12. PACIFIC SALMON

California's salmon resources are many things to the people of California. They are a source of highly nutritious food for the general population and an important source of income for the commercial salmon industry. Recreational anglers value them for their excellent sporting qualities and Native Americans celebrate them in annual events welcoming the returning adults. Salmon play a key role and occupy a unique niche within the State's highly diverse marine and inland ecosystems. They are a high level predator, but also contribute to the sustenance of other high level predators. In addition, their spawned-out carcasses enhance the nutrient base of their ancestral spawning streams. Like other anadromous species (migrate from the ocean to freshwater streams to spawn), their survival depends on the quantity and quality of freshwater spawning and rearing habitat available to them. The destruction of that habitat over the past two centuries has resulted in many naturally spawning populations of salmon becoming so diminished that, in some cases, they face biological extinction or have been completely extirpated from their native range. A brief overview of the importance and role of salmon in the management of California's living marine fishery resources follows.

Review of the Salmon Fishery

Of the five species of Pacific salmon found on the West Coast, Chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) are most frequently encountered off California. Small numbers of pink salmon (*O. gorbuscha*) are landed on occasion, mainly in odd-numbered years. Chum salmon (*O. keta*) and sockeye salmon (*O. nerka*) are rarely seen in California.

Salmon fisheries existed in California long before European settlers made their first appearance in the state circa 1775. Native Americans may have harvested over 8.5 million pounds (3,859 metric tons) of salmon annually. In northern coastal areas, native peoples subsisted primarily on salmon. Salmon not only formed the bulk of their diet, a family might eat up to 2,000 pounds (0.9 metric tons) a year, but it was also used as barter with other tribes. Salmon was consumed fresh or dried and smoked for later use throughout the year. The fish were of such significance to these early fishers that ceremonies and rituals honoring their existence and importance were created. Traditional fishing methods included gill and dip nets, fishing spears, and communal fish dams.

Commercial salmon fishing in California began in the early 1850s, coinciding with the massive inflow of miners into the gold country. By 1860, these gill net salmon fisheries were well established in the San Francisco area (primarily Suisun and San Pablo bays) and the lower Sacramento and San Joaquin rivers. The fishery gradually spread to include river basins north of San Francisco, although the Sacramento-San Joaquin fishery remained the largest. Growth of this fishery was stimulated by the canning industry. In 1864, the first salmon cannery on the Pacific

coast started operations on the Sacramento River. By 1880, there were 20 canneries operating in the Sacramento-San Joaquin river system and intensified fishing efforts provided them with an ample supply of salmon. The fishery reached its peak in 1882 when about 12 million pounds (5,448 metric tons) were landed and processed.

Shortly thereafter, the fishery collapsed due to a sudden decline in salmon stocks caused primarily by the pollution and degradation of rivers by mining, agriculture, and timber operations, combined with increased fishery landings. By 1919, the last cannery had shut down and one by one, the rivers became closed to commercial fishing. State legislation closed the Mad River fishery in 1919, the Eel River fishery in 1922, and fisheries (including tribal) on the Smith and Klamath rivers in 1933. In 1957, the last inland commercial fishing area open to the general citizens of California (Sacramento-San Joaquin rivers) was permanently closed.

The ocean troll commercial salmon fishery began in Monterey Bay during the 1880s. These early fishers trolled for salmon using small sailboats that supported two-hand rods, one on each side of the boat with a single hook and leader attached to each line. Circa 1908, several Sacramento-San Joaquin fishermen transported their powered gill net boats to Monterey Bay and began trolling for salmon. These boats were a great improvement over the sailboats, but were still small compared to current standards. The fishery grew to approximately 200 boats and by 1916, had expanded north to Fort Bragg, Eureka, and Crescent City.

During the 1920s and 1930s, a typical salmon troller fished four to nine lines that each carried five or more hooks with up to 30-pounds (13.6-kilograms) of lead attached to keep the line at the proper depth. In 1935, an estimated 570 trollers were active in the fishery. Pulling weights, lines, and salmon onto a moving boat by hand was a backbreaking job, so power gurdies were soon developed to pull the lines and, by the mid-1940s, were used by most of the professional salmon trollers.

Commercial salmon vessel trolling north of Golden Gate Bridge.

A significant increase in fishing effort occurred after World War II, in conjunction with improved transportation and a rebound in salmon populations. By 1947, the fleet had nearly doubled to 1,100 vessels and was continuing to grow. The fleet peaked at almost 5,000 vessels in the 1970s and included many summer fishermen who had other jobs during the remainder of the year. Some of these summer participants were serious about commercial fishing and had adequate ocean-going boats, but most used small sport-type boats that could be conveniently towed on a trailer. In 1983, a limited entry program was established for the fishery.

Since its inception, the number of active participants has steadily declined. In 2006, less than 500 vessels were active in the fishery.

Salmon trollers today still use the basic fishing techniques developed during the 1940s, including powered gurdies and trolling four to six main lines. Today's vessels, however, are also equipped with various electronic devices that greatly aid in finding and staying on the fish. Radio communications are possible among several vessels simultaneously over large distances. Highly sensitive sonar equipment aids the troller in finding the salmon or baitfish schools and in pinpointing the depth at which to position lures. Precise vessel positioning is made possible through the use of global positioning systems. It is easy today to replicate a troll path or "tack" within a few feet of a previous or suggested path. Collectively, these instruments have significantly improved the efficiency of the modern troller compared to 60 years ago.

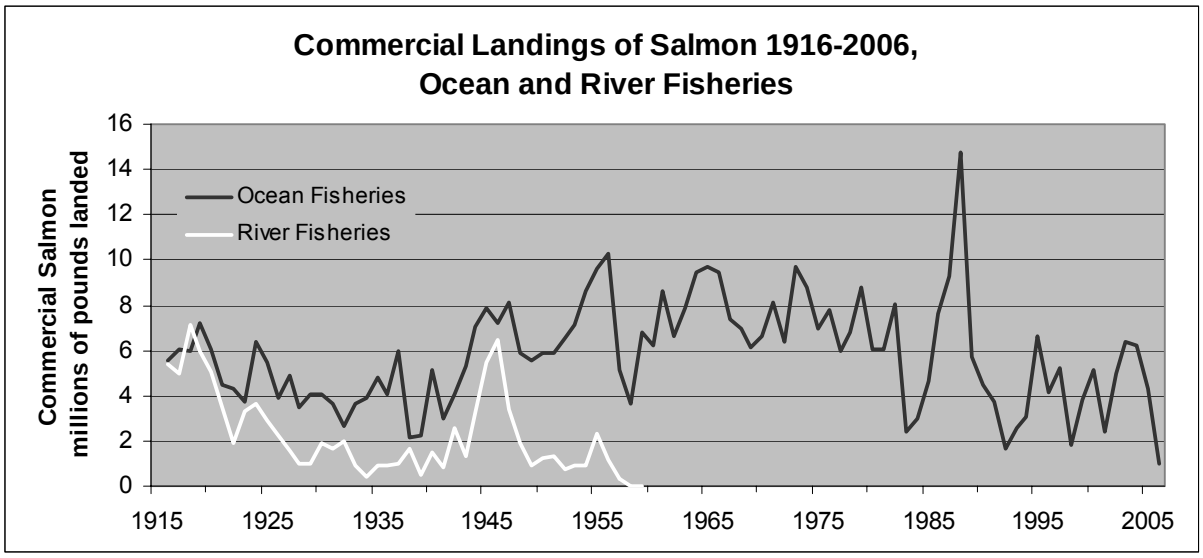

Figure 12.1. Annual commercial landings (pounds) of salmon taken in the river and ocean fisheries from 1916 to 2006. Catch data includes Chinook and coho salmon taken in the ocean and California coastal rivers, including the Sacramento and Klamath. The Klamath River commercial fishery closed in 1934 and the Sacramento commercial fishery closed in 1957. The take of coho salmon in river fisheries was prohibited after 1922. Data Source: CDFG Catch Bulletins and commercial landing receipts.

Estimates of commercial salmon catches are available in one form or another for years as early as 1874. In 1952, the California Department of Fish and Game (Department) began a systematic sampling of commercial ocean salmon landings. During the 1960s and 1970s, the industry enjoyed relatively high and consistent harvests, mainly of Chinook, averaging almost 8 million pounds (3,632 metric tons) dressed (gutted and gills removed) weight. The following two and a half decades produced much more variable catches. The largest commercial landings observed in California occurred in 1988 when more than 14.4 million pounds (6,538 metric

tons) of Chinook (1.3 million fish) and 319,500 pounds (145 metric tons) of coho (51,000 fish) were landed. The lowest landings occurred in 2006 when just over 1 million pounds (454 metric tons) of Chinook (68,800 fish) were taken in the commercial ocean fishery. Although oceanic and in-river conditions play a major role in salmon catches, variation among years can also be attributed to changes in fishery regulations and reduced fishing effort. Since the mid-1980s, progressively more restrictive regulations have been placed on the ocean fishery to protect salmon stocks of special concern. (Figures 12.1 and 12.2 and Table 12.1)

Fishing revenue from the 2006 commercial harvest of Pacific salmon was about $5.3 million (ex-vessel 2006 dollars). The contribution to total business output, for the State, from this 2006 commercial harvest is estimated to be $10.1 million. Likewise, total employment and wages from Pacific salmon is estimated to be the equivalent of 80 jobs and $4.7 million, respectively.

