Spotted Sand Bass, *Paralabrax maculatofasciatus* Enhanced Status Report

Spotted Sand Bass, *Paralabrax maculatofasciatus*. (Photo Credit: Heather Gliniak, CDFW).

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Marine Region

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Contributor: Heather Gliniak (2019).

Enhanced Status Reports

The Marine Life Management Act (MLMA) is California's primary fisheries law. It requires the California Department of Fish and Wildlife (Department) to regularly report to the California Fish and Game Commission (Commission) on the status of fisheries managed by the state. The 2018 Master Plan for Fisheries expanded on this general requirement by providing an outline for Enhanced Status Reports (ESRs) that is based on the MLMA's required contents for Fishery Management Plans (FMPs). The goal of ESRs is to provide an overview of the species, fishery, current management and monitoring efforts, and future management needs, and provide transparency around data and information that is unavailable or unknown. ESRs can help to guide Department efforts and focus future partnerships and research efforts to address information gaps and needs to more directly inform management. It is also anticipated that some ESRs will be foundations for future FMPs by providing background information and focusing analyses and stakeholder discussions on the most relevant issues.

Note that in order to describe management measures in clear terms, ESRs contain summaries of regulatory and statutory language. To ensure full compliance with all applicable laws and regulations, please refer directly to the relevant sections of the Fish and Game Code and/or Title 14 of the California Code of Regulations.

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List of Acronyms

CalCOFI	California Cooperative Oceanic Fisheries Investigations
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CPFV	Commercial Passenger Fishing Vessel
CPUE	Catch Per Unit Effort
CRFS	California Recreational Fisheries Survey
DDT	Dichloro-Diphenyl-Trichloroethane
ENSO	El Niño Southern Oscillation
EFI	Essential Fishery Information
FGC	Fish and Game Code
FL	Fork Length
FMP	Fishery Management Plan
M	Natural Mortality
MLMA	Marine Life Management Act
MPA	Marine Protected Area
MRFSS	Marine Recreational Fisheries Statistics Survey
MSE	Management Strategy Evaluation
NGO	Non-Government Organization
NPGO	North Pacific Gyre Oscillation
PCB	PolyChlorinated Biphenyl
PDO	Pacific Decadal Oscillation
RecFIN	Recreational Fisheries Information Network

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Fishery-at-a-Glance: Spotted Sand Bass

Scientific Name: *Paralabrax maculatofasciatus*

Range: Spotted Sand Bass are considered sub-tropical and range from Monterey, California to Mazatlan, Mexico, including the Gulf of Mexico, but they are uncommon north of Santa Monica Bay.

Habitat: Spotted Sand Bass primarily reside in nearshore habitats, including bays, estuaries, and eelgrass beds. They can be found from the intertidal zone to 200 feet (61 meters).

Size (length and weight): Spotted Sand Bass are the smallest of the three species in the genus *Paralabrax spp*., reaching up to 22.0 inches (55.9 centimeters) in length. The International Game Fish Association World Record Spotted Sand Bass was 6.7 pounds (3.0 kilograms) 23.0 inches (58.4 centimeters) long, and 10 years old.

Life span: The maximum observed age of Spotted Sand Bass is 14 years.

Reproduction: Spotted Sand Bass release eggs and sperm into the water column where fertilization occurs. Spotted Sand Bass in southern California reach sexual maturity by 2 years and 225.0 millimeters (8.9 inches) standard length. Populations of Spotted Sand Bass can be anywhere on the spectrum between gonochorism (each individual is either male or female) to protogynous hermaphroditism (females may eventually develop both male and female sex organs).

Prey: Adult Spotted Sand Bass in southern California feed primarily on crabs and clams. A much smaller proportion of their diet includes fishes such as gobies and Northern Anchovy.

Predators: Spotted Sand Bass may be prey for larger piscivores such as sharks and marine mammals like seals and sea lions.

Fishery: There is only a recreational fishery for Spotted Sand Bass.

Area fished: Within California, Spotted Sand bass are typically targeted in coastal embayments and at harbor mouths spanning from Monterey southward to Mexico at depths to about 200 feet (61 meters); however, they are not commonly caught north of Santa Monica Bay. Most of the CRFS sampled catch occurs within San Diego Bay, Mission Bay, Newport Bay, Anaheim Bay, and Los Angeles/Long Beach Harbor.

Fishing season: Spotted Sand Bass can be fished year-round.

Fishing gear: Spotted Sand Bass are caught using hook and line.

Market(s): There is no market for Spotted Sand Bass given the absence of a commercial fishery.

Current stock status: No formal stock assessment exists for Spotted Sand Bass. There are no concerns about the population status at this time.

Management: Spotted Sand Bass have been managed collectively as part of the saltwater bass complex (Barred Sand Bass, Kelp Bass, and Spotted Sand Bass) since the early 1900s. Due to concerns about the status of both Barred Sand Bass and Kelp Bass, the current bag limit of five fish in aggregate and minimum size limit of 14.0 in (35.6 cm) was established in 2013.

1.The Species

1.1Natural History

1.1.1. *Species Description*

Spotted Sand Bass (*Paralabrax maculatofasciatus*), also referred to as Spotted Bay Bass, are one of the most common sea basses inhabiting southern California coastal waters along with two other species: Barred Sand Bass (*Paralabrax nebulifer*) and Kelp Bass (*Paralabrax clathratus*). They are olive brown in color with several faint or dark bars, and round black to brown spots covering their head, body, and fins. Spotted Sand Bass are the smallest of the three species in the genus *Paralabrax* spp., growing up to 23.0 inches (in) (58.4 centimeters (cm)) in length (L. Allen personal communication). Spotted Sand Bass are easily distinguished from Kelp Bass by the height of their third dorsal spine, which is much longer than the rest of their dorsal spines. Spotted Sand Bass are distinguished from Barred Sand Bass by spots that cover their entire body.

1.1.2. *Range, Distribution, and Movement*

Spotted Sand Bass are considered sub-tropical and range from Monterey, California to Mazatlan, Mexico, including the Gulf of Mexico, but they are uncommon north of Santa Monica Bay (Allen et al. 1995) (Figure 1-1). They have also been recorded from San Francisco in the late 1800s (Miller and Lea 1972). Spotted Sand Bass can be found from the intertidal zone to 200 feet (ft) (61 meters (m)) (Miller and Lea 1972; Kells et al. 2016). Adults and juveniles occupy shallow harbors, bays, estuaries, and lagoons characterized by warm water, mud or sand bottom, and the presence of eelgrass and rock relief (Allen et al. 1995).

Spotted Sand Bass are believed to be non-migratory. Morphologic and genetic analyses suggest the San Diego based population in southern California is significantly different from populations farther south in the Pacific and northern Gulf of California (Tranah and Allen 1999), which indicated that Spotted Sand Bass do not migrate long distances. Freedman et al. (2015) noted the absence of homing behavior of tagged and relocated Spotted Sand Bass from two southern California estuaries in close proximity to each other, which further supports the hypothesis of limited or no migration. Movement of this sub-tropical species appears to be restricted in southern California because of the isolation of the preferred estuarine habitat types (Allen et al. 1995).

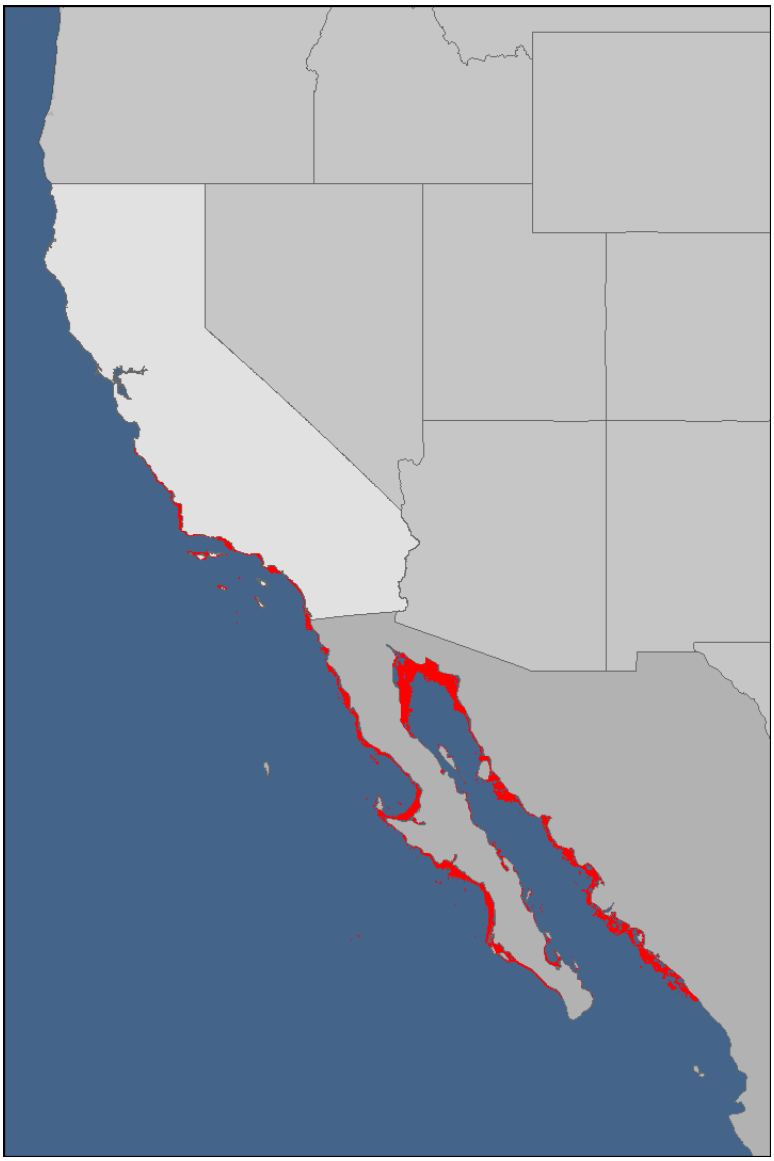

Figure 1-1. Range map for Spotted Sand Bass.

