

CHAPTER 22

Subsistence, Commercial, and Recreational Fisheries

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Introduction

The marine fisheries of California extend back thousands of years and encompass many dozens of species. This chapter describes the broad trends in these fisheries from the time of the first aboriginal fishermen to the present day. We can only paint with a broad brush and we will leave the mass of catch statistics and other detailed analyses for such technical works as Leet et al. (2001).

It is important to note that over the years landings in both the recreational and commercial fisheries have been quite volatile. As noted by Thomson (2001), "Landings tend to increase with stock abundance, as fish are easier and less costly to locate and harvest when they are at higher levels of abundance. The availability of some species on local fishing grounds may vary across seasons or years, depending on ocean temperature and environmental factors. Weather conditions and economic circumstances (market demand and prices) may discourage or encourage fishing activity. Fishing behavior is also affected by regulatory restrictions."

Along with overfishing, which has occurred on many occasions in California's history, perhaps the most important factor determining fish abundances is the cycle of alternating warm and cold ocean temperature regimes that occur off the coast. The warm phase brings with it large numbers of warm-temperate or even tropical species, such as Pacific sardines, Pacific mackerel, Pacific barracuda, yellowtail, and white seabass. During this phase, many of these fishes are found further north than during colder periods. For instance, during a warm water period in the eighteenth century, fishermen in San Francisco Bay caught large numbers of white seabass; while Pacific barracuda were very common in the Monterey Bay catch. These species are rare north of southern California during cold-water periods. Colder water periods appear to be marked by increased reproductive success of many species of rockfishes, lingcod, and other temperate forms (MacCall, 1996).

Subsistence Fishing

Humans have lived along much of the California coast for 10,000 years and there is evidence that some occupation

occurred during the late Pleistocene, at least 12,000 years before the present (BP) (Erlandson et al., 1996; Rick, 1999). Many of these early subsistence communities utilized an extremely wide range of marine and terrestrial animals and plants. And while these earliest settlers captured fishes as part of their diet, shellfish were usually more important (Erlandson, 1991, 1994; Warren, 1968). However, it is clear that there was a great deal of variability in the food habits of the first California residents. For instance, fishes contributed 50–65% (edible meat) to the diets of the inhabitants of Daisy Cave, San Miguel Island, a site dated to at least 12,000 BP (Rick, 1999).

Fish species central to the diets of coastal peoples varied with location. Most often, fishermen focussed on whatever species were abundant and readily captured with existing technology. Native Americans living on the open coast of northern and central California concentrated on intertidal and nearshore rocky reef fishes and shellfishes, primarily rockfishes, lingcod, cabezon, kelp greenling, and monkeyface eels, as Native Americans living on these wave-swept coasts did not fish far from shore. Various surfperches and such schooling nearshore species as Pacific herring were also locally important (Gobalet and Jones, 1995; Schwaderer, 1992). Inhabitants of relatively sheltered areas, such as Morro Bay and Elkhorn Slough, concentrated on small schooling species, such as Pacific herring, Pacific sardine, northern anchovy, starry flounder, and various silversides (Gobalet and Jones, 1995). Those peoples living inside San Francisco Bay caught large numbers of sturgeon and salmon, as well as a wide range of other bay and estuarine fishes (Gobalet, 1990, 1994). At least one researcher believes that the first evidence for overfishing in California comes from the middens of the peoples living around San Francisco Bay. In these kitchen waste disposal sites once-abundant sturgeon remains were later replaced by sharks and bat rays (Broughton, 1997).

Wave height becomes smaller south of Point Conception, as the coastline becomes south facing and the northern Channel Islands shelter the mainland. In response, the inhabitants of the southern California Bight utilized watercraft to a much greater extent than did those peoples living further north. A number of the Channel Islands were well occupied and

there was a very active trade between the mainland and the islands. However, as with groups further north, nearshore fishes predominated in the catches of the southern California peoples. Over reefs, sheephead were particularly important, as were rockfishes, kelp bass, cabezon, lingcod, and surfperches. Sardines, grunion, white croaker, California halibut, leopard sharks, shovelnose guitarfish, and bat rays were among the most common species captured from sandy areas. Quasi-pelagic or highly migratory species, such as bonito, barracuda, Pacific mackerel, and yellowtail were also commonly taken. Large pelagic species such as albacore, yellowfin and bluefin tunas and swordfish, are rarely found in the middens of these peoples (Salls, 1988, 1989; Rick, 1999).

The earliest California inhabitants fished with gorges (objects, such as a piece of bone attached in the middle of a line, that were easy to swallow but difficult to eject), spears and perhaps primitive nets. However, several technological advances led to greater use of fishes by these peoples. As early as 3,300 BP, shell hooks (made from abalone, mussels, and other invertebrates) were developed and eventually these became truly elegant circle hooks, complete with barbs and flanges for line attachment (Raab et al., 1995; Strudwick, 1986). The use of hooks often led to major increases in fishing effort (Glassow, 1993; Erlandson, 1994; Raab et al., 1995; Rick, 1999). By about 1,500 BP, relatively seaworthy plank canoes were in use in southern California and this greatly expanded the range and location of fishing activities (Arnold, 1995).

In general, the importance of fishes to the diets of coastal peoples increased with time. It is likely that a major factor driving this trend was an increase in population that lead to decreases in the availability of shellfish and other resources. This was coupled with the development of new fishing technologies that increased the ability of native peoples to catch fishes. In particular, around 1,000 BP the density of fish bones in middens, particularly those on the Channel Islands, increased exponentially. This massive increase in fishing appears to have occurred during a relatively cold and dry period, when ocean productivity was high and terrestrial resources scarce (Kennett and Kennett, 2000). In many locations, fishes became the most important source of protein. Fishes were often transported well away from the coast, at least as far as 50 miles inland (Gobalet, 1992).

By the Spanish Period, the Chumash along the Santa Barbara Channel and the peoples on the southern California Channel Islands intensively fished nearshore waters. Fishing was also important to groups to the north and south, although they had more mixed economies. In 1770, Miguel Costanso, a member of the Portola expedition to California, wrote of the Chumash, "They know all the arts of fishing and fish abound along their coast" (King, 1990). Indeed, many of the explorers of that time commented on the importance that fishes played in diets of California coastal Native Americans and on the many ways that fishes were captured. These included sophisticated hooks and line, harpoons, various types of nets and relatively seaworthy vessels. All of these allowed for the catch of a very wide range of fish species, although nearshore fishes (found in kelp beds and over shallow reefs and in calmer sandy and muddy areas) predominated.

Tragically, the convulsive effects of the Spanish and later Mexican occupation of California, particularly the removal of Native Americans to missions, destroyed this civilization and its way of life.

Commercial Fishing

While both the federal and state governments took some interest in commercial fisheries as early as 1872, monthly reports by wholesale dealers to the state did not begin until 1911 and were not universal until 1917. Until the 1920s, most fishing trips lasted only one day and the landing data from a port fairly accurately reflected the general location of each catch. By the 1920s, local depletion of fishery resources caused fishermen to build larger vessels capable of carrying ice and this allowed for trips to distant fishing grounds. In response, the Department of Fish and Game adopted a system of numbered blocks throughout California marine waters in 1933, each 20 miles on a side, in order to more precisely record the locality of each catch (Scofield, 1954). This block system is still in use today. It should be noted that fishermen are responsible for declaring the location (block) of their catches and it has long been clear that, to protect their favorite fishing locations, fishermen may give misleading block information regarding catch locations.

1850 to 1899

It is not clear when commercial fishing began in California. Certainly, early explorers bartered for fishes with Native American fishermen (Menzies, 1924). However, we know very little about California fisheries in the period between the fall of the missions (about 1834) and the Gold Rush. During this period, California was very sparsely populated and most fishing was probably for subsistence by surviving Native Americans and the local Californios (those inhabitants of Spanish and Mexican heritage).

The beginnings of commercial fishing occurred with the first flood of immigrants just prior to and during the Gold Rush. Gold was discovered in 1848 and within 2 years, tens of thousands of gold seekers had made their way to San Francisco. While many of these immigrants left for the gold fields, thousands of other stayed and worked in the city, making it by far the largest settlement in California. Indeed, until the late nineteenth century, San Francisco, and to a much lesser extent Monterey and San Diego, were the only coastal population centers and almost all commercial fisheries centered on these three ports. By 1880, San Francisco handled more fishes than all the other ports combined from San Diego to Puget Sound (Scofield, 1954). In 1892, the Bay area accounted for 93% of California's commercial fishery products (Skinner, 1962).

What was the San Francisco commercial fishery like in those early years? The first full-time commercial fishermen were a group of Italians who came to San Francisco in 1848. Fishing out of lateens, small sail boats, they fished for salmon, sturgeon, various flatfishes, silversides, smelts, Pacific herring, and rockfishes using beach seines, hand or set lines (called trawl lines), and gill nets. Virtually all fishing was conducted in the Bay, just outside the Golden Gate and in the Sacramento River (Scofield, 1954).

By the 1880s, there had been a marked increase in the region's fisheries. Vessels routinely fished throughout San Francisco Bay, along the coast from Pt. Reyes to Half Moon Bay and, during calm winter days and throughout the summer, at the Farallon Islands. In addition, fishes were shipped by rail to San Francisco from as far away as Humboldt Bay on the north and San Diego Bay on the south (Jordan, 1887, 1892).

The first major technological advance in these marine fisheries was the introduction of the *paranzella* net, a form of bottom trawl developed in Europe. The *paranzella* was shaped somewhat like a sock, with a line attached to each side of the net opening. It was towed by two vessels sailing a parallel course and was, compared to set lines, gill nets and beach seines, an efficient means of catching large numbers of fishes, particularly soles and flounders, living on muddy or sandy bottom. In 1876, a group of San Francisco fishermen secretly built and experimented with this net and it proved to be extremely cost-effective. Almost immediately, this flood of fish caused wholesale prices to plummet. By 1880, with the San Francisco fishing fleet numbering 85, the 6 *paranzella* vessels landed a greater volume of fish than all the other vessels combined. A further advancement in efficiency occurred in the mid-1880s, when steam powered fishing vessels replaced sailing ones in the trawl fisheries (Jordan, 1887; Scofield, 1948).

The *paranzella* fishery was one of the first to come under fire for its perceived destructive nature. Competing fishermen did not like it and members of a nascent conservation movement feared it. It was believed that large numbers of fishes were discarded, dead at sea and that very large catches often went to waste for lack of buyers even when landed. In a statement that eerily resonates today, Jordan (1887) pointed out that, "The drag-nets destroy and waste immense quantities of fish, doubtless amounting to several hundred tons per year. Comparatively few of these, however, are immature fish, and the greater part is composed of species unmarketable, either through small size or repulsive appearance. The reason that the other fishermen are so bitterly opposed to the use of these nets is that, by means of them, a few men can bring such quantities of fish to market as greatly to reduce the price . . . Although considered as a temporary method, these nets do but little harm and have as yet probably not materially decreased the amount of fish in the vicinity of San Francisco, there is no doubt that, if continued long enough, they will do so. It is certainly the most wasteful method of fishing I know. The use of such nets should be discontinued altogether, or the nets required to be of such coarse mesh as to allow the small fish to pass through."

While most fishes taken in the San Francisco fishery were sold fresh, a substantial quantity was dried, salted, smoked, or occasionally pickled. However, because fishes were not iced after capture, even during two or three day fishing trips, and because they were mishandled after landing, the quality of "fresh" fish was often poor. Jordan (1892) described the results: "For the market of San Francisco is the poorest to be found in any large seaport in the country . . . We find that in San Francisco the fishes are brought in either from the wharves or express offices in boxes; that they are exposed to open stalls to the dust of the street, or even to the rays of the sun; that before noon a large share of the fishes are rotten; that the fresh fish of one day are mixed with the rotten fishes of the preceding day. In the stalls in Clay Street we can find at any time plenty of fishes whose scales have been dried by the rays of the sun, and whose viscera are swollen by the gas produced by the decay of the contents of the stomachs or of the internal organs themselves."

During the 1870s, the commercial fisheries of Monterey Bay were also on the increase, although they were much smaller than those of San Francisco. Salmon, flatfishes, rockfishes, cabezon, and silversides dominated the catch. Interestingly, barracuda and white seabass were also important, probably evidence of relatively warm ocean waters during that time.

Fishes were taken in the same manner as at San Francisco, except that *paranzella* nets were not used. Much of the catch was shipped to San Francisco, initially by stage to Salinas and then by rail, and later directly by rail from Monterey. By 1879, 200–800 pounds of fish per day were sent to San Francisco from Monterey. The fishery in San Diego occurred primarily in the bay, where beach seiners concentrated on silversides and flatfishes. There was also a small hook and line fishery on the open coast and these fishermen targeted sheephead, Pacific barracuda, and Pacific bonito. Most fishes were sold fresh or were dried and some were exported to Asia.

Of supreme importance for the next century, canneries had begun to pack sardines in both San Francisco and San Pedro. The first fish cannery on the West Coast was built in 1864. It was located near Sacramento and canned chinook salmon caught in the Sacramento River. Canned salmon found a ready domestic market and, in the 1860s, was even exported to Australia. In 1889, the Golden Gate Packing Company built the first cannery on the Pacific Coast devoted solely to marine fishes. It packed anchovies and sardines caught by beach seine in the bay. Due to only sporadic availability of these fishes, the cannery was not a financial success and, in 1893, the cannery moved to San Pedro, in southern California. Here a gasoline-powered vessel using a purse seine, thought to be the first use of this net in California, caught anchovies and Pacific mackerel for the packing house (Smith, 1895; Fry, 1931; Scofield, 1951).

Who were these early California fishermen? Virtually all were immigrants. Some of the first were Italian and Portuguese seaman who jumped ship for the Gold Country, then came back to San Francisco to fish. By 1854, Chinese fishermen were encamped in the Bay on the eastern shore of the San Francisco Peninsula, a spot that was to be theirs for decades. About the same time, large numbers of northern Italians, from Genoa and other ports, arrived and set up shop in North Beach. Smaller numbers of Greeks, Slavs and Spaniards also began to arrive. Harsh conditions in Sicily during the 1870s caused many to leave and join the fishing community, although perhaps communities would be the more proper term. Immigrant groups tended to live apart from one another, often plying specific niche fisheries. In San Francisco, for instance, many Chinese concentrated on shrimp, sturgeon and small fishes in the Bay, drying the seafood on the beaches and exporting it to China. Meanwhile, Europeans tended to emphasize flatfishes, salmon, and rockfishes, both inside and outside the Bay. While early fishermen made a good living at the trade, the rise of *paranzallas* depressed wages and many lived a marginal existence (Jordan, 1887, 1892; Scofield, 1954; Weaver, 1892).