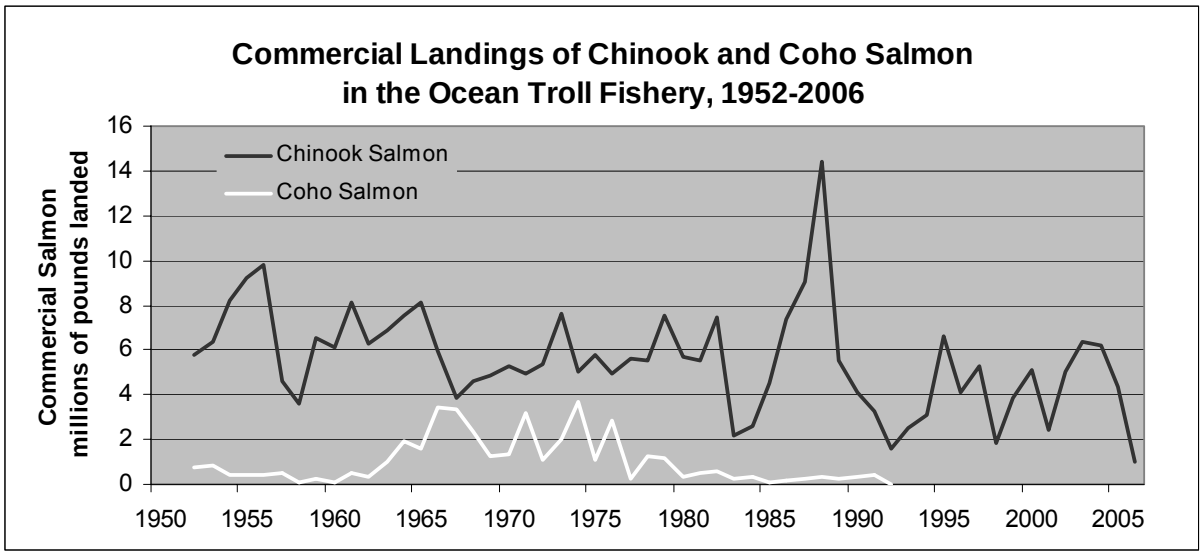

Figure 12.2. Annual commercial landings (pounds) of Chinook and coho salmon in the California ocean troll fishery from 1952 to 2006. The take of coho salmon was prohibited after 1992. Data Source: CDFG Ocean Salmon Project and commercial landing receipts.

Ocean sport fishing for salmon became popular with the development of the commercial passenger fishing vessel (CPFV) industry after World War II. In 1962, the Department expanded its dockside monitoring to include recreational landings of private skiffs and CPFVs. From its initial monitoring through the 1980s, the sport industry contributed 17 percent on average to the total salmon catch landed annually in California. Most of this sport catch (over two-thirds) was by anglers fishing on CPFVs. Since 1990, the sport fishery contribution to total California salmon landings has been increasing and accounted for 32 percent on average of the total annual landings. In 2006, the sport salmon catch exceeded the commercial catch for the first time since monitoring began, contributing 57% of total Chinook landings. In addition, the sport catch has also been more evenly distributed between CPFVs and

private skiff anglers in recent years. The highest sport landings occurred in 1995 when anglers landed a record 397,200 Chinook; the lowest landings in recent years occurred after strong El Niño events in 1983 (63,800 Chinook), 1978 (72,700 Chinook) and 1992 (73,600 Chinook). (Figure 12.3 and Table 12.2)

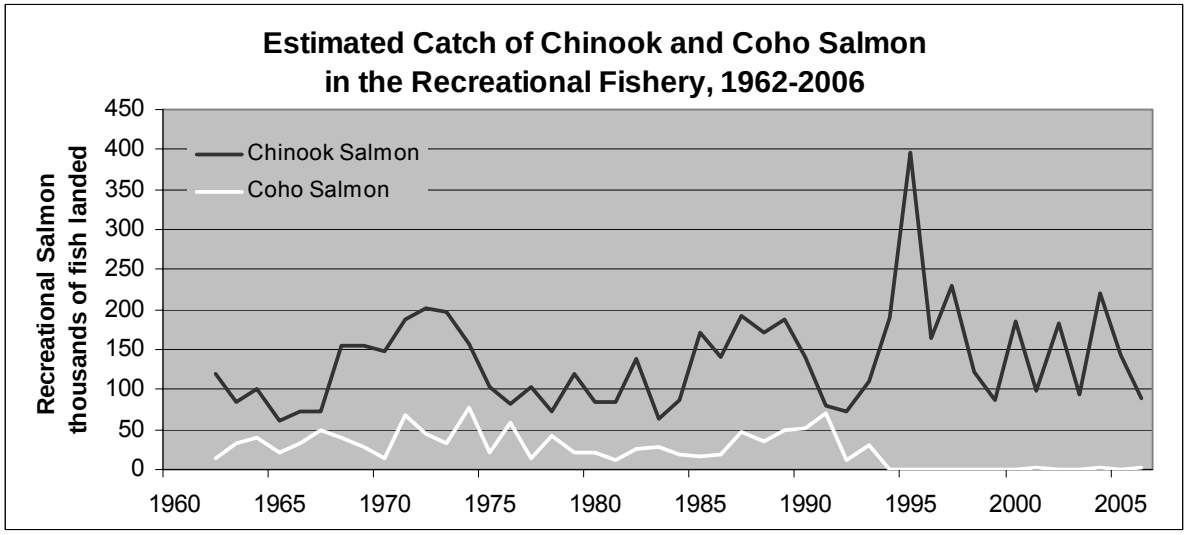

Figure 12.3. Estimated annual catch of Chinook and coho salmon in the California ocean recreational fishery from 1962 to 2006. The take of coho salmon was prohibited after 1995. Data Source: CDFG Ocean Salmon Project.

During the early 1990s, a fishing technique known as mooching began to gain popularity among salmon sport anglers in San Francisco and Monterey Bay areas. Mooching is preferred when salmon are feeding on forage fish, such as anchovies or herring, in nearshore areas. Mooching differs from trolling in that the bait is drifted to resemble dead or wounded prey instead of being pulled through the water to simulate live swimming prey. When trolling, the hook generally sets itself in the mouth of the fish as the salmon attacks the moving prey. Whereas during mooching, line is fed out to the salmon when it strikes to encourage the salmon to swallow the bait and hook. Thus more salmon are gut-hooked when caught by mooching.

Onboard observations conducted by the Department's Ocean Salmon Project (OSP) on CPFVs during 1993-1995 found that 60 percent of the sublegal salmon (<20-inches (51-centimeters) total length) caught via mooching were hooked in the gut or gills. Since studies have shown that 80 to 90 percent of sublegal salmon hooked in the gut or gills die, there was concern that this fishing technique could seriously impact stocks of special concern. Studies conducted by the OSP during 1995-1997 found that the use of circle hooks significantly reduced the hooking mortality on sublegal salmon.

Beginning in September 1997, all sport anglers mooching with bait were required to use circle hooks to reduce the hooking mortality on all released salmon, including coho. The popularity of mooching peaked in 1995 when almost 80 percent

of anglers in the San Francisco and Monterey Bay areas mooched for salmon. In recent years, the proportion of anglers mooching has gradually declined due to a change in the distribution and schooling patterns of salmon off California. Not only have the salmon been more offshore, but the schools have also been more dispersed. In 2006, only 13 percent of anglers mooched for salmon, primarily in the Monterey Bay area.

The State's jurisdiction over tribal commercial fishing in the Klamath Basin was challenged in 1969 when a Yurok tribe member had his gill nets confiscated by the State for fishing on the lower Klamath River. After years of litigation in the lower courts, the issue was decided by the First District Court of Appeals in 1975. The court ruled that the right of a tribal member to fish on a reservation was created by presidential executive order, which was derived from statute and thus not subject to state regulation.

