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**CENTRAL VALLEY ANADROMOUS SPORT FISH ANNUAL RUN-SIZE,
HARVEST, AND POPULATION ESTIMATES, 1967 THROUGH 1991**

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THIRD DRAFT

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CENTRAL VALLEY ANADROMOUS SPORT FISH ANNUAL RUN-SIZE, HARVEST, AND POPULATION ESTIMATES, 1967 THROUGH 1991 ^{1/}

INTRODUCTION

Central Valley anadromous sport fish estimated population sizes and abundance trend data for the baseline period of 1967-1991 are provided in this report. This report has been prepared as supportive documentation required for implementation of Public Law 102-575, the Central Valley Project Improvement Act (CVPIA) passed by Congress and signed into law by the President on October 30, 1992. The CVPIA requires the Secretary of the Interior to implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the 25-year period of 1967-1991.

Anadromous sport fish species using the rivers and streams of California's Central Valley include: chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*O. mykiss*), sturgeon (*Acipenser ssp.*), striped bass (*Roccus saxatilis*), and American shad (*Alosa sapidissima*).

Virtually all anadromous fishes populations in the Central Valley of California have exhibited significant declines from 1967 through 1991. The major losses in the populations have been primarily from the naturally reproducing components. These declines are recognized as partially the result of water management activities, as well as habitat degradation, poor water quality, and catastrophic natural events.

GENERAL DESCRIPTION OF CENTRAL VALLEY ANADROMOUS FISH RESOURCES

Anadromous fish migrate from freshwater to estuarine and marine environments early in their life, mature in the ocean, and return inland to spawn in freshwater streams and rivers. Chinook salmon and striped bass are the predominant anadromous species using the waterways of the Central Valley. The four distinct runs of chinook salmon which spawn in the Sacramento River system are named for the season during which they first return to freshwater as adults. Fall-run chinook usually spawn within a few weeks of their arrival in the fall. Late-fall-run chinook spawn in the winter. Spring-run chinook spend the summer in deep, cool pools and spawn in the fall. Winter-run chinook enter the river in the winter and spawn early the following summer.

Both spring- and fall-run chinook salmon were abundant in the upper Sacramento River prior to Federal-State water development, although significant declines were noted by 1929.

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Causes of the declines were thought to include overharvest, blockage by irrigation dams, and habitat degradation. There is limited information on the magnitude of the salmon runs prior to the construction of the Central Valley Project (CVP) and the early decline of the populations. However, in 1905 the combined chinook salmon egg collection at three upper Sacramento River egg stations located off the main river represented the spawn of at least 30,000 adult salmon, which would indicate that the total from all other tributaries and main stem could easily exceed that number by more than tenfold. Based on total catch data for the Sacramento-San Joaquin rivers, it has been estimated that the peak chinook salmon runs in the Sacramento River system may have been as large as 800,000 to 1 million fish, with an average run size of about 600,000 prior to 1915.

The large runs of salmon in the San Joaquin River near Fresno during the 1940s were predominantly spring-run chinook. This significant run of salmon was extirpated as a result of the closure of Friant Dam in 1949. Chinook salmon production in the San Joaquin River drainage (ocean harvest plus spawning escapement) historically approached 300,000 adults but probably averaged nearer 150,000 prior to the construction of recent water storage projects.

The San Joaquin River system now supports only a remnant run of fall chinook salmon, and the population numbers can vary widely from year to year depending upon the timing and magnitude of flows available for migration, spawning, rearing, and emigration. San Joaquin River salmon populations are particularly affected by water export operations in the Sacramento-San Joaquin Delta which often can capture all of the San Joaquin River flow.

Sturgeon were common in the Delta in the mid-1800s, but commercial exploitation severely reduced the population by 1900.

American shad, introduced in the Sacramento River in 1871, are found in the Sacramento and San Joaquin river systems. In the Sacramento River and its major tributaries, their upstream migrations extend to Nimbus Dam on the American River, the Oroville Project Fish Barrier Dam on the Feather River, and to Englebright Dam on the Yuba River. Few adults pass Red Bluff Diversion Dam on the Sacramento River. Shad enter the lower portions of the Tuolumne and Stanislaus rivers, which are tributary to the San Joaquin River.

Striped bass were introduced into the lower Sacramento-San Joaquin Delta in two small plants from the East Coast. The first release of 132 small fish was made near Martinez in 1879 and in 1882 an additional 300 were released in lower Suisun Bay. Within 10 years a commercial fishery had developed and did well until it was closed in 1935 in an effort to build up the sport fishery.

Fall-run Chinook Salmon

Fall-run chinook are the most abundant run of salmon in the Central Valley. Adult fall run migrate into the river system from July through December and spawn from early October

through late December. Peak spawning occurs in October and November, although the timing of runs varies from stream to stream. Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June. Although the majority of young fall chinook migrate to the ocean during the first few months following emergence, a small number may remain in fresh water and migrate as yearlings. Chinook salmon mature at 3-4 years of age although sexually mature 2-year-old males ("jacks") are common. The traditional fall-run chinook spawning areas are downstream from the major dam sites; therefore, this run has not been as severely affected by dam construction as the spring and winter runs which historically spawned at higher elevations. The fall runs of the Sacramento and San Joaquin systems may be genetically distinct and the San Joaquin fall-run chinook is managed by the California Department of Fish and Game (CDFG) as a separate stock.

The most abundant spawning populations are in the main stem Sacramento, Feather, Yuba, and American rivers (Figure 1). Important Eastside Delta streams include the Cosumnes and Mokelumne rivers (Figure 2). Chinook salmon spawning areas in the San Joaquin drainage are located in the Stanislaus, Tuolumne, and Merced rivers (Figure 3).

Late-fall-run Chinook Salmon

Late-fall chinook migrate into the Sacramento River from mid-October through mid-April, which overlaps the mid-October through December fall-run spawning migration. The late-fall-run spawn from January through mid-April. Incubation occurs from January through June, and rearing and emigration of fry and smolts occurs from April through mid-October. Although the presence of late-fall chinook was recognized prior to 1970, they were not included in earlier Central Valley spawning stock inventories. Annual counts of late-fall-run chinook salmon became possible following the construction and operation of the Red Bluff Diversion Dam (RBDD) and its fish ladders in the late 1960s.

Late-fall-run chinook salmon estimated population sizes presented in this report are for the main stem Sacramento River (Figure 1).

Winter-run Chinook Salmon

Most winter-run chinook migrate into the Sacramento River system at age 3, with 100% spawning in the main stem of the river (Figure 1). A few winter-run salmon were observed in the Calaveras River during the late 1980s. Winter-run salmon enter the Sacramento River from mid-December through early August and spawn in the upper main stem Sacramento River from mid-April to mid-July. The winter run usually appear in the Sacramento River near Red Bluff in December and often spend a relatively long time in-river before spawning. Incubation occurs from mid-April through mid-August, with emigration of fry and smolts beginning in late July and ending the following June.

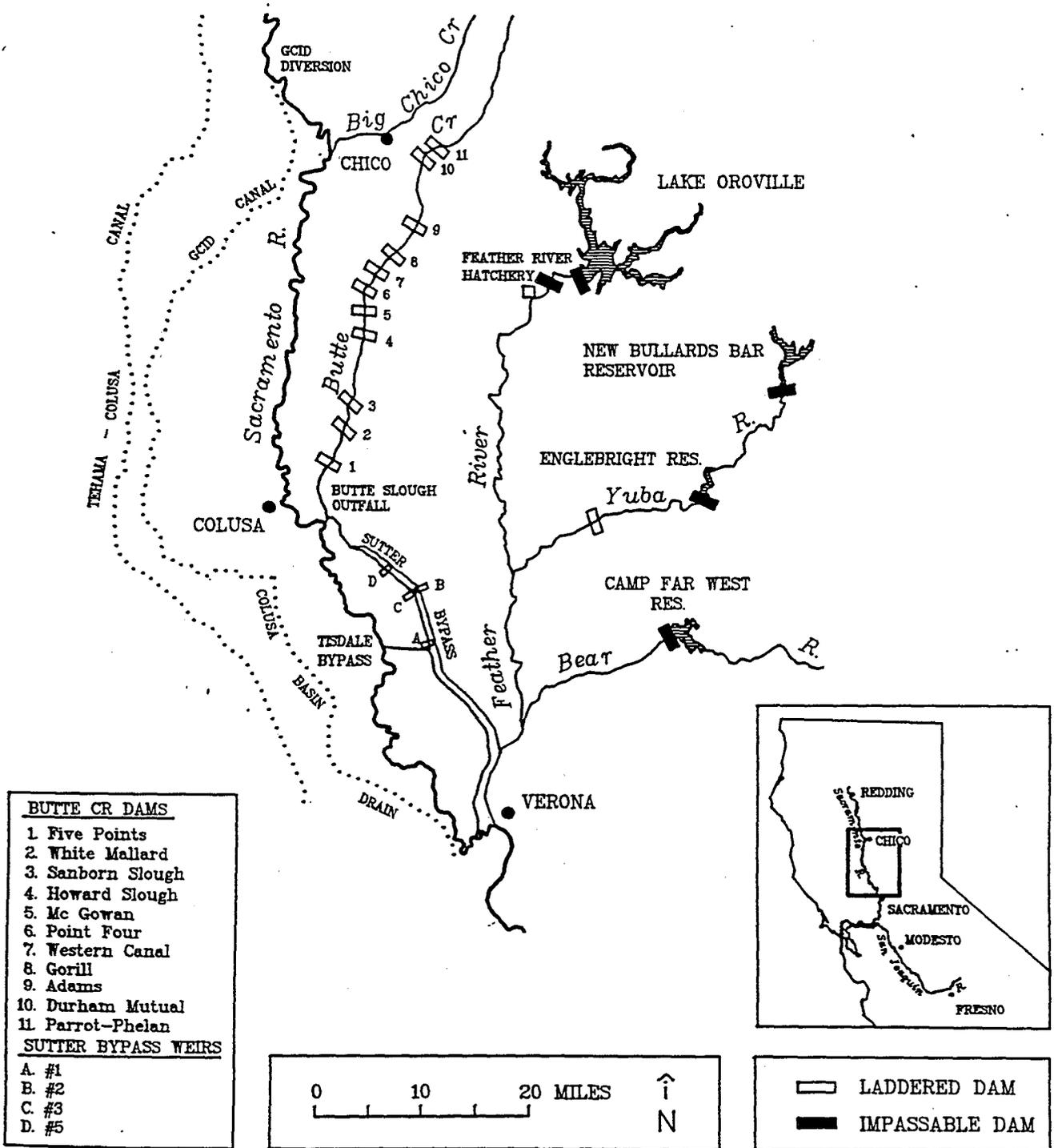


FIGURE 2. Location Map of the Sacramento River from Chico to Verona.

Central Valley Anadromous Fish Populations, 1967-1991

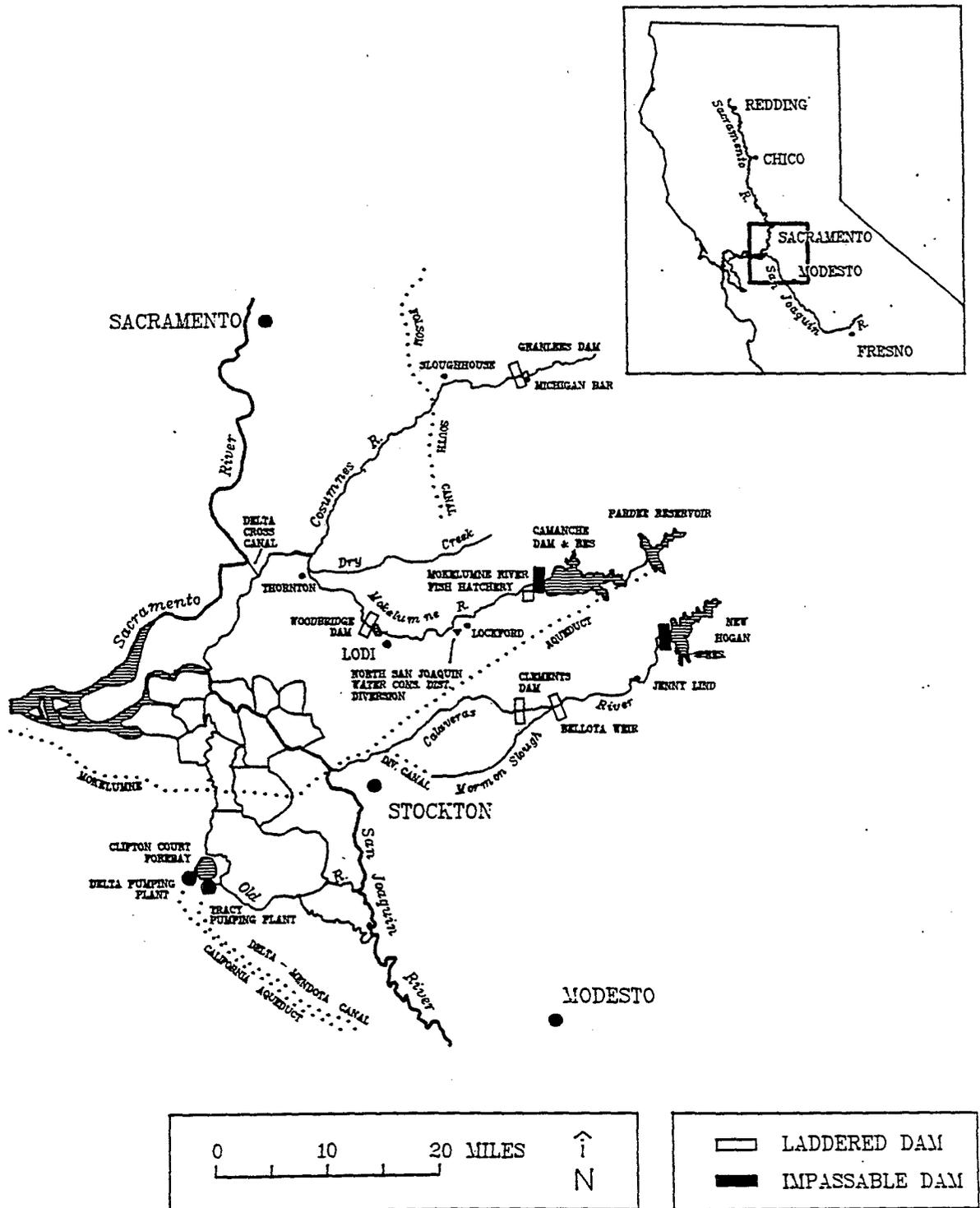


FIGURE 3. Location Map of the Eastside Delta Tributary Streams.

Historically, winter-run chinook salmon spawned during April to July in the McCloud River. The completion of Shasta and Keswick dams in the early 1940s blocked their access to the stream. Winter-run salmon, however, were able to spawn successfully below Keswick Dam, taking advantage of cooler summer water temperatures provided by water storage project releases. With water conditions similar to those denied them by the dam, they recovered dramatically during the 1940s and 1950s, eventually surpassing the main stem spring-run chinook in significance. Beginning in 1970, fish counts at RBDD revealed a dramatic decline in winter-run stocks. The population has declined from a high of nearly 118,000 spawners in 1969, to less than 200 spawners in recent years.

Spring-run Chinook Salmon

Spring-run chinook were, perhaps, historically the most abundant stock in the Central Valley. The race migrated to headwater areas upstream from the present location of major dams. Construction of dams causing barriers to migration, higher water temperatures, and streamflow alteration have resulted in the extirpation of spring-run chinook in the San Joaquin River system and in most other Central Valley tributaries. Now only the Sacramento River and its tributaries support remnant runs.

Spring-run chinook enter the Sacramento River from late March through September. Many early arriving adults hold in cool-water habitats through summer, then spawn in the fall. Spawning occurs from mid-August through early October with the peak in September. Spring- and fall-run salmon spawning overlaps during early October in the main stem Sacramento River and other places where their habitats have been reduced by dams. Incubation occurs from mid-August through mid-March with rearing and emigration of fry and smolts beginning in late November and continuing through April. A significant migration of yearlings from upper tributary watersheds also occurs in September through December. Because this race is a fall spawner like fall-run chinook, populations of spring- and fall-run chinook have interbred in the main stem Sacramento and Feather rivers. A genetically uncontaminated stock may still exist in eastside Sacramento River tributaries above the mouth of the Feather River such as Deer, Mill, Antelope, Battle, Big Chico, and Butte creeks (Figures 4 and 5)

Steelhead Trout

Steelhead trout is an anadromous strain of rainbow trout that migrates to sea and later returns to inland rivers as adults to spawn. In contrast to chinook salmon, not all steelhead die after spawning. With natural spawning greatly reduced in the Sacramento-San Joaquin river system, steelhead populations are highly dependent on hatcheries to maintain fishable populations. Nevertheless, steelhead are highly prized by inland sport anglers.

Steelhead are generally distributed from southern California to the Aleutian Islands. Within California's Central Valley, a viable population of naturally produced steelhead is

Central Valley Anadromous Fish Populations, 1967-1991

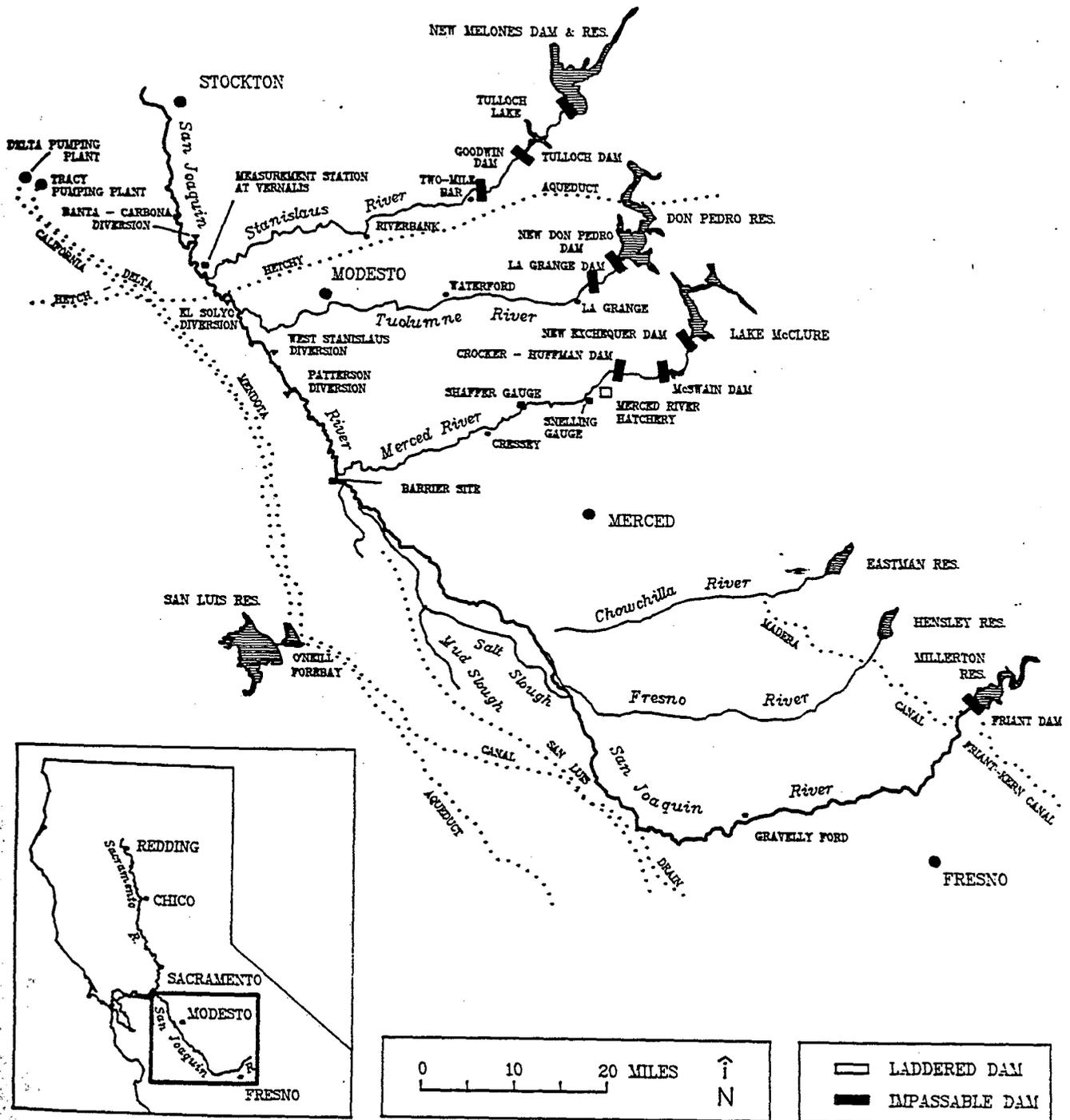


FIGURE 4. Location Map of the San Joaquin Drainage.

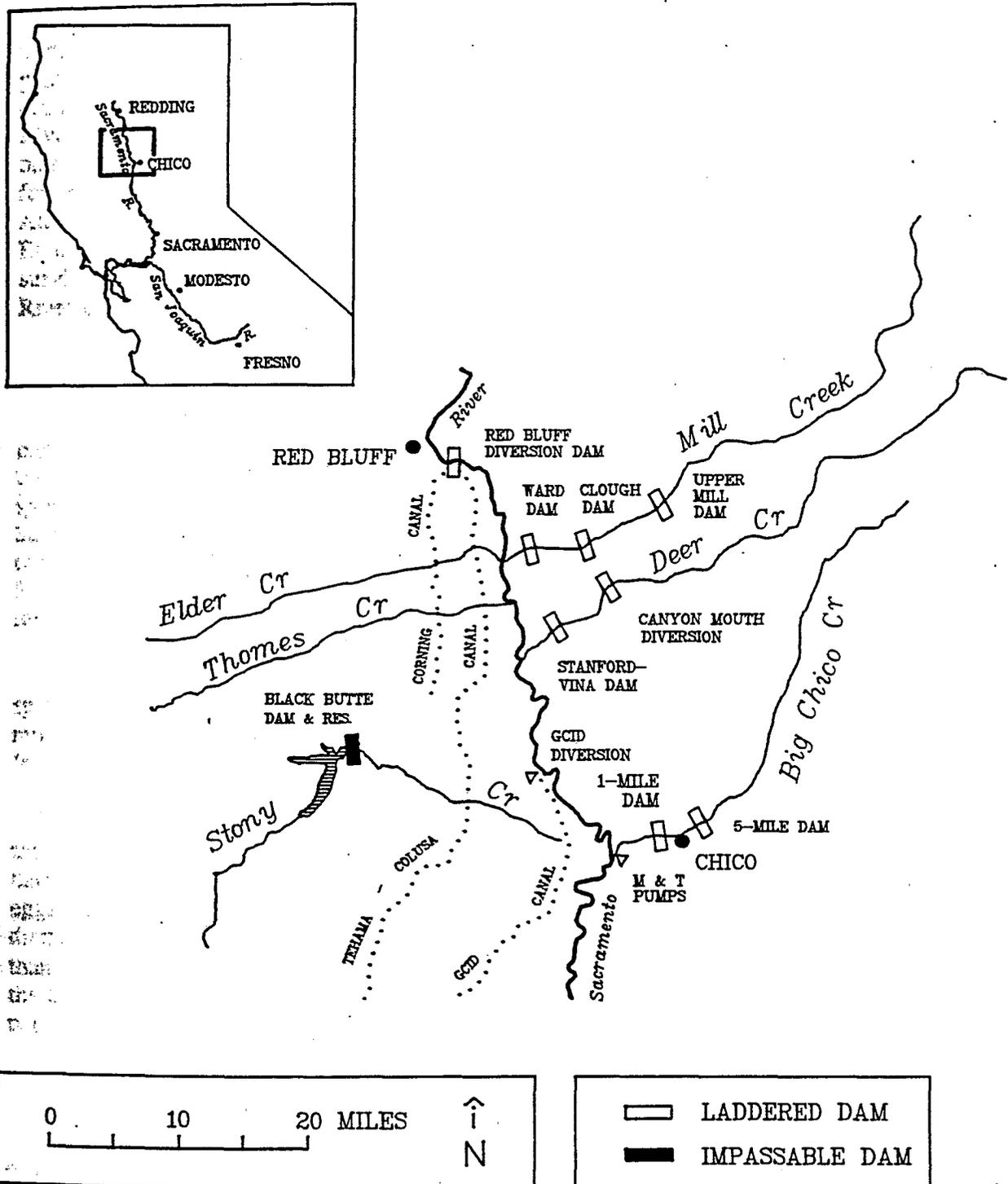


FIGURE 5. Location Map of the Sacramento River from Red Bluff to Chico.

only found in the Sacramento River and its tributaries. No significant steelhead populations now occur in the San Joaquin River system.