At the end of the nineteenth century, fisheries along the California coast were rapidly expanding. In particular, the influx of immigrants to southern California created new markets for fishery products and both San Pedro and San Diego began to be important ports. Salmon (almost all chinook), much of it taken in rivers but increasingly caught in the ocean, was by far the most valuable fishery. Of the strictly marine and estuarine species, flatfishes (particularly English and petrale sole, starry flounder and California halibut), sardines, Pacific herring, striped bass, rockfishes, Pacific barracuda, kelp and sand bass, and white seabass were most important (Wilcox, 1902). Most fishes were sold fresh locally. However, efficient rail service and the advent of inexpensive freezing and icing facilities began to make it possible to ship fresh and fresh-frozen fish from California throughout the United States and even to Europe. Dried and salted fishes of

many types, but particularly tuna, Pacific barracuda, rockfishes, yellowtail, and the fins of various sharks were also very valuable. Much of this catch was shipped overseas to Asia (Weaver, 1892; Wilcox, 1902; Scofield, 1954; T. Thomas, pers. comm.).

By the turn of the century, gill and trammel nets were by far the most commonly used fishing technique, but hook and line (particularly for rockfishes and kelp bed species), paranzella trawls and beach seines were also in common use. Commercial trolling for salmon was just becoming important. Most commercial fishing vessels were wind powered, but steam and gasoline engines were becoming more common in the fleets (Scofield, 1954; Ueber, 1988).

1900 to 1950

The marine fisheries of California experienced rapid growth early in the twentieth century. Within 25 years, led by sardines and tunas, a combination of events dramatically altered a rather sleepy industry into an industrialized giant.

The population boom experienced throughout the state, primarily in southern California, helped drive an expanded market for fishes. Between 1900 and 1920, the population of Los Angeles alone went from 170,000 to almost one million and the state grew from 1,500,000 to 3,500,000. In addition, relatively inexpensive energy from newly developed California oil and gas fields made the creation of canneries and reduction plants more economical.

As early as 1895, the first gasoline engines were used in San Francisco fishing vessels and by 1899 33 of 82 of these boats were motorized. By 1915, most of the fishing vessels on the California coast were gasoline powered. Trolling with gasoline engines was far more efficient than with sails and trawlers, too, quickly took to the new engines (Scofield, 1956). The increased demand for fish and depletion of local stocks created a need for larger vessels that could carry larger loads and work fishing grounds further from port and improved vessel designs filled this need. At the same time, continuing improvement in transportation allowed fish to be shipped much more inexpensively. As an example, an edition of *Pacific Fishermen* from 1914 notes that an experimental load of 40,000 pounds of albacore were shipped to Chicago and that frozen fish were being shipped to Australia and New Zealand.

The early part of the century also saw the creation of inexpensive ice production, paving the way for multi-day fishing trips that allowed vessels to fish on more distant grounds. It should be noted that well into mid-century ice was not used for many short trips. As an example, Scofield (1947) stated that the rockfish fishermen in Monterey Bay usually made single day runs and that "None of the boats carried ice and all fish were delivered in the round with no cleaning at sea." Parenthetically, some salmon trollers still do not use ice but they do clean the fish at sea.

The first world war had a profound effect on California's fisheries. Before the war, a few canneries had begun a modest business, packing Pacific sardines, albacore, and other species. When the war halted the North Sea sardine fishery, the California canneries quickly filled the gap, with sardine catches skyrocketing from about 2,000 metric tons in 1915 to 71,000 metric tons in 1918. And while there had been a handful of canneries in California in 1910, by 1919 there were 44. Moreover, after the U.S. entered the war there was a great push to increase fisheries for domestic consumption. Under the

auspices of the Federal Food Administration, Bureau of Fisheries and other agencies and spearheaded by the rather blunt slogan "Eat More Fish," seafood consumption rapidly increased, peaking in 1918. Several studies were conducted on which species were underutilized and how fish handling and storage could be improved (Starks, 1918a, b). In addition, in the effort to increase landings, a number of fishing regulations were temporarily relaxed. These included allowing the catch and sale of corbina, yellowfin and spotfin croakers, species formerly restricted to recreational anglers, and the catch of small and formerly undersized, California halibut (Anon., 1918a, b; Cobb, 1918).

THE CANNERY AND REDUCTION FISHERIES

Historically, many California fish species, including rockfishes, California halibut, and barracuda have been canned and/or reduced for fishmeal and oil.¹ However, Pacific sardines and the tunas (albacore, yellowfin, bluefin, skipjack, and Pacific bonito) and to a lesser extent jack mackerel, northern anchovy, Pacific herring, and Pacific mackerel were most important. While all of these species, particularly the tunas, also found a place in fresh fish markets, the vast majority of the catch was purchased by the odiferous plants that lined the wharves of San Francisco, Monterey Bay, Los Angeles-Long Beach Harbor and San Diego. Historically, *pelagic wetfish* also referred to all of these species, except for the tunas. Pelagic wetfish are packed in cans in a raw state and then cooked, hence the name wetfish. Tunas are first cooked and then packed in the can.

While preserving fishes by smoking, salting and drying remained a common practice well into the mid-twentieth century, ultimately the canning and reduction industries were the driving forces behind California's two largest fishing industries, those for Pacific sardine and the tunas. During the early part of the twentieth century, the development of canneries and reduction plants had the greatest single effect on California fisheries and it is arguable that several coastal communities would hardly exist but for those fishes.

Pacific Sardine

Pacific sardines have been a part of California fisheries since prehistoric times. It was only with the rise of the fish canning industry that the fishery took on its overwhelming importance (figs. 22.1a-c). For more than three decades, ending in the late 1940s, the sardine catch dominated the California fishery, exceeding the combined catch of all other fishes. Indeed, for a number of years the fishery was the world's largest. And the crash, when it came, had devastating and lasting effects on the fisheries of California. It is instructive, and hopefully salutary, to discuss in some detail the meteoric rise and dismal fall of that fishery.

The Golden Gate Packing Company of San Francisco was the first sardine cannery on the Pacific Coast, producing canned sardines from 1890 through 1892. But the experiment did not succeed and in the late nineteenth century the machinery was shipped to San Pedro where sardines were

¹I have divided commercial fisheries into two broad categories, *cannery and reduction* and *market*, using the designations first coined in the early twentieth century by the California Division (later Department) of Fish and Game. While other terms have some currency, such as *finfish* for some of the species sold fresh or frozen, I believe these older terms most accurately capture the original use of the various species.



FIGURE 22-1 The Pacific sardine fishery off Monterey. (a) Setting lampara net. Photo credit: Maritime Museum of Monterey. (b) Brailing sardines from purse seine onto fishing vessel. Photo credit: Maritime Museum of Monterey. (c) Sardine-laden vessels tied up to cannery dock. Photo credit: Maritime Museum of Monterey.

more consistently abundant. Fishermen first caught these fish using primitive purse seines that were heavy and required large crews to deploy and retrieve. High costs and relatively low catches ensured that these first efforts were not successful and canners soon switched to tuna, canning only small quantities of sardines during the off-season (Thompson, 1921a).

Sardine canning did not begin its wild ride until F.E. Booth erected a small shed in Monterey and packed a small amount in 1902. Sardines in the first few years were dried in the sun, placed in cans with hand solder lids and then cooked. For the first few years, because of market preferences, Mr. Booth labeled his cans of larger fish "mackerel" until the federal government requested a move toward veracity. These first fish were taken by gill nets and later by the still inefficient purse seine. In 1905, one of Booth's fishermen, Pietro Ferrante, suggested using a Mediterranean encircling net called the lampara. Based on Ferrante's recommendation, in 1905 Booth purchased one from Tangiers, Morocco; this was the first lampara in the United States. Compared to purse seines, lamparas were lighter and could be pulled in by fewer crew members on smaller vessels in a shorter time. The new net was a quick success and it is clear that while the canneries created the sardine industry, the lampara allowed it to flourish. After 1905, sardine fishing in Monterey greatly improved, due to the introduction of this more efficient technology and the evolution of a greater understanding of the behavior of sardines (Scofield, 1951). Southern California fishermen quickly picked up the lampara and for a number of years it was the primary method for catching sardines.

Though a lucrative fishery nearly from its inception, World War I, with its high demands for canned sardines, brought with it a large surge in catches that eventually topped 150,000,000 pounds in 1918. "The sardine industry in California is . . . essentially a product of the great war" (Thompson, 1921a). Although thought to be a remarkable amount at the time, the catch actually more than doubled every six years thereafter, reaching its peak at a billion and a half pounds in 1936. While some of this remarkable expansion was due to a growing demand (both domestic and foreign) for inexpensive canned sardines, far more important were the profits to be made from reducing sardines to oil and meal. In the California fish canning industry, reduction began in 1913 as a way to market the offal from the sardine canneries (Anon., 1914). In the reduction process, waste body parts, such as heads, but also spoiled fish were converted to oil and fishmeal. Sardine oil, in particular, found a ready market in the paint and soap industry, while the fish meal was immediately accepted as chicken feed by the farming community. Within a few years, it was clear to cannery owners that the profit margin for reduced sardines was much higher than that for fish in cans (Scofield, 1938). In fact, for most of this fishery's life, sardine reduction drove the industry. So profitable was reduction that in the 1920s, when the California Division of Fish and Game prohibited reducing whole sardines, processors responded by placing only a small portion of each fish in a can and reducing most of the animal. As Clark (1949) noted, "As a result canning practically became a by-product of the reduction process."

Suspensions and uneasiness regarding the reduction industry had culminated in the State Reduction Act of 1919, prohibiting the use of fish for reduction without written permission from the California Division of Fish and Game (Hughes, 1949). Nonetheless, throughout the 1920s and 1930s, there was continuous pressure to increase the allowable take for reduction purposes. Representatives of that industry approached the California legislature year after year and generally received what they wanted. This occurred despite a clear, and ever-louder, series of warnings from biologists of the Division of Fish and Game. Very early in the fishery, scientists were clearly uneasy about the state of the sardine stocks. Commenting in 1921 on the lack of basic biological knowledge on the species and on the great population fluctuations that had occurred in the Atlantic sardine fisheries, DFG biologist W.F. Thompson (1921b) wrote, "So the most ordinary business sense dictates an energetic inquiry into the probability that such great changes will occur in California, and into the chance of foreseeing them." By 1922, Thompson went further in discussing a number of California fisheries, particularly for sardines, when he stated "If trouble were afar, and it were possible safely to say, 'Let us overcome that problem when we get to it', this report would not carry much weight for the ordinary man. But there is every reason to believe that the problem is near at hand. Our fishery has advanced farther than we have perhaps dreamed . . . they have perhaps gone too far." By the late 1920s, major sardine biologists at DFG were openly convinced that there was good evidence of sardine depletion. "Although the total catch was still rising, it was not doing so in proportion to the expansion in fishing effort. The average age of fish in the catch had declined from ten years to six years. Individual boats were travelling farther from port and spending more time on the water to make their catches. All were classic signs of overfishing; Scofield [N. B.] and Frances Clark recommended an annual limit on the catch between 200,000 and 300,000 tons" (McEvoy, 1986). However, throughout the life of the fishery, and even at its downfall, many in the industry as well as in the legislature clearly believed with Knut Hovden (a major Monterey canner) that "It is absurd for anyone who really knows the facts to say that you can deplete the supply of sardines in the Pacific Ocean." (Enea, 2000).

The greater demand for sardines meant that vessels had to be larger in order for new fishing grounds further from port to be opened up and to allow greater catches to be retained. This signaled the return of the purse seine, always able to catch many more fish than a lampara net and now power (rather than hand) pulled. By 1930, purse seines were again well established in the fishery and by 1940 lampara nets had all but disappeared from the commercial sardine industry (although still used in the lucrative squid fishery).

In the 1930–1931 seasons, a new factor was introduced into the mix as floating offshore reduction plants, anchored in federal waters outside state control, began processing sardines into fishmeal and oil. This privately-owned floater was followed in the 1931–1932 season by one owned by a fishermen's cooperative, an attempt to free themselves of what they considered to be intolerable financial control by cannery. Everyone in the business, including those who both reduced and canned, and those who only reduced, lobbied for a continuation and, in fact, an increase in sardine quotas. While arguments were often made in terms of resource conservation, ultimately the arguments were over who should do the reduction. Although, as Davis (2000) notes, "there were likely some owners of small canneries whose profits did not rely on fish-

meal production and were seriously concerned about conservation." As the reduction fishery grew and particularly as the Depression took hold, the economics of the industry were too powerful for any regulatory body to withstand.

In the mid-1930s, bills were submitted to the U.S. Congress to prohibit offshore reduction and in 1936 congressional hearings were held. Fish and Game biologists repeated in strong terms their consensus that sardines were being overfished and catches had to be reduced. However, their testimony was undermined by U.S. Bureau of Fisheries spokesman Elmer Higgins when he testified that there was "no clear-cut or convincing evidence that will satisfy everyone that the sardine supply is in danger of being seriously depleted." And he went on to state that "We believe very firmly that restrictions which are unnecessary hamper or restrict legitimate business enterprise." A colleague added that "to us, conservation means wise use. We do not believe in hoarding our fishery resources, but, rather, believe they should be prosecuted to a degree compatible with the abundance of the species" (McEvoy, 1986).

During these same hearings, the sardine industry was divided on ending the offshore reduction industry. Some cannery and shoreside reducers favored the bill and, naturally, the offshore industry opposed it. In testimony that now simply resonates with the irony of subsequent events, William Denman testified that those opposed to the huge offshore reduction represented a conspiracy of cannery, DFG scientists and recreational anglers. He claimed that sardines reproduced so heavily that any depression of the population would be temporary at most. And, in a statement that modern fishery managers can relate to, he said that for scientists to ignore the beliefs of commercial fishermen, who felt that sardines were abundant, was "the most brutal kind of medieval scholasticism" (McEvoy, 1986). Ultimately, no action was taken.

By the late 1930s, Fish and Game biologists were extremely frustrated. An extraordinary article, published anonymously but possibly by Frances Clark, one of the great sardine experts of the twentieth century, says it best when it discusses the unequal battle that Fish and Game scientists waged with commercial fishermen, cannery, reducers, their lawyers and the state legislature. Referring to those who made money from the sardine industry, Anon. (1938) writes, "People will go to absurd lengths to defend a premise which they have endorsed after accepted facts and even their own common sense have proved that it is false. . . . Having presented the results of his labors the biologist can not defend them. He must remain in the background as a spectator while lawyers, business men and others question his disinterest, deliberately misinterpret plain statements and befog simple issues with soaring flights of oratory, which admittedly are sometimes much more effective in gaining the end sought than detailed facts and cold logic."

Until the early 1940s, the Fish and Game Commission, ostensibly a guardian of the sardine continued to push for catch reductions while both state and federal legislators caved in to the sardine industries' demands for higher quotas. In their 1938 report, they note the "unmistakable signs of depletion in the sardine population" and the "imperative need to reduce the harvest." In 1939 the governor of California replaced all of the members of the Commission and even this token resistance disappeared, as the 1942 report concluded that there was "no reason to be concerned over the possibility of the extermination of the sardine by the fishermen" just "a possibility that if the fishery is carried on too intensively, the population will decline to a point where the success of a fishing season will depend upon the chance occurrence of an

abundant year-class" (McEvoy, 1986). Thus, the way was clear for whatever was about to happen.

