

Socio-Economic Profile of the California Wetfish Industry

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Socio-Economic Profile of the California Wetfish Industry

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Abstract

This study presents a socio-economic profile of the California wetfish industry, comprised of the fishermen, receivers and processors who are involved in the capture and processing of northern anchovy, jack and Pacific mackerel, Pacific sardine and California market squid. In southern California, the industry also targets coastal tunas and Pacific bonito. The profile is based on archival, survey and ethnographic research, and focuses on the spatial and temporal organization of the present day industry, the socio-economic characteristics of its participants, and the environmental, social, economic and regulatory context in which they operate. The present day California wetfish industry has strong connections to the "traditional" industry of the last century. Most fishermen and processors have a long personal and family history in the fishery. Relationships among them are social as well as economic, and have enabled many to withstand the challenges of variable and uncertain environmental, regulatory and economic conditions. Whereas the traditional wetfish industry directed effort primarily toward reduction and canning, the present day fishery is focused largely on the production of high quality fresh, frozen product for human consumption and other uses.

The present day industry is organized around three regional centers of activity including the Monterey Bay, Ventura/Port Hueneme and San Pedro/Terminal Island areas. The complex linkages among these centers of activity have been enhanced by processors' development of receiving and processing capabilities and fishermen's increased mobility among regions, and the social and economic ties between processors and fishermen. Each of the three regions has two major ports and associated infrastructure that play a critical role in the industry as receiving stations and/or home ports for the fishing operations. Harbor infrastructure, from receiving and docking facilities to ice plants, boatyards and marine supply stores, varies considerably among these sites. In most cases, these harbors and marine businesses depend upon the commercial wetfish industry as a source of revenue, to qualify for federal dredging funds and/or as a cultural backdrop to tourism. The wetfish industry is linked to local agricultural economies through its shared use of transport services, ice plants, packing materials, cold storage facilities, and seasonal labor.

Although sardine, mackerel and anchovy have been the "bread and butter" of the wetfish industry, the recent growth of the squid fishery has prompted a substantial infusion of resources and energy into the industry. However, sharp fluctuations in the availability of squid and in associated

markets (especially since the 1997-98 El Niño), and the recovery of the sardine resource and new markets have allowed many fishermen and processors to redirect some of their energies toward sardine. In 2000, commercial landings of wetfish and coastal tunas totaled 455.6 million pounds (227,734 short tons) worth \$38.9 million, and accounted for 83.6% by weight and 29.3% by value of all commercial fish landings in California.

Section 1: Introduction

The California wetfish industry is steeped in history that dates back more than a century to the use of purse seines and lanterns by Chinese fishermen to catch squid off Monterey, and the canning of sardines and other species that were transported to diverse and often distant markets. The primary outputs of the industry at that time included dried, canned, reduced and fresh products. Since the early development of the commercial wetfish fisheries, the industry has experienced immense changes and fluctuations in environmental, economic and regulatory conditions that have resulted in changes in technologies, practices and social and economic relations. The present day California wetfish industry has much in common with its precursor, but also differs from it in important ways.

We define the "California wetfish industry" as the fishermen, receivers and processors who catch, handle, process and pack four coastal pelagic finfish species: northern anchovy (*Engraulis mordax*), jack and Pacific mackerel (*Trachurus symmetricus* and *Scomber japonicus*) and Pacific sardine (*Sardinops sagax*), and California market squid (*Loligo opalescens*).¹ Together these species are traditionally known as "wetfish" (because they were packed "wet" (or raw) in cans, then cooked) (Leet et al. 1992), or the "coastal pelagic species" (CPS). Some of the wetfish fishery participants also are involved in the fishery for coastal tunas [e.g., yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), Pacific northern bluefin (*Thunnus thynnus*)] and Pacific bonito (*Sarda chiliensis*). An important commonality among wetfish fishermen is their use of "round haul" gear such as lampara nets, purse seines and drum seines to catch CPS. A smaller group of fishermen uses scoop or brail gear, rather than round haul gear, to catch wetfish. In contrast to the round haul fleet, scoop and brail vessels deliver fish primarily to the live bait market, restaurants or small producers of specialty products for human consumption. This socio-economic profile focuses primarily on the round haul fleet and associated receivers and processors, but also provides some data and discussion pertinent to others engaged in the wetfish industry.

In this chapter, we present a socio-economic profile of the present day California wetfish industry that illustrates not only the commonalities and differences relative to the traditional industry, but more importantly, the similarities and differences within the present day industry. The second section of this chapter provides a brief overview of the background and methods of the studies upon which this report is based. The third section outlines key developments between the latter 1800s and 1995 that helped shape the present day industry. The fourth section describes the present day industry. Our discussion is organized around the three regional centers of activity in the fishery, which are (from north to south): the Monterey Bay area, the Ventura/Port Hueneme area, and the San Pedro/Terminal Island area (Figure 1). We describe the socio-economics of the

¹ We use the following conventions throughout this chapter. Unless otherwise noted, "mackerel" refers to both jack and Pacific (or chub) mackerel, tons are reported as short tons (one short ton = 2,000 pounds), and landings revenues are reported in nominal, ex-vessel dollars, unadjusted for inflation. See Hackett's Wetfish Economics report for the 1982 Producer Price Index ratios, which can be used to calculate real (i.e., inflation-adjusted) values from the ex-vessel revenues reported in this chapter. To protect confidentiality, the figures do not show data for those cases where fewer than three vessels or receivers reported landings.

wetfish industry at each of these sites in terms of resource availability, port and fishery infrastructure, processor receiving capabilities, and the characteristics of the fishermen and vessels involved in the region's fishery. In the fifth section, we discuss the key similarities and differences among the three regions. In a concluding section, we identify socio-economic factors that are most critical to understanding the dynamics and prospects for the future of the present day California wetfish industry.

Section 2: Background and Methods

The information reported here is based upon two studies recently completed by the authors and colleagues, and augmented by additional research conducted with support from the California Seafood Council (CSC). The first study, conducted by Pomeroy and FitzSimmons under a research grant awarded by California Sea Grant, focused on the changing socio-economic organization of the California market squid fishery. The second study, conducted by Pomeroy and assisted by Hunter, Los Huertos and others under contract to the National Oceanic and Atmospheric Administration (NOAA), built upon the Sea Grant study, and focused on the socio-economic impacts of potential marine reserves at the Channel Islands. For both studies, we collected archival, ethnographic and survey interview data. Archival data included information from the gray, refereed and trade literatures, and landings data from the Pacific States Marine Fisheries Commission's Pacific Fisheries Information Network (PacFIN) database. Field data were collected using ethnographic and survey research methods. The former included direct observation of the fishery and related activities, and key informant interviews with fishermen, receivers and processors, harbor personnel, operators of support services, resource managers and others knowledgeable of the industry. The survey interviews targeted skippers of squid catcher vessels and light boats engaged in the squid fishery. The survey conducted for the Sea Grant study sought information on skippers' fishing history and experience, demographics, fishing operations, markets, relationships and practices, and opinions about current and pending squid fishery management actions. The survey conducted for the Channel Islands study focused explicitly on the fishing experience and effort of skippers from all three regions who regularly fish the Channel Islands, and their historic and current dependence on that area.²

Although both studies were driven primarily by questions and issues surrounding the squid fishery, the research necessarily entailed considerable attention to the other components of the wetfish fishery (i.e., for sardine, mackerel and anchovy). For most squid fishermen, CPS finfish are a critical part of their annual round of fishing activities, and the foundation of their identity as fishermen. Similarly, most receivers and processors involved in the squid fishery also have a history of involvement in the wetfish industry as a whole, as do the ports and other providers of goods and services to the industry.³

For this study, we augmented this information to bring the wetfish industry into sharper focus by conducting additional archival and field research in the summer and fall of 2001 with support from the CSC. Supplemental archival research included retrieval and review of pertinent literature from a variety of sources, and further analysis of the fleet's wetfish landings data. For the latter, we secured permission to continue working with landings data from the PacFIN

² A total of 73 skipper survey interviews were conducted for the two studies: 33 purse seine skippers and 3 light boat skippers were surveyed for the SG study, and 27 purse seine skippers and 8 light boat skippers were interviewed for the CI study. Seventeen of the purse seine skippers were interviewed for both studies. Study participants have reviewed and validated the findings of the two studies. Tables 2 through 9 represent data from the surveyed purse seine skippers.

³ Overviews of the two studies are provided in Pomeroy and FitzSimmons (2001) and Pomeroy and Hunter (2001).

database used for the Sea Grant and Channel Islands studies, and obtained landings data for the year 2000 to augment the data in hand. The data include all California, Oregon and Washington landings (of all species) by vessels that landed squid between 1981 and 2000.⁴ The data were managed using Statistical Analysis Software (SAS), and analyzed using Statistical Package for the Social Sciences (SPSS) and Excel. Strict protocols were observed to insure confidentiality of study participant data.

Field data collection included a mail survey, telephone and in-person interviews with California wetfish processors, site visits to processing facilities in central and southern California, and telephone and in-person interviews with wetfish fishermen. Several of the receivers, processors and fishermen had participated in our previous studies of the squid fishery. The mail survey, which was designed by Hackett and Pomeroy, sought information on processors' sources of wetfish, product types, quantities and revenues in 2000, facilities, observations of changes in the industry and its environmental, economic and regulatory context over the past several years, and issues facing the industry. The survey was mailed to 62 processors identified using the Directory of California Seafood Producers (CSC 2000) and Pomeroy's knowledge of the industry. Nine respondents, who together accounted for 61% of CPS wetfish landings, 61% of squid landings and 8% of coastal tuna landings in California, provided data by return fax, phone interview or in-person interview.⁵

⁴ Landings by these vessels and their skippers in Alaska are currently unavailable.

⁵ The survey was mailed to California wetfish receivers/processors in June 2001, then followed with a phone call and second mailing in July 2001. We then sought in-person interviews with receiver/processors. Respondents included 7 of the 16 major wetfish receiver/processors as identified by industry participants, and 2 smaller firms. [The number of large and small firms that participate in the industry varies over time (Figures 5a-5d).] The nine survey respondents provided important input that validated and added to data from the Sea Grant and Channel Islands studies to enable us to provide a more complete picture of California wetfish processors. The sample accounts for most of the wetfish landed in California, but does not capture the full variability among large and small processors within the industry.

Section 3: Development of the California Wetfish Industry Through 1995

Although the history of the wetfish fishery is discussed in depth elsewhere in this report, we provide a brief overview of the development of the wetfish industry here as context for the socio-economic profile that follows. We begin by describing the emergence of each species as a component of the wetfish industry, then discuss key changes in resource availability, fishing and processing technologies and practices, markets, and regulations that followed (Table 1). These changes have occurred in clusters over time, and may be used to help characterize "eras" in the development of the wetfish industry.

The five wetfish species and coastal tunas differ in how and when they became a part of the California wetfish industry. Although a bait fishery for Pacific sardine was in place by the late 1800s, it was not until the turn of the century that it became the focus of a commercial fishery. The development of the commercial sardine fishery followed from the decline of salmon canning, the success of experiments in canning sardine, and identification of potential markets (McEvoy 1986). The introduction of the lampara net by a Monterey fisherman in 1905, and the first use of a purse seine net in the fishery at San Pedro twenty years later also played an important role in the sardine fishery's establishment (McEvoy 1986). A small fishery for northern anchovy, primarily for reduction, developed alongside the fishery for sardine, but did not become notable until 1947, when the scarcity of sardines led to the beginning of anchovy canning operations (Bergen and Jacobson 2002). The Pacific mackerel fishery emerged as a complement to the sardine fishery in the 1920s. California's commercial fisheries for squid and coastal tunas developed earlier and apart from wetfish. The fishery for California market squid was initiated by Chinese immigrants at Monterey in the 1860s; small quantities of squid were first landed in southern California in the early 1900s. Fields (1965) reported landings ranging between 1 and 2,862 short tons in the Los Angeles area between 1944 and 1960. The fishery for coastal tunas was started by Portuguese immigrants in both central and southern California in the 1880s, although the commercial fisheries for bluefin, yellowfin and skipjack did not emerge until forty years later (McEvoy 1986, Bayliff 2002, Coan 2002).

From the early 1900s through and just beyond World War II, the wetfish industry experienced phenomenal growth, due to technological, infrastructure and market developments fueled by the world wars. Much of this development was spurred by federal contracts to expand the production of sardine as a critical source of protein. Under the War Food Administration, nearly 50% of the catch went to reduction for fishmeal to support the growing poultry industry and other wartime needs (McEvoy 1986). The end of this era, however, also saw the collapse of the sardine fishery in the Monterey Bay area in the early 1950s, soon followed by the collapse of the fishery in southern California (Parrish 2000, Wolf et al. 2002). Industry observers assert that the collapse of the sardine fishery was due, in part, to increased federal pressure for fish products to meet wartime needs, and a concomitant lack of regulation (Crehan pers. comm.).

The late 1950s through the early 1960s constitute the next era in the industry, one characterized by the devastation of the sardine collapse on the one hand and the emergence of new technologies and opportunities on the other. While the larger seiners and canneries shifted their effort and operations offshore, the smaller seiners, lampara and scoop boats and fresh fish markets were forced to face the challenge presented by the collapse of the sardine fishery. To adapt, they shifted their effort to the more abundant anchovy, mackerel, squid and coastal tuna fisheries

which until then had played a secondary role to sardine. Fishermen in both the large vessel and the small vessel fleets adopted several technological innovations including nylon nets to replace cotton ones, the power block to assist and speed retrieval of the net, and spotter planes and sonar to help them locate schools of wetfish and coastal tunas. Shoreside, the fresh fish markets began to develop new freezing and storage capabilities on a small scale (in some cases closely linked to regional agricultural production) to improve and expand production of the available species.

Resource availability continued to deteriorate, however, leading to a shift in state resource management strategies and the beginning of the next period in the industry's development. From 1965 through 1974, the California wetfish industry, along with several others in the state and the nation, became subject to control through the use of quotas and other measures. By 1970, fishing for all of the CPS finfish species was sharply curtailed by a series of measures: the imposition of a quota on anchovy reduction in 1965, a moratorium on the directed non-bait sardine fishery in 1967, and a moratorium on the Pacific mackerel fishery in 1970. The bait fishery for sardine remained open until 1974, when it, too, was closed pending recovery of the stock.

The circumstances of the wetfish industry changed again in the mid 1970s with the passage of the Magnuson Fishery Conservation and Management Act in 1976. In 1977, the mackerel fishery was re-opened under a strict quota. The following year, the federal government approved the Northern Anchovy Fishery Management Plan (FMP), which transferred management authority for the anchovy fishery from the state to the Pacific Fishery Management Council (PFMC), and started a long process of shifting management authority for all West Coast wetfish species to the Council. In 1975, U.S. fishing vessels were excluded from Mexican waters (Leet et al. 1992). This, followed by Mexico's 1976 declaration of its 200-mile Exclusive Economic Zone, eliminated most of the transboundary fishery for coastal tunas that had helped support the San Pedro wetfish fleet (and other tuna fishermen in southern California) during the severe wetfish shortages since the 1950s. The closure of the Mexican fishing grounds to the U.S. fleet disrupted the supply of tuna to southern California canneries. Together with other factors including water quality, marine mammal and other environmental protection regulations, this led to most of the remaining southern California tuna canneries to cease local operations. Amid these declines, however, many in the wetfish industry again turned their harvesting and processing attention to squid.

