegal to possess any White Seabass less than the minimum size limit, and the daily bag limit was reduced from ten to three fish (§28.35, Title 14, California Code of Regulations (CCR)).

In 1980, a seasonal closure was enacted which prohibited the possession of any White Seabass from March 15 through June 15. In 1984, an allowance of one legal size fish per day during the closed season was enacted (§28.35, Title 14, CCR). These restrictions were put in place to protect White Seabass during spawning and to provide for spawning opportunities before the fish were caught (Skogsberg 1939).

### *3.1.1 Overview and Rationale for the Current Management Framework*

California's White Seabass fishery is currently managed under the White Seabass Fishery Management Plan (WSFMP), developed by the Department and adopted by the Commission in June 2002. The WSFMP includes a provision for annual monitoring and assessment of the White Seabass fisheries. The annual review (www.wildlife.ca.gov/Conservation/Marine/WSFMP) includes fishery-dependent data (e.g., commercial and recreational landings and length frequencies), and fishery-independent data (e.g., recruitment information) if available, as well as documented changes within the social and economic structure of the recreational and commercial industries that utilize the White Seabass resource within California. The review also includes information, if available, on the harvest of White Seabass from Mexican waters and other relevant data.

The WSFMP also established a White Seabass Scientific and Constituent Advisory Panel (WSSCAP) to assist the Department and Commission with review of the fishery assessments, management proposals, and plan amendments. The WSSCAP consists of seven members representing the scientific community, recreational and commercial fishing industries, and environmental groups. Included within the scope of WSSCAP responsibilities is the annual review. Based on the results of the annual review, in cooperation with the WSSCAP, the Department provides management recommendations, if needed, to the Commission.

The annual review process is intended to foster a continuous and vigilant review of the White Seabass stocks and fisheries to prevent overfishing or other resource damage. Measurable long-term fishery-dependent and fishery-independent data such as catch trends, recruitment patterns, and forage abundance indices are used to monitor the effectiveness of current management measures and can alert the Department and WSSCAP to potential problems within the White Seabass stocks. The Department and WSSCAP can then determine appropriate trigger mechanisms for the White Seabass stocks and can use them to provide management recommendations to the Commission. In turn, the Commission could implement needed management measures in a timely manner through the points of concern process (CDFG 2002).

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

In 2002, the Commission established a fishing season of September 1 through August 31 of the following year. The Commission also adopted an Optimum Yield (OY) that serves as the harvest guideline or quota for each season. The OY is based on a proxy for Maximum Sustainable Yield (MSY) and is currently set at 1.2 million lb (544 mt). Under this proxy, a catch exceeds this amount in a single season would be considered overfishing.

To assist the Commission in determining if management targets are being met, the WSFMP framework includes points of concern criteria to help determine when management changes are needed to address resource issues. This FMP framework provides the authority to act based solely on the points of concern. Thus, the Commission may act quickly and directly to address a resource conservation issue. The points of concern are:

1. Catch is expected to exceed the current harvest guideline or quota.
2. Any adverse or significant change in the biological characteristics of White Seabass (size composition, age at maturity, or recruitment) is discovered.
3. An overfishing condition exists or is imminent. This is evaluated based on the following criteria: A) a 20% decline in the total annual commercial landings of White Seabass for the past two consecutive seasons compared to the prior five season average; B) a 20% decline in both the number of fish and the average size of fish caught in the recreational fishery; C) a 30% decline in Ocean Resources Enhancement and Hatchery Program (OREHP) recruitment indices for juvenile White Seabass compared to the prior five season average.
4. Any adverse or significant change in the availability of White Seabass forage or in the status of a dependent species is discovered.
5. New information on the status of White Seabass is discovered.
6. An error in data or stock assessment is detected that significantly changes estimates of impacts due to current management.

None of the points of concern have been met so no management changes have been adopted since the inception of the WSFMP. However, because the stock assessment has shown the population to be in decline (See section 1.2.1), the Department continues to closely monitor the fishery.

*3.1.1.2* *Past and Current Stakeholder Involvement*

White Seabass is one of the most important commercial and recreational fisheries in California and is targeted by a diverse group of recreational fishermen ranging from divers and kayakers to hook and line and gill net fishermen. The commercial fishery for White Seabass is largely composed of a small group of fishermen who target White Seabass with set and drift gill nets and hook and line gear. Many of these stakeholders are directly involved with White Seabass management through the WSSCAP, as well as the OREHP. Stakeholders involved with the OREHP include representatives from recreational fishermen, K-12 education, commercial fishermen, non-profit environmental and educational organizations, academic scientists, non-consumptive recreation, and the aquaculture industry.

### *3.1.2 Target Species*

#### *3.1.2.1 Limitations on Fishing for Target Species*

##### *3.1.2.1.1 Catch*

The fishing season for White Seabass is September 1 through August 31 of the following year (§51.01, Title 14, CCR). The OY, which serves as the catch limit, is currently set at 1.2 million lb (544 mt) (§51.05, Title 14, CCR). The OY has not been reached since it was set in 2002.

##### *3.1.2.1.2 Effort*

The total number of participants in the White Seabass recreational and commercial hook and line fisheries are not limited by regulation. However, the commercial gill net fishery has been a limited entry fishery since 1986 when 862 general gill net permits were purchased by eligible fishermen. Of these, only 121 gill net vessels landed White Seabass during the 1986-1987 season. Since then, this number has steadily decreased to 119 general gill net permits purchased by eligible fishermen, with only 28 gill net vessels landing White Seabass during the 2016-2017 season.

##### *3.1.2.1.3 Gear*

The commercial fishery targets White Seabass primarily by set and drift gill nets. Gill nets with meshes of a minimum length of 6.0 in (152.4 mm) may be used to take White Seabass except during June 16 to March 14 when not more than 20% by number of a load of fish may be White Seabass, up to ten fish per load, can be taken in gill or trammel nets with meshes 3.5 to 6.0 in (88.9 to 152.4 mm) in length (FGC §8623). The use of purse seine or round haul nets to take White Seabass is prohibited (FCG §8623(a)) (Section 3.1).

There are no specific gear restrictions for recreational fishing of White Seabass. Most White Seabass are caught by the recreational fleet onboard CPFVs and private boats using hook and line. White Seabass are also taken by divers using spear, but likely to a lesser extent (Section 2.2.1).