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

Spotted Sand Bass release eggs and sperm into the water column where fertilization occurs. Southern California populations typically form spawning aggregations near the mouths of harbors and bays. Spawning occurs from June through August according to gonadal somatic index analysis (Allen et al. 1995), but spawning events have been observed with fish held captive in aquaria from May through December (Miller and Allen 2006a). Female Spotted Sand Bass are batch spawners, meaning they develop eggs throughout the spawning season and are capable of spawning daily (Oda et al. 1993). Maximum annual fecundity was reported to be 68,000 offspring/year (Shanks and Eckert 2016), though this number may be an under-estimate given the much higher values for the two congener species of Spotted Sand

Bass (Barred Sand Bass and Kelp Bass). It is more probable that the reported estimate in Shanks and Eckert (2016) is an estimate for the number of eggs produced in a batch by one female.

Populations of Spotted Sand Bass can be anywhere on the spectrum between gonochorism (each individual is either male or female) to protogynous hermaphroditism (females may eventually develop both male and female sex organs) (Hovey and Allen 2000; Oda et al. 1993; Hastings 1989). During their observations of captive fish, Miller and Allen (2006b) observed different mating strategies depending on spawning aggregation density. In smaller, low density spawning aggregations, pair spawning primarily occurred with dominant males. In larger, more dense spawning aggregations, group spawning was typically observed. This flexibility in spawning strategies and the ability to utilize larger, dominant males when spawning aggregation densities are low is a reproductive advantage typical of other protogynous hermaphroditic fish species (Miller and Allen 2006b). Also, this strategy could contribute to a population's resilience to isolation, fishing pressure, and periods of unfavorable environmental conditions.

After spawning occurs, fertilized eggs enter the plankton as larvae for 28 to 37 days (Allen and Block 2012) and then settle down to eelgrass beds in shallow, sheltered embayments in the summer and fall (Love 2011).

1.1.4. ***Natural Mortality***

Determining the natural mortality (M) of marine species is important for understanding the health and productivity of their stocks. Natural mortality results from all causes of death not attributable to fishing such as old age, disease, predation, or environmental stress. Natural mortality is generally expressed as a rate that indicates the percentage of the population dying in a year. Fish with high M 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.

Estimating M is difficult and often relies on evaluation of life history traits, and several different methods have been developed. Allen et al. (1995) estimated an annual M rate of 20% that was based on age class data (ages 2 through 10 yr). However, a study by Then et al. (2015) found that a method that used maximum age produced more reliable estimates of M. Using the maximum age validated in a study (14 yr) suggests that the natural mortality is higher, and that 35.4% of the Spotted Sand Bass population dies from natural causes each year.

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. Because growth is highly variable, the oldest fish may not be the largest. The California Saltwater Angling Record for Spotted Sand Bass was 6.7 pounds (lb) (3.0 kilograms (kg)), 23.0 in (58.4 cm) long, and 10 years (yr) old (L. Allen personal communication).; while the maximum observed age is 14 years and that specimen was 400 millimeter (mm) (15.7 in) standard length (Allen et al. 1995). The von Bertalanffy Growth Model is most often used in fisheries management, but other growth functions may also be appropriate. Growth parameters have been calculated for Spotted Sand Bass for both sexes combined by fitting data to the von Bertalanffy growth function:

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

where L_t is the standard length in millimeters at age t, L_∞ is the maximum average length, k is the relative growth rate, t is the age of the fish, and t_0 is the theoretical age when the length of the fish is zero. The values of those estimated parameters are L_∞ = 351.3 mm, k = 0.1077, t_0 = -6.990 (Allen et al. 1995).

The relationship between weight and length for Spotted Sand Bass (both sexes combined) has also been modeled using the exponential equation:

$$W = aL^b$$

Where W is the weight in grams, L is the standard length in millimeters, a is a constant indicating the intercept, and b is a constant indicating the slope of the regression line (a = 0.000026, b = 3.0187) for Spotted Sand Bass (Allen et al. 1995).

1.1.6. *Size and Age at Maturity*

Spotted Sand Bass in southern California reach sexual maturity by 2 years and 225 mm (8.9 in) standard length. Females mature sooner than males, with 50% of females mature at less than 1 year and 155.0 mm (6.1 in) standard length, and 50% of males mature at 1.4 years and 180.0 mm (7.1 in) standard length (Allen et al. 1995).

1.2. **Population Status and Dynamics**

No formal stock assessment exists for Spotted Sand Bass in southern California. However, inferences regarding the status of the population can be made based on

trends in fishery-dependent data sources, and species-specific life history information can help scientists make assumptions about the resilience or susceptibility of the stock to fishing and other pressures. Spotted Sand Bass in southern California may be especially vulnerable due to several factors, including the isolation of adult populations; sporadic recruitment events tied to environmental factors; habitat degradation; and anthropogenic effects. Trends in total catch, landings, and effort suggest even though fewer Spotted Sand Bass have been caught by anglers over time, this may be due to other factors rather than to population declines. For example, fewer anglers may be targeting this species and fewer individuals may be retained after the increase in the minimum size limit in 2013. In addition, this is primarily a catch-and-release fishery and the age structure of the adult population represented in catch data appears to be healthy. For these reasons, there are no concerns about the population status at this time.

1.2.1. ***Abundance Estimates***

Reliable abundance estimates for Spotted Sand Bass in southern California from fishery-independent data sources are not available because consistent long-term monitoring does not occur within their primary habitat. Some Spotted Sand Bass have been recorded on scuba transects at King Harbor, California and in some power plant impingement data, but the numbers are too low to have confidence in any trends over time. Quarterly offshore CalCOFI plankton tows capture *Paralabrax* larvae, but the larvae cannot be identified to species level, making it a less informative index. Spotted Sand Bass have been caught in short-term surveys in southern California bays. Allen et al. (2002) surveyed San Diego Bay quarterly from 1994 to 1999 and estimated the biomass of Spotted Sand Bass to be 50.2 metric tons (second only to Northern Anchovy (*Engraulis mordax*)), making up about 13% (second only to Round Stingray (*Urobatis halleri*) of the bay's biomass (g). Therefore, the Department must rely on trends in fishery-dependent catch data as a proxy for an abundance index for Spotted Sand Bass (see section 2.3).

1.2.2. ***Age Structure of the Population***

As there is no stock assessment for Spotted Sand Bass, recreational catch data were used to assess the age structure of the population. Length data of retained catch from all fishing modes (private/rental boats, Commercial Passenger Fishing Vessel (CPFV), manmade/jetty, and beach/bank), were converted to age, with the majority of length data taken from private/rental boats. Ages were estimated using the length at age relationship for Spotted Sand Bass as reported in Allen et al. (1995). At least six age classes of Spotted Sand Bass were represented in the catch from 1980 to 1988, and this increased to between 10 and 12 age classes from 1993

to 2017 (Figure 1-2). The proportion of fish in each age class fluctuated over time, with the most notable shifts occurring from 1988 to 1993 (no data were collected from 1989 to 1992) and in the years following the regulation change in 2013. The reason for the increase in age classes between the 1980s and 1990s is unknown; however, there tends to be a greater number of age classes for years that have a greater number of samples. This makes it difficult to determine if environmental or other factors may also be responsible. which makes discerning any trends in age classes over time more difficult. In April 2013, the minimum size limit was increased from 12.0 to 14.0 in (30.4 to 35.6 cm), which now legally protects fish up to the age of 9 years old from being harvested and explains the shift in age classes to older fish in recent years. Despite this shift, about 43% of the sampled harvested fish are 8 years old and younger after 2013, which means anglers continue to keep sublegal fish. Before the regulation change, fish 4 years old and younger were not legal to keep yet made up 18% of the catch. Given that the Spotted Sand Bass fishery has about a 96% discard rate, the amount of retained sublegal catch is very minimal. The number and distribution of age classes represented in the kept catch throughout the entire time series is indicative of a healthy adult population structure.