Even during this period of immense catches Parrish (2000) notes that the fishery was probably only slightly overfished. The period from the mid-1920s to the mid-1940s saw relatively warm ocean conditions along the Pacific Coast; conditions conducive to successful sardine spawning and the sardine populations were relatively large. Parrish makes the case that the downfall of the fishery ultimately has its roots in World War II and a shift to colder ocean conditions beginning in the mid-1940s. As he notes, "In the late 1930s a small group of heroic fishery biologists from the California Department of Fish and Game. . . was approaching the point where I believe they would have convinced the California Legislature that a 250,000 ton quota should be adopted. I use the term heroic in the old fashioned sense, denoting those who continue to fight even though they have lost every battle they have ever been in."

During World War II, the federal government took over the regulation of the sardine industry and, with the intent of maximizing the amount of canned sardines, ignored the 250,000-ton proposal. By the time the California Legislature regained control, and fisheries biologists could inventory the stock, the damage was done. The late 1940s saw the end of the Monterey fishery and the early 1950s saw the demise of the southern California sardine stock. Parrish (2000) notes that overfishing was actually most intense in the late 1950s and early 1960s, long after the sardine had essentially disappeared from central California and when the last remnants of the southern California stock were decimated. Parrish sums up this phase of the sardine story thusly, "The short of it is that the collapse occurred in slow motion and a lot of things went wrong for sardines over an extended period. The primary ingredients were overfishing, a long-term cooling in the California Current, WW II, El Niño and nobody home in the California Legislature."

Several decades of cold ocean water ended in 1976–1977 with the return of a warm water cycle. By the mid-1980s, sardines were once again back in California waters in some numbers. A small fishery was permitted in the late 1980s and it has continued throughout the 1990s. It is interesting to note that, as of 2001, ocean waters appear to be cooling and it remains to be seen what will become of the current relatively robust sardine population.

The Tunas

The canned tuna industry paralleled that of the sardine. In 1903, a lack of sardines forced the San Pedro packing plant of A. P. Halfhill to turn to albacore, California halibut, and rockfishes (Clemens and Craig, 1965, quoting Halfhill, 1951). Until then, albacore and other tunas were caught in low numbers either for the fresh fish market or were salted and dried. And albacore, in particular, fetched very low prices. While halibut and rockfish canning did not pan out, albacore proved to be extremely popular and by 1911 a new industry and fishery was born. During these early years, albacore were taken from small vessels manned by three fishermen. After fish were located by trolling, the vessel was brought to a stop and live sardines, anchovies or smelt were thrown over to attract the school. Early on, fish were caught on baited handlines, but this was soon discarded for bait or barless lures attached by short leaders to bamboo poles (Scofield, 1914). Catches less than one ton were considered poor and those of four to six tons were common.

Interestingly, despite an abundance of bluefin tuna, albacore was the only tuna canned in California for a number of

years. However, the increased demand for all fish during World War I led canners to experiment with yellowfin, bluefin, and skipjack tunas. In 1918, when adverse water conditions led to a low albacore catch, purse seiners began to target bluefin off California and later yellowfin and skipjack off Mexico. By 1927, the yellowfin and skipjack catch, made almost entirely off Baja California and Mexico, had surpassed albacore and bluefin landings and this pattern held true until the demise of most canneries in the late twentieth century. Beginning about 1930, larger vessels began to explore further south and by 1934 most fishing occurred off Central America, including the Galapagos Islands. Very little of the yellowfin and skipjack landed at the many canneries of San Diego and Terminal Island were caught inside state waters (Godsil, 1949).

The realities of the global market place eventually spelled the end of California tuna canning, as an industry consisting of almost 2,000 fishermen, as well as 6,000 additional cannery workers, boat builders and boatyard personnel, disappeared over a three year period. Bowing to economics, between 1982 and 1984 almost every cannery moved outside the U. S. for the greener pastures of Asia, Puerto Rico, and the South Pacific. Currently, most of the tuna caught in state waters are marketed to the fresh fish trade.

Other Pelagic Wetfish

Volatile best expresses the fisheries for Pacific mackerel, jack mackerel, Pacific herring, and northern anchovy during the first half of the twentieth century.

In some ways, the Pacific mackerel fishery mirrored that for Pacific sardine (Crocker, 1938). Both species are more abundant during warm water cycles and both were overfished to the point of collapse. Until 1927, the Pacific mackerel was a moderately important market fish as sporadic attempts to develop a canned product had been uniformly unsuccessful. In that year, a southern California canner succeeded where others had failed, producing canned mackerel that caught the public's fancy. The canner first tried marketing the mackerel in the Philippines, at the time a major consumer of sardines and pink salmon. To gain market share, "a ruse was resorted to in order to get the mackerel started. . . . Nearly all [cans] bore a picture of a salmon-like fish and the words 'salmon brand,' 'salmon style pack' were placed in a prominent position. Naturally the buyers thought they were getting a new kind of salmon at a real low price, so sales mounted rapidly" (Crocker, 1933). Pacific mackerel remained a major fishery throughout the first half of the twentieth century, ultimately crashing in the mid-1960s (Konno and Wolf, 1992).

Until 1947, jack mackerel were a very minor part of the California commercial fishery. It was sold fresh or, if canned, was exported. The collapse of the sardine fishery in the 1947–1948 season led fishermen to seek out and canners to purchase large quantities of, as it was called at the time, "horse mackerel." Clearly, this name would not appeal to domestic consumers and the California Division of Fish and Game proposed the name "jack mackerel" and this was made official in 1948.

Until the collapse of the Pacific sardine fishery, the northern anchovy formed a very minor commercial fishery. Except for the period 1916–1921, when reduction was permitted, much of the catch was preserved for bait. Beginning in the late 1940s, the catch drastically increased as canneries switched to the more abundant anchovy. With a relatively few years, catches declined as the market for canned product was small (Phillips, 1949; Jacobson, 1992).

During this period, Pacific herring catches mirrored those of northern anchovy. A large reduction fishery during World War I ended in 1921 with the State Reduction Act, prohibiting the use of fish for reduction purposes without written permission from the California Division of Fish and Game. Catches remained low for most of the rest of the period and most of the harvest was used for bait. As with northern anchovies and jack mackerel, catches surged in the late 1940s, as attempts were made to replace the declining sardine stock. Ultimately, herring proved to be a poor substitute and catches declined within a decade (Hughes, 1949; Spratt, 1992).

THE MARKET FISHERIES

Market fishes are those that are sold fresh or, starting in the mid-1940s, frozen or thawed after being frozen. In the California fisheries, this includes at least 60 species.

The fresh (and later frozen) fish preferences of Californians during the first half of the twentieth century were very similar to those of nineteenth century consumers. This very limited set of preferences, particularly when compared to citizens of most other countries, was noted by Starks (1918b) who lamented the small number of species that found favor in the California fish markets. As an example, Starks wondered why Pacific herring found such a poor reception in California, when European fishermen relentlessly pursued a very similar species and exported it to California in large quantity.

"The 1924 Commercial Catch of Fish in California" (Scofield, 1925), reported that the most popular market species were flatfishes (primarily English sole, petrale sole, Pacific sanddab, starry flounder, and California halibut), salmon, Pacific barracuda, rockfishes, and white seabass. In general, these were to be the perennial favorites for the first half of the twentieth century. Almost 25 years later (1947), sole (of the same species as noted above), salmon, rockfishes, Pacific barracuda, lingcod, California halibut, and white seabass were the most important market fishes (Bureau of Marine Fisheries, 1949). It should be noted that yellowtail were both marketed fresh and were also canned.

A number of species, particularly yellowtail, but also Pacific bonito, Pacific mackerel, and jack mackerel, enjoyed some popularity in fish markets, but most of the catch was canned. Canning of yellowtail was particularly large during years of high abundance and low wholesale price (Greenhood, 1949). And while there was always a market for many of the other species inhabiting California waters, such as surfperches, sablefish, sheephead, white croaker, smelts, silversides, cabezon, and even tunas and swordfish, they played a relatively minor role and, with the exception of tunas (including Pacific bonito) were most often a bycatch of other targeted fisheries.

Only one major market fish fishery began during this period. For decades, Dover sole had been a substantial part of the trawl catch, particularly in northern and central California. However, because Dover sole flesh is very soft, there was little demand for this species and almost all of the catch was discarded at sea. The rise of the balloon trawl fishery for rockfishes (see Fishing Techniques section) and the subsequent creation of the quick-frozen fillet industry opened the way for marketing this species, as it was discovered that freezing the fillets hardens the flesh. Dover sole catches rapidly expanded from 28 tons in 1943 to 3,600 tons in 1948.

Sharks, skates, and rays also comprised a minor fishery, symptomatic of a widespread prejudice on the part of many

Californians. A small market did exist for skates, taken as bycatch in many fisheries; these were purchased almost entirely by persons who had emigrated from Asia and Western Europe. There was also a substantial trade for shark fins, most of them were shipped to Asia. Shark meat, particularly from soupfin, shortfin mako, sevengill, and thresher sharks, was widely passed off as other species, as noted by Ripley (1949), "The fact that shark fillets are used for human consumption is unknown to the consuming public in many cases. Shark has been commonly substituted for other species of fish such as the California and Pacific halibut, white sea bass [sic], barracuda, sole, rockfish, etc. [sic] and even salmon. During the summer of 1944 the author observed soupfin shark fillets purvey in a Long Beach restaurant as white sea bass, California halibut, barracuda and salmon. Upon questioning, the owner of the establishment admitted that the fillets sold for salmon had been treated with food coloring to simulate the color of salmon tissue."

A brief, but intense, fishery for soupfin sharks and later spiny dogfish occurred in the late 1930s. In 1937, a new market for soupfin sharks suddenly developed with the discovery that their livers had unusually high levels of vitamin A. At that time vitamin A could not be synthesized, and, as the onset of World War II ended the traditional sources from North Atlantic fisheries, a shark liver gold rush ensued. Within two years, 600 vessels, from large Alaskan set liners to small local gillnetters, were working the California coast. Starting at about \$40 per ton, livers rose in value to \$2,000 per ton in 1941. Within a few years, the fishery had overfished the sharks and the vitamin industry began importing vitamin A fish oils from Mexico and South America (Ripley, 1946).

Fishing Techniques

Just as fish preferences did not appreciably change between the nineteenth and early twentieth centuries, fish harvesting methods also were very similar, although a number of technological improvements made them far more efficient.

In the nineteenth century, trolling was a minor part of the commercial fishery. Jordan (1887) noted that a small-scale troll fishery in southern California caught barracuda, yellowtail, Pacific bonito, and other surface-dwellers (fig. 22-2). Interestingly, during these years commercial fishermen did not know that salmon could be caught in the open ocean in large quantities and they focussed their attention in the major rivers and in San Francisco Bay. This was despite a very popular recreational troll fishery for king and silver salmon conducted each summer in Monterey Bay. This changed drastically in 1901, with the commercial development of 'mildcuring,' a process of salting and brining salmon that made it possible to store large quantities of fish. By 1904, there were 175 sailing vessels trolling for salmon in Monterey Bay. With the rise of dependable gasoline engines, trolling became a major part of the state's salmon fishing industry and by 1916 salmon trollers were found throughout northern and central California. By the early 1930s, two-thirds of the salmon catch was made in the ocean and most of the river fishery had disappeared. It was estimated that in 1947 more than 1,100 commercial vessels trolled for salmon (and over 5,000 by 1983). Early in the century, trolling also became a major factor in the albacore fishery. Although most of the fish were taken by barbless lures or bait attached by leaders to poles, the tuna were first located through trolling (Fry, 1949; Scofield, 1956).



FIGURE 22-2 A troller lands a Pacific barracuda. Photo credit: Ed Ries Collection.

The roundhaul nets, primarily lampara and purse seine, were widely used throughout the first half of the twentieth century. While they were virtually the sole technique for capturing Pacific sardines and northern anchovies, they were also very important in fisheries for other schooling species, such as the tunas, Pacific mackerel, jack mackerel, white croaker, and, until prohibited in 1941, California barracuda, yellowtail, and white seabass. Early purse seines were cumbersome to set and retrieve and required both a large vessel and crew. For this reason, for the first few decades of the new century, the smaller, but lighter and more user-friendly, lampara net was the net of choice. As larger vessels were built, as the demand for Pacific sardines, Pacific mackerel and other pelagic species increased and as net design improved, purse seines reclaimed most of these fisheries. By the end of the 1940s, lampara nets were used mainly to catch live bait for the recreational fishing industry and in the Monterey Bay squid fishery (Scofield, 1951).

Trawl fishing was a major fishing method throughout this period. From the 1870s until the 1930s, two-vessel paranzella nets supplied millions of pounds of flatfishes (primarily English, petrale and rex sole, Pacific sanddab, and California halibut), sablefish, various rockfishes, and lingcod to fish markets around the state. Until the late 1940s, most of the product was sold fresh, except for sablefish (also known as “black cod”) most of which were smoked. Probably the greatest change in fishing technology for market fishes, particularly for rockfishes, occurred in the late 1930s and early 1940s with the demise of the paranzella and the rise of the otter trawl. Rather than depending on two vessels to keep a net’s mouth open,

the otter trawl net is spread apart by wood or metal otter boards or doors, thus allowing one vessel to do the work of two. The mouths of otter trawls had a high vertical dimension and caught more of the fish that tended to rise above the net when disturbed. Between 1930 and 1940, otter trawls were adopted in large numbers off Washington and Oregon. Late in that decade, these fishermen began to move south, first to Eureka and then to San Francisco, bringing with them this more efficient technology. By 1943 paranzellas had disappeared from California waters.

It was, however, the development of a lighter and higher-riding otter trawl, the *balloon* trawl, which opened up new fisheries. As the name implies, rather than drag along the substrate, most of a balloon trawl rides up above the bottom, allowing it to be fished over low rocks. As a result, central and northern California rockfish catches, particularly of bocaccio and chilipepper, vastly increased (Scofield, 1948; Ripley, 1949). Balloon trawls were also responsible for the advent of the frozen fillet market on the Pacific Coast. When it was demonstrated that the trawl could provide large quantities of rockfishes at low prices, the U.S. Army placed substantial orders for their California bases. With the end of World War II, these orders ceased and fish processors scrambled to find new markets for their rockfish fillets, a need that directly led to the rise of the frozen fillet industry in California.

Multiple hook lines, often referred to as set, drift and hand lines, played a major role in the nineteenth and parts of the twentieth centuries, but ultimately their inherent inefficiencies drove them from most fisheries. Vertical lines often contained

a few dozen hooks and were either attached to the vessel or buoyed off. Setlines could stretch for many hundreds of feet and often had hundreds of hooks attached. Depending on the desired species, lines were either laid along the sea floor or in the water column. Rockfishes, California halibut, Pacific mackerel, sharks, and other market species were commonly caught by this method. Early in the development of California's fisheries, line fishing had a number of advantages. A single fisher, in a small vessel, with a low initial investment in line and hooks could enter many fisheries. Hook-and-line fisheries for rockfishes, lingcod, sablefish, Pacific mackerel, kelp and barred sand bass, sharks, and other species all flourished until about the 1940s (figs. 22-3a–c).

