Fishery-at-a-Glance: Jacksmelt

Scientific Name: *Atheriopsis californiensis*, family Atherinopsidae

Range: Jacksmelt range from Yaquina Bay, Oregon to Santa Maria Bay, Baja California, Mexico.

Habitat: Jacksmelt are found shallow habitats and typically are found in estuaries, bays, kelp canopy, sandy beaches, and along the nearshore. Juveniles and adults school in nearshore waters from 5 to 50 feet (1.5 to 15 meters) in depth, although they can be found in depths down to 95 feet (29 meters).

Size (length and weight): The maximum length of Jacksmelt measured is 19.3 inches fork length (494 mm) weighing 0.57 kg (1.26 pounds); however, a 22-inch (559 mm) fish was reported.

Life span: The maximum age range of Jacksmelt is 9 to 11 years.

Reproduction: Jacksmelt are oviparous and capable of spawning year-round; although spawning peaks in the fall into the spring. Females deposit eggs with adhesive filaments that adhere to vegetation and to each other.

Prey: The diet of Jacksmelt are omnivorous feeding on invertebrates, small fish, algae and detritus. Larvae feed on copepods, diatoms and bivalve veligers. Juvenile and adults prey on small fish, gammarid amphipods, and mole crabs.

Predators: Jacksmelt are forage for a variety of species including game fish, marine mammals, and birds.

Fishery: Jacksmelt do not support a commercial fishery—they are caught as bycatch by roundhaul boats targeting coastal pelagic species and hook-and-line boats fishing nearshore. Sport anglers fishing from shore, man-made structures, and boats

Area fished:

Fishing season:

Fishing gear:

Market(s):

Current stock status:

Management:

1 The Species

1.1 Natural History

1.1.1 Species Description

Jacksmelt, *Atherinopsis californiensis* is a member of the silversides family Atherinopsidae which includes Grunion, *Leuresthes tenuis*, and Topsmelt, *Atherinops affinis*, in California marine waters. Osmeridae or “true” smelts, have a single dorsal fin and an adipose fin, whereas the silversides, i.e., Jacksmelt and Topsmelt, have two dorsal fins (one with spines) as shown in figures 1-1 and 1-2. The insertion of the anal fin occurs between the two dorsal fins in Jacksmelt—the anal fin inserts at the origin of the anterior dorsal fin in Topsmelt.

Figure 1-1. Jacksmelt, *Atherinopsis californiensis*. (Photo credit: Kirk Lombard, Sea Forager).

Figure 1-2.Topsmelt, *Atherinopsis tenuis*. (Photo credit: Kirk Lombard, Sea Forager).

1.1.2 Range, Distribution, and Movement

The geographic range of Jacksmelt extends from Yaquina Bay, Oregon to Santa Maria Bay, Baja California, Mexico (Watson 1996; Love 2011) (Figure 1-3).

Figure 1-3. Jacksmelt (*Atherinopsis californiensis*) range. (Source: Google Earth Pro. March 29, 2019).

1.1.3 Reproduction, Fecundity, and Spawning Season

Jacksmelt are oviparous and capable of spawning year-round with peaks in the fall to early spring. In southern California, mature fish were documented with spawning peaks occurring from October through March (Middaugh et al. 1990). In northern

California, spawning activity peaked in January to February (DeLeón 1999). Females deposit eggs with adhesive filaments that adhere to vegetation and to each other. Jacksmelt are batch spawners—Clark (1929) observed females carrying embryos in approximately three different size groups—ranging in diameter from less than 0.4 mm (0.01 in); 0.4-0.8 mm (0.01-0.03 in) and 2.0-2.5 mm (0.08-0.1 in). Clark (1929) noted that the smallest group of eggs were absent during the spawning season.

1.1.4 Natural Mortality

Determining the natural mortality (M) of marine species is important for understanding the health and productivity of their stocks. Natural mortality results from all causes of death not attributable to fishing such as old age, disease, predation or environmental stress. Natural mortality is generally expressed as a rate that indicates the percentage of the population dying in a year. Fish with high natural mortality rates must replace themselves more often and thus tend to be more productive. Natural mortality along with fishing mortality result in the total mortality operating on the fish stock. Currently, there are no natural mortality estimates for Jacksmelt.

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 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.

Jacksmelt larvae hatch at approximately 6-9 mm (0.2-0.4 in), transform from larvae to juvenile at 18-20 mm (0.7-0.8 in). Jacksmelt grow fast and may average 190 mm (7.5 in) in length during the first two years of life (Clark 1929). Maximum recorded size is approximately 491 mm fork length (19.3 in) (RecFIN data 2019); however, a 22 in (558 mm) Jacksmelt was reported by Miller and Lea 1972.

1.1.6 Size and Age at Maturity

Aging studies for Jacksmelt were based primarily on length frequencies although scales were used for assigning ages to determine maximum ages (Clark 1929). Jacksmelt grow to an average length of 114 mm (4.5 in) in their first year of life and 185 mm (7.3 in) by the end of their second year, when most are sexually mature (Clark 1929).

1.2 Population Status and Dynamics

No formal stock assessment has been conducted on Jacksmelt.

1.2.1 Abundance Estimates

The Department has limited data from fisheries independent sources for Jacksmelt. Existing databases include a combination of fishery-dependent and fishery-independent sources that can be used to evaluate the status of Jacksmelt. These

sources include: estimated recreational catch and effort, provided by the California Recreational Fisheries Survey (CRFS); commercial landing receipts from California Fisheries Information System (CFIS), which in 2018 were incorporated into the Marine License Database (MLDS); and, fishery-independent sampling. In combination, these data sources provide estimates of relative effort, landings (catches), catch composition, and length at capture and can be used to develop abundance indices provided that potentially confounding factors unrelated to stock abundances are identified, e.g., market, environmental conditions, and regulatory changes.

The Department's San Francisco Bay Study conducts indices of abundance surveys for a range of finfish and invertebrate species including Atherinopsidae. Sampling gears include midwater trawl data from established stations in San Francisco and San Pablo bays since 1980 (Figure 1-4). Catch per unit effort (CPUE) indices were determined from midwater trawl catches and adjusted by the volume of water filtered through the mouth of net (DeLeón 1999).

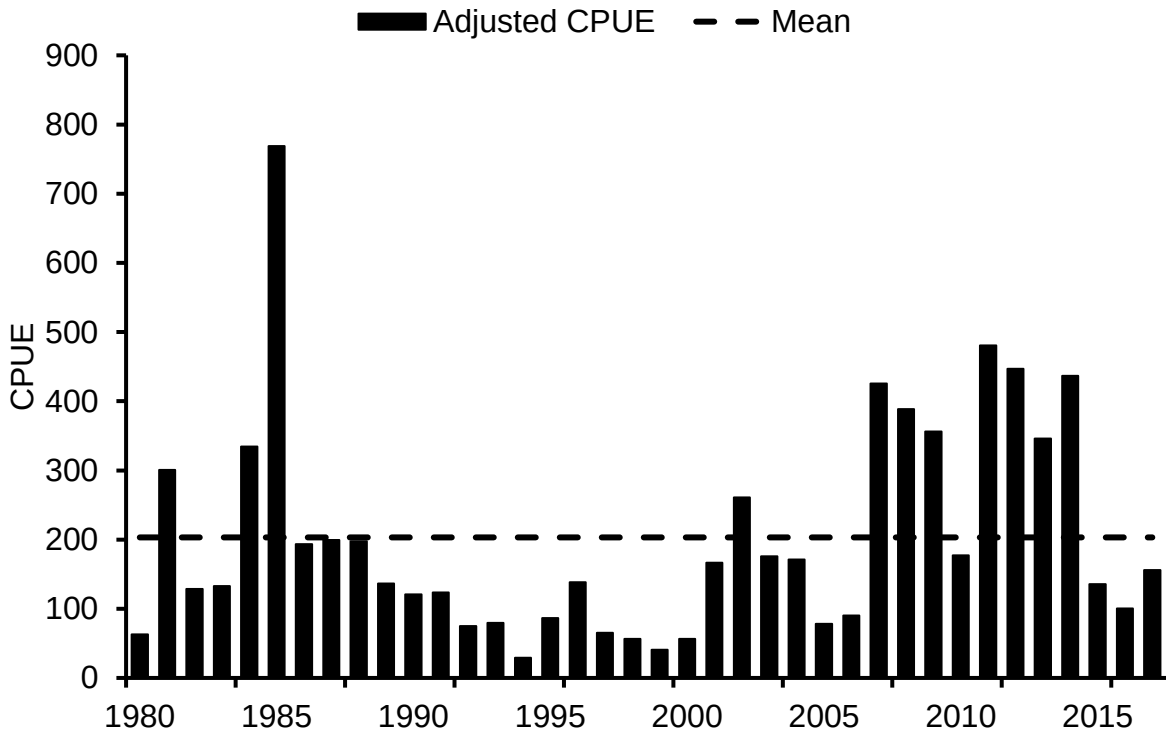

Figure 1-4. Jacksmelt abundance indices from the Interagency Ecological Program (IEP) San Francisco Bay Study: 1980-2017. (Source: CDFW San Francisco Bay Study).

1.2.2 Age Structure of the Population

The true age composition or age frequency of Jacksmelt is not known primarily due to issues related to sampling logistics and gear selectivity. Population age frequencies derived from hook-and-line gear used by commercial and recreational fishermen/anglers reflect only the age composition of the fished population due to the selectivity of the gear used; YOY and 1-yr old fish are very likely to be under-

represented. The small mouths of younger fish may impede hooking and retention of samples and therefore, may be a source of bias. Below, length frequency of CRFS sampled Jacksmelt, all samples combined from 2005 to 2018, n = 16,685, indicate multiple year classes in the fishery (Figure 1-5) with approximately 48% of the catch in the 260 mm to 300 mm length bins (FL).

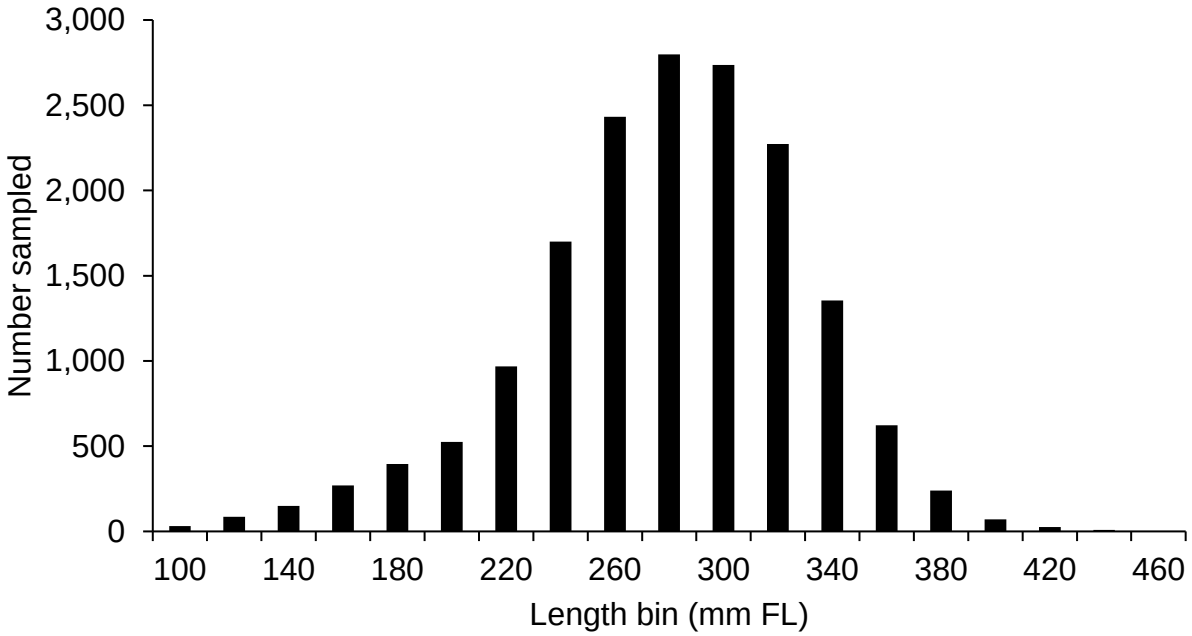

Figure 1-5. Length frequency of CRFS sampled Jacksmelt from 2005-2018. (Source: RecFIN 2019).