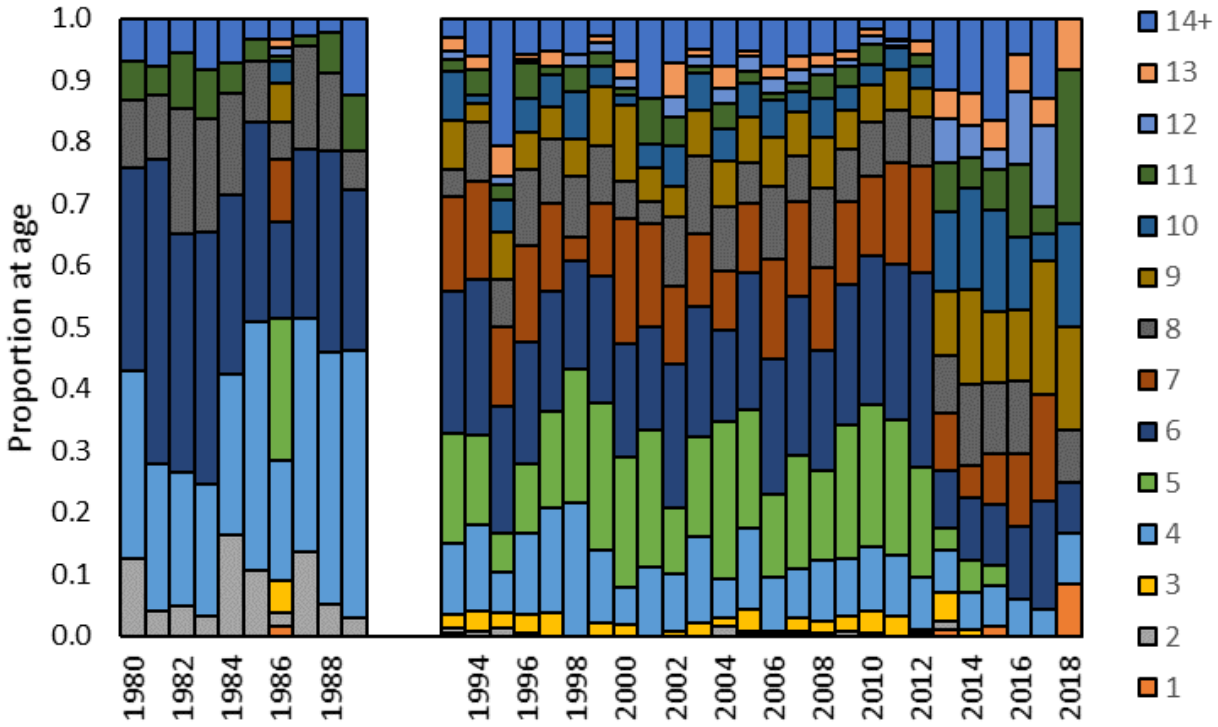

Figure 1-2. Age structure of harvested Spotted Sand Bass from 1980 to 2018 (n = 5,970). Age classes were converted from length data of retained catch from all fishing modes. All fish older than 14 years are represented in a summed category, 14+. A size limit increase in 2013 altered the distribution of retained fish (no data collected from 1990 to 1992) (Recreational Fisheries Information Network (RecFIN 2019)).

1.3. **Habitat**

Aside from pelagic larvae, all other Spotted Sand Bass life stages are dependent upon warm, shallow water embayments such as harbors, estuaries, bays, and lagoons. Some adults can be found in more exposed habitat just outside of these harbors and bays, but most occur inside. Eelgrass beds within these embayments serve as nursery areas (Allen et al. 2002). Adult Spotted Sand Bass are also common in these eelgrass beds. In southern California, these types of habitats are limited in number and connectivity, which contributes to the isolation of Spotted Sand Bass populations.

1.4. **Ecosystem Role**

Spotted Sand Bass have been described as occupying the tertiary carnivore trophic level in a study analyzing bay-estuarian fish assemblages in southern California (Allen et al. 2006; Cross and Allen 1993), which was the highest trophic level described in the bay-estuarine habitat. Spotted Sand Bass may be prey for larger piscivores such as sharks and marine mammals like seals and sea lions.

1.4.1. ***Associated Species***

Spotted Sand Bass primarily reside in shallow, coastal embayments. Other commonly co-occurring fish species in southern California shallow bays are listed in Table 1-1 (Allen et al. 2006).

Table 1-1. Species co-occurring with Spotted Sand Bass.

Common name	Species name
Arrow Goby	*Clevelandia ios*
Barred Pipefish	*Syngnathus auliscus*
Barred Sand Bass	*Paralabrax nebulifer*
Bat Ray	*Myliobatis californica*
Bay Blenny	*Hypsoblennius gentilis*
Bay Pipefish	*Syngnathus leptorhynchus*
Black Perch	*Embiotoca jacksoni*
California Halibut	*Paralichthys californicus*
California Killifish	*Fundulus parvipinnis*
Cheekspot Goby	*Ilypnus gilberti*
Deepbody Anchovy	*Anchoa compressa*
Diamond Turbot	*Hypsopsetta guttulata*
Dwarf Perch	*Micrometrus minimus*
Gray Smoothhound	*Mustelus californicus*
Jacksmelt	*Atherinopsis californiensis*
Longjaw Mudsucker	*Gillichthys mirabilis*
Northern Anchovy	*Engraulis mordax*
Pacific Staghorn Sculpin	*Leptocottus armatus*
Round Stingray	*Urobatis halleri*
Shadow Goby	*Quietula y-cauda*
Shiner Perch	*Cymatogaster aggregata*
Slough Anchovy	*Anchoa delicatissima*
Spotted Turbot	*Pleuronichthys ritteri*
Striped Mullet	*Mugil cephalus*
Tidewater Goby	*Eucyclogobius newberryi*
Topsmelt	*Atherinopsis affinis*
Yellowfin Croaker	*Umbrina roncador*

1.4.2. ***Predator-prey Interactions***

Adult Spotted Sand Bass in southern California feed primarily on crabs and clams. A much smaller proportion of their diet includes fishes such as gobies and Northern Anchovy (Allen et al. 1995). Both seasonal and size related changes in their diet have been recorded in Mexico based populations, most likely due to changes in prey availability and the physical capabilities of larger Spotted Sand Bass, respectively (Bocanegra-Castillo et al. 2002; Mendoza-Carranza and Rosales-Casián 2000).

1.5. Effects of Changing Oceanic Conditions

Oceanic changes due to climatic events impacting water temperature and nutrient availability such as El Niño Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and the North Pacific Gyre Oscillation (NPGO) can have profound effects on fishes and fisheries. One might assume that a sub-tropical species would benefit from conditions associated with increasing ocean temperatures, but the effects of changing oceanic conditions on Spotted Sand Bass populations is unclear. Allen et al. (1995) found a significant positive correlation between Spotted Sand Bass recruitment and average summer sea surface temperatures in southern California. In contrast, Jarvis et al. (2004) found a negative correlation with the PDO index and powerplant impingement rates of Spotted Sand Bass. In Mission Bay, San Diego, Basilio et al. (2017) observed lower settlement rates and poor larvae condition during 'The Blob' (Pacific Warm Anomaly) conditions and postulated that increased ocean temperatures associated with climate change may have adverse effects on Spotted Sand Bass settlement and recruitment. The seemingly conflicting results of these studies may be the result of several other factors not tested in the studies that could have influenced the measure of Spotted Sand Bass abundance. In addition, each study analyzed the relationship of various climate change indicators to indices of Spotted Sand Bass that corresponded to different life history stages. Allen et al. (1995) back calculated birth years of sampled adult Spotted Sand Bass to determine recruitment. Jarvis et al. (2004) utilized impingement data that typically captures young-of-the-year or juvenile fish, while Basilio et al. (2017) looked at fish in their newly settled larval stage.

2. The Fishery

2.1. Location of the Fishery

Within California, Spotted Sand bass are typically targeted with hook and line gear in coastal embayments and at harbor mouths spanning from Monterey southward to Mexico at depths to about 200 ft (61 m) (Eschmeyer and Herald 1999); however, they are not commonly caught north of Santa Monica Bay (Allen et al. 1995; RecFIN). Spotted Sand Bass have been known to sporadically recruit to Catalina Harbor on the backside of Santa Catalina Island (Allen et al. 1995), but no catch from that location has been sampled by California Recreational Fisheries Survey (CRFS). Most of the CRFS sampled catch occurs within San Diego Bay, Mission Bay, Newport Bay, Anaheim Bay, and Los Angeles/Long Beach Harbor (RecFIN).

2.2. Fishing Effort

2.2.1. *Number of Vessels and Participants Over Time*

Saltwater anglers can fish for Spotted Sand Bass in a variety of ways, including from private and rental vessels, shore, piers, jetties, float tubes, and “party boats” (CPFVs). Ideally, fishing effort could be described for each of those modes by quantifying the number of anglers, angler hours, angler trips, or boat trips targeting a particular species. For modes in which a log must be submitted, such as for CPFVs, the Department collects records of reported effort. For most modes, logs are not submitted and effort must be estimated.