In 1977, the Bureau of Indian Affairs (BIA) took over the management of tribal reservation fisheries in the Klamath Basin and the lower 20 miles of the Klamath River was opened to tribal gill net fishing for subsistence and commercial harvest; however in 1978, the BIA closed the fishery. The so-called Conservation Moratorium remained in effect until 1987 when the BIA reopened commercial fishing by Native Americans on the lower Klamath River. In 1993, the Department of the Interior determined that the Yurok and Hoopa Valley Indian tribes possessed a federally reserved right to take 50 percent of the harvestable surplus of Klamath Basin fall Chinook salmon.

Status of Biological Knowledge

Pacific salmon are anadromous and semelparous (die after spawning). Both Chinook and coho salmon have similar spawning requirements and habits. Successful spawning requires water temperatures less than 56° F (13.3˚ C), clear water, suitable gravel riffles, and a stream velocity sufficient to permit excavation of redds (nests) and provide high subgravel flow to the deposited, fertilized eggs. The female digs the nest, lays the eggs, and covers them after the male fertilizes them. After a period of time, depending primarily on water temperature (usually 50-60 days in California), the eggs hatch into yolk sac larvae (alevins), which remain buried in the gravel until the yolk sac is absorbed. The young salmon (fry) wriggle up out of the gravel and begin feeding on microscopic organisms.

When the salmon are about 2-inches (52-millimeters) long, their backs become brown and their bellies light silver so that they blend inconspicuously with their background. Referred to as fingerlings, the length of stream-residency by these juveniles varies according to species and race. Following a period of rapid growth, the salmon begin changing physiologically in preparation for life in the ocean. A young salmon that has undergone the anatomical and physiological changes that allow it to live in the ocean is called a smolt. Following an instinctive internal cue, the smolts begin migrating in schools downstream towards the ocean.

Many of the fish pause in estuaries, remaining there until the smoltification process is completed. The salmon then enter the sea where they begin a period of rapid growth. After spending 1 to 6 years in the ocean, depending on species, they become sexually mature and begin their arduous journey upriver to their natal stream.

Chinook salmon

Chinook are the largest of the salmon species. The State record for a sport-caught Chinook is 88-pounds (40-kilograms), landed by an angler on the Sacramento River in 1979. The largest Chinook on record is a 127-pounder (58-kilograms) taken from a trap in Alaska.

In California, there are two primary basins that support the majority of the State's Chinook: the Central Valley (Sacramento-San Joaquin rivers and their tributaries) and the Klamath Basin (Klamath-Trinity rivers and tributaries). Chinook are also found in many coastal streams north of San Francisco Bay.

Historically, Chinook spawned as far south as the Ventura River in southern California. Spawning migrations can require minimal effort, with spawning occurring within a few hundred feet of the ocean, or it can be a major undertaking, with spawning occurring hundreds of miles upstream. In addition, dams and other diversion structures can seriously impede the upstream passage of adults by creating physical barriers and confounding migration cues due to changes in river flow and water temperatures.

The female Chinook selects a nesting site that has good subgravel water flows to ensure adequate oxygenation. Since Chinook eggs are larger and have a smaller surface-to-volume ratio, they are also more sensitive to reduced oxygen levels than eggs of other Pacific salmon. Female Chinook will defend their redds once spawning has begun and will stay on the eggs from four days to two weeks, depending on the time in the spawning period.

Spawning adults can be easily chased off redds by minor disturbances which may result in unsuccessful spawning. At the time of emergence, fry generally swim or are displaced downstream, although some fry are able to maintain their residency at the spawning site. As they grow older, the fingerlings tend to move away from shore into midstream and higher velocity areas. Once smoltification is complete, the young Chinook migrate to the ocean, where they tend to be distributed deeper in the water column than other Pacific salmon species.

Chinook spend 2 to 6 years at sea before returning to spawn in their natal streams. The small percentage of Chinook that mature at age two are predominately males and are commonly referred to as "jacks" or "grilse." The older age classes of Chinook are generally composed of equal proportions of males and females.

Ocean fisheries can have a significant impact on the average age of spawning Chinook because ocean-fishing gear often selects for larger, older fish. In

addition, minimum size limits allow for the harvest of Chinook in the sport fishery starting at age two (≥20-inch (51-centimeter) minimum) and in the commercial fishery at age three (≥26-inch (66-centimeter) minimum). As ocean harvest rates increase, the average age of adult spawners declines. Fish destined to mature at age five must survive two more years of ocean fisheries than fish destined to mature at age three. It has not been documented that the selectivity of the ocean fisheries for older maturing fish has adversely affected the genetics of the populations, but it has probably reduced the utilization of spawning habitats that are best suited for larger, older fish. Larger fish, for example, are probably better able to utilize the larger gravel found in the main stems of most river systems. High rates of ocean harvest in recent decades have led to the virtual disappearance of five-year-olds in Chinook salmon runs throughout the State.

All Pacific salmon exhibit a strong tendency to return at a specific time each year to spawn in their natal streams. This has resulted in the development of distinct stocks, or populations, within each species that are, to varying degrees, both reproductively and behaviorally isolated. Stocks are often grouped into "runs" based on the time of the year during which their upstream spawning migration occurs. In California, there are four distinct Chinook runs: fall, late-fall, winter, and spring. In a river where all four runs of Chinook spawn, adults migrate upstream and juveniles migrate downstream during almost all months of the year. The timing of Chinook spawning is often influenced by stream flow and water temperature, and therefore varies somewhat from river to river, and even within river systems.

All four runs are found in the Central Valley basin, with fall run being the most numerous. Although relatively large numbers of winter and spring Chinook occurred historically in the upper Sacramento drainage, they were significantly reduced by the construction of Shasta Dam in 1945. Spring Chinook also existed in the San Joaquin River basin but the completion of Friant Dam in 1942 contributed to the run's subsequent extirpation. Late-fall Chinook are found primarily in the upper Sacramento River.

In the Klamath Basin, only fall and spring Chinook are found; the abundance of both runs reduced by barrier dams built in upper river areas during the late 1800s. On the coast, fall runs exist in the Eel, Mad, and Smith rivers. Spring Chinook also appear occasionally in the Eel and Smith rivers. Smaller coastal rivers have only fall Chinook.

Fall run. Fall Chinook salmon are the most numerous salmon in California today. They arrive in spawning areas between September and December,

depending upon the river system, but peak arrival time is usually during October and November. Spawner escapement is generally dominated by three-year-old fish followed by jacks (age 2) and four-year-olds. Five-year-old fish are rare. Spawning occurs in the main stem of rivers, as well as in tributaries, from early October through December. In general, there is a large outmigration of fry and fingerlings from the spawning areas between January and March. An additional outmigration from the spawning areas, consisting primarily of smolts, occurs from April through June. The juveniles enter the ocean as smolts between April and July.

Late-fall run. Late-fall Chinook arrive in upper-river spawning areas between October and mid-April. The runs tend to consist of equal numbers of three- and four-year-old fish. Spawning occurs from January through mid-April, primarily in the main stem of the Sacramento River. Some of the juveniles start migrating seaward as fry during May, but the bulk of the juveniles leave the upper river between October and February. Late fall smolts enter the ocean between November and April.

Winter run. Winter Chinook salmon are unique to the Sacramento River system. Adults arrive in the upper Sacramento River spawning area from mid-December through early April, with a peak in March. Spawning occurs primarily in the main stem of the upper Sacramento River below Keswick Dam between late-April and mid-August. May and June are peak spawning months. The juveniles migrate seaward from early July though the following March, but the bulk of the juveniles move seaward in September. Winter run smolts enter the ocean between December and May. The adults mature and spawn primarily as three-year-olds, unlike the other races, which include many four-year-old fish.

Spring run. Spring Chinook salmon arrive in the spawning areas between March and June, with the peak time of arrival usually occurring in May or June, depending upon flows. They rest in the deep, cooler pools during the summer and then move onto the gravel riffles and spawn between late August and early October. Emergence of fry varies among drainages with fry emerging in some tributaries as early as November, while fry in other areas wait until late March to appear. Juveniles either exit their natal tributaries soon after emergence or remain throughout the summer, exiting the following fall as yearlings, usually with the onset of storms starting in October. Yearling emigration from the tributaries may continue through the following March, with peak movement usually occurring in November and December. Juvenile emigration alternates between active movement, resting and feeding. Juvenile salmon may rear for up to several months within the Delta before ocean entry. Spring Chinook runs tend to be dominated by three-year-old fish followed by four-year-olds and jacks.

Ocean distribution. The development and widespread use of the coded wire tags (CWT) since the mid-1970s have provided extensive data on the ocean distributions of Pacific coast salmon stocks. Recovery of CWTs in ocean salmon fisheries has provided a better understanding of the temporal and spatial distribution of various Chinook stocks, particularly those from the Central Valley and Klamath

Basin. For example, although Central Valley fall Chinook are distributed primarily off of California and Oregon, they are also frequently recovered off Washington and British Colombia. A few fish have even ventured as far north as Alaska. Klamath River fall Chinook are more narrowly distributed primarily between Cape Falcon, Oregon and Point Sur, California. Ocean conditions have also been shown to affect the ocean distribution patterns of these and other Pacific coast salmon stocks.