The 1982-83 El Niño brought further declines in the coastal pelagic species (CPS) with the exception of Pacific mackerel and bonito (Squire 1993, Konno et al. 2002). This downturn did not last, however. Close monitoring of the sardine resource by the California Department of Fish and Game (CDFG) indicated that the spawning biomass had substantially increased. This led to the opening of a small directed fishery in 1986 of 1,000 short tons, although it would still be several years before sardine would resume an important role in the industry (Wolf et al. 2002). In 1985, landings of squid in southern California overtook those in the Monterey area (Yaremko 2002), signaling the expansion of that fishery as an integral part of the California wetfish industry. Over the ensuing 10 years, the industry benefited from improving resource conditions and changes in regulations that spurred new developments in the industry. In the late 1980s, prohibitions on the use of purse seines and attracting lights in Monterey Bay were lifted.⁶ By 1992, nearly all of the Monterey wetfish fleet had switched from lampara nets to purse seine gear (Spratt and Ferry 1993). Several fishermen built or bought newer, larger, more seaworthy vessels, while others had

⁶ The use of light boats, however, was and remains prohibited in District 17.

their vessels stretched and sponsored to support the use of purse seine gear and larger catches. These changes also increased the mobility of Monterey Bay area fishermen. Although some had been traveling to southern California during the winter months to fish for squid since the early 1980s, the changes that occurred in the late 1980s made it possible for more of the Monterey fleet to do so. In the early 1990s, conditions in the fishery continued to improve somewhat, supported by a small but growing squid fishery (Yaremko 2002). In 1991, the sardine quota was increased from 1,000 to 8,150, and then to 10,000 short tons. The 1992-93 El Niño brought warmer temperatures and a temporary drop in otherwise improving resource conditions, although its impacts were minor compared to the 1982-83 El Niño.

Between 1994 and 1996, the industry continued to focus primarily on squid, spurred by the opening of the Chinese market and declining resource conditions in squid fisheries elsewhere (e.g., the Falkland Islands). The squid fishery attracted fishermen from Washington and Alaska, some with strong family ties to the historic San Pedro fishery. Receivers and processors likewise focused more of their attention on squid, activating and further investing in latent communication, transportation and production networks to build new capacity for receiving squid (and to a lesser extent, other wetfish). Several processors expanded their operations to include facilities at two or all three of the industry's three centers of activity: Monterey, Ventura/Port Hueneme and San Pedro/Terminal Island. Meanwhile, the sardine resource continued to rebound, and the quota continued to increase (Wolf et al. 2002). Together, squid and sardine held new promise for the industry and its participants as they entered a new era during the latter half of the 1990s, that of the present day California wetfish industry.

Section 4: The Present Day California Wetfish Industry

The present day wetfish industry emerged from the many and diverse developments in the historic industry described in the previous section. To provide a socio-economic profile of the present day industry, we build upon that understanding with in-depth analysis of its three centers of activity (from north to south): the Monterey Bay area in central California, and the Ventura/Port Hueneme and San Pedro/Terminal Island areas in southern California (Figure 1). We describe the fishery, participants and practices at each of these sites in terms of four key features: resource availability; ports and associated infrastructure; processors' (or "markets") receiving capacity; and the fishermen, their fishing operations and their ties to those markets.

Before proceeding, however, we provide a general overview of how the industry operates across these sites. Even as there are important distinctions within and among the three centers of activity, they also have much in common in how they harvest, deliver, receive, process and distribute California wetfish, the rules that govern these activities, and the basic infrastructure, goods and services that both support and depend upon the industry.

Fishing for wetfish and coastal tunas occurs in state and federal waters off the California coast and around the Channel Islands. Fishermen deliver their catch primarily at Monterey and Moss Landing in central California, and San Pedro, Terminal Island, Port Hueneme and Ventura in southern California (Figures 2, 3 and 4).⁷ Fishing for wetfish commonly entails the use of round

⁷ From time to time, CPS finfish and squid are also landed at other California ports such as Avila/Port San Luis and San Diego.

haul gear such as purse seines and drum seines to catch CPS finfish, squid and coastal tunas. Most fishing occurs at night, with vessels leaving port as early as noon (from San Pedro to fish the northern Channel Islands) and as late as midnight (from Monterey to fish the Bay). Present day vessels are equipped with fish-finding equipment including sonar, fathometers and global positioning systems (GPS). Skippers also draw upon their own knowledge and experience to locate fish. Most use radios and cellular telephones to communicate with running partners, spotter pilots and light boat operators, other vessels in the fleet and the market.

When a "fishable" school of CPS finfish (anchovy, mackerel or sardine) is located, the net is deployed from the stern of the vessel, assisted by a skiff, which holds one end of the net and its purse line, while the purse seiner lays out the net to encircle the fish. Once the net is fully deployed, the skiff returns the purse line to the seiner, where it is drawn using a hydraulic winch to enclose the fish in the net. The skiff man then fastens one side of the net to the skiff rail to help hold it open while the crew on the seiner work the net. The purse seine crew, assisted by a power block, begins to "dry up" the net to concentrate the catch alongside the boat. The crew deploys a hydraulic pump to pump the fish aboard through a large (12-24") hose, through a dewatering box and into the hold. (A few seiners use a hydraulically powered scoop net rather than a pump to load the catch. Scoop boats use manual power or a hydraulic stocking brail to load the catch.) Seiners typically make two to four sets a night of several tons each, either to reach a market-imposed limit or to fill the boat if no limit is in effect. [Wetfish purse seiners have an average capacity of about 60 short tons (PacFIN data).] Some vessels are equipped with separate (or separable) holds, allowing them to catch and deliver more than one species on a trip. Seiners may also catch mixed loads of mackerel and sardine, which sometimes school together.

The vessel then returns to port to deliver the fish to receivers. Most receiving stations consist of a docking facility with a shore-based pump that is used to transfer the fish from the hold to a weighing bin with a scale. Once the fish is weighed, it is transferred to totes, which dockside laborers pack with ice. The loaded totes are then transferred by forklift to a truck for transport to the processing plant. (Where a receiver/processor also has on-site processing facilities, the fish is pumped directly into weighing bins and then released into dry totes, which are moved by forklift directly to the packing line.)

Statewide, there are 16 major firms, and a number of smaller receivers and processors who participate in the California wetfish industry (Figures 5a-5d). Processing and packing facilities for California wetfish are located as far north as Watsonville and as far south as San Diego. The catch is variously processed, packed and sold in a variety of forms domestically for human consumption, petfood and bait, and exported for secondary processing, human consumption and aquaculture feed. (See Hackett's Wetfish Economics report for more detailed information.)

The wetfish industry's squid and tuna activities differ in a few notable ways from those associated with CPS finfish. When fishing for squid, seiners usually are assisted in locating and/or attracting squid by smaller "light boats" equipped with high intensity lights (limited to 30,000 watts per vessel). Typically, seiners pay the light boat 20% of the gross revenues for squid caught by this method. Some light boats also scoop squid for bait operations and/or specialty markets. As with CPS finfish, most squid fishing occurs at night, with landings delivered to receivers in the Monterey, Port Hueneme/Ventura and San Pedro/Terminal Island areas in the morning, pumped into totes, and trucked to processing and packing facilities. Squid caught in Monterey Bay is landed and delivered to packing facilities within that area. Most of the southern

California catch is received at Ventura, Port Hueneme and San Pedro, by processors based in the Monterey, Port Hueneme/Ventura and San Pedro/Terminal Island areas, and delivered to packing facilities from the Monterey area to San Diego (Figures 2, 3 and 4).

The distinctive features of the industry's tuna activities include the use of larger purse seine nets and spotter pilots. Seiners typically pay spotter pilots 5 to 6% of their gross revenue from CPS finfish and coastal tunas.⁸ Most tuna landed by the fleet is received by the wetfish markets and sold whole or headed and gutted, either fresh or frozen locally, or frozen for export.

Within the state, an extensive array of marine service and supply providers, from harbors, fuel docks and boatyards to trucking companies and packing material suppliers, play a critical supporting role to the industry, and in turn depends on the industry for business, revenues and other benefits. Harbors provide docking and associated facilities and services to both fishermen and receiver/processors for a fee, while relying on the tonnage delivered by the fleet to qualify for federal dredging support. Fuel docks and boatyards provide fuel and other necessary goods and services for vessel maintenance and operation, and depend on the fleet for revenues. Ice facilities supply both fishing and receiving operations. While some of these facilities are specialized to serve the fishing industry, many also support the agriculture industry. This is also the case for many of the trucking companies, cold storage facilities, as well as businesses that supply packing materials and day laborers.

At present the wetfish industry is governed by both state and federal law. Except for World War II, when the federal government managed the wetfish fishery to maximize production, the State of California has had authority over the fishery. Since the 1960s, state regulation has included quotas on sardine, mackerel and anchovy. Since the late 1970s, portions of the quota have been allocated to the state's northern region (north of San Simeon to the Oregon border) and to its southern region (south of San Simeon to the U.S.-Mexico border). In 1998, Amendment 8 to the Northern Anchovy FMP assigned sardine, jack and Pacific mackerel and squid to the same management unit as anchovy under the FMP, renamed the Coastal Pelagic Species (CPS) FMP. Under the CPS FMP, sardine and Pacific mackerel are "actively managed" by the PFMC and subject to annually determined harvest limits based on biomass estimates. Anchovy, jack mackerel and squid are "monitored" species not subject to federal harvest limits, but potentially to other forms of management. In 1999, the Council adopted a limited entry program for the CPS finfish fishery south of Point Arena, California, effective January 1, 2000.

Over time, squid fishing has been regulated by the state with legislative measures that restrict the use of lights to attract squid, limit days or times when fishing is allowed, and for several years, prohibited the use of purse seines in Monterey Bay. The growth of the squid fishery especially since the early 1990s has prompted increased management. In 1997, the California Legislature passed SB 364, which instituted a \$2,500 permit for catcher vessels and light boats, and a 3-year moratorium on entry into the fishery. SB 364 also mandated a study of the resource and the fishery (funded by permit fees) to provide data for the development of a squid fishery management plan. In the interim, the California Fish and Game Commission has adopted

⁸ Spotter pilots also assist in some wetfish fishing operations, including those of some vessels that do not also fish for tuna. Some spotter pilots also receive 2 to 3% of the revenue from squid fishing, although they do not usually assist in that activity.

regulations that extend the Monterey Bay area weekend closure statewide and require light shields and limit squid attracting lights to 30,000 watts per vessel. A draft management plan is being developed and will soon enter the public review process, with a final plan to be adopted by December 31, 2002.

Coastal tunas and bonito are subject to minimum size regulations and other management measures established by the state and consistent with federal regulations.⁹ Federal regulations are largely focused on tuna seiners, vessels three to four times the net tonnage of California wetfish vessels, that fish in the Eastern Tropical Pacific. Nonetheless, these regulations also affect the local wetfish fishery. Skippers who fish for yellowfin tuna are required to obtain a license and participate in a logbook program mandated by the Inter-American Tropical Tuna Commission. The fishery is also limited by an international quota (310,000 metric tons in 2002) (Donley pers. comm.) Although no such regulations govern the capture of bluefin tuna, dealers who import or export bluefin tuna are required to have a license and follow strict reporting requirements for all shipments. There are no regulations regarding skipjack tuna at present.

The apparent abundance of the wetfish and coastal tuna species has varied considerably over time. Evidence suggests that their spatial and temporal distribution and their availability to the fishery are strongly influenced by water temperatures (as influenced by variable weather and climate). In a study of the relative abundance of pelagic species targeted by the California wetfish fishery between 1962 and 1990, Squire (1993) found that sardine showed declining abundance between 1966 and 1983, but then began to increase into the mid 1980s, and that trend has continued to the present (Wolf et al. 2002). In 1999, CDFG declared the sardine resource to be fully recovered (CDFG 1999). Anchovy abundance increased through the 1970s, peaked in 1981, then declined through the 1980s (Squire 1993). The continued low biomass of anchovy is attributed to natural influences, as the directed fishery remains small due to the relatively low value of the species compared to other wetfish species (Bergen and Jacobson 2002). The northern anchovy has been labeled a "boom-and-bust" species, subject to extreme short- and long-term fluctuations in response to changing oceanographic conditions (Starr et al. 1998). Squid are particularly vulnerable to changing oceanographic conditions (especially water temperature), which play an important role in their spawning, distribution and abundance (Hixon 1983). Declines in the availability of squid appear to be correlated with El Niño events, including the 1997-98 event (CDFG 2001).

In the following sections, we present characteristics of the California wetfish industry for each of the three regional centers of activity. We begin in the most northerly area, Monterey Bay, and proceed south, discussing the Ventura/Port Hueneme area, and then the San Pedro Terminal Island area.

Section 4.a: The Monterey Bay Area Fishery

Section 4.a.1: The Resource

⁹ The minimum size for bluefin tuna is 7.5 pounds; the minimum size for bonito is 24 inches fork length or 5 pounds (California Fish and Game Code Sections 8375 and 8377(a)).

Sardine, anchovy and squid are the primary species targeted by the Monterey Bay wetfish fishery. Both sardine and anchovy are schooling fish, and are found in fishable aggregations along the coast, usually within state waters. Squid are targeted in spawning aggregations, which occur in relatively shallow waters within Monterey Bay and further north and south along the coast. Monterey wetfish fishermen tend to fish within a few miles of port and within Monterey Bay, although they have ranged further up and down the coast to fish squid in recent years.

Landings of wetfish in the Monterey Bay area have fluctuated widely since 1981 (Figures 2, 3 and 4). (Landings of coastal tunas are very small in the area's cooler waters.) In the early 1980s, landings were dominated by squid, northern anchovy and mackerel. Landings of mackerel increased during the 1982-83 El Niño, replacing squid and anchovy which had become more scarce with the warmer water. In 1985, the squid fishery re-gained some strength, and was the major fishery for the fleet through the late 1980s. Landings of Pacific sardine by the fleet appeared in the latter 1980s, but did not expand notably until the mid 1990s when growth in local processing capacity made this a more viable fishery for the fishermen. Landings of all of the wetfish species strengthened in 1994, dipped briefly in 1995, and peaked in 1997. With the onset of the El Niño in late 1997, however, landings of all of these species except Pacific sardine dropped off substantially. Although squid landings have been slow to recover in the Monterey Bay area, landings of Pacific sardine have remained strong with 12,000 short tons worth over \$950,000 in ex-vessel value landed in 2000.

Section 4.a.2: Ports and infrastructure

Monterey and Moss Landing are the two major wetfish receiving ports in the Monterey Bay area. Although they share a long history in the wetfish fishery, they differ notably from one another in their administration, facilities and activity related to commercial fishing in general and the wetfish fishery in particular. Pillar Point Harbor (often referred to as Princeton or Half Moon Bay) has been the site of wetfish industry activity as well, but on a much smaller scale.

Pillar Point Harbor is the only protected harbor between San Francisco and Santa Cruz. It was established by the San Mateo County Board of Supervisors in 1933, and is administered by the San Mateo County Harbor District. The harbor supports commercial fishing, recreational fishing, other recreational boating and tourism activities. It has 369 berths for commercial and recreational vessels, and four commercial fish receiving facilities (San Mateo County Harbor District 2002). On-site marine facilities include a fuel dock and ice facility; other marine service and supply businesses are located nearby.

Compared to Moss Landing and Monterey, Pillar Point Harbor has been the site of limited squid landing activity, and considerably less CPS finfish offloading. Between 1981 and 2000, the wetfish fleet landed just over 11,000 short tons of squid and less than 2,000 short tons of CPS finfish (most of it anchovy). Most of the wetfish landed at the harbor is loaded into iced totes and trucked to processing facilities in Watsonville and Salinas.