The number of vessels in the private/rental boat fleet and the annual number of private/rental boat trips or beach/bank angler trips specifically targeting Spotted Sand Bass is unknown, but a more generalized approach to effort may be taken by considering the estimated number of angler trips occurring in Spotted Sand Bass habitat. Effort reports on RecFIN can be categorized by water area and trip type. The estimated number of angler trips for the private/rental boat mode in southern California designated as “inland” water area and “inshore” trip type remained relatively stable from 2006 to 2011 (Figure 2-1). Effort dropped from a high of roughly 58,000 angler trips in 2012 to a low of about 18,000 angler trips in 2015. In more recent years (2015 to 2018) the number of angler trips has remained low. The Department considers this trend as a proxy for Spotted Sand Bass effort because it represents the best available information, though these trips might not all be actively targeting Spotted Sand Bass. This particular mode was presented because the majority of estimated Spotted Sand Bass catch estimates come from this mode (See Chapter 2.3.1).

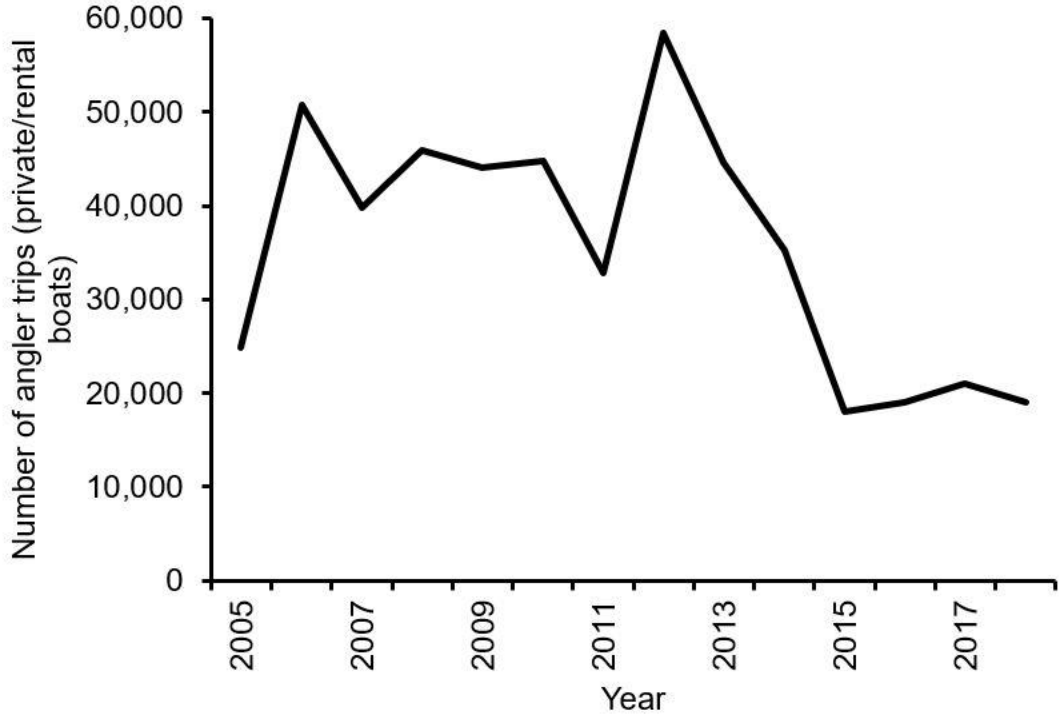

Figure 2-1. Number of inshore private/rental boat angler trips occurring in inland waters from 2005 to 2018 in southern California (RecFIN 2019).

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

Spotted Sand Bass are caught by hook and line. Recreational anglers fishing from boat or shore may use any number of hooks and lines. On public piers, no person may use more than two rods and lines. Hook and line anglers typically use artificial lures.

The most common size of Spotted Sand Bass caught by hook and line from 2013 to 2017 was 14.2 in (360.0 mm) and the average size was 13.3 in (337.0 mm) Fork Length (FL) (RecFIN). However, these sizes may be slightly inflated since fewer discarded fish were measured relative to those that were legal size and kept. Of the discarded fish that were sampled, the smallest was 124.0 mm (4.9 in) FL.

2.3. **Landings in the Recreational and Commercial Sectors**

2.3.1. *Recreational*

Catch data for the recreational fishery are provided by the CRFS estimates on all fishing modes available from the RecFIN website. In southern California, Spotted Sand Bass are caught year-round, but they are most commonly fished during the summer months of June, July, and August (RecFIN) (Figure 2-2).

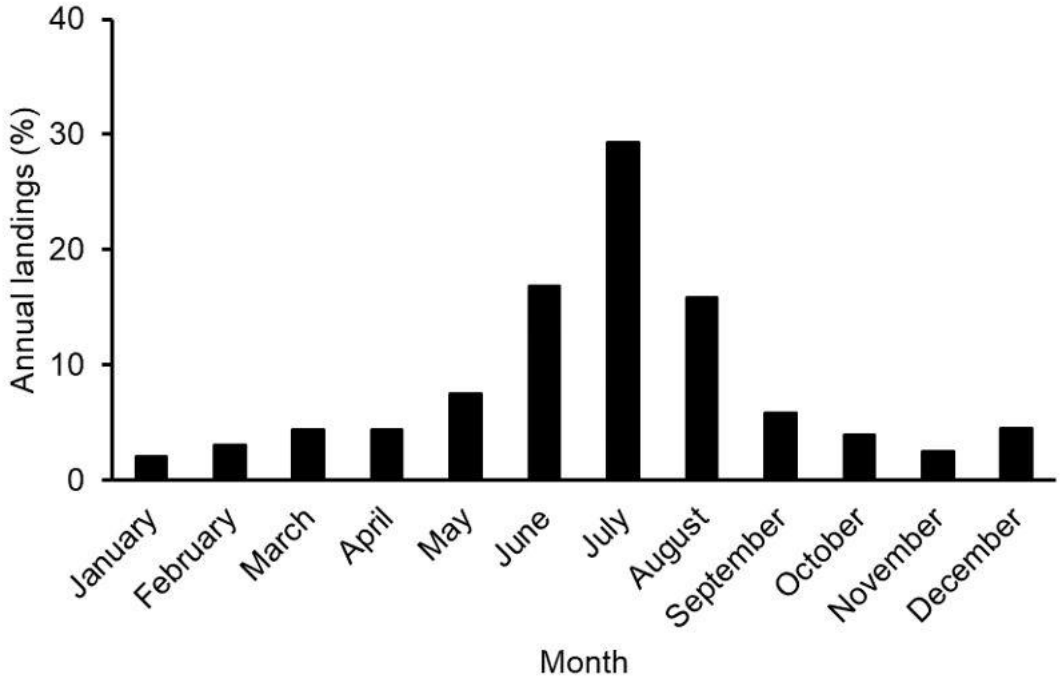

Figure 2-2. Proportion of the yearly landings (all modes) of Spotted Sand Bass by month in southern California from 2005 to 2018 (RecFIN 2019).

The private/rental boat mode keeps the largest portion of the catch (64.1%), followed by the beach/bank mode (25.6%) (Table 2-1).

Fishing mode	Percent of catch
Private/rental	64.1
Beach/bank	25.6
Manmade/jetty	9.9
Party/charter	0.4
Total number of fish	177,105

Table 2-1. Percent of Spotted Sand Bass landings (retained fish) in the recreational fishery by mode from 2004 to 2018 (no 2010, 2011, or 2018 data used) and the estimated total number of fish retained by all modes for all years (RecFIN 2019).

The Spotted Sand Bass fishery is mostly catch-and-release; 96% of estimated catch in southern California was discarded from 2004 to 2018 (RecFIN). This coupled with their extremely limited distribution, likely accounts for the generally low rank compared to other species landings (kept fish) occurring inland and nearshore from beach/bank, manmade/jetty, and private/rental boat modes (Figure 2-3, dashed line). Spotted Sand Bass landings rank fluctuated from 2005 to 2012 between 19 and 29. From 2012 to 2013 there was a decrease in Spotted Sand Bass rank by landings from 25 to 48, followed by an increase into 2016 that peaked at 23 and dropped the following years to 54 in 2018 (Figure 2-3). Several factors could be affecting these changes in ranks, including shifts in effort, availability, and/or desirability of other

species that anglers typically keep. Looking at the trend in ranking of Spotted Sand Bass by total catch (kept and released) shows a different, and perhaps more complete, story because it incorporates all of the Spotted Sand Bass discards. Since 2009, Spotted Sand Bass have consistently ranked in the top 5 species in total catch in southern California for trips occurring inland and nearshore from beach/bank, manmade, and private/rental boat modes (Figure 2-3).