Coho salmon

Coho salmon are smaller than Chinook salmon; the average size of a mature coho is 7- to 12-pounds (3.2- to 5.4-kilograms). The California record for a sport-caught coho salmon is 22-pounds (10-kilograms), taken on Paper Mill Creek (Marin County) in 1959. The world record is a 33-pound (15-kilogram) coho caught by a sport angler in British Columbia in 1989.

In California, coho spawn in suitable streams from northern Monterey Bay northward, but they are rarely found in the Central Valley basin. Coho enter many small coastal streams that are not utilized by Chinook, but they also spawn in some larger river systems where Chinook occur. Compared to Chinook salmon, there are relatively few coho in California today. Most California streams utilized by coho salmon are short in length, but some coho do make relatively long migrations, particularly into the Eel River system. Many smaller coastal rivers have runs of coho salmon that enter during brief periods after the first heavy fall rains and move upstream.

Within California river systems, coho salmon populations include only one run, which is generally consistent as to spawning area used and time of spawning. Most spawning occurs between December and February. The juveniles usually spend a little more than a year in freshwater before migrating to the ocean; a few spend two years. Most coho mature at the end of their third year of life. Coho salmon older than three years are relatively rare. A few males, or grilse, mature at age two.

Genetic analysis of California coho populations has indicated a wide degree of mixing of the stocks in the past, probably reflecting historical stocking and transplantation practices involving hatchery fish. Recovery of CWTs from California hatchery coho stocks have shown that they were historically harvested in the ocean fisheries during their third year of life. Some were caught as far north as the central Washington coast, but most were recovered within 100 miles (161 kilometers) of the stream from which they entered the ocean.

Status of Spawning Populations

In the Central Valley, a multitude of factors have contributed to the decline of salmon stocks. These include unscreened irrigation diversions in the Sacramento Valley, the Delta and in the San Joaquin Valley; poor or lost gravel deposition in salmon spawning and rearing areas; pollution; aberrant river flow fluctuations caused by alternating water-release schedules from dams to meet downstream water-quality standards and water diversion contracts; elevated water temperatures stemming from power generation operations and reduction in cold water storage as reservoirs are emptied to meet agricultural contracts; and impediments to migration such as dams or diversions. The massive export of water from the southern Sacramento-San Joaquin Delta has probably been the greatest cause of decline in Central Valley salmon.

Red Bluff Diversion Dam on the upper Sacramento River continues to be a significant impediment to adult upstream migration, a major point of diversion and loss of downstream migrating juveniles, and a haven for predatory Sacramento pikeminnow, *Ptychocheilus grandis,* and non-native striped bass*, Morone saxatilis*. Lifting of the gates at this facility has been implemented in the fall through spring to protect all races of Chinook; however, the Bureau of Reclamation has determined that current dam operations do not adequately allow passage of ESA listed species. To help address this issue, the Bureau of Reclamation and the Tehama-Colusa Canal Authority developed an Environmental Impact Statement in 2002 to generate options that maximized fish passage while minimizing impacts to the agricultural irrigation supply. Following an extended public review and comment period, an option was selected that raised the gates for 10 months (closed July and August) and added a new pumping station to provide agricultural water.

Central Valley Fall Chinook. Fall Chinook are the most abundant of the four races of Central Valley salmon (Figure 12.5), spawning predominately in the Sacramento River basin. The run is heavily supplemented by production at five hatcheries. The spawning populations of fall Chinook in the Sacramento River and San Joaquin drainages averaged about 362,000 from 1952 to 1959; 270,000 from 1960 to 1969; 210,400 from 1970 to 1979; 255,000 from 1980 to 1989; 259,700 from 1990 to 1999; and 519,100 from 2000 to 2006. The average run size during the last decade was nearly double that observed the previous three decades; however this was due primarily to enormous runs (greater than 575,000) during 2001-2003. Although the escapement in 2006 was near the 30-year average (268,200 spawners), it also included the lowest number of jacks on record.

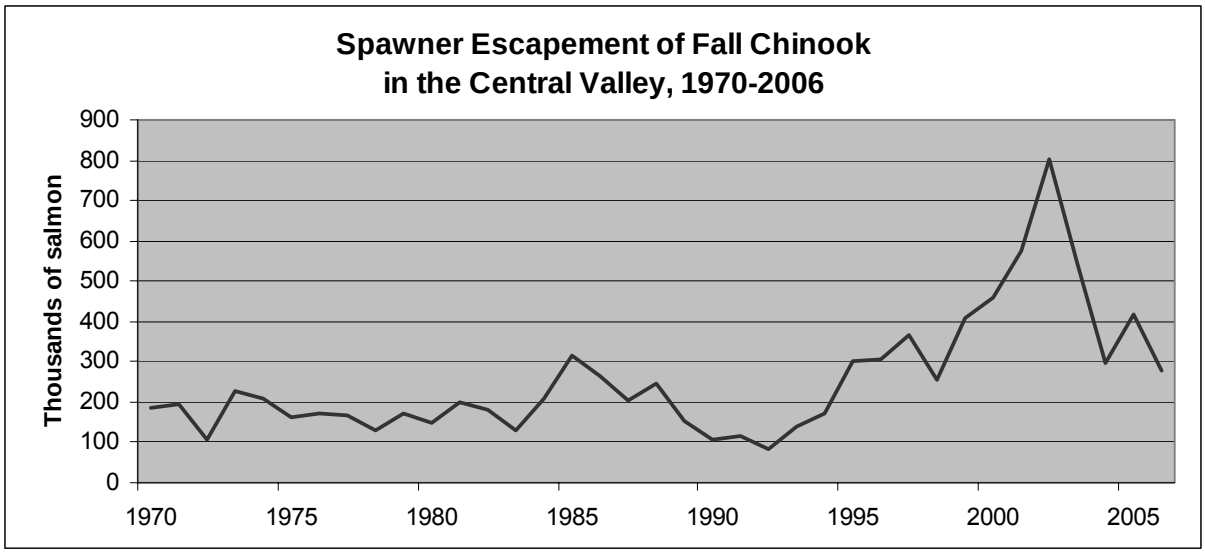

Figure 12.5. Escapement of Fall Chinook to the Central Valley from 1970 through 2006. Data Source: CDFG.

Central Valley Late-fall Chinook. Late-fall Chinook spawn primarily in the main stem Sacramento. The run, which was not identified until the construction of a dam and fish ladder at Red Bluff enabled monthly counts of spawners, averaged between 10,000 to 15,000 spawners with some years seeing as many as 40,000 spawners (Figure 12.6). The late-fall run is highly variable, but has been on an increasing trend since the severe decline in the mid-1990s. More recent estimates of run size have been made difficult by changes in the operation of the Red Bluff Diversion Dam.

Sacramento River Winter Chinook. Winter Chinook was the first anadromous fish to receive protection under the Federal Endangered Species Act (ESA) in 1989, immediately following its listing under the California Endangered Species Act (CESA) the same year. Winter Chinook no longer exist in any of its original spawning habitat above Shasta Dam and the run persists only because of the new habitat created by cold water releases from the dam into the mainstem Sacramento River. The spawning populations below Shasta declined from an average of 28,000 fish observed in the 1970s to only a few hundred in the early 1990s. More recently, spawning populations have been on the increase and averaged 7,400 from 2001 to 2006 (Figure 12.6). Because of the winter Chinook's unique life history, ocean fisheries are structured to target more abundant fall Chinook during spring and summer months, reducing the impact on this listed stock.

Central Valley Spring Chinook. Spring Chinook, which were historically the second most abundant run, now spawn in relatively small numbers in streams in the northern Sacramento River basin. Spawning populations are extremely variable but have been on an upward trend since the late 1990s, particularly the Deer and Butte Creek stocks (Figure 12.6). Spring Chinook are listed as threatened under the ESA

(1999) and CESA (1999).

