State of California The Resources Agency Department of Fish and Game Anadromous Fisheries Branch and Regions 1, 2, and 4

KING (CHINOOK) SALMON SPAWNING STOCKS IN CALIFORNIA'S CENTRAL VALLEY, 1968 $\frac{1}{2}$

Edited by

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SUMMARY

During 1968, the California Department of Fish and Game conducted its sixteenth annual king (chinook) salmon, <u>Oncorhynchus</u> tshawytscha, spawning stock inventory of the Sacramento-San Joaquin River System.

Counts of carcasses, live fish, and redds were bases for spawning estimates.

During 1968, an estimated 211,000 (210,977) king salmon spawned in the Sacramento-San Joaquin River System as compared with an estimated 181,000 fish in 1967. Of these, 192,000 (91%) spawned in the Sacramento River and its tributaries from the American River north.

King salmon counts and population estimates were as follows:

	<u>Fall Run</u>	Spring Run	Combined
Sacramento, Main Stem	110,229	No estimate	110,229
Northern Sacramento River Tributaries (North of Chico Creek)	24,766	No estimate	24,766
Southern Sacramento River Tributaries (Chico Creek and South)	56,577	663	57,240
San Joaquin River Tributaries (Including the Mokelumne and Cosumnes rivers)	18,742	None	18,742
Total	210,314	663	210,977

Fall-run estimates were made on all major streams and on all minor streams which have a fall run in most years. Some spring-run fish could not be separated from the fall-run and were included in the fall-run estimates.

Spring-run estimates are incomplete; they were made on only three streams.

No winter-run fish are included in any of these estimates.

(Complete report available upon request.)

1/ Anadromous Fisheries Administrative Report No. 69-4. (July 1969)

INTRODUCTION

This report covers the sixteenth annual Central Valley king (chinook) salmon spawning stock inventory. Estimates and counts were principally of fall-run fish; for a few streams, separate spring-run salmon stock estimates were included. Spring-run salmon were included in fall-run estimates for the Upper Sacramento River and areas of the Feather River where an overlap in spawning period made it impractical to separate fall- and spring-run stocks. Winterrun salmon began entering the Upper Sacramento River just as the survey ended; these fish are almost entirely confined to the main stem of the Sacramento River. The winter-run spawning period extends from April into July, therefore no estimate was made of their number, and few - if any - were included in the counts. In 1968, the total spawning stock estimate of fall-run king salmon in the Central Valley was 211,000 which was somewhat above last year's (1967) estimate of 181,000 fish.

A summary of estimates of all streams for years 1953 through 1968 is presented in Table 1.

METHODS

Most population figures were obtained by counting dead salmon and estimating what percentage of the run was counted. Although this method may not give as accurate an estimate of salmon populations as the use of a counting station, it is at present the most economical method for large-scale statewide programs. Dependability and accuracy of this method is based primarily on two factors: 1) The relationship to tag-and-recovery studies on selected streams. In a tagand-recovery study, fish are usually caught, tagged, and released near the downstream end of a spawning area. After the fish have spawned and died, as many carcasses as possible are recovered, and the ratio of tagged-to-untagged fish is determined. 2) The availability of a well-trained observer who is familiar with methods of evaluation. The tag-and-recovery method has proven quite valuable as a method of training personnel to estimate the size of the run in a stream. After a man has learned from a tagging experiment the proportion of fish he can expect to see under certain conditions such as quantity of flow, amount of turbidity, and weather conditions, he is much better able to estimate the size of the run in a stream where no tagging has been done.

Carcasses were examined for fin marks, tags, sex and completeness of spawning, and were then cut in half to prevent recounting on subsequent trips. Aerial counts of redds and live fish were used in conjunction with carcass recovery for population estimates in some stream sections. Additional counts were made at fishways, hatcheries, and egg-collecting stations.

Regions 1, 2, and 4 conducted all surveys and prepared individual reports. Anadromous Fisheries Branch served as liaison between regions to assure uniformity of methods and compiled the regional reports into this annual report. Spawning stock surveys were conducted by 12 Department of Fish and Game personnel, as follows: Region 1, four; Region 2, six, and Region 4, two. This does not include personnel at counting stations.