1.3 Habitat

Jacksmelt are found shallow habitats and typically are found in estuaries, bays, kelp canopy, sandy beaches, and along the nearshore (Vejar 2011). Juveniles and adults primarily school in nearshore waters at 1.5-15 m (5-50 ft) depth, although they can be found in depth up to 29 m (95 ft) (Baxter 1974; DeLéon 1999).

1.4 Ecosystem Role

Jacksmelt fill a mid-level predator role in bay, estuarine, open coast nearshore, and surf ecosystems. Newly born and YOY Jacksmelt feed upon zooplankton while larger fish forage on a variety of invertebrates and small fish. In turn, both species are forage for larger fish, marine mammals, and birds. Jacksmelt show sensitivity to El Niño-Southern Oscillation (ENSO) events and may be less available as forage to species that prey upon them (Radovich 1961).

1.4.1 Associated Species

California's open coast nearshore ecosystem is comprised by a range of habitats including sandy beach, soft mud, and rocky reef which Jacksmelt occupy. Open coast sandy beach habitat is characterized by high energy surf conditions, tidal flow, turbulence, seasonally strong winds, and currents with varying beach slope and swash zones (Allen and Pondella 2006; Nielsen et al. 2013; Dugan et al. 2017; Nielsen et al. 2017). These factors confound efforts to conduct direct assessment surveys of species with scuba and beach seine methods along many central and northern California coast locations. Although Southern California surf conditions are less extreme relative to northern California, direct sampling surveys are difficult (Carlisle et al. 1960; Allen and Pondella 2006).

The Department conducted fisheries independent surveys at selected stations in southern California using beach seines during the 1950s, 1990s, and 2000s (Carlisle et al. 1960; Gliniak et al. 2009). Gliniak et al. (2009) noted temporal changes in species composition and abundance of species in these beach seine data from the 1950s to the 2000s (CDFW unpublished data). Department staff conducted hook-and-line surveys from Orange to San Diego counties from 2007 to 2011. Species sampled with Jacksmelt in Department beach seine and hook-and-line surveys included the following: Northern Anchovy (*Engraulis mordax*), California Corbina (*Menticirrhus undulates*), Walleye Surfperch (*Hyperprosopon argenteum*), Shiner Perch (*Cymatogaster aggregata*), Spotfin Croaker (*Roncador stearnsii*), Yellowfin Croaker (*Umbrina roncador*), Queenfish (*Seriphus politus*), Topsmelt (*Atherinops affinis*), Leopard Shark (*Triakis semifasciata*) and Pacific Sardine (*Sardinops sagax*).

Angler surveys were conducted by the Department from Smith River, Del Norte County to Point Arguello, Santa Barbara County from 1957 to 1961 (Miller and Gotshall 1965). The results of their surveys indicated that Jacksmelt comprised 6.7% of the shore angler catch ranking it second behind Barred Surfperch (*Amphistichus argenteus*)—21.7% during their sampling period (1957-1961). The Department's California Recreational Fisheries Survey (CRFS) documented species composition of angler catches based on angler interviews and sampled catches statewide. In southern California (Ventura to San Diego counties) from 2005-2018, Jacksmelt was ranked number seven kept and released species by beach/bank anglers behind Barred Surfperch (*Amphistichus argenteus*), Spotted Sand Bass (*Paralabrax maculatofasciatus*), California Halibut (*Paralichthys californicus*), Kelp Bass (*Paralabrax clathratus*), Yellowfin Croaker, and Pacific (Chub) Mackerel (*Scomber japonicus*).

Department staff conducted routine FIS from beaches using hook-and-line along central to north coast beaches from 2007 to 2018 from Del Norte to San Luis Obispo counties (Department unpublished data). From Santa Cruz to San Luis Obispo counties, hook-and-line catches were dominated by Barred Surfperch, Striped Bass (*Morone saxatilis*), with Jacksmelt rounding out the top three species taken by number. Common species caught with Jacksmelt from 2008 to 2018 from Sonoma to San Mateo counties open coast beaches in hook-and-line FIS included: Barred Surfperch, Silver Surfperch (*Hyperprosopon ellipticum*), and Walleye Surfperch (H. argenteum), Striped Seaperch (*Embiotoca lateralis*), Black Perch (*E. jacksoni*), and Striped Bass.

Common species associated with Jacksmelt in CRFS beach/bank surveys conducted from 2005 to 2018 in Humboldt and Del Norte counties included: Redtail

Surfperch, Surf Smelt (*Hypomesus pretiosus*), Black Rockfish (*Sebastes melanops*), Striped Seaperch, Silver Surfperch, Kelp Greenling (*Hexagrammos decagrammus*), and Shiner Perch (Figure 1-6). It is important to note that species caught during nighttime hours by recreational anglers is under-represented in Figure 1-6—CRFS does not interview anglers during nighttime hours due to field staff personal safety issues.

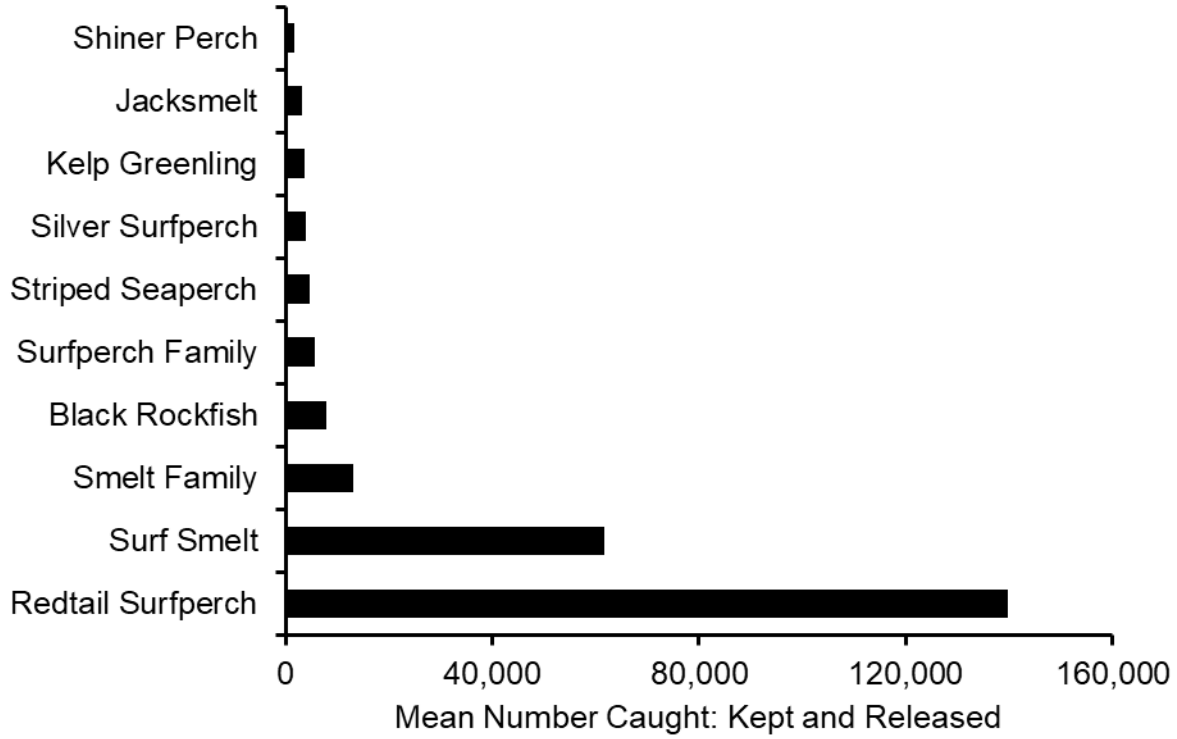

Figure 1-6. Mean number of finfish caught by Humboldt and Del Norte counties beach/bank anglers from 2005 to 2017. (Source: RecFIN 2019).

The Department's San Francisco Bay Study based in Stockton samples annually from South San Francisco Bay to the western Delta monthly. Samples were collected by a combination of beach seine, midwater and bottom trawl gear. There are some data gaps that may influence data relevant to Jacksmelt: limited midwater trawl sampling in 1994 and no winter sampling from 1989 to 1997 (Interagency Ecological Program Newsletter Winter 2012). Beach seines were conducted only from 1980 to 1987 while midwater and otter trawls are ongoing. Abundance indices are routinely calculated for more than 35 species of fishes, several species of crabs, and Caridean shrimp. Finfish species associated with Jacksmelt included: Topsmelt, Northern Anchovy, Pacific Herring (*Clupea pallasii*), Longfin Smelt (*Spirinchus thaleichthys*), Striped Bass, White Croaker (*Genyonemus lineatus*), Inland Silverside (*Menidia beryllina*), Plainfin Midshipman (*Porichthys mirabilis*), Yellowfin Goby (*Acanthogobius flavimanus*), Arrow Goby (*Clevelandia ios*), Staghorn Sculpin (*Leptocottus armatus*), and Shiner Perch (Orsi 1999).

MSI, based in Redwood City, California, is a nonprofit organization focusing on marine science research and education. Since 1970, MSI has conducted fishery-

independent surveys in San Francisco, San Pablo, and Suisun bays using bottom trawls with small-mesh cod ends. Approximately 12,140 tows were conducted through 2015 with 90.7% occurring in southern, 8.0 percent in central San Francisco Bay and the remainder occurring in San Pablo and Suisun Bays (MSI, Redwood City 2017: All Catch Data). No tow data were available during 1982 to 1984 and 1987 to 1991. For each tow, all finfish were counted and identified to species, except for gobies and sanddabs, the latter of which were subsequently determined to be Speckled Sanddabs (*Citharichthys stigmaeus*).

Jacksmelt were caught in all but 10 years of the sampling period. Jacksmelt (coded JS) ranked 34th in mean frequency of occurrence for the entire period 1970 to 2015 (Figure 1-7. Species/species groups co-occurring with Jacksmelt in decreasing order of relative abundance were: NA (Northern Anchovy), SSP (Shiner Surfperch), ES (English Sole (*Parophrys vetulus*)), SHS (Staghorn Sculpin), CH (California Halibut), CG (Chameleon Goby (*Treidentiger trigonocephalus*)), WC (White Croaker (*Genyonemus lineatus*)), SSD (Speckled Sanddab), PSD (Pacific Sanddab (*Citharichthys sordidus*) and YG (Yellowfin Goby). Other associated species that occurred frequently in the catch but in lower relative abundances included BR (Bat Ray (*Myliobatis californica*)), PH (Pacific Herring), SD (sanddab species), BG (Bay Goby (*Lepidogbius lepidus*), PMS (Plainfin Midshipman), CT (California Tonguefish (*Symphurus atricauda*)), SF (Starry Flounder (*Platichthys stellatus*)), BS (Brown Smoothhound (*Mustelus henlei*)), and LFS (Longfin Smelt (*Spirinchus thaleichthys*)) round out the top 20 species (Appendix B).