Issues for the wetfish industry at Pillar Point Harbor include the limited infrastructure for supporting wetfish offloading operations and the distance to the region's wetfish processing and packing facilities. A second issue is competition with other harbor uses such as sport fishing and tourism, although commercial fisheries are valued as a cultural backdrop and provide product for local fish markets and restaurants that in turn attract business to the area.

Monterey Harbor, which falls under the jurisdiction of the City, has supported wetfish industry activities since the late 1800s. Commercial fish receiving operations are located on Municipal Wharf Number 2, the more northerly of the two wharves inside the harbor. (Wharf Number 1, also known as "Fisherman's Wharf", hosts tourism businesses.) Although the wharf had not been upgraded in many years, a \$3 million renovation began in 1999 (Scheiblaue pers. comm.). Five fish wholesalers have facilities located on the wharf, which they operate under 5-year leases from the city. The wharf has two wetfish pumps and limited fish packing and storage facilities, and is therefore used predominantly for offloading fish into trucks for transport to processing and packing plants in nearby Sand City and agricultural centers such as Watsonville and Salinas. Because of the limited space for vehicle traffic, receivers generally try to limit themselves to one truck on the wharf at a time.

Other services including a fuel dock, a boatyard and chandleries are located just off the wharf and across the harbor near the breakwater. Approximately 140 commercial fishing vessels, including more than a dozen purse seiners, occupy harbor slips (Scheiblaue pers. comm.). The harbor also has nearly 200 moorings in the outer harbor and east of the wharf where some of the squid light boats tie up. Since 1997, wetfish deliveries at Monterey have diminished, with more of the catch being delivered to Moss Landing. Nonetheless, the commercial wetfish industry is still seen by many as an important economic, social and cultural component of the Monterey community.

Moss Landing Harbor, Monterey Harbor's regional counterpart for the wetfish industry, differs markedly. Moss Landing Harbor was opened in 1947 as a fish receiving site to complement Monterey and as a key fuel receiving site along the central California coast. The Moss Landing Harbor District is chartered to operate under the direct authority of the state. Adjacent to Highway 1 and a coastal railroad line, and less than 30 miles from the area's agricultural production centers, it is well situated for fish receiving and commerce. The harbor itself is enclosed by a spit of land known as "the island", which extends west and north from the mainland and is the site of most of the harbor's commercial fishing facilities and activities.

Moss Landing supports a diversity of commercial fishing and receiving operations, including three wetfish receiving operations, two owned and operated by area processors and one owned and operated by a receiver that does not process wetfish. As occurs at Monterey, wetfish are pumped from the holds of the boats to iced totes that are then loaded into trucks for transport to processing plants in nearby Watsonville, Sand City and Salinas. A fourth wetfish receiving station is under construction as part of a larger Moss Landing Harbor renovation project. Current support facilities include a fuel dock and marine supply store, a boatyard and other boat maintenance services. In 1999, an estimated 300 commercial fishing vessels tied up at Moss Landing; about 10 of those were purse seiners (Stilwell pers. comm.).

In recent years, wetfish have not played a large role relative to some of the other fisheries based at Moss Landing, but that may be changing with the recovery of the sardine fishery and new products and markets being developed by local processors. Through the 1990s, until the devastating 1997-98 El Niño, squid came to play an increasingly important seasonal role in the harbor as well.

In addition to commercial fishing, Moss Landing supports other forms of light industry including marine research, which has grown in its scope and land use in the past few years, recreational

fishing and marine tourism (e.g., whale watching). There are tensions among these user groups, although commercial fishing continues to be a high priority for the harbor (Stillwell pers. comm.). An issue for both the commercial fishing industry and the marine research community, however, has been the interruption of regular dredging of the harbor following the identification of DDT and other hazardous materials in harbor sediments.

Section 4.a.3: Processors and receiving capabilities

Four major wetfish receiver/processors are based in the Monterey Bay area. All have long-standing family ties to the fishing industry and to the region. Three have primary wetfish receiving operations at Moss Landing Harbor. Two firms directly receive wetfish at Moss Landing; the third contracts with a local receiver to offload vessels. Two of the Moss Landing receiver/processors also have facilities on the Monterey wharf. One of these regularly receives wetfish at the Monterey wharf, as does the fourth Monterey Bay area receiver/processor. All four of the wetfish receivers load fish into iced totes for transport to processing and packing facilities in Watsonville, Sand City and Salinas.

These four firms differ in their processing and packing capabilities and capacities, products and distribution. Their permanent staff ranges from 6 to 80 full time employees, with up to an additional 80 to 500 people employed by these firms during the height of the season, primarily at their packing plants. In addition to receiving, processing, management and sales staff, Monterey Bay area processors employ truckers, either directly or under contract with local trucking companies. For example, one processor reported using up to 27 "semi" trucks per day when landings are at their height to transport fish from receiving stations to the processing plant.

Most of the wetfish produced by these four receiver/processors is frozen and sold overseas. In the mid 1990s, one Monterey Bay area processor built a large canning facility in anticipation of new fishing and market opportunities for sardine. This facility also produces "individual quick-frozen" sardine, and other products from wetfish. Other Monterey Bay area processors produce "value added" product such as tubes, tentacles and breaded squid. While much of this product is exported for secondary processing, human consumption, bait and animal feed, some is locally and nationally distributed to secondary processors as well as wholesale and retail outlets.

Section 4.a.4: Fishing operations and their participants

Although a great number of vessels have landed wetfish at Monterey Bay area ports over time, a smaller subset of them, known collectively as the Monterey Bay wetfish fleet, accounts for the majority of landings. The skippers and crew who operate these vessels have extensive social, cultural and economic ties to the wetfish fishery.

Our Sea Grant (SG) and Channel Islands (CI) studies of the squid fishery included surveys of 11 purse seine skippers from the Monterey Bay area wetfish fleet. (Four of these skippers were interviewed for both studies.) Our ethnographic research included informal interviews with these and other members of the Monterey wetfish fleet, and observation of fishing-related activities in the area. The quantitative results presented below are drawn from the surveys conducted for the SG study (N=8), the CI study (N=9), or both ("SG+CI", N=11), and from PacFIN data on vessel characteristics.

The 11 wetfish vessels operated by the Monterey skippers average 56.8 feet in length, 43.2 net tons, and 333 horsepower (Table 2). These vessels range in age from 11 to 53 years, the oldest among them having been built just as the Monterey sardine fishery collapsed. Eight of the 11 vessels are of steel construction, representing a generation of vessels primarily from the late 1970s through the late 1980s (Table 3). The skippers interviewed for the SG study reported an average hold capacity of 55.7 short tons for wetfish (Table 4). Two-thirds of the fishing operations sampled use a drum seine, which reduces the number of crew needed. Average crew size of these operations was 4.6 and 4.7 (excluding the skipper) for the SG and CI samples, respectively, but ranged from three to seven for both groups (Tables 4 and 5).

The skippers we interviewed from the Monterey fleet are relatively young compared to those based at southern California ports. In 2000, they ranged in age from 25 to 44 years (mean = 36) (Table 6). They have an average of 11.8 years of formal education. Eight (72.7%) are members of families with historical ties to the fishery. Seven (63.6%) have family involved in their fishing operation. As of 2000, these skippers had an average of 20 years of commercial fishing experience (range = 9-25 years). Of the 11 skippers interviewed for the SG and CI studies, 10 (91%) fish both central and southern California squid; some of them also fish for CPS finfish in both regions as well. Some of the Monterey fishermen interviewed have participated in the southern California fishery since the early 1980s. All, however, consider their home port to be in the Monterey Bay area (Table 8). Of the 11 Monterey wetfish fishermen interviewed, all except one have fished for multiple Monterey Bay area companies. As a rule, however, they sell their catch to one processor at a time; all of them sell to Monterey Bay area receiver/processors in both central and southern California.

To complete their annual round of fishing, many Monterey skippers fish for San Francisco Bay herring and Alaska salmon (Table 9). Recent events in these fisheries, however, have prompted many Monterey fishermen to depend more on California wetfish. In the late 1990s, purse seiners were eliminated from the San Francisco Bay herring fishery when the fishery was reserved for gillnet fishermen. Purse seiners received two gillnet permits in exchange for each purse seine permit, but not all have remained in the herring fishery. Moreover, resource and market conditions in the fishery have been highly variable. The Alaska salmon fisheries have likewise been problematic, primarily due to the low ex-vessel prices of the past several years.

Of the skippers interviewed for both studies, 81.8% own their vessels. Skippers were asked to estimate the replacement value of their purse seiners for both studies (Tables 4 and 5). Replacement values ranged widely, but averaged about \$726,000 among SG study respondents and \$751,000 among CI study respondents. Skippers were also asked to provide estimates of operating expenses, which generally included fuel, maintenance, mooring and insurance, but excluded crew, light boat and spotter pilot payments.¹⁰ Estimates of annual operating expenses for the SG study averaged \$82,365; for the CI study, estimated expenses for 1999 averaged \$94,373

¹⁰ These figures do not include permit fees, gear or vessel purchases, and some other expenses. Respondents noted that insurance costs have increased dramatically over the past several years, but vary also depending upon whether and where they are actively fishing. Mooring costs also vary among ports and by type of accommodation (slip or mooring buoy, transient or permanent). Several respondents reported expenses for a temporary slip (e.g., at Ventura or Channel Islands Harbor for the winter squid fishery) as well as a permanent homeport slip.

in 1999. (See Pomeroy and FitzSimmons 2001 and Pomeroy and Hunter 2001 for further information on expenses.)

Section 4.b: The Ventura/Port Hueneme Area Fishery

Section 4.b.1: The Resource

The fishing grounds in the Ventura/Port Hueneme area include the northern Channel Islands and the mainland coast from Point Conception south. These fishing grounds lie within the Southern California Bight, which includes a diversity of oceanic biophysical habitats and a rich diversity of species, including all of those targeted by the California wetfish fishery. Spawning aggregations of Pacific sardine and Pacific and jack mackerel peak in the spring and early summer in this region (Weber 1997). Bluefin tuna periodically occur in the region, but Pacific bonito are more common. Both species are caught by California wetfish fishermen in the late summer and early fall.

As in the Monterey area, landings by the wetfish fleet in the Ventura/Port Hueneme area have fluctuated since the early 1980s, although there has been a notable increase in landings overall, due primarily to the growth in the squid fishery (Figures 2, 3 and 4). A number of fishermen from both the Ventura/Port Hueneme area and San Pedro, however, report that this area has been an important source of Pacific mackerel and coastal tunas, especially in the late 1980s. Through the early 1980s, anchovy and mackerel dominated the catch, but were surpassed by squid landings in 1986. Whereas anchovy landings remained well below 400 short tons through 1996, and average annual landings of mackerel dropped from 5,100 short tons in the 1980s to just over 400 short tons between 1990 and 2000, sardine and squid landings grew. Sardine landings first exceeded mackerel landings in 1990, and averaged over 1,300 short tons per year through 2000. Squid landings in the area jumped from 1987 to 1988 and again from 1994 to 1995. With the exception of El Niño years 1992 and 1998, squid have been the most important species in tons and value caught in the Ventura/Port Hueneme area since 1986.

Section 4.b.2: Ports and infrastructure

Four harbors in the Ventura/Port Hueneme area play an important role in the California wetfish fishery. From north to south, they are: Santa Barbara, Ventura, Channel Islands Harbor and Port Hueneme.

Santa Barbara Harbor is administered by the City of Santa Barbara, and is geared primarily toward coastal tourism and recreation. Nonetheless, it has supported a variety of commercial fisheries since 1933 (Hazard pers. comm.). It has over 1,100 slips, 19% of which are reserved for commercial fishing vessels, although in mid 1999, only 10 to 11% were in use (Hazard pers. comm.). On-site facilities include a fuel dock, an ice-producing facility, a chandlery, a small drydock facility, and a marine surveyor, and serve both commercial and recreational users.

Compared to Port Hueneme and Ventura, Santa Barbara Harbor has played a minor role in the wetfish industry. Very little wetfish is landed at Santa Barbara, although a few thousand dollars worth of northern anchovy and mackerel have been landed in some years. Since 1984, landings of

coastal tunas by those involved in the wetfish fishery have amounted to less than \$3000 per year. Squid, however, has played a more prominent role, especially in the past seven years. At least some squid has been landed at Santa Barbara every year since 1981, although there is no permanent receiving station at the harbor. Santa Barbara Harbor's interest in squid increased in the mid 1990s. Because of the harbor's tourism and recreation focus, however, the offloading of squid has been tightly managed. The harbor requires the use of a portable pump and tanker trucks rather than totes, and limits offloading to the early morning hours. One receiving operation offloaded squid at Santa Barbara in 1996 and 1997, but did not do so the next year because the scarcity of squid during the 1997-98 El Niño made this operation economically impractical. Almost no squid was landed at Santa Barbara in 1999; landings picked up again in 2000. In late 2001, a Monterey Bay area firm established a receiving station at the harbor (in place of the previous one).

Although Santa Barbara Harbor is strongly oriented toward recreation and tourism, former Harbormaster Hazard noted that commercial fisheries bring both tangible and intangible value to the harbor. Nonetheless, there are several issues associated with squid offloading at the harbor. These include sanitary issues caused by birds attracted to the offloading site, spillage and staining of docks and walkways by wastewater ("stick water") from vessels and offloading operations that contains fish, seawater and oil residues, and other potential incompatibilities with tourism and recreation businesses and activities at the harbor.

Ventura Harbor is operated by an independent port district that was established by the City following a vote of its citizens in 1952. In contrast to Port Hueneme, Ventura Harbor is a shallow-draft, small boat harbor. Existing facilities that support the commercial fishing industry include a "fisheries building" that houses three fish buying stations and a fish market, an ice flaking facility, a boatyard, a fuel dock and a nearby chandlery. Recent additions include a 150-ton boatlift and a second fuel dock. The harbor has over 1,300 slips in 3 marinas. Commercial fishing activity is concentrated in one of the marinas (adjacent to Ventura Harbor Village, the tourism complex). About 70% of the marina's 200 slips are occupied by commercial vessels (Johnson pers. comm.), the majority of those being fishing vessels. There are three wetfish/squid pumping stations located at Ventura Harbor. The first of these was installed in 1985. A fourth receiver has used a portable pump to receive squid at the harbor as well. Although space for trucks is limited, a few can park behind and between the fisheries building and the boatyard office. The wetfish (primarily squid) landed at Ventura Harbor is pumped from the vessels to weighing stations (through lines laid under the Harbor Village walkway) where it is loaded into totes with ice. The totes are loaded into refrigerated trucks and transported to processing plants in the Monterey Bay, Los Angeles and San Diego areas.

A recent Ventura Harbor Port District study cited commercial fishing as one of three economic sectors, along with tourism and recreational boating, of "crucial importance" to the harbor (Belknap 2001). The report also notes, "The health of the commercial fishing industry impacts the harbor in several primary and secondary ways. Direct revenues are generated from slip leases, fish handling and fuel usage. Indirectly, the commercial fishing workers bring activity and spending to the retail area and fishing operations also provide an attraction for visitors" (Belknap 2001: 21).