Line fishing was competitive with nets as long as fishes were plentiful and could be located close to ports. However, as stocks were depleted and net technology improved, multi-hook gear tended to become unprofitable and often was used only by the most marginal of fishermen. A major exception was in the rockfish and lingcod fisheries because hook and line gear could fish the high-relief rocky outcrops inaccessible to balloon trawls.

Throughout the first half of the twentieth century both gill and trammel nets were of major importance (fig. 22-4). This was particularly true in those parts of central and southern California where trawl nets were banned. While many species were taken, these nets were particularly important in the California halibut,



FIGURE 22-3 Before the more efficient balloon otter trawls and gill nets were introduced hook-and-line fishing was a major part of the California commercial fishery. These images are of rockfish fishing off Monterey in the 1930s. (a) Baiting hooks. Photo credit: Maritime Museum of Monterey. (b) Landing rockfishes. Photo credit: Maritime Museum of Monterey. (c) A boat full of bocaccio. Photo credit: Maritime Museum of Monterey.



FIGURE 22-4 Monofilament gill nets revolutionized several fisheries in the 1970s and 1980s. Here is a vermilion rockfish caught in a monofilament gill net off central California. Photo credit: Milton Love.

white seabass, rockfish, Pacific barracuda, kelp and sand bass, and shark fisheries (Holmberg, 1949; Ueber, 1988).

One other, rather specialized, technique was used to harvest fish; both swordfish and marlin were taken by harpoon. Vessels equipped with long bow planks sought out fish that were slowly swimming at the surface. Fishermen at the end of these planks thrust the harpoons, attached to strong lines and buoys, into the fish. When the fish had tired itself out, the buoy, line and fish was recovered. Swordfish were not a popular food until the 1930s, and then rapidly gained a large following. Commercial fishing for marlin was banned in 1937 (Greenhood and Carlisle, 1949).

Fishermen

The nationalities of California fishermen changed over time. Up through the 1930s, fishermen identifying themselves as born in the United States comprised less than half of the industry. And while dozens of countries were represented, persons born in Italy (including Sicily), Japan, and those from Slavic regions were most prevalent. Up until about 1940, nationalities tended to congregate around specific ports. Scandinavians were primarily found in northern California, Italian fishermen predominated in San Francisco and Monterey, while a majority of fishermen working out of Long Beach and San Pedro were Japanese.

By 1948, vast changes had occurred. As noted in Daugherty (1949), "The war [World War II] brought a number of changes. No Japanese, either United States or foreign born, was permitted to fish. Other foreign nationals were required to become naturalized citizens before they were eligible for a commercial fishing license. A number of the younger fishermen were drafted as the war continued. To replace these and to help fill

the increased demand for fish, many new fishermen appeared. Some were older men who had retired from fishing; some were young boys, particularly from fishermen's families, but many were men from eastern and Midwestern states who had had no previous contact with fishing." For whatever reasons, the ethnic composition of the 1949 commercial fishermen was very different from that of the past 100 years with the vast majority of fishermen identifying themselves as having been born in the United States. Italians, Yugoslavians, and Portuguese made up most of the others and there were no Japanese fishermen listed. By the early 1950s, a few Japanese fishermen had returned to the industry, but their numbers were never as large as before World War II.

By mid-century, a wide range of factors had substantially altered the commercial fisheries of California. Overfishing and an oceanographic regime shift had decimated the once thriving sardine fishery and purse seine fishermen were attempting to switch to Pacific mackerel, jack mackerel, Pacific herring, and northern anchovy. Many purse seine fishermen had given up on California fisheries and spent most of their fishing time pursuing tuna south of the U.S. border. Soupfin sharks had briefly provided a very lucrative fishery, but they too, had been overfished. The introduction of the balloon trawl had created a large rockfish fishery and increased catches had given rise to the frozen fish industry. This, in turn, had stimulated a new fishery for previously discarded Dover sole. Meanwhile, continued population growth in California was creating additional demand for traditional market fishes and, while a wide variety of species were taken, popular species had changed little from the previous century. Along with Pacific sardines and soupfin sharks, there was evidence that a number of other species, such as the California halibut, were showing the early effects of overfishing at least near major ports. Early in the century, most fishermen were neither citizens nor native-born. By mid-century, most fishermen were both. Compulsory relocation during World War II had decimated the once-thriving Japanese fishing community and, while some of these fishermen returned to fisheries after the war, most did not.

1951 to 2001

A commercial fisher of 1951, suddenly thrust forward to 2001, would have difficulty comprehending the changes that had occurred. New technologies, the rise of new fisheries and the declines of some older ones, a booming export market and a troubling import one, increased competition with recreational anglers and unprecedented regulations all had profoundly reshaped the industry.

A REVOLUTION IN TECHNOLOGY

If the first half of the twentieth century saw little change in the way fishermen pursued and caught fishes, the second half was marked by revolution, as many technical improvements made commercial fishing far more efficient than in the past. The years between 1950 and 1955, for instance, saw major new developments. Nylon netting was introduced; it was lighter, stronger and resistant to rot and allowed fishermen to catch more fish at a lower price. Hydraulically operated drums were first used during this period; these laborsaving devices eased the burden of hauling in both trawls and purse seines. Engines of increased horsepower allowed trawl nets to be towed in deeper waters. Another laborsaving hauling device, the Puretic Power Block, was invented in 1955 by a California

commercial fisher. All three devices made net retrieval much faster, allowing for additional hauls per day with a reduced crew. It has been said that the combination of nylon nets and the power block made possible the worldwide tuna seine industry (Browning, 1980).

Trawls underwent a major evolution during the 1960s and 1970s. Previously designed for use on soft or low-relief sea floors, trawlers began to outfit their nets with tires, which allowed this roller gear to be towed over high-relief rocky outcrops. Fishes, such as many species of rockfishes that could previously only be fished with hook and line, could now be taken with the more efficient trawl gear. Another advancement, the monofilament gill net, first extensively used by immigrant Vietnamese fishermen in the early 1970s, had a profound effect on fisheries. Inexpensive, easy to replace, and less visible in the water than nets made of other materials, monofilament nets could be set on those rocky reefs that had often been avoided in the past. In addition, far more netting could be deployed at the same cost. Within a few years of their large-scale introduction, many commercial fishermen had turned to monofilament gillnets and they were a very visible part of the industry.

After the passage of the Magnuson Act in 1976, the commercial industry underwent another revolution, as the federal government began to provide substantial funds, loan guarantees, and tax credits and shelters to commercial fishermen to upgrade their ability to catch what were now purely domestic fishes. Inevitably this produced more and larger vessels, with larger engines, capable of towing or setting larger nets and ultimately leading to overcapitalization in a number of fisheries.

Lastly, the spectacular improvement in electronic tools radically altered many fisheries. Beginning with radar and loran navigation aids, and ending with sonar, global positioning systems, position (track) plotters and nearly real time satellite images of the ocean surface, the advancements in electronics revolutionized fishing operations. Vessels could now much more easily find, fish and return to productive fishing grounds.

Simply put, within a short period there were too many fishermen, with too efficient equipment, chasing too few fish.

FOREIGN FISHERIES, THE MAGNUSON ACT, AND THE GLOBALIZATION OF CALIFORNIA'S FISHERIES

From the earliest days of California's commercial fisheries, fishery products have been both imported and exported. As far back as the 1860s, canned Sacramento River salmon went to Australia, while nineteenth century Chinese fishermen exported many tons of dried fishes to Asia. Canned California sardines were a staple in many countries during and after World War I, canned mackerel was very popular in the Philippines during the 1930s and beyond and, with the collapse of the sardine industry, canned anchovies were also exported. Similarly, despite large domestic herring stocks, millions of tins of higher-quality kippered North Sea herring were imported into California. However, until the 1970s the domestic market for fish products vastly outweighed the export trade.

What might be termed the globalization of California's fisheries had its birth in the 1960s and early 1970s with the massive increase in foreign vessels fishing off U.S. shores. Off California, for example, large numbers of Japanese, Soviet, South Korean, and other fishermen targeted Pacific hake,

sablefish, and rockfishes. In response, Congress in 1976 passed the Magnuson Act that ultimately mandated the expulsion of foreign vessels within 200 miles of the U.S. coast. One of the effects of this act was to nationalize several fisheries that had been important to other countries, particularly to the Soviets and Japanese, thus creating instant export markets for California fishermen.

Sablefish are a good example of this process. Historically, the domestic market for sablefish was small, with annual landings ranging from one million to four million pounds. California fishermen first started exporting sablefish in the early 1970s and by 1975 landings had risen to about 14 million pounds. In 1977, the fishery was entirely in U.S. hands, the Japanese had to import most of their sablefish, and the catch rose to 28 million pounds (Henry, 1992).

The large Pacific herring fishery is also export-based although the closure of U.S. waters to foreign fishermen did not play a role in its inception. Herring roe, called "kazunoko" in Japan, is a popular and expensive delicacy. When the Japanese herring harvest declined in the late 1960s, they began to buy herring from both U.S. and Canadian sources. Since the early 1970s, but particularly after 1980, San Francisco, and to a lesser extent other northern California embayments, have played host to valuable fisheries that target spawning herring. The herring are frozen, shipped to South Korea and China, the roe removed and sent to Japan. An allied fishery, called roe-on-kelp, harvests kelp blades after spawning herring have attached their eggs. Called "kazunoko kombu", this is also a high-value export to Japan (Spratt, 1992).

California's fisheries have benefited from the new ease with which countries trade with one another. The integration of national economies, the dropping of trade barriers and the development of new uses for fishes have all helped California gain an international market share for a number of products. Currently, along with sablefish and Pacific herring a number of other species including thornyheads, sardines, and Pacific hake are caught primarily for the export market. And while thornyheads are destined to be consumed as sushi in Japan, and many Pacific hake wind up as surimi, sardines are exported either to Asia, to be used as bait by tuna longliners, or to Australia as food for pen-reared bluefin tuna. The sardine industry has come a long way from the days of canning and reduction.

While globalization has created large markets for a number of species and has certainly enriched some fishermen, it is also fraught with pitfalls. In 1900, when a Monterey fisher marketed his entire catch to a few markets on a pier, or to a wholesaler who sold his entire catch to San Francisco middlemen, a recession in Japan or a move in the relationship between the yen and the dollar meant nothing. Today, many California fisheries are as tied to the world economy as are computer chips, automobiles or wheat. This was instantly apparent to sablefish fishermen in 1978, when following their record year of 28 million pounds, the Japanese sablefish market collapsed, sablefish prices sank and fishermen were in economic shock.

New export fisheries often engendered a Gold Rush mentality. Until 1988, there was no market for Pacific hagfish, although hagfish were used to make eelskin wallets and other products in Korea. In 1988, buyers from Korea began approaching fishermen in California and purchased 690,000 pounds from Monterey and San Francisco operators. Within three years, the fishery had expanded to the entire California coast (and beyond) and California landings exceeded

2,600,000 pounds. Everyone, it seemed, wanted to enter the fishery and everyone did. Vessels that could barely float were called into service and fishermen who could barely bait a trap put out to sea. And then, within a year, the fishery disintegrated. Buyers gave a number of reasons for pulling out. They complained of the quality of the skins of California hagfish, perhaps reflecting how the fish were stored after capture. They implied that better, or perhaps less expensive, product was available on the East Coast of the United States. For whatever reason, just a few years after it started, the hagfish fishery disappeared as if it never was (E. Melvin, pers. comm.).

Globalization means that California fishermen also must compete with imported fishes and salmon aquaculture. For instance, during some years, California wholesalers have purchased Asian-caught swordfish for less than California fishermen wished to be paid. California salmon fishermen must compete with Atlantic salmon farmed in Chile and Canada. California consumers are now more attracted to the bright white fillets of Chilean sea bass (Patagonian toothfish) than the faintly gray ones of the domestic white seabass. And while many of the most enthusiastic fish purchasers in California are recent Asian immigrants, they often prefer purchasing those species they grew up with, which translates to a healthy trade in frozen, imported saury, pomfret, milkfish, croakers, and cutlassfish (Kato, 1994).

TRADITIONAL FISHERIES

The latter half of the twentieth century saw great turmoil in and, ultimately, the near demise of, the cannery and reduction fisheries. With the collapse of their fishery in the early 1950s, many sardine fishermen moved into the tropical tuna fisheries that targeted yellowfin tuna and skipjack. The development of nylon netting and the power block net hauling system allowed these fishermen to much more efficiently purse seine tuna schools and, as larger and larger seiners were built, the tuna industry came to dominate the California commercial fishing industry. However, as the industry became more closely tied to the world economy, it became obvious that there were large cost savings in canning these tunas outside the United States. Between 1982 and 1984 most of the canneries relocated outside the continental United States, the purse seiners went with them and the industry was gone.

The Pacific sardine, Pacific mackerel, and northern anchovy fisheries all had their ups and downs during this period, but at the end of the century the once thriving industry was a shadow of its former self. For two decades, beginning in 1965, northern anchovies were the basis of a large reduction fishery. However, beginning in 1983, the chronically low prices offered fishermen essentially ended that fishery. After being decimated by overfishing, both sardine and mackerel populations made a comeback in the oceanic warming trend that began in the late 1970s. Fishery managers now closely control catches and the species are caught for a variety of purposes, including canning for human consumption and pet food or export for aquaculture feed or commercial fishing bait. However, in a number of years the allowable catch quotas have not been met, the result of low prices to fishermen, sporadic fish availability, scarce market orders and the lure of more lucrative fisheries, such as squid (Jacobson, 1992; Konno and Wolf, 1992; Wolf and Smith, 1992; California Department of Fish and Game, 2000; K. Hill, pers. comm.). By the beginning of the twenty-first century, much of the catch was

exported; only relatively small amounts were destined for canning and reduction.

During much of this period the traditional market fisheries flourished. Increased demand for seafood, a greatly expanded trawl and gill net fleet, along with the development of new technology to help harvest these animals, meant a surge in fisheries for such long-important species as chinook salmon, swordfish, lingcod, rockfishes, various flatfishes, California halibut, and white seabass. At the same time, increased consumer sophistication and an influx of Asian immigrants, combined with decreased stocks of traditional species led to new, or at least expanded, fisheries for previously disdained species. The market for angel, thresher, and shortfin mako sharks, white croaker, and grenadiers vastly increased during this period. Perhaps most notable were the explosive rise of these fisheries, sometimes mirrored by an equally precipitous fall. For example, while only 328 pounds of angel shark were landed in 1977 more than 1,200,000 pounds were landed in 1985 and 1986. By 1990, catches had dropped to about 200,000 pounds, the result of overfishing, belated minimum size restrictions (Richards, 1992), as well as a partial ban on gillnets.