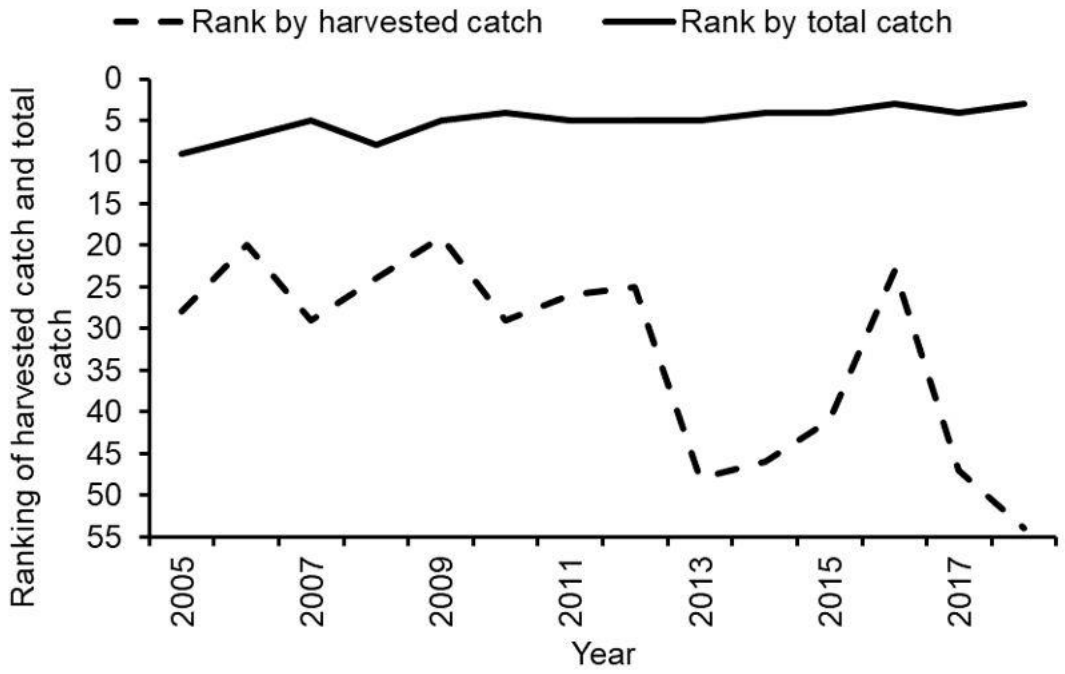

Figure 2-3. Ranking of retained catch (dashed line) and total catch (solid line) from private/rental boats, manmade/jetty mode, and beach/bank mode for Spotted Sand Bass relative to other finfish species in southern California from 2005 to 2018 (RecFIN 2019).

Annual trends in total catch (kept and released fish) and Catch Per Unit Effort (CPUE) (kept and released fish per angler) for the private/rental boat mode varied similarly for Spotted Sand Bass until 2013 (Figure 2-4). Landings decreased by 59% from 2013 to 2015 and then slowly began to rise, increasing by 52% from 2015 to 2017. The drop in catch after 2013 was most likely not due to the bass regulation change in April 2013 because of the extremely high release rate in this fishery. The decrease in catch may be due to a decrease in effort, which coincides with the similar trend in angler trips aboard private/rental boats (Figure 2-1), but the cause of the decrease in effort is unknown. The increase in total catch from 2015 to 2017 may also be due in part to an increase in effort during those same years (Figure 2-1). In contrast with catch estimates, CPUE continued to steadily climb after 2013, increasing by 35% from 2013 to 2018 (Figure 2-4). This increase in CPUE may be due to fewer anglers now catching more fish per angler because of the decreased effort.

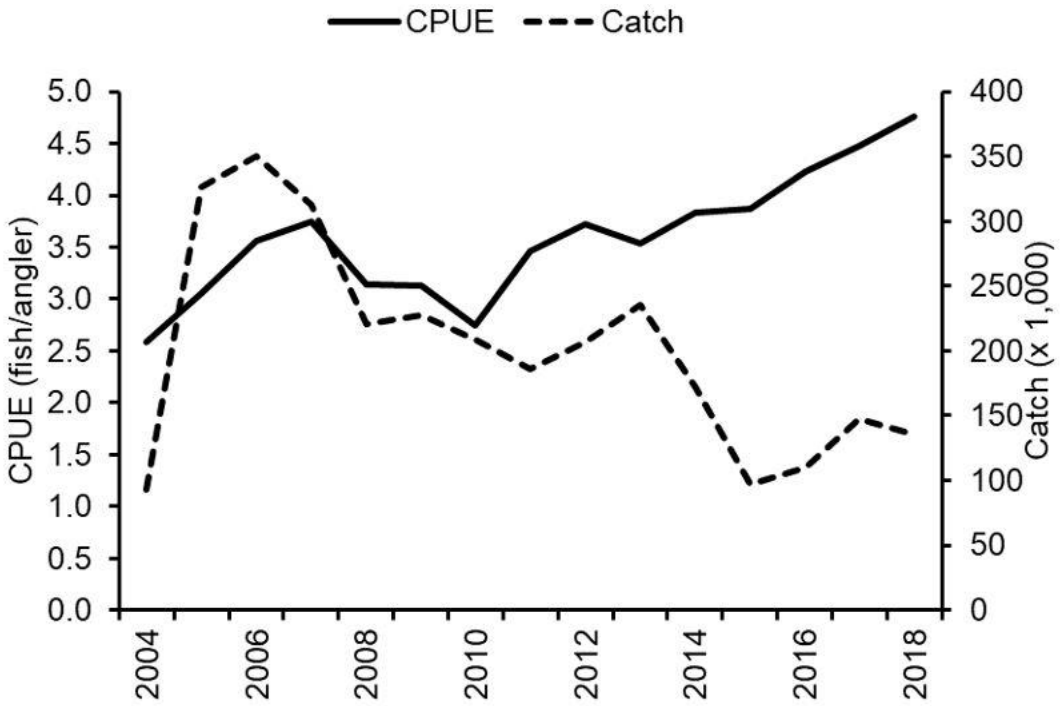

Figure 2-4. Temporal trends in CPUE (solid line) and catch estimates (hashed line) for Spotted Sand Bass kept and released by private/rental boats from 2004 to 2018 (RecFIN 2019).

2.3.2. ***Commercial***

From the early 1900s until 1953, a small commercial fishery using primarily hand and set lines existed for the three sea bass species common to southern California: Kelp Bass, Barred Sand Bass, and Spotted Sand Bass. Historic Department records often combined landings for all three species into a general “rock bass” category starting in 1916, though Kelp Bass and Barred Sand Bass made up the majority of the landings in this category. Landings were relatively high during World War I (from 1914 to 1918) as was the case for many other commercial fisheries in California, because of the increased demand for food, (CDFG 2004). These landings dropped after the war ended and then rose again into the late 1920s (Figure 2-5). Afterward, landings began a general, continuous decline until the commercial take of sea basses was prohibited in 1953 due to concerns about sustainability of this fishery (Young 1963).

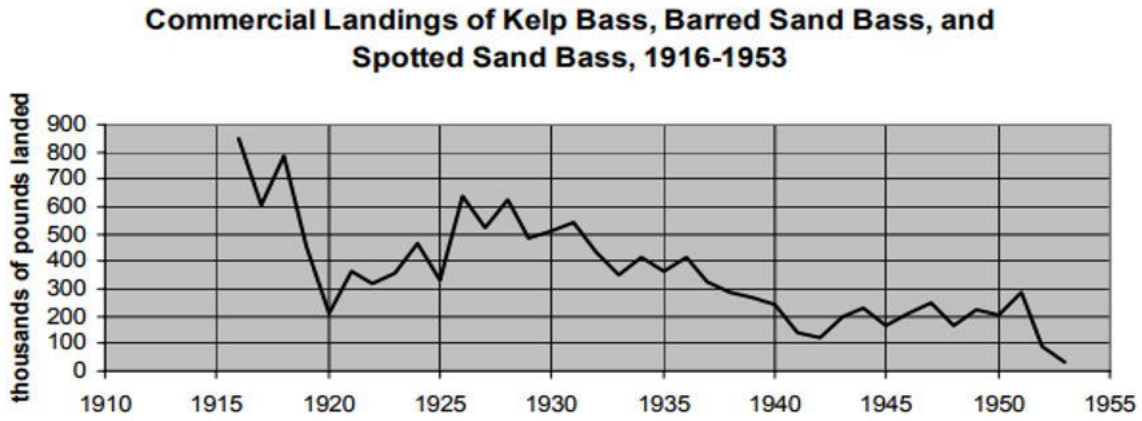

Figure 2-5. Annual commercial landings (lb) of sea basses (combined landings of Kelp Bass, Barred Sand Bass, and Spotted Sand Bass) from 1916 to 1953 (Reproduced from CDFG 2004).

2.4. **Social and Economic Factors Related to the Fishery**

Marine recreational fishing in general supports the economy through the contributions of various local businesses and other indirect, fishing related expenditures. The total economic contribution generated for California in 2011 was roughly $2.8 billion and 10,000 jobs (Lovell et al. 2013). An official socioeconomic analysis has never been completed for Spotted Sand Bass; however, this species is very popular with catch and release anglers fishing from private boats, shore, manmade structures, and float tubes. Declines in Spotted Sand Bass availability could negatively impact the southern California recreational fishing industry and other associated businesses if other, equally desirable fishing opportunities are not available.

Though most Spotted Sand Bass are thrown back, a small portion is kept for consumption. This fact raises some public health concerns given that individual fish showed high concentrations of dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyl (PCB), and mercury when tested as part of a pollutant bioaccumulation study in San Diego Bay (Loflen 2013).