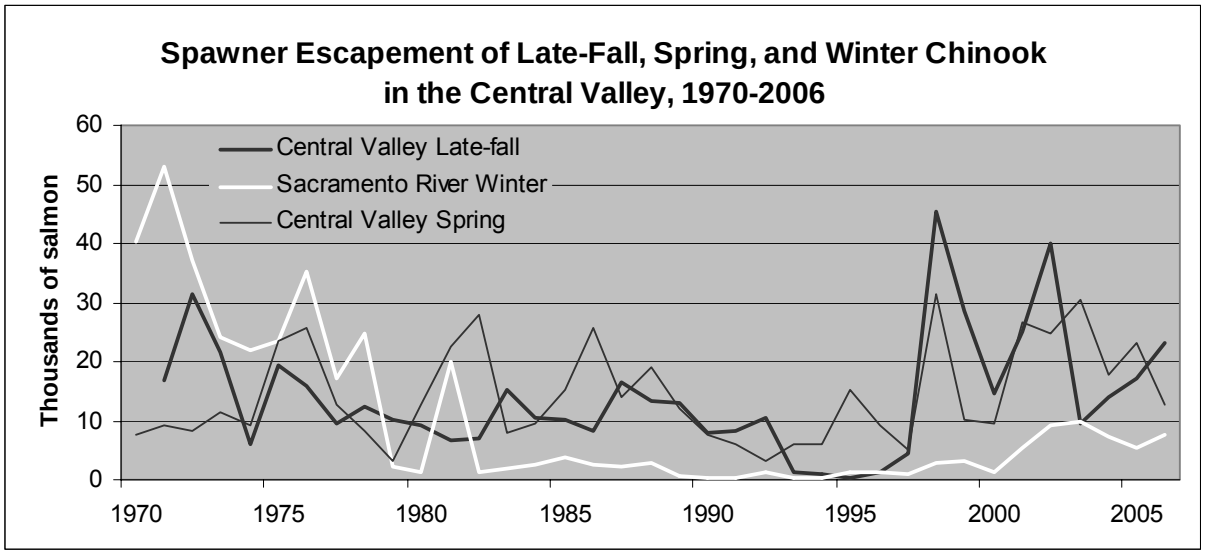

Figure 12.6. Escapement of Central Valley late-fall Chinook, Sacramento River winter Chinook and Central Valley spring Chinook from 1970 through 2006. Data Source: CDFG.

Declines in coastal river Chinook and coho salmon populations have been caused by many of the same factors as the Central Valley. In addition, these areas have been affected by past and, in some instances, present timber harvest practices. These practices have reduced stream shading, resulting in high temperatures, and have accelerated erosion and filling of pools.

Coastal Chinook and Coho Populations. Coastal California streams support small populations of coho and Chinook salmon. Habitat blockages, logging, agriculture, urbanization and water withdrawals have resulted in widespread declines of both species. All coastal coho populations in California are listed as threatened under the ESA (1996 and 1997) and coho south of San Francisco are listed as endangered under CESA (1995). California Coastal Chinook, which include northern California coastal streams between and including Redwood Creek and the Russian River, are listed as threatened under the ESA (1999). Spawning population estimates are limited for coastal Chinook to nonsystematic surveys of a few tributaries of the Mad and Eel rivers.

Klamath Basin. The Klamath Basin has two hatcheries and supports fall and spring run Chinook within its two primary rivers, the Klamath and Trinity. The adult spawning populations of fall Chinook in the Klamath Basin ranged from a low of 18,100 (hatchery and natural) in 1991 to almost 199,700 in 1995. The population seems to be cyclical with several years of high spawners followed by several years of low numbers of returning fish (Figure 12.7).

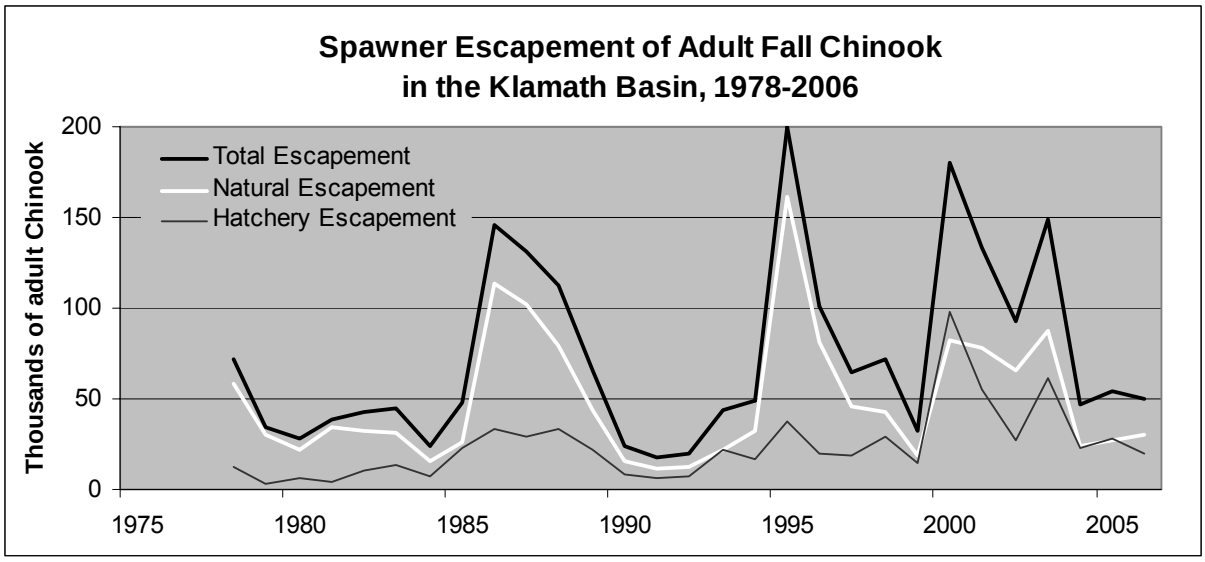

Figure 12.7. Escapement of adult fall run Chinook in the Klamath Basin from 1978 through 2006. Data Source: CDFG.

In 2002, an unprecedented fish-kill in the Klamath Basin of approximately 35,000 salmon, among other fishes, died prior to spawning primarily due to disease outbreaks as a result of reduced water flow and high fish density. The two responsible pathogens were the myxozoan parasite, *Ichthyopthirius multifilis* , (commonly referred to as Ich) and a bacterial pathogen, *Flavobacterium columnare* (columnaris). These two common pathogens are found in the Klamath River at all times, but rarely cause significant problems unless other factors such as stressful environmental conditions are present. Reduced water flow, resulting in warm water temperatures, coupled with high fish densities created an ideal condition for the spread of disease which ultimately resulted in the fish-kill. The Shasta River, an important spawning stream in the upper Klamath, has historically supported over 63,000 adults, but only 700 adult Chinook spawned there in 2006. Spring Chinook in the Trinity and Salmon rivers in the Klamath Basin have also been at very low levels in recent years and are largely supported by hatchery production.

Salmon Management

In 1947, the Pacific Marine Fisheries Commission (PMFC) was formed by the states of Alaska, Washington, Oregon, Idaho and California. The primary objective of the alliance was to make better use of the marine resources shared by the member states. Prior to that time, there was minimal coordination of marine fishing regulations between the states, including season dates and size limits. The first commercial salmon recommendation of the PMFC was a 26-inch (66-centimeter) total length minimum size limit and a March 15 to October 31 maximum season length for Chinook. For many years the states uniformly adopted the 26-inch (66-centimeter) standard and an April 15 opening date for commercial Chinook fishing

with a general September 30 closing date.

In 1976, the Magnuson Fishery Conservation and Management Act (Act) established the Exclusive Economic Zone and the authority of the Secretary of Commerce to manage fisheries covered under federal fishery management plans from 3 to 200 miles (5 to 322 kilometers) offshore. The Act created regional fishery management councils to develop fishery management plans and recommend fishing regulations to the states, Native American tribes, and the National Marine Fisheries Service (NMFS). Thus the Pacific Fishery Management Council (PFMC) was created with management authority over the federal fisheries off the coasts of Washington, Oregon and California. Representation on the PFMC currently includes the chief fishery officials of California, Idaho, Oregon, and Washington, the NMFS, a Native American representative, and eight knowledgeable private citizens. The PFMC receives advice from a Salmon Technical Team (STT) and a Salmon Advisory Sub-panel composed of various industry, tribal, and environmental representatives.

The PFMC's Salmon Fishery Management Plan (FMP) was developed in 1977 and was the first FMP developed by the organization. The PFMC annually develops management measures that establish fishing areas, seasons, quotas, legal gear, possession and landing restrictions, and minimum lengths for salmon taken in federal waters off Washington, Oregon, and California. The management measures are intended to prevent overfishing while achieving optimum yield and to allocate the ocean harvest equitably among ocean commercial and recreational fisheries. The measures must meet the goals of the FMP that address spawning escapement needs and allow for freshwater fisheries. The needs of salmon species listed under the federal Endangered Species Act (ESA) must also be met as part of the process. The measures recommended to the NMFS by the PFMC must be approved and implemented by the Secretary of Commerce.

In 1979, a moratorium was placed on the issuance of permits to new participants in the ocean commercial salmon fishery. This was done primarily to reduce the overall fishery impacts on the resource and ensure sustained income for participating trollers. During the 1980s, California ocean salmon fisheries were increasingly regulated under quotas and area closures; and in 1983, a limited-entry program was implemented that capped the fishery at just over 4,600 commercial salmon vessels.