By the end of the century, almost without exception, a combination of factors had caused a marked decline in most of these fisheries. Gear restrictions, such as the nearshore gill net ban in southern California, took a heavy toll on catches of such species as white seabass, California halibut and angel shark. Overfishing had led to restrictive quotas and limited seasons on rockfishes, lingcod, and other species. The continuing degradation of spawning habitat had reduced the numbers of some runs of salmon available to fisheries.

The newest commercial fishery was also one that was still evolving. Beginning in the mid-1980s, a market developed for live fish, ultimately destined for Asian restaurants and markets. Fishermen quickly found that the value of their catch was dramatically higher when kept alive (often one to six dollars per pound and occasionally much more) than when dead (rarely more than 50 cents per pound). The fishery, which began in central and southern California, soon spread to the north coast and by the end of the century ranged from the intertidal zone to a depth of about 100 feet. About 300 vessels (from kayaks to 100-foot long craft) landed 94% of a catch totaling about 478 metric tons. The same fishery brought in over 700 tons of dead fish. Cabezon, California sheephead, various nearshore rockfishes (including gopher, grass, black-and-yellow, and brown), and California scorpionfish comprised the bulk of the catch. Live fish were transported by trucks or vans equipped with aerated trucks and shipped to markets and restaurants throughout the state. Most fish were taken in traps and an assortment of hook-and-line gear (California Department of Fish and Game, 2000). The fishery was a particularly contentious one, as it, more than most commercial efforts, directly and very visibly competed with recreational anglers and spearfishermen. Responding to concerns regarding allocation and over-harvest, the California Department of Fish and Game began to place limits on the fishery through such restrictions as limited entry, size limits and quotas.

The years between 1950 and 2001 saw major changes in the commercial industry. It was no longer an industry of boundless frontiers, but rather one beset with problems that included declining fish stocks, increasingly restrictive regulations and rising costs. In an attempt to lower capacity in some fisheries, managers were encouraging attrition and were not

TABLE 22-1
Number of Vessels that Made Commercial Landings Only in
California, 1981 to 1999

<i>Year</i>	<i>CA Only</i>
1981	5,832
1982	5,762
1983	5,257
1984	4,779
1985	4,451
1986	4,305
1987	4,162
1988	4,204
1989	4,376
1990	4,155
1991	4,032
1992	3,536
1993	3,271
1994	3,102
1995	3,074
1996	2,994
1997	2,857
1998	2,505
1999	2,495

NOTE: From Thomson 2001.

allowing replacements. By the end of the twentieth century, the commercial industry had shrunk to half its size of 20 years before (table 22-1). The cannery and reduction industries were but a small fraction of their previous size; much of the pelagic wetfish catch was exported. Many of the major fisheries, such as sablefish and thornyhead, were almost entirely export-based. This globalization of California's fisheries was not without problems, as domestic fishermen faced greater competition within the state from foreign sources. Salmon fishermen were facing lower prices due to increased supplies from Alaska and farmed fish. There was still a thriving market fish industry, although catches were almost uniformly lower than at their peaks. The live-fish fishery had become a major industry, bringing welcome revenue to many fishermen, but it was also a flash point with the recreational industry.

Recreational Fishing

1850 to 1940

Compared to the commercial fisheries, the early years of recreational marine angling off California are much less well documented and changes in this industry do not fall as neatly into distinct periods. One problem with documenting recreational angling is that it is difficult to determine when subsistence fishing becomes fishing for pleasure. A second complication is that, except for the barest of mentions, the Department of Fish and Game did not collect data on recreational angling until the mid-1930s.

If we use paying for fishing as one marker for recreational angling it was only a few years after the Gold Rush that organized fishing trips were under way. An illustration in a mid-1850s San Francisco newspaper portrays a boatload of formally dressed anglers handlining off the Farallon Islands. By the

1870s, occasional fishing excursions were advertised in a newspaper in Humboldt County, wherein anglers could sail aboard one of several tugboats to Cape Mendocino and fish for rockfishes and Pacific halibut. In the 1890s, tourists visiting Monterey Bay regularly chartered small sail-powered commercial fishing vessels and trolled for salmon.

It was, however, in southern California and with Charles Frederick Holder that California marine recreational angling received its first big boost. Born of a wealthy Massachusetts family, Holder moved to Pasadena in 1885. A tireless publicist for southern California, recreational fishing and conservation, he became a major voice for more sportsman-like fishing because of experiences such as the following, "The day of my first landing at Avalon [1886] I saw men casting big hand-lines (cod-lines) from the beach, catching yellowtails from eighteen to thirty-five pounds as fast as they could pull them in. I saw that I had stumbled upon an angling paradise; also, I recognized the fact that no fishing-ground could stand such methods" (Holder, 1910) (fig. 22-5).

Holder created the Tuna Club of Santa Catalina Island in 1898, with the goal of changing fishing quantity to quality. As he noted, "The object of this club is the protection of the game fishes. . . . to encourage and foster the catching of all fishes, and especially tuna, yellowtail, seabass, black seabass, etc., with the lightest rod and reel tackle, and to discourage handline fishing, as being unsportsmanlike and against the public interest." (Young, 1969).

But these noble sentiments were really aimed at the wealthy or at least well-to-do, the few Zane Grays of the world, because hiring a launch and guide was an expensive endeavor. Through the end of the nineteenth century, relatively few average anglers fished from boats. Indeed, before World War I, pier and surf fishing were the choice of the masses. Except for the very end of some privately owned piers, both types of fishing were free and, considering the relatively primitive fishing tackle of the day, fishing from piers was often excellent (fig. 22-6). Holder (1913) observes that, "The explanation of these piers is that they are for fishing or angling. . . . On some when the fish are running you may see two or more hundred men, women and children, all fishing with long bamboo rods for surf-fish [perch], roncador [yellowfin croaker], sea-trout [young white seabass], jack-smelt, mackerel, croakers and hoping for yellowtail, sea-bass and big game which frequently come. No better evidence that there is a love of angling among all peoples can be seen than in this angling contingent, some of whom sleep on the piers Saturday night. . . . to secure a position Sunday when all the piers are crowded."

The appearance of the party vessel (now called the Commercial Passenger Fishing Vessel, CPFV) and barge fishing first allowed the average angler to enjoy deep-sea fishing (fig. 22-7). It appears that the CPFV industry had its beginnings just before World War I. At this time, converted commercial craft in Long Beach and other ports began carrying anglers on a regular schedule without the fishermen having to charter the entire vessel. In the early days of the industry, anglers either trolled or used salted bait. By the mid-1920s, operators began catching anchovies, sardines and other small fishes and the live bait boats came into vogue. In the beginning, each boat carried a bait net and passengers often helped in net deployment and retrieval. Within a few years, some vessels began to specialize in catching bait for recreational vessels and these "bait boats" have been an integral part of the CPFV industry ever since. The industry was an immediate success and by 1930 CPFVs were operating from

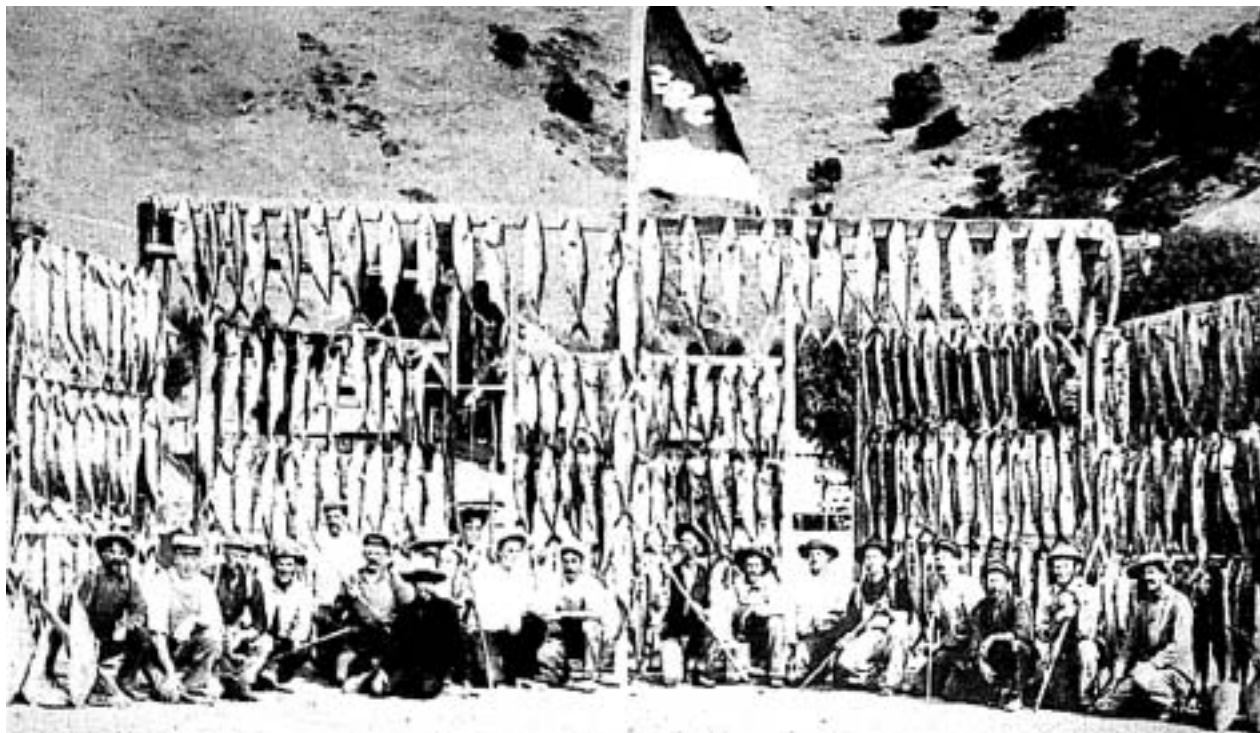


FIGURE 22-5 A large catch of yellowtail made off Santa Catalina Island in the nineteenth century. Photo credit: Ed Ries Collection.



FIGURE 22-6 Before commercial passenger fishing vessels, fishing barges, and inexpensive private vessels, most southern California ocean anglers fished from piers. Photo credit: Ed Ries Collection.

every pier in southern California. By the late 1930s, CPFV and barge anglers accounted for the majority of fishes taken in the marine recreational fishery. Over 200 CPFVs operated out of southern California, as well as small numbers in Morro Bay, Monterey Bay and San Francisco Bay; northern

California did not host them until after World War II. Except for yachts of the wealthy, small privately owned pleasure boats were a rarity and, during this period, did not play a large role in the recreational fishery (Croker, 1939; Ries, 1997; Ries, 2000a,b).



FIGURE 22-7 The first commercial passenger fishing vessels were primitive, but the abundance of fishes made up for the lack of amenities. Photo credit: Ed Ries Collection.

Most CPFV angling occurred in southern California, reflecting that region's greater population, more equitable weather and greater numbers of the more gamy semi-pelagic species (Pacific barracuda, yellowtail, and Pacific bonito) widely sought after by anglers. Through the start of World War II, almost all CPFVs ran from April to September, that time of the year when these preferred species migrated north from Mexico. The beginnings of the industry coincided with a warm-water period and this was reflected in the species caught, with Pacific mackerel, Pacific barracuda, kelp and barred sand bass, Pacific bonito and California halibut taken in largest numbers in southern California and rockfishes predominating in central California. Both yellowtail and white seabass were also popular species, although rarely caught in the same abundance as the previous species. About 75% of all CPFV anglers fished from vessels leaving from Los Angeles or Orange County piers and these anglers fished primarily at three locations; Horseshoe Kelp off San Pedro, Santa Monica Bay and Santa Catalina Island. So important was the Pacific barracuda to the southern California fishery that during that period "the success of the entire fishing season depends on the barracuda run" (Croker, 1939).

What were early vessels like? In the beginning, all were relatively small, mostly between 50 and 65 feet long, and had been converted from commercial fishing vessels. Compared to modern CPFVs, these early boats lacked almost all amenities including galleys, bunks, or any indoor space in which anglers could get out of the weather. It was not until 1934 that a boat specifically designed for sport fishing was launched.

However, what the early vessels lacked in comfort, they more than made up for in quality fishing. There were simply more fishes in the 1920s and 1930s than there are today and fishing was excellent much of the time, despite the fact that even the most sophisticated fishing tackle was crude by

today's standards. Handlines were commonly employed aboard sportfishing vessels, and were still occasionally seen on deep-water rockfish trips well into the late 1950s. Jackpoles, long bamboo shafts to which were attached short lines and hooks, were also common. The tackle of even the most sophisticated angler left much to be desired. Rods were either stiff and broomstick-like or very long and overly supple. Until the 1930s, most reels had no drags other than a leather flange. Line, almost universally known as cuttyhunk, was made of linen and rotted easily if not dried at the end of a fishing day. Leader material was made either of wire or silkworm gut and both were easily seen by fishes.

Despite C. F. Holder's admonitions, the typical angler during this period sought quantity; notions of catch and release were not even contemplated. Indeed, the distinctions between recreational and commercial fishermen were blurred, as fishes caught aboard CPFVs and barges could be sold.

At about the time that live bait fishing was in its infancy, a second kind of deep-sea fishing began. In 1921, A. B. Hohenshell, an enterprising entrepreneur purchased a dilapidated barge, anchored it two miles off Long Beach, southern California and invited the public to come fishing (fig. 22-8). For a nominal charge, anglers were ferried from a pier to the barge and, if they had no fishing equipment, provided with basic fishing tackle (bamboo poles, 20 feet of cotton line, a hook and sinker) and salted anchovies, sardine or mackerel. This first barge, the PAPROCA, was capable of holding 100 anglers and proved to be wildly popular. In the first five years, 100,000 fares were sold. By 1933, there were 25 barges situated from San Diego to Santa Barbara (and briefly in Monterey Bay), moored from 100 yards to four miles offshore. Despite their name, many of these vessels had once been large sailing schooners, now stripped down and capable of carrying 250 or more anglers. Early barges were quite primitive, but they soon



FIGURE 22-8 Beginning in the 1920s, reasonably priced fishing barges were extremely popular with the angling public in Southern California. Photo credit: Ed Ries Collection.

became much more refined, often including galleys, lounge rooms, restrooms and even sleeping quarters for those who might want to spend the night. Live bait was soon routinely provided. Unlike most CPFVs, some barges remained open throughout the year. Pacific mackerel was the most commonly taken species by barge anglers, although white croaker, Pacific sanddab, California halibut, Pacific barracuda, and Pacific bonito were often taken. During the 1920s and 1930s, giant sea bass and yellowtail were frequently caught. In fact, many barges had a jewfish bridge where anglers equipped with heavy gear soaked whole barracuda or mackerel and waited for a giant sea bass bite. After World War II, barge fishing slowly declined in popularity, perhaps the result of the vast increase in small boat ownership and the last fishing barge in California was removed in 1998 (Van Deventer, 1926; Fry, 1932; Clark and Croker, 1933).