MAIN STEM OF SACRAMENTO RIVER (Figure 1)

by

W. Donald Weidlein and William Hodges - Region 1

The main stem Sacramento River was surveyed between Keswick Dam and Squaw Hill Bridge from October 1, 1968 to January 10, 1969 (Figure 1). Earlier spot checks indicated few salmon had completed spawning before October.

Fall Run

The flow release from Keswick Dam remained constant at about 10,000 cfs during September 1968 but was reduced to 7,500 cfs on October 3; to 6,500 cfs on November 15; to 5,500 cfs on December 12; to 5,000 cfs on December 18; to 4,500 cfs on December 26; to 4,000 cfs on January 1 and to 3,000 cfs on January 2 where it remained until the end of the survey period. Clear water during most of the survey period and the absence of flood flows resulted in good recovery conditions.

Carcass recoveries were used for estimating the 1968 fall-run king salmon spawning population. The estimated carcass recovery rate for 1968 is based on the 1959 to 1965 historical average recovery rate as described in the 1966 salmon spawning stock report. Using this average recovery rate data, an appropriate recovery rate was computed for the 1968 season. We first corrected the historical average carcass recovery rate by the number of counting trips made in 1968 (obviously a higher percentage of carcasses should be counted when more counting trips are made, and vice versa). The recovery rate was then corrected to compensate for the 1968 recovery conditions (turbidity, flow, etc.) that were different from historical average conditions. In the 1968 season, recovery conditions were estimated to be about 25% better than average because of clear water and relatively low flows. These conditions were about the same as in the 1967 season when conditions were estimated to be 20% better than normal. However, because of very low flows late in the 1968 season, a slightly higher (5%) percentage was used for this year.

Table 2 shows the fully-adjusted recovery rate which was used to estimate the 1968 spawning population.

To show how the calculations were made, the river section from Tehama Bridge to Squaw Hill Bridge is used as an example:

$$R_{68} = R_{(59-65)} \times \frac{T_{68}}{T_{(59-65)}} \times \frac{C_{68}}{C_{(59-65)}}$$
$$= 0.7 \times \frac{4.0}{3.3} \times \frac{125}{100}$$
$$= 1.06$$

In the above:

 $T_{68} = number of survey trips in 1968 = 4$ $T_{(59-65)} = average number of survey trips, 1959-65 = 3.3$ $C_{68} = recovery conditions 1968 = 125\%$ $C_{(59-65)} = average recovery conditions 1959-65 = 100\%$

The distribution of the run in the main stem Sacramento River was similar to that estimated in previous years (Table 3). One notable exception was the section from Keswick Dam to Anderson-Cottonwood Irrigation District Dam where an estimated 7% of the run spawned; the previous high for this section was 4% in 1967. In the two sections of river below Red Bluff, percentage recovery of carcasses was well above average.

It should be noted that the Red Bluff Diversion Dam was not impounding water after October 5, 1968 and that normal river-run passage (rather than ladder passage) occurred for the rest of the fall-run season. Therefore, there should have been little or no delay at the dam.

Estimate of Fall-Run from Carcass Survey

From 2 to 10 survey trips were made in various sections of the main stem Sacramento River between Keswick Dam and Squaw Hill Bridge. During these trips 2,693 salmon carcasses were examined. The estimated number of spawners was 110,229; this includes 1,374 fish trapped at Keswick Dam and 1,455 fish trapped at A.C.I.D. Dam and subsequently trucked to the Coleman hatchery holding facilities (Table 2).

Originally 2,376 fish were trucked from A.C.I.D. Dam to Coleman; however, 921 fish, assumed to be from this group, escaped downstream into Battle Creek. Theoretically, these escapees would be included in the spawning stock survey estimate; therefore, they were subtracted from the 2,376 fish, leaving 1,455 trapped at A.C.I.D. Dam.

Spring Run: No estimate was made in 1968.