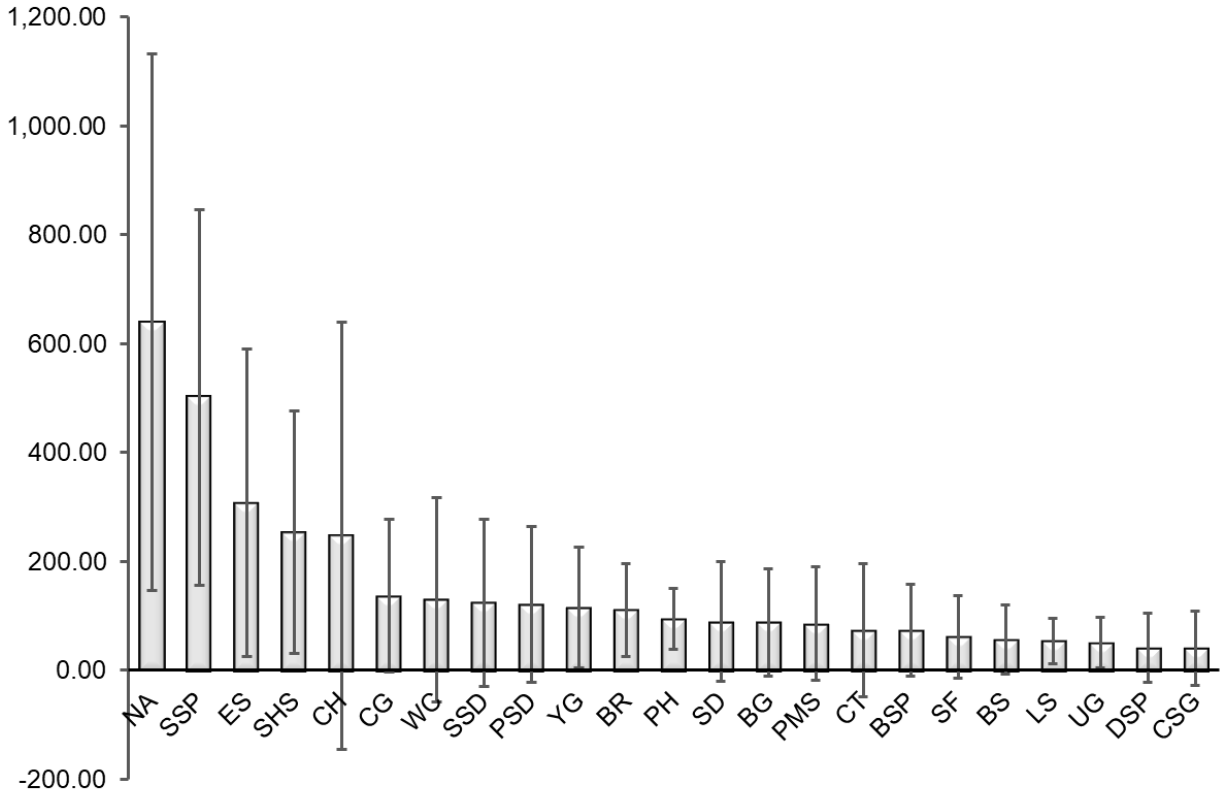

Figure 1-7. Mean frequency of occurrence with standard deviations of species/species groups from Marine Science Institute trawl data collected from 1970-2015. No tows

occurred during 1982-1984 and 1987-1991. (Source: MSI, Redwood City 2017: All Catch Data).

Jacksmelt were documented as incidental and bycatch in Coastal Pelagic Species (CPS) fisheries ranging from Half Moon Bay to La Jolla targeting California Market Squid (*Doryteuthis* (*Loligo*) *opalescens*) fishery. They were also sampled as incidental catch from other CPS fisheries e.g., Northern Anchovy (*Engraulis mordax*), Pacific Sardine (*Sardinops sagax*), and Pacific Chub Mackerel (*Scomber japonicus*). Other incidental and bycatch species associated with Jacksmelt observed in CPS catches are shown in Tables 4-1, 4-2, 4-4, 4-5 , and 4-7 of the draft April 2019 Pacific Fisheries Management Council Stock Assessment and Fishery Evaluation (SAFE) document https://www.pcouncil.org/wp-content/uploads/2019/04/Appendix-A-SAFE-Tables-Draft-April-2019.pdf.

1.4.2 Predator-prey Interactions

The diet of Jacksmelt consists primarily of invertebrates. Larvae feed on copepods, diatoms and bivalve veligers in southern California (Watson and Davis 1989). Juveniles and adults are believed to be omnivores (Boothe 1967; Baxter 1974; Ruagh 1976; Horn et al. 2006), but they feed mostly on gammarid amphipods, detritus, and algae (Barry et al. 1996; Horn et al. 2006). They are taken by surf anglers using baits intended for surfperch such as Pacific Mole Crab (*Emerita analoga*) and polychaete worms. Jacksmelt also consume small fish (Gregory 1992). Anglers targeting salmon with mooching gear, drift fishing with a dead bait fish, e.g., anchovy, herring, sardine, will occasionally hook Jacksmelt.

Jacksmelt are forage for a variety of species including game fish, marine mammals, and birds. Predatory fish include Striped Bass (*Morone saxatilis*), California Halibut, Pacific Bonito (*Sarda chiliensis*), Lingcod (*Ophiodon elongatus*), salmon (*Onchorhynchus spp*.), rockfishes (*Sebastes spp*.), Kelp Bass, Barred Sand Bass, and Leopard Shark (Thomas 1967; Oda and Crane 2013). Jacksmelt also fall prey to birds such as Great Blue Heron (*Ardea Herodias*), Least Tern (*Sternula antillarum*), Caspian Tern (*Hydroprogne caspia*), Forster's Tern (*Sterna forsteri*), cormorants (*Phalacrocorax* spp.), Common Loon (*Gavia immer*), Osprey (*Pandion haliaetus*), and various gulls. Marine mammals also forage on surfperch such as Harbor Seals (*Phoca vitulina*), California Sea Lions (*Zalophus californianus*), and in estuaries North American River Otters (*Lontra canadensis*) (Leet 2001; Orsi (Ed.) 1999).

1.5 Effects of Changing Oceanic Conditions

No studies have examined the effects of changing oceanic conditions on Jacksmelt. Although, temperature and salinity tolerances have not been determined for adult Jacksmelt, Middaugh and others (1991) found larvae had higher survival in lower salinities (10 ppt) and optimal growth rates from 10 to 20 ppt. It's common to observe pier and shore anglers catching Jacksmelt relatively warm water conditions—trends in ocean warming and higher sea levels may expand Jacksmelt distributions particularly in estuaries.

Environmental conditions play a critical role in reproductive patterns and distribution of marine organisms and consequently, the fisheries that they support (Radovich 1961; Parrish et al.1981). Significant changes in ocean current flow and water temperatures, for example during El Niño events, are attributed to displacing or shifting species within faunal groups (Parrish et al. 1981). Water temperature directly affects metabolic functions, preferred food availability, and the distribution of predators (Radovich 1961).

During strong El Niño events, many southern marine species were documented north of their typical range and some successfully spawned—among these were Yellowtail (*Seriola dorsalis*), Striped Mullet (*Mugil cephalus*) and most notably, Grunion successfully spawned (Radovich 1961; Martin et al. 2013). There were no records of Grunion in San Francisco Bay until 2001 and in 2005, they were discovered spawning in Tomales Bay (Martin et al. 2013). Martin et al. 2013 theorized that Grunion began colonizing the northern bays following the strong 1997-1998 El Niño.

El Niño winter storm activity producing inclement conditions including high surf, flooding, and sand excavation (Glynn 1988; Dugan et al. 1994) reduced fishing effort on impacted beaches and increased effort on “fishable” beaches. Pacific Mole Crab life history characteristics, notably fecundity, are negatively correlated with surf water temperatures (Dugan et al. 1994) which suggests that El Niño events may diminish invertebrate forage for Jacksmelt and impact fisheries; however, mole crab incursions northward were documented in Washington State and British Columbia in the 1957-1958 and 1982-1984 El Niños (Glynn 1988).

2 **The Fishery**

2.1 Location of the Fishery

Currently, Jacksmelt do not support an active commercial fishery—landings are incidental to other fisheries due to weak market demand throughout their range. Contemporary significant ports of landing since 2000 in order of importance are: Santa Cruz, Moss Landing, Terminal Island, San Pedro, and Emeryville. Note, from 2010 through 2018, 85% of the statewide (Figure 2-1).

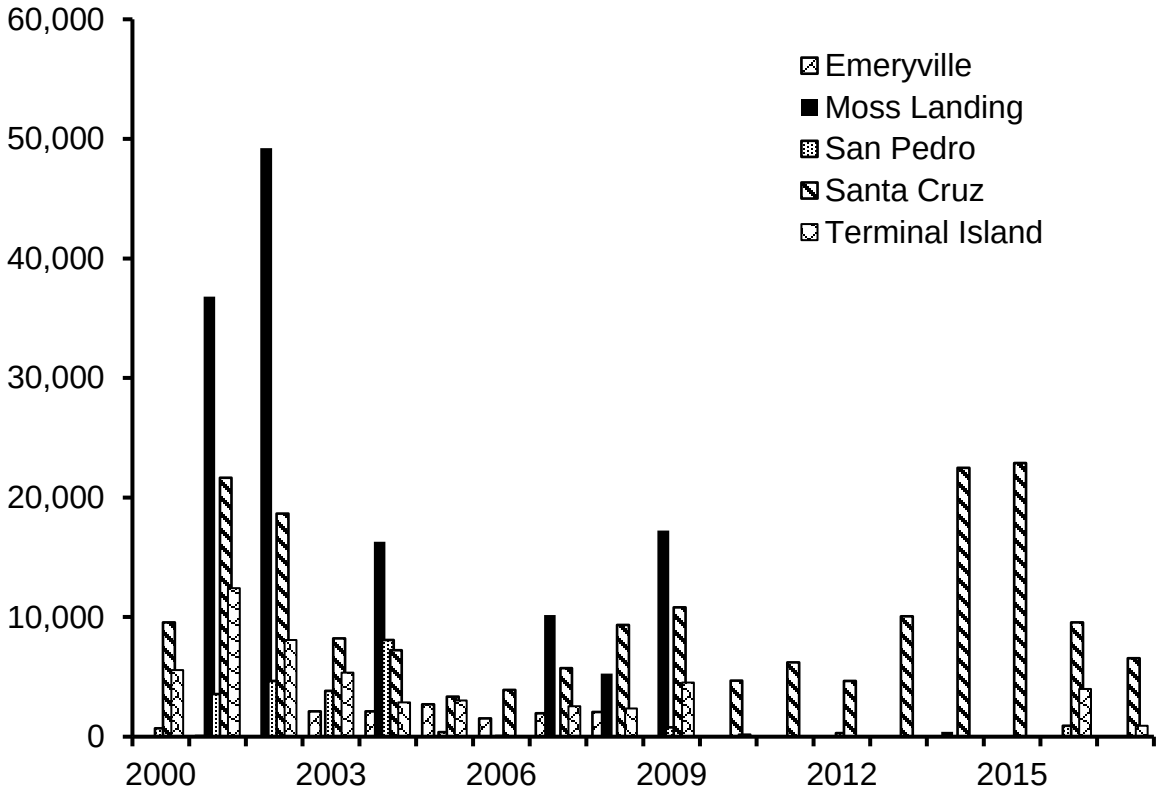

Figure 2-1. Jacksmelt landings by primary California ports. (Source: CDFW Marine Landings Database System (MLDS 2019)).

Shore-based recreational anglers fishing from man-made and beaches, will target Jacksmelt opportunistically as will boat anglers. Although, Jacksmelt are not highly prized for consumption; smaller Jacksmelt are, however, taken by anglers targeting other species, e.g., California Halibut, Striped Bass, and Lingcod, for live bait purposes. CRFS data indicates that the bulk of the Jacksmelt recreational catch originated from San Francisco Bay area counties. It is important to note, however, that beach/bank surveys were discontinued (Figure 2-2).

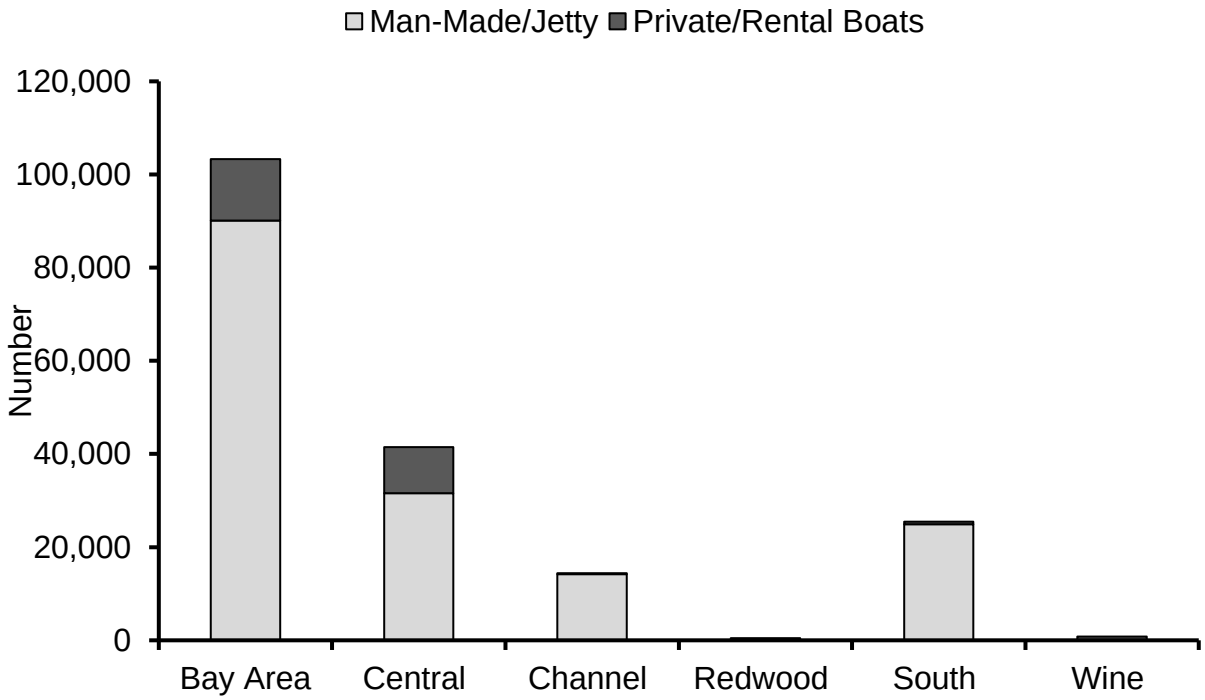

Figure 2-2. 2018 Jacksmelt catch by CRFS district and fishing mode except Beach/Bank (BB) which were discontinued in 2018. (Source: RecFIN 2019).