##### *3.1.2.1.4 Time*

To protect White Seabass during spawning, the commercial fishery for White Seabass is closed between Point Conception and the U.S. and Mexico border from March 15 to June 15, except one fish may be taken, possessed, or sold by a vessel each day if taken incidental by gill and trammel net fishing operations (§155, Title 14, CCR).

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The recreational fishery is open all year, but most of the recreational take occurs between March and September. The daily bag limit is three fish, except from March 15 through June 15 when the daily bag limit is one fish (§28.35, Title 14, CCR) (Section 3.1).

*3.1.2.1.5 Sex*

There are no restrictions on the sex of White Seabass that can be retained.

*3.1.2.1.6 Size*

There is a minimum size limit of 28 in (711 mm) for both the commercial and recreational fisheries (§28.35(a), Title 14, CCR; FGC §8383.5). This is to provide White Seabass spawning opportunities, at least twice, before recruiting into the fisheries.

*3.1.2.1.7 Area*

To further protect White Seabass and other commercial stocks as well as reduce the levels bycatch in associated coastal fisheries, White Seabass cannot be taken by gill and trammel nets in ocean waters that meet the following conditions (Article XB, California Constitution; FGC §8610.2):

- in waters less than 70 fathoms or within one mile, whichever is less, around the Channel Islands, consisting of the Islands of San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente.

- area within three nautical miles offshore of the mainland coast, and the area within three nautical miles off any manmade breakwater, between a line extending due west from Point Arguello and a line extending due west from Mexican border.

- in waters less than 35 fathoms between a line running 180 degrees true from Point Fermin and a line running 270 degrees true from the south jetty of Newport Harbor.

*3.1.2.1.8 Marine Protected Areas*

Pursuant to the mandates of the Marine Life Protection Act (Fish and Game Code (FGC) §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. No-take designations include State Marine Reserves (SMRs) and no-take State Marine Conservation Areas (no-take SMCAs). Limited take MPAs include SMCAs, State Marine Parks, and State Marine Recreational



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Management Areas. Special closures are not MPAs, but relatively small, discrete marine areas that protect nesting and roosting seabirds and marine mammals from disturbance by restricting seasonal or year-round access (CDFW 2016). While this section focuses on MPAs pursuant to the MLPA, it is important to note that there are other spatial closures created for fishery management purposes under separate state and federal authority, such as Rockfish Conservation Areas (RCAs), state trawl closures, the Cowcod Conservation Area, and Essential Fish Habitat closures (CDFW 2018).

Between Point Conception (Santa Barbara County) and the U.S. and Mexico border, 50 MPAs were implemented in 2012 (including 13 previously established at the northern Channel Islands that were retained without change). These MPAs cover approximately 355 square miles ($mi^2$) (or 15%) of state waters in the region, including approximately 275 $mi^2$ (or about 12%) within SMRs and no-take SMCAs (CDFW 2016). White Seabass may benefit from the spatial management of MPAs. For example, the MPAs between Point Conception and the U.S. and Mexico border protect approximately 3.5% of eelgrass and 10.2% of kelp habitats are protected (CDFW Marine Region Geographic Information System). Since juvenile White Seabass associate with eelgrass and kelp habitats (Section 1.3), the protection of these habitats from consumptive activities may help increase juvenile White Seabass survival before they recruit into the fishery.

#### *3.1.2.2 <u>Description of and Rationale for Any Restricted Access Approach</u>*

The drift and set gill net fisheries have been limited entry fisheries since 1986. New permits may not be issued, and there are restrictions on the transfer of existing permits. For a transfer to be approved, the new participant must meet certain conditions, including proof of participation in the fishery for a certain period and proof of passing a proficiency examination administered by the Department. These restrictions are designed to control fishing capacity, as well as to assure that fishermen are knowledgeable and/or experienced in the fishery before they are permitted to operate a gill net vessel.

### *3.1.3 Bycatch*

#### *3.1.3.1 <u>Amount and Type of Bycatch (Including Discards)</u>*

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.

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*Discards of Sublegal White Seabass*

White Seabass that are smaller than the minimum size limit of 28 in (711 mm) must be discarded (FGC §8383.5; §28.35(a), Title 14, CCR). Discard after capture may cause injury, permanent damage, or death. White Seabass may be particularly vulnerable due to their weak, soft mouths that are easily torn, as well as their susceptibility to barotrauma (CDFG 2002). Barotrauma (trauma due to rapid changes in atmospheric pressure) injuries affecting the gas bladders of White Seabass have been observed in fish brought up from depths as shallow as 10 ft (3 m) (CDFG 2002). Fish caught in depths greater than 50.0 ft (15.2 m), most likely suffer barotrauma injuries that result in death, regardless of proper gas bladder deflation.

Recreational anglers tend to land smaller fish than those from the commercial fishery due in part to the selectivity of commercial gill nets in capturing larger fish because of the mesh size. It is unknown how often sublegal White Seabass are released and the level of associated mortality in the recreational fishery. In 2009, the Department prepared and distributed a brochure targeting recreational anglers to improve compliance with the minimum size limit for White Seabass (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=36629&inline). Since this brochure was distributed, less than 10% of fish measured by the California Recreational Fisheries Survey were shorter than the minimum size limit.

It is also unknown how many sublegal White Seabass are caught in the commercial gill net fisheries. It is thought that very few are caught and discarded because of the selectivity of the gear for large fish. An observer program conducted by the National Oceanic and Atmospheric Administration (NOAA) Fisheries between 1990 and 2017 documented that only 2% of White Seabass were discarded dead (Charles Villafana personal communication); most likely these fish were discarded because of sea lion or sand flea damage.

*Non-Target Finfish Species*

Much of the recent data on non-target finfish in the White Seabass commercial gill net fishery comes from the NOAA Fisheries Onboard Observer Program from 1990 to 2017. Observations have been sporadic over the years, but the data collected does provide information on non-target finfish since the implementation of Proposition 132 in 1994 that moved the White Seabass gill net fishery farther from shore.