SACRAMENTO RIVER TRIBUTARIES NORTH OF CHICO CREEK (Figure 1.)

by

W. Donald Weidlein and William Hodges - Region 1

Due to low flows and high water temperatures in most of the Upper Sacramento River tributaries, king salmon did not move into them in significant numbers until mid-November. This situation was quite similar to 1967 but the run was substantially larger in 1968.

The population estimates in the Upper Sacramento River tributaries were obtained by the same general method described for the main stem Sacramento River (Table 4).



Figure 1. Upper Sacramento River and Tributaries above Chico Creek covered during the 1968 King Salmon Spawning Stock Survey.

Clear Creek

Fall Run

Five survey trips were made on Clear Creek from October 29 until December 31. On the first survey, only 9 carcasses were recovered; about 25 live salmon were observed just above the mouth. The water was clear on the first three trips while visibility was limited to about 1 to 2 feet on the last two trips.

On the five survey trips, 280 carcasses were recovered and 89 live salmon seen. The run was estimated to be 800 fish (Table 4).

Spring Run: None.

Cow Creek

Fall Run

Two survey trips were made on Cow Creek and most of its tributaries. No carcasses and very few live salmon were seen on the first survey trip which was conducted prior to November 30. On the second survey trip, 430 carcasses were recovered; this is about seven times as many as were recorded on all survey trips in 1967. Recovery conditions were generally good, but because relatively large numbers of live salmon were seen on the final trip, we estimated a lower recovery rate than might otherwise be indicated.

The fish counted included 430 carcasses and 93 live salmon. The run was estimated to be 7,540 fish (Table 4).

Spring Run: None.

Cottonwood Creek

Fall Run

Relatively clear, low water afforded good recovery conditions for the two survey trips on the North and Middle Forks of Cottonwood Creek, as well as the single survey trip on the main stem. The recovery conditions on the South Fork were good on the first survey trip and so poor on the second that no carcasses were recovered.

Totals of 297 carcasses and 192 live salmon were counted on Cottonwood Creek. Most of the live salmon were on the main stem. The run was estimated to be 8,540 fish (Table 4).

Spring Run

No estimate was made. Spring-run fish are known to enter Cottonwood Creek but the population size is unknown.

Fall Run

Bear Creek

Three survey trips were made on Bear Creek. The first trip was made on October 22, and although there were no physical barriers to fish migration,

Fall run (Bear Creek) continued

no salmon were seen. The second and third trips were both made during December. Recovery conditions were good on the second trip and very poor on the third. The total count included 25 carcasses and 5 live salmon.

A fall run of 310 fish was estimated for Bear Creek (Table 4).

Spring Run: None.

Battle Creek

Fall Run

Surveys were made on Battle Creek from October 9, 1968 through January 10, 1969. The water was rated as clear on eight of the 10 survey trips. We estimated a 60% carcass recovery this year.

On the 10 survey trips 1,769 carcasses were counted and the run below the hatchery was estimated to be 2,950 fish. The total run in Battle Creek, including 3,526 fish taken at the Battle Creek trap (Coleman hatchery), was 6,476 fish (Table 4).

As stated previously, 921 salmon trucked to Coleman hatchery from the A.C.I.D. Dam escaped into Battle Creek. We do not know the proportion of these fish that spawned in Battle Creek or went back to the Sacramento River; any that spawned in Battle Creek would have been included in the Battle Creek spawning stock survey estimate.

Spring Run

No estimate was made. Spring-run fish are known to enter Battle Creek but the population size is unknown.

Antelope Creek

Fall Run

Two survey trips were made on Antelope Creek from Cone Grove Park to about two miles upstream. The water was low and clear on October 31 and December 19 when the surveys were made.

No dead or live salmon were counted on the first survey; only five carcasses and no live salmon were counted on the second survey. The run was estimated to be 80 fish (Table 4).

Spring Run

No estimate was made. Spring-run fish are known to enter Antelope Creek but the population size is unknown.

Mill Creek

Fall Run

Three survey trips were made on Mill Creek, and the recovery conditions were rated as poor on all trips.

Thirty carcasses were counted on the three survey trips. The run was estimated to be 750 king salmon (Table 4).