In the Sacramento River, upstream migration occurs from early August through November with the peak occurring in mid-September. Some upper Sacramento River steelhead runs peak in mid-winter. Sacramento River system steelhead spawners are typically 2- or 3-years old and weigh 2-12 lbs. The Eel River strain of steelhead introduced into the American River at Nimbus Fish Hatchery has mixed with the remnants of the American River, and other Sacramento River strains; this seems to have resulted in steelhead larger than those found in the upper Sacramento River. Mad River steelhead were also introduced in the American River, but the results have been inconsequential. Spawning in the Sacramento River and its tributaries usually occurs from January through March, and individuals which survive the spawning run return to the sea between April and June. Females in the American River contain an average of 3,500 eggs, with a range of 1,500-4,500.

Striped Bass

Striped bass are native to the Atlantic Coast from the Gulf of St. Lawrence to the eastern part of the Gulf of Mexico. Since being introduced into the San Francisco Bay complex in the latter part of the last century they have become one of the most popular and abundant sport fish within the Central Valley. The bulk of the striped bass population is in the Sacramento-San Joaquin River system including the San Francisco Bay complex, the nearby ocean, the Delta, and the larger tributary streams downstream from the impassable dams. Striped bass support one of the most important sport fisheries in the San Francisco Bay region, the Delta, and the lower part of the Sacramento River.

Striped bass begin spawning in the spring when the water temperature reaches 58°F. Most spawning occurs from April to mid-June. They spawn in fresh water where there is moderate to swift current. One important spawning area is the main stem Sacramento River from Courtland to Colusa.

Female striped bass usually spawn for the first time in their fourth or fifth year when they are about 18 to 22 inches long. Most males mature at age 3. A 5-lb female may release as many as 250,000 eggs in one season, and a 12-lb fish may release over a million eggs. The eggs are quite small but after being released and fertilized they absorb water, triple their diameter, and become transparent and very hard to see. The eggs are only slightly heavier than water. With moderate current they are held suspended in the water column but sink to the bottom and die in the absence of sufficient flow. The larval bass are hatched in about two days, the length of time depending upon the temperature.

Sturgeon

Sturgeons include the largest fishes found in fresh water and some are among the largest of all fishes. Sturgeon are slow growing and very long-lived. There are two species of

sturgeon in California: the white sturgeon (*A. transmontanus*) and the green sturgeon (*A. medirostris*).

The commercial sturgeon fishery was short-lived and in 1901 the Legislature temporarily abolished the fishery. At the time white sturgeon were claimed to be on the verge of extinction. The fishery remained closed until 1910, was re-opened for two years, and then closed until 1916. In 1917 the fishery was again abolished by the Legislature, and the taking or possession of sturgeon was completely prohibited until 1954, at which time the fishery was reopened for sport fishing only. At present, angling for sturgeon is most intense in San Pablo Bay, but some sturgeon are taken well up the larger rivers.

White sturgeon are most abundant in the Sacramento-San Joaquin River system. Studies by the CDFG indicate that the adult sturgeon spawning migration occurs in late winter and spring when fish move through the Delta, using both the Sacramento and San Joaquin channels. Some migrate well up the Sacramento River past the mouth of the Feather River. By summer, following spawning, most have returned to the lower estuary and bay.

Actual spawning of either white or green sturgeon has not been well described. Other species of sturgeon are known to migrate upstream and spawn in areas of fast water and coarse gravel bottom. The eggs settle into the crack between rocks and are adhesive. Hatching time for some other species of sturgeon ranges from two to five days depending partly on water temperature.

American Shad

American shad are members of the herring family. American shad were first introduced into the Sacramento River in 1871, with several supplemental introduction later. Shad did remarkably well and were being harvested in marketable quantities by 1879.

American shad are very strongly anadromous. Shad spawning runs occur from late April to early July. In many of the spawning streams some shad go as far upstream as they are able, but unlike salmon, shad do very poorly at ascending fishways and are stopped even by relatively low dams. Formerly, shad ascended the Sacramento River to Redding in some years. Since the construction of the RBDD, most of the run stops at that point.

Spawning takes place where there is good current in tidal fresh water or farther upstream. Most spawning occurs over gravel or sand bottoms and a female may release from 120,000 to 650,000 eggs. Many shad die after completion of spawning. The fertilized eggs are not adhesive and are slightly heavier than water and drift with the current near the bottom. Hatching is usually completed in 4 to 6 days depending on water temperature.

Some young shad move downstream into brackish water soon after hatching but large numbers remain in fresh water into November when they are 5 to 6 months old. By December most have left fresh water.

RESOURCE ASSESSMENT AND POPULATION ESTIMATION PROCEDURES AND METHODS

Population Estimation Procedures

Common methods used to estimate inland population sizes of anadromous fish species include (i) direct counts, (ii) mark-recapture methodology, and (iii) indexing of spawning areas.

The direct count method generally involves observing and counting salmon and steelhead as they ascend a fishway or ladder. This method is used in the Central Valley at the RBDD in the Sacramento River and at hatchery facilities that propagate salmon and steelhead. A variant of the direct count method is use of electronic fish counting devices calibrated to register the passage of an adult-sized fish through a confined tube. Direct counts usually involve procedures to account for fish passage when an observer is not present, or to calibrate errors in electronic counting devices. Often, direct counts are impaired by high turbidity or flows which eliminate opportunities to observe fish. Counts for days of no observation are generally accounted for by interpolation of data surrounding the periods of no observation.

Snorkel surveys are conducted to observe and count adult spring-run chinook during the summer as they reside in deep, cool pools in the upper reaches of some tributary streams. This method of direct count requires intensive and exhaustive efforts by skilled observers to locate and identify spring-run. Generally, snorkel counts are used as a relative measure of fish abundance and not as an absolute count.

Mark-recapture techniques include the use of various methods such as the Petersen, Schaefer, Schumacher and Eschmeyer, and Jolly-Seber methods. The most common method is the Adjusted Petersen Method. This method is a "single census" method in which fish are marked once and during subsequent recapture efforts the numbers of marked and unmarked fish are recorded. The other methods are of the "multiple census" type in which fish are marked and added to the population over a considerable period during which samples are taken and examined for recaptures.

The various mark-recapture methods all have similar assumptions about survival of marked fish, loss of tags, marked fish becoming randomly mixed with the unmarked population, all marks are recognized and reported, and only negligible recruitment to the population during the recovery period. In many instances it is possible to provide corrections to negate known violation of the assumptions, such as corrections for tag loss or adjustments for known mortality.

Indexing is a more speculative approach to population estimation and relies heavily on the experience and knowledge of the observer. This method is most often used on small tributary streams having chinook salmon spawning populations that are too small to allow

mark-recapture methods or would require intensive efforts to conduct direct counts. In this method, the observer may conduct one or two surveys of the creek or a portion of the creek during the spawning season and, based on observations, estimate population abundance in increments of 100 fish. Usually this method is for streams that support several hundred or fewer fish.

Aerial redd counting is a method used in the Sacramento Valley, particularly in the Sacramento River between Princeton and Keswick. The redd counts below RBDD are compared to redd counts above RBDD and a ratio is calculated. The number of salmon spawning above RBDD is determined by direct count and the number of salmon spawning below is determined by multiplying the redd ratio and the number of spawners above RBDD.

Salmon. Historically, salmon populations were indirectly monitored by commercial catch records but beginning in the early 1940s spawning ground surveys were initiated. These early surveys developed the groundwork methodology for making population estimates that became refined by the 1960s. Spawning stock surveys are routinely conducted by the CDGF to determine compliance with the management goals for Central Valley salmon stocks. The estimates involve a combination of spawning ground surveys using mark and recapture methodology, fish ladder counts, and aerial redd surveys. The methods used throughout the 1967-1991 time period have been consistent and are relatively reliable. In some years, due to budgetary constraints, minor tributaries were not surveyed, therefore, no estimates are available for these streams. These spawning ground surveys are applicable only to fall-run salmon populations and yield the most complete and thorough estimates of all Central Valley stocks.

With the completion of RBDD in 1967, and its associated fish counting facilities, resource assessment in the upper Sacramento River began a new phase. Runs of spring, late-fall, and winter chinook salmon along with steelhead trout could be systematically counted. Although these runs and species were previously known to be abundant, no consistent method for enumeration was possible because of annual variations in flow, visibility, and lack of reliable counting facilities. Conventional spawning ground surveys using mark and recapture methods could not be employed because spawning and migration times typically occur during seasonal high water. Counts of steelhead entering many tributaries are lacking for the same reasons previously mentioned. Additionally, some unknown number of salmon and steelhead remain below RBDD and spawn in the lower river and tributaries. Therefore, for spring, late-fall and winter chinook along with steelhead, the total estimates are incomplete and represent only that proportion passing upstream of the counting facilities.

Annual salmon population levels are compiled from published and draft annual spawning stock reports and hatchery production reports. Each annual report details methods used for population determinations. These records are organized and arranged at various levels from individual river or tributary to the entire Central Valley. Since spawning stock estimates are reported as total number of spawners, both adults and grilse combined, determination of annual age structure was necessary. Currently the proportion of grilse is reported from each

annual survey. Prior to 1980, the annual fraction of grilse was unreported. Fortunately, field survey records are available to determine the annual age composition within individual rivers. It was assumed that the fraction of grilse observed at RBDD was applicable to all tributaries in the upper Sacramento River.

Steelhead Trout. Steelhead estimates are derived from direct counts at fishways and at hatcheries. Some estimates are the result of mark-recapture experiments, and some are a variant calculated by dividing hatchery returns by the estimated harvest rates.

Sturgeon. Tagging studies are the method by which mark-recapture estimates of abundance of white sturgeon ≥ 40 inches total length (the minimum legal size until 1990). Sturgeon of both species were captured for tagging in trammel nets in the fall in San Pablo Bay, and occasionally in Suisun Bay. Sturgeon were tagged with disc-dangler tags attached below the anterior end of the dorsal fin, measured, and immediately released near the site where they were captured.

In years when a recapture sample was available from tagging in a later year(s), white sturgeon abundance was estimated using the Petersen Method. When adequate recapture samples from later years were not available, the multiple census method of Schumacher and Eschmeyer was used and was based on recaptures during the same tagging season.

Some assumptions inherent in sturgeon mark-recapture experiments are probably violated. These include:

1. Assumptions of random distribution of tagged sturgeon in the untagged population and equal vulnerability of tagged and untagged fish to the fishing gear are likely violated by the multiple census technique.
2. Both methods deal with a population that is probably not closed and the proportion of the entire population represented by the estimate is unknown and may vary between estimates.

Few green sturgeon were tagged each year and none were recaptured during tagging, so no independent estimate of their abundance was possible. Instead, green sturgeon abundance was estimated by dividing white sturgeon abundance estimates by the ratio of white:green sturgeon observed during tagging.

For the purpose of calculating 1967-1990 mean abundance, population estimates in years when no tagging occurred were computed by linear interpolation.

Striped Bass. The abundance of adult striped bass (fish ≥ 38 cm FL before 1982 and fish ≥ 42 cm FL since 1982) was estimated using mark-recapture experiments since 1969. A modified Petersen estimator $N = M(C+1)/(R+1)$ is used, where N = bass abundance, M =

number of tagged fish released, C = number of fish subsequently examined for tags, and R = number of tagged fish in the recapture sample.

Gill nets and fyke traps are used to capture bass during their spring spawning migration to the Delta and Sacramento River. The fish are tagged with individually numbered disc-dangler tags and released. The population is sampled during a year-round census of angler catches and during subsequent spring tagging.

From 3,100 to 18,400 tags have been applied annually. Creel census clerks, sampling at 4-6 fishing ports from Wednesday to Sunday each week, have observed 1,500 to 38,700 bass and 16 to 891 tags annually. Since 1969, the tagged:untagged ratio has varied from 1:37 (1973) to 1:108 (1985).

The abundance estimation procedures are complicated by sex- and age-sampling biases. Males spend more time on the spawning grounds than females, so two to three times as many males are tagged. In contrast, censused females slightly outnumber censused males. Three- and 4-year-old striped bass are underrepresented in the tagging sample because many of those fish are not mature and they have not taken up adult migratory patterns. Also, the gill nets tend to select for smaller fish. Hence, all tagging and recapture samples are stratified by sex and age.

Sex is determined for each fish tagged. If milt is extruded, the fish is classified as male and if not, it is classified as female. About 75-90% of the censused fish are sexed by dissection. The remainder of censused fish are assumed to have the same sex ratio as this sample.

To stratify by age, scales are sampled and lengths are measured on nearly all tagged bass. Scales are obtained from 75-905 individual censused bass. For both tagged and censused fish, a computer program uses an age-length key developed from the aged fish to apportion unaged fish into the appropriate age classes.

These procedures allow the estimation of abundance of individual year classes and to increase sample sizes for estimates of each year class with each successive sampling period.

Two additional problems must be solved in estimating 3-year-old striped bass abundance.

1. Only about one-half of age 3 fish are legal size during the tagging period and recruitment is not complete until about 6 months later. Therefore, the tagged:untagged ratio observed during the first creel census after tagging would underestimate total age 3 abundance, but overestimate abundance of legal-sized age 3 fish. (The solution is to estimate abundance starting with the tagging sample taken the following spring.)

2. Few 3-year-old females are tagged so their abundance is estimated indirectly by assuming that it is equal to the abundance of 3-year-old males.

Due to the sampling biases, the most accurate annual estimates for both sexes, except that the age 3 estimates, are first divided by two to eliminate fish recruited after the tagging period.

American Shad. Except for 1976 and 1977, no annual population estimated of adult American shad are available for Central Valley rivers and streams. Populations of adult American shad in the Sacramento River system were estimated at 3.04 and 2.79 million in 1976 and 1977, respectively. These estimates were derived from mark-recapture data. Adult fish were captured in gill nets in the Sacramento-San Joaquin River Estuary (Delta) near Pittsburg during their upstream migration in March, April, and May. This location is downstream from sport fishing areas. The Petersen estimator was derived from creel census of areas upstream from the tagging and release site. Angler captured fish were examined for tags and an estimator was calculated based on the number of marked fish observed in the sample.

Central Valley Creel Census and Angler Survey Data. Creel census is often used to monitor the harvest of anadromous fish within rivers and streams of the Central Valley. Typically, creel census methodology uses a stratified random sampling procedure in which census areas are predefined and then sampled on a random, but structured, basis throughout the survey period. Sampling is stratified by location and time. Catch and effort data collected during the structured sampling are expanded to account for days, times, and location where no sampling occurred.

Occasionally, angler surveys are conducted in conjunction with mark-recapture studies to gather tag recovery data to estimate population size (Appendix 1).

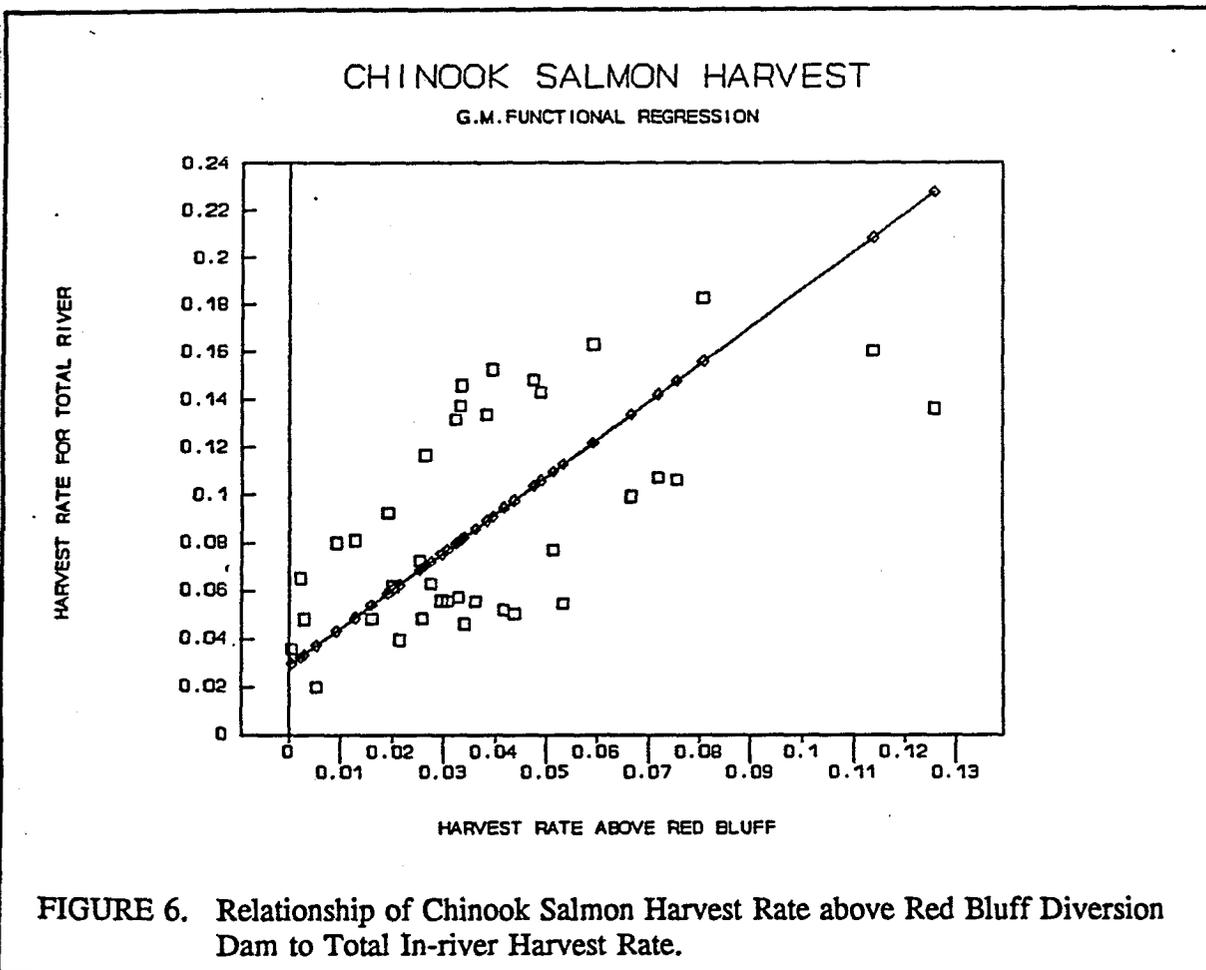
Limited harvest information is available for determinations of inland sport catches of salmon and steelhead resources. While no comprehensive measure of in-river sport catches have been made on a consistent basis, fragmented census surveys have been made for some rivers during various times. River sport catches of chinook salmon has received little emphasis because of low annual mortality associated from this source. One simple approach to estimate annual harvest made by Meyer (1985) and assumed a constant fraction of the total escapement run was harvested annually. He applied 10% of the ocean sport catch as a reasonable estimate, combining the various runs. Rowell (Unpublished report, Red Bluff) conducted a salmon and steelhead creel census during 1967 through 1975. These estimates combined with Red Bluff Diversion Dam (RBDD) counts provide estimates for both the river reach above RBDD and the total in-river harvest.

Bill to add

Chinook Salmon

A significant relationship between harvest rates above RBDD and the total river allows annual estimates of individual salmon races to be made (Figure 6, Appendix 1).

A similar analysis was applied to steelhead catch and population statistics; a relationship between total population levels and catch. Hallock (1961), Rowell (1980) and Wixom (pers comm.) reported steelhead catches for a several differing time periods. The annual proportion caught varied between 20 to 66%, but averaged around 35%. Staley (1976) found during two years studied a similar harvest rate for the American River; 33%.

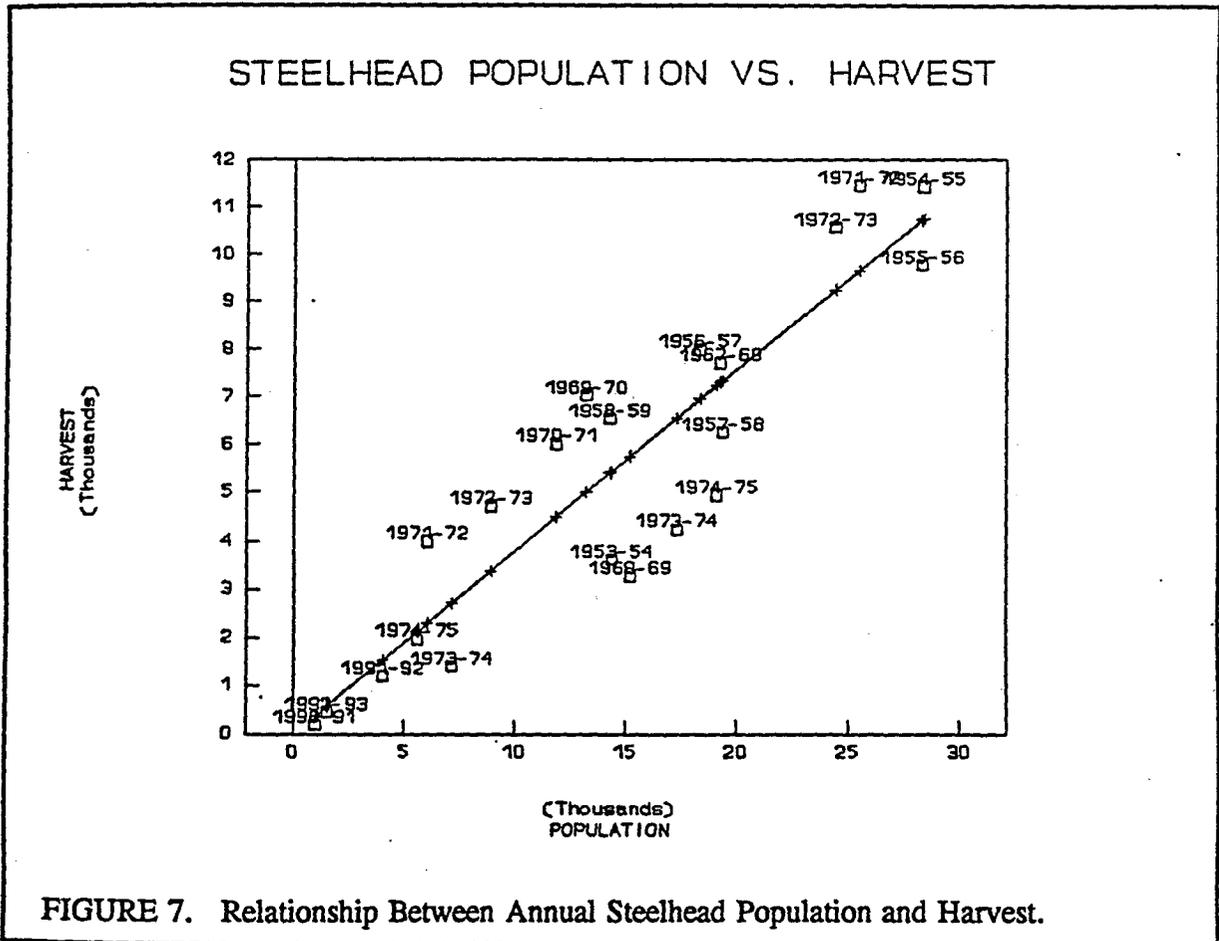


Staley found

Unfortunately, annual steelhead populations are not measured for most Central Valley rivers. Estimates of harvest can only be obtained for the Sacramento River, using RBDD counts as

an index of total population. A significant relationship between population size and catch was developed for Sacramento River steelhead harvest and applied to RBDD counts (Figure 7).