Klamath River fall Chinook (KRFC) was one of the first salmon stocks to be managed under the PFMC's Salmon FMP in 1983. The FMP's conservation objective requires that a minimum of 35,000 KRFC adults return to spawn in natural areas each year. In addition, there can be no more than a 67 percent natural spawner reduction rate in the ocean fisheries. The ocean fisheries must also be managed to provide for the federally reserved fishing rights of the Yurok and Hoopa Valley Indian tribes (i.e., 50 percent of the allowable KRFC harvest). Both in the early 1990s and between 2004 to 2006, Klamath fall Chinook failed to meet their adult spawner escapement objective. During the 2006 management cycle, it was

predicted that the KRFC would not meet their spawner escapement goal, even with the complete closure of all ocean fisheries. An emergency rule was issued by NMFS that allowed PFMC to structure the ocean fisheries so that no less than 21,000 KRFC adults return to spawn in natural areas the following fall.

The FMP also established a conservation objective for Sacramento River fall Chinook. It requires that ocean fisheries are managed to allow a range of 122,000 to 180,000 natural and hatchery adults return each year to spawn. This goal has been met every year since 1992.

With the listing of Sacramento River winter Chinook as endangered under ESA and CESA in 1989, a new dimension was added to salmon management. The ESA requires that NMFS assess the impacts of ocean fisheries on listed salmon populations and develop standards that avoid the likelihood of jeopardizing their continued existence. The initial ESA jeopardy standard for winter Chinook required a 31 percent increase in the adult spawner replacement rate relative to the observed mean rate for 1989 to 1993. To meet the goals of this standard, additional restrictions were placed on California's commercial and recreational fisheries, including increased minimum size limits designed to protect the smaller-at-age winter Chinook.

In April 2000, NMFS placed a cap on the ocean harvest rate (≤16 percent) of age-4 Klamath fall Chinook to protect California coastal Chinook stocks. Since information on California coastal Chinook was very limited, Klamath fall Chinook were considered the best surrogate for estimating fishery impacts on these stocks. In 2002, the NMFS modified the winter Chinook jeopardy standard to include season opening and closing date restrictions, in addition to minimum size limits, to provide additional protection to this endangered stock.

There are currently 16 Evolutionarily Significant Units (ESUs) of salmon under the ESA. As the listings have occurred, NMFS has initiated formal consultation standards and issued "Biological Opinions" that consider the impacts resulting from implementation of the FMP or from annual management measures to listed salmon stocks. NMFS has also reinitiated consultation on certain ESUs when new information becomes available on the status of the stocks or on the impacts of the FMP on these stocks. Amendment 12 of the FMP added the generic category "species listed under the ESA" to the list of stocks in the salmon management unit and modified respective escapement goals to include "manage consistent with NMFS jeopardy standards or recovery plans to meet immediate conservation needs and long-term recovery of the species." Amendment 14 of the FMP specified those listed ESUs and clarified which stocks in the FMP management unit were representative of the ESUs.

The NMFS has concluded that the harvest of the relatively abundant Central Valley fall Chinook stocks could continue at reduced levels in California's ocean fisheries without jeopardizing the recovery of listed Chinook and coho populations. The California Fish and Game Commission, PFMC and NMFS have implemented various protective regulations to reduce fishery impacts on California populations of

Central Valley winter and spring Chinook, and coastal Chinook and coho, all of which are listed. In 1992, the PFMC began to severely curtail the ocean harvest of coho salmon in California due to the depressed condition of most coastal stocks. In anticipation of the federal listing of California coho salmon stocks, the NMFS extended the protective measures to a complete prohibition of coho retention off California.

SALMON: DISCUSSION

Challenges to Inland Salmon Management

Maintaining salmon runs in California depends on the restoration and preservation of the State's rivers and streams as living systems. A poor law or regulation affecting fishing can be changed long before the damage it causes becomes permanent, but a stream that is blocked near its mouth by an impassable dam will produce no more salmon. A stream kept dry through the spawning season by diversion is no better, but may prove salvageable if water can eventually be provided. Diverting all the water from a stream during the downstream migration period of juveniles will prevent any of them from reaching the ocean, even if adequate fish screens are in place to keep them from entering the irrigation canals. Reducing stream flows or removing vegetation that provides shade may result in a stream becoming too warm for salmon. Siltation from logging or road construction can smother salmon eggs and suppress production of aquatic invertebrates upon which the young fish depend for food. The decline in California's salmon populations vary somewhat from river to river, but there are two major causes: (1) destruction or loss of habitat, and (2) water diversion.

Substantial efforts have been made during the past two decades to ensure that the ecological requirements of anadromous fish receive equal consideration with other economic and social demands placed on the State's water resources. The Central Valley Improvement Act of 1992 required a program designed to double natural production of anadromous fish in Central Valley streams. In 1995, the federal government and California initiated the CALFED Bay-Delta program to address environmental and water management problems associated with the Bay-Delta system. The primary mission is to develop a long-term comprehensive plan that will restore ecological health and improve water management for the beneficial uses of the Bay-Delta system. In 2002, the Legislature created the California Bay-Delta Authority to oversee implementation of the Bay-Delta Program, and two years later, Congress approved a 30-year plan that includes goals and science-based planning to facilitate collaborative and informed decisions for future Bay-Delta projects. In 2006, a ten-year action plan was developed to help chart a course for the CALFED, including addressing water supply and ecosystem functioning problems. To date, the CALFED has invested more than $850 million dedicated to improving water quality and restoring habitats, among other local improvement

projects. Projects include providing fish passage ways including dam removal, installing fish screens, aquatic and riparian habitat restoration, channel dynamic and sediment transport improvements, floodplain and bypass restoration, agricultural modifications, local watershed planning, improving natural flow regimes, recovering water and sediment quality, environmental water management, fishery monitoring and temperature control of water releases.

Many similar improvements have also been made in the Klamath Basin. The Trinity River Basin Fish and Wildlife Restoration Act was enacted in 1984 to restore fish populations to levels existing prior to the diversion of water to the Central Valley. In 1986, Congress adopted the Klamath River Basin Fishery Resources Restoration Act, a 20-year-long cooperative program to restore anadromous fisheries within the Basin. With a $21 million budget, many conservation projects were completed including in-stream, riparian, and upland protection and restoration, fish rearing, water conservation and water quality improvement, assessment and research, and community education. The "Klamath Act" also created the Klamath Fishery Management Council (KFMC) and several advisory groups, including the Klamath River Technical Advisory Team (KRTAT) and the Klamath River Basin Task Force (KRBTF). The KFMC provides guidance to the PFMC regarding allocation among user groups to help achieve efficient and effective use of the Basin's resources. In September of 2006, the Klamath Act expired and was not reauthorized by Congress; thus the KFMC, KRTAT, and KRBTF no longer officially exist.

Although the listing of salmon populations under the ESA has meant new restrictions on recreational and commercial fishing, it has also provided a mechanism for addressing the effects of dams, irrigation diversion, logging, gravel extraction, road construction, etc. on aquatic environments. Species management under provisions of the ESA requires that existing and proposed federal actions and permitted activities be conducted in a manner that will not jeopardize the continued existence of the animal or result in the destruction or adverse modification of habitat essential to the continuation of the species. Federal agencies must consult with NMFS when they propose to authorize, fund, or carry out an action that could potentially adversely affect listed salmon or steelhead. Likewise, state-sponsored activities that might affect state-listed species must be reviewed under the provisions of CESA.

Hatchery fish have been important to maintaining ocean and in-river fisheries, but have incorrectly been perceived as a viable alternative to maintenance of natural spawning populations. Unfortunately, a successful hatchery program can mask the decline in the natural run due to straying of the returning adults, and this appears to be the case for Chinook in many areas of the Central Valley and the Klamath River basin. Hatchery adults spawning in the wild can compete with naturally produced fish for adult spawning and juvenile fish rearing areas. Interaction of hatchery and naturally produced salmon is most acute in the close vicinity of the rearing facilities. Battle Creek below Coleman Hatchery and Bogus Creek adjacent to Iron Gate Hatchery typically are overloaded with spawning fish each fall due to straying of

hatchery adults. To help mitigate these issues, the Central Valley hatcheries have modified operating procedures to accept all returning fish to reduce competition and help protect the genetic integrity of naturally spawning stocks. In addition, the Central Valley has initiated a Constant Fractional Marking (CFM) program to aid in determining the success of restoring naturally spawning populations. The CFM program will allow fishery managers to determine the contribution of hatchery and natural fish in the spawning population, and thus determine the success of habitat restoration efforts.