Spring Run

No estimate was made in 1968. The spring run of 1963 and 1964 averaged 1,427 fish.

Fall Run

Deer Creek

Two survey trips were made on Deer Creek - the first on November 25 and the second on December 19. Recovery conditions were rated as fair and poor, respectively.

Sixteen carcasses and five live salmon were counted on the two surveys. An estimated 270 king salmon spawned in Deer Creek during the fall of 1968 (Table 4).

Spring Run

No estimate was made in 1968. The spring run of 1963 and 1964 averaged 2,288 fish.

SACRAMENTO RIVER TRIBUTARIES, CHICO CREEK AND SOUTHWARD (Figure 2)

by

Charles Young - Region 2

The salmon spawning stock survey for this area was carried out from September 25, 1968 to January 15, 1969.

Chico Creek

Fall Run

No estimate. (The fall run in Chico Creek is zero in some years and very small in others.)

Spring Run

The spawning area of Chico Creek from below Higgins Hole to just below Ponderosa Way Bridge was surveyed on September 27 - the only trip made. The water, as usual, was low and clear, and spawning activity was in progress. Twelve redds and 15 live salmon were counted below Higgins Hole and 15 live salmon in the hole. Five live salmon plus two redds were seen just below Ponderosa Way Bridge.

No carcasses were found. The population estimate based on live fish counts and redds was 175 fish (Table 5).



Figure 2. Sacramento River Tributaries from Chico Creek, south, covered during the 1968 King Salmon Spawning Stock Survey.

- 7a -

Butte Creek

Fall Run

No estimate. (In some years a few fall spawners have been observed below Highway 99 Bridge.)

Spring Run

In August, a preliminary survey was made in the main spawning area of Butte Creek below the Centerville Power House to obtain a rough estimate of the number of salmon holding in this section of stream. Six holding pools were inspected by free diving and 43 salmon counted. This was a minimum count as there are several other suitable holding pools which were not checked.

Two survey trips were made of Butte Creek between Centerville Power House and Paradise Highway Bridge in late October and early November. Good recovery conditions prevailed as the water was clear and fairly constant. Under these conditions, in past seasons, we have been able to recover about 33% of the spawning population. This season we recovered only 20 carcasses but counted 27 single redds and 12 multiple redds, or a minimum of 51 individual redds. The number of redds indicates a larger population than would a carcass recovery of 33%. We used an estimated carcass recovery rate of 20% for this season.

Butte Creek, above Centerville Power House, was also surveyed on August 13 and 14. At this time, 180 salmon were counted in holding pools. Most of these fish had moved up from the lower holding area in July after the P.G.& E. flume broke about 7 miles above Centerville Power House and allowed about 130 cfs of water to flow into Butte Creek at that point. After the flume was repaired, the flow in this section of stream returned to the normal summer and fall flow of 5 cfs, which is not enough for successful spawning. On September 26, another trip was made to this section and we found that most of these fish had perished with no sign of spawning. A few fish were still alive in the uppermost pools.

Based on recovered carcasses, live fish and redd counts, the spawning population was estimated to be 100 fish. This, plus 180 salmon observed above Centerville Power House, represents a total run of 280 fish in Butte Creek (Table 5).

Feather River

Fall Run

This is the first year that Oroville Dam has had a major effect on downstream flows. In the area between Oroville and Thermalito Afterbay R. Outlet (formerly Sutter Butte Dam), the flow was a constant 400 cfs throughout the spawning season. Most of the spawning took place in this section. An additional 400 to 600 cfs was added to the river at the outlet. Recovery conditions were good because of low, clear water, and it was especially good in the section of stream above the outlet. This is in contrast to previous years when flows were high and usually very turbid, making carcass recovery difficult.

Eight survey trips were made from Oroville to Honout Greek and 3,445 carcasses were recovered from an estimated spawning population of 12,200 fish. Combining this with 5,944 fish taken at Feather River Hatchery gives a total run of 18,144 fall-run salmon.