In recent years, Ventura has become an important site for squid offloading operations (Figure 2). In 1997, squid accounted for 94% of the fish offloaded at the harbor (Peña pers. comm.). As at

Port Hueneme, squid landings at Ventura Harbor first increased notably in 1985, but then dropped to near zero in the early 1990s. Landings resumed at a much higher level in 1993, and continued to increase through 1996. The ex-vessel value of landings dropped somewhat in 1997 with the onset of the 1997-98 El Niño late in the year, just as the winter squid season was getting under way. Landings in 1998, at the height of the El Niño, were 10% of landings for 1997, but rebounded in 1999 to over 12,000 short tons of squid worth \$4 million, and in 2000 to more than 20,000 short tons worth \$6.8 million. Over the past 20 years, the annual ex-vessel value of Pacific sardine, mackerel and coastal tuna landings by wetfish fishermen has been about the same, at just over \$100,000, less than 1% of the value of squid landed at Ventura Harbor. Whereas mackerel and coastal tuna landings have been spread out across the 20-year period, most sardine landings occurred between 1996 and 1999. Northern anchovy landings have been minimal, with 219 short tons worth less than \$40,000 in ex-vessel value landed over the past 20 years, and less than 4 short tons worth \$2,000 landed since 1996.

Ventura Harbor managers' efforts to accommodate a diversity of activities at the harbor, including commercial fishing, has highlighted issues for the wetfish industry. Recent improvements at the harbor have been geared, in part, toward supporting the commercial fishing industry. At the same time, the multiple and diverse uses of the harbor at times compete with one another, and raise concerns about public safety amid commercial fish offloading operations and associated liability issues. Moreover, harbor managers are concerned about the wide fluctuations in resource availability, and recent and pending changes in marine resource management. In particular, they are concerned that proposed marine reserves at the Channel Islands could limit or reduce the fishery's viability and its economic contribution to the harbor.

Channel Islands Harbor, located between Ventura and Port Hueneme, is owned and administered by Ventura County. Its primary focus is recreation, including sport fishing. It is the site of a live bait holding facility that provides anchovy, sardine and squid to commercial and private recreational fishing operations in the area. Other than this facility, there is no wetfish receiving station at the harbor. Several commercial fishing vessels and fish buyers not associated with the wetfish fishery use the harbor to deliver and receive fish and tie up. Support facilities include a boatyard, chandlery, fuel dock and other marine services. About 60 of the harbor's 2800 slips are allocated to commercial fishing vessels (Anonymous. n.d.). Most of these are located at the harbor's "Commercial Fishing Marina" on the west side of the harbor. As many as four or five purse seiners, and several squid light boats tie up at this location. Some of the purse seiners are resident year-round, while others are based there only during the winter squid season. Members of the Monterey Bay wetfish fleet also tie up at Channel Islands Harbor during the winter squid fishing season at slips located on the east side of the harbor at Channel Islands Landing.

Because little wetfish receiving and no wetfish pumping occur at the harbor, the issues for the wetfish industry at Channel Islands Harbor pertain more to vessel maintenance and traffic than fishing or offloading per se. The harbor's emphasis on recreation limits the support directed toward commercial fishing operations.

The Port of Hueneme is the top wetfish receiving harbor in the area, and has been the top squid receiving port in the state since 1985. It falls under the jurisdiction of the Oxnard Harbor District, chartered by state government (like Moss Landing). As the only deepwater port between Los Angeles and San Francisco, it serves the cargo and offshore oil industries. The port also hosts commercial fishing activity, primarily the offloading of fish. [The harbor has 18 small craft

berths, few of which are used by commercial fishing vessels (Port of Hueneme 2002).] The port also has a diesel-only fuel dock, but does not have ice, drydock, a chandlery or other facilities on-site, although Oxnard, nearby Channel Islands Harbor and Ventura offer many of these goods and services. Six firms, including five processors of seafood and one bait company, offload wetfish at Port Hueneme. Each of the five processors has a portable pump and other equipment set up at a leased site in the port. Two of these stations are located in the inner port area, and three are located just inside the entrance to the port.

Port Hueneme has long been a site of wetfish offloading activity (Figures 2 and 4). A 1979 report on the commercial fishing facilities in the region noted that the majority of the landings at Port Hueneme consisted of squid and anchovy, which were then processed at a cannery in Oxnard and trucked to Los Angeles for distribution (Bybee and Richards 1979:22). Landings of northern anchovy at Port Hueneme declined following the 1982-83 El Niño through the end of the 1980s, but have increased in the 1990s. Mackerel landings were strong through the 1980s, dropped off in 1991, and have increased in the past few years (with considerable inter-annual variation). Landings of Pacific sardine began as soon as the moratorium was lifted in 1986, but remained small until 1990 when an increased quota allowed for more fishing activity. Although landings dipped in 1998, over 980 short tons of Pacific sardine worth over \$230,000 was landed at Port Hueneme in 1997 and again in 1999. In 1985, following the 1982-83 El Niño, squid landings at Port Hueneme began to increase markedly, with over 3,200 short tons landed in 1985, the year southern California landings first exceeded those in Monterey. Through 1994, when 18,500 short tons were landed, the ex-vessel value of squid landings at Port Hueneme ranged between \$700,000 and over \$4.7 million (except during 1992, a relatively mild El Niño year). The ex-vessel value of landings jumped in 1995 to about \$14 million. Landings dropped to less than a tenth of that value in 1998, the height of the 1997-98 El Niño. Landings rebounded in 1999 to over 57,000 short tons worth just under \$20 million, and slowed somewhat to just over 50,000 worth just under \$10 million.

The issues for the wetfish industry at Port Hueneme are quite different from those described for most of the other wetfish harbors in the state, owing to the port's primary role as a cargo port. Vessels associated with the loading and offloading of cargo have priority over fishing vessels. Fishing vessels are required to remain outside the harbor until given permission by the port to enter, and must leave the harbor as soon as they have offloaded their catch. On occasion, the offloading of wetfish vessels has been interrupted and the vessels have been required to leave the harbor temporarily to make room for an incoming or outgoing cargo vessel. A second issue for the wetfish industry arose at Port Hueneme in 1999, when water quality problems were detected coincident with the high level of offloading activity at the port. The wetfish industry has since implemented measures to better contain stick water from the vessels and offloading operations. Finally, the more general lack of support facilities such as an ice plant are problematic for the industry. At present, receivers must truck ice in to the port, either from a local ice plant that serves the region's local agricultural industry or from plants near the Monterey and Los Angeles area wetfish processing facilities. Recent discussions between the port and receivers and service providers, however, may lead to reorganization of offloading at the port to address many of the foregoing issues, and would include the installation of an ice plant on site.

Section 4.b.3: Processors and receiving capabilities

Historically, Port Hueneme has played an important role in the wetfish industry, predominantly as a receiving station, although a local cannery packed anchovy and squid through the late 1970s (Bybee and Richards 1979). With the recent growth in the southern California squid fishery, however, wetfish receiving capabilities have greatly expanded throughout the Ventura/Port Hueneme area. Although the number of receivers and processors operating in the area varies some from year to year, eight wetfish processors regularly receive wetfish in the Ventura/Port Hueneme area. Two of the eight (including one Monterey Bay area processor) have processing and packing operations in Oxnard, within a few miles of their receiving stations. Three of the port's wetfish receiver/processors are headquartered in the Monterey Bay area, nearly 300 miles to the north. Two are based in or near the San Pedro/Terminal Island area, about 80 miles to the south. Three processors are based locally, although the processing and packing facilities of two of these are located at least 80 miles from the receiving station. (The characteristics of the processing firms based in the Monterey and San Pedro/Terminal Island areas are described in their respective sections.)

Although the logistics and cost of establishing and maintaining these facilities are not trivial, the arrangements described above have proven practical. Improvements in navigation and fish finding equipment, and in vessel safety and seaworthiness have enabled fishing operations to access and work more efficiently along the Ventura area coast and offshore at the Channel Islands. Growth in the demand and new market opportunities for squid and, to a lesser extent, sardine, have made it worthwhile for fishermen to fish the area and for processors to develop local receiving capabilities. Key factors that limit this expansion, however, include vessel transit time and the perishability of the product (especially squid). Transit time between the Channel Islands and Ventura/Port Hueneme area coastal fishing grounds and receiving stations in the San Pedro/Terminal Island and Monterey areas ranges from about 8 to well over 14 hours. In contrast, transit time from the fishing grounds to Ventura Harbor or Port Hueneme is generally less than 6 hours. It is more cost effective for processors to receive squid (and in some cases, wetfish) as soon as possible after it is caught, thoroughly ice and refrigerate it, and truck it to processing facilities several hours away. Moreover, the recent influx of purse seiners primarily from Washington to this area has increased the potential supply of squid to processors.

Wetfish receiving operations in the Ventura/Port Hueneme area include a newly established portable pump at Santa Barbara, three permanent pumps and one portable pump at Ventura Harbor, and five portable pumps at Port Hueneme, as well as bait receiving facilities at Channel Islands Harbor and Port Hueneme. Each wetfish pumping operation employs from 2 to 10 individuals to offload the fishing vessels. Whereas some receivers operate their own trucks, most contract with individual truck drivers or trucking companies to supplement or entirely cover their fish transporting needs. The two local processing plants employ a few additional core management and sales staff, and contract with temporary agencies for seasonal line labor to process and pack the fish. The timing of the southern California squid fishery during the winter months complements the local spring-summer-fall agricultural season, and affords ready sources of labor, transport and cold storage to the wetfish industry during the agricultural off-season.¹¹

¹¹ This arrangement has worked well for the past several years, although it was stressed during and immediately following the 1997-98 El Niño. During the El Niño, the scarcity of squid led to

Section 4.b.4: Fishing operations and their participants

The fishing operations and fishermen involved in the Ventura/Port Hueneme fishery include large subsets of the Monterey Bay and San Pedro/Terminal Island fleets. Although these fleets and participants are described in detail in the context of their respective home port areas, we provide some background on their activities in the Ventura/Port Hueneme area, followed by a detailed description of the Ventura fleet and its participants.

Many of the same factors that have prompted the development of shore-based receiving and processing infrastructure for wetfish in the Ventura/Port Hueneme area have also attracted Monterey Bay and San Pedro/Terminal Island fishermen to the area. In addition to the "pull" of the area's squid (and other wetfish) resources and associated economic opportunities, additional "push" factors have prompted purse seiners from Monterey Bay and San Pedro as well as those from out-of-state to fish the Ventura/Port Hueneme area. For Monterey Bay area fishermen, the winter Channel Islands squid fishery has provided a critical substitute for purse seiners recently excluded from the San Francisco Bay herring fishery. Also for the Monterey Bay fishermen, and for purse seiners from out of state, the squid fishery has proved lucrative in the face of declining revenues from summer salmon fishing in Alaska. San Pedro/Terminal Island fishermen have long fished the Channel Islands for mackerel, squid and coastal tunas, and particularly for squid in the latter 1990s. Although the San Pedro fishermen usually have ready access to wetfish closer to their home port, increased abundance and demand for squid have made it worthwhile for them to make the long run up to the Channel Islands to fish. At the height of the season, some San Pedro vessels deliver to receivers and tie up at Ventura Harbor.

The Ventura fleet consists of the subset of fishermen who fish in southern California waters and tie up at area ports during most or all of the time they fish in California. These vessels include a small year-round purse seine fleet, and a larger fleet of seiners from out-of-state, primarily Washington. Of the 20 Ventura-based purse seine skippers surveyed for the SG and CI studies, 11 fish for CPS finfish as well as squid.

The 18 vessels operated by the Ventura wetfish skippers we interviewed average 55.8 feet in length, 56.5 net tons, and 364 horsepower (Table 2). The vessels range in age from 8 to 64 years (mean = 22.7 years). Eight of the vessels are of fiberglass construction, seven have steel hulls, two have wood hulls, and one has a "plastic" hull (Table 3). The 13 skippers interviewed for the SG study reported an average hold capacity of 63.6 short tons for wetfish (Table 4). As with the Monterey fleet, just under two-thirds of the fishing operations sampled use a drum seine. Even so, mean crew size was smaller than that of the Monterey fleet, at 3.5 for the SG study and 4.1 for the CI study (Tables 4 and 5). All of the Ventura wetfish fishermen have fished for different companies over time. Generally, however, fishermen sell their catch to one receiver/processor at a time.

The skippers we interviewed from the Ventura fleet are older than those in the Monterey fleet, ranging in age from 30 to 60 years (mean = 44.4) (Table 6). They have an average of 13.2 years of formal education. Nearly two-thirds (65%) of them come from fishing families; just under one-

cutbacks in local receiving and processing operations. The re-appearance and abundance of squid in the spring and summer of 1999 put a strain on local labor, trucking and cold storage resources, competing with the local agricultural growing season.

third (30%) have family involved in their fishing operation. In some cases, family history includes parents or grandparents who lived and fished in the San Pedro area decades ago. Ventura skippers' commercial fishing experience averaged 25 years (as of 2000), and ranged from 15 to 41 years. Over half (55%) of the 20 skippers interviewed reported residing out-of-state. The 9 Ventura skippers who reside in-state live in southern California, between Santa Barbara and San Diego (Table 7). Seven of the eleven (63.6%) out-of-state residents consider their home port to be in Washington, while three (36.4%) reported Ventura as their home port.

In terms of their annual round of fishing, the Ventura fishermen fall into two groups (Table 9). One group, consisting primarily of resident fishermen, fishes in southern California only for CPS finfish, squid and, on occasion, coastal tuna and bonito. Although some of these fishermen have also fished for wetfish and/or squid in the Monterey Bay area, none reported doing so regularly. The second group, which consists primarily of out-of-state fishermen, also fishes in Alaska during the late spring and summer with purse seine or gillnet for salmon and/or herring. This second group has been attracted by new opportunities in southern California's winter squid fishery, especially with the availability and price problems in the Alaska salmon fisheries that were noted for Monterey fishermen.

Fourteen of the 20 Ventura/Port Hueneme skippers (70%) own their vessels. Skippers estimated the replacement value of their purse seiners for both studies (Tables 4 and 5). Replacement value ranged widely, averaging over \$1 million in the SG study and \$714,000 in the CI study. Market value (measured in the SG study only) averaged just over \$700,000, and ranged from \$150,000 to \$1.8 million. Estimates of annual operating expenses, averaged about \$103,000 in the SG study and \$126,000 in the CI study.

Section 4.c: The San Pedro/Terminal Island Area Fishery

Section 4.c.1: The Resource

The fishing grounds most readily accessed by the San Pedro/Terminal Island wetfish fleet are the areas along the mainland coast spanning both north and south of the Los Angeles area, offshore banks, and islands to the west, most notably Santa Catalina. The local wetfish fishery targets the full range of wetfish species (northern anchovy, Pacific and jack mackerel, Pacific sardine and market squid), coastal tunas and bonito. The availability of these species to the fishery, however, varies considerably in time and space (Figures 2, 3 and 4). . Most fishing for mackerel occurs from mid summer through the early fall when stocks are generally found closer to shore (subject to the availability of the resource and the quota). Through the 1980s, mackerel (primarily Pacific mackerel) accounted for the greatest proportion, in both tons and value of the wetfish landed by the San Pedro fleet. Mackerel landings increased in the latter 1980s, and peaked at a little over 52,000 short tons in 1988 and 1989. They declined in the early 1990s, and have ranged between about 10,000 and 20,000 short tons since, and peaked at just over 23,000 short tons in 2000. In 2001, some southern California wetfish fishermen reported finding little mackerel, despite a reasonably high quota. Sardine are a growing, year-round target of the fleet. Incidental landings of Pacific sardine occurred in the early 1980s, then increased to 300 short tons in 1986 when the directed fishery reopened. Landings fluctuated through 1990, then increased notably from about 1,200 short tons to over 6,000 short tons in 1991 and 15,000 short tons in 1992. Landings have continued to grow as the annual quota has been raised with evidence of the recovery of the resource. Landings in the latter half of the 1990s ranged between 26,000 and just over 40,000

short tons, making Pacific sardine the second most important species to the region's wetfish fishery in both weight and value landed. Northern anchovy landings played an important role in the fishery of the early 1980s, but are currently the least important wetfish species to the San Pedro/Terminal Island area. Over 88% of all northern anchovy landings between 1981 and 2000 were caught in 1981 and 1982. Since then landings have averaged about 450 short tons per year, with just over 1,500 short tons landed in 1999 and 1,300 short tons landed in 2000.