Between 1990 and 2017, 1,037 sets were observed from the set gill net fishery with a total of 96 finfish species taken (Charles Villafana pers. comm.). The most common species caught were Swell Sharks (*Cephaloscyllium ventriosum*), Pacific Spiny Dogfish (*Squalus suckleyi*), Leopard Sharks (*Triakis semifasciata*), Brown Smoothhound Sharks (*Mustelus henlei*), Common Thresher Sharks (*Alopias vulpinus*), and Yellowtail (*Seriola lalandi*) (Table 3-1). Other species caught included Soupfin Shark (*Galeorhinus galeus*), Pacific Mackerel, California Halibut, California Scorpionfish (*Scorpaena guttata*), Lingcod (*Ophiodon elongatus*), Cabezon (*Scorpaenichthys marmoratus*), California Barracuda (*Sphryaena argentea*), Pacific Angel Sharks (*Squatina californica*), and Horn Sharks (*Heterodontus francisci*) (Table 3-1). Of the non-target finfish species caught, 58% were kept for sale or personal use, 10% were released dead, and 19% were released alive. Of the finfish released alive, 64% were shark species, while the discarded dead species mainly consisted of Pacific Mackerel (15%), Spiny Dogfish (14%), and Brown Smoothhound Shark (14%). Additionally, the gill net fisheries are allowed to retain one Giant Sea Bass (*Stereolepis gigas*), which is a protected species in California, incidentally per trip. Between 1990 and 2017, there were 23 Giant Sea Bass caught by the set gill net fishery, with 74% kept, 8% discarded dead, and 17% returned alive (Charles Villafana pers. comm.).

While it is illegal to retain a White Shark in California state and federal waters, they are occasionally caught in the set and drift gill net fisheries. Most White Sharks caught in gill net gear are YOY and juveniles (Lowe et al. 2012). A NOAA Fisheries status review of the local White Shark population estimated the average annual bycatch from 2001 to 2011 as 28 individuals with 16 mortalities per year (NMFS 2013).

Much of the commercial hook and line effort takes place in nearshore waters adjacent to and within kelp beds. Reported incidental catches include several nearshore sharks and rays (Bat Rays (*Myliobatis californica*), Leopard Sharks, Soupfin Sharks, and Swell Sharks), California Halibut, Pacific Sandab (*Citharichthys sordidus*), California Barracuda, rockfish (Vermillion Rockfish (*Sebastes miniatus*), Canary Rockfish (*Sebastes pinniger*), Copper Rockfish (*Sebastes caurinus*), Gopher Rockfish (*Sebastes carnatus*), and Blue Rockfish (*Sebastes mystinus*)), Ocean Whitefish (*Caulolatilus princeps*), California Sheephead (*Semicossyphus pulcher*), Yellowtail, and Giant Sea Bass.

Recreational anglers targeting White Seabass commonly catch Barred Sand Bass (*Paralabrax nebulifer*), Kelp Bass (*Paralabrax. clathratus)*, California Halibut, California Barracuda, California Sheephead, Bat Rays, Shovelnose Guitarfish (*Rhinobatos productos*), Pacific Mackerel, Soupfin Shark, and other species of sharks. In addition to these species, Sargo (*Anisotremus davidsonii*), Yellowfin Croaker *(Umbrina roncador*), and Yellowtail are caught aboard CPFV's while fishing for White Seabass (CDFG 2002).

Table 3-1. List of the most common non-target finfish species caught in the set gill net White Seabass fishery from 1991 to 2017 (NOAA Fisheries Observer Program; Charles Villafana pers. comm.).

| Finfish Species | Number Caught | Percent Kept | Percent Discarded Dead | Percent Returned Alive |
|---|---|---|---|---|
| Swell Sharks | 745 | 8% | 2% | 81% |
| Spiny Dogfish | 597 | 23% | 18% | 27% |
| Leopard Shark | 582 | 33% | 7% | 6% |
| Brown Smoothhound Shark | 446 | 18% | 24% | 30% |
| Common Thresher Shark | 446 | 48% | 2% | 2% |
| Yellowtail | 196 | 99% | 1% | 0% |
| Soupfin Shark | 142 | 23% | 16% | 10% |
| Pacific Mackerel | 127 | 13% | 86% | 1% |
| California Halibut | 120 | 38% | 18% | 39% |

| | | | | |
|---|---|---|---|---|
| California Scorpionfish | 90 | 67% | 8% | 24% |
| Lingcod | 72 | 29% | 26% | 38% |
| Cabezon | 68 | 31% | 10% | 57% |
| California Barracuda | 64 | 50% | 50% | 0% |
| Pacific Angel Shark | 63 | 10% | 11% | 43% |
| Horn Shark | 54 | 13% | 11% | 30% |

*Seabirds*

Gill nets can capture surface foragers (e.g. gulls) as well as diving birds such as cormorants. Seabird bycatch has been a problem in the nearshore gill net fisheries of central California, particularly for the Marbled Murrelet (*Brachyramphus marmoratus*), a threatened species, and the Common Murre (*Uria aalge*). From 1983 to 1989, the Department conducted an onboard observer program that covered the nearshore White Seabass gill net fishery (CDFG 2002). During this period, 818 sets of gill nets were observed on 250 days (approximately 3% coverage of the total logged fishing activity). A total of ten cormorants (*Phalacrocorax* spp.) died because of gear interactions. No other bird species suffered injuries or died. During the NOAA Fisheries Observer Program from 1990 to 1993, 14 cormorants died in the White Seabass gill net fishery in southern California while 20 Common Murres (*Uria aalge*) were entangled in gill nets in central California (CDFG 2002). Observed bycatch from more recent fishery observation data from 2012 included one pelagic cormorant (*Phalacrocorax pelagicus*) and three unidentified commorants (Carretta 2014).

*Marine Mammals*

The Marine Mammal Protection Act (MMPA) mandates that all commercial fisheries be classified by the level of incidental marine mammal death and serious injury. Since the White Seabass set and drift gill net fisheries occasionally take marine mammals, they are listed as Category II fisheries. Observer coverage has been sporadic for both these fisheries in recent years. The most recent observed marine mammal bycatch for the White Seabass set and drift gill net fisheries included only California Sea Lions (*Zalophus californianus*) (Carretta et. al. 2014). Between 2008 and 2012, there were 49 California sea lion deaths/serious injuries attributed to the gill net fisheries. In addition to bycatch estimates from the NOAA Fisheries observer program, information on fishery-related sea lion deaths and serious injuries comes largely from stranding data. Stranding data represent a minimum number of animals killed or injured, since many entanglements are likely unreported or undetected (Carretta et al. 2017).