In an age when boat fishing was beyond the pocket book of most anglers, pier and surf fishing were very popular throughout the late nineteenth and early twentieth centuries. In the early 1920s, both CPFV and barge fishing were perfected and both allowed the average angler access to deep-sea fishing. By the late 1930s, it was estimated that the CPFV and barge catch dwarfed the other recreational fisheries. In the main, only wealthy individuals could afford private vessels. CPFVs operated out of most southern California piers and at a few sites along the central California coast. Barges were anchored throughout southern California. Fishing tackle of the times was relatively primitive; most anglers used bamboo rods and linen line although handlines were also popular.

1941 to 2001

The economic upswing that presaged the United States entrance into World War II added to the rising popularity of marine recreational angling and it was World War II that caused its abrupt halt.

Even before the United States entrance into the war, a note in the September 1941 California Division of Fish and Game, State Fisheries Laboratory Monthly Report demonstrated that profound changes were coming. "The Navy has established a mine field right across Horseshoe Kelp, the best ocean sport

fishing grounds in the State. . . . this field has effectively ended fishing as far as most of the Long Beach and San Pedro sport boats are concerned". After Pearl Harbor, all CPFVs and barges were shut down and most did not return into operation until after the end of the war (Young, 1969).

However, within a few years, recreational marine angling, first from CPFVs but soon from private vessels, began a boom that lasted for decades. A number of factors led to this tremendous rise in popularity. Perhaps the most important was the rapid growth of industry in, and after, World War II that brought many immigrants to California, particularly to southern California. Ultimately, the proliferation of freeways meant that millions of potential anglers were within a short drive of the coast. Many returning veterans, both those who had been in the prewar recreational fishing industry and those who had just been avid anglers, saw the immense potential that these new immigrants represented. As a result, construction of vessels specifically designed as CPFV began in boatyards even before the war had ended. Between 1945 and 1965 about 10 newly built vessels entered the California CPFV fleet annually. Between this building surge and converting surplus navy vessels to civilian use, over 400 vessels were registered as CPFVs in 1949, twice the number from before the War. By 1955, that number had risen to about 600 vessels. While many of these new vessels were in the range of 55–65 feet long, boats up to 85 feet long soon made their appearance (Young, 1969).

A major factor in the rising postwar popularity of marine angling was the introduction of new materials that made fishing easier and more fun. Fiberglass rods, clearly superior to bamboo, wood or steel, made their appearance in 1948 and quickly took over the market. Improved conventional reels with light spools that make casting much more efficient, and improved drag systems that prevented gear stripping were also soon available. By the 1960s, spinning reels that allowed novice anglers to cast baits and lures without fear of backlashes, yet were tough enough to withstand a saltwater pounding, had created a huge following. Within about 10 years of its introduction around 1950, monofilament line that was soft, clear, and rot-proof, outsold all other lines (Smith, 1979). Over the years, there would be many new additions to the marine recreational fishing

industry, including better hooks, dazzlingly lifelike plastic lures and high tech rods, reels and lines, but none had anything like the impact of fiberglass rods, improved reels and monofilament line.

During the 1950s, the CPFV fishery gradually evolved to year round service. Since its inception, most of the CPFV fleet had shut down during winter months, when the most popular game fishes, such as Pacific barracuda, were less abundant. Historically, in southern California, a few vessels shifted to fishing for deep-water rockfishes, but because the rods, reels and lines of the time were not easily adapted to deepwater fishing, most rockfishes were caught by handlines supplied by the vessels. Davis (1949) describes the experience of using a handline and eight-pound weights to catch these fishes by stating "That's codfishing [deep-water rockfish]—and if you don't like it I don't blame you. However, as we have said, it provides a day out in the open, healthful exercise and some mighty 'good-eating' fish." However, with improved tackle, fishing for deep-water species became far less arduous and the vastly increased number of anglers provided a ready market for all year service. As a result, southern California rockfish catches soared, at some ports increasing by 400–500% between 1947 and 1955. Since the mid-1950s, rockfishes have become a staple group at most ports.

The late 1940s saw the introduction of inexpensive fiberglass boats and more user-friendly outboard engines. The relatively light, stable, mass-produced vessels allowed anglers the freedom and flexibility, and a place away from dozens of other anglers, denied those fishing on CPFVs. By the 1960s, CPFVs were being challenged by small vessels for dominance in the deep-sea fishing arena (Young, 1969; Smith, 1979).

In certain respects, the recreational marine fishing industry of the early twenty first century was little changed from that of 1950. Anglers still plied beaches, piers and jetties or fished from private vessels and CPFVs. And although there had been many introductions of new materials for rods, reels, lines and lures, these had brought, at best, only incremental improvements to the fisheries. For the private boat owner (now the major force in the recreational industry) and the CPFV operator, as for the commercial fisher, the revolution had been in the great improvements in electronic devices (such as radar, fish finders, and global position systems) and in information technology. Through the use of the internet, data on water temperature, the location of oceanographic fronts and up-to-date information on fish locations were readily at hand. All of these put the motivated private vessel owner on the same playing field as the CPFV skipper.

In general, but with some telling exceptions, species composition in the various fisheries had changed little over the last 30–40 years (table 22-2). The faunal break between southern California and central/northern California, caused by current patterns, had always been reflected in the composition of the recreational catch. In the private vessel and CPFV fisheries of central and northern California, rockfishes, salmon, striped bass, lingcod and white sturgeon dominated the catch. Kelp and barred sand bass, rockfishes, Pacific barracuda, Pacific mackerel, yellowtail, Pacific bonito, white seabass, California halibut, and albacore played a major role in the southern California fishery. Much of the southern California fishery was based on species that were either highly migratory and whose presence was linked to water temperatures (Pacific barracuda, Pacific mackerel, yellowtail, albacore) or whose reproductive success was dependent on highly variable oceanic conditions such as upwelling (rockfishes). Hence, compared

to fisheries in the northern part of the state, the southern California catch was always more at the mercy of the vagaries of both decadal long trends in water temperature, and such transitory events as El Niños and La Niñas. The extreme instance of this occurred during the 1980s and 1990s, when generally warmer waters and increasingly frequent El Niños brought northward large numbers of previously unusual yellowfin tuna and dorado (Deweese et al., 1990; Norton and Crooke, 1994).

Of all the fisheries, the most profound changes in catch composition occurred in the southern California private vessel and CPFV fisheries (table 22-2). Most striking was the sharp decline in the numbers of certain rockfishes, particularly bocaccio, and olive and blue rockfishes. Once mainstays of the fishery, these almost disappeared from the recreational catch (Love et al., 1998a). It is likely this was caused both by overfishing (by both recreational and commercial fishermen) and 25 years of juvenile recruitment failure from adverse oceanographic conditions (Love et al., 1998a, b). During the same period, a number of warm-water species, such as yellowtail, Pacific barracuda, California scorpionfish, ocean whitefish, vermilion rockfish, and honeycomb rockfish became much more abundant.

There had been large changes in some parts of the industry. Private vessels were now the single largest component of the recreational fishery (table 22-3). Throughout California, the fishing effort by private vessel anglers was almost equal to all other fishing modes combined and private vessel anglers caught almost 50% of the entire marine recreational catch. Overfishing and environmental changes had created declines of rockfish, lingcod and other stocks, changing the face of fishing. Federally mandated rebuilding plans had cut bag limits, created closed seasons, set minimum size limits and even marine reserves. In the face of these new realities, creative CPFV operators were offering sanddab specials during rockfish closures, while declines in rockfish stocks in central and northern California brought about combination Dungeness crab and rockfish trips. In an effort to reduce pressure on some stocks, some members of the industry had begun encouraging catch and release, a virtually unthinkable idea to most anglers of the past. Some CPFVs were also diversifying into such areas of ecotourism as whale and bird watching.

As ocean waters warmed in the late 1970s, southern California anglers greatly benefited from the increase in abundance of such highly sought-after species as kelp bass, barred sand bass, Pacific barracuda, and yellowtail and the staggering population increase of the Pacific sardine. Because these fishes were readily available, the gradual decline of many rockfishes, long a mainstay of the fishery, was not viewed with alarm. It will be interesting to note what effect a regime shift to colder water will bring to the recreational fisheries. While it is quite possible that many of these warm temperate species will be less abundant, it is not clear that the rockfishes will return to their former abundance.

Recreational angling became a very big business after World War II, the result of a burgeoning population and much better fishing tackle. Throughout this period, southern California remained the center of fishing activity, although recreational fishing was very popular around all major fishing ports in central and northern California, particularly around San Francisco Bay. The important species in the various fisheries vary between southern California and central/northern California, mirroring the faunal break at Point Conception. Many species remain important for decades, particularly in the fisheries north of Point Conception. Southern California

TABLE 22-2
The Ten Most Numerous Species in Four Recreational Fishing Modes

<i>Southern CA</i>		<i>Northern/Central CA</i>	
	<i>Beach and Bank^a</i>	<i>Beach and Bank^b</i>	
	1995–2000	1958, 1960 ^c	1995–2000
	Barred surfperch	Barred surfp.	Barred surfp.
	Yellowfin croaker	Redtail surfp.	Striped seap.
	Opaleye	Silver surfp.	Cabazon
	Walleye surfperch	Walleye surfp.	Silver surfp.
	Corbina	Jacksmelt	Redtail surfp.
	Silver surfperch	Striped seap.	Kelp greenl.
	White croaker	Kelp greenling	Walleye surfp.
	Black perch	Calico surfp.	Calico surfp.
	Jacksmelt	Striped bass	Jacksmelt
	Kelp bass	Cabazon	Rock greenl.
<i>Manmade Structures</i>		<i>Manmade Structures</i>	
1963 ^a	1995–2000 ^c	1958	1995–2000
Queenfish	Pacific mackerel	White croaker	White croaker
White croaker	Jacksmelt	Jacksmelt	Walleye surfp.
Pacific bonito	Pacific sardine	Shiner perch	Shiner perch
Walleye surfperch	Queenfish	Walleye surfp.	Jacksmelt
Shiner perch	White croaker	Barred surfp.	Barred surfp.
Black perch	Walleye surfperch	Topsmelt	Striped seap.
California halibut	Barred surfperch	Silver surfp.	Silver seap.
Pacific mackerel	Yellowfin croaker	Pac.Stghrn S.	White seap.
Jacksmelt	Topsmelt	Pile perch	Pacific mack.
Kelp bass	Opaleye	Calico surfp.	Pac. sardine
<i>Private and Rental Vessels</i>		<i>Private and Rental Vessels</i>	
1975–1976 ^f	1995–2000	1959–1960 ^c	1995–2000
White croaker	Pacific mackerel	Blue rockfish	Blue rockfish
Pacific bonito	Barred sandbass	White croaker	Black rockfish
Barred sand bass	Yellowtail	Black rkf	Pac. mack.
Bocaccio	Kelp bass	Pacific sandd.	Chinook sal.
Kelp bass	White croaker	Copper rkf	Gopher rkf
Pacific mackerel	Pacific barracuda	Lingcod	White croaker
Olive rockfish	California scorpionfish	Canary rkf	Brown rkf
Blue rockfish	Pacific sanddab	Jacksmelt	Lingcod
Sablefish	Vermilion rockfish	Gopher rkf	Canary rkf
Black perch	California halibut	Chinook sal	Pac. sandd.
<i>CPFV</i>		<i>CPFV</i>	
1975–1978 ^f	1995–2000	1960 ^c	1995–2000
Bocaccio	Barred sand bass	Blue rockfish	Yellowtail rkf
Kelp bass	Pacific mackerel	Yellowtail rkf	Blue rkf
Pacific mackerel	Kelp bass	Olive rkf	Canary rkf
Chilipepper	Pacific barracuda	Bocaccio	Olive rkf
Olive rockfish	California scorpionfish	Chinook sal.	Gopher rkf
Pacific bonito	Ocean whitefish	Canary rkf	Chilipepper
Barred sand bass	Pacific sanddab	Vermilion rkf	Starry rkf
Blue rockfish	Yellowtail	Striped bass	Widow rkf
Pacific barracuda	Vermilion rockfish	Copper rkf	Black rkf
White croaker	Honeycomb rockfish	Lingcod	Rosy rkf

^a There were no surveys of beach and bank anglers before the MFRSS.

^b These rankings do not include the surfsmelt net fishery, which represents the largest fishery by number of individuals taken.

^c Miller and Gotshall (1965).

^d Pinkas et al. (1967).

^e Wine and Hoban (1976).

^f Data from a California Department of Fish and Game creel census, as reported in Love et al. (1987).

NOTE: In each mode, comparisons are made between the most recent data and that from the earliest previous surveys. No beach and bank surveys had previously been conducted in southern California. The beach and bank mode includes both sandy beach and rocky shore habitats, manmade structures include piers and jetties. Data from 1995–2000 comes from the Marine Recreational Fisheries Statistics Survey.

TABLE 22-3
Average Annual Marine Recreational Fishing Effort and Harvest in California During 1998–1999
by Fishing Mode

Area/Fishing Mode	1000s of Angler Trips	1000s of Fish			Total
		Landed Whole	Released Alive	Other Disp.	
Southern California					
Man-made	624	837	644	233	1,714
Beach	281	327	247	17	590
CPFV	641	1,733	973	262	2,968
Private	1,324	1,960	4,075	211	6,246
Total	2,869	4,857	5,939	723	11,518
Central/Northern California					
Man-made	440	533	192	67	792
Beach	344	1,582	206	17	1,805
CPFV	168	1,131	122	171	1,423
Private	921	1,459	648	205	2,311
Total	1,872	4,705	1,168	460	6,331
Total California					
Man-made	1,064	1,370	836	300	2,506
Beach	625	1,909	453	34	2,395
CPFV	808	2,864	1,095	433	4,391
Private	2,245	3,419	4,723	416	8,557
Total	4,741	9,562	7,107	1,183	17,849

NOTE: From Thomson 2001; Marine Recreational Fishery Statistics Survey. Includes harvests in U.S. waters only. "Other Disp." refers to fish used as bait, filleted, given away or discarded dead.

fisheries are more sensitive to changes in water temperature. The number of anglers in the industry may have peaked in the late 1980s or early 1990s and private vessels are now the most important part of the industry.

Fishery Management

"A self-preserving fishing industry would respect the biological limits of its resource's productivity, limiting its seasonal take to some safe minimum so as to guarantee future harvests. Fishing industries, however, do not generally manage their affairs in such a rational way" (McEvoy, 1986).

1850 to 1899

Salmon formed the first great commercial fishery in California and it was to protect that species that the first concerns were raised. Indeed, as far back as 1852, the first law that limited commercial fishing was passed, creating a closed season for salmon in some inland waters. In these early years, local governmental entities also passed some fishing restrictions. For instance, in 1893, San Francisco County passed an ordinance prohibiting the sale of striped bass less than eight pounds in weight (Craig, 1928).

In 1870, the perceived need to further protect salmon and to improve other stocks led the California legislature to establish the Board of Fish Commissioners to "provide for the

restoration and preservation of fish in the waters of this state." (Bryant, 1921). In 1878, the Fish and Game Commission was formed, it had additional responsibilities for fishery enhancement and protection.