Feather River continued

Spring Run

The number of spring-run salmon taken at the Feather River Fish Hatchery was 208 fish. A few may have spawned in the river but no attempt was made to separate them from fall-run fish.

The total combined run of fall- and spring-run salmon in the Feather River was estimated to be 18,400 (18,352) fish (Table 5).

Marked Fish

Fourteen marked fish (excised dorsal fins) were recovered during the spawning survey. These had been marked earlier this year at a trapping site located a short distance upstream from Honcut Creek.

Fall Run

Yuba River

Spawning activity was light throughout the entire season. Flows were fairly constant at 600 to 700 cfs, but upstream construction caused considerable turbidity, resulting in poor recovery conditions.

Six inventory trips were made on the Yuba River and 742 carcasses recovered for an estimated spawning population of 7,000 salmon (Table 5).

Spring Run: Extinct.

Tagged Fish

Twenty-one tagged salmon (spaghetti-type tags) were recovered; these fish were tagged by the U. S. Fish and Wildlife Service at a weir near Baldwin Gravel Plant.

Fall Run

American River

Carcass recovery conditions were very favorable in the American River. The water was fairly low and clear throughout the survey period.

Eleven survey trips were made from the Nimbus racks to Watt Avenue Bridge. The number of carcasses recovered in this section was 7,088 for an estimated population of 23,600 salmon. From the upper side of the Nimbus racks 1,854 carcasses were recovered. Based on a 75% recovery, the population between the racks and Nimbus Dam was estimated to be 2,500 salmon.

There were 5,233 salmon that entered Nimbus Hatchery, bringing the total population estimate in the American River to 31,300 (31,333) fish (Table 5).

Spring Run: Extinct.

Other Sacramento River Tributaries, South of Chico Creek

Tributaries to Natomas East Drain and Natomas Cross Canal

Fall Run

Only one spot check was made on Secret Ravine; 12 salmon (combination of live fish and carcasses) were seen. Based on this survey and reports from local residents, the run was estimated to be 100 fish. No observations or estimates were made on other tributary creeks in this area.

Spring Run: None.

LOWER SAN JOAQUIN RIVER TRIBUTARIES (Figure 3)

by

Charles Young - Region 2

The salmon spawning stock survey for this area was conducted from November 27, 1968 to January 11, 1969.

Cosumnes River

Fall Run

Survey conditions were good on the Cosumnes River as the water was low and clear most of the season. An unusually large number of jacks were recovered; they outnumbered adult males two to one.

Eight trips were made from Michigan Bar Bridge to Bridge House and seven trips from Bridge House to Slough House. There were 439 carcasses recovered; the run was estimated to be 1,500 fish (Table 6).

Spring Run: None.

Mokelumne River

Fall Run

The Mokelumne River was low and clear throughout the salmon migration and spawning period. Flows below Woodbridge Dam increased from October 30 to November 1 as flashboards at the Dam were removed to drain Lodi Lake. During this increased flow period, about 50 salmon went over the Dam. About 100 other salmon that tried to go over when flows had subsided were trapped in the riprap on the downstream side of the Dam and died there.

On November 25, a survey of the river between Camanche Dam and Lockford Bridge was made to observe spawning conditions. On this survey, 52 redds were counted, and 62 carcasses - most of them jacks - were recovered.

Two methods of counting fish at Woodbridge Dam were used this season: 1) From October 15 to October 28, counting took place from 0600 to 1200 and from 1400 to 1800 hours each day. During this period, 38 fish were counted. In past years, 70% of the daily migration occurred in these periods. From this, we



Figure 3. San Joaquin River Tributaries covered during the 1968 King Salmon Spawning Stock Survey.

Fall Run (Mokelumne River) continued

estimated that 54 salmon passed through the ladder between these dates. 2) From October 29 to December 23, all salmon ascending the fishway were trapped and counted; of these, 217 males and 172 females were trucked to the Mokelumne River Fish Installation. The remainder of the 1,603 counted during this period were released above Woodbridge Dam.