California sea lions are also incidentally killed and injured by hooks from recreational and commercial fisheries. Sea lion deaths due to hook and line fisheries are often the result of complications resulting from ingestion of hooks, perforation of body cavities leading to infections, or the inability of the animal to feed. Many of the animals die post-stranding during rehabilitation or are euthanized as a result of their injuries. Between 2008 and 2012, there were 124 California sea lion deaths/serious

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injuries attributed to hook and line fisheries, or an annual average of 25 animals (Carretta et al. 2014b).

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

*Non-target Finfish Species*

The White Seabass recreational and commercial fisheries, like most other fisheries, have some bycatch that is either kept or discarded. In large part, gear designs used by fishermen help to lessen the take of non-targeted species. Choices such as hook design and size, bait types, mesh sizes, and how and where these gears are used help to minimize the risk of catching juvenile or undersized finfish as well as non-targeted species. Hook and line fishermen also make significant efforts to release unwanted bycatch alive, including releasing them without removing them from the water.

Many of the non-target finfish species listed in section 3.1.3.1 are managed by both state regulations and under Federal Fishery Management Plans which take in to account bycatch in gill net and other fisheries. Pacific Spiny Dogfish, Leopard Sharks, Lingcod, Cabezon, and California Scorpionfish are all managed under the Pacific Coast Groundfish Fishery. The Department also manages the Leopard Shark fishery within state waters with daily bag, size, and area limits. Thresher and Shortfin Mako sharks are managed under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species. Additionally, regulations are in place to help reduce the levels of Thresher and Shortfin Mako Shark bycatch by prohibiting the use of drift gill nets to take shark or swordfish from February 1 to April 30 (FGC §8576(a)), as well as only allowing drift gill nets fishing for either White Seabass or California Barracuda to be in possession or sell two Thresher and Shortfin Mako Sharks if incidentally taken, or if at least 10 Barracuda or five White Seabass are landed at the same time as the incidentally taken Thresher or Shortfin Mako Sharks (FGC §8576(b)). Also, gill netting is prohibited within three miles of the coast (Section 3.1.2.1.7), which effectively reduces bycatch of shallower species (Carretta et al. 2017) and shark pups which reside along the coast (Article XB, California Constitution; FGC §8610.2). For these reasons the White Seabass fishery is unlikely to impact the populations of finfish species that are taken as bycatch or incidentally.

*Seabirds*

The Marbled Murrelet is rare in southern California, and none have been reported killed in the gill net fisheries of this region (CDFG 2002). Therefore, the White Seabass gill net fishery is not likely to impact this species since most fishing occurs south of Point Conception. Common Murres are winter visitors to southern California, so interactions are possible, but unlikely since the highest level of fishing effort occurs during the summer months. Additionally, the area closure as noted in the paragraph above and in section 3.1.2.1.7 reduces bycatch of seabirds such as cormorants and

DRAFT

gulls since these species are typically found in shore rather than the open ocean. For these reasons the White Seabass fishery is unlikely to impact seabird populations.

*Marine Mammals*

As noted above, the White Seabass set and drift gill net fisheries are listed as Category II fisheries under the MMPA and are subject to certain provisions of the MMPA, such as registration, observer coverage, and take reduction plan requirements. Participants must obtain a marine mammal authorization certificate each year from NOAA Fisheries and are required to report within 48 hours all incidental deaths or injuries of marine mammals during commercial fishing operations to NOAA Fisheries. They must also accommodate observers onboard their vessels upon request.

California Sea Lions are not listed as endangered or threatened under the Endangered Species Act or as depleted under the MMPA. The total fishery mortality and serious injury rate (389 animals per year) for California Sea Lions in the White Seabass set and drift gill net fisheries is less than 10% of the calculated potential biological removal (PBR) of 9,200 sea lions per year (Carretta et al. 2016). As a result, it is unlikely that the incidental catch of this species by the White Seabass gill net fisheries is detrimental to the California Sea Lion population.

### *3.1.4 Habitat*

#### *3.1.4.1 Description of Threats*

Impacts on the substrate by fishing gears used to target White Seabass vary. A drift net, which consists of one or more panels of webbing fastened together, drifts with the current, usually near the surface or just below it while attached to the operating vessel. Because they do not come into contact with the substrate they have no impact on benthic habitat. Set gill nets consist of a single netting wall kept vertical by a float line and a weighted ground line. The net is set on the bottom, or at a distance above it, and is held in place with anchors or weights on both ends. By adjusting the design, these nets can fish at various depths depending on target species. Because the set gill net White Seabass fishery operates in a limited area (south of Point Conception) and mainly over soft sediment at around 15 fm (27 m), this type of gear has a low to moderate impact on the substrate. Hook and line gear presents a vertical line in the water that has minimal impact on the seafloor. The most vulnerable habitat that hook and line White Seabass fishing can occur is kelp forests. Adverse impact to kelp forests can result from the anchoring of vessels or fishing gear snagging on kelp; however, this impact is likely minimal.

Gear used in the commercial and sport fisheries of California can impact the nearshore environment inhabited by White Seabass. Gill nets used by commercial fishermen can be lost, and this gear can continue to capture fish, mammals, and invertebrates which become entangled and die. In addition, species that are not targeted during active fishing, can incur physical trauma from contact with nets and this trauma can increase susceptibility to disease. Finally, fishing debris such as lost hooks

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may be attractive to fish or other animals and cause injury if ingested, and the animals can become entangled in the monofilament line attached to the hooks.

Pollution from wastewater discharge can have negative impacts on kelp forest habitats, but there are thought to be less than the impacts observed for bays and estuaries as environmental conditions play a larger role in kelp ecosystem health (North and Hubbs 1968; Schiff et al. 2000). These threats are most likely to impact juvenile White Seabass given they spend more time in nearshore waters closer to potential pollution impacts than adults.

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

Given the gear types used in the White Seabass commercial and recreational fisheries are unlikely to have substantial interactions with sensitive benthic habitats, no gear restrictions have been implemented to mitigate habitat impacts.