Coastal tunas (including bonito) have been of considerable importance to the San Pedro wetfish industry, even as the closing of local canneries has reduced market opportunities for the catch. Fishing for coastal tunas usually occurs in August and September when the fish migrate into southern California waters. These species are more available to the fishery during warm water years, when they migrate into southern California waters from foreign waters further south. The fleet's landings of coastal tunas in the 1980s varied between about 4,300 and 8,900 short tons, and between about 1,500 and 8,700 short tons in the 1990s. Just over 1,200 short tons of coastal tunas and bonito were landed in the San Pedro/Terminal Island area in 2000.

During the latter half of the 1990s, squid landings in the San Pedro/Terminal Island area grew tremendously. Squid landed at San Pedro/Terminal Island had an ex-vessel value of nearly \$1 million in 1981, but dropped thereafter to a low of less than \$40,000 in 1984. The following year, however, landings nearly reached their 1981 value. Landings held at well over \$1 million annually from 1986 through 1991, then dropped during the mild El Niño of 1992. Landings rebounded the following year and climbed to over \$5.8 million in ex-vessel revenue in 1997, then plummeted to just over \$130,000 worth in 1998. As occurred in the Ventura/Port Hueneme area, however, the fishery rebounded strongly in 1999, with landings worth over \$9.1 million in ex-vessel value. Although much of this catch came from the region's nearby fishing grounds, some of it also came from the Channel Islands, as some local fishermen continued to deliver to receivers at San Pedro/Terminal Island despite the long transit.

Section 4.c.2: Ports and infrastructure

San Pedro Harbor and Fish Harbor on Terminal Island are the area's main wetfish harbors. Both fall under the jurisdiction of the Port of Los Angeles. Although extensive commercial fishing related activity occurs at both sites, most wetfish-related activity occurs in San Pedro Harbor. San Pedro Harbor includes the San Pedro Municipal Fish Market located on the west side of the Port's main channel, and a side channel known as the "San Pedro slip". The fish market houses five receiver/processors who are involved in a variety of other domestic and import fisheries, as well as the wetfish fishery. The landward side of the building includes loading docks. Facilities in the vicinity include a fuel dock, boatyards, marine repair facilities and chandleries.

Fish Harbor is located on Terminal Island, which lies just east of the Port of Los Angeles' main channel and San Pedro Harbor. Many of the area's canneries were located at Fish Harbor through the 1950s, with some remaining through the 1990s. (The last cannery closed in Fall 2001.) One major wetfish receiving and processing operation is located at Fish Harbor, along with a petfood processing plant. A third site at Fish Harbor has been used on a temporary basis for wetfish receiving at various times by receiver/processors from all three regions. Other commercial fish receiving and processing also occurs, and a diversity of fishing operations, from local gillnetters to longliners from overseas, tie up at Fish Harbor. A boatyard is located on the west side of the harbor.

Despite its lengthy history and strong social, cultural and economic ties to the area, the San Pedro/Terminal Island wetfish fishery has been overshadowed by the Port's stronger interest in and attention to the cargo, oil and gas, and cruise ship industries. The loss of canning operations through the latter twentieth century and the expansion of these other activities in recent years have exacerbated the neglect of the local commercial fishery facilities.

Section 4.c.3: Processors and receiving capabilities

Like the Monterey Bay area, the San Pedro/Terminal Island area's history as a receiving and processing center for California wetfish dates back to the late 1800s. With the enhancement of freezing and storage capacities begun in the 1960s, the departure of the canneries, and the growth of new markets for squid, San Pedro's fish markets assumed a more prominent role in the wetfish industry. As several industry participants have noted, "the fish *markets* became fish *processors*".

In the San Pedro/Terminal Island area, five major receiver/processors receive wetfish at the Municipal Fish Market. Each of these firms operates offloading facilities which are leased from the Port. Each has a dockside pump to offload fish from the boats, scales to weigh the fish, and an enclosed area for small scale processing and/or packing. Wetfish are pumped ashore and into weighing bins, then released into totes and packed with ice. The totes are then moved by forklift from the dockside weighing station inside the facility where, in some cases, the fish are processed and packed, then loaded into trucks for regional distribution. Most of the catch, however, is transported by truck to processing and packing facilities elsewhere in the Los Angeles area (e.g., Wilmington).

Two additional receiver/processors operate at Fish Harbor on Terminal Island. Whereas one produces petfood, the other processes and packs CPS finfish, squid and tuna products for human consumption. These operations, in contrast to most other wetfish receiving/processing operations, are entirely self-contained. The former is supplied by one or two purse seiners that regularly deliver anchovy, sardine and mackerel. Fish are pumped from each vessel, up a two-story conveyor, and into the plant to be processed into petfood. The fish delivered to the latter firm's dockside receiving station is pumped directly from the vessel to a weighing bin inside the plant, released into totes, and then transferred by forklift to the packing line.

Most of the San Pedro/Terminal Island wetfish receiver/processors can receive between 200 and 300 short tons of fish per day from as many as twelve purse seiners during the height of the winter squid fishery. They employ from 6 to 20 dock personnel, and from 50 to over 300 people to process the fish. They also employ truck drivers, cold storage, sales, managerial and maintenance personnel. Whereas some firms rely on seasonal labor to fill out their workforce during the winter peak season, others maintain a large permanent staff.

The San Pedro/Terminal Island processors export most of the California wetfish and coastal tuna they receive. Much of this product is exported to China, Japan and Southeast Asian countries in frozen 50-pound blocks for secondary processing into frozen and canned products for human consumption. Some of the product, however, especially squid, is packed whole in 1-, 3-, 5- and 25-pound boxes. At least one local firm does some "value added" production of prepared tubes, tentacles, rings and other squid products. Some processors also distribute a small amount of wetfish locally.

In addition to these receiver/processors, the San Pedro/Terminal Island area also is the site of a number of live and dead bait suppliers that serve private and commercial local sport fishing operations. Typically, there is one live bait firm at each southern California harbor. At San Pedro, however, there are two, each of which is supplied by one or two live bait vessels. Each live bait operation maintains barges in the harbor that serve as holding pens for sardine, anchovy and squid. Private and commercial sport fishing boats can purchase live bait by the scoop (50-200 pounds or more) directly at the barge, which is tended by one or two overseers. Dead bait is produced in the San Pedro/Terminal Island area, both by the wetfish receiver/processors described above, and by dedicated bait receiver/processors with facilities located nearby (e.g., in Gardena). These bait operations are considerably smaller, employing no more than a dozen individuals. They are regularly supplied by a few of the smaller seiners. Almost all of this bait production is packaged in small units (e.g., one-pound bags) for sale to sport fishermen through retailers throughout the region and, in a few cases, in other states.

Section 4.c.4: Fishing operations and their participants

The San Pedro wetfish skippers and crew, like their central California counterparts, have extensive social, cultural and economic ties to the wetfish industry. Several of the skippers, and many of the crew, come from families whose involvement in wetfish fisheries extends not only back in time, but also back to Italy and the former Yugoslavia.

Survey interviews conducted for the Sea Grant (N=12) and Channel Islands (N=8) studies of the squid fishery included 16 purse seine skippers from the San Pedro/Terminal Island area fleet. (Because all of them tie up at San Pedro Harbor, we refer to them as the "San Pedro fleet".) Our ethnographic research also included informal interviews with other members of the San Pedro wetfish fleet, and observation of fishing-related activities in the area.

The vessels operated by the San Pedro skippers we interviewed average 67.2 feet in length, 62.7 net tons, and 366 horsepower (Table 2). These purse seine vessels range in age from 11 to 65 years, the oldest having been built at the height of the southern California sardine fishery. The San Pedro purse seine fleet is notably larger (in length) and older (average vessel age = 39.4 years) than the Monterey and Ventura fleets. Seven of the 16 vessels have steel hulls, 6 have wood hulls, and the remaining three have fiberglass or aluminum hulls (Table 3). The skippers interviewed for the SG study reported an average hold capacity of 64.6 short tons for wetfish (Table 4). In contrast to the Monterey and Ventura/Port Hueneme fleets, only one-third of the San Pedro fishing operations sampled for the SG study uses a drum seine. Average crew size (not including the skipper) was 5.5 (range = 3 - 8) for SG study operations and 6.9 (range = 3 - 9) for CI study operations (Tables 4 and 5). Operations that do not use a drum seine carry three to five more crew than those that do. In addition, most seiners add a crewman when fishing for tuna.

The skippers we interviewed from the San Pedro fleet are older than their Monterey and Ventura counterparts, and range in age from 33 to 67 years (mean = 49.8) (Table 6). They have an average of 9.7 years of formal education. All of the skippers we interviewed come from fishing families, although only 6 (37.5%) have family involved in their fishing operation. Experience as commercial fishermen ranged from 18 to 59 years, and averaged 35.6 years (as of 2000), considerably longer than the two other fleets. Of the 16 skippers interviewed for the SG and CI studies, none fishes in the central California wetfish fishery. Fifteen (93.8%) of the skippers

interviewed reported San Pedro as their home port, including two fishermen who reside in Washington (Table 8). All three of the Washington residents have strong family, social and cultural ties to San Pedro.

San Pedro fishermen are almost entirely dependent on CPS finfish, squid and coastal tuna for their income (Table 9). Four of the 16 skippers interviewed have fished San Francisco Bay herring in the past, but none does any longer. Six (37.5%) of them have fished for salmon in Alaska in the past, but fewer do so at present. All of the San Pedro wetfish fishermen interviewed except one have fished for different markets over time. As a rule, however, they sell their catch to one of the San Pedro/Terminal Island receiver/processors at a time.

Most of the San Pedro skippers interviewed (87.5%) own their vessels; two are non-owner operators. Skippers estimated the replacement value of their purse seiners, which ranged widely but averaged about \$1 million for both studies (Tables 4 and 5). Average market value (estimated for the SG study only) was considerably lower, at \$529,000. Generalized estimates of annual operating expenses for the SG study averaged about \$99,800. For the CI study, which focused on 1999 expenses only, this figure averaged just over \$225,000.

Section 5: The California Wetfish Industry as a Whole

We have analyzed a variety of sources of data on the California wetfish fishery, including archival, survey and ethnographic data, to describe the cultural traditions and changing dynamics of the present day fishery. The three regional centers of activity described in the preceding section are the primary nodes in the complex social and economic network that constitute the California wetfish industry. The main participants in the industry, the receiver/processors, the fishermen and their fishing operations, are characterized by a range of mobility and diversification that influences their capacity to adapt to variability and uncertainty in both supply and demand for California wetfish and coastal tuna products.

The variability and uncertainty in supply stems from both "natural" and "anthropogenic" factors. Natural factors such as oceanic conditions, especially water temperature, have been shown to be closely correlated with the abundance and distribution of CPS finfish, squid and coastal tunas (e.g., Squire 1993, Leos 1999). The disappearance of squid from the fleets' central and southern California fishing grounds during the 1997-98 El Niño provides a stark example of the potential for short-term fluctuations in resource availability to the fishery.

Among the significant anthropogenic factors that influence the supply of wetfish are commercial fishery regulations. It is assumed that fishermen will always find a market for their fish, and that the market will expand indefinitely to accommodate increased catches (although prices may also fall as supply increases. This approach, which is the basis for most fishery regulation, oversimplifies how most fishery systems operate (Pomeroy and FitzSimmons 2001). The amount of wetfish caught has been governed by quotas for each of the three CPS finfish species since the 1960s. These have included moratoria on directed take of Pacific mackerel and Pacific sardine from 1970 to 1977 and from 1974 through 1985, respectively. Time and area closures such as the weekend closure in the squid fishery also have influenced the supply of wetfish and associated species, as have closures of Santa Monica Bay and areas at Santa Catalina Island and the Channel Islands to round haul or all commercial fishing gear. The closure of Mexican waters to U.S. tuna fishermen in the late 1970s, and increased enforcement of the international border by the U.S.

government in recent years have also limited tuna fishing by the San Pedro fleet. Most recently, the moratorium on entry into the squid fishery in 1998 (and the prospect of permanent limited entry) as well as the implementation of limited entry in the CPS finfish fishery in 2000 have also affected the supply of these species.

Finally, supply is likely to be impacted by the proposed closure of fishing grounds as part of state, federal and international efforts to establish marine protected areas (MPAs) along the U.S. West Coast. Within the state, a network of marine reserves is being planned pursuant to the 1999 Marine Life Protection Act (MLPA). The recent Channel Islands marine reserve process pertains to both state and federal waters around the Islands. Also in federal waters, the PFMC is considering marine protected areas (MPAs) for the U.S. west coast. A larger initiative involving the U.S., Canada and Mexico may lead to the establishment of a system of MPAs from Alaska to Baja California in the near future. These factors may affect the total quantity of fish landed, and are likely to influence the temporal and spatial distribution of activity both on the water and shoreline.

Similarly, the fishery is affected by variability and uncertainty in domestic and especially global market demand for particular species, product types, amounts and prices. These, in turn, are a function of the supply, for example, of squid from the Falkland Islands or anchovies from Peru, and demand for low cost squid by China or table quality sardine by Japan. These components of supply and demand external to the California wetfish fishery interact with one another in a global context to dictate demand for California product.

California wetfish fishermen and receiver/processors alike have certain cultural characteristics, and have particular strategies they use, to respond to uncertainty and variability in resource, economic and regulatory conditions. Many industry participants have strong family ties and other social and economic relations that afford a source of resilience in times of economic stress. Within and across years, fishermen and receiver/processors also adapt by diversifying their activities, although the nature and extent of this diversification has changed over time and varies considerably within and among centers of activity, their respective fleets of fishermen, and groups of receiver/processors.

Historically, the industry focused on the production of large volumes of CPS finfish to produce a limited set of products for lower end markets. Fishermen and processors were diversified in the sense that they shifted their effort among wetfish species according to their availability and their price in the market place.

This pattern has shifted somewhat, with the demand for high quality products in more complex and competitive global markets. As in the traditional wetfish industry, California wetfish fishermen are diversified in their ability to shift among the wetfish species. Market-imposed trip limits and other factors, however, have prompted many fishermen to improve their at-sea handling of fish. Those who also fish for San Francisco Bay herring or tuna are more diversified within their respective regional fishery contexts. Still others who fish in Alaska are perhaps even more diversified. This diversification has its liabilities, however, given the additional investments required to participate in these other fisheries and their own variability and uncertainty, which have been especially evident in recent years. Receiver/processors of California wetfish likewise have diversified to some extent. Forms of diversification among them have included the shift of

fish markets to fish processors, reliance on multiple species, identification of and response to new market opportunities and the development of new product lines.

The rebirth of the sardine fishery and the growth of the squid fishery have occurred amid a growing interest in squid, and to a lesser extent, sardine for human consumption. Changes in infrastructure such as the loss of wetfish and tuna canneries and reduction markets, and the global demand for high quality product have led to incremental changes in how fish is handled on the boat, landed and packed, and to the identification and production of new product forms.

Section 6: Conclusion

Variability and uncertainty in resource availability and market demand are a given for the fishing industry. Many fishermen and processors view this as an opportunity, but also as a challenge. The value of California wetfish products is inextricably linked to sharp fluctuations in supply and value of competing commodities in the global market. Nevertheless, wetfish account for a significant proportion of California commercial fishing landings, nearly 84% by weight and over 29% by ex-vessel value in 2000.