3. Management

3.1. Past and Current Management Measures

Spotted Sand Bass, Barred Sand Bass, and Kelp Bass have always been managed together as one group with a combination of minimum size and bag limits. The state Legislature limited the take of “kelp bass and rock bass” in 1939 with a 15 fish aggregate bag limit (Table 3-1). Over the next decade, the bag limit changed several times and a minimum size limit was introduced in 1953. The term “rock bass” was dropped from the regulations in 1957 and the minimum size limit increased over the next few years, until reaching 12.0 in (30.5 cm), where it remained for many years. This minimum size limit was determined from age, growth, and natural mortality data to yield the maximum weight for this fishery (Young 1963). There were a few more changes to the bag limit in the 1970s, but the next regulation update did not occur for nearly 40 years. In 2013, stricter size and bag limits were introduced to address concerns regarding the status of Barred Sand Bass and Kelp Bass populations.

Table 3-1. Historical record of southern California sea bass (*Paralabrax* spp.) minimum size and bag limit regulations (Reproduced from Jarvis et al. 2014).

Year	Saltwater bass species	Regulation
1939	Kelp Bass, rock bass	Bag limit: 15 fish in aggregate
1949	Kelp Bass, rock bass	Bag limit: 10 fish in aggregate
1951	Kelp Bass, rock bass	Bag limit: 15 fish in aggregate, with not more than 10 of any one species
1953	Kelp Bass, rock bass, Barred Sand Bass, Spotted Sand Bass	Cannot be sold or purchased. Minimum size limit: 26.7 cm (10.5 in) total length
1957	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Minimum size limit: 27.9 cm (11.0 in) total length
1958	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Minimum size limit: 29.9 cm (11.5 in) total length
1959	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Minimum size limit: 30.5 cm (12.0 in) total length
1972	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Bag limit: 20 fish in aggregate, with not more than 10 of any one species
1975	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Bag limit: 10 fish in aggregate, with not more than 10 of any one species
2013	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Bag limit: 5 fish in aggregate; Minimum size limit: 35.6 cm (14.0 in) total length

3.2. Overview and Rationale for the Current Management Framework

Minimum size limits are usually set to allow fish to live long enough to reproduce for one or more seasons before reaching a size at which they can be legally retained. The current size limit of 14.0 in (35.6 cm) corresponds with fish that are 9-plus years of age and allows for several years of spawning before the fishery can legally take fish. Bag limits are typically utilized to limit the number of reproductive individuals that can be removed from the population. The current reduced bag limit from ten to five fish (in combination with Barred Sand Bass and Kelp Bass) is designed to limit the impact of fishing on this stock.

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

The Department has not established overfishing criteria for the Spotted Sand Bass fishery. There is no specific trigger for making a regulation change in this fishery and any decision to re-evaluate the current management strategy is based on supporting evidence from multiple sources. Staff continue to monitor catch, effort, and size trends annually. These data are evaluated relative to historic trends and environmental factors. A stock assessment and FMP have not been completed for the Spotted Sand Bass resource.

3.2.2. *Past and Current Stakeholder Involvement*

Stakeholder involvement has most recently occurred during regulation changes for the saltwater basses. The last regulation change in 2013 increased the minimum size limit and decreased the bag limit (CCR Title 14 §28.30). Leading up to the regulation change, various stakeholder groups, including Tribes, CPFV operators, recreational anglers, spearfishers, Non-governmental Organizations (NGOs), other scientists, and the general public were consulted and given the opportunity to comment through the Commission process. A series of informative presentations by Department staff were presented to stakeholders, and stakeholder input was considered.

To create effective future management strategies for Spotted Sand Bass, the Department will continue to engage stakeholders when regulation changes or novel approaches to managing the fishery are being considered, when FMPs are being developed, and if new collaborative opportunities arise for research and monitoring.

3.3. **Target Species**

3.3.1. ***Limitations on Fishing for Target Species***

3.3.1.1. *Catch*

The Department continues to manage the three saltwater bass species (Kelp Bass, Barred Sand Bass, Spotted Sand Bass) together with a bag and possession limit of five fish in any combination of species.

3.3.1.2. *Effort*

Currently, no regulatory limits on effort are in place for Spotted Sand Bass. Only a sport fishing license is required for recreational anglers not fishing off a pier.

3.3.1.3. *Gear*

Spotted Sand Bass are taken only by hook and line. Recreational anglers fishing from boat or shore may use any number of hooks and lines, with the following exception: on public piers, no more than two lines may be used.

3.3.1.4. *Time*

The Spotted Sand Bass fishery is open year-round.

3.3.1.5. *Sex*

Both sexes of Spotted Sand Bass may be taken in the recreational fishery. It is not possible to determine sex externally throughout their life cycle indisputably; however, spawning females and males can exhibit different colors and patterns.

3.3.1.6. *Size*

For the three saltwater bass species (Spotted Sand Bass, Barred Sand Bass, and Kelp Bass) there is a minimum size limit of 14.0 in (35.6 cm) Total Length or 10.0 in (25.4 cm) alternate length (defined as the length from the base of the foremost spine of the dorsal fin to the longest tip of the tail) (§28.30, Title 14, CCR). The basses also have a fillet length regulation that permits the filleting of legal-sized bass aboard vessels while at-sea. All species of bass fillets must be a minimum of 7.5 in (19.1 cm) in length and bear intact a one in square patch of skin to aid in identifying the fish species for enforcement purposes (§27.65(1), Title 14, CCR).

3.3.1.7. *Area*

Aside from Marine Protected Areas (MPA), there are no limitations on where fishing can occur for Spotted Sand Bass.

3.3.1.8. *Marine Protected Areas*

Pursuant to the mandates of the Marine Life Protection Act (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%. 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.

The MPA network was not designed to specifically benefit a single species such as Spotted Sand Bass, but the network does protect some of their primary habitat types: 7.2% of estuary habitats, 3.5% of eelgrass habitats, 21.3% of surfgrass habitats, and 8.6% of shallow soft bottom habitats in southern California are within MPAs. Given that some of these categories overlap, the total number of percentages cannot simply be added up to get an exact amount of primary Spotted Sand Bass habitat occurring in MPAs. No studies specific to Spotted Sand Bass have been conducted that analyze MPA effects, but the current network of MPAs in southern California is not likely to provide much protection. Spotted Sand Bass are generally limited to the bays and harbors to which they recruit to (Freedman et al. 2015) and none of the bays in which they are most commonly caught (e.g. Mission Bay, San Diego Bay, Newport Bay) are within an MPA. For more information on the specific Southern California MPAs visit our website at https://www.wildlife.ca.gov/conservation/marine/mpas/network/southern-california.

3.3.2. ***Description of and Rationale for Any Restricted Access Approach***

The recreational Spotted Sand Bass fishery is an open access fishery. There is no restricted access program in place at this time.

3.4. **Bycatch**

3.4.1. ***Amount and Type of Bycatch (Including Discards)***

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, are desirable and are thus retained as incidental catch, and does not always indicate a negative impact.

To assess the most commonly caught species with Spotted Sand Bass, all private/rental boat trips that were sampled by CRFS and where at least one Spotted Sand Bass was caught were analyzed. For the two other bass species managed along with Spotted Sand Bass, Barred Sand Bass and Kelp Bass, CPFV logbook data were analyzed. Spotted Sand Bass are rarely caught on CPFVs, so those data are not useful. Because private/rental boaters (main source of landings; see Table 2-1) do not need to submit logs, these data are not as precise as the logbook data but are still the best available.

The most common species caught in 2017 on private/rental boat trips where Spotted Sand Bass were caught included Barred Sand Bass, Kelp Bass, Pacific Mackerel (*Scomber japonicus*), California Halibut, Pacific Barracuda (*Sphyraena argentea*), California Lizardfish (*Synodus lucioceps*), Shortfin Corvina (*Cynoscion parvipinnis*), the silverside family, California Scorpionfish (*Scorpaena guttata*), and Pacific Bonito (*Sarda chiliensis*) (Table 3-2). Although Spotted Sand Bass were caught on 100% of these trips and are the most abundant species caught, they may not always be the primary target. These other species may be primary or secondary targets on private/rental boat trips that are also keeping Spotted Sand Bass. Note that several of these species are also associated with bay and estuarian habitat (see section 1.4.1). Other species such as Pacific Mackerel, Pacific Barracuda, and Pacific Bonito are mostly pelagic, but are known to come into bays and hang around piers and jetties where private boaters may be fishing while also targeting or opportunistically catching Spotted Sand Bass. California Scorpionfish and Kelp Bass are also not typically associated with Spotted Sand Bass habitat but can also be caught around piers and jetties. Few Spotted Sand Bass are caught on trips targeting these other mainly pelagic or rocky reef associated species (Table 3-2). With the exception of California Lizardfish, Shortfin Corvina, and two members of the silverside family (Jacksmelt and Topsmelt), all other incidentally caught species listed in Table 3-2 have state or federal management measures in place. None of the species caught with Spotted Sand Bass on CRFS sampled trips are prohibited or of special concern.

Table 3-2. Number caught and percent of trips (frequency of occurrence) for the top ten most abundant species on private/rental boat trips (n=664) where at least one Spotted Sand Bass was caught in 2017 (RecFIN).