### 3.2 Requirements for Person or Vessel Permits and Reasonable Fees

The California Code of Regulations describes the permits required to fish in California waters:

Table 3-2. 2019 White Seabass annual permit fees. Please visit the CDFW website for the most current commercial (https://www.wildlife.ca.gov/Licensing/Commercial/Descriptions) and recreational (https://www.wildlife.ca.gov/Licensing/Fishing#44521415-items--fees) annual permit fees.

| Permit | Fee |
|---|---|
| Commercial Fishing License – Residents | $141.11 |
| Commercial Fishing License – Non-residents | $417.75 |
| Commercial Boat Registration | $351.50 |
| General Gill/Trammel Net Permit | $482.72 |
| Commercial Ocean Enhancement Stamp | $52.27 |
| Recreational Fishing License – Residents | $49.94 |
| Recreational Fishing License – Non-Residents | $134.74 |
| Recreational – Ocean Enhancement Validation | $5.66 |

All gill net fishermen must have a commercial fishing license and a vessel permit. Commercial Fishing Licenses are required for any resident 16 yr of age or older who uses or operates or assists in using or operating any boat, aircraft, net, trap, line, or other appliance to take fish for commercial purposes, or who contributes materially to the activities on board a commercial fishing vessel. The commercial boat registration fee is required for any resident owner or operator for any vessel operated in public waters in connection with fishing operations for profit in the state. Fishermen using any type of gill/trammel net must obtain a general gill/trammel net permit. The Commercial Ocean Enhancement Stamp is required for commercial fishing vessels operating south of Point Arquello (Santa Barbara County) who take, possess aboard a commercial fishing vessel, or land White Seabass.

A sport fishing license is required for any person attempting to take fish, mollusks, crustaceans, invertebrates, amphibians, or reptiles in inland or ocean waters. A Recreational Ocean Enhancement Stamp is required for any person taking fish south of Point Arquello (Santa Barbara County).

General gill/trammel net permits are transferrable. The fee to transfer a gill net permit is $100. The permitee must meet either of the following criteria to transfer a permit: A) Provide proof that he/she has landed fish for commercial purposed in 15 of the past 20 yr (this may be done by providing copies of fish landing receipts, logbooks or by a letter of verification from the Department's Marine Fisheries Statistics Unit). Or, B) Submit a current letter from a qualified doctor stating that the permittee has become disabled in such a manner that he/she can no longer earn a livelihood from commercial fishing. For permit transfer purposes, a serious illness or permanent disability qualifies.

In the case where the permittee has died, his/her heirs or estate must submit a transfer request with a copy of the death certificate within 1 yr of the death of the permitee. The transferee must hold a current California Commercial Fishing License and provide proof of having met either of the following criteria: A) Worked as a crewmember for at least 12 months on vessels using gill nets or trammel nets and must have worked at least 180 days at sea on those vessels during the 5 yr period prior to the date of application. This may be substantiated by copies of logbooks or a notarized statement by the owner/operator of the vessel(s) on which the experience was acquired. He/she must prove the experience was obtained while holding a valid California Commercial Fishing License. Or, B) Passed a proficiency examination administered by the Department.

All fees include a nonrefundable 3% application fee.

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# 4 Monitoring and Essential Fishery Information

## 4.1 Description of Relevant Essential Fishery Information

The MLMA requires that Essential Fishery Information (EFI) be identified for each managed stock. EFI is defined as the information that must be collected in order to understand the status of the resource. Below is a description of the types of information necessary to manage the White Seabass fishery.

*Estimates of Abundance*

This information helps to determine how many individuals of a population are available to the fishery. Estimates of stock size can be determined through direct (e.g., surveys) or indirect (e.g., examination of the exploitation history) means. Specific EFI includes relative densities of target and non-target species, habitat-specific absolute densities, length frequency distributions, relative density estimates of life stages (i.e., eggs, larvae, YOY, juveniles, or adults), recapture rates of tagged fish, and Catch Per Unit Effort (CPUE) information.

A White Seabass stock assessment was completed and peer reviewed in 2016 using best available data through 2012 (Valero and Waterhouse 2016). Prior to that, limited indirect information regarding current abundances was available from catch data only. MacCall et al. (1976) estimated the abundance of White Seabass in the mid-1970s, and a pre-exploitation abundance was estimated by Dayton and MacCall (1992).

*Distribution of Stocks*

A stock is a population unit that is selected for management purposes. It may be defined based on its ecology, genetics, and/or geographic separation. Discrete stocks of a given species may have very different growth rates, reproduction schedules and capacity, and even ecological relationships. Stock distribution refers to where a stock is found and is important in addressing jurisdictional issues. Specific EFI includes the depth and geographic range of a species, the amount of gene flow and genetic structure of the stock, and whether stocks are separate of continuous.

Little information on stock distribution exists for White Seabass other than the work done by Allen and Franklin (1988) and Franklin (1997). These findings are supported by isotopic analysis of otoliths suggesting that a single population of White Seabass exists along their distribution of the Pacific coast (Romo-Curiel et al. 2015).

*Movement Patterns*

This information identifies the spatial distribution of fish and their residence time in specific habitats. Many species may exhibit movement patterns that are associated with specific oceanographic conditions. Certain species may aggregate in specific areas for spawning, move in predictable patterns, or move to certain locales that make them especially vulnerable to harvest. Insights into the movement patterns of fish are important to the development of management strategies based on regional catch quotas or marine protected areas. Specific EFI includes the home range, homing ability, seasonal migrations, environmental cues, and spawning grounds of a species.

DRAFT

Adult White Seabass are believed to move northward with seasonally warming ocean temperatures (Skogsberg 1939). Few data exist on the migration of juvenile and adult White Seabass, or how movement is affected by oceanographic changes; however, there is increasing data on the movement of hatchery-reared White Seabass (CDFG 2002). Seasonal movement and temperature profiles have shown that White Seabass aggregate closer to the surface during spring and summer months (Aalbers and Sepulveda 2015).

*Reproductive Characteristics*

Understanding key reproductive characteristics, like the reproduction potential of a fish stock and its ability to replenish itself, allows managers to set appropriate open and closed seasons as well as opened and closed areas based on important spawning habitat. This information is also crucial in selecting size and slot limits, escape mechanisms for traps, and mesh-size restrictions. Specific EFI for a species includes the number of eggs released, size at maturity, fertilization and spawning period, geographic spawning area, and the nature of mating systems.

Some of the reproductive characteristics of White Seabass have been identified. Fecundity and preferred spawning temperatures are known from laboratory studies; however, size at first maturity information is limited to a study done many years ago with very few samples (Clark 1930). The Department is currently collecting data for an age-at-maturity study.

*Age and growth characteristics*

Age and growth studies typically measure how long a species lives, the age at which it reproduces, and how fast individuals grow. This information is important to determine a population's ability to replenish itself, at what rate it might be harvested, and when individuals will reach a harvestable size. Changes in the age structure and growth rate of a population also serve as indicators of that population's health. This information is often essential for stock assessments and models that guide management strategies. Specific EFI includes von Bertalanffy growth parameters (k), length to weight ratios, longevity, age to length ratios, age to size at sexual maturity, and age to length at recruitment into the fishery.