2.2 Fishing Effort

2.2.1 Number of Vessels and Participants Over Time

The number of vessels and participants in the commercial Jacksmelt fishery has fluctuated over time. Jacksmelt and Topsmelt, unlike the true smelt (Osmeridae—Night Smelt (*Spirinchus starksi*) and Surf Smelt (*Hypomesus pretiosus*) have not been the object of a directed fishery with consistent market demand. Figures 2-3 and 2-4 show statewide Jacksmelt landings and vessels statewide from 1981-2018.

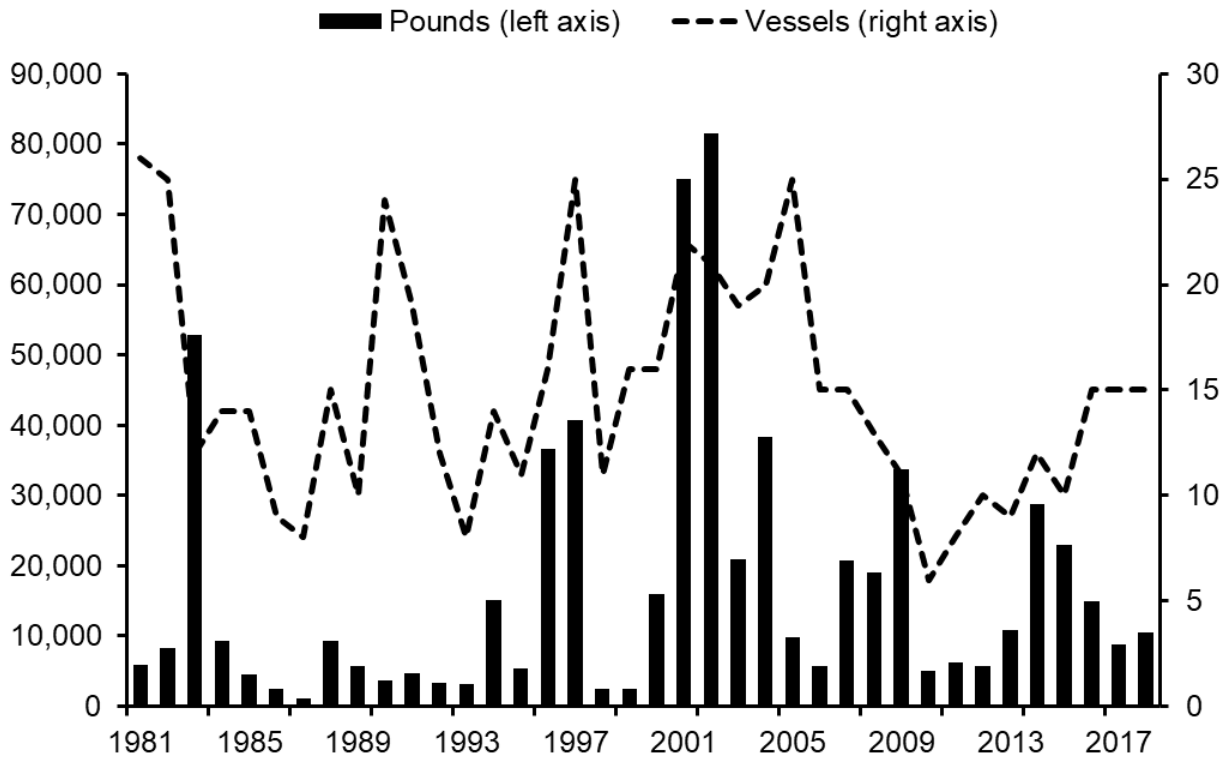

Figure 2-3. Commercial statewide Jacksmelt landings and number of fishing vessels—1981-2018. (Source: CDFW MLDS).

Jacksmelt are caught year-round with winter and fall landing peaks coinciding with round haul fishery activity for coastal pelagic species, i.e., California Market Squid. Most landings are from hook and line vessels making day trips (Figure 2-4). Annual landings ranged from a peak of 14.1% in September to a low of 4.1% in March. Approximately 90% of all Jacksmelt in December and January 2001 and 2002 were landed in Moss Landing.

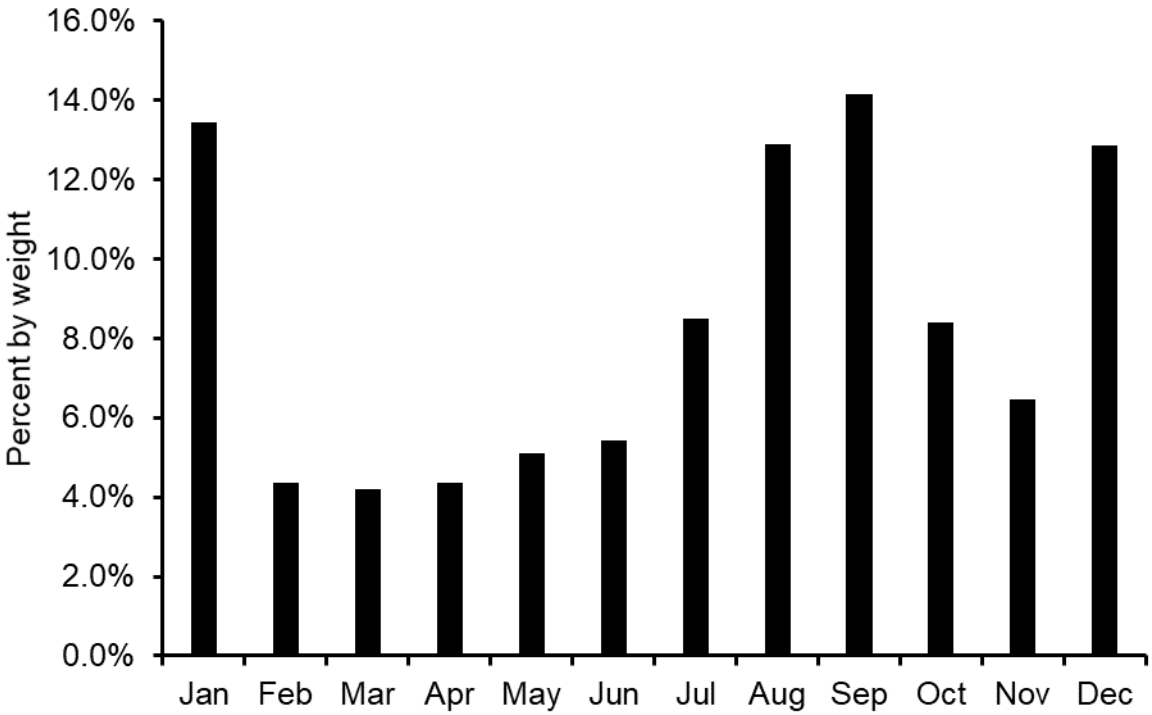

Figure 2-4. Percent composition of combined commercial statewide Jacksmelt landings by month: 1981-2018. (Source: CDFW MLDS 2019).

Recreational Jacksmelt angling effort is comprised primarily by two shore-based modes, as defined by CRFS: beach/bank (BB) and man-made (MM) structures. Historic Jacksmelt recreational fisheries catch and effort were reported by Miller and Gotshall (1965) for central to northern California, and southern California by Pinkas and others (1968). More recently, Karpov and others (1995) presented statewide recreational angler survey data collected by the Marine Recreational Statistics Survey. Historical estimates of surfperch angler effort were “angler days” by Miller and Gotshall (1965), “pole hours” by Pinkas and others (1968), and “fishing days” by Karpov and others (1995). Contemporary effort estimates are available through the Recreational Fisheries Information Network (RecFIN). From the RecFIN website, (https://www.recfin.org/):

> “Established in 1992, the Pacific Coast Recreational Fisheries Information Network is designed to integrate state and federal marine recreational fishery sampling efforts into a single database to provide important biological, social, and economic data for Pacific coast recreational fishery biologists, managers and anglers.”

RecFIN https://reports.psmfc.org/recfin/f?p=601:1000 enables users to generate reports using recreational sample data for California, Oregon, and Washington. Figure 2-5 shows the estimated number of trips by angler modes that most likely include Jacksmelt: beach/bank (BB), man-made (MM), and private/rental (PR) boat statewide based on CRFS data. Note, RecFIN does not currently produce species-specific effort; therefore, Figure 2-5 reflects effort for all species combined.

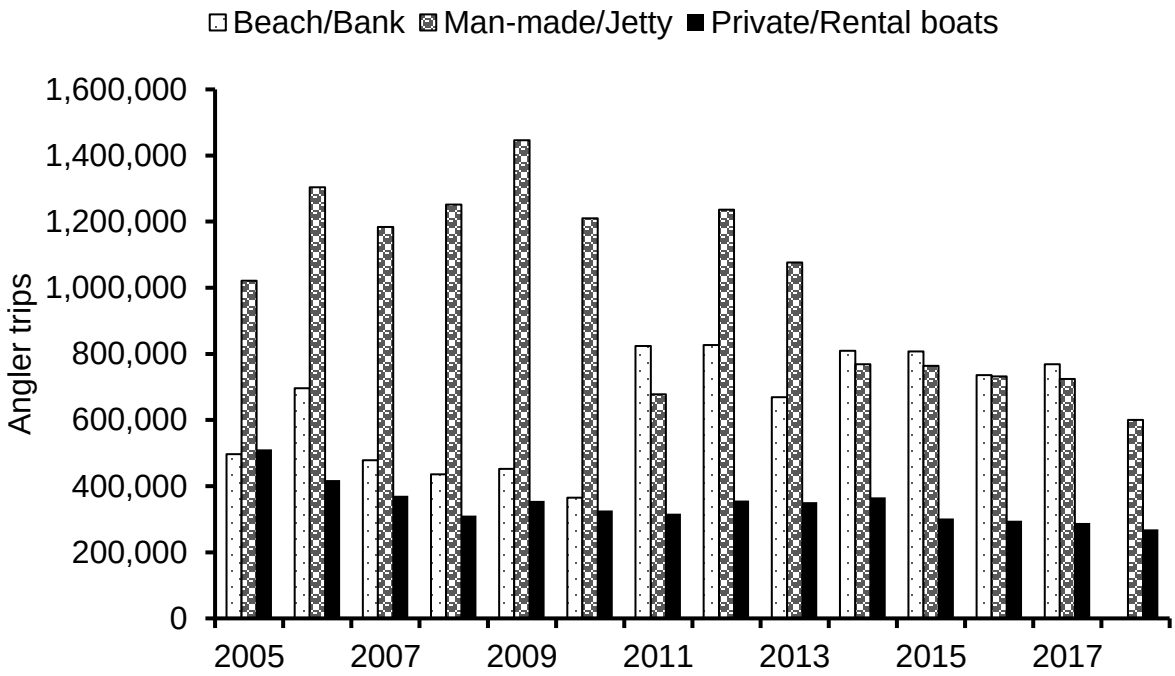

Figure 2-5. Estimated angler effort statewide from beach bank, man-made, and private/rental boat modes: 2005-2018 based on CRFS. (Source: RecFIN 2019).

2.2.2 Type, Amount, and Selectivity of Gear

Atherinopsids are classified as a member of the "Designated Forage Fish Species or Species Groups (Federal Shared Ecosystem Component Species)" in Title Section 111, Title 14, California Code of Regulations (CCR) https://govt.westlaw.com/calregs/Document/I0B5DFA5EA244445E92DCEF40D46DB160?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default). This regulation was implemented in 2017 prohibiting directed boat-based commercial fishing for designated forage species including Jacksmelt. It limits individual commercial vessel landings to 10 mt per trip and 30 mt per annum and may have impacted fishery participation and landings.