Trucking operations in the Central Valley have greatly increased hatchery fish survival by reducing in-stream losses of fish to diversions and predators. However, these operations have also reportedly increased the rate of straying of returning adults, possibly to the detriment of the naturally produced fish. As a result of reviewing off-site release data, it was determined that the risks posed to natural populations seemed to outweigh the benefits from increased survival of off-site releases. The CDFG and NMFS have advised all California hatcheries to release fish at or near the hatchery whenever feasible.

Many salmon sport anglers are attracted to rivers from Santa Cruz County north. Historically, almost half of the effort was in the Sacramento-San Joaquin River System. Most of this activity occurs upstream from the city of Sacramento. The main stem of the Sacramento River is the most important Central Valley stream, followed by the Feather and American rivers. In 2006, the Central Valley creel census was reinstated to provide improved estimates of inland fishing effort and harvest. Of the coastal streams, the Klamath Basin receives by far the most effort, followed by the Smith and Eel. Much of the fishing in coastal river systems occurs in estuaries. The Klamath and Smith river mouths draw large numbers of anglers from great distances and concentrate them in a small area. The term "madhouse" is appropriate during the peak of a good run. The catch in both of these rivers consists primarily of Chinook salmon.

Challenges to Ocean Management

Ocean salmon fisheries harvest a mixture of stocks that can differ greatly in their respective abundance and productivity. It has long been recognized that the management of mixed stock salmon fisheries is difficult and complex; fisheries supported by hatcheries can deplete less productive, naturally produced stocks unless programs are in place to monitor and evaluate their status and make necessary adjustments in harvest. Ideally, some differences in the spatial and temporal distribution of “strong” and “weak” stocks exist that allow managers to develop measures that selectively protect stocks of concern. When faced with the difficulties of estimating ocean distribution and presence of salmon from weak stocks, fishery managers prefer a precautionary approach to reduce ocean harvest rates to levels sufficiently low that ocean impacts are unlikely to extinguish these weak ESA populations of salmon.

Ocean abundance estimates are not available for most of California's listed salmon and harvest rates on these stocks are subject to speculation. Determining levels of harvest that are appropriate for recovery is challenging. Without age-specific mortality and population size estimates, it is difficult to assess the relative effects of harvest, improvements in freshwater habitats, or changes in ocean productivity or precipitation. An incremental approach to harvest reductions seems to have produced encouraging results with respect to winter Chinook. At the time of listing, spawning populations were estimated at less than 200 fish. In 2006, more than 17,000 winter Chinook returned to spawn in the Sacramento River.

In 2005, a pilot-study was initiated by the Department and CALFED to determine the age structure of all Central Valley Chinook, including the listed winter and spring Chinook. Age-specific data will aid in determining population size, hatchery/natural proportions, and ocean abundance by age, similar to the Klamath Basin program currently in place.

During the last several years, there have been several test fisheries conducted in California to evaluate the use of Genetic Stock Identification (GSI) in ocean fisheries management. There are many distinct salmon stocks off California and although population sizes vary year to year, some of these stocks are relatively productive and could support a substantial fishery while others cannot withstand much fishing pressure at all. These stocks co-mingle along the coast and, at the time of harvest, it is usually impossible to determine which salmon come from abundant stocks and which come from weaker stocks in need of protection. Regulations are crafted each year to protect the weak stocks, using the best available information from CWTs and modeling outputs based on past fishing seasons. This sometimes results in severely constraining fishermen's access to more abundant salmon stocks. The GSI technology for identifying Chinook stocks is now developed to the point where it may be potentially useful for fishery management. Genetics labs from Alaska to California have collaborated on a coastwide data base that includes over 120 Chinook stocks on the Pacific coast. However, when stocks of special concern are at extremely low abundance and comprise a very small fraction of ocean catches, even GSI methods are unlikely to produce accurate estimates of ocean impacts on these populations. Although these challenges exist, a great deal of effort has been placed on continuing and improving GSI studies, and may become a component of ocean fishery management in the future. The long-term goal is to increase the information available to managers on the temporal and spatial distribution of west coast salmon stocks.

Although the KRFC escapement in 2006 surpassed the lowered floor of 21,000 adult natural spawners established by NMFS emergency action, it was the third consecutive year that the KRFC missed the FMP conservation objective spawner floor of 35,000 natural adults. As a result, the stock was declared overfished which automatically triggered an overfishing review and rebuilding plan by the PFMC's STT. This report is to be completed by March 2008. In addition, after multiple public hearings and a thorough environmental assessment, the PFMC

recommended and NMFS approved a FMP amendment that allows for the limited harvest of KRFC in ocean salmon fisheries whenever shortfalls are projected. This amendment increases the flexibility in the rule-making process whenever KRFC conservation goals are not expected to be met and would provide for a de minimus, or limited, fishery. Amendment 15 of the FMP is intended to allow PFMC to continue fishing without the need for NMFS to approve an emergency rule.

Ocean salmon fishery managers must continually be prepared to respond to changes in the fisheries. Likewise, the ocean environment continues to change, physically as well as biologically. Relative to the salmon resource, coastal water quality needs to be monitored and protected. There also appear to be increasing conflicts between ocean fishermen, both recreational and commercial, and marine mammals, in particular harbor seals and California sea lions. Federal legislation aimed at protecting these animals has been very effective in increasing their numbers and has led to increased depredation on sport- and commercially-hooked salmon. Most of the problems have been in the marine area, particularly in the Monterey-San Francisco region, but problems have also occurred in some lower river areas, such as the Klamath River estuary where tribal and sport anglers harvest salmon.

Specific Management Recommendations

The major threat to California's salmon resource continues to be degradation and elimination of freshwater and estuarine habitats. Restoration of inland spawning and rearing habitats and renegotiation of inland water management policies, particularly in the Klamath Basin, must be pursued if salmon production levels from naturally spawning areas are ever to return to their former levels. Prudent regulation of the fisheries will be required to equitably distribute the available fish between the various ocean and in-river users and to meet spawning escapement needs. To these ends, the California Department of Fish and Game should:

1) Continue its efforts to improve, restore, and enhance freshwater and estuarine habitats for salmon. Specific focus should be on:
   a. Maintenance and improvement of suitable stream flows and temperatures
   b. Screening of water diversions
   c. Participation in discussions regarding water diversion contracts
   d. Abatement of pollution sources, chemical and thermal
   e. Reductions in siltation and gravel compaction levels
   f. Control of naturally occurring diseases such as Ich and columnaris, and preventing Infectious Hematopoetic Necrosis (IHN) and bacterial kidney disease (BKD) in the hatcheries.
2) Continue development and implementation of plans addressing habitat and fishery management to reverse the status of depleted salmon stocks, in particular Klamath Basin and Central Valley spring Chinook, Sacramento winter Chinook and California Coastal Chinook and coho stocks.

3) Support studies to determine the run size at age, particularly for stocks in the Central Valley.
4) Continue funding of Central Valley monitoring programs and CWT constant fractional marking.
5) Develop cohort reconstruction and ocean harvest models for key California salmon stocks.
6) Operate hatcheries and rearing facilities and conduct fish stocking practices responsibly to minimize effects on natural production.

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Table 12.1. Commercial Salmon Harvest in Pounds (Page 1 of 3)						
Year	Chinook	Coho	Ocean Total [a]	Sacramento	Klamath [b]	Total
1916	----	----	5,592,216	3,450,786	1,896,592	10,939,594
1917	----	----	6,085,997	3,975,487	999,097	11,060,581
1918	----	----	5,933,346	5,938,029	1,221,813	13,093,188
1919	----	----	7,208,382	4,529,222	1,408,123	13,145,727
1920	----	----	6,066,190	3,860,312	1,207,317	11,133,819
1921	----	----	4,483,105	2,511,127	996,700	7,990,932
1922	----	----	4,338,317	1,765,066	131,741	6,235,124
1923	----	----	3,736,924	2,243,945	1,109,391	7,090,260
1924	----	----	6,374,573	2,640,110	1,000,586	10,015,269
1925	----	----	5,481,536	2,778,846	126,371	8,386,753
1926	----	----	3,863,677	1,261,776	958,626	6,084,079
1927	----	----	4,921,600	920,786	669,543	6,511,929
1928	----	----	3,444,306	553,777	480,483	4,478,566
1929	----	----	4,033,660	581,497	429,714	5,044,871
1930	----	----	4,085,650	1,213,698	703,546	6,002,894
1931	----	----	3,666,841	941,605	686,065	5,294,511
1932	----	----	2,649,204	1,264,987	703,990	4,618,181
1933[c]	----	----	3,657,661	454,253	446,520	4,558,434
1934	----	----	3,921,530	397,572	-	4,319,102
1935	----	----	4,773,112	888,868	-	5,661,980
1936	----	----	4,093,475	949,179	-	5,042,654
1937	----	----	5,934,996	974,871	-	6,909,867
1938	----	----	2,170,921	1,668,376	-	3,839,297
1939	----	----	2,238,755	496,933	-	2,735,688
1940	----	----	5,160,393	1,515,588	-	6,675,981
1941	----	----	2,946,030	844,963	-	3,790,993
1942	----	----	4,063,306	2,552,944	-	6,616,250
1943	----	----	5,285,527	1,295,424	-	6,580,951
1944	----	----	7,021,848	3,265,143	-	10,286,991
1945	----	----	7,912,754	5,467,960	-	13,380,714
1946	----	----	7,196,527	6,463,245	-	13,659,772
1947	----	----	8,104,297	3,380,484	-	11,484,781
1948	----	----	5,860,915	1,939,801	-	7,800,716
1949	----	----	5,531,021	899,090	-	6,430,111
1950	----	----	5,867,346	1,202,890	-	7,070,236
1951	----	----	5,849,530	1,343,171	-	7,192,701
1952	5,785,214	751,677	6,536,891	738,081	-	7,274,972
1953	6,335,634	800,589	7,136,223	896,696	-	8,032,919
1954	8,167,724	431,855	8,599,579	900,961	-	9,500,540
1955	9,245,882	411,114	9,656,996	2,320,746	-	11,977,742
1956	9,814,366	460,536	10,274,902	1,139,585	-	11,414,487
1957	4,640,709	536,200	5,176,909	321,824	-	5,498,733