Length-at-age and length-at-weight relationships have been calculated for White Seabass but need to be verified by further age and growth studies. Thomas (1968) produced the best known estimate of a length-weight relationship for White Seabass, which has been supplemented by work done by Donohoe (1997), otolith ageing conducted by the Department (CDFG unpublished data), and Romo-Curiel (2015).

*Recruitment*

Recruitment refers to a measure of the number of fish that survive to a particular life stage and is often used to predict future population size. In this context, recruitment refers to both recruitment to the fishery and recruitment to the population. Many species depend on successful recruitment events for replenishment of the stock. Recruitment



DRAFT

success can be highly variable because it depends on the proper combination of many factors. As a result, sustainable harvest of the fishery may depend on only a few strong cohorts (born the same year) to provide harvestable stocks until the next successful recruitment event. Resource managers must consider this variable recruitment success when setting harvest levels by allowing sufficient portions of stocks to “escape” harvest and provide spawning biomass for future recruitment successes. Specific EFI includes the duration and distribution of egg and larvae, size and timing of settlement, and annual cohort success. Information on the availability of habitats and levels of predators and prey items is also important.

California Cooperative Oceanic Fisheries Investigations (CalCOFI) surveys between 1950 and 1978 identified the distribution of eggs and larvae along the Baja/California coast (Moser et al. 1983). Work by Allen and Franklin (1997) and Allen et al. (2001) have furthered our knowledge of the rates, patterns and magnitude of White Seabass recruitment (CDFG 2002). Additionally, juvenile gill net surveys have been conducted annually since 1993 (except during 2009 to 2011) as part of monitoring for the OREHP (CASG 2017).

*Total mortality*

This information refers to all removals of fish from the biomass and is used to predict how many animals remain to reproduce and replenish the population. Mortality figures are essential for stock assessments and models to determine the number or weight (biomass) that may be safely harvested from a population or stock on a sustainable basis. Total mortality is traditionally separated into natural mortality and fishing mortality. Natural and fishing mortality rates comprise the sum of all individuals removed from a population over a fixed period of time (often over 1 yr). Fishing mortality is the number of animals removed from the population by fishing. Natural mortality refers to all other forms of removal of fish from the population, such as predation, old age, starvation, or disease. Specific EFI includes catch data by species and area, amount and size of discarded catch, landings by gear type, and survivability of fish that are released.

The current level of total mortality for White Seabass is unknown. However, there are a few studies that provide estimates of total mortality for various time periods throughout the fishery (Thomas 1968; MacCall et al. 1976).

*Ecological interactions*

This information identifies the interaction of fishes within the environment, habitat, and ecological community. Ecological relationships include the effects of oceanographic regimes and anthropogenic perturbations on physiological, energetic, or behavioral variables; ecological niches and placement in food webs (prey and predators); density-dependent and density-independent interrelationships within and among species; and the importance of essential fish habitat and habitat quality to a species. Estimation of any ecological relationship demands a species-specific within-habitat approach due to environment and organism cross correlations.

DRAFT

No statewide coordination exists for studies of ecological interactions of White Seabass. Consequently, little is known about the region-specific effects of oceanographic regimes and anthropogenic effects on the physiological, energetic, and behavioral characteristics of White Seabass, or the species that they interact with as prey, predators, or competitors (CDFG 2002). Stock assessments and biomass estimates of forage species such as Market Squid, Pacific Mackerel, and Pacific Sardine are used to inform management decisions for the White Seabass fishery. Any adverse change in the availability or status of White Seabass forage species would trigger one of the points of concern in the WSFMP (Section 3.1.1.1).

*Socio-economic*

The economic stability of coastal communities and quality of life may be affected by changes in activities related to recreational fishing, or commercial fishing and processing. These changes may be caused by indirect factors or regulatory changes that directly affect fishing activities. Indirect factors include triggers from consumer or financial markets such as: 1) changes in consumer demand due to the favorable pricing and supply of a substitute item for a fishery product(s); 2) inflation; and, 3) tax changes that affect business investments or activities. These effects may be manifested locally through resultant changes in business output, employment, population, and public service demand.

Adequate information on employment, expenditures, and revenues for certain basic sector industries are readily available or can be derived from existing sources. Such sources include the periodic surveys and reports prepared by the Bureau of the Census, Bureau of Labor and Statistics, Bureau of Economic Analyses, U.S. Fish and Wildlife Service, Department, and local institutions and academic affiliates. Combined information from these sources allows analyses of impacts or contribution to local economies by commercial fishing activities, and to some degree, by recreational charter activities. However, these sources do not provide adequate information relevant for a thorough recreational fishing analysis in the California nearshore area.

In addition, there is little information available regarding resource demand by the recreational fishing community, commercial industry, or consumer end users. Consequently, there are no means of analyzing or predicting reactions of these user groups when faced with changes in the costs, quantity, or quality of goods, services, or raw materials derived from the fishery. This is essential information that must be considered when deciding harvest levels or the allocation of fisheries resources between competing user groups (CDFG 2002).

## 4.2 Past and Ongoing Monitoring of the Fishery

### *4.2.1 Fishery-dependent Data Collection*

Fishery-dependent data for White Seabass have been collected from the commercial and recreational sectors since 1916 and 1936 respectively (Thomas 1968; Hill and Schneider 1999). Commercial data in the form of landing receipts, which are filled out when the catch is sold to fish businesses or by fishermen selling directly to the public, are a major source of information on the amount of fish landed, landing location, gear used and value of the catch. Landing receipts to date have provided little EFI other than a broad idea of when and where fishing activity occurs and total dressed (gutted) catch (Table 4-1). Logbooks are another useful tool for tracking fishing activity and helps to supplement and ground truth data gathered from landing receipts. For White Seabass, logbook information is gathered from the set and drift gill net fishery. The information recorded on the logs consists of date, boat name and identification number, crew size, catch location, numbers or pounds of fish, gear type used, mesh size, principle target species, associated species taken and landing receipt number. For the recreational sector of the White Seabass fishery, CPFV logbook has been the primary source for recreational fishing activity. Data entered on these logs includes date, vessel name and number, port of landing, number of anglers, species and number caught, hours fished, and catch location (Young 1969).