The number of Mokelumne River salmon passing over Woodbridge Dam, not including the ones lost in the riprap below the Dam, was estimated to be 1,700 (1,707) fish (Table 6). A larger proportion than normal - 549 of 1,603 counted - were recorded as grilse. The 38 fish counted through the ladder earlier were not classified according to size.

Spring Run: Extinct.

UPPER SAN JOAQUIN RIVER TRIBUTARIES (Figure 3)

by

Jerry Goertzen - Region 4

The salmon spawning stock survey for this area was carried out from November 11, 1968 to January 4, 1969.

Low, clear water made conditions good for recovering carcasses in all three rivers (Stanislaus, Tuolumne and Merced), but heavy rains in late December caused the survey to terminate early. The total number of spawners was estimated to be less than last season but above the poor showing of the early 1960's. Some of the returning spawners may be the result of the initial plant of young salmon made in all three rivers during the 1964-65 season and the continued annual plants of yearlings in the Stanislaus and Merced rivers.

Stanislaus River

Fall Run

Flow conditions in the Stanislaus River were very good this season, resulting in a higher than normal percentage recovery of carcasses. The flow from mid-October to November 1 ranged from 60 to 80 cfs at Orange Blossom Bridge. The flow during most of the spawning season was 100 cfs, with slight increases from runoff during rains. At the end of the survey season (early 1969), the flow increased to 460 cfs.

Visibility was very good in low-flow periods except for the section of river below Standard Materials Gravel Plant (below Oakdale). Poor visibility prevailed in all sections on the last survey (January 2-4, 1969).

A trap for capturing adult salmon was installed and operated by Region 4 personnel from Moccasin Creek Hatchery, from October 23 to December 14. It was located about one-half mile above the Orange Blossom Bridge; previously, it was about one-quarter mile below the bridge. During this period, 384 males and 101 females were captured for a total of 485 salmon.

The run started later than last year, but when it did start, a large number of spawners came in at one time. There was a fish kill (an estimated 100 salmon) Fall Run (Stanislaus River) continued

in the Riverbank area in mid-October, believed to have been caused by pollution. This may have been the reason for the fish being late or it may have been due to low attraction flows or, more likely, a combination of the two.

The heaviest spawning this season took place in the section of stream from the trap site to Oakdale. Apparently, a few salmon went beyond the trapping site before the trap was installed as some redds were seen on November 14 between the trap and Knights Ferry. No salmon were seen on a pre-season check of the section from Goodwin Dam to Knights Ferry, so this area was not covered on the first regular survey. After the trap was removed, some female salmon entered the river section above the trap site. The proportion of females spawning in this upper section was considerably less than last season, due mainly to a longer trapping season.

While the trap was in operation, a large concentration of salmon was seen in pools immediately below the trap. For example, on the first trip (November 15), about 100 live salmon were observed in one pool and more than 200 were counted from the trap to three-quarters of a mile downstream.

Eight unspawned female carcasses, one above the trap and seven below, were found. Of the total carcasses recovered, 52% were grilse which is far above normal. More large-sized salmon were seen this season than during the past several years.

The sex ratio recorded at the trap was comparable to carcass recoveries for the past three seasons. For example, in 1968, females comprised 21% of the salmon trapped and 26% of the carcass recoveries; in 1967 the ratio was 41% to 52%, and in 1966 it was 26% to 29%. Note that the percentage of females each season is slightly lower for the trapped group.

The low, warm flows this season were conducive to heavy aquatic weed encroachment, especially water primrose. There is very little good spawning area below Standard Materials Gravel Plant (Oakdale). Heavy siltation of the river and resultant aquatic growth have destroyed many spawning riffles. Quite a few trees, brush and other debris were cleared from the river channel during the low-water period. This work was necessary before a boat could be used to conduct the survey.

Poaching was heavy this year, encouraged by low, clear water. Fish and Game wardens from Region 4 were brought into the area and worked a Department airplane crew to deter poachers. Publicity of the warden patrols in a local paper also helped discourage poaching.

Five survey trips were made on the Stanislaus River and 1,054 carcasses were recovered. The spawning population was estimated to be 6,385 fish, including the 485 salmon taken at the trap near Orange Blossom Bridge (Table 6).