Some of the early efforts by the Board focussed on introducing food and game fishes to California waters, actions that soon led to booming populations of both striped bass and shad. Continuing concerns regarding salmon depletion led to efforts to reduce coastal stream pollution by sawmills, mandated the building of fishways at dams, recommended a closed salmon season on the Sacramento and San Joaquin rivers and made mesh size provisions for nets. The licensing of commercial fishermen, begun in 1887, was also an attempt to control salmon fishing.

However, the only intense efforts to place limits on any marine fishery during this period was the blatantly anti-Chinese fishing law passed in 1880. This act, passed with other anti-Chinese laws, prohibited all aliens incapable of becoming citizens (the Chinese) from fishing in state waters. And while it was ruled unconstitutional in federal court, violating the equal protection clause of the Fourteenth Amendment, it was symptomatic of the seething hatred this group engendered. Indeed, having quickly been ousted from gold mining, attempts were often made to drive the Chinese out of the fishing industry as well as other economic sectors in California. "One government observer noted in 1873 that the salmon business on the Sacramento River was entirely controlled by whites, 'no Chinamen being allowed to participate in it.' 'There is no law regulating the matter . . . but public

opinion is so strong in relation to it that any attempt on their part to engage in salmon-fishing would meet with a summary and probably fatal retaliation” (McEvoy, 1986).

It was the Chinese prosecution of the San Francisco Bay shrimp fishery that most inspired the ire of some segments of the public. This net fishery, charged a few nascent conservationists, newspapers and the Italian Fishermen's Union, caught large quantities of small fishes and this by-catch was impacting other fisheries (Jordan, 1887, 1892). However, from our vantage, it is difficult to know to what degree the complaints voiced represented a real problem, a perceived threat of competition in the minds of other fishermen or the pervasive racism of the times. For instance, as early as 1870, it was noted that the Italian-run beach seine fishery was very wasteful, with large numbers of small fishes discarded and allowed to drift dead on the tides and yet no complaints were voiced in this instance (Skinner, 1962). And, as noted by Scofield (1954), “Destruction of some small fish in the shrimp nets opened an opportunity for unscrupulous politicians to propose hampering legislation so that a campaign fund to kill the bill would be collected from the Chinese. The fishermen knew they were being robbed but they paid rather than fight.”

Ultimately, as summarized by McEvoy (1986), the Fish and Game Commission of that time found it much easier to plant exotic species, such as striped bass and shad, in an effort to “improve” fisheries, rather than to promulgate and enforce fishery laws. The philosophical underpinnings of the concept that natural resources truly belonged to all citizens and could not be randomly harvested by anyone, in any quantity, at any time, had not yet truly flowered.

1900 to 1950

With its upsurge in fisheries, the new century brought the first large flurry of management activity. Perhaps most important was the realization that very little was known of the life histories and populations of economically-important fishes and, in consequence, the state legislature and Fish and Game Commission set about to remedy these deficiencies. By 1914, scientific investigations on the life history of California salmon and trout were underway and plans were afoot to create a research laboratory in San Pedro. In the same year, the Fish and Game Commission (soon the Division of Fish and Game and still later the Department of Fish and Game) began *California Fish and Game*. This journal was initially designed to provide a two-way conversation between the public and Commission and early issues contained a mixture of articles summarizing the major fishes of California, the art of dryfly trout fishing, exhortations from conservationists and summaries of new fish and game laws. However, within a few years, the journal was transformed into an outlet for much of DFG's research activities and ultimately provided a clear picture of the organization's thinking about fisheries management.

The twentieth century also ushered in an attempt to better understand the nature of commercial fisheries. In 1909, a fisher was first required to give a detailed description of himself (including country of origin), the name of the vessel upon which he fished or the type of fishing he pursued, and his address. In 1911, a law was passed requiring that fish dealers keep a record of fish purchased. In 1915, this was amended to require monthly reports and legislation in 1919 required that every fish purchased be recorded in triplicate. The first (white)

copy went to the fisher, the second (yellow) to the buyer and the third (pink) went to the California Department of Fish and Game. Since that time, the landing data submitted to Fish and Game has been referred to as “pink ticket” data, although this particular system is not longer used (Scofield, 1954).

In 1917, work was begun on a State Fisheries Laboratory (later in the century to be the home of the Department of Fish and Game) at San Pedro whose purpose it was to investigate problems connected with the rapidly growing fisheries of the state. The first state research vessel was built in 1918 (Bryant, 1921; Scofield, 1948).

As the century progressed, a large number of commercial fishery laws were passed and these were generally designed to minimize the catch of juveniles, reduce fisheries during spawning seasons or reduce the overall catch. Limiting conflicts between user groups, particularly between commercial and recreational anglers, was also periodically attempted. A few areas were also set off limits to fishing. Typical examples of these types of regulations include banning the sale of sturgeon (1901), California corbina, yellowfin and spotfin croaker (1917) and striped bass (1935), mandating minimum weights on barracuda (1917), prohibiting the use of purse seines to capture yellowtail, white seabass, and Pacific barracuda (1941) and banning most commercial fishing from the area around Santa Catalina Island (1913) (Scofield, 1921; Greenhood, 1949; McCully, 1949; Scofield, 1951; Young, 1969).

The trawl fisheries were the targets of some of the earliest severe regulations. Even in its infancy, many, even those in the commercial industry, disliked trawlers. As Scofield (1948) noted, “The trawlers remained the objects of bitter hatred by other fishermen because trawl-caught fish had brought down the prices paid.” Trawlers could also fish in heavier weather than smaller vessels and thus gained a competitive advantage. In addition, the heavy, and unsaleable, bycatch of these early fisheries did not sit well with many observers. Probably the last straw occurred when a number of trawlers operating in southern California destroyed large numbers of undersized California halibut. Partially in response to this perceived destructive fishery, in 1913 trawl nets were banned from state waters (to three miles offshore) throughout all southern California. A series of revisions followed and, with some exceptions, trawling remained legal in state waters in most of northern and central California and illegal from Santa Barbara to the Mexican border (Clark, 1931; Scofield, 1948).

As has been previously noted regarding sardine stocks, early in the century Division of Fish and Game biologists were well aware of the potential dangers of overfishing. As early as 1919, Thompson wrote, “Fisheries are subject to depletion because of too intense exploitation, as has been proved in Europe and in our own country. It is the duty of the government, as the one element in the situation which is concerned with the perpetuation of the fisheries, to be able to recognize depletion, to know how to prevent it, and how best to promote the fisheries.” Within a few years, biologists had stated that sardines were in danger of overfishing, and that this was also true for several other fisheries, including California halibut, Pacific barracuda, and white seabass, all in southern California (Thompson and Higgins, 1923; Craig, 1927; Clark, 1931). Clark (1931) noted that the tendency for fishermen to build larger vessels and make multi-day trips was directly due to overfishing of local stocks.

Until the 1930s, little attempt was made to understand marine recreational fisheries. However, during that period it became clear that recreational anglers caught large numbers of

fishes and that estimates of this catch were necessary. As noted by Clark and Croker (1933), "from time to time controversies have arisen as to whether the sportsmen or the commercial operators are taking the greater part of the total catch...It became the duty of the California Division of Fish and Game to determine the quantities of fish caught by marine sport fishermen in order that its conservation program be administered wisely." In 1932, a pilot system was initiated in which party vessel and barge operators and pier concessionaires were requested to keep a count on the fishes taken each day. Because these voluntary reports were undependable, in 1936, new laws mandated daily catch reports (reported monthly to the state) by skippers of party vessels (it appears that the barge and pier reports were not a success). Croker (1939), commenting on the first three years of the program, stated that "Even with a law to support the program, it is not always easy to convince the boat operator of the desirability of good reports, and frequently diplomacy is necessary and once in a while an arrest must be made." These early problems notwithstanding, the system begun in 1936 is still in operation today. Log accuracy has always been a question and appears to be greatest for charismatic species, such as yellowtail or white seabass, and less accurate for some other species (Baxter and Young, 1953). Nevertheless, despite its weaknesses, the log system has made it possible to reasonably track broad changes in the CPFV fishery.

Looking back on this era, several things are clear. First, even when there was virtual unanimity in the scientific community, particularly in the Division of Fish and Game, regarding overfishing, economics ruled fisheries management. The state legislature and other regulatory bodies were loath to either end a fishery, or even decisively reduce its size. Second, those fishery laws that were passed tended to make fishing less efficient through 1) area closures, 2) closed seasons, 3) gear restrictions, or 4) size restrictions. There was little or no attempt either to set specific quotas or limit the number of fishermen. As W. L. Scofield, one of the preeminent DFG biologists noted, "What is probably the most effective restriction has not as yet been applied to California, that is, the direct limitation of total catch by the establishment of boat catch limits or regional or state-wide bag limits for a season" (Scofield, 1951).

1951 to 2001

In 1900, a commercial fisher needed little more than a fishing license, a way to catch fish and a baloney sandwich. In 2000, a fisher's life was much more complicated and baloney had been found to harden the arteries. Indeed, looking back from the twenty-first century, some aspects of the California commercial fisheries are almost unrecognizable.

Management practices changed little during the 1950s, 1960s and 1970s. Indeed, except for small adjustments in various fisheries, management was much the same as it had always been. This included, with the collapse of the Pacific mackerel fishery in the mid-1960s, the same inability on the part of the California Legislature to effectively deal with overfishing. This obvious truth was made clear in a paper by the well-known fisheries biologists J. L. Baxter, J. D. Isaacs, A. R. Longhurst, and P. M. Roedel. Writing about the collapse of the Pacific mackerel, they stated, "Parenthetically we note that the stakes in scientific management are greater than the potential yield of the Pacific mackerel fishery. Despite scientific evi-

dence attesting to the Pacific mackerel's decline, presented over many years, no action has yet been taken which might rehabilitate this resource. This *prima facie* evidence substantiates allegations that the State cannot manage its resources on a scientific basis" (Baxter et al., 1967).

Ultimately, the largest shift in how California fisheries were managed had its genesis in the wave of federal environmental legislation of the late 1960s and 1970s that began to view the environment from an ecosystem perspective, rather than a series of constituent parts. It was the Magnuson Act of 1976 and the later reauthorized and broadened Magnuson-Stevens Act of 1996 that had the most profound effect. Partially driven by a fear of foreign vessels fishing off U. S. coasts, the Magnuson Act excluded foreign fishermen within 200 nautical mile of the coast, except for extraordinary circumstances. It also created a system for the monitoring and management of the fish stocks and set in motion a process that eventuated an American take over of harvesting and processing from foreign fleets. The 1976 Act also created a system of regional fishery management councils that were to act as forums for states and user groups; fisheries off California fall under the jurisdiction of the Pacific Fisheries Management Council (PFMC). In addition, the Act required that fishery management plans be drawn up to protect fish stocks.

Among a number of important new developments, the Sustainable Fisheries Act (SFA), part of the 1996 reauthorization, redirected U.S. fisheries policy away from promoting fishery growth and toward conservation and sustainability of those fisheries. For the first time, managers were specifically directed to protect essential fish habitat from the adverse effects of fishing. In addition, the SFA required Management Councils to consider the plight of the fishing industry and dependent communities in their management decisions (Weber and Heneman, 2000). Over time, Magnuson and later Magnuson-Stevens have had a considerable effect on both fisheries and fishermen. For the first time, through the management plans developed for salmon, pelagic coastal species (jack mackerel, northern anchovy, Pacific mackerel, Pacific sardine), and groundfishes (flatfishes, lingcod, Pacific cod, Pacific whiting, rockfishes, sablefish, and thornyheads), limited entry fisheries were created, individual trip limits were enacted and quotas for entire fisheries were established. Recently, both the PFMC and Congress have entered new management territory by introducing a limited observer program on commercial vessels, as well as discussing individual quotas and, in the groundfish fishery, capacity reduction through buyback programs.

The sometime labyrinthine degree of complexity and control exacted on fisheries by the PFMC can be seen in the chinook salmon fishery. Commercial fishermen may only harvest chinook salmon with trolling gear, using barbless hooks. In 1983, in order to decrease competition among fishermen and to reduce fleet size the fishery was made limited entry by a moratorium on new entrants. There are minimum size limits and a limited season with various time and area closures. The difficulties faced by the Council in this effort is well summed up in California Department of Fish and Game (2000), "In 1999, the PFMC again enacted restrictive commercial and recreational ocean salmon regulations in California to achieve 1) the escapement goal for Sacramento River fall chinook salmon of 122,000 to 180,000 hatchery and natural adults combined; 2) a 12.3% exploitation rate on age-4 Klamath River fall chinook salmon to accommodate inriver [sic] recreational and tribal subsistence and commercial fisheries . . . 3) a 31% increase in adult spawner replacement rate for

endangered Sacramento River winter chinook salmon relative to the observed 1989–93 mean rate.”

Unfortunately, despite a number of efforts to control fisheries, the PMFC was unable to prevent widespread overfishing of a number of species, including bocaccio, cowcod, canary, widow, darkblotched, and yellowtail rockfishes, Pacific ocean perch and lingcod. This failure, certainly not limited to the Pacific Council or to the Council system in general, occurred through a combination of events. However, it is clear that among other factors, inaccurate models of optimal catch, bitter resistance from fishermen to any lowering of quotas and reluctance on the part of Council members to cause economic hardship, all played a role. The result is that under some rebuilding scenarios, some of these species will not return to fishable levels for many decades.

It is important to note that California must make its management plans consistent with those of the federal government. In many instances, for those species for which management plans exist, federal regulations supplant those of the state and this has created a veritable tidal wave of new recreational regulations.

Unlike the closely scrutinized commercial fisheries, California marine recreational fisheries were essentially unregulated until the 1950s. The earliest laws came into effect in last few years of the 1940s and these set the pattern for the next 50 years. Virtually all of the regulations dealt with limiting daily individual retention, through bag limits, or preventing large catches of immature fishes, through minimum size limits. Except for grunion and salmon caught in ocean waters, until recently there have been very few closed seasons and almost no tackle restrictions. And, while minimum size limits clearly had a biological basis, until the late 1990s daily bag limits did not. Bag limits were created to minimize fish wastage that occurred when anglers caught, and retained, more than could be used. Biological considerations, such as sustainable yield, were not considered (Miller and Gotshall, 1964). With the exception of garibaldi, and later giant sea bass, no species were prohibited from all take.

However, in the 1990s, there was undeniable evidence of depletion in the rockfish and lingcod populations of California, including declarations from the National Marine Fisheries Service that some of these species were officially overfished. In response, the PMFC passed regulations drastically reducing the overall catch of these species and these regulations impinged not only on the commercial catch, but also on those of recreational anglers. As part of the same process that began to restrict commercial groundfish fisheries, California substantially lowered bag limits on rockfishes, closed seasons for rockfishes and lingcod and participated in the creation of the Cowcod Closure Areas, comprising 4,300 square miles of offshore banks in southern California. Clearly, for the first time in California history, management of commercial and recreational fisheries was viewed as two sides of the same coin.