Table 4-1. Contributions of past and ongoing monitoring of the White Seabass fishery to essential fisheries information.

| Type of monitoring or data collected | Contribution to essential fisheries information |
|---|---|
| Commercial landing receipts | Fishing mortality; estimates of abundance |
| Logbooks (Gill net and CPFV) | Fishing mortality; estimates of abundance |
| Dockside sampling | Age and growth |
| At-sea observation | Age and growth |
| Age and growth studies | Age and growth |
| Tag and recapture studies | Movement patterns |
| Fecundity studies | Reproductive characteristics |
| Genetics | Distribution of stocks |
| YOY studies | Recruitment |
| OREHP gill net surveys | Recruitment |

In addition to the collection of passive data sets, the Department has actively collected fishery-dependent data on White Seabass through dockside sampling and at-sea interception of commercial and recreational fishermen. The typical data collected are species identification, size, weight, and disposition (i.e. kept, discarded), fishing method, catch location, and date. Additional data gathered whenever possible consist of sex, maturity through gonad collection, prey items through examination of stomachs, and ageing from otoliths.

For the commercial component of the White Seabass fishery, biological data have been collected at commercial fish businesses from San Diego to Santa Barbara during the mid-1970s, through an at-sea commercial gill net observation project between 1983 and 1989, and as part of the OREHP monitoring since 2008. Data have been collected from various segments of the recreational fishery by the Department since 1962. Included in these surveys are a launch-ramp study, an at-sea CPFV survey, and a survey of private boat owners’ catch and effort (CDFG 2002).

Data collected from both the commercial and recreational fisheries are used in the annual WSFMP review (Section 3.1.1.1). One of the points of concern can be triggered by any adverse or significant change in the length frequency of fish being caught. If catch is projected to significantly exceed the current harvest control rule or quota, a second point of concern may be triggered. Fishery-dependent data is also used to determine if an overfished condition exists or is imminent, a third point of concern in the WSFMP. An overfished condition is indicated, in part, by a reduced number and average weight of catch, and a reduction in commercial catch.

### *4.2.2 Fishery-independent Data Collection*

Fishery-independent data are important because they yield estimates of the abundance and distribution and the life history characteristics of the stocks that are more objective than those obtained from fishery-dependent data. Fishery-independent data: 1) provide measures of the relative abundance, trends, and estimates of the size and age structure of fish stocks which are not affected by fishing practices or management regulations; 2) calibrate trends in fishery-dependent estimates and tune assessment models; and 3) encompass a broad suite of information on the biological community, the physical environment and the ecosystem as a whole that cannot be obtained directly via fishery-dependent measures. These data facilitate both classical demographic modeling as well as alternatives (e.g. bioenergetic, mass-balance, and dynamic modeling). More powerful and sophisticated models can, in turn, enhance the accuracy of stock estimates and the predictability of fishable biomass (CDFG 2002).

There have been few fishery-independent studies on White Seabass. Over the years, these studies have been limited to collecting data on age and growth in the 1920s, 1930s and 1990s; movement patterns, fecundity, and genetics in the mid-1970s (Maxwell 1977); at-sea observations of the commercial fishery in the mid-1980s; and settlement patterns and habitat of YOY in the late 1980s and early 1990s. Over the past 20 yr, fishery-independent research has mainly focused on ways to improve hatchery operations and survivability of hatchery-reared fish. This research has included studies on genetics, aquaculture commercialization, feeding ecology, and the distribution and abundance of juvenile fish (CDFG 2002). Since 1993, juvenile gill net surveys have been conducted annually as part of the fishery-independent monitoring for the OREHP, except from 2009 to 2011 due to insufficient funding (CASG 2017). This information is used to help determine if an overfished condition exists or, which would trigger one of the WSFMP points of concern (Section 3.1.1.1). In addition, any adverse or significant change to the recruitment index as indicated by the juvenile gill net surveys may also trigger a Department recommendation for a management decision for this species.

#### *Ocean Resources Enhancement and Hatchery Program*

The Ocean Resources Enhancement and Hatchery Program (OREHP) was established by the California Legislature in 1983 to conduct research into the restoration and enhancement of marine finfish species populations important to California for their sport and commercial fishing value. The program is managed by the Department with the assistance of a 10-member Ocean Resources Enhancement Advisory Panel. The

OREHP includes a marine fish hatchery operated by Hubbs-SeaWorld Research Institute (HSWRI), and 10 growout pens operated by volunteer organizations throughout Southern California. Since 1990, White Seabass has been the OREHP's research focus, and as such, are raised at the hatchery and transported to the growout pens for their eventual release along the coast.

In 2018, the Department, in collaboration with California Sea Grant (CASG), released the results of an extensive multi-year evaluation by an independent Scientific Advisory Committee (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=154110&inline). The evaluation report concluded that while the program has significantly contributed to the scientific understanding of marine enhancement science, it has not substantially increased the abundance of legal-sized White Seabass. The report also included a suite of recommendations to improve achievement of the OREHP's objectives and goals, whether focusing on White Seabass or another species.

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# 5 Future Management Needs and Directions

## 5.1 Identification of Information Gaps

The White Seabass fishery is actively managed with different sustainability criteria that are evaluated on an annual basis to determine whether there is a need for management changes. However, there are additional pieces of information that, if available, could improve management of this fishery. Many of these gaps were identified as part of the stock assessment development process (Valero and Waterhouse 2016). These informational gaps are described in Table 5-1 along with their priority for management.

Table 5-1. Informational needs for White Seabass and their priority for management.

| Type of information | Priority for management | How essential fishery information would support future management |
|---|---|---|
| Size and age at first maturity | High | The existing information on White Seabass maturity is almost 100 yr old and based on very few individuals. Additional data is needed to assess the ability of the current size limit to protect juvenile fish. |
| Discard mortality rates | High | Necessary to determine what level of mortality sublegal fish experience in each sector. High mortality rates would indicate that a size limit may not be an effective management tool in that sector. |
| Bycatch rates and composition | High | Better bycatch data is needed to assess the ecosystem impacts of the White Seabass fishery. |
| Location, timing, and spatial extent of spawning grounds | Medium | Could inform whether current commercial closure between Point Conception and the U.S. and Mexico border from March 15 to June 15 is likely to protect spawning White Seabass. |
| Distribution and movement of White Seabass relative to fishing grounds | Medium | Observed fluctuations in the CPUE of White Seabass may be due to stock declines or changes in the spatial distribution of the stock, making White Seabass less available to the fishery at certain times. A better understanding of the distribution and movement of the stock under different environmental conditions would improve the precision of stock assessment estimates. |

## 5.2 Research and Monitoring

### *5.2.1 Potential Strategies to Fill Information Gaps*

*Size and Age at First Maturity*

The only published study on White Seabass maturity was based on data collected from eight female fish and concluded that females began maturing at 27 in (600 mm) TL, and all White Seabass are mature by 31.5 in (800.0 mm) TL (Clark 1930). A recent study by the Pfleger Institute of Environmental Research (PIER) collected 77 female and 20 male White Seabass between 2007 and 2015 and found that all female White Seabass are mature at around 34 in (870 mm) (Valero and Waterhouse 2016).