The annual harvest rate determined by this relationship is equivalent to 38% of the available population. These steelhead catches should be considered as minimum estimates.



Anglers participating in the coastal charter boat and sport skiff fisheries for salmon are censused upon return to port. Not every boat is sampled but the methodology allows for expansion of data to provide an estimate for total sport harvest.

Overview

California ocean salmon harvest statistics are extrapolated from data obtained by fishery sampling programs, in combination with data from records that DFG requires commercial salmon buyers and commercial charterboat operators to maintain. California's ocean fishery sampling programs are designed to sample at least 20% of the salmon (chinook and coho) landed in the ocean commercial and recreational (charterboat and skiff) fisheries.

Commercial salmon buyers are required to complete California Fish and Game market receipts for all deliveries of salmon that they buy. Charterboat operators are required to maintain California Fish and Game logbook records for all fishing trips.

Area and Time Stratifications

The five major ports sampled for the ocean troll fishery are Crescent City, Eureka, Fort Bragg, San Francisco, and Monterey. In some cases, the major ports may consist of several small adjacent sub-ports. Sampling is carried out during the entire season at all ports.

The same basic five ports design is used to sample the recreational skiff and charterboat fisheries. However, major ports may contain several smaller sub-port strata. Sub-ports are areas within major ports where anglers may come ashore, but which are small enough to allow the sampler to interview all private skiff fishermen that land within that area on a sample day. The charterboat sample area includes all docks in a port area where landings occur. Sampling is also carried out the entire season at all five ports for the charterboat and skiff fisheries.

Semi-monthly time periods are the basic time strata used to sample all fisheries. The periods are from the 1st to the 15th and the 16th to the end of the month. In addition, recreational sampling is stratified by weekend day, or holiday, and weekday.

Fishery Sampling Programs

Ocean Commercial (Troll) Fishery. Field samplers are assigned to the five major port areas and instructed to sample commercial salmon buying stations on a random basis, bearing in mind that they must sample boats returning from multi-day trips and those that have fished only one day. The sample unit is a landing of salmon by a commercial troller and from each boat the sampler must obtain a complete sample of all fish for the sample to be valid.

Ocean Recreational (Charterboat and Skiff) Fishery. Field samplers are assigned to pre-selected sub-ports chosen on a random basis and stratified by weekend, or holiday, and

weekday. They are instructed to interview all recreational skiff anglers who landed within their assigned sample area, and to tally number of boats missed and not sampled.

Estimation Procedure

Commercial Fishery. Numbers of salmon landed by the commercial fishery within time and port stratum and by species are estimated by dividing the pounds of salmon sold to the commercial salmon buyers and reported on pink tickets, by species average weights obtained from sample data. The estimation equation is:

$$\text{Total number of salmon} = \frac{\text{Weight of salmon landed}}{\left(\frac{\text{Weight of salmon sampled}}{\text{Number of salmon sampled}} \right)}$$

Recreational Fishery. Numbers of salmon landed by the recreational skiff fishery within time and port stratum and by species are estimated from field sampling.

The estimation equation is:

$$\text{Total number of salmon} = \left(\frac{\text{Number of sampled fish}}{1} \right) \left(\frac{\text{Number of possible fishing days}}{\text{Number of days sampled}} \right) \left(\frac{\text{Number of ports}}{\text{Number of subport samples}} \right)$$

Artificial Production Facilities

Salmon and Steelhead Hatcheries

Salmon and steelhead are propagated at four State-operated hatcheries and one federally operated hatchery in the Central Valley. The State hatcheries include Feather River Hatchery, Nimbus Hatchery on the American River, Mokelumne River Hatchery, and Merced River Hatchery. The U.S. Fish and Wildlife Service operates Coleman National Fish Hatchery on Battle Creek, tributary to the upper Sacramento River.

All the hatcheries propagate fall-run chinook and steelhead. Feather River Hatchery also propagates spring-run chinook, and Coleman National Fish Hatchery propagates winter-run and late-fall-run chinook.

Hatchery counts generally represent the number of fish counted during spawning and sorting procedures associated with propagating the various races and species.

DATA SUMMARY AND POPULATION ESTIMATES

Chinook Salmon

Estimates of the number of naturally spawning chinook salmon (all races combined) during 1967-1991 ranged from 106,603 in 1990 to 490,723 in 1969, with a 25-year average of 246,994 (Table 1).

During the base period, Sacramento fall-run chinook salmon were the predominate race spawning in the Central Valley. Estimated numbers of naturally spawning fall-run chinook in the Sacramento system ranged from 92,442 in 1990 to 256,817 in 1969 with a 25-year average of 176,092 (Table 1, Appendix 2). Estimates of naturally spawning San Joaquin fall-run chinook salmon, including the Mokelumne, Cosumnes, and Calaveras rivers, ranged from 854 in 1991 to 76,184 in 1985 with a 25-year average of 20,644 (Table 1, Appendices 2 and 3).

Late-fall-run chinook salmon are found predominantly in the Sacramento River. Observers have recorded late-fall-run fish in many other tributaries of the Sacramento River but, because of typically high flows and turbidity during their spawning period, no estimates of abundance are available other than those based on the RBDD counts. In the Sacramento River, the numbers of late-fall-run chinook salmon have ranged from 1,141 in 1982 to 37,208 in 1967 with a 25-year average of 14,159 (Table 1, Appendix 4).

Spring-run chinook salmon estimated spawning populations have ranged from 1,641 in 1991 to 27,335 in 1969 with a 25-year average of 12,990 (Table 1).

Winter-run chinook salmon have been observed in the Calaveras River during the late 1970's and early 1980's, however, they are presently found only in the Sacramento River. Estimated numbers of winter-run spawners in the Sacramento River have ranged from 191 in 1991 to 117,808 in 1969 with a 25-year average of 23,109 (Table 1).

During the same period, ocean sport and commercial fishers harvested an average of 706,595 chinook salmon (grilse and adults combined) along the coast from Crescent City to Monterey. Catch estimated ranged from 357,805 in 1983 to 1,488,568 in 1988 (Table 2, Appendices 5 and 6).

During the base period, an average of 28,435 salmon (all races combined) returned to hatcheries in the Central Valley (Table 3, Appendices 7, 8, and 9). Hatchery returns were primarily fall-run chinook with relatively few spring-run and late-fall-run fish (Table 3).

TABLE 1. Estimated number of chinook salmon returning to spawn naturally in rivers and streams of the Central Valley during 1967 through 1991 (Sheet 1 of 2).

| Year | Sacramento Fall-run chinook ¹ | | | San Joaquin Fall-run chinook ² | | | Sacramento Late-fall-run chinook ³ | | |
|---------|---|---------|---------|--|--------|--------|--|--------|--------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 38,410 | 104,790 | 143,200 | 1,176 | 21,359 | 22,535 | 5,730 | 31,478 | 37,208 |
| 1968 | 18,181 | 155,859 | 174,040 | 11,211 | 6,577 | 17,788 | 1,910 | 32,823 | 34,733 |
| 1969 | 48,528 | 208,289 | 256,817 | 1,935 | 49,662 | 51,597 | 1,747 | 35,431 | 37,178 |
| 1970 | 30,121 | 147,279 | 177,400 | 8,539 | 28,550 | 37,089 | 1,823 | 17,367 | 19,190 |
| 1971 | 35,775 | 140,691 | 176,466 | 2,986 | 38,580 | 41,566 | 2,277 | 12,046 | 14,323 |
| 1972 | 43,795 | 80,622 | 124,417 | 2,321 | 11,954 | 14,275 | 2,398 | 29,155 | 31,553 |
| 1973 | 40,640 | 197,193 | 237,833 | 674 | 6,438 | 7,112 | 711 | 21,493 | 22,204 |
| 1974 | 25,364 | 185,953 | 211,317 | 762 | 3,625 | 4,387 | 329 | 6,116 | 6,445 |
| 1975 | 29,691 | 141,884 | 171,575 | 885 | 5,841 | 6,726 | 816 | 15,847 | 16,663 |
| 1976 | 21,926 | 155,767 | 177,693 | 434 | 3,465 | 3,899 | 581 | 14,699 | 15,280 |
| 1977 | 22,831 | 139,971 | 162,802 | 60 | 990 | 1,050 | 873 | 8,217 | 9,090 |
| 1978 | 23,635 | 115,363 | 138,998 | 244 | 2,333 | 2,577 | 959 | 7,921 | 8,880 |
| 1979 | 46,397 | 152,982 | 199,379 | 456 | 3,897 | 4,353 | 44 | 8,696 | 8,740 |
| 1980 | 25,472 | 110,833 | 136,305 | 702 | 5,600 | 6,302 | 566 | 7,181 | 7,747 |
| 1981 | 42,575 | 145,503 | 188,078 | 8,022 | 20,295 | 28,317 | 168 | 1,429 | 1,597 |
| 1982 | 43,396 | 129,388 | 172,784 | 2,681 | 14,214 | 16,895 | 186 | 955 | 1,141 |
| 1983 | 41,714 | 88,676 | 130,390 | 32,312 | 10,970 | 43,282 | 1,221 | 12,053 | 13,274 |
| 1984 | 40,859 | 114,563 | 115,422 | 18,335 | 37,641 | 55,976 | 2,357 | 3,550 | 5,907 |
| 1985 | 41,563 | 211,695 | 253,258 | 4,311 | 71,873 | 76,184 | 1,670 | 5,990 | 7,660 |
| 1986 | 27,356 | 212,739 | 240,095 | 3,117 | 18,588 | 21,705 | 490 | 6,220 | 6,710 |
| 1987 | 66,364 | 150,965 | 217,329 | 18,269 | 6,689 | 24,958 | 780 | 13,663 | 14,443 |
| 1988 | 26,517 | 197,841 | 224,358 | 1,138 | 20,798 | 21,937 | 2,094 | 8,589 | 10,683 |
| 1989 | 24,060 | 116,726 | 140,786 | 282 | 3,489 | 3,771 | 286 | 9,589 | 9,875 |
| 1990 | 9,443 | 83,499 | 92,942 | 312 | 663 | 975 | 1,536 | 5,385 | 6,921 |
| 1991 | 11,546 | 87,070 | 98,616 | 207 | 647 | 854 | 888 | 5,643 | 6,531 |
| Average | 33,046 | 143,046 | 176,092 | 4,855 | 15,789 | 20,644 | 1,298 | 12,861 | 14,159 |

TABLE 1. Estimated number of chinook salmon returning to spawn naturally in rivers and streams of the Central Valley during 1967 through 1991 (Sheet 2 of 2).

| Year | Sacramento Spring-run chinook ⁴ | | | Sacramento Winter-run chinook ⁵ | | | Central Valley Total chinook salmon | | |
|---------|---|--------|--------|---|---------|---------|--|---------|---------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 11,397 | 12,297 | 23,694 | 24,985 | 32,321 | 57,306 | 81,698 | 202,245 | 283,943 |
| 1968 | 3,317 | 11,827 | 15,144 | 10,299 | 74,115 | 84,414 | 44,917 | 281,202 | 326,119 |
| 1969 | 2,843 | 24,492 | 27,335 | 8,953 | 108,855 | 117,808 | 64,006 | 426,729 | 490,735 |
| 1970 | 1,420 | 6,017 | 7,437 | 8,324 | 32,085 | 40,409 | 50,226 | 231,297 | 281,525 |
| 1971 | 2,464 | 6,336 | 8,800 | 20,864 | 32,225 | 53,089 | 64,366 | 229,878 | 294,244 |
| 1972 | 1,343 | 7,053 | 8,396 | 8,541 | 28,592 | 37,133 | 58,398 | 157,376 | 215,774 |
| 1973 | 2,082 | 9,680 | 11,762 | 4,623 | 19,456 | 24,079 | 48,729 | 254,261 | 302,990 |
| 1974 | 2,538 | 5,545 | 8,083 | 3,788 | 18,109 | 21,897 | 32,782 | 219,347 | 252,129 |
| 1975 | 7,683 | 15,670 | 23,353 | 7,498 | 15,932 | 23,430 | 46,573 | 195,174 | 241,747 |
| 1976 | 4,067 | 22,006 | 26,073 | 8,634 | 26,462 | 35,096 | 35,642 | 222,399 | 258,041 |
| 1977 | 5,421 | 8,409 | 13,830 | 2,186 | 15,028 | 17,214 | 31,372 | 172,614 | 203,986 |
| 1978 | 1,093 | 7,063 | 8,156 | 1,193 | 23,669 | 24,862 | 27,124 | 156,349 | 183,473 |
| 1979 | 707 | 2,203 | 2,910 | 113 | 2,251 | 2,364 | 47,717 | 170,029 | 217,746 |
| 1980 | 3,734 | 8,081 | 11,815 | 1,072 | 84 | 1,156 | 31,545 | 131,780 | 163,325 |
| 1981 | 8,249 | 13,066 | 21,315 | 1,744 | 18,297 | 20,041 | 60,757 | 198,591 | 259,348 |
| 1982 | 4,528 | 21,644 | 26,172 | 270 | 972 | 1,242 | 51,061 | 167,173 | 218,234 |
| 1983 | 672 | 3,809 | 4,481 | 392 | 1,439 | 1,831 | 76,311 | 116,947 | 193,258 |
| 1984 | 4,373 | 3,988 | 8,361 | 1,869 | 794 | 2,663 | 67,794 | 160,535 | 228,329 |
| 1985 | 3,792 | 7,631 | 11,423 | 329 | 3,633 | 3,962 | 51,665 | 300,822 | 352,487 |
| 1986 | 1,606 | 17,290 | 18,896 | 451 | 2,013 | 2,464 | 33,020 | 256,850 | 289,870 |
| 1987 | 4,177 | 7,330 | 11,507 | 236 | 1,761 | 1,997 | 89,826 | 180,408 | 270,234 |
| 1988 | 2,132 | 9,521 | 11,653 | 708 | 1,386 | 2,094 | 32,589 | 238,136 | 270,725 |
| 1989 | 884 | 6,304 | 7,188 | 53 | 480 | 533 | 25,566 | 136,587 | 162,153 |
| 1990 | 948 | 4,376 | 5,324 | 16 | 425 | 441 | 12,256 | 94,347 | 106,603 |
| 1991 | 433 | 1,208 | 1,641 | 38 | 153 | 191 | 13,112 | 94,721 | 107,833 |
| Average | 3,276 | 9,714 | 12,990 | 4,687 | 18,421 | 23,109 | 47,162 | 199,832 | 246,994 |

1. Escapement data for the Sacramento River and its tributaries north of and including the American River.
2. Escapement data for the Mokelumne, Cosumnes, Calaveras, Stanislaus, Tuolumne, and Merced rivers.
3. Escapement data for the main stem Sacramento River above Red Bluff Diversion Dam.
4. Escapement data for the main stem Sacramento River above Red Bluff Diversion Dam.
5. Escapement data for the main stem Sacramento River above Red Bluff Diversion Dam.

TABLE 2. Chinook salmon harvest estimates for the ocean commercial (troll) and sport (charterboat and skiff) fisheries during 1967 through 1991.

| YEAR | Ocean Commercial Chinook Harvest | Ocean Sport Chinook Harvest | Total Ocean Harvest of Chinook |
|---------|-------------------------------------|--------------------------------|-----------------------------------|
| 1967 | 337,884 | 72,566 | 410,450 |
| 1968 | 472,009 | 154,244 | 626,253 |
| 1969 | 551,423 | 155,768 | 707,191 |
| 1970 | 516,648 | 147,800 | 664,448 |
| 1971 | 433,927 | 188,271 | 622,198 |
| 1972 | 492,203 | 200,522 | 692,725 |
| 1973 | 816,968 | 197,953 | 1,014,921 |
| 1974 | 491,562 | 157,465 | 649,027 |
| 1975 | 578,709 | 103,734 | 682,443 |
| 1976 | 539,930 | 80,993 | 620,923 |
| 1977 | 600,185 | 103,585 | 703,770 |
| 1978 | 637,658 | 72,722 | 710,380 |
| 1979 | 726,760 | 119,628 | 846,388 |
| 1980 | 588,650 | 85,185 | 673,835 |
| 1981 | 588,059 | 84,027 | 672,086 |
| 1982 | 765,160 | 138,724 | 903,884 |
| 1983 | 293,983 | 63,822 | 357,805 |
| 1984 | 299,759 | 87,803 | 387,562 |
| 1985 | 366,298 | 171,109 | 537,407 |
| 1986 | 825,588 | 141,616 | 967,204 |
| 1987 | 876,334 | 192,543 | 1,068,877 |
| 1988 | 1,317,207 | 171,361 | 1,488,568 |
| 1989 | 530,938 | 186,627 | 717,565 |
| 1990 | 423,447 | 139,829 | 563,276 |
| 1991 | 294,865 | 80,833 | 375,698 |
| Average | 574,646 | 131,949 | 706,595 |

TABLE 2. Returns of chinook salmon for the troll and sport fisheries during 1967 through 1991.

TABLE 3. Returns of chinook salmon (all races combined) to hatchery facilities operated in the Central Valley during 1967 through 1991.

| Year | Fall-run Chinook Salmon Hatchery Return | | | Spring-run Chinook Salmon Hatchery Returns | | | Late-fall-run Chinook Salmon Hatchery Returns | | | Total Returns of Salmon to Hatcheries | | |
|---------|---|--------|--------|--|--------|-------|---|--------|-------|---------------------------------------|--------|--------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 3,310 | 11,383 | 14,693 | 3 | 143 | 146 | 0 | 0 | 0 | 3,313 | 11,526 | 14,839 |
| 1968 | 4,331 | 14,155 | 18,486 | 0 | 216 | 216 | 0 | 0 | 0 | 4,331 | 14,371 | 18,702 |
| 1969 | 2,841 | 9,435 | 12,276 | 1 | 111 | 112 | 37 | 750 | 787 | 2,879 | 10,296 | 13,175 |
| 1970 | 2,874 | 16,474 | 19,348 | 0 | 235 | 235 | 291 | 2,769 | 3,060 | 3,165 | 19,478 | 22,643 |
| 1971 | 3,485 | 15,241 | 18,726 | 0 | 484 | 484 | 192 | 1,017 | 1,209 | 3,677 | 16,742 | 20,419 |
| 1972 | 4,859 | 9,512 | 14,371 | 0 | 256 | 256 | 42 | 507 | 549 | 4,901 | 10,275 | 15,176 |
| 1973 | 4,409 | 21,926 | 26,335 | 0 | 205 | 205 | 13 | 390 | 403 | 4,422 | 22,521 | 26,943 |
| 1974 | 2,719 | 16,383 | 19,102 | 0 | 198 | 198 | 36 | 669 | 705 | 2,755 | 17,250 | 20,005 |
| 1975 | 2,996 | 14,092 | 17,088 | 0 | 691 | 691 | 73 | 1,425 | 1,498 | 3,069 | 16,208 | 19,277 |
| 1976 | 2,149 | 11,484 | 13,633 | 14 | 699 | 713 | 23 | 586 | 609 | 2,186 | 12,769 | 14,955 |
| 1977 | 2,098 | 19,190 | 21,288 | 0 | 121 | 121 | 73 | 683 | 756 | 2,171 | 19,995 | 22,165 |
| 1978 | 3,516 | 11,871 | 15,387 | 0 | 202 | 202 | 200 | 1,653 | 1,853 | 3,716 | 13,726 | 17,442 |
| 1979 | 6,905 | 16,999 | 23,904 | 0 | 50 | 50 | 4 | 825 | 829 | 6,909 | 17,874 | 24,783 |
| 1980 | 4,730 | 24,802 | 29,532 | 0 | 122 | 122 | 63 | 804 | 867 | 4,793 | 25,728 | 30,521 |
| 1981 | 9,578 | 34,830 | 44,408 | 113 | 356 | 469 | 274 | 2,331 | 2,605 | 9,965 | 37,517 | 47,482 |
| 1982 | 10,303 | 30,784 | 41,087 | 210 | 1,700 | 1,910 | 307 | 1,579 | 1,886 | 10,821 | 34,062 | 44,883 |
| 1983 | 11,731 | 19,992 | 31,723 | 72 | 1,640 | 1,712 | 88 | 870 | 958 | 11,891 | 22,502 | 34,393 |
| 1984 | 11,568 | 34,461 | 46,029 | 251 | 1,311 | 1,562 | 251 | 377 | 628 | 12,070 | 36,149 | 48,219 |
| 1985 | 6,767 | 36,587 | 43,354 | 39 | 1,593 | 1,632 | 85 | 303 | 388 | 6,891 | 38,483 | 45,374 |
| 1986 | 6,495 | 30,008 | 36,503 | 191 | 1,242 | 1,433 | 58 | 730 | 788 | 6,743 | 31,981 | 38,724 |
| 1987 | 13,375 | 21,139 | 34,514 | 287 | 926 | 1,213 | 43 | 760 | 803 | 13,706 | 22,824 | 36,530 |
| 1988 | 3,168 | 28,074 | 31,242 | 280 | 6,553 | 6,833 | 90 | 367 | 457 | 3,538 | 34,994 | 38,532 |
| 1989 | 4,133 | 25,566 | 29,699 | 693 | 4,385 | 5,078 | 26 | 856 | 882 | 4,851 | 30,808 | 35,659 |
| 1990 | 4,330 | 21,404 | 25,734 | 0 | 1,306 | 1,306 | 43 | 149 | 192 | 4,372 | 22,860 | 27,232 |
| 1991 | 3,130 | 25,080 | 28,210 | 155 | 4,148 | 4,303 | 38 | 241 | 279 | 3,323 | 29,469 | 32,792 |
| Average | 5,432 | 20,835 | 26,267 | 92 | 1,156 | 1,248 | 94 | 826 | 920 | 5,618 | 22,816 | 28,435 |

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C-044200

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Steelhead Trout

Estimates of the numbers of naturally spawning steelhead are very conservative, and do not include estimates for locations where steelhead likely spawn. Counts conducted earlier than the specified base time period had enumerated populations in excess of 1,000 steelhead in both Mill and Deer creeks. The primary source of data regarding naturally spawning steelhead is from annual counts at RBDD. These counts are corrected by subtracting the number of steelhead returning to Coleman National Fish Hatchery and the difference is assumed to represent the naturally spawning component. During the base period and average of 6,574 steelhead spawned naturally in the Sacramento River system above RBDD and ranged from 470 in 1989 to 19,615 in 1968 (Table 4).

Sturgeon

Estimates of the abundance of white sturgeon range from 20,700 in 1974 to 114,700 in 1967 with a 25-year mean of 63,501 (Table 5). Green sturgeon abundance has ranged from 200 in 1974 to 1,850 in 1967 with a 25-year mean of 867 (Table 5).

Striped Bass

Estimates of the abundance of legal-sized striped bass have ranged from 574,364 in 1990 to 1,948,000 in 1967 with a 25-year mean of 1,252,259 (Table 6).

American Shad

Only two estimates of the abundance of American shad are available from studies conducted in the Sacramento River system. Results of that study estimate that 3.04 and 2.79 million adult American shad were present in 1976 and 1977, respectively.

Inland Harvest of Chinook Salmon and Steelhead

The estimated catch of all races of chinook salmon in the Sacramento River exclusive of the tributary streams ranged from 5,133 in 1983 to 19,750 in 1969 (Table 7, Appendix 10). Fall chinook were most abundant with an average inland harvest of 7,615. Steelhead harvest ranged from 470 in 1989 to 19,615 in 1968 (Table 8, Appendix 11).