Historically, Jacksmelt were taken by a wide range of gears including: set long line, gill net, beach seine, lampara, purse seine, and hook and line with rod and reel. Contemporary landings are comprised by fishermen using hook and line, purse seine, lampara, and drum seine gear (Figure 2-6).

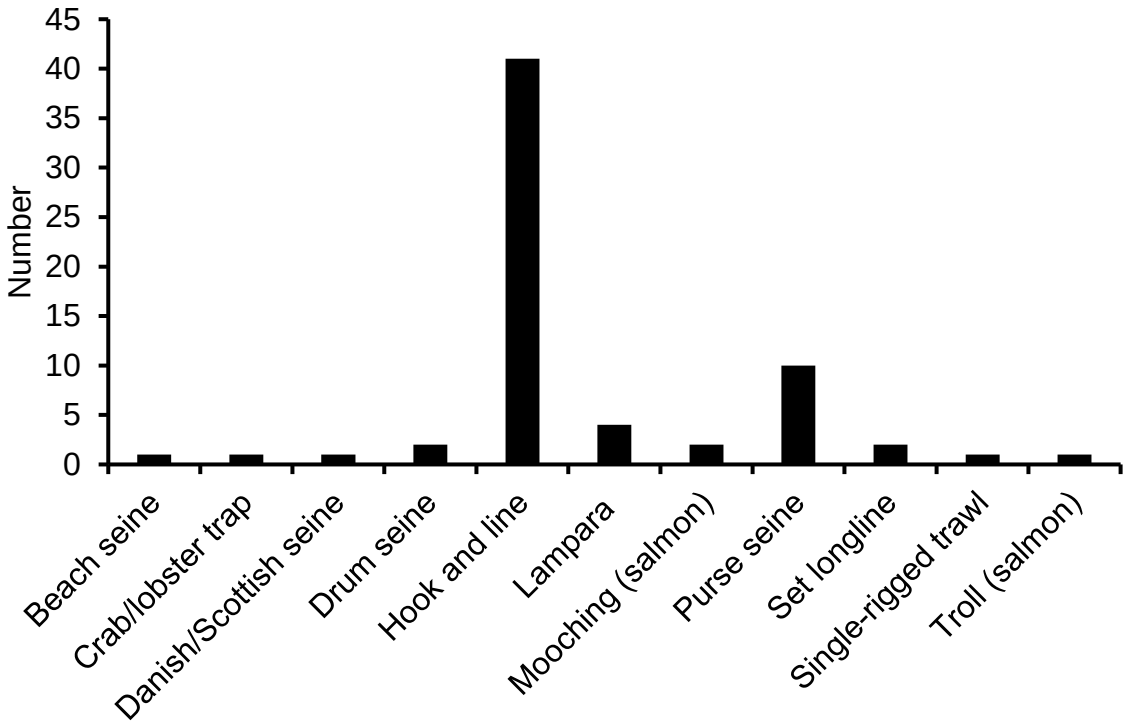

Figure 2-6. Total number of different vessels by gear type that landed Jacksmelt: 2010-2018. (Source: CDFW MLDS).

Hook and line vessels range from small skiffs to 40-foot salmon trollers/crabbers while round haul vessels such as 100-ton capacity round haul vessels targeting Coastal Pelagic Species (CPS), e.g., Northern Anchovy, *Engraulis mordax*, Pacific Sardine, *Sardinops sagax*, and California Market Squid, *Doryteuthis opalescens* typically have length over all (LOA) exceeding 50-feet.

The Department has no commercial Jacksmelt sample data. Size and age composition and selectivity of the various gears for Jacksmelt has not been well studied. Clark (1929) reported sampling Jacksmelt from markets in Los Angeles and Orange County and receiving fish from a single commercial fisherman operating out of San Pedro. Clark noted that market samples were comprised mostly of larger fish while samples sourced from the San Pedro fisherman contained primarily younger year classes indicating sampling bias—it's unclear whether the bias was due to location fished or gear since the gear was not specified.

Recreational fishermen target Jacksmelt with a variety of hook and line terminal gear that influence selectivity from hook size, fishing method—bait, artificial lures including flies, and some use cast nets. Size composition of the landed catch was presented in Section 1.2.2 (Figure 1-6). The size distribution of the samples bias towards keeping larger fish and/or gear selectivity rather than a reflection of population abundances.

2.3 Landings in the Recreational and Commercial Sectors

2.3.1 Recreational

Estimates of recreational catch were generated by the Marine Recreational Fisheries Statistics Survey (MRFSS) from 1980-1989 and from 1993-2003 and presented by Vejar 2011 (Figure 2-7). From 2004 to the present, catch estimates are produced by CRFS using an improved sampling design. Both surveys rely on an angler-intercept method to determine species composition and catch rates, coupled with a telephone survey to estimate fishing effort. Due to potential sampling bias in the

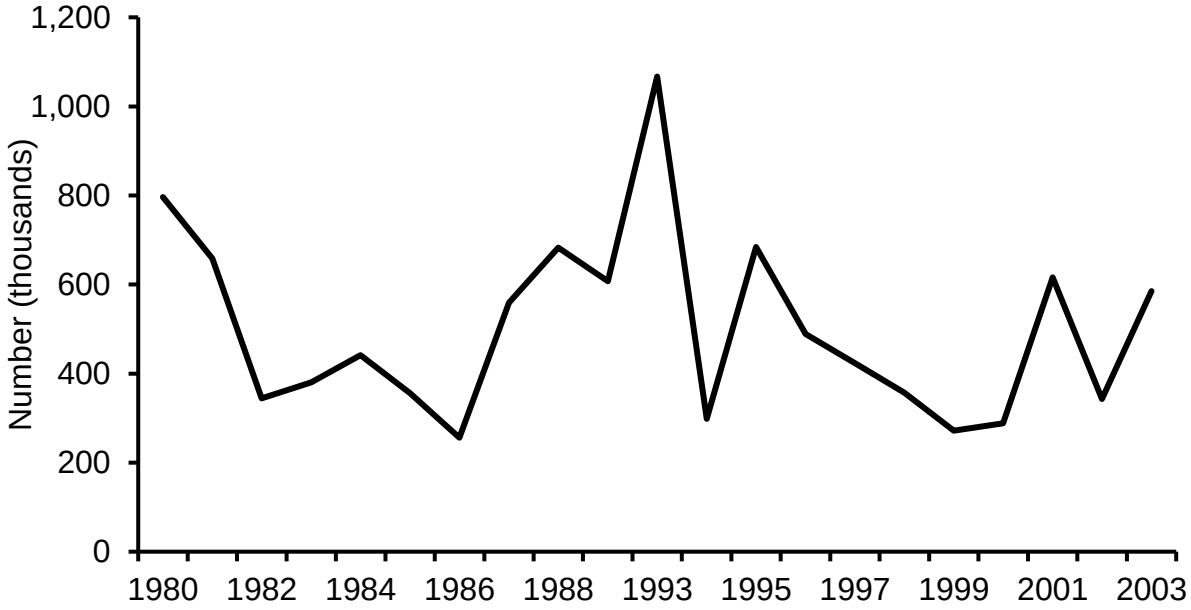

Figure 2-7. Statewide estimated number (in thousands) by MRFSS of Jacksmelt caught by recreational angler modes: 1980-2003. (Source: Marine Recreational Fisheries Statistical Survey (MRFSS) 2011).

telephone survey, interpreting the total catch estimates as absolute measures is problematic; however, the catch estimates are useful for identifying trends in catches. Though similar methodology in general was used for each, the two sampling designs are sufficiently different that catch estimates generated from MRFSS and CRFS are not considered comparable.

MRFSS catch estimates indicate a decline in overall recreational Jacksmelt take between 1981 and 1989. Beginning in 1986 and for 3 yr thereafter, the BB and MM modes were collectively designated the shore mode. However, more recent estimates from CRFS indicate a generally stable level of catch from 2005 to 2009. CRFS reduced sampling levels for the BB mode in 2010 and BB and MM in 2011; therefore, the estimates for 2010 and 2011 are not comparable with the 2005 to 2009 estimates.

Contemporary recreational statewide catch estimates by CRFS are shown below in Figure 2-8). Catch estimates were below the 13-year average since 2010 except for 2017. The Beach and Bank (BB) surveys were discontinued in 2018 and will contribute

to lower estimated landings of all shore targeted species until BB surveys are reinstated.

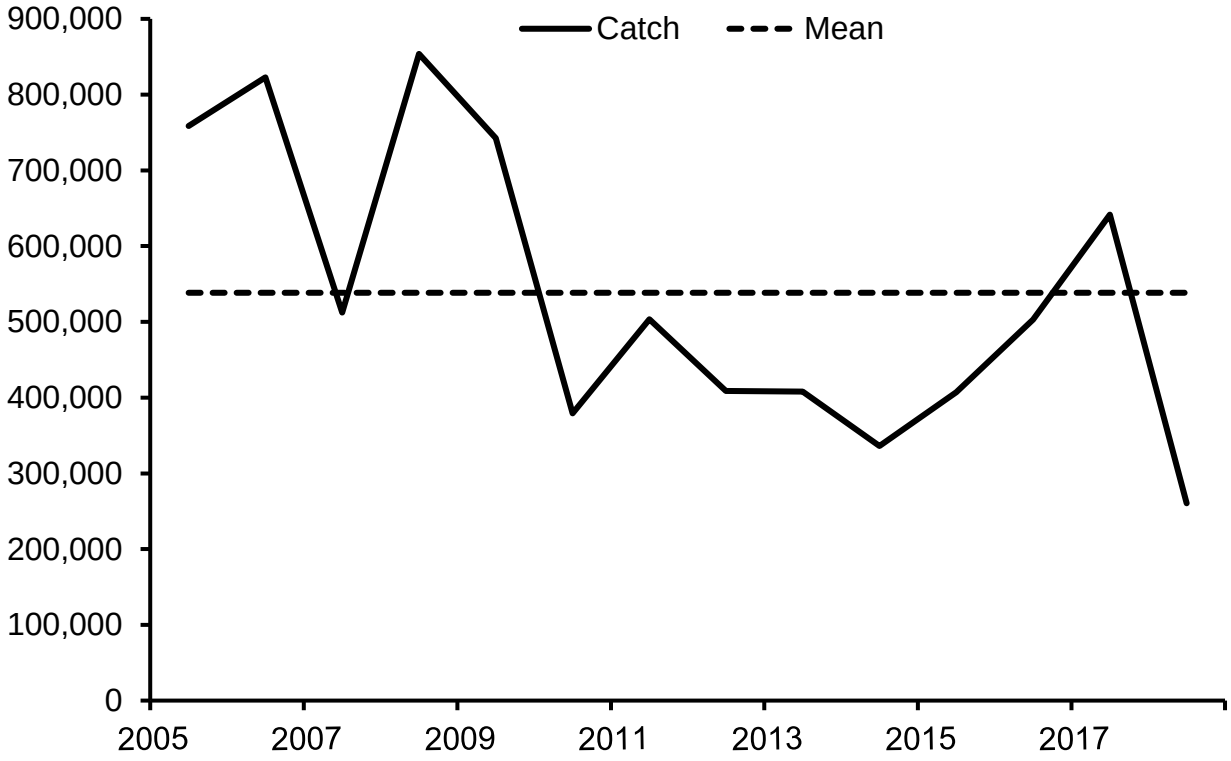

Figure 2-8. Statewide total (released plus kept) recreational estimated Jacksmelt catch from CRFS: 2005 to 2018. (Source: RecFIN 2019).

Historically, Jacksmelt were caught by anglers using relatively light hook and line gear for fishing from piers, beaches, and vessels using a variety of baits, e.g., strips of squid. Contemporary anglers, use “sabiki” jigs—gangions of reflective material or specially processed fish skin tied to small hooks, strips of squid suspended beneath floats, or metal lures. They are often caught by anglers targeting surfperch along sandy beaches. Although many anglers and commercial fishermen use traditional bait fishing methods, there is a growing trend among anglers to fish with lighter rods 7-10 ft in length (2.1-3.0 m), traditionally used for steelhead and freshwater bass to cast artificial baits, artificial lures such as soft plastic “grubs”, and hard plastic minnows in the surf. Fly anglers also successfully target Jacksmelt (Figure 2-9).