Lastly, two acts passed by the California legislature also signaled that a new day had dawned in fisheries management at the state level. The Marine Life Management Act (MLMA) of 1998 was the first act that attempted to create integrated fisheries management in California. Weber and Heneman (2000) summarized the act by noting that it “...applies not only to fish and shellfish taken by commercial and recreational fishermen, but to all marine wildlife....the MLMA was intended to shift the burden of proof toward demonstrating that fisheries and other activities are sustainable....while the Legislature

retained its control over some of the State’s commercial fisheries, it gave the [Fish and Game] Commission new authority.” The Act was far-reaching and had several underlying goals. Chief among these was the concept of conserving entire ecosystems rather than focussing on one species. The Act also held that marine life need not be consumed to provide important benefits to citizens and that fisheries, should they be allowed, must be sustainable in the long-term. Noting that some fisheries were depressed, it called for specific rebuilding plans and for habitat maintenance, restoration or enhancement. Clean fishing, one that limits or eliminates bycatch, was to be encouraged. Lastly, the Act recognized that fisheries management may have negative impacts on fishermen and their communities and provided for minimization of these impacts (Weber and Heneman, 2000).

In 1999, California passed another act that would alter marine fishing practices. The Marine Life Protection Act (MLPA), while not specifically directed toward fisheries management, required that the Department of Fish and Game develop a plan for establishing networks of marine protected areas in California waters to protect habitats and preserve ecosystem integrity. Supported by a number of conservation, diving, scientific and education groups, and some fishing interests, the MLPA, by preventing some fishing activities along the coast, would also influence marine fisheries.

The Competition between Recreational and Commercial Fishermen

We have before us the fiendishness of business competition. . .

(Karl Barth)

For many years, recreational anglers and commercial fishermen battled over resource allocation. And, in the early days of the twenty-first century, California recreational anglers and commercial fishermen still found themselves engaged in an intense competition for fishes. This competition was played out in the print media, over the airwaves, on the internet, in the courthouse and in legislative bodies. The battle was heightened by the often correct perception that some fish stocks are at alarmingly low levels.

For a blissfully short period, when few fished California’s waters, there was little hostility among the two communities (Holder, 1913). Gradually, however, recreational anglers perceived a decline in the fish populations, and, in a pattern repeated over the years, laid the blame solely on commercial fishermen. Writing of Santa Catalina Island, Holder (1914) wrote “The angling here in 1886 to 1900 was the most remarkable in the world . . . but with the coming of power boats the seines, trawls and other nets, the fisheries began to decrease until it was evident that something must be done. The most menacing danger was the alien who attached a gill net to the kelp and ran it out into the sea. . . . I believe in developing all the sea products, intelligently, saving for the people everything that can be used; but it is very evident that the people cannot trust the army of alien market fishermen to conserve American interests.” Additionally, Holder (1913) makes a second argument that is still used in the current debates, when he writes “In the meantime from fifty to one hundred angling boatmen established themselves at Avalon, representing with various industries, dependent upon angling, a investment of three quarters of a million dollars.”

These same sentiments, with its scarcely-hidden racist, or at least nativist slant, were repeated 16 years later in Thomas

and Thomas (1930), "To insure a continuance of our Pacific fish, both for food and sport purposes, the entire Southern California coast should be kept reasonably free of live-bait [hook and line commercial vessels] and net boats. It is unreasonable and wasteful to allow one industry to destroy the fish of California's southern coast, thereby hurting other interests. When one considers that the men doing the actual fishing often are foreigners—either Japanese or Europeans—many of who cannot speak English, the need for protection is intensified."

The Department of Fish and Game first publicly noted the potential for rivalry between the industries when Croker (1939), writing of the surging party vessel fishery noted, "This new fishery has brought its problems, particularly as it competes with the long-established commercial fishing industry for the same fishing grounds and the same kinds of fish." Interestingly, until 1947, the distinction between recreational angler and commercial fisher was blurred as it was legal and, in fact, common for recreational anglers aboard party vessels to sell their catch or give them to crew members for later sale. In addition, it was common for crews of party vessels to use the vessel for commercial fishing during the down season (Croker, 1939; Ries, 1997).

However, it was Ray Cannon, writing in the years just following the collapse of the sardine industry, in *How to Fish the Pacific Coast* (1953), who gave the clearest direction yet of the impending battle. "The absolute necessity for outdoor recreation for the well-being of our citizenry is no longer theory; scientific facts have proven it. . . . We must regulate or halt every fish-depleting force or agency. In regulating commercial fishing we already have enough scientific facts to warrant rigid management. In cases where a fish population is suspected of being reduced, commercializing it should be halted until research proves it has regained its former abundance, plus a surplus...There is a total lack of wisdom shown in holding angler daily-bag-limits down to two-to-ten fish, while allowing commercials to capture whole schools, and as often as they can."

Thus, for much of the last 100 years, the recreational angler's view has been that 1) any depletion is caused by commercial fishermen, 2) recreational angling is somehow on a higher moral plain than commercial fishing, and 3) recreational angling has a greater economic importance to California.

Historically, the response from commercial fishermen has been to either deny that depletion was occurring and/or either deny or minimize their role in it. In addition, the prevailing philosophy among commercial fishermen was nicely summed up in a letter by a former commercial fisherman to the industry publication *National Fishermen*. Commenting on the allocation conflicts he stated that, "Of all of us, the commercial fishermen have the highest right to the resource, because without them, none of us would eat fish. They should come first in considering the management of the resource."

In the 1950s and 1960s, the inherent tensions between the two industries were publicly voiced on only rare occasions. In the late 1950s, for instance, anglers in Monterey and Morro Bays believed that commercial trawling operations were responsible for a decrease in CPFV rockfish catches. California Department of Fish and Game studies demonstrated that the recreational fishes of that time targeted inshore species, such as blue and olive rockfishes, while trawlers worked offshore and caught bocaccio, chilipepper and other deeper-water

forms. At about the same time, pier anglers on the Cayucos pier (located just north of Morro Bay) believed that live bait haulers using lampara nets were threatening pier fishing success; CDFG surveys showed that this, too, was incorrect. Ironically, when skin and scuba diving first became popular, hook-and-line recreational anglers also voiced fears regarding competition from the early spear fisher (Heimann and Miller, 1960; Heimann, 1963; Miller and Gotshall, 1965).

Beginning in the 1960s, but particularly in the 1970s and 1980s, the long-simmering conflict between recreational and commercial user groups greatly intensified; this escalation of hostilities had a number of causes. First, this period saw a rapid rise in the number of recreational fishermen, particularly those relatively affluent fishermen who owned private vessels and fished aboard CPFVs. In addition, the ultimately successful attempt to develop a northern anchovy reduction fishery, despite the great fears of recreational anglers who remembered the demise of the Pacific sardine, gave public voice to nascent anti-commercial fishing sentiments. And during the same period, the well-publicized foreign fishing fleet operating just off the coast was a constant reminder of external competition for fishes.

It was the burgeoning gill net fishery, however, initially spearheaded by newly arrived Vietnamese fishermen that galvanized the anti-commercial fishing community. During the mid-1970s, immigrant Vietnamese fishermen settled in California, first in central California, operating out of Monterey ports, but soon in southern California. Lacking funds to purchase large fishing vessels, these fishermen were only able to acquire small boats, often ones originally designed for recreation. After their arrival, most of these fishermen began using gill nets, particularly those made of monofilament, because, as noted by Orbach (1983): 1) they were previously familiar with that method, 2) it did not require large vessels or expensive equipment, 3) it was relatively inexpensive to purchase, and 4) because many Vietnamese started fishing for relatively unpopular species, such as white croaker, gill nets allowed the Vietnamese to avoid competition with established U.S. fishermen. It should also be noted that the Vietnamese tended to set out nets that were two or three times as long as those used by U.S. fishermen.

These new fishermen brought gill netting into the public eye. Nets were often set in shallow waters, off popular beaches. In some areas, these nets caught large numbers of seabirds, whose dead bodies washed up on those beaches. In contrast to most traditional fisheries, fishes were routinely offloaded in recreational launch areas. Many established fishermen quickly saw the new potential for gill nets and they, too, began using this gear. At the same time, great publicity was given to by-catch problems, including marine mammals, sea birds and turtles, associated with drift gill nets in the central Pacific. This combination of factors culminated in considerable anti-gill net sentiment, among both recreational anglers, who clearly saw these nets as competition for desired species, and some members of the general public, many of whom were concerned about marine mammal and sea bird by-catch.

The initial response by angler associations was to push for passage in the California legislature of a bill limiting gill net fisheries. When that bill failed, angler groups and some environmental organizations went through the initiative process resulting in the placement on the ballot of Proposition 132 (the Marine Resources Protection Act of 1990), that prohibited the use of gill nets within three miles of the mainland coast in

southern California and within one mile of the Channel Islands. During the ensuing campaign, the initiative's proponents emphasized the putative damage to marine mammal populations, despite biological studies indicating that marine mammal populations were healthy and expanding in the presence of gill net fisheries. However, it is likely that the clear subtext for most recreational anglers was that gill nets were harming recreational fish populations. Parenthetically, it should be noted that studies by the Department of Fish and Game implied that gill net activity was having little appreciable effect on the catch of most recreational species (Vojkovich et al., 1990). In 1990, voters passed the ballot initiative. In limiting a form of commercial fishing, Proposition 132 represented a defining moment when recreational anglers and their allies clearly showed their strength.

The victory had a certain energizing effect on the recreational industry; it made them more willing to confront commercial fishermen in the public arena. While the trawling industry had come in for its share of criticism, it was the nearshore live-fish fishery that is seen as the most direct competitor. Many recreational anglers would prefer to see commercial fishermen driven out of the nearshore altogether or at least limited to very low quotas.

However, circumstances, in the form of the reauthorized Magnuson-Stevens Act, The Marine Life Management Act and The Marine Life Protection Act, have changed the dynamics of the debate. A major effect of these acts is to link these once-separate industries together because fisheries managers have begun to understand that both industries contribute to overfishing, although the degree of responsibility varies with the fishery. Clearly, commercial fishing was responsible for overfishing Pacific mackerel, canary rockfish, and angel and thresher sharks. However, localized depletion of nearshore rockfishes by recreational anglers was well underway long before the birth of the commercial live fish fishery (Love, 1978). Regarding rockfishes, and perhaps lingcod, it might be argued that in some locations commercial fishermen first take the majority of fishes, but that recreational anglers continue to keep the populations low. As Love et al. (1998a) noted, "While commercial vessels often stop fishing an area when it is economically non-viable, recreational vessels do not. This is exemplified by the importance [in the southern California CPFV rockfish catch] of squarespot rockfish and other small species . . . On some trips most of the rockfish catch now comprises either dwarf or small species or juvenile rockfishes. Thus CPFVs tend to continue fishing reefs that harbor few, if any, larger rockfishes thereby preventing a rebound in populations."

Perhaps because of their century of rancor, it is ironic that at the beginning of the twenty-first century both the commercial and the CPFV industries found themselves almost equally under siege. In the face of clear evidence of overfishing, governmental actions in the form of drastically reduced quotas, closed seasons, and area and gear restrictions put severe pressure on both industries, placing their viability into question. In particular, the specter of marine protected areas threw together recreational and commercial entities. New Zealand recreational and commercial fishermen faced with a movement to create reserves responded with "Everyman has a right to catch a fish", precisely the philosophy of a number of California anglers and fishermen. However, it should be noted that, despite some misgivings, New Zealand is moving ahead with reserve designations.

What some members of both industries failed to see was that Californians lived on the edge of an increasingly urban sea. The vision on the part of some commercial and recreation fishermen of operating on some unsullied frontier was untrue. It was now difficult to ignore the interests of nonconsumptive parties, such as recreational (non-spearfishing) divers, boaters and marine mammal and bird watchers, if only because they represented an increasingly powerful political voice.

Obviously, it was, and will be, in the best interests of both consumptive and nonconsumptive groups to work together. As might be imagined, given their very diverse and in some cases opposing interests, this had often proven exceedingly difficult, although on occasion these parties had breached their instinctual distrust. For instance, salmon rehabilitation projects throughout the state had benefited from the cooperation of recreational anglers, commercial fishermen and environmentalists. In the future there is the real possibility that some non-governmental organizations will take management and marine reserve matters into their own hands if the contestants cannot work together. In California, it is relatively easy to bring citizen-sponsored initiatives onto the state ballot. It would be ironic, for instance, if recreational anglers, who spearheaded the anti-gill netting initiative Proposition 132, were to find 50% of the coastline unavailable to fishing through an initiative sponsored by another interest group.

In the long-term, the citizens of California have to decide what they want in their marine systems; these are societal rather than scientific issues. Society will have to decide how much underwater wilderness it wants. Society will have to decide how much fish stock depletion it will tolerate. And society will have to decide how best to achieve these goals. If citizens want to have a set of more "natural" or wilderness-like marine ecosystems, then greater protection will have to be afforded and this will be at the expense of both recreational and commercial fisheries. If it is deemed most important to have relatively unfettered recreational and/or commercial fishing opportunities or if it is decided that vastly degraded fish stocks are acceptable, then the requisite laws can be altered to allow this.

Before any competent decisions are made, it is important to have an understanding of fish populations and the status of major marine habitats. At the present time, there are no stock assessments for many of the economically important species, such as kelp bass, barred sand bass, spotted sand bass, California halibut, all of the nearshore rockfishes, most of the deepwater rockfishes, sea and surfperches, and black sea bass. An assessment of most nearshore and virtually all offshore habitats has not been conducted. There is also little analysis of the social or economic costs of various management options. A rational decision making process demands that this data be acquired.

All of this will have an effect on the fate of both commercial fishing and recreational angling. Barring some unforeseen circumstance, it is likely that both industries will continue well into the future, albeit with substantial changes. Through the marine reserve process, both industries will be excluded from some traditional fishing grounds, although which grounds and what form of exclusion remains to be determined. Through attrition, governmental buyouts or governmental regulations, some commercial fisheries will shrink in size. It is likely that commercial fishermen will face additional restrictions on, or even banning of, some gear as well as additional reductions in some quotas. Spatial management for

non-pelagic species and more output management (such as Individual Transferable Quotas) are also likely to occur.

Recreational fishing will also evolve. Shore-based and pier fisheries will likely see little changes. However, continuing catch restrictions and the creation of marine reserves will impact CPFV and private vessel fisheries. Half day CPFV trips appear to be gaining in popularity, both with anglers and operators. As fuel costs rise, these shorter excursions to nearby fishing grounds keep expenses, and fares, down. Marine angling, particularly from CPFVs, seems to have peaked in the late twentieth century and will probably continue to trend downward, at least as a percentage of the state's overall population. Purely as a way of maintaining some stocks, catch and release, once the *bete noir* of the CPFV industry, may become more popular. Lastly, as their economic clout diminishes, it is quite possible that the power of both the commercial and recreational industries will continue to be marginalized.

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