SUMMARY AND CONCLUSIONS

The Act requires restoration goals to be established for Central Valley anadromous fish populations at not less than twice the average levels attained during the period of 1967-1991. Lack of quantitative data for some of the fisheries during the 1967-1991 base period precludes determination of some elements that need to be encompassed in setting goals. For example, it is not known how many Central Valley chinook salmon were harvested in the ocean fisheries nor is it known how many were harvested inland. Likewise, except for two

TABLE 4. Estimates of steelhead trout returning to the Upper Sacramento River and to hatcheries operated throughout the Central Valley, 1967 through 1991.

| Year | Natural Spawning | Steelhead Returns to Hatcheries | | | | | Grand Total |
|---------|------------------|---------------------------------|---------------|--------|-----------|----------|-------------|
| | Upper Sacramento | Coleman | Feather River | Nimbus | Mokelumne | Subtotal | |
| 1967 | 15,312 | 1,532 | 563 | 642 | 17 | 2,754 | 18,066 |
| 1968 | 19,615 | 3,229 | 1,005 | 1,183 | 103 | 5,520 | 25,135 |
| 1969 | 15,222 | 4,939 | 361 | 3,056 | 24 | 8,380 | 23,602 |
| 1970 | 13,240 | 4,046 | 1,945 | 1,734 | 134 | 7,859 | 21,099 |
| 1971 | 11,887 | 3,742 | 78 | 3,033 | 115 | 6,968 | 18,855 |
| 1972 | 6,041 | 1,486 | 288 | 2,256 | 14 | 4,044 | 10,085 |
| 1973 | 8,921 | 2,645 | 1,000 | 2,506 | 11 | 6,162 | 15,083 |
| 1974 | 7,150 | 1,834 | 715 | 3,157 | 18 | 5,724 | 12,874 |
| 1975 | 5,579 | 1,099 | 458 | 2,164 | 2 | 3,723 | 9,302 |
| 1976 | 8,902 | 2,162 | 573 | 3,181 | 0 | 5,916 | 14,818 |
| 1977 | 6,099 | 2,069 | 163 | 1,307 | 0 | 3,539 | 9,638 |
| 1978 | 2,527 | 697 | 131 | 619 | 0 | 1,447 | 3,974 |
| 1979 | 3,499 | 865 | 189 | 680 | 0 | 1,734 | 5,233 |
| 1980 | 11,887 | 4,264 | 314 | 1,310 | 0 | 5,888 | 17,775 |
| 1981 | 3,363 | 1,118 | 547 | 821 | 0 | 2,486 | 5,849 |
| 1982 | 2,757 | 1,275 | 891 | 3,190 | 0 | 5,356 | 8,113 |
| 1983 | 3,486 | 938 | 1,238 | 1,003 | 0 | 3,179 | 6,665 |
| 1984 | 2,036 | 529 | 783 | 5,155 | 0 | 6,467 | 8,503 |
| 1985 | 4,489 | 2,084 | 1,721 | 910 | 0 | 4,715 | 9,204 |
| 1986 | 3,769 | 2,299 | 1,554 | 1,193 | 0 | 5,046 | 8,815 |
| 1987 | 2,963 | 1,176 | 1,018 | 1,431 | 48 | 3,673 | 6,636 |
| 1988 | 1,872 | 915 | 2,587 | 705 | 0 | 4,207 | 6,079 |
| 1989 | 470 | 492 | 1,106 | 289 | 7 | 1,894 | 2,364 |
| 1990 | 2,272 | 1,319 | 1,193 | 594 | 11 | 3,117 | 5,389 |
| 1991 | 991 | 991 | 1,024 | 223 | 20 | 2,258 | 3,249 |
| Average | 6,574 | 1,910 | 858 | 1,694 | 40 | 4,482 | 11,056 |

TABLE 5. Estimates of the abundance of white sturgeon and green sturgeon in the Central Valley, 1967 through 1991.

| Year | White Sturgeon Abundance | Years Abundance Estimated | Ratio White: Green | Green Sturgeon Abundance |
|---------|--------------------------|---------------------------|--------------------|--------------------------|
| 1967 | 114,700 | ** | 62.0:1 | 1,850 |
| 1968 | 40,000 | ** | 38.6:1 | 1,040 |
| 1969 | 36,783 | | | 900 |
| 1970 | 33,567 | | | 760 |
| 1971 | 30,350 | | | 620 |
| 1972 | 27,133 | | | 480 |
| 1973 | 23,917 | | | 340 |
| 1974 | 20,700 | ** | 101.9:1 | 200 |
| 1975 | 31,460 | | | 444 |
| 1976 | 42,220 | | | 688 |
| 1977 | 52,980 | | | 932 |
| 1978 | 63,740 | | | 1,176 |
| 1979 | 74,500 | ** | 52.6:1 | 1,420 |
| 1980 | 83,120 | | | 1,378 |
| 1981 | 91,740 | | | 1,336 |
| 1982 | 100,360 | | | 1,294 |
| 1983 | 108,980 | | | 1,252 |
| 1984 | 117,600 | ** | 106.3:1 | 1,210 |
| 1985 | 107,700 | ** | 127.3:1 | 760 |
| 1986 | 96,850 | | | 635 |
| 1987 | 86,000 | ** | 163.7:1 | 510 |
| 1988 | 66,267 | | | 520 |
| 1989 | 46,553 | | | 530 |
| 1990 | 26,800 | ** | 49.7:1 | 540 |
| 1991 | -- | | | -- |
| Average | 63,501 | | | 867 |

TABLE 6. Estimated abundance of adult striped bass in the Central Valley, 1967 through 1991.

| Year | Adult Striped Bass Abundance | | | | | | |
|---------|------------------------------|---------|---------|---------|---------|---------|--------------|
| | Age 3 | Age 4 | Age 5 | Age 6 | Age 7 | Age 8+ | Total Adults |
| 1967 | -- | -- | -- | -- | -- | -- | 1,948,000 |
| 1968 | -- | -- | -- | -- | -- | -- | 1,944,000 |
| 1969 | 1,083,448 | 412,448 | 269,245 | 170,505 | 69,147 | 182,957 | 1,646,026 |
| 1970 | 1,309,098 | 484,360 | 201,040 | 128,928 | 89,809 | 168,708 | 1,727,394 |
| 1971 | 858,574 | 602,350 | 224,357 | 118,366 | 77,139 | 148,216 | 1,599,715 |
| 1972 | 1,249,964 | 521,549 | 407,093 | 124,223 | 61,635 | 143,425 | 1,882,907 |
| 1973 | 742,520 | 480,825 | 234,728 | 176,698 | 173,945 | 199,703 | 1,637,159 |
| 1974 | 941,360 | 338,683 | 272,919 | 136,202 | 108,783 | 149,946 | 1,477,213 |
| 1975 | 933,690 | 619,066 | 265,656 | 160,725 | 76,422 | 261,056 | 1,849,770 |
| 1976 | 1,037,674 | 480,548 | 190,596 | 130,718 | 123,493 | 136,884 | 1,581,076 |
| 1977 | 534,040 | 176,888 | 223,172 | 92,257 | 25,101 | 139,863 | 924,301 |
| 1978 | 1,213,574 | 254,939 | 136,032 | 33,091 | 42,797 | 77,996 | 1,151,642 |
| 1979 | 929,368 | 398,345 | 179,211 | 48,490 | 26,797 | 38,174 | 1,155,701 |
| 1980 | 379,696 | 560,208 | 211,661 | 85,511 | 29,323 | 39,448 | 1,115,999 |
| 1981 | 531,916 | 342,590 | 186,690 | 54,036 | 27,787 | 34,249 | 911,300 |
| 1982 | 821,584 | 217,768 | 97,861 | 41,291 | 35,796 | 21,618 | 825,126 |
| 1983 | 564,464 | 394,577 | 232,066 | 39,333 | 25,684 | 35,856 | 1,009,748 |
| 1984 | 867,977 | 359,026 | 187,021 | 27,919 | 10,341 | 24,373 | 1,042,668 |
| 1985 | 418,749 | 538,559 | 190,319 | 64,699 | 5,267 | 15,970 | 1,024,188 |
| 1986 | 526,171 | 329,553 | 282,682 | 105,575 | 22,710 | 34,522 | 1,037,127 |
| 1987 | 629,384 | 274,892 | 172,848 | 132,469 | 56,632 | 46,816 | 998,349 |
| 1988 | 350,695 | 386,400 | 133,161 | 112,265 | 43,050 | 42,189 | 892,413 |
| 1989 | 271,064 | 322,833 | 145,643 | 43,819 | 46,890 | 19,863 | 724,580 |
| 1990 | 325,543 | 151,540 | 149,504 | 59,245 | 27,361 | 23,944 | 574,364 |
| 1991 | 207,588 | 210,395 | 151,888 | 54,586 | 39,158 | 65,881 | 625,702 |
| Average | 669,126 | 354,334 | 189,816 | 85,638 | 49,803 | 82,066 | 1,252,259 |

Central Valley Anadromous Fish Populations, 1967-1991

TABLE 7. Estimated harvest of chinook salmon in the Sacramento River, 1967 through 1991.

| Year | Late-Fall Run | Winter Run | Spring Run | Fall Run | Total |
|---------|---------------|------------|------------|----------|--------|
| 1967 | 2,504 | 3,602 | 1,885 | 4,267 | 12,258 |
| 1968 | 2,047 | 11,308 | 802 | 4,471 | 18,628 |
| 1969 | 1,433 | 9,095 | 1,659 | 7,563 | 19,750 |
| 1970 | 748 | 4,440 | 762 | 7,889 | 13,839 |
| 1971 | 1,165 | 6,735 | 400 | 9,477 | 17,778 |
| 1972 | 2,658 | 2,944 | 1,149 | 5,987 | 12,303 |
| 1973 | 2,599 | 2,944 | 1,149 | 6,465 | 13,157 |
| 1974 | 567 | 2,014 | 1,047 | 10,632 | 14,883 |
| 1975 | 1,190 | 2,014 | 1,047 | 10,632 | 14,883 |
| 1976 | 921 | 4,268 | 2,145 | 11,047 | 18,381 |
| 1977 | 1,058 | 1,667 | 830 | 4,889 | 8,443 |
| 1978 | 528 | 910 | 538 | 4,839 | 6,816 |
| 1979 | 477 | 107 | 151 | 7,438 | 8,173 |
| 1980 | 460 | 55 | 803 | 4,839 | 6,172 |
| 1981 | 335 | 961 | 1,185 | 3,699 | 6,179 |
| 1982 | 162 | 50 | 1,115 | 4,578 | 5,905 |
| 1983 | 593 | 59 | 234 | 4,247 | 5,133 |
| 1984 | 241 | 78 | 745 | 6,087 | 7,150 |
| 1985 | 430 | 548 | 1,171 | 16,533 | 18,682 |
| 1986 | 2,340 | 138 | 1,846 | 15,340 | 19,665 |
| 1987 | 943 | 89 | 688 | 9,630 | 11,350 |
| 1988 | 680 | 0 | 600 | 11,488 | 12,768 |
| 1989 | 685 | 0 | 322 | 6,850 | 7,856 |
| 1990 | 330 | 0 | 215 | 5,290 | 5,835 |
| 1991 | 531 | 0 | 57 | 10,075 | 10,663 |
| AVERAGE | 1,025 | 2,143 | 855 | 7,615 | 11,637 |

Central Valley Anadromous Fish Populations, 1967-1991

TABLE 8. Estimated harvest of steelhead above Red Bluff Diversion Dam, 1967-1991.

| Year | Upper Sacramento Population Estimate | Estimated Angler Harvest above Red Bluff Diversion Dam |
|---------|--------------------------------------|--|
| 1967 | 15,312 | 5,795 |
| 1968 | 19,615 | 5,761 |
| 1969 | 15,222 | 5,761 |
| 1970 | 13,240 | 5,011 |
| 1971 | 11,887 | 4,499 |
| 1972 | 6,041 | 2,286 |
| 1973 | 8,921 | 3,376 |
| 1974 | 7,150 | 2,706 |
| 1975 | 5,579 | 2,111 |
| 1976 | 8,902 | 3,369 |
| 1977 | 6,099 | 2,308 |
| 1978 | 2,527 | 956 |
| 1979 | 3,499 | 1,324 |
| 1980 | 11,887 | 4,499 |
| 1981 | 3,363 | 1,273 |
| 1982 | 2,757 | 1,043 |
| 1983 | 3,486 | 1,319 |
| 1984 | 2,036 | 771 |
| 1985 | 4,489 | 1,699 |
| 1986 | 3,769 | 1,426 |
| 1987 | 2,272 | 860 |
| 1988 | 1,872 | 708 |
| 1989 | 470 | 178 |
| 1990 | 2,272 | 860 |
| 1991 | 991 | 375 |
| Average | 6,574 | 2,488 |

37.8
29.4
37.8
37.8
37.8
37.8

Central Valley Anadromous Fish Populations, 1967-1991

years of population data, no contemporaneous data exists for American shad. In compliance with the Act, the average population levels for chinook salmon, steelhead trout, sturgeon, striped bass, and American shad are determined to be as follows.

TABLE 9. Estimated average numbers of anadromous fish in the ocean sport and commercial fisheries, inland sport fisheries, spawning escapements, and population estimates for the 1967-1991 baseline period.

| Species or Stock | | 1967-1991 Average Harvest Estimate | 1967-1991 Average Population Estimate |
|------------------|--------------------------------------|------------------------------------|---------------------------------------|
| Chinook Salmon | Sacramento Fall Run | 7,615 ¹ | 176,092 |
| | San Joaquin Fall Run | No estimate | 20,644 |
| | Spring Run | 855 ¹ | 12,990 |
| | Late-fall Run | 1,025 ¹ | 14,159 |
| | Winter Run | 2,143 ¹ | 23,109 |
| | Ocean Sport Harvest (Statewide) | 131,949 | Not applicable |
| | Ocean Commercial Harvest (Statewide) | 574,646 | Not applicable |
| Steelhead | Sacramento Valley | 2,488 ¹ | 6,574 |
| | San Joaquin Valley | No estimate | No estimate |
| Sturgeon | White | Contained in population estimate | 63,501 |
| | Green | Contained in population estimate | 867 |
| Striped Bass | Central Valley | Contained in population estimate | 1,252,259 |
| American Shad | Sacramento Valley | No estimate | No estimate |
| | San Joaquin Valley | No estimate | No estimate |

¹. Harvest estimate for main stem Sacramento River and does not include estimated harvest of salmon or steelhead in tributary streams or rivers.

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**APPENDIX 1. Angler Harvest Estimates for the Sacramento River Basin,
1967-1991.**

BACKGROUND

Limited harvest information is available for determinations of inland sport catches of salmon and steelhead in the Central Valley. Although no comprehensive measure of in-river sport harvest has been made on a consistent basis, fragmented census surveys have been made for some rivers during various times. Inland sport catch of chinook salmon has received little emphasis because of low annual mortality associated from this source. One simple approach to estimate annual in-river harvest of chinook salmon was made by Meyer (1985) who assumed the in-river harvest was a constant fraction of the total ocean sport harvest. He applied 10% as a reasonable estimate, combining the various runs. Rowell (unpublished report, Department of Fish and Game, Red Bluff) conducted a salmon and steelhead creel census in the Sacramento River above Red Bluff Diversion Dam during 1967 through 1975. These estimates combined with RBDD counts provide estimates for both the river reach above RBDD and the total harvest of chinook salmon in the Sacramento exclusive of the tributaries, and for the harvest of steelhead trout above RBDD.

Methods and Results

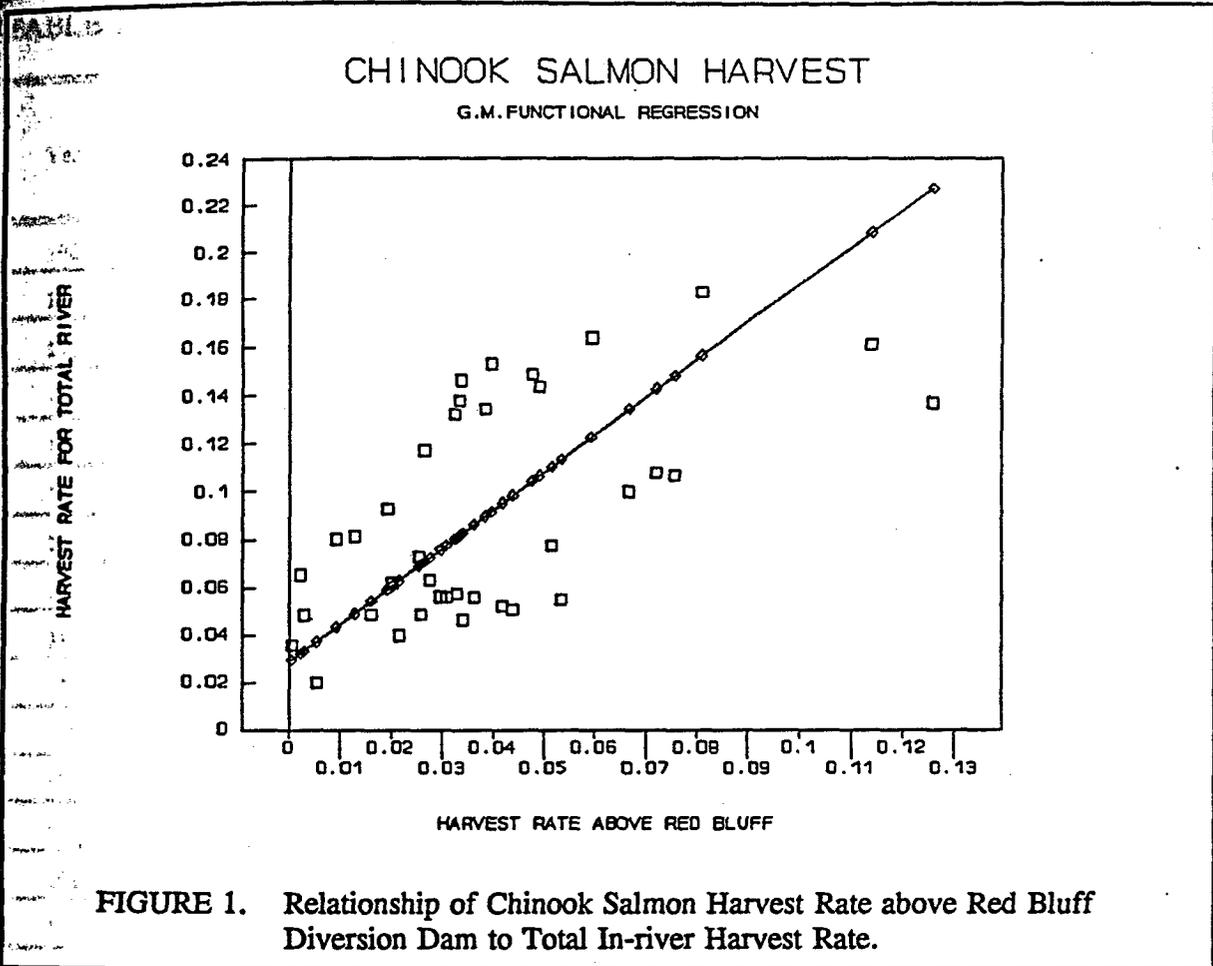
Chinook Salmon

A significant relationship between harvest rates above RBDD and the total river allows annual estimates of individual salmon races to be made (Figure 1).

Annual spawning stock survey reports from 1967-1991 provide estimates of salmon harvest rates in the reach above RBDD. Ladder counts combined with estimated catches made at resorts and boat ramps permit crude estimates of annual harvest upon individual salmon runs (Table 1). The spawner estimates and estimated catches presented in the tables are not segregated to account for those fish destined to spawn naturally and those returning to hatcheries.

These catches reflect only that portion of the run caught above Red Bluff. Considerable numbers are harvested in the river below Red Bluff with stocks caught further downstream to the Carquinez Straits. Converting the numbers caught to proportions (Table 2) allows application of the relationship between harvest above RBDD to total river catches.

Thus applying an estimated annual harvest rate for the total river to yearly spawning escapements yields a harvest index for each run (Table 3).



Central Valley Anadromous Fish Populations, 1967-1991

TABLE 1. Salmon Counts and Estimated Catches Upstream of Red Bluff Diversion Dam.

| Year | Late-fall run chinook | | Winter-run chinook | | Spring-run chinook | | Fall-run chinook | |
|---------|-----------------------|-----------------|--------------------|-----------------|--------------------|-----------------|------------------|-----------------|
| | Spawner Estimate | Estimated Catch | Spawner Estimate | Estimated Catch | Spawner Estimate | Estimated Catch | Spawner Estimate | Estimated Catch |
| 1967 | 37,208 | No est. | 57,306 | No est. | 23,514 | No est. | 89,220 | 821 |
| 1968 | 34,733 | 668 | 84,414 | 5,631 | 14,864 | 239 | 12,2095 | 354 |
| 1969 | 38,752 | 207 | 117,808 | 3,628 | 26,505 | 571 | 13,3815 | 1,714 |
| 1970 | 25,310 | 26 | 40,409 | 2,080 | 3,652 | 416 | 80,935 | 3,110 |
| 1971 | 16,741 | 435 | 43,089 | 3,484 | 5,830 | 148 | 63,918 | 3,139 |
| 1972 | 32,651 | 1,092 | 37,133 | 1,204 | 7,346 | 308 | 42,503 | 2,022 |
| 1973 | 23,010 | 1,229 | 24,079 | 1,428 | 7,762 | 587 | 53,891 | 2,136 |
| 1974 | 7,855 | 217 | 21,897 | 580 | 3,933 | 133 | 54,952 | 1,804 |
| 1975 | 19,659 | 398 | 23,430 | 851 | 10,703 | 469 | 63,091 | 3,132 |
| 1976 | 16,198 | 290 | 35,096 | 2,067 | 25,983 | 888 | 60,719 | 3,307 |
| 1977 | 10,602 | 478 | 17,214 | 744 | 13,730 | 277 | 40,444 | 825 |
| 1978 | 12,586 | 107 | 24,862 | 127 | 5,903 | 234 | 39,826 | 674 |
| 1979 | 10,398 | 114 | 2,364 | 25 | 2,900 | 43 | 62,108 | 1,128 |
| 1980 | 9,481 | 120 | 1,156 | 14 | 9,696 | 333 | 37,610 | 1,031 |
| 1981 | 6,807 | 89 | 20,041 | 246 | 21,025 | 370 | 53,744 | 299 |
| 1982 | 4,913 | 14 | 1,242 | 9 | 23,438 | 282 | 48,431 | 1,069 |
| 1983 | 15,190 | 101 | 1,831 | 4 | 3,931 | 77 | 42,096 | 737 |
| 1984 | 7,163 | 23 | 2,663 | 1 | 8,147 | 324 | 73,254 | 1,556 |
| 1985 | 8,436 | 120 | 3,962 | 275 | 10,747 | 547 | 97,707 | 5,079 |
| 1986 | 8,286 | 1,331 | 2,464 | 43 | 16,691 | 867 | 104,873 | 5,681 |
| 1987 | 16,049 | 307 | 1,997 | 20 | 11,204 | 233 | 103,063 | 2,856 |
| 1988 | 11,597 | 221 | 2,094 | 21 | 9,781 | 203 | 139,966 | 3,878 |
| 1989 | 11,639 | 223 | 533 | 5 | 5,255 | 109 | 84,057 | 2,329 |
| 1990 | 7,039 | 77 | 441 | 4 | 3,922 | 65 | 55,710 | 1,598 |
| 1991 | 7,039 | 209 | 191 | 0 | 773 | 22 | 44,937 | 5,655 |
| Average | 15,984 | 337 | 22,709 | 937 | 11,089 | 323 | 71,719 | 2,237 |

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Central Valley Anadromous Fish Populations, 1967-1991

TABLE 2. Calculated Harvest Rates of Individual Salmon Races Upstream of RBDD and Estimated Total River Based on Regression.