Figure 2-9. Fly fishing angler with a Jackmelt. Photo credit: Richard Gilliam, angler).

2.3.2 Commercial

Prior to 1976, Jacksmelt and Topsmelt landings were co-mingled with true smelt, Osmeridae, in annual landings published in California Department of Fish and Wildlife (Department) annual catch bulletins (Gregory 1992; Vejar 2011). State-wide annual Jacksmelt commercial landings and value data are presented in Figure 2-10.

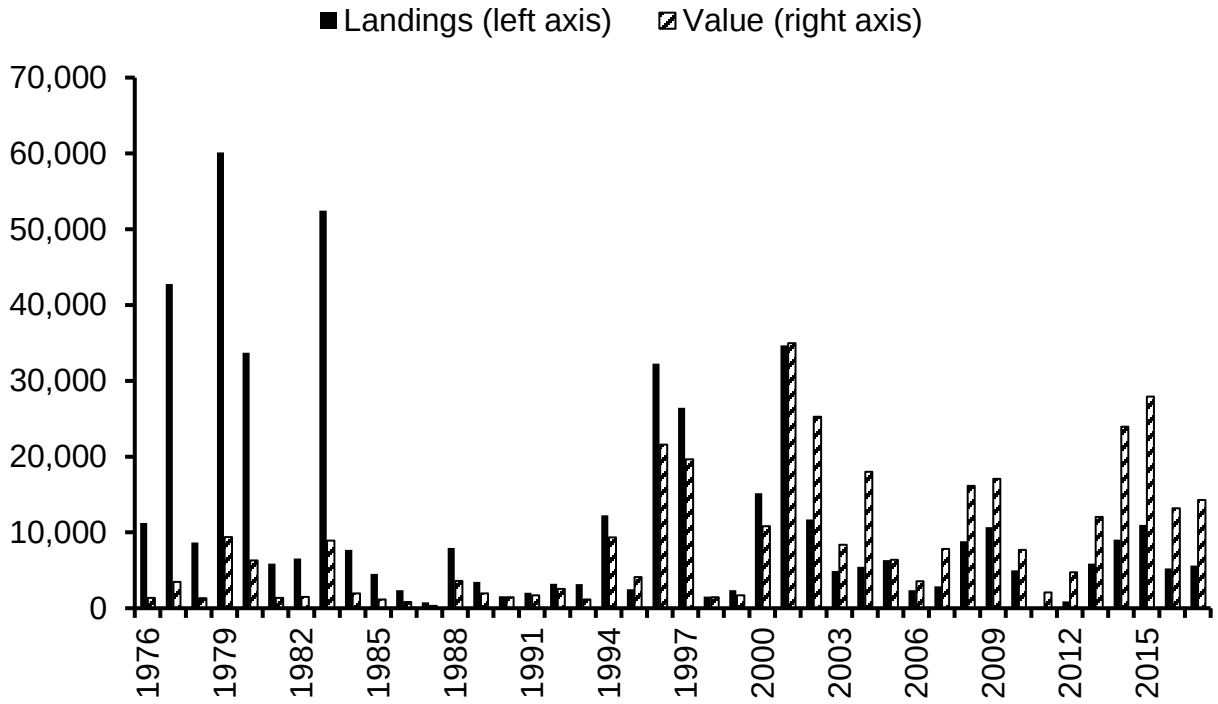

Figure 2-10. Commercial statewide Jacksmelt landings and value: 1976-2018. Source: CDFW Marine Landings Database System (MLDS).

The commercial Jacksmelt fishery has largely been incidental to other fisheries and of minor importance (Gregory 1992; Vejar 2011). Sporadic landing peaks throughout the history of the fishery were associated with fluctuations in market demand often related to reduced availability of other fish, e.g., rockfish (Leet et al. 1992), regulatory changes, and likely incorrect market category coding. Regulations were implemented prohibiting the use of near shore gill nets resulting in displaced fishermen exploring alternative fisheries contributing to market variability; however, Jacksmelt landings have historically been relatively low.

Significant ports of landing were presented in Figure 2-1; additionally, Jacksmelt were landed in over 100 locations statewide (Appendix B).

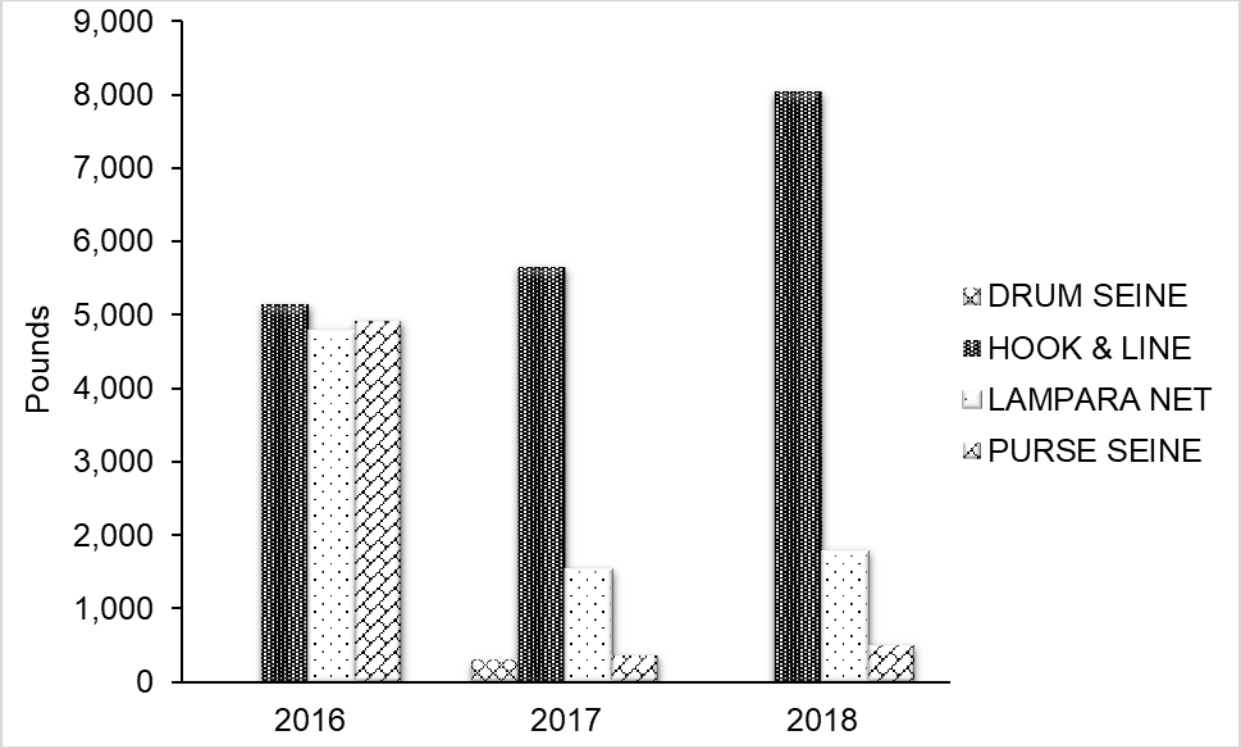

Figure 2-11. Composition of landings (pounds) by primary gear types: 2016-2018. Source: CDFW Marine Landings Database System (MLDS).

2.4 Social and Economic Factors Related to the Fishery

Commercial fishery trends, historically, have also been impacted by factors beyond the scope of fish behavior and abundance. silversides were not sorted to species and were co-mingled with osmerids ("true smelt") until 1976. Market demand for "smelt" spiked in 1945 at two million pounds; however, landings fluctuations have not been attributed to abundances but rather to demand (Gregory 2001). Historically important ports of landing were in southern California, e.g., San Pedro and Terminal

Island; however, over 90% of the 2018 statewide catch was landed in Santa Cruz (Figure 2-12).

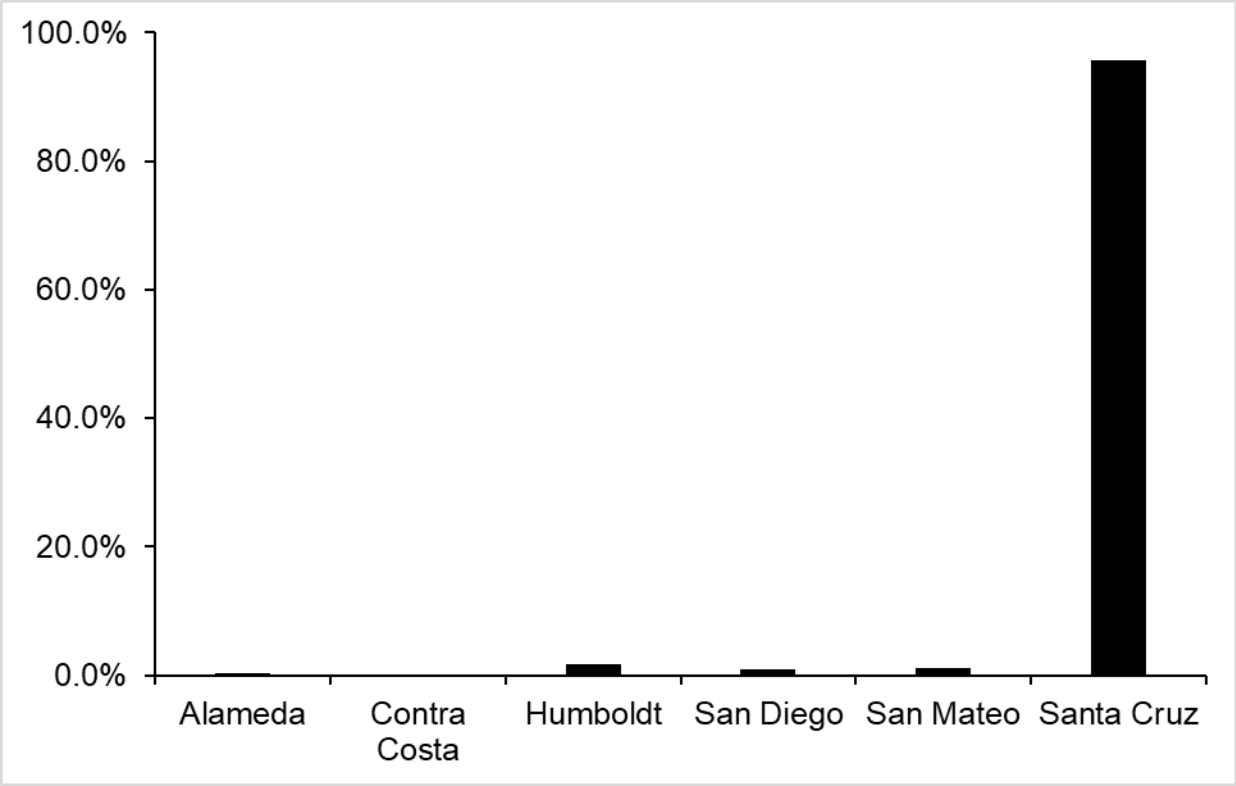

Figure 2-12. Jacksmelt percentage of total landings by county in 2018. Source: CDFW Marine Landings Database System (MLDS).

The primary market for Jacksmelt is for human food; however, historically, the market has largely been incidental. Ex-vessel value, price per pound paid to the fishermen, in 2018 averaged $1.88 for a total value of $18,365 (Figure 2-10 and 2-13). Increases in ex-vessel pricing over time reflect higher proportion of the catch taken with hook and line gear which typically produce deliver fish that are in good condition.