The receptiveness of California ports and the maintenance of infrastructure to support the industry varies within and among the three regions. Many port managers see value in the wetfish industry to provide revenue to harbor operations directly, to help qualify for federal dredging dollars, and to support local businesses. In some areas, the wetfish industry also provides a visible cultural backdrop of the traditional fishing operations associated with historic California ports and harbors. However, real or perceived competition with other uses at some ports has created tensions and problems. Fishing, receiving and processing operations require well maintained infrastructure and adequate space for efficient operation. They also need access to goods and services including ice, fuel, marine supply goods, boatyards and qualified personnel to provide these, all at reasonable cost. These facilities, goods and services must be able to adapt to fluctuations in fishery activity associated with the seasonality and the inter-annual variability of the fisheries. At some ports, these facilities are in place or under construction, either in the interest of supporting the commercial fishing industry, or because such infrastructure is of value to other harbor users as well. At other ports such as Port Hueneme and San Pedro, the high value of cargo and related industries has put a premium on space and facilities. As a result, the fishing industry has been allocated a minimum of space, and operations have become congested.

In addition to the port and infrastructure issues noted above, California wetfish processors face additional challenges. Although many in the industry have mechanized their operations in recent years, the production of value-added products from wetfish continues to require considerable human participation. As one processor noted, when it comes to producing value-added product, wetfish processing is still an "artisanal industry". In terms of both labor and facilities, the wetfish fishery is complementary to the regional agricultural economies of the Monterey and Ventura/Port Hueneme areas, as it draws upon the same labor pool, services, supplies and supporting facilities during agriculture's low season. Freezing and cold storage capabilities to produce and store "blast frozen" and "individual quick frozen" products also serve a critical function in meeting the demand for quality products as well as providing fishermen and processors with the means to deal with the multiple sources of variation in both the supply and demand for wetfish products. Industry participants note that wholesale prices have not kept pace with the costs of these inputs.

The issues for California wetfish fishermen and their fishing operations include access to resources and the revenue they receive for their role in adding value to California wetfish and coastal tunas. The importance of access to resources follows from the inherent variability and uncertainty in both local resource availability and demand for the catch. It is assumed that fishermen will find a market for their fish, and that the market will expand indefinitely to accommodate increased catches (though prices paid to fishermen may also fall as supply increases). Fishermen frequently highlight the importance of their annual round and the need to

adapt to changes in resource availability and demand. They count on at least one, hope for two of their fisheries to sustain their operations each year; an ideal year is one in which three of their fisheries are abundant and bring a reasonable price. These may be the wetfish species (anchovy, mackerel, sardine and squid), but more likely also include coastal tunas, San Francisco Bay herring or Alaska salmon. Over the past two decades, however, ex-vessel prices have not kept pace with the costs of fishing. Moreover, increases in ex-vessel value during that time have not kept pace with increases in export value, as the real value of California wetfish and coastal tuna increased by 317 percent between 1989 and 2000, real harvester revenues increased by 88.4 percent in the same time period (Hackett Wetfish Economics report).

We have identified key socio-economic features of the present day wetfish fishery that are essential to understanding its dynamics and prospects for the future. Of particular importance are the extensive and long standing social and economic linkages among fishery participants, which afford both human and social resources and resilience that are critical to the fishery's viability. The increased mobility of fishermen and processors, their use of enhanced communications capabilities, and response to market demand for higher quality product have played a key role in shaping the current dynamic of the fishery. These features demonstrate the ability of California wetfish industry participants to adapt to uncertain and variable environmental, regulatory and global market conditions.

References

- Anonymous. n.d. Channel Islands Harbor Overview. <http://www.sailorschoice.com/ciharbor.htm>. accessed January 2002.
- Bayliff, W.H. 2002. Bluefin tuna. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.
- Belknap, A.S. 2001. Ventura Port District Study. Prepared for the City of Ventura. Ventura, CA.
- Bergen, D., and L. Jacobson. 2002. Northern anchovy. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.
- California Department of Fish and Game (CDFG). 2001. Status of the Market Squid Fishery with Recommendations for a Conservation and Management Plan. Report to the Legislature. Sacramento: Marine Region, California Department of Fish and Game.
- _____. 2000. Review of some California fisheries for 1999. California Cooperative Oceanic Fisheries Investigations Reports 41.
- _____. 1999. Pacific sardine resource now officially recovered. CDFG Press Release, January 15, 1999.
- California Seafood Council (CSC). 2000. Directory of California Seafood Producers. Santa Barbara: CSC.
- Coan, A.L., Jr. 2002. Skipjack tuna. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.
- _____. 2002. Yellowfin tuna. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.
- Crehan, T. Personal communication, February 2002.
- Donley, P. Personal communication, January 2002.
- Fields, W.G. 1965. The structure, development, food relations, reproduction, and life history of the squid *Loligo Opalescens* Berry. Fish Bulletin 131. Sacramento: California State Resources Agency, Department of Fish and Game.
- Hazard, J. Personal communication, June 1999.
- Hixon, R.F. 1983. *Loligo opalescens*. In P.R. Boyle, ed., Cephalopod Life Cycles, volume 1: Species Accounts. London: Academic Press. pp.95-114.
- Johnson, J. Personal communication, December 1998.

- Konno, E., P. Wolf, and D. Bergen. 2002. Pacific mackerel. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.
- Leet, W.S., C.M. Dewees, and C.W. Haugen, eds. 1992. California's Living Marine Resources and Their Utilization. Davis, CA: Sea Grant Extension Program, Dept. of Wildlife and Fisheries Biology, University of California.
- Mason, J., and T. Bishop. 2002. Jack mackerel. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.
- McEvoy, A.F. 1986. The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980. Cambridge: Cambridge University Press.
- Parrish, R. 2000. A Monterey sardine story. In Thomas, T., ed. The Sardine Fisheries. J.B. Phillips Historical Fisheries Report. Monterey: Monterey Maritime Museum, pp. 2-4.
- Peña, O. Personal communication, February 1999.
- Pomeroy, C., and M. FitzSimmons. 2001. Socio-Economic Organization of the California Market Squid Fishery: Assessment for Optimal Resource Management. California Sea Grant Project Final Report.
- Pomeroy, C., and M.S. Hunter. 2001. The Channel Islands squid fishery. Summary prepared for the March 21, 2001 Marine Reserves Working Group Meeting, Santa Barbara, CA, March 17, 2001.
- Port of Hueneme. http://www.portofhueneme.org/html/technical_info.html. accessed January 2002.
- San Mateo County Harbor District. <http://www.smharbor.com/pillarpoint/>. accessed January 2002.
- Scheiblaue, S. Personal communication, May 1999.
- Spratt, J.D., and L.A. Ferry. 1993 A profile of the Monterey squid fleet in 1992. Marine resources administrative report no. 93-1. Sacramento, CA: State of California, The Resources Agency, Department of Fish and Game.
- Squire, J.L. 1993. Relative abundance of pelagic resources utilized by the California purse-seine fishery: Results of an airborne monitoring program, 1962-90. Fishery Bulletin 91(2): 348-361.
- Starr, R. M., K. Johnson, E. Laman, and G. Cailliet. 1998. Fishery resources of the Monterey Bay National Marine Sanctuary. La Jolla, California Sea Grant College System, University of California.

Stilwell, J. Personal communication, May 1999.

Weber, M.L. 1997. The Marine Fisheries of Southern California: A Briefing Book. San Pedro, CA: Cabrillo Marine Aquarium and Palos Verdes/South Bay Audubon Society.

Wolf, P., P. Smith, and D. Bergen. 2002. Pacific sardine. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.

Yaremko, M. 2002. California market squid. In Leet, W., C. Dewees, R. Klingbeil, and E. Larson, eds. California's Living Marine Resources: A Status Report. California Department of Fish and Game.



Figure 1. Map of California with key wetfish industry locations indicated in red. The Channel Islands include San Miguel, Santa Rosa, Santa Cruz, Anacapa and Santa Barbara Islands. (Source: G. Wade and N. Wright, CDFG Marine Region GIS Lab)

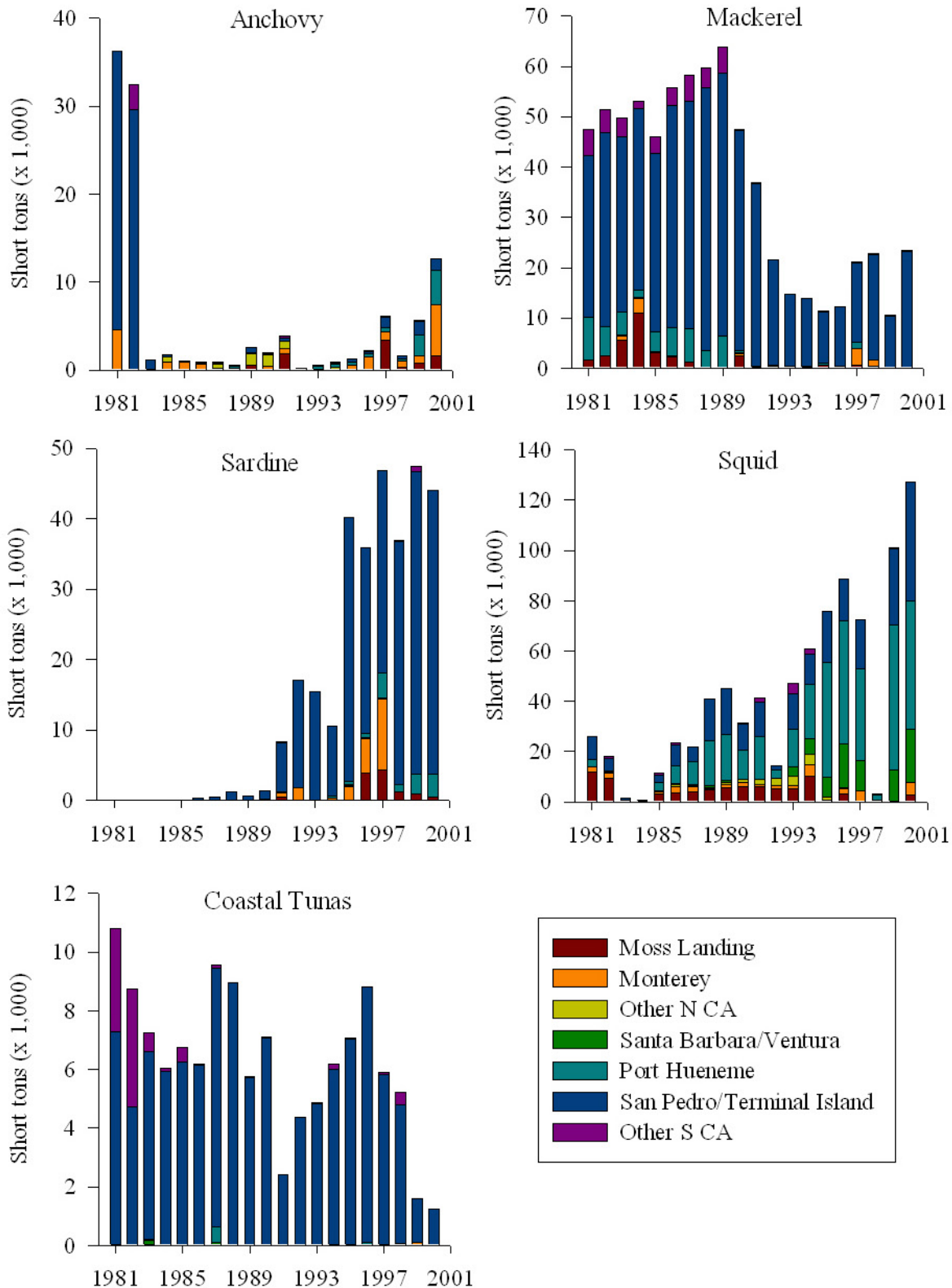
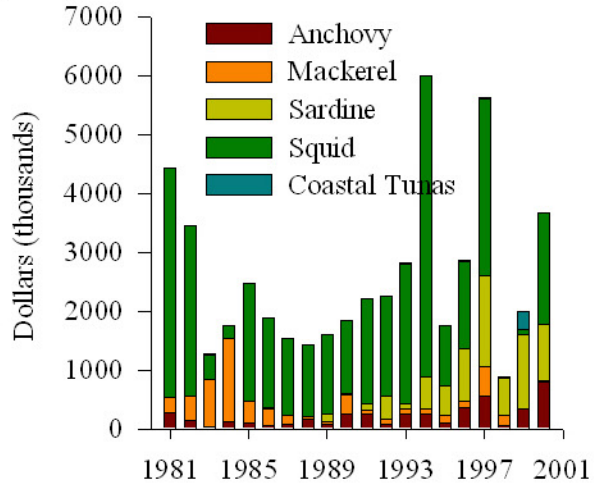
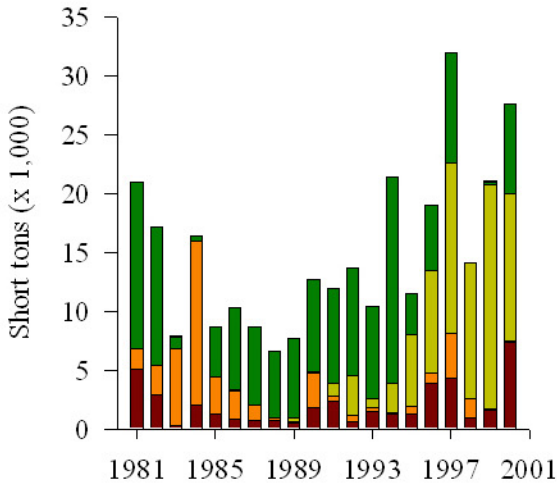
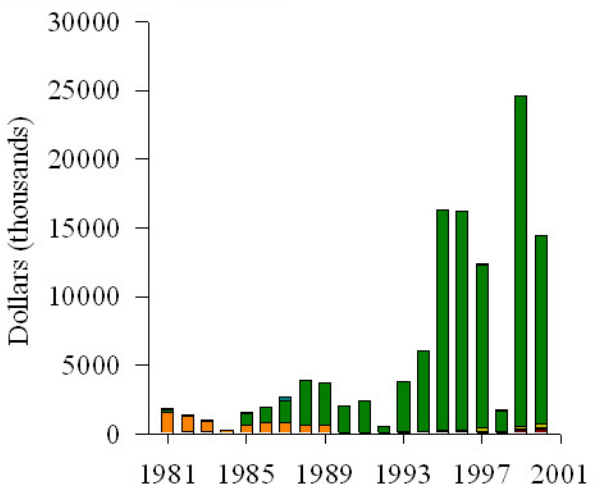
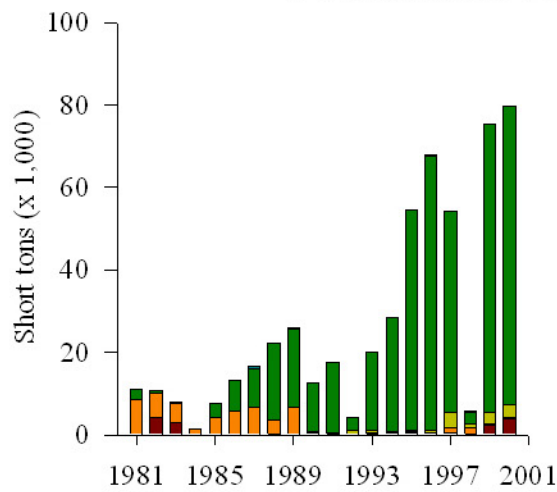