| Year | Harvest Rate Above Red Bluff Diversion Dam | | | | Total River Harvest Rate | | | |
|---------|--|------------|------------|----------|--------------------------|------------|------------|----------|
| | Late-Fall Run | Winter Run | Spring Run | Fall Run | Late-Fall Run | Winter Run | Spring Run | Fall Run |
| 1967 | nc | nc | nc | 0.9% | 6.7% | 6.3% | 8.0% | 4.3% |
| 1968 | 1.9% | 6.7% | 1.6% | 0.3% | 5.9% | 13.4% | 5.4% | 3.3% |
| 1969 | 0.5% | 3.1% | 2.2% | 1.3% | 3.7% | 7.7% | 6.3% | 4.9% |
| 1970 | 0.1% | 5.1% | 11.4% | 3.8% | 3.0% | 11.0% | 20.9% | 8.9% |
| 1971 | 2.6% | 8.1% | 2.5% | 4.9% | 7.0% | 15.6% | 6.9% | 10.6% |
| 1972 | 3.3% | 3.2% | 4.2% | 4.8% | 8.1% | 8.0% | 9.5% | 10.4% |
| 1973 | 5.3% | 5.9% | 7.6% | 4.0% | 11.3% | 12.2% | 14.8% | 9.1% |
| 1974 | 2.8% | 2.6% | 3.4% | 3.3% | 7.2% | 7.0% | 8.2% | 8.0% |
| 1975 | 2.0% | 3.6% | 4.4% | 5.0% | 6.1% | 8.6% | 9.8% | 10.7% |
| 1976 | 1.8% | 5.9% | 3.4% | 5.4% | 5.7% | 12.2% | 8.3% | 11.5% |
| 1977 | 4.5% | 4.3% | 2.0% | 2.0% | 10.0% | 9.7% | 6.0% | 6.1% |
| 1978 | 0.9% | 0.5% | 4.0% | 1.7% | 4.2% | 3.7% | 9.1% | 5.5% |
| 1979 | 1.1% | 1.1% | 1.5% | 1.8% | 4.6% | 4.5% | 5.2% | 5.7% |
| 1980 | 1.3% | 1.2% | 3.4% | 2.7% | 4.9% | 4.8% | 8.3% | 7.2% |
| 1981 | 1.3% | 1.2% | 1.8% | 0.6% | 4.9% | 4.8% | 5.6% | 3.7% |
| 1982 | 0.3% | 0.7% | 1.2% | 2.2% | 3.3% | 4.0% | 4.8% | 6.3% |
| 1983 | 0.7% | 0.2% | 2.0% | 1.8% | 3.9% | 3.2% | 5.9% | 5.6% |
| 1984 | 0.3% | 0.0% | 4.0% | 2.1% | 3.4% | 2.9% | 9.1% | 6.2% |
| 1985 | 1.4% | 6.9% | 5.1% | 5.2% | 5.1% | 13.8% | 10.9% | 11.1% |
| 1986 | 16.1% | 1.7% | 5.2% | 5.4% | 28.2% | 5.6% | 11.1% | 11.4% |
| 1987 | 1.9% | 1.0% | 2.1% | 2.8% | 5.9% | 4.4% | 6.1% | 7.2% |
| 1988 | 1.9% | 1.0% | 2.1% | 2.8% | 5.9% | 0.0% | 6.1% | 7.2% |
| 1989 | 1.9% | 0.9% | 2.1% | 2.8% | 5.9% | 4.4% | 6.1% | 7.2% |
| 1990 | 1.1% | 0.9% | 1.7% | 2.9% | 4.5% | 0.0% | 5.5% | 7.4% |
| 1991 | 3.0% | 0.0% | 2.8% | 12.6% | 7.5% | 0.0% | 7.4% | 22.7% |
| Average | 2.4% | 2.8% | 3.4% | 3.3% | 6.7% | 6.5% | 8.2% | 8.1% |

Central Valley Anadromous Fish Populations, 1967-1991

TABLE 3. Annual Chinook Salmon Harvest Estimate for the Sacramento River, 1967-1991.

| Year | Late-Fall Run | Winter Run | Spring Run | Fall Run | Total |
|---------|---------------|------------|------------|----------|--------|
| 1967 | 2,504 | 3,602 | 1,885 | 4,267 | 12,258 |
| 1968 | 2,047 | 11,308 | 802 | 4,471 | 18,628 |
| 1969 | 1,433 | 9,095 | 1,659 | 7,563 | 19,750 |
| 1970 | 748 | 4,440 | 762 | 7,889 | 13,839 |
| 1971 | 1,165 | 6,735 | 400 | 9,477 | 17,778 |
| 1972 | 2,658 | 2,944 | 1,149 | 5,987 | 12,303 |
| 1973 | 2,599 | 2,944 | 1,149 | 6,465 | 13,157 |
| 1974 | 567 | 2,014 | 1,047 | 10,632 | 14,883 |
| 1975 | 1,190 | 2,014 | 1,047 | 10,632 | 14,883 |
| 1976 | 921 | 4,268 | 2,145 | 11,047 | 18,381 |
| 1977 | 1,058 | 1,667 | 830 | 4,889 | 8,443 |
| 1978 | 528 | 910 | 538 | 4,839 | 6,816 |
| 1979 | 477 | 107 | 151 | 7,438 | 8,173 |
| 1980 | 460 | 55 | 803 | 4,839 | 6,172 |
| 1981 | 335 | 961 | 1,185 | 3,699 | 6,179 |
| 1982 | 162 | 50 | 1,115 | 4,578 | 5,905 |
| 1983 | 593 | 59 | 234 | 4,247 | 5,133 |
| 1984 | 241 | 78 | 745 | 6,087 | 7,150 |
| 1985 | 430 | 548 | 1,171 | 16,533 | 18,682 |
| 1986 | 2,340 | 138 | 1,846 | 15,340 | 19,665 |
| 1987 | 943 | 89 | 688 | 9,630 | 11,350 |
| 1988 | 680 | 0 | 600 | 11,488 | 12,768 |
| 1989 | 685 | 0 | 322 | 6,850 | 7,856 |
| 1990 | 330 | 0 | 215 | 5,290 | 5,835 |
| 1991 | 531 | 0 | 57 | 10,075 | 10,663 |
| AVERAGE | 1,025 | 2,143 | 855 | 7,615 | 11,637 |

Steelhead Trout

A similar analysis was applied to steelhead catch and population statistics; a relationship between total population levels and catch. Hallock (1961), Rowell (1980) and Wixom (pers comm.) reported steelhead catches for a several differing time periods. The annual proportion caught varied between 20 to 66%, but averaged around 35%. Staley (1976) found during two years studied a similar harvest rate for the American River; 33%. Unfortunately, annual steelhead populations are not measured for most Central Valley Rivers. Estimates of harvest can only be obtained for the Sacramento River, using RBDD counts as an index of total population. A significant relationship between population size and catch was developed for Sacramento River steelhead harvest and applied to RBDD counts (Figure 2.)

The annual harvest rate determined by this relationship is equivalent to 38% of the available population and yields the catch estimates of Table 4. These steelhead catches should be considered as minimum estimates.

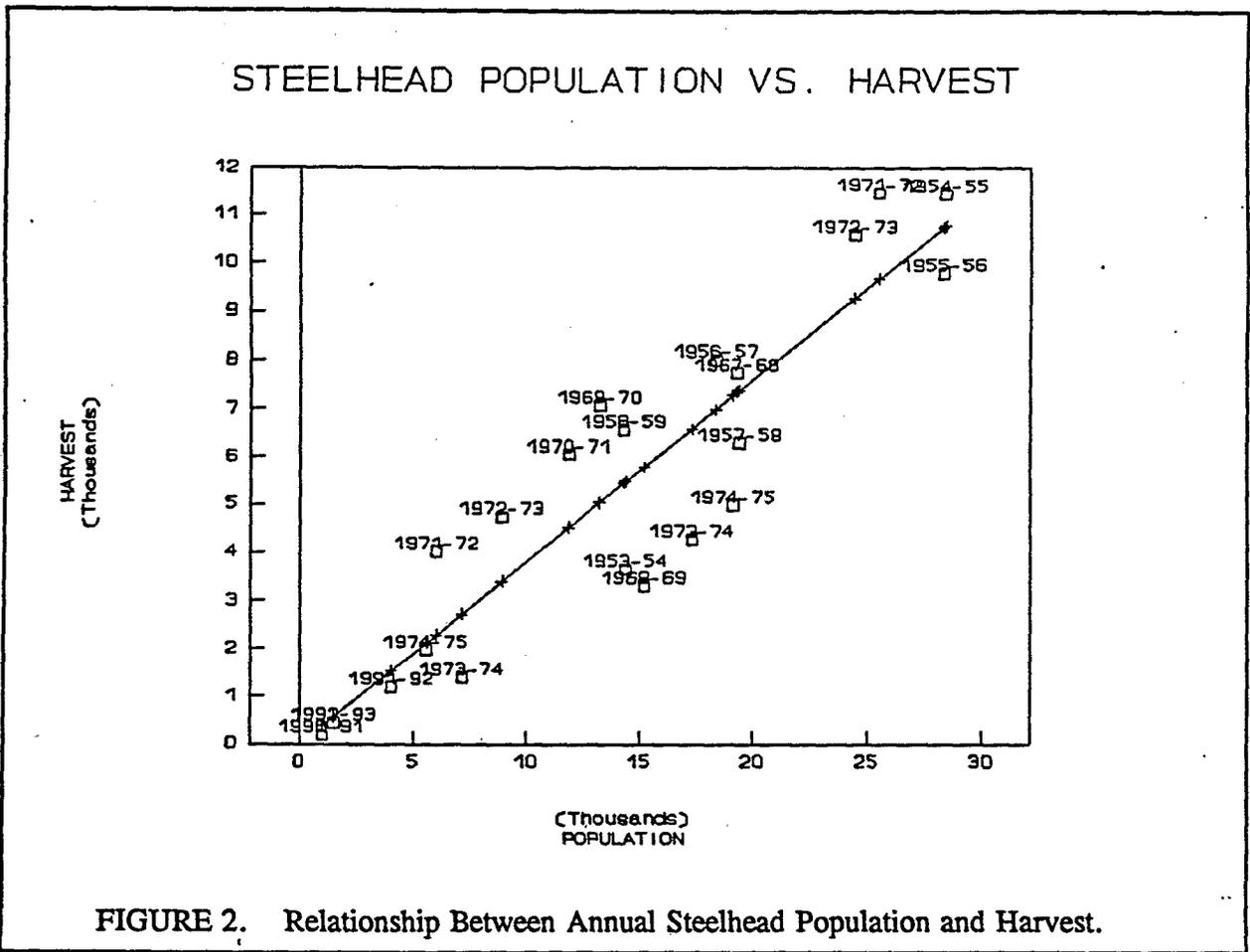


FIGURE 2. Relationship Between Annual Steelhead Population and Harvest.

Central Valley Anadromous Fish Populations, 1967-1991

TABLE 4. Annual Steelhead Harvest Above Red Bluff Diversion Dam.

| Year | Upper Sacramento Population Estimate | Estimated Angler Harvest above Red Bluff Diversion Dam |
|---------|---|--|
| 1967 | 15,312 | 5,795 |
| 1968 | 19,615 | 5,761 |
| 1969 | 15,222 | 5,761 |
| 1970 | 13,240 | 5,011 |
| 1971 | 11,887 | 4,499 |
| 1972 | 6,041 | 2,286 |
| 1973 | 8,921 | 3,376 |
| 1974 | 7,150 | 2,706 |
| 1975 | 5,579 | 2,111 |
| 1976 | 8,902 | 3,369 |
| 1977 | 6,099 | 2,308 |
| 1978 | 2,527 | 956 |
| 1979 | 3,499 | 1,324 |
| 1980 | 11,887 | 4,499 |
| 1981 | 3,363 | 1,273 |
| 1982 | 2,757 | 1,043 |
| 1983 | 3,486 | 1,319 |
| 1984 | 2,036 | 771 |
| 1985 | 4,489 | 1,699 |
| 1986 | 3,769 | 1,426 |
| 1987 | 2,272 | 860 |
| 1988 | 1,872 | 708 |
| 1989 | 470 | 178 |
| 1990 | 2,272 | 860 |
| 1991 | 991 | 375 |
| Average | 6,574 | 2,488 |

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APPENDIX 2. Estimates of abundance for naturally spawning stocks of fall-run chinook salmon in the Sacramento River basin, 1967-1991 (N.E. = No Estimate). (Sheet 1 of 5).

| Year | Sacramento River | | | Clear Creek | | | Cow Creek | | | Cottonwood Creek | | |
|---------|------------------|---------|---------|-------------|--------|-------|-----------|--------|-------|------------------|--------|-------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 15,714 | 71,586 | 87,300 | 67 | 303 | 370 | 94 | 426 | 520 | 108 | 492 | 600 |
| 1968 | 9,881 | 97,519 | 107,400 | 74 | 726 | 800 | 694 | 6,846 | 7,540 | 786 | 7,754 | 8,540 |
| 1969 | 15,864 | 116,336 | 132,200 | 149 | 1,091 | 1,240 | 668 | 4,902 | 5,570 | 596 | 4,371 | 4,967 |
| 1970 | 11,418 | 60,392 | 71,810 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1971 | 18,928 | 61,275 | 80,203 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1972 | 17,944 | 32,746 | 50,690 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1973 | 17,335 | 43,065 | 60,400 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1974 | 14,780 | 61,014 | 75,794 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1975 | 22,242 | 68,173 | 90,415 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1976 | 12,288 | 70,736 | 83,024 | 150 | 863 | 1,013 | 107 | 619 | 726 | 359 | 2,068 | 2,427 |
| 1977 | 12,676 | 51,997 | 64,673 | 267 | 1,095 | 1,362 | N.E. | N.E. | N.E. | 296 | 1,216 | 1,512 |
| 1978 | 17,035 | 65,258 | 82,293 | 12 | 48 | 60 | N.E. | N.E. | N.E. | 232 | 888 | 1,120 |
| 1979 | 38,246 | 76,953 | 115,199 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1980 | 11,059 | 41,355 | 52,414 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1981 | 27,180 | 41,805 | 68,985 | 1,447 | 2,225 | 3,672 | N.E. | N.E. | N.E. | 1,322 | 2,034 | 3,356 |
| 1982 | 11,970 | 29,594 | 41,564 | 226 | 559 | 785 | N.E. | N.E. | N.E. | 202 | 498 | 700 |
| 1983 | 23,997 | 34,247 | 58,244 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 412 | 588 | 1,000 |
| 1984 | 21,753 | 34,311 | 56,064 | 1,552 | 2,448 | 4,000 | 97 | 153 | 250 | 194 | 306 | 500 |
| 1985 | 19,604 | 83,575 | 103,179 | 133 | 567 | 700 | 57 | 243 | 300 | 76 | 324 | 400 |
| 1986 | 11,666 | 90,664 | 102,330 | 144 | 1,116 | 1,260 | 34 | 266 | 300 | 68 | 532 | 600 |
| 1987 | 39,214 | 69,413 | 108,627 | 235 | 415 | 650 | 181 | 320 | 500 | 217 | 383 | 600 |
| 1988 | 11,931 | 74,523 | 86,454 | 615 | 3,838 | 4,453 | 28 | 172 | 200 | 17 | 103 | 120 |
| 1989 | 12,092 | 47,476 | 59,568 | 437 | 1,717 | 2,154 | 51 | 199 | 250 | 142 | 558 | 700 |
| 1990 | 5,371 | 44,361 | 49,732 | 86 | 713 | 799 | 8 | 67 | 75 | 19 | 156 | 175 |
| 1991 | 3,591 | 25,372 | 28,963 | 251 | 1,776 | 2,027 | 31 | 219 | 250 | 85 | 602 | 687 |
| Average | 16,951 | 59,750 | 76,701 | 365 | 1,219 | 1,584 | 171 | 1,203 | 1,373 | 302 | 1,345 | 1,647 |

APPENDIX 2 (continued). Estimates of abundance for naturally spawning stocks of fall-run chinook salmon in the Sacramento River basin, 1967-1991 (N.E. = No Estimate). (Sheet 2 of 5)

| Year | Battle Creek | | | Paynes Creek | | | Antelope Creek | | | Mill Creek | | |
|---------|--------------|--------|--------|--------------|--------|-------|----------------|--------|-------|------------|--------|-------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 389 | 1,771 | 2,160 | N.E. | N.E. | N.E. | 11 | 49 | 60 | 90 | 410 | 500 |
| 1968 | 271 | 2,679 | 2,950 | N.E. | N.E. | N.E. | 7 | 73 | 80 | 69 | 681 | 750 |
| 1969 | 384 | 2,816 | 3,200 | 36 | 264 | 300 | 22 | 158 | 180 | 204 | 1,496 | 1,700 |
| 1970 | 528 | 2,792 | 3,320 | N.E. | N.E. | N.E. | 64 | 336 | 400 | 110 | 580 | 690 |
| 1971 | 775 | 2,510 | 3,285 | N.E. | N.E. | N.E. | 48 | 157 | 205 | 231 | 749 | 980 |
| 1972 | 719 | 1,311 | 2,030 | N.E. | N.E. | N.E. | 97 | 178 | 275 | 223 | 408 | 631 |
| 1973 | 1,234 | 3,066 | 4,300 | N.E. | N.E. | N.E. | 57 | 143 | 200 | 121 | 299 | 420 |
| 1974 | 447 | 1,847 | 2,294 | N.E. | N.E. | N.E. | 86 | 354 | 440 | 184 | 760 | 944 |
| 1975 | 597 | 1,829 | 2,426 | N.E. | N.E. | N.E. | 22 | 68 | 90 | 297 | 911 | 1,208 |
| 1976 | 466 | 2,681 | 3,147 | N.E. | N.E. | N.E. | 9 | 51 | 60 | 36 | 209 | 245 |
| 1977 | 1,098 | 4,506 | 5,604 | N.E. | N.E. | N.E. | 129 | 531 | 660 | 89 | 367 | 456 |
| 1978 | 366 | 1,404 | 1,770 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 62 | 238 | 300 |
| 1979 | 1,471 | 2,959 | 4,430 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 269 | 541 | 810 |
| 1980 | 1,042 | 3,898 | 4,940 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 68 | 252 | 320 |
| 1981 | 2,732 | 4,201 | 6,933 | N.E. | N.E. | N.E. | 160 | 247 | 407 | 402 | 618 | 1,020 |
| 1982 | 2,094 | 5,176 | 7,270 | 9 | 21 | 30 | 47 | 115 | 162 | 372 | 918 | 1,290 |
| 1983 | 2,154 | 3,073 | 5,227 | 41 | 59 | 100 | 25 | 35 | 60 | 82 | 118 | 200 |
| 1984 | 3,225 | 5,087 | 8,312 | 35 | 55 | 90 | 101 | 159 | 260 | 2,250 | 3,550 | 5,800 |
| 1985 | 4,553 | 19,408 | 23,961 | 11 | 49 | 60 | 3 | 12 | 15 | 794 | 3,386 | 4,180 |
| 1986 | 2,138 | 16,615 | 18,753 | 17 | 133 | 150 | 2 | 18 | 20 | 65 | 509 | 574 |
| 1987 | 2,856 | 5,056 | 7,912 | 7 | 13 | 20 | N.E. | N.E. | N.E. | 102 | 180 | 282 |
| 1988 | 7,294 | 45,558 | 52,852 | 1 | 9 | 10 | 1 | 9 | 10 | 205 | 1,282 | 1,487 |
| 1989 | 3,872 | 15,204 | 19,076 | 10 | 40 | 50 | 12 | 48 | 60 | 317 | 1,247 | 1,564 |
| 1990 | 697 | 5,756 | 6,453 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1991 | 820 | 5,793 | 6,613 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 19 | 131 | 150 |
| Average | 1,689 | 6,680 | 8,369 | 19 | 71 | 90 | 48 | 144 | 192 | 278 | 827 | 1,104 |

APPENDIX 2 (continued). Estimates of abundance for naturally spawning stocks of fall-run chinook salmon in the Sacramento River basin, 1967-1991 (N.E. = No Estimate).

| Year | Deer Creek | | | Miscellaneous Streams ¹ | | | Butte Creek | | | Big Chico Creek | | |
|---------|------------|--------|-------|------------------------------------|--------|-------|-------------|--------|-------|-----------------|--------|-------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 11 | 49 | 60 | 5 | 25 | 30 | N.E. | N.E. | 30 | N.E. | N.E. | N.E. |
| 1968 | 25 | 245 | 270 | 29 | 281 | 310 | N.E. | N.E. | 310 | N.E. | N.E. | N.E. |
| 1969 | 90 | 660 | 750 | 194 | 1,426 | 1,620 | N.E. | N.E. | 1,620 | N.E. | N.E. | N.E. |
| 1970 | 80 | 421 | 500 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1971 | 59 | 189 | 248 | 24 | 76 | 100 | 145 | 470 | 615 | N.E. | N.E. | N.E. |
| 1972 | 108 | 196 | 304 | 42 | 78 | 120 | 159 | 291 | 450 | N.E. | N.E. | N.E. |
| 1973 | 194 | 482 | 676 | 108 | 268 | 376 | N.E. | N.E. | 376 | N.E. | N.E. | N.E. |
| 1974 | 125 | 515 | 640 | 59 | 242 | 300 | 39 | 161 | 200 | N.E. | N.E. | N.E. |
| 1975 | 81 | 247 | 328 | 148 | 452 | 600 | 246 | 754 | 1,000 | N.E. | N.E. | N.E. |
| 1976 | 47 | 268 | 315 | 53 | 303 | 356 | 95 | 545 | 640 | N.E. | N.E. | N.E. |
| 1977 | 43 | 177 | 220 | 63 | 257 | 320 | N.E. | N.E. | 320 | N.E. | N.E. | N.E. |
| 1978 | 19 | 71 | 90 | N.E. | N.E. | N.E. | 4 | 16 | 20 | N.E. | N.E. | N.E. |
| 1979 | 259 | 521 | 780 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1980 | 44 | 166 | 210 | 32 | 119 | 151 | N.E. | N.E. | 151 | N.E. | N.E. | N.E. |
| 1981 | 323 | 497 | 820 | 260 | 400 | 660 | N.E. | N.E. | 660 | N.E. | N.E. | N.E. |
| 1982 | 138 | 342 | 480 | 52 | 128 | 180 | N.E. | N.E. | 180 | N.E. | N.E. | N.E. |
| 1983 | 152 | 218 | 370 | 87 | 123 | 210 | 412 | 588 | 1,000 | N.E. | N.E. | 500 |
| 1984 | 264 | 416 | 680 | 116 | 184 | 300 | N.E. | N.E. | 300 | N.E. | N.E. | 200 |
| 1985 | 171 | 729 | 900 | 11 | 49 | 60 | 19 | 81 | 100 | N.E. | N.E. | 25 |
| 1986 | 29 | 227 | 256 | 26 | 204 | 230 | N.E. | N.E. | 230 | N.E. | N.E. | N.E. |
| 1987 | 23 | 41 | 64 | 16 | 29 | 45 | N.E. | N.E. | 45 | N.E. | N.E. | N.E. |
| 1988 | 2 | 14 | 16 | 1 | 9 | 10 | 21 | 129 | 150 | N.E. | N.E. | N.E. |
| 1989 | 73 | 285 | 358 | 20 | 80 | 100 | 1 | 4 | 5 | N.E. | N.E. | N.E. |
| 1990 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| 1991 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. |
| Average | 103 | 303 | 406 | 67 | 237 | 304 | 114 | 304 | 418 | 96 | 146 | 242 |