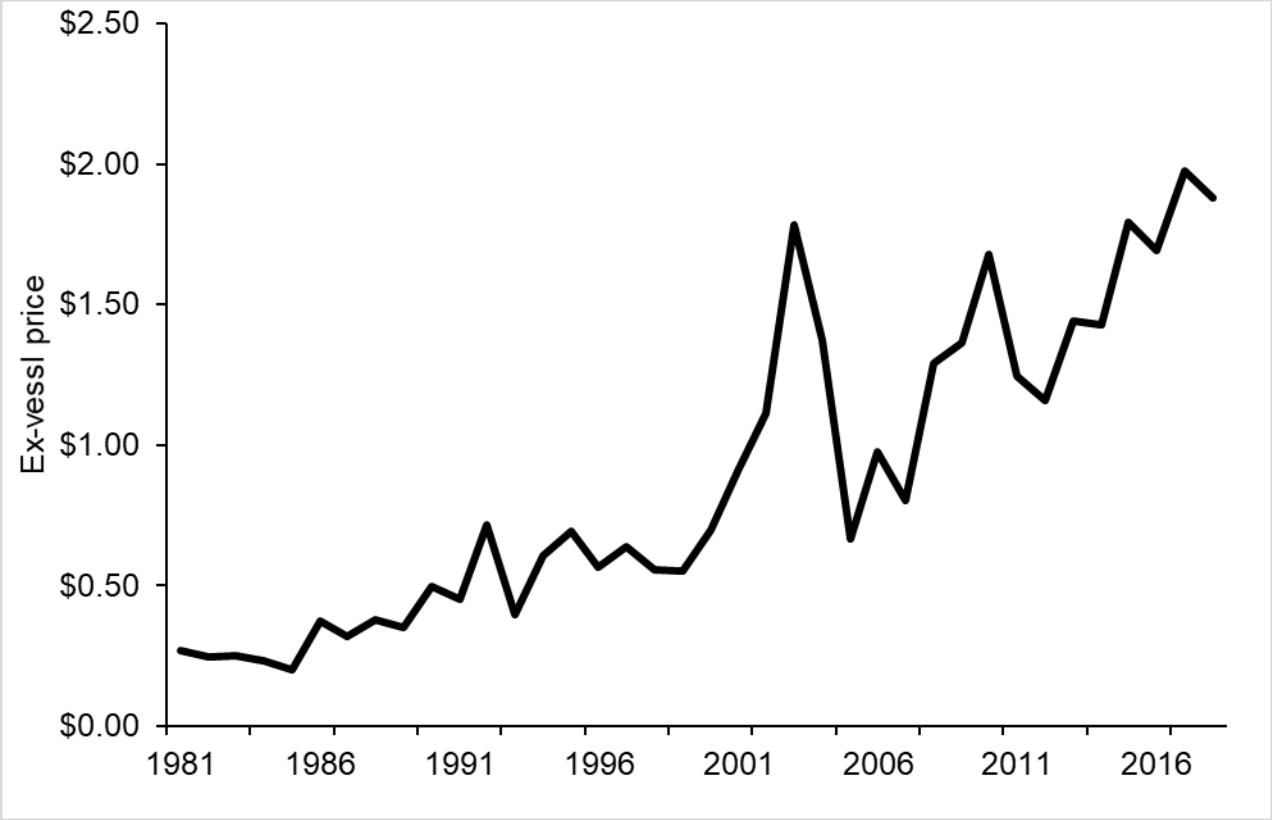

Figure 2-13. Jacksmelt average ex-vessel price (price per pound): 1981 to 2018. Source: CDFW Marine Landings Database System (MLDS).

Hook and line gear caught fish usually receive premium pricing over other gear types—in 2018, hook and line caught Jacksmelt averaged $2.04 per pound whereas round haul gear (lampara, drum seine, and purse seine) fishermen received $0.76 per pound. Due to limited market demand, catch restrictions as a specified forage species, Jacksmelt will likely to remain an artisanal fishery composed of hook and line and round haul vessels targeting other species and retaining Jacksmelt as incidental catch.

In 2018, the 15 Jacksmelt fishermen documented on landing receipts ranged in age from 27 to 68 years and averaged 53.9 years of age. There is no available information regarding crew members—on smaller boats, e.g., skiffs, it's probable that fishermen opt to fish alone. Larger vessels, e.g., purse seiners, require larger crews to run the deck, and set nets—they will operate with as many as three to five crew on deck and one person in the power skiff used for setting/hauling (Schofield 1951).

3 **Management**

3.1 Past and Current Management Measures

Prior to 2017, Silversides (Atherinopsidae) were unmanaged by the department—there were no commercial restrictions in place except those pertaining to licensing and area closures, e.g., Marine Protected Areas. In 2017, the department, under the authority of Fish and Game Code (FGC) §7652, initiated conformance of federal regulations protecting unmanaged forage species including Silversides in federal waters to state waters (Zero to 3 miles of the coastline). With the implementation of CCR Title 14 §111, new directed commercial fishing is prohibited for species identified in Table 3-1. Directed commercial fishing is defined as "For the purposes of this section, "directed commercial fishing" means that a fishing vessel lands designated forage fish species or species groups without landing any species other than designated forage fish species or species groups, or lands designated forage fish species or species groups with other species and in amounts more than:

(A) 10 metric tons combined weight of all designated forage fish species or species groups from any fishing trip; or

(B) 30 metric tons combined weight of all designated forage fish species or species groups in any calendar year" as stated in CCR Title 14 §111(b)(2).

Table 3-1. List of Federal Shared Ecosystem Component Species

Common Name	**Family or Genus Species**
Pacific Sand Lance	*Ammodytes hexapterus*
Pacific Saury	*Cololabis saira*
Pelagic squids	*Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuthidae, Ommastrephidae*
Round Herring	*Etrumeus teres*
Silversides	*Atherinopsidae*
Thread Herring	*Ophisthonema libertate* and *O. medirastre*
True smelt	*Osmeridae*

Currently, there is no bag or possession limit for sport anglers taking Jacksmelt, Topsmelt, or Grunion (CCR Title 14 §27.60(b). Cast nets are not authorized for taking Jacksmelt statewide; note, Topsmelt may be take north of Pt. Conception with dip nets and Hawaiian throw nets (CCR Title 14 § 28.80).

3.1.1 Overview and Rationale for the Current Management Framework

Jacksmelt are not actively managed by the department—the fishery throughout its history has been taken incidentally to other fisheries and of minor economic importance (Vejar 2011). Cumulative and individual landings are limited by CCR Title 14 § 111.

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

The Department has not conducted formal stock assessments for Jacksmelt. Jacksmelt's status has not been determined; however, abundance indices from the Department's Bay Studies Project are developed annually and

3.1.1.2 Past and Current Stakeholder Involvement

Jacksmelt do not support an active fishery significance and have not been a priority species for management. There has not been a need to identify and engage stakeholders for

3.1.2 Target Species

3.1.2.1 Limitations on Fishing for Target Species

3.1.2.1.1 Catch

Jacksmelt daily landing per landing is limited to 10 mt and 30 mt per annum (CCR Title 14 § 111(b)(2)).

3.1.2.1.2 Effort

There are no limits on effort for Jacksmelt.

3.1.2.1.3 Gear

Contemporary commercial Jacksmelt landings are comprised largely by vessels using hook-and-line and round haul gear. The California State Legislature (CSL) declared in FGC § 9025.1 "that the use of hook and line gear be regulated in a manner that assures the orderly development of the fisheries, maintenance of viable resources, and sustainable and satisfying commercial and recreational harvests." Sections of the FGC regulating the of commercial hook and line and round haul gear relevant to Jacksmelt fisheries are listed in Table 3-2.

Table 3-2. FGC code sections relevant to Jacksmelt fisheries.

FGC Code Section	Summarized regulation
§ 8751	In Districts 1, 2, and 3, round haul nets may not be possessed on any boat, except in that part of District 3 lying within the boundaries of the Moss Landing Harbor District, where round haul or any other type of nets may be possessed on any boat, and except in that part of District 2 lying within Marin County.
§ 8752	In Districts 6, 7, 8, 9, 10, and 11, purse and round haul nets may be used.
§ 8754	In Districts 16, 17, 18, and 19, purse and round haul nets may be used, except that purse seines or ring nets may not be used in that portion of District 19 lying within three miles offshore from the line of the high-water mark along the coast of Orange County from sunrise Saturday to sunset Sunday from May 1 to September 10, inclusive.

	Purse seine or ring nets may not be used from May 1 to September 10, inclusive, in the following portions of District 19: (a) Within a two-mile radius of Dana Point. (b) Within a two-mile radius of San Mateo Point. (c) Within two miles offshore from the line of the high-water mark along that portion of the coast of Orange County lying between the northernmost bank of the mouth of the Santa Ana River and a point on that coast six miles south therefrom.
§ 8755	In Districts 20A and 21, purse and round haul nets may be used. (a) Purse and round haul nets may be used, except: (1) from sunrise Saturday to sunset Sunday, in that portion of District 20 from a line extending three nautical miles east magnetically from the extreme easterly end of Santa Catalina Island southwesterly and northerly to a line extending three nautical miles southwest magnetically from the most southerly promontory of China Point and (2) at any time during the period commencing on June 1st and ending on September 10 in each year, in that portion of District 20 from a line extending three nautical miles east magnetically from the extreme easterly end of Santa Catalina Island southerly to a line extending three nautical miles southeasterly magnetically from the United States government light on the southeasterly end of Santa Catalina Island. (b) Subdivision (a) shall not be construed as restricting the right to use the waters therein specified for anchorage of vessels at any time.
§ 8757	Notwithstanding Section 8661, and in addition to Sections 8754, 8755, and 8780, round haul nets may be used to take fish in those portions of Districts 19 and 20 that are closed to the use of round haul nets by Sections 8754 and 8755 and in Districts 19A and 19B, but only for use or sale of those fish for live bait and subject to the following restrictions: (a) In Districts 19A and 19B, round haul nets may not be used within 750 feet of any public pier. (b) It is unlawful to buy, sell, or possess in any place of business where fish are bought, sold, or processed, any dead fish taken under the authority of this section.
§ 8780	(a) As used in this chapter, the term “bait net” means a lampara or round haul type net, the mesh of which is constructed of twine not exceeding Standard No. 9 medium cotton seine twine or synthetic twine of equivalent size or strength. Notwithstanding Section 8757, except for drum seines and other round haul nets authorized under a permit issued by the department pursuant to this section, the nets may not have rings along the lead line or any method of pursing the bottom of the net. (b) Bait nets may be used to take fish for bait in Districts 6, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 19A, 19B, 20A, 21, 118, and 118.5.

	(c) In District 19A, bait nets may be used only to take anchovies, queenfish, white croakers, sardines, mackerel, squid, and smelt for live bait purposes only. Bait nets may not be used within 750 feet of Seal Beach Pier or Belmont Pier. (d) No other species of fish may be taken on any boat carrying a bait net in District 19A, except that loads or lots of fish may contain not more than 18 percent, by weight of the fish, of other bait fish species taken incidentally to other fishing operations and that are mixed with other fish in the load or lot.
§ 9025.5(a)	Troll or handlines having not more than two hooks can be used in any district; troll line with more than two hooks may be used in Districts 6, 7, 10, 16 to 19, 19A, and that portion of District 11 west of the Golden Gate Bridge
§ 9025.5(c)	Portions of District 10 to 13, four troll lines with not more than two hooks each; if more than one commercial fisherman is onboard, no more than six troll lines with not more than two hooks are authorized.
§ 9027	(a) (1) Notwithstanding Section 9026, 9028, or 9029, in the area described in subdivision (b), it is unlawful to use more than 150 hooks on a vessel to take a fish for commercial purposes when using fishing lines authorized pursuant to this article. (2) In the area described in subdivision (b), not more than 15 hooks shall be attached to any one fishing line, and no fishing line shall be attached to another fishing line, while those lines are being used for commercial fishing pursuant to this article except that a single troll line with not more than 30 hooks may be used to take California halibut. (3) Each fishing line used pursuant to this article that is not attached to a vessel fishing in the area described in subdivision (b) shall be buoyed and the commercial fishing license identification number issued pursuant to Section 7850 to the permittee who is using the fishing line shall be marked on, and visible on the upper one-half of each buoy, in numbers at least two inches high. (b) This section applies only to waters within one mile of shore within Fish and Game Districts 6, 7, and 10, but not including ocean waters in Fish and Game District 7 between a line extending 203 degrees magnetic from Gitchell Creek and a line extending 252 degrees magnetic from False Cape in Humboldt County and not including ocean waters in Fish and Game District 10 between a line extending 245 degrees magnetic from the most westerly point of the west point of the Point Reyes headlands in Marin County and a line extending due west magnetic from Point Bolinas in Marin County.
§ 9027.5	(a) (1) Notwithstanding Section 9026, 9028, or 9029 in the area described in subdivision (b), it is unlawful to use more than 150 hooks on a vessel to take fish for commercial purposes when using fishing lines authorized pursuant to this article. (2) In the area described in subdivision (b), no more than 15 hooks shall be attached to any one fishing line, and no fishing line shall be attached to another fishing line, while those lines are being used for commercial fishing pursuant to this article.