1958	3,576,385	80,456	3,656,841	----	-	3,656,841
1959[d]	6,543,223	225,476	6,768,699	463	-	6,769,162

Table 12.1. Commercial Salmon Harvest in Pounds (Page 2 of 3)

Year	Chinook	Coho	Ocean Total [a]	Sacramento	Klamath [b]	Total
1960	6,096,384	125,061	6,221,445	-	-	6,221,445
1961	8,100,964	536,943	8,637,907	-	-	8,637,907
1962	6,301,520	371,341	6,672,861	-	-	6,672,861
1963	6,829,048	1,019,642	7,848,690	-	-	7,848,690
1964	7,562,445	1,918,770	9,481,215	-	-	9,481,215
1965	8,102,205	1,571,469	9,673,674	-	-	9,673,674
1966	5,979,027	3,467,427	9,446,454	-	-	9,446,454
1967	3,866,374	3,375,944	7,242,318	-	-	7,242,318
1968	4,612,488	2,337,629	6,950,117	-	-	6,950,117
1969	4,895,322	1,234,529	6,129,851	-	-	6,129,851
1970	5,269,494	1,341,820	6,611,314	-	-	6,611,314
1971	4,925,826	3,183,830	8,109,656	-	-	8,109,656
1972	5,372,779	1,050,355	6,423,134	-	-	6,423,134
1973	7,586,832	1,993,863	9,580,695	-	-	9,580,695
1974	5,048,456	3,700,084	8,748,540	-	-	8,748,540
1975	5,781,321	1,128,304	6,909,625	-	-	6,909,625
1976	4,943,891	2,843,849	7,787,740	-	-	7,787,740
1977	5,637,016	283,222	5,920,238	-	-	5,920,238
1978	5,492,397	1,295,200	6,787,597	-	-	6,787,597
1979	7,547,752	1,197,983	8,745,735	-	-	8,745,735
1980	5,715,203	301,566	6,016,769	-	-	6,016,769
1981	5,534,833	477,237	6,012,070	-	-	6,012,070
1982	7,448,589	551,939	8,000,528	-	-	8,000,528
1983	2,144,365	266,412	2,410,777	-	-	2,410,777
1984	2,621,248	348,417	2,969,665	-	-	2,969,665
1985	4,519,113	80,396	4,599,509	-	-	4,599,509
1986	7,396,810	201,500	7,598,310	-	-	7,598,310
1987	9,047,188	245,608	9,292,796	-	-	9,292,796
1988	14,430,838	319,489	14,750,327	-	-	14,750,327
1989	5,489,784	230,581	5,720,365	-	-	5,720,365
1990	4,122,400	313,731	4,436,131	-	-	4,436,131
1991	3,237,900	459,200	3,697,100	-	-	3,697,100
1992[e]	1,632,100	10,901	1,643,001	-	-	1,643,001
1993	2,537,000	-	2,537,000	-	-	2,537,000
1994	3,103,128	-	3,103,128	-	-	3,103,128
1995	6,633,000	-	6,633,000	-	-	6,633,000
1996	4,113,000	-	4,113,000	-	-	4,113,000
1997	5,248,250	-	5,248,250	-	-	5,248,250
1998	1,847,350	-	1,847,350	-	-	1,847,350
1999	3,852,601	-	3,852,601	-	-	3,852,601
2000	5,130,763	-	5,130,763	-	-	5,130,763

2001	2,408,609	-	2,408,609	-	-	2,408,609
2002	5,007,523	-	5,007,523	-	-	5,007,523
2003	6,391,621	-	6,391,621	-	-	6,391,621
2004	6,230,198	-	6,230,198	-	-	6,230,198

Table 12.1. Commercial Salmon Harvest in Pounds (Page 3 of 3)

Year	Chinook	Coho	Ocean Total [a]	Sacramento	Klamath [b]	Total
2005	4,347,388	-	4,347,388	-	-	4,347,388
2006 [f]	1,029,708	-	1,029,708	-	-	1,029,708

a. Prior to 1952, harvest was not available by species.
b. Also includes other coastal ports.
c. Klamath and other coastal ports closed after 1933.
d. Sacramento ports closed after 1959.
e. Coho were no longer permitted for take after 1992.
f. Preliminary data.
Data Source: DFG Catch Bulletins, DFG Ocean Salmon Project, and commercial landing receipts.

Table 12.2. Recreational Harvest in Numbers of Fish (Page 1 of 2)					
	Chinook		Coho		
Year	CPFV	Skiff	CPFV	Skiff	Total
1962	85,700	33,900	1,900	11,100	132,600
1963	66,200	17,600	6,300	26,300	116,400
1964	77,300	24,600	14,700	24,800	141,400
1965	46,000	14,200	5,700	14,800	80,700
1966	62,700	10,900	7,500	24,900	106,000
1967	60,900	11,700	24,000	26,300	122,900
1968	113,600	40,600	14,000	26,400	194,600
1969	100,000	55,800	11,400	16,800	184,000
1970	93,000	54,800	5,300	9,300	162,400
1971	108,400	79,900	22,400	45,000	255,700
1972	139,800	60,700	11,800	32,700	245,000
1973	119,500	78,500	5,200	26,500	229,700
1974	91,700	65,800	16,200	60,400	234,100
1975	68,300	35,400	5,500	15,800	125,000
1976	50,600	30,400	15,300	42,600	138,900
1977	54,700	49,600	2,400	11,800	118,500
1978	42,000	34,100	3,600	41,000	120,700
1979	71,800	40,600	2,000	14,500	128,900
1980	62,900	22,500	1,700	20,400	107,500
1981	59,600	24,200	1,100	9,500	94,400
1982	91,500	47,200	3,900	22,800	165,400
1983	46,500	17,300	500	26,700	91,000
1984	68,200	19,600	800	18,200	106,800
1985	107,300	63,800	1,400	14,400	186,900
1986	86,500	55,100	2,200	16,500	160,300
1987	121,800	70,700	4,300	43,000	239,800
1988	109,100	62,300	3,500	31,200	206,100
1989	105,000	81,700	6,200	43,400	236,300
1990	78,300	61,600	10,200	41,500	191,600
1991	39,900	40,600	13,500	55,800	149,800
1992	42,400	31,100	1,000	10,500	85,000
1993	66,000	44,000	4,200	25,600	139,800
1994[a]	99,100	84,100	25	500	183,725
1995[a]	182,000	215,200	25	900	398,125
1996	72,908	91,245	closed	635	164,788
1997	122,300	106,600	closed	500	229,400
1998	59,700	62,300	closed	100	122,100
1999	40,500	47,400	closed	600	88,500
2000	91,900	94,000	closed	400	186,300
2001	43,200	55,600	closed	1,243	100,043
2002	85,107	96,937	closed	785	182,829
2003	48,300	46,387	closed	550	95,237

2004	124,656	96,458	closed	1,406	222,520

Table 12.2. Recreational Harvest in Numbers of Fish (Page 2 of 2)

	Chinook		Coho		
Year	**CPFV**	**Skiff**	**CPFV**	**Skiff**	**Total**
2005	61,347	81,910	closed	662	143,919
2006[b]	34,688	54,791	closed	1,417	90,896

a. Recreational fishing for coho was allowed before May 1 during 1994 and 1995. Coho were no longer permitted for take after 1995.

b. Preliminary data.

Data Source: DFG Ocean Salmon Project.