APPENDIX 2 (continued). Estimates of abundance for naturally spawning stocks of fall-run chinook salmon in the Sacramento River basin, 1967-1991 (N.E. = No Estimate). (Sheet 4 of 5)

| Year | Feather River | | | Yuba River | | | American River | | | Total Natural Spawners | | |
|------|---------------|--------|--------|------------|--------|--------|----------------|--------|--------|------------------------|---------|---------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 3,515 | 6,585 | 10,100 | 15,275 | 8,225 | 23,500 | 3,132 | 14,868 | 18,000 | 38,410 | 104,790 | 143,200 |
| 1968 | 2,428 | 9,772 | 12,200 | 1,141 | 5,859 | 7,000 | 2,777 | 23,423 | 26,200 | 18,181 | 155,859 | 174,040 |
| 1969 | 19,895 | 36,305 | 56,200 | 2,218 | 3,012 | 5,230 | 8,208 | 35,452 | 43,660 | 48,528 | 208,289 | 256,817 |
| 1970 | 13,495 | 44,675 | 58,170 | 1,673 | 12,157 | 13,830 | 2,753 | 25,927 | 28,680 | 30,121 | 147,279 | 177,400 |
| 1971 | 10,005 | 33,495 | 43,500 | 350 | 5,300 | 5,650 | 5,210 | 36,470 | 41,680 | 35,775 | 140,691 | 176,466 |
| 1972 | 16,243 | 26,957 | 43,200 | 4,907 | 4,351 | 9,258 | 3,352 | 14,107 | 17,459 | 43,795 | 80,622 | 124,417 |
| 1973 | 13,671 | 51,429 | 65,100 | 3,232 | 20,887 | 24,119 | 4,688 | 77,554 | 82,242 | 40,640 | 197,193 | 237,833 |
| 1974 | 6,523 | 52,777 | 59,300 | 1,353 | 16,456 | 17,809 | 1,769 | 51,827 | 53,596 | 25,364 | 185,953 | 211,317 |
| 1975 | 2,604 | 35,131 | 37,735 | 756 | 4,885 | 5,641 | 2,699 | 29,433 | 32,132 | 29,691 | 141,884 | 171,575 |
| 1976 | 6,645 | 52,157 | 58,802 | 491 | 3,288 | 3,779 | 1,181 | 21,978 | 23,159 | 21,926 | 155,767 | 177,693 |
| 1977 | 1,959 | 35,709 | 37,668 | 1,509 | 7,213 | 8,722 | 4,701 | 36,904 | 41,605 | 22,831 | 139,971 | 162,802 |
| 1978 | 4,257 | 28,743 | 33,000 | 1,053 | 6,363 | 7,416 | 595 | 12,334 | 12,929 | 23,635 | 115,363 | 138,998 |
| 1979 | 3,268 | 25,147 | 28,415 | 1,989 | 10,441 | 12,430 | 896 | 36,419 | 37,315 | 46,397 | 152,982 | 199,379 |
| 1980 | 2,276 | 29,329 | 31,605 | 2,146 | 10,260 | 12,406 | 8,805 | 25,454 | 34,259 | 25,472 | 110,833 | 136,305 |
| 1981 | 4,250 | 40,488 | 44,738 | 1,978 | 12,047 | 14,025 | 2,521 | 40,941 | 43,462 | 42,575 | 145,503 | 188,078 |
| 1982 | 8,296 | 39,660 | 47,956 | 15,668 | 23,699 | 39,367 | 4,323 | 28,677 | 33,000 | 43,396 | 129,388 | 172,784 |
| 1983 | 4,382 | 18,441 | 22,823 | 2,452 | 11,804 | 14,256 | 7,313 | 19,087 | 26,400 | 41,714 | 88,676 | 130,390 |
| 1984 | 6,358 | 35,196 | 41,554 | 2,641 | 7,324 | 9,965 | 2,196 | 25,251 | 27,447 | 40,859 | 114,563 | 155,422 |
| 1985 | 1,807 | 48,385 | 50,192 | 2,927 | 10,139 | 13,066 | 11,392 | 44,728 | 56,120 | 41,563 | 211,695 | 253,258 |
| 1986 | 6,277 | 40,567 | 46,844 | 2,445 | 16,961 | 19,406 | 4,443 | 44,929 | 49,372 | 27,356 | 212,739 | 240,095 |
| 1987 | 14,390 | 44,584 | 58,974 | 6,164 | 12,346 | 18,510 | 2,960 | 18,185 | 21,145 | 66,364 | 150,965 | 217,329 |
| 1988 | 2,711 | 51,505 | 54,216 | 1,785 | 6,716 | 8,501 | 1,905 | 13,974 | 15,879 | 26,517 | 197,841 | 224,358 |
| 1989 | 2,999 | 26,987 | 29,986 | 1,574 | 8,263 | 9,837 | 2,459 | 14,619 | 17,078 | 24,060 | 116,726 | 140,786 |
| 1990 | 875 | 24,125 | 25,000 | 1,220 | 2,780 | 4,000 | 1,167 | 5,541 | 6,708 | 9,443 | 83,499 | 92,942 |
| 1991 | 2,502 | 25,300 | 27,802 | 2,740 | 11,239 | 13,979 | 1,506 | 16,639 | 18,145 | 11,546 | 87,070 | 98,616 |
| | | 24,528 | 41,003 | 3,187 | 9,681 | 12,868 | 3,718 | 28,589 | 32,307 | 33,046 | 143,046 | 176,092 |

APPENDIX 2 (continued). Estimates of abundance for naturally spawning stocks of fall-run chinook salmon in the Sacramento River basin, 1967-1991. (Sheet 5 of 5)

Footnotes:

1. Miscellaneous streams include Spring Gulch, China Gulch, Olney, Ash, Stillwater, and Inks creeks.

APPENDIX 3. Estimates of naturally spawning fall-run chinook salmon in the San Joaquin River drainage, 1967-1991
(N.E. = No Estimate).

| Year | Stanislaus River | | | Tuolumne River | | | Merced River | | | San Joaquin Totals | | |
|---------|------------------|--------|--------|----------------|--------|--------|--------------|--------|--------|--------------------|--------|--------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 345 | 11,540 | 11,885 | 333 | 6,467 | 6,800 | 141 | 459 | 600 | 819 | 18,466 | 19,285 |
| 1968 | 3,620 | 2,765 | 6,385 | 6,510 | 2,090 | 8,600 | 310 | 240 | 550 | 10,440 | 5,095 | 15,535 |
| 1969 | 308 | 12,019 | 12,327 | 580 | 31,620 | 32,200 | 25 | 575 | 600 | 913 | 44,214 | 45,127 |
| 1970 | 2,585 | 6,712 | 9,297 | 3,146 | 15,254 | 18,400 | 1,584 | 3,116 | 4,700 | 7,315 | 25,082 | 32,397 |
| 1971 | 913 | 12,708 | 13,621 | 1,444 | 20,441 | 21,885 | 142 | 1,448 | 1,590 | 2,499 | 34,597 | 37,096 |
| 1972 | 443 | 3,855 | 4,298 | 857 | 4,243 | 5,100 | 399 | 2,129 | 2,528 | 1,699 | 10,227 | 11,926 |
| 1973 | 49 | 1,185 | 1,234 | 93 | 1,896 | 1,989 | 169 | 628 | 797 | 312 | 3,708 | 4,020 |
| 1974 | 246 | 504 | 750 | 99 | 1,051 | 1,150 | 71 | 929 | 1,000 | 416 | 2,484 | 2,900 |
| 1975 | 172 | 1,028 | 1,200 | 136 | 1,464 | 1,600 | 207 | 1,493 | 1,700 | 515 | 3,985 | 4,500 |
| 1976 | 134 | 466 | 600 | 165 | 1,535 | 1,700 | 79 | 1,121 | 1,200 | 378 | 3,122 | 3,500 |
| 1977 | 0 | 0 | 0 | 0 | 450 | 450 | 29 | 321 | 350 | 29 | 771 | 800 |
| 1978 | 17 | 33 | 50 | 94 | 1,206 | 1,300 | 89 | 436 | 525 | 199 | 1,676 | 1,875 |
| 1979 | 6 | 94 | 100 | 123 | 1,060 | 1,183 | 253 | 1,667 | 1,920 | 382 | 2,821 | 3,203 |
| 1980 | 17 | 83 | 100 | 53 | 506 | 559 | 80 | 2,771 | 2,851 | 150 | 3,360 | 3,510 |
| 1981 | 24 | 976 | 1,000 | 4,504 | 9,749 | 14,253 | 2,733 | 6,758 | 9,491 | 7,261 | 17,483 | 24,744 |
| 1982 | N.E. | N.E. | N.E. | 378 | 6,748 | 7,126 | 68 | 3,006 | 3,074 | 445 | 9,755 | 10,200 |
| 1983 | 250 | 250 | 500 | 12,195 | 2,641 | 14,836 | 12,603 | 3,850 | 16,453 | 25,048 | 6,741 | 31,789 |
| 1984 | 4,438 | 7,001 | 11,439 | 7,246 | 6,556 | 13,802 | 6,165 | 18,495 | 24,660 | 17,849 | 32,052 | 49,901 |
| 1985 | 1,252 | 12,070 | 13,322 | 1,452 | 38,870 | 40,322 | 1,083 | 13,758 | 14,841 | 3,787 | 64,698 | 68,485 |
| 1986 | 1,001 | 4,887 | 5,888 | 503 | 6,785 | 7,288 | 381 | 5,142 | 5,523 | 1,885 | 16,814 | 18,699 |
| 1987 | 2,265 | 4,027 | 6,292 | 13,748 | 1,003 | 14,751 | 1,390 | 1,505 | 2,895 | 17,403 | 6,535 | 23,938 |
| 1988 | 494 | 11,850 | 12,344 | 311 | 6,038 | 6,349 | 190 | 2,570 | 2,760 | 995 | 20,458 | 21,453 |
| 1989 | 57 | 1,911 | 1,968 | 45 | 1,229 | 1,274 | 25 | 104 | 129 | 127 | 3,244 | 3,371 |
| 1990 | 191 | 301 | 492 | 21 | 75 | 96 | 6 | 18 | 24 | 218 | 394 | 612 |
| 1991 | 106 | 166 | 272 | 8 | 45 | 53 | 30 | 89 | 119 | 144 | 300 | 444 |
| Average | 789 | 4,018 | 4,807 | 2,162 | 6,761 | 8,923 | 1,130 | 2,905 | 4,035 | 4,049 | 13,523 | 17,572 |

APPENDIX 4. Estimates of naturally spawning fall-run chinook salmon in the Cosumnes, Mokelumne, and Calaveras rivers, 1967 through 1991 (N.E. = No Estimate).

| Year | Cosumnes River | | | Mokelumne River | | | Total Eastside | | |
|---------|----------------|--------|-------|-----------------|--------|--------|----------------|--------|--------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 55 | 445 | 500 | 303 | 2,448 | 2,750 | 358 | 2,893 | 3,250 |
| 1968 | 513 | 987 | 1,500 | 258 | 495 | 753 | 771 | 1,482 | 2,253 |
| 1969 | 695 | 3,705 | 4,400 | 327 | 1,743 | 2,070 | 1,022 | 5,448 | 6,470 |
| 1970 | 157 | 443 | 600 | 1,068 | 3,024 | 4,092 | 1,225 | 3,467 | 4,692 |
| 1971 | 55 | 446 | 500 | 433 | 3,537 | 3,970 | 487 | 3,983 | 4,470 |
| 1972 | 424 | 1,176 | 1,600 | 198 | 551 | 749 | 622 | 1,727 | 2,349 |
| 1973 | 105 | 795 | 900 | 256 | 1,936 | 2,192 | 362 | 2,730 | 3,092 |
| 1974 | 66 | 219 | 285 | 280 | 922 | 1,202 | 346 | 1,141 | 1,487 |
| 1975 | 120 | 605 | 725 | 249 | 1,252 | 1,501 | 370 | 1,856 | 2,226 |
| 1976 | N.E. | N.E. | N.E. | 56 | 343 | 399 | 56 | 343 | 399 |
| 1977 | N.E. | N.E. | N.E. | 31 | 219 | 250 | 31 | 219 | 250 |
| 1978 | 6 | 94 | 100 | 39 | 563 | 602 | 45 | 657 | 702 |
| 1979 | 10 | 140 | 150 | 64 | 936 | 1,000 | 74 | 1,076 | 1,150 |
| 1980 | 40 | 160 | 200 | 513 | 2,079 | 2,592 | 553 | 2,239 | 2,792 |
| 1981 | 1 | 4 | 5 | 760 | 2,808 | 3,568 | 761 | 2,812 | 3,573 |
| 1982 | N.E. | N.E. | N.E. | 2,236 | 4,459 | 6,695 | 2,236 | 4,459 | 6,695 |
| 1983 | 126 | 74 | 200 | 7,137 | 4,156 | 11,293 | 7,264 | 4,229 | 11,493 |
| 1984 | 80 | 920 | 1,000 | 406 | 4,669 | 5,075 | 486 | 5,589 | 6,075 |
| 1985 | 15 | 205 | 220 | 509 | 6,970 | 7,479 | 524 | 7,175 | 7,699 |
| 1986 | N.E. | N.E. | N.E. | 1,232 | 1,774 | 3,006 | 1,232 | 1,774 | 3,006 |
| 1987 | N.E. | N.E. | N.E. | 866 | 154 | 1,020 | 866 | 154 | 1,020 |
| 1988 | 30 | 70 | 100 | 113 | 271 | 384 | 143 | 341 | 484 |
| 1989 | N.E. | N.E. | N.E. | 155 | 245 | 400 | 155 | 245 | 400 |
| 1990 | N.E. | N.E. | N.E. | 94 | 269 | 363 | 94 | 269 | 363 |
| 1991 | N.E. | N.E. | N.E. | 64 | 346 | 410 | 64 | 346 | 410 |
| Average | 147 | 617 | 764 | 706 | 1,847 | 2,553 | 806 | 2,226 | 3,072 |

APPENDIX 5. Estimates of naturally spawning spring-run chinook salmon in tributaries of the Sacramento River, excluding the Feather River, 1967 through 1991 (N.E. = No Estimate).

| Year | Sacramento River | | | Mill Creek | | | Deer Creek | | | Butte Creek | | | Spring-run Totals | | |
|---------|------------------|--------|--------|------------|--------|-------|------------|--------|-------|-------------|--------|-------|-------------------|--------|--------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 11,31 | 12,20 | 23,514 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 87 | 93 | 180 | 11,39 | 12,29 | 23,694 |
| 1968 | 3,255 | 11,60 | 14,864 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 61 | 219 | 280 | 3,317 | 11,82 | 15,144 |
| 1969 | 2,757 | 23,74 | 26,505 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 86 | 744 | 830 | 2,843 | 24,49 | 27,335 |
| 1970 | 698 | 2,954 | 3,652 | 287 | 1,214 | 1,500 | 382 | 1,618 | 2,000 | 54 | 231 | 285 | 1,420 | 6,017 | 7,437 |
| 1971 | 1,632 | 4,198 | 5,830 | 280 | 720 | 1,000 | 420 | 1,080 | 1,500 | 132 | 338 | 470 | 2,464 | 6,336 | 8,800 |
| 1972 | 1,175 | 6,171 | 7,346 | 80 | 420 | 500 | 64 | 336 | 400 | 24 | 126 | 150 | 1,343 | 7,053 | 8,396 |
| 1973 | 1,374 | 6,388 | 7,762 | 301 | 1,399 | 1,700 | 354 | 1,646 | 2,000 | 53 | 247 | 300 | 2,082 | 9,680 | 11,762 |
| 1974 | 1,235 | 2,698 | 3,933 | 471 | 1,029 | 1,500 | 785 | 1,715 | 2,500 | 47 | 103 | 150 | 2,538 | 5,545 | 8,083 |
| 1975 | 3,521 | 7,182 | 10,703 | 1,15 | 2,349 | 3,500 | 2,797 | 5,704 | 8,500 | 214 | 436 | 650 | 7,683 | 15,67 | 23,353 |
| 1976 | 4,053 | 21,93 | 25,983 | N.E. | N.E. | N.E. | 7 | 37 | 44 | 7 | 39 | 46 | 4,067 | 22,00 | 26,073 |
| 1977 | 5,382 | 8,348 | 13,730 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 39 | 61 | 100 | 5,421 | 8,409 | 13,830 |
| 1978 | 791 | 5,112 | 5,903 | 124 | 801 | 925 | 161 | 1,039 | 1,200 | 17 | 111 | 128 | 1,093 | 7,063 | 8,156 |
| 1979 | 705 | 2,195 | 2,900 | N.E. | N.E. | N.E. | N.E. | N.E. | N.E. | 2 | 8 | 10 | 707 | 2,203 | 2,910 |
| 1980 | 3,064 | 6,632 | 9,696 | 158 | 342 | 500 | 474 | 1,026 | 1,500 | 38 | 81 | 119 | 3,734 | 8,081 | 11,815 |
| 1981 | 8,137 | 12,88 | 21,025 | 6 | 9 | 15 | 10 | 15 | 25 | 97 | 153 | 250 | 8,249 | 13,06 | 21,315 |
| 1982 | 4,055 | 19,38 | 23,438 | 121 | 579 | 700 | 260 | 1,241 | 1,500 | 92 | 442 | 534 | 4,528 | 21,64 | 26,172 |
| 1983 | 590 | 3,341 | 3,931 | N.E. | N.E. | N.E. | 75 | 425 | 500 | 8 | 43 | 50 | 672 | 3,809 | 4,481 |
| 1984 | 4,261 | 3,886 | 8,147 | 100 | 91 | 191 | N.E. | N.E. | N.E. | 12 | 11 | 23 | 4,373 | 3,988 | 8,361 |
| 1985 | 3,568 | 7,179 | 10,747 | 40 | 81 | 121 | 100 | 201 | 301 | 84 | 170 | 254 | 3,792 | 7,631 | 11,423 |
| 1986 | 1,419 | 15,27 | 16,691 | 25 | 266 | 291 | 46 | 497 | 543 | 117 | 1254 | 1371 | 1,606 | 17,29 | 18,896 |
| 1987 | 4,067 | 7,137 | 11,204 | 32 | 57 | 89 | 73 | 127 | 200 | 5 | 9 | 14 | 4,177 | 7,330 | 11,507 |
| 1988 | 1,790 | 7,991 | 9,781 | 105 | 467 | 572 | N.E. | N.E. | N.E. | 238 | 1062 | 1300 | 2,132 | 9,521 | 11,653 |
| 1989 | 646 | 4,609 | 5,255 | 68 | 488 | 556 | 9 | 68 | 77 | 160 | 1140 | 1300 | 884 | 6,304 | 7,188 |
| 1990 | 698 | 3,224 | 3,922 | 150 | 694 | 844 | 82 | 376 | 458 | 18 | 82 | 100 | 948 | 4,376 | 5,324 |
| 1991 | 204 | 569 | 773 | 84 | 235 | 319 | 119 | 330 | 449 | 26 | 74 | 100 | 433 | 1,208 | 1,641 |
| Average | 2,815 | 8,274 | 11,089 | 199 | 624 | 824 | 345 | 971 | 1,317 | 69 | 291 | 360 | 3,276 | 9,714 | 12,990 |

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APPENDIX 6. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Recreational Fishery by Area and Month, 1967-1991 (Sheet 1 of 6).

CHINOOK SALMON LANDINGS (STATEWIDE)

| YEAR | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|---------|
| 1967 | 4,333 | 13,464 | 6,259 | 5,912 | 5,835 | 10,616 | 10,879 | 8,315 | 5,552 | 1,401 | 72,566 |
| 1968 | 7,523 | 12,139 | 7,233 | 7,661 | 12,018 | 24,396 | 39,508 | 25,850 | 10,001 | 7,914 | 154,244 |
| 1969 | 10,097 | 20,326 | 10,654 | 8,439 | 16,296 | 30,664 | 27,745 | 13,896 | 12,229 | 5,414 | 155,768 |
| 1970 | 6,251 | 8,823 | 7,907 | 10,725 | 20,132 | 32,731 | 36,533 | 16,423 | 7,113 | 1,161 | 147,800 |
| 1971 | 11,622 | 39,387 | 14,473 | 10,314 | 14,396 | 32,217 | 40,963 | 11,070 | 9,153 | 4,676 | 188,271 |
| 1972 | 33,183 | 30,925 | 15,870 | 9,099 | 21,525 | 31,315 | 26,550 | 21,485 | 9,443 | 1,127 | 200,522 |
| 1973 | 6,837 | 16,300 | 20,595 | 13,709 | 21,308 | 51,563 | 30,186 | 18,338 | 12,826 | 6,291 | 197,953 |
| 1974 | 15,734 | 40,670 | 18,904 | 9,004 | 18,080 | 23,425 | 15,678 | 7,607 | 6,802 | 1,561 | 157,465 |
| 1975 | 18,791 | 4,661 | 13,451 | 10,804 | 11,142 | 15,532 | 13,574 | 6,405 | 5,758 | 3,616 | 103,734 |
| 1976 | 2,686 | 1,221 | 6,634 | 13,031 | 14,125 | 11,813 | 12,619 | 5,654 | 10,616 | 2,594 | 80,993 |
| 1977 | 4,096 | 5,510 | 15,525 | 5,038 | 9,450 | 35,221 | 14,783 | 8,406 | 4,063 | 1,492 | 103,585 |
| 1978 | 9,790 | 8,594 | 3,149 | 2,899 | 9,066 | 15,050 | 9,001 | 4,925 | 7,642 | 2,606 | 72,722 |
| 1979 | 7,876 | 15,161 | 11,597 | 5,219 | 16,617 | 28,382 | 14,353 | 13,456 | 6,967 | 0 | 119,628 |
| 1980 | 4,703 | 12,033 | 6,671 | 5,807 | 18,229 | 19,379 | 8,911 | 5,404 | 4,048 | 0 | 85,185 |
| 1981 | 3,393 | 3,141 | 8,471 | 3,372 | 10,649 | 23,703 | 16,074 | 8,912 | 4,993 | 1,319 | 84,027 |
| 1982 | 11,187 | 11,379 | 5,052 | 7,406 | 15,911 | 24,307 | 31,220 | 15,112 | 13,952 | 3,198 | 138,724 |
| 1983 | 2,627 | 3,080 | 4,790 | 11,389 | 12,427 | 15,104 | 8,189 | 4,550 | 1,610 | 56 | 63,822 |
| 1984 | 392 | 758 | 5,932 | 7,434 | 17,264 | 26,585 | 18,901 | 7,461 | 2,317 | 759 | 87,803 |
| 1985 | 12,134 | 17,970 | 11,950 | 17,575 | 28,587 | 45,422 | 23,552 | 7,302 | 4,898 | 1,719 | 171,109 |
| 1986 | 1,183 | 16,091 | 23,458 | 9,528 | 24,729 | 37,415 | 21,386 | 5,280 | 1,962 | 584 | 141,616 |
| 1987 | 5,520 | 14,084 | 19,211 | 12,368 | 23,113 | 51,041 | 44,051 | 14,946 | 7,126 | 1,083 | 192,543 |
| 1988 | 6,808 | 15,934 | 24,943 | 20,482 | 38,219 | 43,329 | 12,190 | 4,032 | 4,610 | 814 | 171,361 |
| 1989 | 7,950 | 12,734 | 42,566 | 8,554 | 27,839 | 48,712 | 19,748 | 12,370 | 3,744 | 2,410 | 186,627 |
| 1990 | 6,690 | 17,599 | 21,645 | 6,088 | 28,109 | 34,015 | 15,185 | 5,039 | 3,756 | 1,703 | 139,829 |
| 1991 | 0 | 8,001 | 13,029 | 4,825 | 19,906 | 25,123 | 5,742 | 1,952 | 2,232 | 23 | 80,833 |
| Average | 8,056 | 13,999 | 13,599 | 9,067 | 18,199 | 29,482 | 20,701 | 10,168 | 6,537 | 2,141 | 131,949 |

APPENDIX 6. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Recreational Fishery by Area and Month, 1967-1991 (Sheet 2 of 6).