Figure 2. Tons of northern anchovy, Pacific and jack mackerel (combined), Pacific sardine, squid and coastal tunas (including bonito) landed in the California wetfish fishery, by port, 1981-2000. No data reported where number of vessels or receivers <3 to insure confidentiality of individual landings data. (Source: PacFIN data)

Monterey Bay



Port Hueneme/Ventura/Santa Barbara



San Pedro/Terminal Island

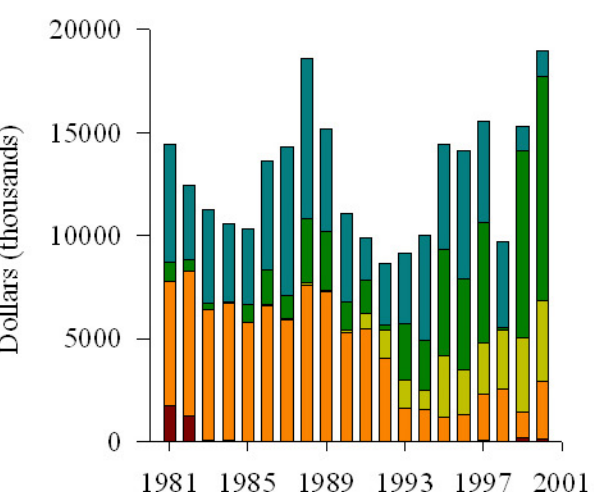
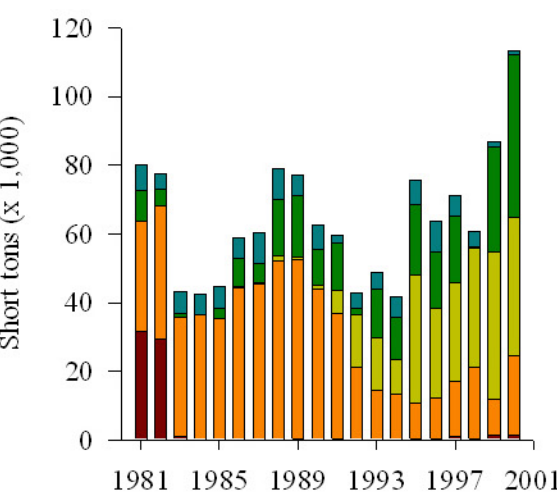


Figure 3. Tons and ex-vessel value of northern anchovy, Pacific and jack mackerel (combined), Pacific sardine, squid and coastal tunas (including bonito) landed in the California wetfish fishery, by regional center of activity, 1981-2000. No data reported where number of vessels or receivers <3 to insure confidentiality of individual landings data. (Source: PacFIN data)

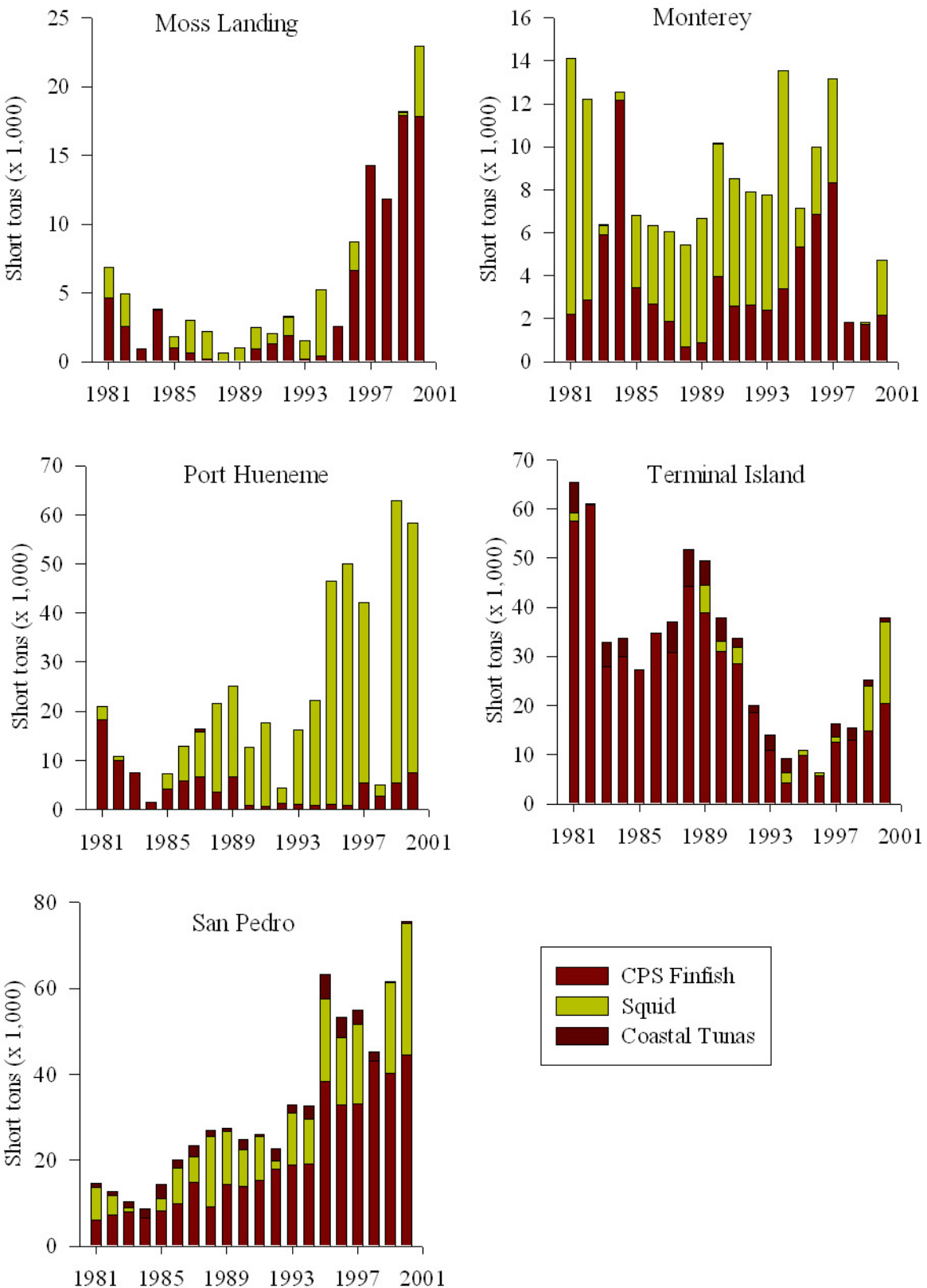


Figure 4. Tons of coastal pelagic finfish species, squid and coastal tunas (including bonito) landed in the California wetfish fishery at the major wetfish receiving ports, 1981-2000. No data reported where number of vessels or receivers <3 to insure confidentiality of individual landings data. Source: PacFIN data)

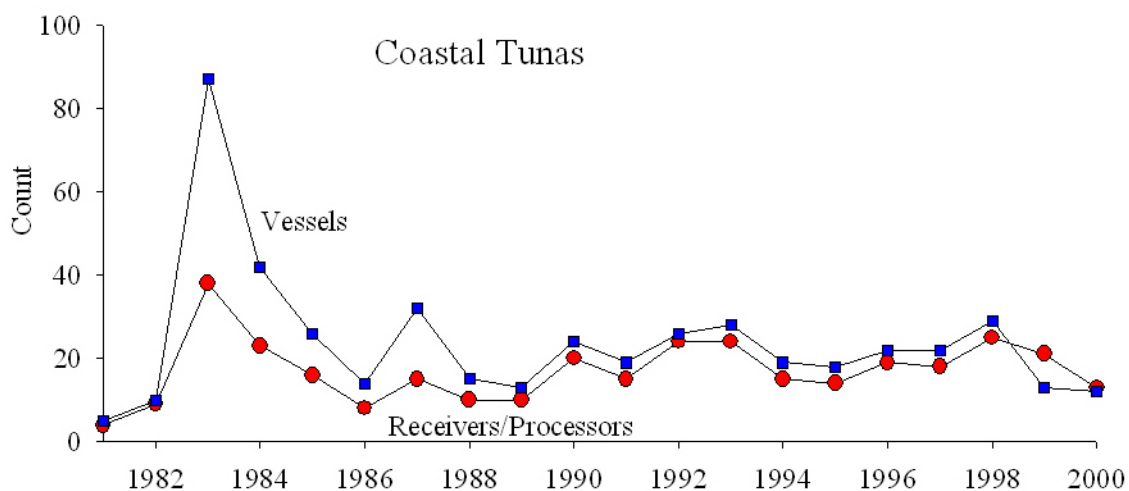
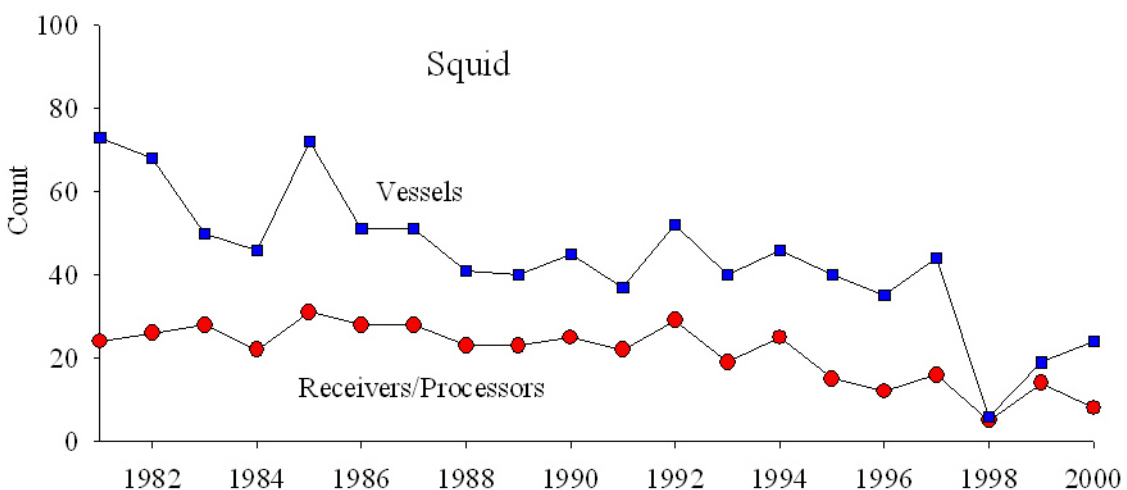
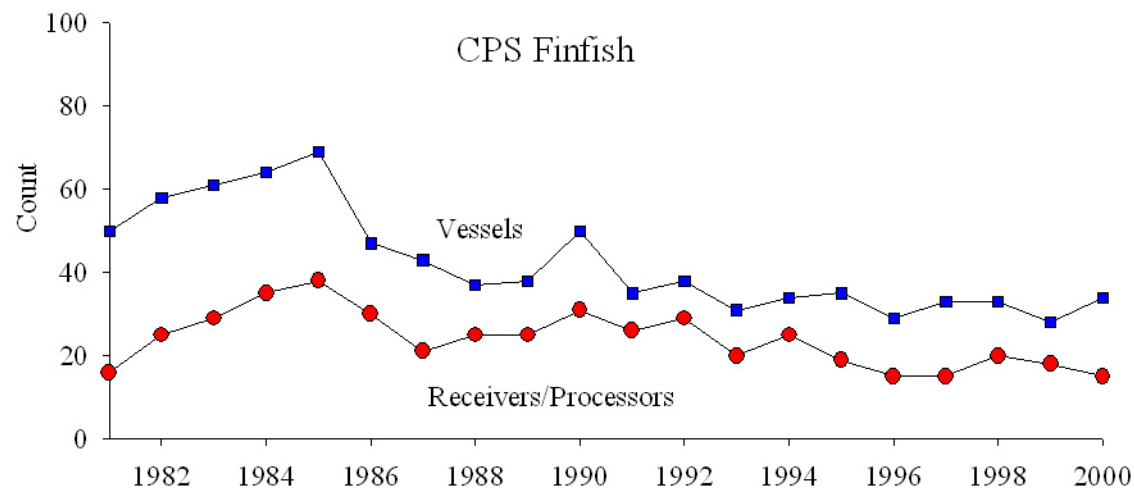


Figure 5a. Number of vessels and processors active in the Monterey Bay area wetfish industry, 1981-2000. (Source: PacFIN data)

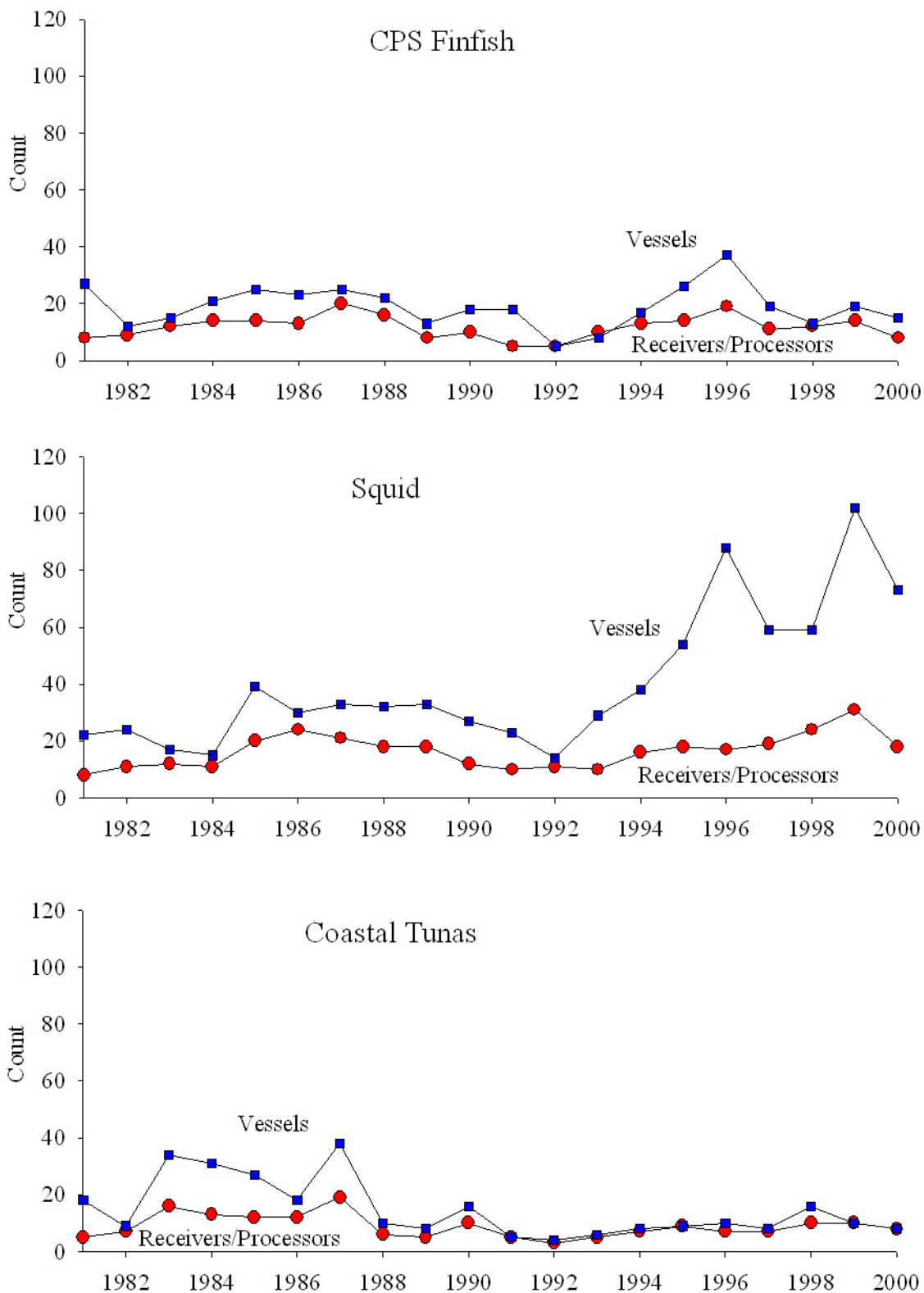


Figure 5b. Number of vessels and processors active in the Ventura/Port Hueneme area wetfish industry, 1981-2000. (Source: PacFIN data)