	(3) Each fishing line used pursuant to this article that is not attached to a vessel fishing in the area described in subdivision (b) shall be buoyed and the commercial fishing license identification number issued pursuant to Section 7852 to the permittee who is using the fishing line shall be marked on, and visible on the upper one-half of each buoy, in numbers not less than two inches in height. (b) This section applies only to waters within one mile of the mainland shore in Fish and Game Districts 17, 18, and 19. (c) Subdivision (a) does not apply to persons who are fishing south of a line extending due west from Point Conception and who are fishing for halibut, white sea bass, sharks, skates, or rays. The exemption in this subdivision does not apply if all of the fish possessed by persons aboard the vessel does not consist of at least 80 percent by number of halibut, white sea bass, sharks, skates, and rays.
§ 9028	Notwithstanding Sections 8603 and 9025.5, it is unlawful to use fishing lines, including, but not limited to, troll lines and handlines more than 900 feet in length unless they are used as set lines pursuant to Sections 8601 and 9026 or they are used as part of deep-set buoy gear authorized under federal law.
§ 9029	(a) Notwithstanding Section 9028, a fishing line which is anchored to the ocean bottom at one end and attached at the surface to a fishing vessel or a buoy may be used in Districts 6, 7, 10, 17, 18, and 19. (b) A fishing line otherwise permitted pursuant to subdivision (a), may not be used under any of the following circumstances: (1) To take shortfin mako (bonito) sharks, thresher sharks, swordfish, or marlin. (2) If the fishing line exceeds 3,000 feet in length from the anchor to the surface vessel or buoy. (3) If any hooks are attached to the upper one-third of the line. (c) A buoy attached to the surface end of a fishing line used pursuant to subdivision (a) shall display above its waterline, in numerals at least two inches high, the fisherman's identification number. For purposes of this section and Section 8601.5, "fisherman's identification number" means the number of the person's commercial fishing license issued pursuant to Section 7850.
§ 9029.5	Notwithstanding Sections 9025.5, 9026, and 9029, it is unlawful to use set lines, vertical fishing lines, or troll lines to take fish for commercial purposes within one mile of the nearest point of land on the mainland shore in Fish and Game District 7 or 10 from sunset on Friday to sunset on the following Sunday or from sunset of the day before a state recognized legal holiday until sunset on that holiday. For the purposes of this subdivision, a "set line" is a fishing line that is anchored to the bottom on each end and is not free to drift with the tide or current and a "vertical fishing line" is a fishing line that is anchored to the ocean bottom at one end and attached at the other end on the surface to a fishing vessel or a buoy. This section does not apply to the taking of salmon or California halibut for commercial purposes.

Although other gear types are not specifically prohibited for taking Jacksmelt, the commercial fishery is dominated by boat-based hook-and-line and round haul (lampara and purse seine) gear. There are no current restrictions on hook-and-line gear that apply to the open coast commercial fishery specifically regarding Jacksmelt; however, Jacksmelt are caught incidentally by other open access as well as restricted access fisheries that are regulated. Recreational anglers fishing from shore may use any number of hooks and lines, with the following exceptions: in San Francisco Bay, only one line with not more than three hooks may be used and on public piers, no person shall use more than two rods and lines.

3.1.2.1.4 Time

There are no commercial or sport seasonal closures for taking Jacksmelt. Sport boat fishing in San Francisco Bay is restricted to one hour before sunrise to one hour after sunset. CCR Title 14 § 27.56 states: “Except as otherwise provided, there are no closed season, closed hours or minimum size limits on fin fish in the Pacific Ocean including all saltwater bays except that in San Francisco Bay between the Golden Gate Bridge and the Carquinez Bridge and in saltwater tributaries to the bay within the area bounded by Interstate 80 and Highways 17, 101 and 37 fin fish may not be taken between one hour after sunset to one hour before sunrise except from shore or piers.”

3.1.2.1.5 Sex

There are no commercial or sport regulations restricting taking Jacksmelt of either sex.

3.1.2.1.6 Size

There are no commercial or sport size limits for Jacksmelt.

3.1.2.1.7 Area

There are no areal closures other than MPAs to commercial and sport fishermen except commercial fishing is not authorized by California State Parks regulation CCR Title 14 § 4305.

3.1.2.1.8 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% 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.

Although Marine Protected Areas (MPAs) usage as a fishery management tool was not one of the primary goals of the Marine Life Protection Act, they function as one for the following reasons:

- They serve as spatial closures to fishing if the species of interest is within their boundaries and is prohibited from harvest.
- They function as comparisons to fished areas for relative abundance and length or age/frequency of the targeted species.
- They serve as ecosystem indicators for species associated with the target species, either as prey, predator, or competitor.
- Many of the MPAs served to displace fishing effort when they were implemented.

Although the network was not designed specifically to protect populations of atherinopsids, many MPAs have significant amounts of their preferred habitat—shallow subtidal open-coast soft bottom. Table 3-3 lists MPAs from north to south that contain habitat for Jacksmelt. State Marine Reserves (SMR) prohibit all take, while State Marine Conservation Areas (SMCA) and State Marine Recreational Management Areas (SMRMA) prohibit some recreational and/or commercial take.

Table 3-3. Marine Protected Areas (MPAs) containing Jacksmelt habitat.

Marine Protected Areas	**County**
Pyramid Point State Marine Conservation Area (SMCA)	Del Norte
Reading Rock SMCA	Humboldt
Samoa SMCA	Humboldt
South Cape Mendocino State Marine Reserve (SMR)	Mendocino
Sea Lion Gulch SMR	Mendocino
Double Cone Rock SMCA	Mendocino
Ten Mile SMR	Mendocino
Ten Mile Beach SMCA	Mendocino
Ten Mile Estuary SMCA	Mendocino
Navarro River Estuary SMCA	Mendocino
Russian River State SMRMA	Sonoma
Russian River SMCA	Sonoma
Estero Americano SMRMA	Sonoma
Estero de San Antonio SMRMA	Marin
Point Reyes SMR	Marin
Estero de Limantour SMR	Marin
Drakes Estero SMCA	Marin
Pillar Point SMCA	San Mateo
Año Nuevo SMR	Santa Cruz
Natural Bridges SMR	Santa Cruz
Elkhorn Slough SMR	Monterey
Asilomar SMR	Monterey
Point Lobos SMR	Monterey
Point Sur SMR	Monterey
Big Creek SMR	Monterey
Piedras Blancas SMR	San Luis Obispo
Morro Bay SMR	San Luis Obispo
Vandenberg SMR	Santa Barbara
Point Conception SMR	Santa Barbara
Naples SMCA	Santa Barbara

Marine Protected Areas	County
Campus Point SMCA	Santa Barbara
Goleta Slough SMCA	Santa Barbara
Point Dume SMCA	Los Angeles
Point Dume SMR	Los Angeles
Point Vincente SMCA	Los Angeles
Abalone Cove SMCA	Los Angeles
Laguna Beach SMR	Orange
Laguna Beach SMCA	Orange
Bolsa Chica Basin SMCA	Orange
Batiquitos Lagoon SMCA	San Diego
San Elijo SMCA	San Diego
San Diego-Scripps Coastal SMCA	San Diego
Matlahuayl SMR	San Diego
South La Jolla SMR	San Diego
Famosa Slough SMCA	San Diego
Cabrillo SMR	San Diego
Tijuana River Mouth SMCA	San Diego
San Miguel Island Special Closure	Channel Islands
Harris Point State and Federal Marine Reserves (SMR)	Channel Islands
Judith Rock SMR	Channel Islands
Skunk Point SMR	Channel Islands
Gull Island SMR	Channel Islands

3.1.2.2 Description of and Rationale for Any Restricted Access Approach

Currently, there are no plans by the PFMC or the Department to go forward with restricted access for Jacksmelt. Jacksmelt have both federal and state forage fish status and will not be the target of any large scale directed fishery.

3.1.3 Bycatch

3.1.3.1 Amount and Type of Bycatch (Including Discards)

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

Jacksmelt are largely incidental catch and generally not a target species. It is unknown what proportion of the directed fishery catch is retained and sold, discarded, or kept for personal use. Jacksmelt have a limited market and not widely in demand. The commercial fisheries that Jacksmelt are caught as bycatch are Coastal Pelagic Species (Pacific Sardine, Northern Anchovy, Pacific Chub Mackerel, and California Market Squid). Jacksmelt are often seen by salmon fishermen but rarely hooked due to their

relatively small mouths. Other species commercially targeted in the same locations as Jacksmelt include: White Croaker, White Sea Bass, California Halibut, Pacific Sanddab, and nearshore rockfish.

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

Historically, Jacksmelt have not been the target of a directed fishery. They are documented as a bycatch species to CPS (PFMC 2019) and are also caught incidentally by hook and line vessels and sold. Species composition of the commercial hook and line fishery bycatch is unknown.

3.1.4 Habitat

3.1.4.1 Description of Threats

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

3.2 Requirements for Person or Vessel Permits and Reasonable Fees

Table 3-4. List of commercial license and permit fees related to the surfperch fishery: April 1, 2018 to March 31, 2019.

Title	Permit Fee (US dollars)	Description
Resident Commercial Fishing License	$141.11	Required for any resident 16 years 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.
Nonresident Commercial Fishing License	$417.75	Required for any nonresident 16 years 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.
Commercial Boat Registration (Resident)	$367.25	Required for any resident owner or operator for any vessel operated in public waters in connection with fishing operations for profit in this State; or which, for profit, permits persons to sport fish.
Commercial Boat Registration (Nonresident)	$1,807.00	Required for any nonresident owner or operator for any vessel operated in public waters in connection with fishing operations for profit in this State; or which, for profit, permits persons to sport fish.
Fish Receiver's License	$798.25	Any person who purchases or receives fish for commercial purposes from a commercial fisherman not licensed as a fish receiver must obtain a Fish Receiver's License.
Fisherman's Retail License	$101.97	A commercial fisherman is required to have this license only if he/she sells all or a portion of his/her catch to ultimate consumers.
Fish Wholesaler's License	$541.50	Any person who, for resale to persons other than the ultimate consumer, purchases or obtains fish from a person licensed to engage in the activities of a fish receiver, fish processor, fish importer or fish wholesaler, is required to obtain a Fish Wholesaler's License.
Fish Processor's License	$798.25	Any person who processes fish for profit and who sells to other than the ultimate consumer must obtain a Fish Processor's License.
Tidal Invertebrate license	$44.29	Authorizes taking specified tidal invertebrates for commercial purposes

An undetermined proportion of recreational fishing revenue contributes to surfperch fisheries since recreational licenses fees are not species specific. Recreational license fees vary based on residency and term of the license selected, e.g., annual or single/ multiple day, or lifetime (Table 3-3).

Table 3-5. Recreational license fees related to the surfperch fishery: April 1, 2018 to March 31, 2019.

Title	License Fee (US Dollars)	Description
Resident Sport Fishing	$48.34	Available for any resident 16 years of age or older.
Nonresident Sport Fishing	$130.42	Available for any non-resident 16 years of age or older.
Reduced-Fee Sport Fishing License - Disabled Veteran	$7.21 at CDFW Offices $7.56 from license agents	Available for any resident or nonresident 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	$7.21	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	$7.21	Available for low-income California residents, 65 years of age and older, who meet the specified annual income requirements. The Reduced-Fee Sport Fishing License for Low Income Seniors is only available at CDFW License Sales Offices.

4 **Monitoring and Essential Fishery Information**

4.1 Description of Relevant Essential Fishery Information

4.2 Past and Ongoing Monitoring of the Fishery

There are data, although, limited on life history EFI for Jacksmelt that are described in Chapter 1, including age and growth, reproduction, and movement. This section however 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 gauge the status of the Jacksmelt stock(s).

4.2.1 Fishery-dependent Data Collection

4.2.2 Fishery-independent Data Collection

5 Future Management Needs and Directions

5.1 Identification of Information Gaps

Table 5-x. Informational needs for Jacksmelt and their priority for management.

Type of information	Priority for management	How essential fishery information would support future management
Number of eggs per m/2 of spawning habitat	High	Information used to determine absolute abundance of spawning stock (in terms of biomass). Used for assessing stock status and setting quotas.
Location and spatial extent of spawning grounds	Medium	Provides information on where the key spawning habitats for [fishery] are located, and how they have changed over time. Important for directing survey efforts.
Number and date of observed spawning waves	Medium	Used to determine number of spawning waves and total spawning stock biomass. Used to assess temporal changes in spawning pattern.

5.2 Research and Monitoring

5.2.1 Potential Strategies to Fill Information Gaps

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.

5.3 Opportunities for Future Management Changes