CHINOOK SALMON LANDINGS (CRESCENT CITY)

| YEAR | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|------|-----|-----|-----|-------|-------|--------|-------|-------|-----|-----|--------|
| 1967 | 0 | 0 | 0 | 1 | 25 | 379 | 258 | 7 | 0 | 0 | 670 |
| 1968 | 0 | 0 | 0 | 0 | 9 | 188 | 183 | 24 | 0 | 0 | 404 |
| 1969 | 0 | 0 | 0 | 0 | 68 | 2,490 | 354 | 4 | 0 | 0 | 2,916 |
| 1970 | 0 | 0 | 0 | 0 | 52 | 165 | 630 | 0 | 0 | 0 | 847 |
| 1971 | 0 | 1 | 0 | 0 | 357 | 689 | 435 | 38 | 0 | 0 | 1,520 |
| 1972 | 0 | 0 | 0 | 0 | 191 | 373 | 601 | 9 | 0 | 0 | 1,174 |
| 1973 | 0 | 0 | 0 | 0 | 1,158 | 2,134 | 839 | 36 | 0 | 0 | 4,167 |
| 1974 | 0 | 0 | 0 | 4 | 98 | 1,088 | 1,237 | 81 | 0 | 0 | 2,508 |
| 1975 | 0 | 0 | 0 | 0 | 327 | 922 | 146 | 0 | 0 | 0 | 1,395 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 1,154 | 1,573 | 264 | 0 | 0 | 2,991 |
| 1977 | 0 | 0 | 0 | 0 | 307 | 4,966 | 2,127 | 0 | 0 | 0 | 7,400 |
| 1978 | 0 | 0 | 0 | 7 | 417 | 701 | 861 | 0 | 0 | 0 | 1,986 |
| 1979 | 0 | 0 | 0 | 3 | 563 | 1,124 | 1,189 | 0 | 0 | 0 | 2,879 |
| 1980 | 0 | 0 | 0 | 1 | 1,061 | 834 | 682 | 140 | 0 | 0 | 2,718 |
| 1981 | 0 | 0 | 0 | 7 | 589 | 1,178 | 2,233 | 0 | 0 | 0 | 4,007 |
| 1982 | 0 | 0 | 0 | 4 | 614 | 2,258 | 3,181 | 139 | 0 | 0 | 6,196 |
| 1983 | 0 | 0 | 0 | 0 | 1,338 | 1,400 | 633 | 74 | 0 | 0 | 3,445 |
| 1984 | 0 | 0 | 0 | 11 | 33 | 1,841 | 1,617 | 21 | 0 | 0 | 3,523 |
| 1985 | 0 | 0 | 0 | 2,462 | 4,619 | 8,857 | 1,961 | 90 | 0 | 0 | 17,989 |
| 1986 | 0 | 0 | 0 | 270 | 1,555 | 2,624 | 1,296 | 15 | 0 | 0 | 5,760 |
| 1987 | 0 | 0 | 0 | 259 | 3,745 | 4,294 | 2,286 | 1,476 | 0 | 0 | 12,060 |
| 1988 | 0 | 0 | 0 | 1,006 | 7,418 | 7,560 | 1,241 | 11 | 0 | 0 | 17,236 |
| 1989 | 0 | 0 | 0 | 417 | 3,589 | 17,990 | 3,227 | 52 | 0 | 0 | 25,275 |
| 1990 | 0 | 0 | 0 | 118 | 6,451 | 5,975 | 151 | 22 | 0 | 0 | 12,717 |
| 1991 | 0 | 0 | 0 | 7 | 1,321 | 1,943 | 35 | 61 | 0 | 0 | 3,367 |
| | | | | 183 | 1,436 | 2,025 | 1,150 | 103 | 0 | 0 | 5,806 |

APPENDIX 6. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Recreational Fishery by Area and Month, 1967-1991 (Sheet 3 of 6).

CHINOOK SALMON LANDINGS (EUREKA)

| YEAR | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---------|-----|-----|-----|-------|-------|--------|--------|-------|-----|-----|--------|
| 1967 | 0 | 0 | 0 | 29 | 276 | 1,661 | 1,182 | 17 | 0 | 0 | 3,165 |
| 1968 | 0 | 0 | 0 | 34 | 249 | 1,415 | 592 | 25 | 0 | 0 | 2,315 |
| 1969 | 0 | 0 | 5 | 46 | 1,448 | 9,135 | 9,716 | 274 | 14 | 0 | 20,638 |
| 1970 | 0 | 0 | 64 | 166 | 5,369 | 12,102 | 13,248 | 1,523 | 52 | 0 | 32,524 |
| 1971 | 0 | 0 | 20 | 80 | 4,960 | 9,205 | 3,620 | 160 | 6 | 0 | 18,051 |
| 1972 | 0 | 2 | 2 | 119 | 1,269 | 3,703 | 1,579 | 205 | 3 | 0 | 6,882 |
| 1973 | 0 | 0 | 0 | 122 | 1,776 | 3,692 | 1,678 | 315 | 1 | 0 | 7,584 |
| 1974 | 0 | 0 | 3 | 167 | 2,068 | 4,342 | 1,765 | 741 | 13 | 0 | 9,099 |
| 1975 | 0 | 0 | 0 | 205 | 2,697 | 4,233 | 679 | 7 | 0 | 0 | 7,821 |
| 1976 | 0 | 0 | 0 | 15 | 3,698 | 2,460 | 819 | 119 | 0 | 0 | 7,111 |
| 1977 | 0 | 0 | 0 | 768 | 309 | 10,141 | 1,991 | 52 | 0 | 0 | 13,261 |
| 1978 | 0 | 0 | 0 | 0 | 713 | 1,117 | 478 | 0 | 0 | 0 | 2,308 |
| 1979 | 0 | 0 | 1 | 8 | 721 | 1,955 | 891 | 50 | 21 | 0 | 3,647 |
| 1980 | 0 | 0 | 0 | 2 | 795 | 2,607 | 584 | 58 | 0 | 0 | 4,046 |
| 1981 | 0 | 0 | 0 | 5 | 268 | 2,474 | 1,653 | 6 | 0 | 0 | 4,406 |
| 1982 | 0 | 0 | 0 | 0 | 3,802 | 2,780 | 483 | 19 | 0 | 0 | 7,084 |
| 1983 | 0 | 0 | 0 | 3 | 2,059 | 2,770 | 510 | 108 | 34 | 0 | 5,484 |
| 1984 | 0 | 0 | 0 | 8 | 95 | 3,840 | 588 | 75 | 5 | 0 | 4,611 |
| 1985 | 0 | 0 | 5 | 6,404 | 4,905 | 12,772 | 2,142 | 156 | 0 | 0 | 26,384 |
| 1986 | 0 | 0 | 0 | 477 | 2,590 | 3,278 | 4,090 | 24 | 0 | 0 | 10,459 |
| 1987 | 0 | 0 | 0 | 1,139 | 3,706 | 6,490 | 6,500 | 601 | 0 | 0 | 18,436 |
| 1988 | 0 | 0 | 0 | 572 | 5,689 | 7,018 | 904 | 162 | 0 | 0 | 14,345 |
| 1989 | 0 | 0 | 0 | 1,645 | 7,503 | 12,195 | 3,200 | 99 | 0 | 0 | 24,642 |
| 1990 | 0 | 0 | 0 | 931 | 5,140 | 4,631 | 374 | 33 | 0 | 0 | 11,109 |
| 1991 | 0 | 0 | 0 | 57 | 6,382 | 2,788 | 13 | 267 | 1 | 0 | 9,508 |
| Average | 0 | 0 | 4 | 520 | 2,739 | 5,152 | 2,371 | 204 | 6 | 0 | 10,997 |

APPENDIX 6. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Recreational Fishery by Area and Month, 1967-1991 (Sheet 4 of 6).

CHINOOK SALMON LANDINGS (FORT BRAGG)

| YEAR | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---------|-----|-----|-----|-------|-------|-------|-------|-----|-----|-----|--------|
| 1967 | 0 | 0 | 0 | 0 | 3 | 659 | 1,501 | 415 | 0 | 0 | 2,578 |
| 1968 | 0 | 2 | 2 | 19 | 207 | 1,280 | 939 | 163 | 11 | 0 | 2,623 |
| 1969 | 0 | 0 | 6 | 0 | 586 | 2,004 | 1,013 | 344 | 6 | 1 | 3,960 |
| 1970 | 0 | 0 | 0 | 246 | 412 | 1,243 | 1,146 | 242 | 2 | 0 | 3,291 |
| 1971 | 0 | 0 | 2 | 14 | 272 | 914 | 1,087 | 84 | 0 | 0 | 2,373 |
| 1972 | 0 | 4 | 26 | 260 | 1,034 | 3,195 | 337 | 18 | 0 | 0 | 4,874 |
| 1973 | 0 | 8 | 6 | 110 | 1,455 | 3,407 | 308 | 4 | 1 | 0 | 5,299 |
| 1974 | 0 | 0 | 4 | 12 | 292 | 1,941 | 1,981 | 38 | 0 | 0 | 4,268 |
| 1975 | 0 | 0 | 0 | 57 | 351 | 922 | 390 | 104 | 0 | 0 | 1,824 |
| 1976 | 0 | 0 | 0 | 18 | 287 | 1,469 | 543 | 6 | 1 | 0 | 2,324 |
| 1977 | 0 | 0 | 0 | 11 | 41 | 2,168 | 3,698 | 405 | 0 | 0 | 6,323 |
| 1978 | 0 | 0 | 1 | 15 | 616 | 1,386 | 516 | 0 | 0 | 0 | 2,534 |
| 1979 | 0 | 0 | 0 | 0 | 564 | 2,877 | 1,110 | 75 | 0 | 0 | 4,626 |
| 1980 | 0 | 0 | 1 | 51 | 328 | 721 | 194 | 13 | 0 | 0 | 1,308 |
| 1981 | 0 | 0 | 5 | 37 | 434 | 1,006 | 290 | 10 | 5 | 0 | 1,787 |
| 1982 | 0 | 0 | 0 | 62 | 843 | 1,319 | 709 | 15 | 0 | 0 | 2,948 |
| 1983 | 0 | 0 | 0 | 12 | 747 | 931 | 232 | 11 | 0 | 0 | 1,933 |
| 1984 | 0 | 0 | 1 | 3 | 251 | 594 | 143 | 7 | 0 | 0 | 999 |
| 1985 | 0 | 0 | 1 | 33 | 806 | 3,913 | 221 | 10 | 1 | 0 | 4,985 |
| 1986 | 0 | 0 | 8 | 170 | 3,227 | 6,399 | 780 | 0 | 0 | 0 | 10,584 |
| 1987 | 0 | 4 | 45 | 253 | 2,359 | 5,208 | 1,115 | 217 | 0 | 0 | 9,201 |
| 1988 | 0 | 0 | 311 | 1,110 | 3,431 | 3,799 | 707 | 48 | 0 | 0 | 9,406 |
| 1989 | 0 | 0 | 58 | 182 | 2,527 | 2,409 | 579 | 36 | 12 | 0 | 5,803 |
| 1990 | 0 | 0 | 1 | 84 | 1,588 | 1,472 | 191 | 52 | 0 | 0 | 3,388 |
| 1991 | 0 | 0 | 6 | 156 | 1,629 | 3,580 | 467 | 16 | 0 | 0 | 5,854 |
| Average | 0 | 1 | 19 | 117 | 972 | 2,193 | 808 | 93 | 2 | 0 | 4,204 |

APPENDIX 6. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Recreational Fishery by Area and Month, 1967-1991 (Sheet 5 of 6).

CHINOOK SALMON LANDINGS (SAN FRANCISCO)

| YEAR | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|---------|
| 1967 | 4,211 | 12,821 | 5,983 | 3,678 | 4,045 | 6,011 | 7,126 | 7,763 | 5,496 | 1,369 | 58,503 |
| 1968 | 6,643 | 8,922 | 3,437 | 4,690 | 9,022 | 18,572 | 34,853 | 22,828 | 8,360 | 6,479 | 123,807 |
| 1969 | 9,455 | 17,108 | 8,152 | 6,942 | 12,453 | 14,861 | 14,879 | 12,758 | 11,831 | 5,070 | 113,517 |
| 1970 | 6,017 | 8,038 | 6,775 | 9,064 | 11,583 | 16,599 | 18,695 | 13,671 | 5,909 | 949 | 97,300 |
| 1971 | 8,973 | 36,964 | 12,124 | 8,280 | 7,716 | 20,086 | 34,171 | 9,882 | 4,907 | 2,776 | 145,879 |
| 1972 | 31,737 | 29,611 | 14,323 | 7,613 | 17,734 | 22,191 | 23,029 | 20,199 | 9,039 | 1,027 | 176,503 |
| 1973 | 6,225 | 14,914 | 18,861 | 12,610 | 16,056 | 37,731 | 26,154 | 17,450 | 11,678 | 5,338 | 167,017 |
| 1974 | 15,025 | 38,079 | 18,516 | 7,667 | 9,998 | 15,276 | 10,632 | 6,725 | 6,779 | 1,545 | 130,242 |
| 1975 | 17,858 | 3,561 | 11,880 | 9,908 | 6,982 | 7,452 | 11,895 | 6,262 | 5,655 | 3,524 | 84,977 |
| 1976 | 2,257 | 929 | 6,023 | 12,021 | 9,155 | 5,594 | 9,497 | 5,232 | 10,505 | 2,547 | 63,760 |
| 1977 | 3,737 | 4,389 | 14,178 | 3,541 | 8,649 | 17,802 | 6,899 | 7,866 | 4,045 | 1,488 | 72,595 |
| 1978 | 9,622 | 8,336 | 2,850 | 2,638 | 6,760 | 11,626 | 7,106 | 4,916 | 7,628 | 2,603 | 64,085 |
| 1979 | 6,829 | 13,752 | 8,538 | 5,095 | 14,735 | 22,273 | 11,080 | 13,300 | 6,945 | 0 | 102,547 |
| 1980 | 4,243 | 11,530 | 5,525 | 5,521 | 15,110 | 14,685 | 7,367 | 5,146 | 3,966 | 0 | 73,093 |
| 1981 | 2,971 | 2,507 | 6,806 | 3,239 | 9,327 | 18,593 | 11,713 | 8,882 | 4,937 | 1,109 | 70,084 |
| 1982 | 10,527 | 10,123 | 2,999 | 7,056 | 10,251 | 17,480 | 26,460 | 14,871 | 13,945 | 3,198 | 116,910 |
| 1983 | 2,332 | 3,000 | 3,812 | 10,325 | 7,928 | 9,571 | 6,785 | 4,347 | 1,561 | 56 | 49,717 |
| 1984 | 377 | 683 | 3,222 | 6,766 | 16,209 | 19,227 | 16,345 | 7,352 | 2,297 | 755 | 73,233 |
| 1985 | 10,486 | 12,784 | 10,688 | 8,519 | 18,017 | 19,475 | 18,857 | 7,033 | 4,897 | 1,719 | 112,475 |
| 1986 | 1,048 | 12,251 | 11,395 | 7,296 | 13,397 | 19,747 | 14,022 | 4,874 | 1,650 | 575 | 86,255 |
| 1987 | 3,801 | 7,390 | 16,763 | 9,307 | 9,849 | 22,360 | 29,666 | 12,261 | 7,052 | 1,077 | 119,526 |
| 1988 | 5,324 | 13,696 | 20,767 | 15,896 | 18,773 | 21,659 | 9,110 | 3,806 | 4,610 | 814 | 114,455 |
| 1989 | 7,321 | 8,234 | 20,365 | 4,803 | 12,260 | 11,424 | 10,974 | 12,158 | 3,716 | 2,404 | 93,659 |
| 1990 | 5,058 | 13,309 | 15,075 | 4,273 | 6,580 | 10,646 | 13,625 | 4,883 | 3,513 | 600 | 77,562 |
| 1991 | 0 | 3,220 | 6,079 | 3,733 | 6,838 | 9,962 | 4,869 | 1,523 | 1,027 | 23 | 37,274 |
| Average | 7,283 | 11,846 | 10,205 | 7,219 | 11,177 | 16,436 | 15,432 | 9,440 | 6,078 | 1,882 | 96,999 |

APPENDIX 6. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Recreational Fishery by Area and Month, 1967-1991 (Sheet 6 of 6).

CHINOOK SALMON LANDINGS (MONTEREY)

| YEAR | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | TOTAL |
|---------|-------|-------|--------|-------|-------|--------|-------|-------|-------|-------|--------|
| 1967 | 122 | 643 | 276 | 2,204 | 1,486 | 1,906 | 812 | 113 | 56 | 32 | 7,650 |
| 1968 | 880 | 3,215 | 3,794 | 2,918 | 2,531 | 2,941 | 2,941 | 2,810 | 1,630 | 1,435 | 25,095 |
| 1969 | 642 | 3,218 | 2,491 | 1,451 | 1,741 | 2,174 | 1,783 | 516 | 378 | 343 | 14,737 |
| 1970 | 234 | 785 | 1,068 | 1,249 | 2,716 | 2,622 | 2,814 | 987 | 1,150 | 212 | 13,838 |
| 1971 | 2,649 | 2,422 | 2,327 | 1,940 | 1,091 | 1,323 | 1,650 | 906 | 4,240 | 1,900 | 20,448 |
| 1972 | 1,446 | 1,308 | 1,519 | 1,107 | 1,297 | 1,853 | 1,004 | 1,054 | 401 | 100 | 11,089 |
| 1973 | 612 | 1,378 | 1,728 | 867 | 863 | 4,599 | 1,207 | 533 | 1,146 | 953 | 13,886 |
| 1974 | 709 | 2,591 | 381 | 1,154 | 5,624 | 778 | 63 | 22 | 10 | 16 | 11,348 |
| 1975 | 933 | 1,100 | 1,571 | 634 | 785 | 2,003 | 464 | 32 | 103 | 92 | 7,717 |
| 1976 | 429 | 292 | 611 | 977 | 985 | 1,136 | 187 | 33 | 110 | 47 | 4,807 |
| 1977 | 359 | 1,121 | 1,347 | 718 | 144 | 144 | 68 | 83 | 18 | 4 | 4,006 |
| 1978 | 168 | 258 | 298 | 239 | 560 | 220 | 40 | 9 | 14 | 3 | 1,809 |
| 1979 | 1,047 | 1,409 | 3,058 | 113 | 34 | 153 | 83 | 31 | 1 | 0 | 5,929 |
| 1980 | 460 | 503 | 1,145 | 232 | 935 | 532 | 84 | 47 | 82 | 0 | 4,020 |
| 1981 | 422 | 634 | 1,660 | 84 | 31 | 452 | 185 | 14 | 51 | 210 | 3,743 |
| 1982 | 660 | 1,256 | 2,053 | 284 | 401 | 470 | 387 | 68 | 7 | 0 | 5,586 |
| 1983 | 295 | 80 | 978 | 1,049 | 355 | 432 | 29 | 10 | 15 | 0 | 3,243 |
| 1984 | 15 | 75 | 2,709 | 646 | 676 | 1,083 | 208 | 6 | 15 | 4 | 5,437 |
| 1985 | 1,648 | 5,186 | 1,256 | 157 | 240 | 405 | 371 | 13 | 0 | 0 | 9,276 |
| 1986 | 135 | 3,840 | 12,055 | 1,315 | 3,960 | 5,367 | 1,198 | 367 | 312 | 9 | 28,558 |
| 1987 | 1,719 | 6,690 | 2,403 | 1,410 | 3,454 | 12,689 | 4,484 | 391 | 74 | 6 | 33,320 |
| 1988 | 1,484 | 2,238 | 3,865 | 1,898 | 2,908 | 3,293 | 228 | 5 | 0 | 0 | 15,919 |
| 1989 | 629 | 4,500 | 22,143 | 1,507 | 1,960 | 4,694 | 1,768 | 25 | 16 | 6 | 37,248 |
| 1990 | 1,632 | 4,290 | 6,569 | 682 | 8,350 | 11,291 | 844 | 49 | 243 | 1,103 | 35,053 |
| 1991 | 0 | 4,781 | 6,944 | 872 | 3,736 | 6,850 | 358 | 85 | 1,204 | 0 | 24,830 |
| Average | 773 | 2,153 | 3,370 | 1,028 | 1,875 | 2,776 | 930 | 328 | 451 | 259 | 13,944 |

APPENDIX 7. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Commercial Fishery by Area and Month, 1967-1991 (Sheet 1 of 6).

CHINOOK SALMON LANDINGS (STATEWIDE)

| YEAR | APRIL | MAY | JUNE | JULY | AUGUST | SEPT | OCT | TOTAL |
|---------|--------|---------|---------|---------|---------|--------|-----|-----------|
| 1967 | 49,077 | 118,813 | 72,262 | 49,922 | 37,740 | 10,070 | 0 | 337,884 |
| 1968 | 34,520 | 114,743 | 126,382 | 112,612 | 66,192 | 17,560 | 0 | 472,009 |
| 1969 | 69,094 | 154,314 | 105,714 | 141,550 | 54,858 | 25,893 | 0 | 551,423 |
| 1970 | 28,434 | 128,466 | 144,528 | 98,587 | 83,006 | 33,627 | 0 | 516,648 |
| 1971 | 327 | 88,515 | 149,567 | 127,705 | 55,138 | 12,675 | 0 | 433,927 |
| 1972 | 321 | 172,198 | 139,402 | 101,736 | 62,277 | 16,269 | 0 | 492,203 |
| 1973 | 60,072 | 224,396 | 212,478 | 192,245 | 79,673 | 48,104 | 0 | 816,968 |
| 1974 | 88,784 | 117,553 | 120,538 | 93,285 | 51,134 | 20,268 | 0 | 491,562 |
| 1975 | 44,452 | 138,455 | 148,075 | 160,738 | 56,117 | 30,872 | 0 | 578,709 |
| 1976 | 56,694 | 144,286 | 132,359 | 149,387 | 36,794 | 20,410 | 0 | 539,930 |
| 1977 | 82,641 | 169,527 | 101,533 | 140,548 | 78,189 | 27,747 | 0 | 600,185 |
| 1978 | 31,522 | 231,946 | 218,193 | 101,789 | 33,940 | 20,268 | 0 | 637,658 |
| 1979 | 38 | 220,130 | 94,688 | 217,652 | 135,674 | 58,578 | 0 | 726,760 |
| 1980 | 0 | 234,283 | 0 | 257,386 | 54,963 | 42,018 | 0 | 588,650 |
| 1981 | 0 | 202,939 | 59,062 | 175,247 | 111,191 | 39,620 | 0 | 588,059 |
| 1982 | 59,844 | 201,249 | 84,193 | 247,387 | 139,373 | 33,114 | 0 | 765,160 |
| 1983 | 2,187 | 93,452 | 84,076 | 83,615 | 26,841 | 3,812 | 0 | 293,983 |
| 1984 | 0 | 32,854 | 57,516 | 113,257 | 74,088 | 22,044 | 0 | 299,759 |
| 1985 | 0 | 92,449 | 88,766 | 106,144 | 59,166 | 19,773 | 0 | 366,298 |
| 1986 | 0 | 223,621 | 293,200 | 215,133 | 84,533 | 9,101 | 0 | 825,588 |
| 1987 | 0 | 264,923 | 301,634 | 205,405 | 84,142 | 20,230 | 0 | 876,334 |
| 1988 | 0 | 390,784 | 382,786 | 370,942 | 111,881 | 60,814 | 0 | 1,317,207 |
| 1989 | 0 | 176,152 | 137,583 | 112,466 | 80,514 | 23,317 | 906 | 530,938 |
| 1990 | 0 | 145,197 | 173,971 | 71,743 | 25,384 | 7,099 | 53 | 423,447 |
| 1991 | 0 | 80,061 | 87,080 | 49,660 | 65,551 | 12,134 | 379 | 294,865 |
| Average | 24,320 | 166,452 | 140,623 | 147,846 | 69,934 | 25,417 | 54 | 574,646 |

APPENDIX 7. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Commercial Fishery by Area and Month, 1967-1991 (Sheet 2 of 6).