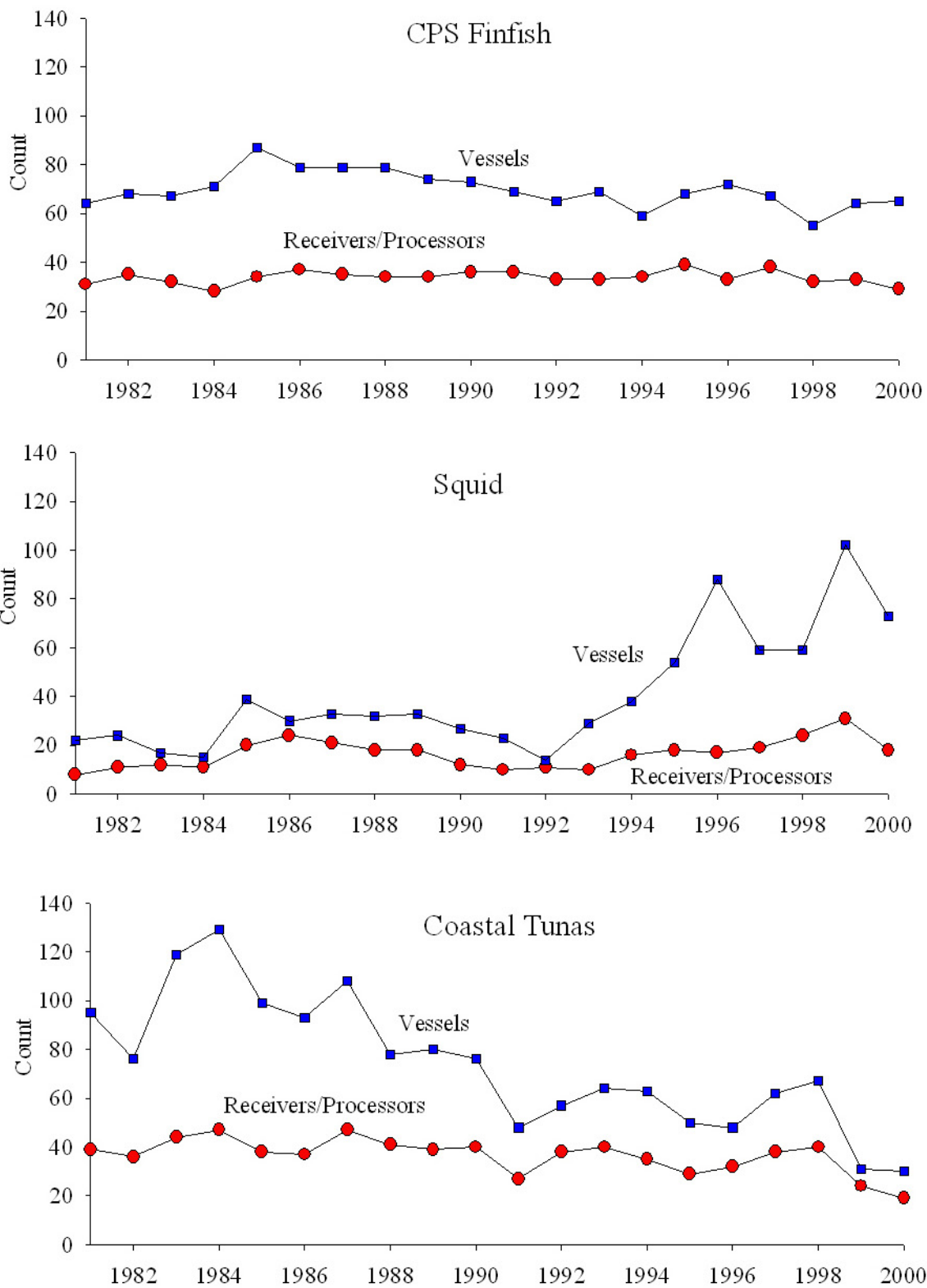


Figure 5c. Number of vessels and processors active in the San Pedro/Terminal Island area wetfish industry, 1981-2000. (Includes all southern California ports other than Ventura/Port Hueneme area ports.) (Source: PacFIN data)

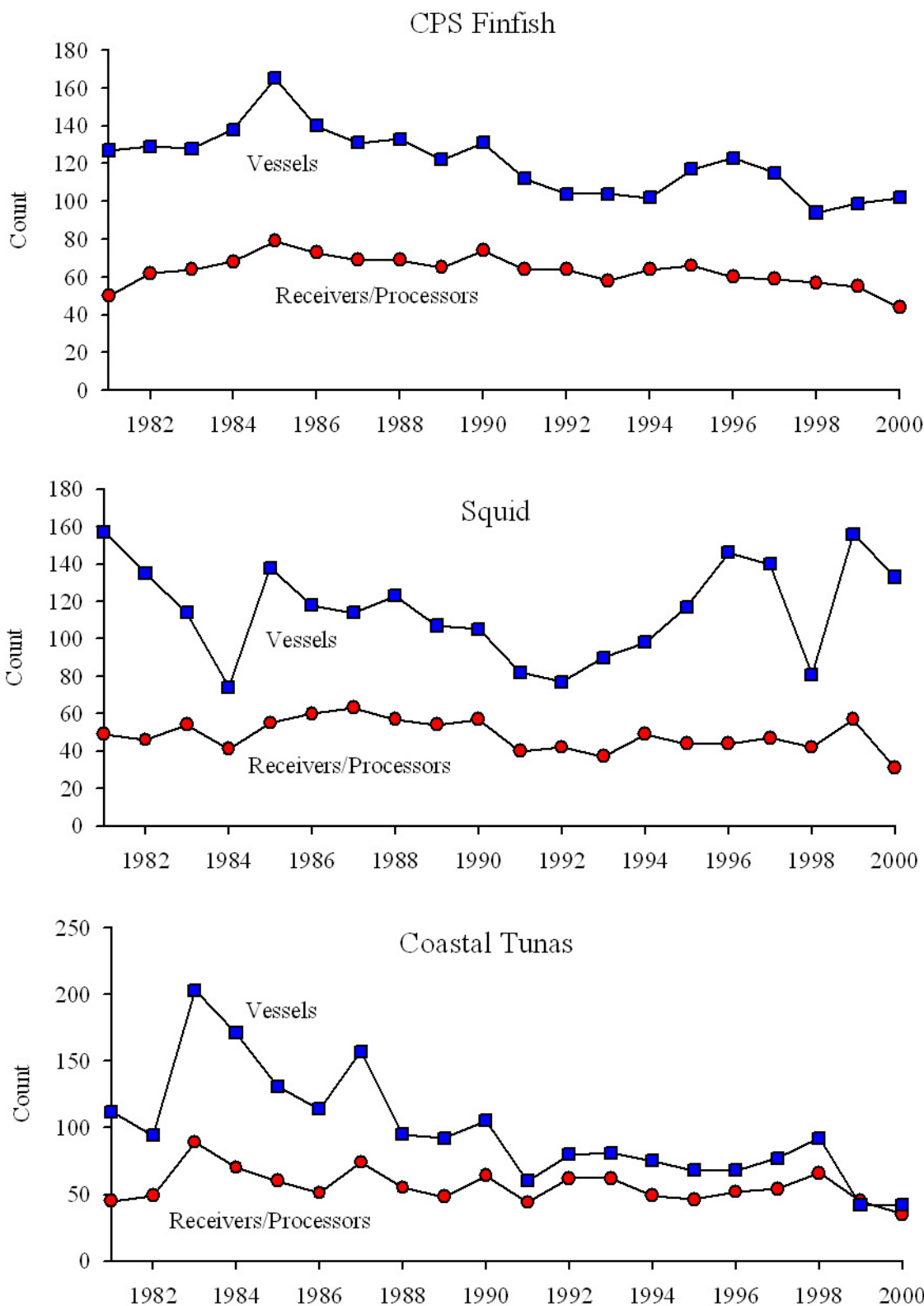


Figure 5d. Number of vessels and processors active in the California wetfish industry statewide, 1981-2000. (Source: PacFIN data)

1863	Commercial fishery for squid started by Chinese at Monterey
1890s	Sardine and mackerel first canned at San Pedro
<1900	Halfhill canned sardines at San Pedro
	Gasoline engine first adopted by some vessels
1902	Booth experimented with canning sardine at Monterey
1905	Lampara net introduced, Monterey Bay
1918	Commercial fishery for northern bluefin tuna began
1920s	Pacific mackerel canned
1925	Norwegian skipper at San Pedro experimented with purse seine to fish sardines
1930s	Lampara boats replaced by purse seines (sardine, mackerel)
1935	CA reduction restriction removed
1945	Squid first landed in S CA
1947	Horse mackerel changed to jack mackerel (by US FDA)
1950-51	Sardine collapse, Monterey
1953	Sardine collapse, San Pedro
1953	Purse seine nets prohibited in Monterey Bay
1956	Nylon purse seine nets [and power block?] introduced
1959	Squid attracting lights banned in Monterey Bay
	Power block adopted
1961	S CA squid fishery emerged
1965	CDFG anchovy reduction quota established
1967	Directed (non-bait) sardine fishery moratorium implemented
1970	Pacific mackerel moratorium implemented
1972	Peruvian anchoveta fishery collapsed
1974	Sardine moratorium implemented
1977	Pacific mackerel fishery re-opened (under quota system)
1978	Northern Anchovy FMP implemented
1980	CA wetfish fleet precluded from fishing Mexican waters for Pacific bonito
1981	Jack mackerel included in Federal Groundfish FMP
1985	State moratorium on Pacific mackerel fishery when biomass <20,000 tons
	S CA squid fishery overtook Monterey fishery in tons landed
1986	Directed fishery for sardine opened
1988	Moratorium on squid attracting lights in most of Monterey Bay lifted
1989	Purse seines and squid attracting lights permitted throughout Monterey Bay
1991	Sardine quota increased from 1,000 tons to 10,000 tons
1994	Opening of the Chinese market for squid
1997	SB 364 Squid Fishery Management Bill passed
1998	\$2,500 permit for squid catcher and light boats instituted
1999	Sardine fishery declared recovered
	Jack mackerel dropped from GFMP and added (as monitored species) to CPS FMP
	30,000 watt limit and light shields required for squid catcher and light boats
	Mandatory logbooks and statewide weekend closures for the squid fishery implemented
2000	CPS Limited Entry implemented; management (except squid) shifted to PFMC

	Monterey (N=11)		Ventura (N=18)		San Pedro (N=16)		Overall (N=45)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Length	56.8	47-78	55.8	19-70	67.2	42-86	60.1	19-86
Net tons	43.2	18-90	56.47 ^a	32-107 ^a	62.7	17-93	55.4 ^b	18-107 ^b
Horsepower	332.7	165-540	364.2	210-540	366.1	200-750	357.2	165-750
Age	22.6	11-53	22.7	8-64	39.4	11-65	28.6	8-65

^a N=17; ^b N=44

	Monterey (N=11)		Ventura (N=18)		San Pedro (N=16)		Overall (N=45)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Aluminum					1	6.3	1	2.2
Fiberglass	2	18.2	8	44.4	2	12.5	12	26.7
Plastic			1	5.6			1	2.2
Steel	8	72.7	7	38.9	7	43.7	22	46.9
Wood	1	9.1	2	11.1	6	37.5	9	20.0

	Monterey (N=8)		Ventura (N=13)		San Pedro (N=12)		Overall (N=33)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Squid boat capacity	55.7	40-80	63.6	50-75	64.6	20-130	62.0	20-130
Market value of vessel (\$)	528,750	250,000-1,000,000	717,308	150,000-1,800,000	529,091 ^c	125,000-850,000 ^c	605,469 ^e	125,000-1,800,000 ^e
Replacement value of vessel (\$)	726,250	350,000-1,200,000	1,054,167 ^b	500,000-2,100,000 ^b	1,035,000 ^d	250,000-2,000,000 ^d	960,333 ^e	250,000-2,100,000 ^e
Operating expenses (\$, 1998 or 1999)	82,365 ^a	31,776-152,660 ^a	103,367	7,236-242,800	99,875	20,000-279,000	97,463 ^f	7,236-279,000 ^f
Crew size	4.7	3-7	3.5	3-5	5.5	3-8	4.5	3-8

^a N=7; ^b N=12; ^c N=11; ^d N=10; ^e N=30; ^f N=32

	Monterey (N=9)		Ventura (N=12)		San Pedro (N=8)		Overall (N=29)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Replacement value of vessel (\$)	751,111	350,000-1,000,000	714,583	75,000-1,500,000	906,250	500,000-2,000,000	778,793	75,000-2,000,000
Operating expenses (\$, 1999)	94,373 ^a	34,376-194,500 ^a	126,178	23,960-305,000	225,381	50,000-450,000	145,434 ^b	23,960-450,000 ^b
Crew size	4.6	3-7	4.1	3-7	6.9	3-9	5	3-9

^a N = 8; ^b N=28

Table 6. Characteristics of surveyed wetfish skippers in 2000, by fleet and overall. (SG+CI)

	Monterey (N=11)		Ventura (N=20)		San Pedro (N=16)		Overall (N=47)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Age	36.0	25-44	44.4 ^a	30-60 ^a	49.8	33-67	44.26 ^b	25-67 ^b
Years schooling	11.8	8-16	13.2	8-17	9.7	0-14	11.7	0-17
Years commercial fishing	20.0	9-25	25.0	15-41	35.6	18-59	27.5	9-59

^aN=19; ^bN=46

Table 7. State of residence of surveyed wetfish skippers, by fleet and overall. (SG+CI)

	Monterey (N=11)		Ventura (N=20)		San Pedro (N=16)		Overall (N=47)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
California	11	100	9	45	13	81.2	33	70.2
Washington			10	50	3	18.8	13	27.7
Alaska			1	5			1	2.1

Table 8. Home port of wetfish skippers, by fleet and overall. (SG+CI)

	Monterey (N=11)		Ventura (N=20)		San Pedro (N=16)		Overall (N=47)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Half Moon Bay	1	9.1					1	2.1
Monterey	10	90.9					10	21.3
Ventura			7	35			7	14.9
Channel Islands Harbor			2	10			2	4.3
San Pedro					15	93.7	15	31.9
San Diego			2	10			2	4.3
Washington			6	30	1	6.3	7	14.9
Alaska			3	15			3	6.4

Table 9. Respondents' annual round of fisheries, by fleet and overall. (SG+CI)

	Monterey (N=11)		Ventura (N=20)		San Pedro (N=16)		Overall (N=47)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Wetfish	10	90.9	11	55	16	100	37	78.7
Squid	11	100	20	100	16	100	47	100
Coastal tunas	1	9.1	3	27.3	14	87.5	18	38.4
SF Bay herring	11	100	4	36.4	4	25	19	51.0
Other CA fisheries	1	9.1	-	-	-	-	1	2.1
AK fisheries	11	100	16	80	6	37.5	33	70.2

Disclaimer

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