Species	Number caught	Percent of trips	Number of Spotted Sand Bass caught on associated trips
Spotted Sand Bass	**6,465**	**100**	**6,465**
Barred Sand Bass	581	9.0	1,211
Kelp Bass	330	5.1	459
Pacific Mackerel	302	4.7	584
California Halibut	270	4.2	1,117
Pacific Barracuda	127	2.0	368
California Lizardfish	94	1.5	161
Shortfin Corvina	41	0.6	187
Silverside Family	27	0.4	41
California Scorpionfish	24	0.4	180
Pacific Bonito	21	0.3	117

Catch and release rates of the target species are extremely high in the Spotted Sand bass fishery, with 94% of Spotted Sand Bass being released between 2004 and 2012, and 98% of Spotted Sand Bass being released between 2013 and 2018 (post bass regulation change) (RecFIN). Discards may include both legal and sublegal fish, however, there is extremely limited size data on discarded fish. The trends in estimated number of discards and discard per unit effort (DPUE) for private/rental boats (Figure 3-1) are almost identical to the tends in catch and CPUE (Figure 2-4) because of the high proportion of discarded catch. The total number of estimated discards has declined from a high of about 334,600 fish in 2006 to a low of about 95,000 fish in 2015. DPUE has experienced an overall increase throughout the timeseries, from a rate of 2.2 discards per angler in 2004 to 4.7 discards per angler in 2018 (Figure 2-4). The DPUE rate continued to increase immediately following the regulation change in 2013 in conjunction with the drop in the total estimated number of discards from 2013 to 2015, which may be due to a decrease in effort, resulting in

fewer anglers catching more fish. The increase in total discards from 2015 to 2018 also coincides with a small increase in effort (Figure 2-1).

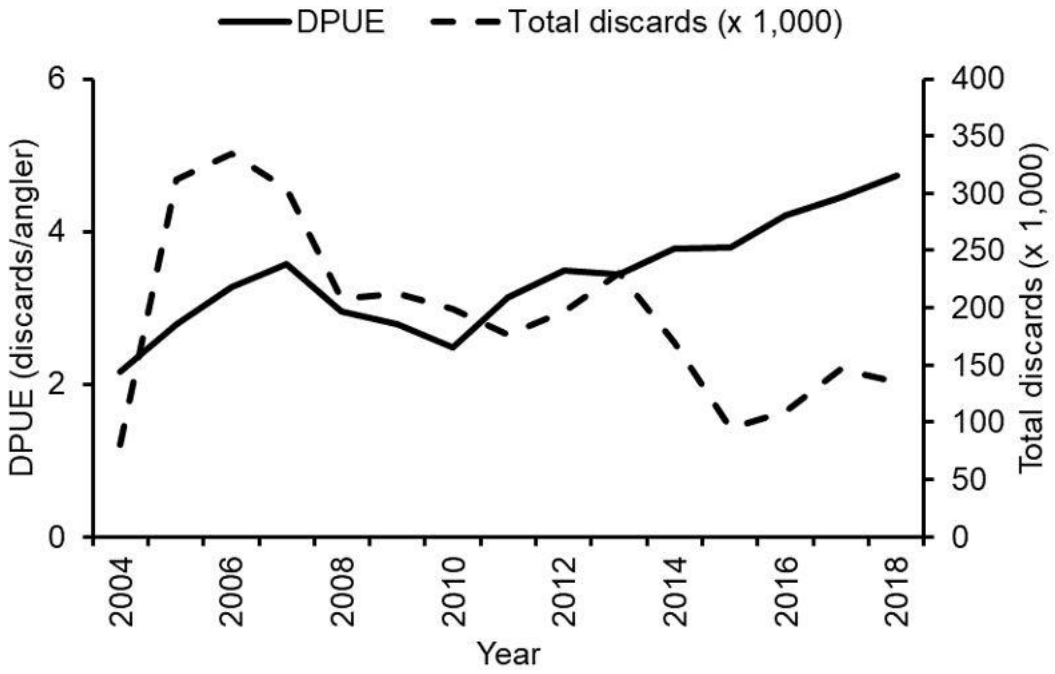

Figure 3-1. Annual trends in bycatch of Spotted Sand Bass presented as DPUE (solid line) and the total estimated number of discards (dashed line) for private/rental boats from 2004 to 2018 (RecFIN 2019).

Discard mortality results from a combination of sources including fishing-related trauma and predation by California Sea Lions (*Zalophus californianus*), sea birds, Harbor Seals (*Phoca vitulina*) and other fish. The initial post-release mortality of Spotted Sand Bass is estimated at 0.63% and short-term (10 days) mortality is estimated at 3.1% (Spotted Sand Bass, Barred Sand Bass, and Kelp Bass combined) (Semmens and Parnell 2014). Most discarded Spotted Sand Bass are quickly released back into the water at the same location. Since the mortality rate is relatively low, it is unlikely there is any substantial impact to the Spotted Sand Bass population or ecosystem. However, to better understand the total impacts of bycatch, further research on the long-term survivorship of discarded Spotted Sand Bass is needed as current mortality estimates are only based on initial and short-term observations.

3.4.2. *Assessment of Sustainability and Measures to Reduce Unacceptable Levels of Bycatch*

Due to this fishery being recreational only, anglers are often targeting a suite of other fishes as well as Spotted Sand Bass. While bycatch information is limited for this

fishery, there are currently no concerns about the impact of bycatch on the sustainability of any other stocks, and there are no specific measures in place to reduce bycatch.

3.5. Habitat

3.5.1. *Description of Threats*

Coastal development, habitat fragmentation, and storm runoff all contribute to the degradation of eelgrass bed habitat (Zedler 1996; Lotze et al. 2006), which serves as nursery habitat for Spotted Sand Bass (Allen et al. 2002). Pollution from wastewater discharge can also have negative impacts on bays and estuaries (Schiff et al. 2000). Increased damage to or loss of suitable bay and estuarine habitats could lead to great reductions of Spotted Sand Bass populations either in specific bays or in southern California as a whole because they are utilized by almost all life history stages with the exclusion of the planktonic larval stage.

3.5.2. *Measures to Minimize Any Adverse Effects on Habitat Caused by Fishing*

While there are many potential threats to Spotted Sand Bass habitat, the Department only has management authority over those habitat impacts that stem from fishing activities. The Spotted Sand Bass fishery is primarily a hook and line recreational fishery. Adverse impacts of this fishery on soft bottom bay, harbor, and estuarine habitat is likely insignificant. Some impact to the eelgrass beds may occur if hooks are snagged within the blades; however, this is likely minimal. Anchoring while fishing from private/rental boats in these habitats may occur when currents are strong, but those effects are also likely minimal. Because of this, no measures to minimize the habitat impacts from fishing are required at this time.

3.5.3. *Requirements for Person or Vessel Permits and Reasonable Fees*

Unless recreationally fishing off a public pier, all anglers 16 years old or older are required to purchase a fishing license. A Recreational Ocean Enhancement Stamp (Validation) is required for any person taking fish south of Point Arquello (Santa Barbara County). Captains operating their vessels as CPFVs or private charters much purchase a permit. In 2019, the cost of an annual resident sport fishing license is $49.94, and an Ocean Enhancement Validation is $5.66. The most current license options and fees for the recreational fishery may be accessed at https://www.wildlife.ca.gov/Licensing/Fishing.

Table 3-3. Annual sport fishing license fees from 1 January to 31 December 2019.

License	Fee	Description
Commercial Passenger Fishing Vessel License	$367.25	Required for any boat from which persons are allowed to sport fish for a fee.
Resident Sport Fishing	$49.94	Required for any resident 16 yr of age or older to fish.
Recreational Non-resident Sport Fishing	$134.74	Required for any non-resident 16 yr of age or older to fish.
Recreation Ocean Enhancement Validation	$5.66	Required to fish in ocean waters south of Point Arguello (Santa Barbara County). An Ocean Enhancement Validation is not required when fishing under the authority of a One or Two-Day Sport Fishing License.
Reduced-Fee Sport Fishing License – Disabled Veteran	$7.47 at CDFW offices. $7.82 from license agents	Available for any resident or non-resident honorably discharged disabled veteran with a 50 percent or greater service-connected disability. After you prequalify for your first Disabled Veteran Reduced-Fee Sport Fishing License, you can purchase disabled veteran licenses anywhere licenses are sold.
Reduced-Fee Sport Fishing License – Recovering Service Member	$7.47	Available for any recovering service member of the US military. The Recovering Service Member Reduced-Fee Sport Fishing License is only available at CDFW License Sales Offices.
Reduced-Fee Sport Fishing License – Low Income Senior	$7.47	Available for low income California residents, 65 yr of age and older, who meet the specified annual income requirements. The Reduced-Fee Sport Fishing License for Low Income Seniors is only available at CDFW License Sales Offices.

4. Monitoring and Essential Fishery Information

4.1. Description of Relevant Essential Fishery Information

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

4.2. Past and Ongoing Monitoring of the Fishery

4.2.1. *Fishery-dependent Data Collection*

Fishery-dependent data collected by the Department provides an excellent way to monitor fishing effort, catch levels, and the size structure of retained Spotted Sand Bass. Fishery-dependent data are collected from CPFV logbooks and from all fishing modes sampled by CRFS. Both CPFV logbook and CRFS data collected by the Department contribute valuable estimates of catch and effort that help Department staff monitor the status of Spotted Sand Bass, though very few Spotted Sand Bass are caught aboard CPFVs.