CHINOOK SALMON LANDINGS (CRESCENT CITY)

| YEAR | APRIL | MAY | JUNE | JULY | AUGUST | SEPT | OCT | TOTAL |
|---------|-------|--------|--------|--------|--------|--------|-----|--------|
| 1967 | 4,261 | 19,012 | 9,670 | 8,190 | 1,749 | 208 | 0 | 43,090 |
| 1968 | 140 | 9,599 | 8,366 | 8,742 | 2,578 | 46 | 0 | 29,471 |
| 1969 | 565 | 6,066 | 8,414 | 4,859 | 2,430 | 399 | 0 | 22,733 |
| 1970 | 684 | 2,171 | 31,969 | 4,519 | 6,219 | 618 | 0 | 46,180 |
| 1971 | 0 | 6,268 | 39,336 | 7,218 | 1,455 | 143 | 0 | 54,420 |
| 1972 | 0 | 18,777 | 14,994 | 3,775 | 1,266 | 259 | 0 | 39,071 |
| 1973 | 244 | 10,369 | 5,912 | 8,699 | 492 | 192 | 0 | 25,908 |
| 1974 | 573 | 7,621 | 10,135 | 4,158 | 1,675 | 148 | 0 | 24,310 |
| 1975 | 63 | 3,032 | 3,677 | 25,374 | 1,007 | 1,511 | 0 | 34,664 |
| 1976 | 55 | 4,129 | 9,894 | 2,977 | 3,382 | 534 | 0 | 20,971 |
| 1977 | 556 | 12,608 | 5,836 | 8,950 | 7,098 | 1,237 | 0 | 36,285 |
| 1978 | 1,053 | 25,472 | 28,342 | 2,438 | 1,649 | 682 | 0 | 59,636 |
| 1979 | 0 | 11,464 | 11,043 | 32,189 | 15,321 | 1,766 | 0 | 71,783 |
| 1980 | 0 | 16,919 | 0 | 4,849 | 5,277 | 5,577 | 0 | 32,622 |
| 1981 | 0 | 27,868 | 2,676 | 6,623 | 31,230 | 13,424 | 0 | 81,821 |
| 1982 | 0 | 9,725 | 8,084 | 18,780 | 33,044 | 3,684 | 0 | 73,317 |
| 1983 | 0 | 2,619 | 15,909 | 4,094 | 2,064 | 0 | 0 | 24,686 |
| 1984 | 0 | 2,872 | 768 | 5,869 | 4,860 | 0 | 0 | 14,369 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 208 | 4,598 | 2,823 | 5,584 | 763 | 0 | 13,976 |
| 1987 | 0 | 781 | 29,165 | 3,211 | 0 | 378 | 0 | 33,535 |
| 1988 | 0 | 727 | 13,770 | 0 | 0 | 1,122 | 0 | 15,619 |
| 1989 | 0 | 392 | 4,447 | 0 | 631 | 0 | 0 | 5,470 |
| 1990 | 0 | 0 | 0 | 0 | 1,386 | 0 | 0 | 1,386 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Average | 328 | 7,948 | 10,680 | 6,733 | 5,216 | 1,308 | 0 | 32,213 |

APPENDIX 7. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Commercial Fishery by Area and Month, 1967-1991 (Sheet 3 of 6).

CHINOOK SALMON LANDINGS (EUREKA)

| YEAR | APRIL | MAY | JUNE | JULY | AUGUST | SEPT | OCT | TOTAL |
|---------|--------|---------|--------|--------|--------|--------|-----|---------|
| 1967 | 29,507 | 64,429 | 32,552 | 7,906 | 2,642 | 791 | 0 | 137,827 |
| 1968 | 7,212 | 61,163 | 32,417 | 8,386 | 6,433 | 69 | 0 | 115,680 |
| 1969 | 12,189 | 52,479 | 18,631 | 26,064 | 17,663 | 1,074 | 0 | 128,100 |
| 1970 | 10,876 | 56,786 | 28,249 | 28,607 | 24,757 | 5,221 | 0 | 154,496 |
| 1971 | 1 | 32,275 | 58,169 | 41,710 | 7,166 | 1,128 | 0 | 140,449 |
| 1972 | 20 | 54,398 | 36,135 | 15,407 | 2,123 | 281 | 0 | 108,364 |
| 1973 | 7,353 | 100,118 | 55,048 | 30,014 | 1,103 | 475 | 0 | 194,111 |
| 1974 | 7,077 | 45,988 | 20,177 | 8,416 | 2,322 | 462 | 0 | 84,442 |
| 1975 | 3,483 | 51,023 | 61,716 | 64,958 | 1,371 | 780 | 0 | 183,331 |
| 1976 | 2,608 | 53,950 | 40,957 | 65,896 | 1,040 | 968 | 0 | 165,419 |
| 1977 | 22,112 | 56,224 | 32,448 | 40,810 | 9,029 | 552 | 0 | 161,175 |
| 1978 | 7,734 | 88,448 | 46,945 | 10,305 | 1,279 | 457 | 0 | 155,168 |
| 1979 | 0 | 101,380 | 22,598 | 35,614 | 42,898 | 15,873 | 0 | 218,363 |
| 1980 | 0 | 89,492 | 0 | 20,264 | 10,846 | 10,681 | 0 | 131,283 |
| 1981 | 0 | 49,196 | 4,149 | 10,845 | 28,315 | 7,204 | 0 | 99,709 |
| 1982 | 0 | 39,618 | 9,364 | 24,348 | 15,952 | 6,372 | 0 | 95,654 |
| 1983 | 0 | 9,292 | 16,381 | 5,841 | 3,663 | 0 | 0 | 35,177 |
| 1984 | 0 | 6,203 | 296 | 4,703 | 2,777 | 0 | 0 | 13,979 |
| 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 15,813 | 4,316 | 13,803 | 2,806 | 0 | 36,738 |
| 1987 | 0 | 0 | 50,279 | 0 | 0 | 4,458 | 0 | 54,737 |
| 1988 | 0 | 0 | 28,795 | 0 | 0 | 17,619 | 0 | 46,414 |
| 1989 | 0 | 0 | 9,831 | 0 | 2,028 | 4,702 | 906 | 17,467 |
| 1990 | 0 | 0 | 0 | 0 | 4,349 | 1,887 | 53 | 6,289 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 4,319 | 379 | 4,698 |
| Average | 4,407 | 40,498 | 24,838 | 18,176 | 8,062 | 3,527 | 54 | 99,563 |

APPENDIX 7. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Commercial Fishery by Area and Month, 1967-1991 (Sheet 4 of 6).

CHINOOK SALMON LANDINGS (FORT BRAGG)

| YEAR | APRIL | MAY | JUNE | JULY | AUGUST | SEPT | OCT | TOTAL |
|---------|-------|--------|---------|---------|--------|--------|-----|---------|
| 1967 | 3,122 | 12,755 | 3,872 | 19,273 | 27,558 | 3,305 | 0 | 69,885 |
| 1968 | 1,172 | 4,322 | 27,357 | 37,706 | 23,461 | 6,632 | 0 | 100,650 |
| 1969 | 6,013 | 18,031 | 15,312 | 49,471 | 16,710 | 14,691 | 0 | 120,228 |
| 1970 | 2,020 | 11,922 | 28,059 | 21,348 | 21,642 | 4,152 | 0 | 89,143 |
| 1971 | 0 | 18,134 | 25,185 | 32,145 | 12,160 | 735 | 0 | 88,359 |
| 1972 | 0 | 30,145 | 28,839 | 43,572 | 10,808 | 1,608 | 0 | 114,972 |
| 1973 | 2,323 | 18,182 | 74,387 | 73,700 | 3,854 | 1,808 | 0 | 174,254 |
| 1974 | 4,047 | 9,590 | 29,329 | 38,795 | 17,066 | 1,303 | 0 | 100,130 |
| 1975 | 2,927 | 11,904 | 51,606 | 42,961 | 11,229 | 5,726 | 0 | 126,353 |
| 1976 | 1,844 | 13,928 | 31,835 | 53,992 | 9,906 | 4,178 | 0 | 115,683 |
| 1977 | 2,943 | 28,357 | 19,284 | 33,689 | 40,283 | 14,330 | 0 | 138,886 |
| 1978 | 1,916 | 30,980 | 45,602 | 34,587 | 12,330 | 6,439 | 0 | 131,854 |
| 1979 | 2 | 30,367 | 7,789 | 80,180 | 57,586 | 26,543 | 0 | 202,467 |
| 1980 | 0 | 20,268 | 0 | 82,602 | 14,102 | 13,471 | 0 | 130,443 |
| 1981 | 0 | 22,485 | 31,675 | 36,661 | 19,081 | 6,722 | 0 | 116,624 |
| 1982 | 7,701 | 25,005 | 19,140 | 100,081 | 17,822 | 8,001 | 0 | 177,750 |
| 1983 | 0 | 8,238 | 21,764 | 18,124 | 7,620 | 140 | 0 | 55,886 |
| 1984 | 0 | 4,438 | 3,579 | 24,292 | 4,118 | 13,324 | 0 | 49,751 |
| 1985 | 0 | 17,269 | 29,524 | 65,724 | 35,816 | 5,647 | 0 | 153,980 |
| 1986 | 0 | 57,019 | 96,525 | 90,197 | 28,104 | 574 | 0 | 272,418 |
| 1987 | 0 | 71,544 | 89,448 | 127,588 | 49,204 | 3,432 | 0 | 341,216 |
| 1988 | 0 | 91,548 | 110,116 | 157,350 | 52,196 | 13,453 | 0 | 424,663 |
| 1989 | 0 | 7,445 | 20,453 | 64,369 | 46,334 | 5,628 | 0 | 144,229 |
| 1990 | 0 | 6,782 | 45,549 | 19,802 | 5,030 | 2,390 | 0 | 79,553 |
| 1991 | 0 | 0 | 0 | 0 | 34,271 | 1,267 | 0 | 35,538 |
| Average | 1,441 | 22,826 | 34,249 | 53,928 | 23,132 | 6,620 | 0 | 142,197 |

APPENDIX 7. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Commercial Fishery by Area and Month, 1967-1991 (Sheet 5 of 6).

CHINOOK SALMON LANDINGS (SAN FRANCISCO)

| YEAR | APRIL | MAY | JUNE | JULY | AUGUST | SEPT | OCT | TOTAL |
|---------|--------|---------|---------|---------|--------|--------|-----|---------|
| 1967 | 11,228 | 17,546 | 20,756 | 13,229 | 3,386 | 3,388 | 0 | 69,533 |
| 1968 | 12,870 | 31,925 | 47,886 | 47,268 | 24,272 | 3,732 | 0 | 167,953 |
| 1969 | 22,459 | 42,069 | 47,164 | 47,752 | 8,931 | 8,374 | 0 | 176,749 |
| 1970 | 10,102 | 39,768 | 44,930 | 30,079 | 19,663 | 18,555 | 0 | 163,097 |
| 1971 | 74 | 22,453 | 20,215 | 40,093 | 33,744 | 9,176 | 0 | 125,755 |
| 1972 | 20 | 49,156 | 46,994 | 36,026 | 46,236 | 11,126 | 0 | 189,558 |
| 1973 | 31,878 | 60,368 | 32,281 | 35,071 | 44,994 | 37,820 | 0 | 242,412 |
| 1974 | 62,093 | 40,603 | 44,583 | 35,590 | 23,977 | 15,939 | 0 | 222,785 |
| 1975 | 27,151 | 46,642 | 18,269 | 19,103 | 32,109 | 17,160 | 0 | 160,434 |
| 1976 | 28,918 | 42,226 | 31,434 | 17,022 | 8,195 | 10,436 | 0 | 138,231 |
| 1977 | 41,645 | 47,678 | 28,007 | 45,951 | 13,501 | 8,382 | 0 | 185,164 |
| 1978 | 10,219 | 50,900 | 46,294 | 31,019 | 11,493 | 8,233 | 0 | 158,158 |
| 1979 | 36 | 52,402 | 42,723 | 57,344 | 15,096 | 12,486 | 0 | 180,087 |
| 1980 | 0 | 75,287 | 0 | 115,499 | 12,343 | 8,649 | 0 | 211,778 |
| 1981 | 0 | 49,499 | 15,908 | 96,108 | 26,918 | 11,477 | 0 | 199,910 |
| 1982 | 22,944 | 86,013 | 27,919 | 74,276 | 58,215 | 12,394 | 0 | 281,761 |
| 1983 | 763 | 30,087 | 5,394 | 25,274 | 10,025 | 3,476 | 0 | 75,019 |
| 1984 | 0 | 2,642 | 26,439 | 71,452 | 58,590 | 8,545 | 0 | 167,668 |
| 1985 | 0 | 54,983 | 50,384 | 35,644 | 22,455 | 12,215 | 0 | 175,681 |
| 1986 | 0 | 72,877 | 119,597 | 79,771 | 26,983 | 3,074 | 0 | 302,302 |
| 1987 | 0 | 157,648 | 110,099 | 49,824 | 28,544 | 9,500 | 0 | 355,615 |
| 1988 | 0 | 220,664 | 173,728 | 175,382 | 47,103 | 25,816 | 0 | 642,693 |
| 1989 | 0 | 121,304 | 77,751 | 25,550 | 20,889 | 10,323 | 0 | 255,817 |
| 1990 | 0 | 84,317 | 78,515 | 25,545 | 9,233 | 1,537 | 0 | 199,147 |
| 1991 | 0 | 58,309 | 52,152 | 30,522 | 28,311 | 5,537 | 0 | 174,831 |
| Average | 11,296 | 62,295 | 48,377 | 50,416 | 25,408 | 11,094 | 0 | 208,886 |

APPENDIX 7. Chinook Salmon Landings (Numbers of Fish) in the California Ocean Commercial Fishery by Area and Month, 1967-1991 (Sheet 6 of 6).

CHINOOK SALMON LANDINGS (MONTEREY)

| YEAR | APRIL | MAY | JUNE | JULY | AUGUST | SEPT | OCT | TOTAL |
|---------|--------|--------|--------|--------|--------|-------|-----|---------|
| 1967 | 959 | 5,071 | 5,412 | 1,324 | 2,405 | 2,378 | 0 | 17,549 |
| 1968 | 13,126 | 7,734 | 10,356 | 10,510 | 9,448 | 7,081 | 0 | 58,255 |
| 1969 | 27,868 | 35,669 | 16,193 | 13,404 | 9,124 | 1,355 | 0 | 103,613 |
| 1970 | 4,752 | 17,819 | 11,321 | 14,034 | 10,725 | 5,081 | 0 | 63,732 |
| 1971 | 252 | 9,385 | 6,662 | 6,539 | 613 | 1,493 | 0 | 24,944 |
| 1972 | 281 | 19,722 | 12,440 | 2,956 | 1,844 | 2,995 | 0 | 40,238 |
| 1973 | 18,274 | 35,359 | 44,850 | 44,761 | 29,230 | 7,809 | 0 | 180,283 |
| 1974 | 14,994 | 13,751 | 16,314 | 6,326 | 6,094 | 2,416 | 0 | 59,895 |
| 1975 | 10,828 | 25,854 | 12,807 | 8,342 | 10,401 | 5,695 | 0 | 73,927 |
| 1976 | 23,269 | 30,053 | 18,239 | 9,500 | 14,271 | 4,294 | 0 | 99,626 |
| 1977 | 15,385 | 24,660 | 15,958 | 11,148 | 8,278 | 3,246 | 0 | 78,675 |
| 1978 | 10,600 | 36,146 | 51,010 | 23,440 | 7,189 | 4,457 | 0 | 132,842 |
| 1979 | 0 | 24,517 | 10,535 | 12,325 | 4,773 | 1,910 | 0 | 54,060 |
| 1980 | 0 | 32,317 | 0 | 34,172 | 12,395 | 3,640 | 0 | 82,524 |
| 1981 | 0 | 53,891 | 4,654 | 25,010 | 5,647 | 793 | 0 | 89,995 |
| 1982 | 29,199 | 40,888 | 19,686 | 29,902 | 14,340 | 2,663 | 0 | 136,678 |
| 1983 | 1,424 | 43,216 | 24,628 | 30,282 | 3,469 | 196 | 0 | 103,215 |
| 1984 | 0 | 16,699 | 26,434 | 6,941 | 3,743 | 175 | 0 | 53,992 |
| 1985 | 0 | 20,197 | 8,858 | 4,776 | 895 | 1,911 | 0 | 36,637 |
| 1986 | 0 | 93,517 | 56,667 | 38,026 | 10,060 | 1,884 | 0 | 200,154 |
| 1987 | 0 | 34,950 | 22,643 | 24,782 | 6,394 | 2,462 | 0 | 91,231 |
| 1988 | 0 | 77,845 | 56,377 | 38,210 | 12,582 | 2,804 | 0 | 187,818 |
| 1989 | 0 | 47,011 | 25,101 | 22,547 | 10,632 | 2,664 | 0 | 107,955 |
| 1990 | 0 | 54,098 | 49,907 | 26,396 | 5,386 | 1,285 | 0 | 137,072 |
| 1991 | 0 | 21,752 | 34,928 | 19,138 | 2,969 | 1,011 | 0 | 79,798 |
| Average | 6,848 | 32,885 | 22,479 | 18,592 | 8,116 | 2,868 | 0 | 91,788 |

APPENDIX 8. Returns of fall-run chinook salmon to hatchery facilities operated in the Sacramento Valley during 1967 through 1991.

| Year | Coleman National Fish Hatchery | | | Feather River Hatchery | | | Nimbus Hatchery | | | Sacramento Valley Totals | | |
|---------|--------------------------------|--------|--------|------------------------|--------|--------|-----------------|--------|--------|--------------------------|--------|--------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 1,339 | 6,101 | 7,440 | 1,186 | 670 | 1,856 | 731 | 4,416 | 5,147 | 3,256 | 11,187 | 14,443 |
| 1968 | 585 | 5,770 | 6,355 | 1,938 | 4,006 | 5,944 | 1,177 | 4,056 | 5,233 | 3,700 | 13,832 | 17,532 |
| 1969 | 441 | 3,237 | 3,678 | 1,668 | 2,710 | 4,378 | 613 | 2,992 | 3,605 | 2,722 | 8,939 | 11,661 |
| 1970 | 1,011 | 5,345 | 6,356 | 882 | 2,473 | 3,355 | 768 | 7,861 | 8,629 | 2,661 | 15,679 | 18,340 |
| 1971 | 860 | 2,785 | 3,645 | 1,030 | 2,511 | 3,541 | 1,405 | 8,705 | 10,110 | 3,296 | 14,000 | 17,296 |
| 1972 | 1,140 | 2,081 | 3,221 | 2,021 | 1,614 | 3,635 | 1,641 | 5,401 | 7,042 | 4,802 | 9,096 | 13,898 |
| 1973 | 1,303 | 3,237 | 4,540 | 1,289 | 7,188 | 8,477 | 1,680 | 10,855 | 12,535 | 4,271 | 21,281 | 25,552 |
| 1974 | 592 | 2,444 | 3,036 | 1,249 | 5,397 | 6,646 | 672 | 7,528 | 8,200 | 2,514 | 15,368 | 17,882 |
| 1975 | 815 | 2,497 | 3,312 | 1,000 | 4,265 | 5,265 | 845 | 6,567 | 7,412 | 2,660 | 13,329 | 15,989 |
| 1976 | 658 | 3,788 | 4,446 | 496 | 2,702 | 3,198 | 892 | 4,323 | 5,215 | 2,045 | 10,814 | 12,859 |
| 1977 | 1,105 | 4,531 | 5,636 | 492 | 8,292 | 8,784 | 501 | 6,367 | 6,868 | 2,098 | 19,190 | 21,288 |
| 1978 | 390 | 1,492 | 1,882 | 880 | 3,879 | 4,759 | 2,049 | 6,113 | 8,162 | 3,319 | 11,484 | 14,803 |
| 1979 | 2,898 | 5,831 | 8,729 | 609 | 3,481 | 4,090 | 3,105 | 7,246 | 10,351 | 6,613 | 16,557 | 23,170 |
| 1980 | 2,005 | 7,498 | 9,503 | 465 | 3,225 | 3,690 | 2,036 | 13,507 | 15,543 | 4,506 | 24,230 | 28,736 |
| 1981 | 5,210 | 8,013 | 13,223 | 977 | 7,305 | 8,282 | 2,801 | 17,792 | 20,593 | 8,988 | 33,110 | 42,098 |
| 1982 | 5,691 | 14,069 | 19,760 | 1,142 | 6,421 | 7,563 | 2,572 | 8,326 | 10,898 | 9,405 | 28,816 | 38,221 |
| 1983 | 3,607 | 5,149 | 8,756 | 1,394 | 6,305 | 7,699 | 2,465 | 6,435 | 8,900 | 7,466 | 17,889 | 25,355 |
| 1984 | 8,399 | 13,249 | 21,648 | 594 | 8,694 | 9,288 | 1,948 | 10,301 | 12,249 | 10,941 | 32,244 | 43,185 |
| 1985 | 3,101 | 13,219 | 16,320 | 198 | 5,613 | 5,811 | 1,309 | 7,784 | 9,093 | 4,608 | 26,616 | 31,244 |
| 1986 | 1,423 | 11,058 | 12,481 | 2,491 | 6,010 | 8,501 | 911 | 4,784 | 5,695 | 4,825 | 21,852 | 26,677 |
| 1987 | 5,892 | 10,429 | 16,321 | 3,467 | 6,641 | 10,108 | 3,021 | 3,476 | 6,497 | 12,380 | 20,546 | 32,926 |
| 1988 | 1,874 | 11,705 | 13,579 | 292 | 6,188 | 6,480 | 664 | 7,961 | 8,625 | 2,830 | 25,854 | 28,684 |
| 1989 | 2,433 | 9,553 | 11,986 | 1,099 | 6,479 | 7,578 | 506 | 9,234 | 9,740 | 4,038 | 25,266 | 29,304 |
| 1990 | 1,581 | 13,054 | 14,635 | 1,868 | 4,257 | 6,125 | 826 | 4,031 | 4,857 | 4,274 | 21,343 | 25,617 |
| 1991 | 1,325 | 9,358 | 10,683 | 1,440 | 8,918 | 10,358 | 356 | 6,772 | 7,128 | 3,121 | 25,048 | 28,169 |
| Average | 2,354 | 7,020 | 9,247 | 1,207 | 5,010 | 6,216 | 1,420 | 7,313 | 8,733 | 4,981 | 19,343 | 24,196 |

APPENDIX 9.

Returns of fall-run chinook salmon to hatchery facilities on rivers tributary to the Eastside Delta and San Joaquin Basin, 1967 through 1991.

| Year | Mokelumne Hatchery | | | Merced Hatchery | | | Eastside and San Joaquin Totals | | |
|------|--------------------|--------|-------|--|--------|-------|---------------------------------|--------|-------|
| | grilse | adults | total | grilse | adults | total | grilse | adults | total |
| 1967 | 54 | 196 | 250 | Merced River Hatchery was first operated in the fall of 1970 | | | 54 | 196 | 250 |
| 1968 | 632 | 322 | 954 | | | | 632 | 322 | 954 |
| 1969 | 119 | 496 | 615 | | | | 119 | 496 | 615 |
| 1970 | 180 | 728 | 908 | 34 | 66 | 100 | 213 | 795 | 1,008 |
| 1971 | 171 | 1,059 | 1,230 | 18 | 182 | 200 | 189 | 1,241 | 1,430 |
| 1972 | 38 | 315 | 353 | 19 | 101 | 120 | 57 | 416 | 473 |
| 1973 | 58 | 350 | 408 | 80 | 296 | 375 | 137 | 646 | 783 |
| 1974 | 134 | 86 | 220 | 71 | 929 | 1,000 | 205 | 1,015 | 1,220 |
| 1975 | 250 | 149 | 399 | 85 | 615 | 700 | 336 | 763 | 1,099 |
| 1976 | 57 | 17 | 74 | 46 | 654 | 700 | 103 | 671 | 774 |
| 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1978 | 180 | 304 | 484 | 17 | 83 | 100 | 197 | 387 | 584 |
| 1979 | 262 | 245 | 507 | 30 | 197 | 227 | 292 | 442 | 734 |
| 1980 | 219 | 420 | 639 | 4 | 153 | 157 | 224 | 572 | 796 |
| 1981 | 324 | 1,062 | 1,386 | 266 | 658 | 924 | 590 | 1,720 | 2,310 |
| 1982 | 894 | 1,783 | 2,677 | 4 | 185 | 189 | 898 | 1,968 | 2,866 |
| 1983 | 2,890 | 1,683 | 4,573 | 1,375 | 420 | 1,795 | 4,265 | 2,103 | 6,368 |
| 1984 | 155 | 804 | 959 | 471 | 1,414 | 1,885 | 627 | 2,217 | 2,844 |
| 1985 | 39 | 184 | 223 | 88 | 1,123 | 1,211 | 127 | 1,307 | 1,434 |
| 1986 | 798 | 1,115 | 1,913 | 45 | 605 | 650 | 843 | 1,720 | 2,563 |
| 1987 | 535 | 95 | 630 | 460 | 498 | 958 | 995 | 593 | 1,588 |
| 1988 | 35 | 93 | 128 | 32 | 425 | 457 | 66 | 519 | 585 |
| 1989 | 31 | 49 | 80 | 16 | 66 | 82 | 47 | 115 | 162 |
| 1990 | 43 | 25 | 68 | 12 | 37 | 49 | 55 | 62 | 117 |
| 1991 | | | | 9 | 32 | 41 | 9 | 32 | 41 |
| | 257 | 503 | 856 | 152 | 416 | 568 | 470 | 847 | 1,317 |

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