The results of this study suggest that the current size limit of 28 in (711 mm) allows for the take of immature females. Additional data on the size, age, sex, and maturity status of White Seabass are needed to determine whether there is a need for a larger size limit. Currently, the Department is collecting White Seabass to determine maturity at length and batch fecundity to improve estimates of White Seabass reproductive parameters.

*Location, Timing, and Spatial Extent of Spawning Grounds*

White Seabass display coordinated spawning behavior and may be more vulnerable to fishing during the spawning season. White Seabass spawning occurs from April to August with a peak in May and June (Young 1973) and may occur in specific nearshore areas (Aalbers and Sepulveda 2012). In their study, Aalbers and Sepulveda (2012) used passive acoustic recorders to detect and record White Seabass spawning sounds in the wild. Findings from this work showed that Long-term Acoustic Recording Systems can be used to identify the locations and periodicities of White Seabass spawning activity. If the location and spatial extent of these areas could be identified, it may be possible to evaluate the efficacy of the current closed commercial season, as well as determine whether additional temporal or spatial protections are needed to reduce vulnerability during this time.

*Distribution and Movement of White Seabass*

White Seabass is a transboundary stock, meaning that the stock occurs in both U.S. and Mexican waters, and is managed separately in each. While the stock assessment in 2016 concluded that there had been large fluctuations in the size of the California White Seabass stock based on historical catch and CPUE data, it was unknown whether these declines represented a decrease in abundance across the entire White Seabass range or a spatial shift in that range, which would make fish less available to California fishermen and would result in decreasing catches and CPUE over those time periods. A large-scale tagging study conducted in collaboration with the Mexican government may help the Department to better understand the distribution of White Seabass and how that distribution changes based on temporal and environmental cues.

*Discard Mortality Rates*

There is little data available on White Seabass mortality on fish that are discarded because they are less than the minimum size limit. Data on discard mortality rates could be collected via the presence of onboard observers, both on commercial gill net vessels as well as recreational CPFVs. Observers could record information on the size and condition of fish discarded, and mortality rates could be estimated from the immediate release condition.

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*Bycatch Rates and Composition*

It is known that the commercial gill net fishery for White Seabass results in bycatch of several different species, but there is limited data available on the bycatch rates and species composition in that fishery. Onboard observers could monitor the amount and type of bycatch. For those species that are discarded, information on their condition could be recorded. For those species that are retained, information on their size distribution could be recorded. This study could be paired with a study to obtain discard mortality rates for juvenile White Seabass on gill net vessels.

### *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, non-governmental organizations, 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.

The Department currently collaborates with number of different organizations and user groups to improve the management of the White Seabass fishery. The Department has worked with both commercial and recreational fishermen to collect samples in various studies, including a study to collect otoliths from White Seabass for aging as well as a study to collect White Seabass gonads to understand maturity. The Department has also collaborated with OREHP researchers, academics, and PIER. There is also a need for collaboration with the Mexican government to better manage the White Seabass stock, which crosses the U.S. and Mexico border.

## 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.*

The White Seabass fishery is actively managed under the WSFMP, which outlines a list of criteria that must be evaluated on an annual basis. This evaluation has been successfully implemented since the adoption of the WSFMP in 2002 and since that time none of the points of concern that would require additional management activities have been triggered. However, the sixth point of concern suggests additional management activities may be necessary if an error in the data is found that may affect the status of the stock under the current management measures. Based on the limited information available on White Seabass maturity suggests that the current size limit may not provide adequate protection. As noted in section 5.2.1, the Department is



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conducting a study to evaluate the size and age at first maturity and may decide that alternative management measures are necessary based on the results of this study.

The first modern stock assessment for California White Seabass was completed in 2016. The stock assessment found very high biomass levels in the mid-2000s, followed by a decline. The stock was estimated to be at 27% of unfished biomass levels in 2015. This value is below the PFMC biomass target depletion of 40% but above the MSST of 25% for groundfish. While this represented a decline in stock abundance, this abundance level was greater than the biomass that would produce MSY (24% of unfished biomass), and thus the stock was not determined to be overfished or depressed. This study also estimated MSY reference points and found that the current proxy for MSY (the OY catch limit), which was based on older population models (MacCall et al. 1976; Dayton and MacCall 1992), may be too high. This may require a reevaluation of the OY proxy for MSY. Given the fluctuations in biomass observed in the White Seabass stock over time, there is a need to monitor declining trends in catch and CPUE, as well as to periodically update the stock assessment as additional data becomes available.

While a Productivity-Susceptibility Analysis found both the commercial gill net and recreational hook and line fisheries to have low-to-moderate vulnerability (MRAG 2016), it is important to be precautionary in management. The Department will continue to proactively manage the White Seabass fishery and to evaluate the criteria outlined in the WSFMP. Should any of the points of concern be passed and additional management measures are required, the Department may consider using the stock assessment as the basis for Management Strategy Evaluation to evaluate the likely efficacy of alternative management actions.

## 5.4 Climate Readiness

There is little information with which to assess the vulnerability of the California White Seabass fishery to climate change. However, given that White Seabass do appear to move towards their preferred thermal environment (Section 1.5), and exhibit northward and westward migration patterns in response to warming SST in the late summer, warmer waters may result in a range shift of White Seabass. Historically, White Seabass were caught frequently in central and northern California, but since the 1930s the bulk of the catch has come from Southern California waters (Figure 2-6). Increased catches north of Point Conception might alert the Department to a range shift. If this type of shift were to occur, White Seabass might be more vulnerable to commercial fishing north of Point Conception during the spring spawning months, because currently the seasonal fishery closure currently only applies to areas south of Point Conception.

DRAFT

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DRAFT