Beginning in 1935, CPFV operators were required to keep daily catch logs and submit them to the Department monthly. These data were collected continuously to present day, except for the years during World War II (from 1941 to 1946) when most CPFVs were not fishing (Hill and Schneider 1999). Logbook data have always included the date fishing occurred, port code, boat name, Department fishing block, angler effort, and the number of fish kept by species, and after 1994 included discarded fish, target species, bait type, and sea surface temperature. However, Spotted Sand Bass were initially recorded within the “rock bass” category, which also included Barred Sand Bass and Kelp Bass, and were not consistently reported by species until 1975. Although initially recorded on paper, as of December 2017, 70% of all CPFV logs are voluntarily entered via the Marine Logs System electronic application that is accessible to Department scientists.

All modes of recreational fishing were surveyed by the Marine Recreational Fisheries Statistics Survey (MRFSS) for estimates of catch and effort between 1979 and 2003. The Pacific States Marine Fisheries Commission ran these surveys with both federal and state funding. A combination of dockside surveys, CPFV sampling, and phone interviews were used to generate the estimates. In January 2004, the Department implemented its own sampling survey, CRFS, to replace the MRFSS surveys using similar methods.

CRFS estimates (from 2004 to 2018) use catch and effort data collected by samplers from all fishing modes. In addition, CRFS also collects size (length and weight) information on kept fish. Numbers of discards are also recorded for all modes and discard lengths are obtained opportunistically on CPFVs. Estimates from CRFS and MRFSS are not directly comparable due to differences in methodology, so only CRFS data are presented in this report. CRFS data on catch estimates and mortality are available electronically to the public within 40 days of collection on the updated RecFIN website (https://www.recfin.org).

4.2.2. ***Fishery-independent Data Collection***

Fishery-independent data can provide a better, less-biased assessment of relative abundance because sampling can be standardized and information on all life stages can be collected.

Some Spotted Sand Bass have been recorded on scuba transects at King Harbor, California and in some power plant impingement data, but the numbers are too low to have confidence in any trends over time. Quarterly offshore CalCOFI plankton tows capture *Paralabrax* larvae, but the larvae cannot be identified to species level and there is too much overlap of spawning seasons for the three species of bass, making it a less informative index. No fishery-independent data sets that could provide an index of abundance for Spotted Sand Bass are available on a continual, annual scale. There have been “snapshot” studies that analyze whole fish assemblages in various years that include Spotted Sand Bass (Allen et al. 2002), but a continual monitoring program would be most useful for monitoring trends in abundance.

5. Future Management Needs and Directions

5.1. Identification of Information Gaps

Additional EFI data are necessary for effectively monitoring the Spotted Sand Bass resource. A long-term fishery-independent monitoring program that is conducted in bay and estuarian habitat could provide an index of abundance on an annual basis (Table 5-1). There is also uncertainty regarding long-term mortality associated with hook and line catch and release practices for this species. A formal stock assessment of Spotted Sand Bass using existing and new EFI would also be helpful in the sustainable management of the fishery. However, an effective stock assessment would depend on reliable estimates of fishery indicators from the beginning of the fishery, when fishing pressure was light, and these data are rarely available for recreational fisheries in California.

Table 5-1. Informational needs for Spotted Sand Bass and their priority for management.

Type of information	Priority for management	How essential fishery information would support future management
Long term post-release mortality	High	Quantifying long-term discard mortality is necessary for a more accurate estimate of overall fishing mortality.
Indices of abundance using SCUBA or other survey methodology	High	Information used to assess annual variability in abundance and size structure of local populations.
Adult movement (home range size, homing behavior, potential migration distance)	Medium	Information used to assess connectivity of populations, evaluate habitat utilization, and effectiveness of MPAs in relation to movement.
Updated estimate of natural mortality	Medium	Natural mortality estimates are used in the calculation of total mortality. Estimated total mortality rates are utilized in stock assessments and when modeling forward projections of the fishery
Estimate of amount of money the fishery contributes to California's economy	Medium	This information would be the goal of a socioeconomic analysis that would be useful when assessing how changes in the fishery impact the economy.
Formal stock assessment	Low	Information used to estimate spawning stock biomass and maximum sustainable yield.
GIS analysis of catch in relation to habitat types and MPA locations	Low	Information used to determine what percentage of catch occurs in each habitat type. This helps to evaluate new MPAs relative to historic fishing.

5.2. Research and Monitoring

5.2.1. *Potential Strategies to Fill Information Gaps*

Department staff will continue to utilize CRFS data to monitor Spotted Sand Bass fishery trends. The Department will also continue to search for and incorporate any relevant results from other fishery-dependent or fishery-independent studies conducted by others. As mentioned above, additional fishery-independent indices of abundance for Spotted Sand Bass will be important for monitoring future trends in the stock. This may require a combination of efforts led by the Department and independent researchers through various grants or other funding sources. Studies could include temporal surveys of the relative abundance and the size of Spotted Sand Bass within bay and estuary habitats in southern California. Moreover, an estimate of long-term discard mortality will be useful to the Department to understand whether restrictive size limits result in increased mortality of sublegal size classes. Research efforts like these may be particularly well suited for graduate studies at local universities

5.2.1.1. *Opportunities for Collaborative Fisheries Research*

The Department has collaborated in the past and will continue to work with outside entities such as academic organizations, NGOs, citizen scientists, and both commercial and recreational fishery participants to help fill information gaps related to the management of state fisheries. The Department will also reach out to outside persons and agencies when appropriate while conducting or seeking new fisheries research required for the management of Spotted Sand Bass. Several of the information gaps identified in section 5.1 are potential areas for collaboration. In particular, surveys to determine Spotted Sand Bass abundance and discard studies to determine long-term catch and release mortality are good subjects for collaborative studies, potentially involving both anglers and academic entities.

5.3. Opportunities for Future Management Changes

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

Unlike Barred Sand Bass and Kelp Bass, the Spotted Sand Bass fishery is primarily catch and release, with a 98% discard rate (RecFIN) since the bass regulation change in 2013 (up from 94% pre-regulation change). Semmens and Parnell (2014) found initial and short-term post release mortality to be low (0.63% and 3.1%, respectively). Therefore, trends in landings, total catch, and CPUE are most likely attributed to changes in fishing effort and/or environmental conditions. In addition, the estimated age structure of the stock suggests low mortality rates and an overall healthy stock. The Department will continue to monitor landings and discard rates to stay informed of changes to the Spotted Sand Bass fishery.

The Department is currently prioritizing fisheries within the Master Plan Update and exploring how to utilize a Management Strategy Evaluation (MSE) approach with certain fisheries. MSE simulates the performance of a fishery in the future by testing a multitude of alternative management procedures against a set of performance metrics and evaluating the tradeoffs. The Department is currently developing a model of the Kelp Bass and Barred Sand Bass populations to conduct an MSE using the Data Limited Toolkit platform. It is hoped this analysis will provide information about what management measures are most likely to meet management objectives, as well as the tradeoffs between different management measures. If this tool is adopted for used on a wider scale by the Department, staff may perform a similar analysis on the Spotted Sand Bass stock. A formal stock assessment on the Spotted Sand Bass fishery would also aid in the sustainable management of this fishery, but is a low priority given that the Spotted Sand Bass appears to not require any additional management at this point in time.

5.4. **Climate Readiness**

Little is known about how climate change may affect Spotted Sand Bass populations and habitats. To incorporate climate readiness into Spotted Sand Bass management it is important to increase our understanding of possible impacts of climate variability. California's coastal waters are already subject to high variability due to episodic events such as the ENSO, the PDO, and the NPGO. Climate change will bring even further uncertainty to these trends, with potentially extreme implications for ecosystem function and fishery sustainability in coastal areas. To manage Spotted Sand Bass populations effectively under climate change, it will be important to take a proactive approach to management. This may entail increased or targeted monitoring of populations and/or precautionary management measures until the uncertainties associated with climate change can be better understood.

Climate change that results in warmer ocean temperatures could have both positive and negative effects on Spotted Sand Bass populations. Spotted Sand Bass

recruitment may increase during warmer water events (Allen et al. 1995), but recruitment and larval condition may also be negatively affected by other environmental regimes, such as “The Blob”, which is associated with warmer water and lower wind speed, chlorophyll a, and upwelling (Basilio et al. 2017). Climate change could affect several other factors, such as food supply, pollution levels, and population density, which may have effects on growth rates (Allen et al. 1995). Ocean acidification may also have a negative impact on prey availability for Spotted Sand Bass, especially for hard-shelled invertebrates.

Protecting the health of key habitats for Spotted Sand bass such as bays and estuaries in southern California is a priority for climate readiness. This might involve protection of eelgrass beds, removal and monitoring of invasive species, and regulation of coastal runoff. Finally, increased monitoring of environmental variables, fish abundance, and distribution from all available data sources will be important to anticipate change and take proactive management actions.

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