Spring Run: Extinct.

Planting of Yearlings

In early November 1968, a total of 134,000 yearling king salmon (1967 brood-Stanislaus River strain) was planted in the Stanislaus River at Knights Ferry. Many of these yearlings were seen in the river during the course of the spawning survey, and many were still there when the survey ended on January 2.

Tuolumne River

Fall Run

The flow in the Tuolumne River was only 100 cfs prior to October 27 when it was increased to 750 cfs. The water was shut off at Don Pedro Dam for about three weeks in November to facilitate laying a sewer pipeline across the river at Modesto. There was leakage of about 7 cfs into the river during this period. On November 27, the work was completed and the flow increased to 700 cfs; it remained at this level until the end of December. There were occasional flow fluctuations up to 2,000 cfs. By the first of January, the river was 3,000 cfs and so muddy it was decided to terminate the survey for this season as very little usable information can be obtained under these conditions.

Water clarity was very good in low-flow periods, providing good observation of spawning activity and good carcass recovery. Clarity was only fair to poor in high-flow periods, but even so, carcass recovery was good at the low point in the daily fluctuations. An exception to this occurred on the later trips below Roberts Ferry where quantities of moss had piled up against willows and brush, hiding many carcasses.

Salmon were moving into the spawning area by the last week of October, and spawning was just starting when the water was shut off at Don Pedro Dam. As the flow decreased, many fish were stranded on shallow riffles. This was especially true at a new haul bridge that had been constructed about a mile below La Grange. The bridge was used by trucks to haul material from the river bed to the new Don Pedro Dam site. A new river channel, just south of the old channel in this area, was made into a wide, relatively flat riffle. As the water receded, there were no pools for the salmon to hide in and mortality was high. Most uncompleted redds in the upper river (Roberts Ferry to La Grange) were deserted during the low-flow period. Spawning activity was very limited at this time, and hundreds of fish could be seen milling in pools waiting for higher water. The effect of this period on spawning is not known.

There were two spawning peaks this season: a small peak just when the water was shut off, and then the main peak shortly after the releases were continued. Carcass recovery also had two peaks, but the second peak was not completely evaluated due to early termination of the survey.

About two-thirds of the carcasses recovered this season were small males. There were large runs of small males in the other two rivers this season also, but the ratio was higher in the Tuolumne. A possible reason for this is that, in past seasons, most female carcasses were recovered on the last two runs which were not made this year. Carcass recoveries have been as high as 50% females after mid-December.

Willows and alders are still a problem above Roberts Ferry Bridge where they are taking over much of the usable spawning area. Below Rairdens Farm, aquatic plants - especially moss - are taking over many of the riffles. Moss, primarily elodea, is very thick in the pools. The major problem in the pools is that the fluctuating flows tear loose large quantities of moss and pile it against the willows and brush. This blocks the water in some areas and forces it through other areas at high velocity, cutting away spawning gravel. During low water, trees and brush were cleared from the river channel for easier boat access and more thorough coverage of the river.

There was extensive poaching in the period when the water was shut off. Fish stranded in shallow riffle areas were easy to catch, even by hand. Also, fish

Fall Run (Tuolumne River) continued

congregated in large numbers in isolated pools where they were susceptible to snagging. Warden effort was increased during this period. When the releases started again, the salmon were not as vulnerable and poaching declined.

Usually the Tuolumne River is surveyed six times each season, but because of high and muddy water late this season the survey was terminated after the fourth trip. In past years, about one-third of the carcasses had been recovered on the last two trips. This information was used to project the percentage of the run that should have been recovered had the survey continued.

Four survey trips were made on the Tuolumne River and 1,261 carcasses recovered for an estimated total population of 8,600 fish (Table 6).

Spring Run: Extinct.

Merced River

Fall Run

The estimated salmon run in the Merced River was down slightly from last year, but it was still much larger than the last 13-year average (Table 1). Spawning was erratic this season with no discernible peak.

Due to low flows, proportionately less spawning habitat was available this season than last in the section of river from Crocker-Hoffman Dam to Highway 59 Bridge. The best conditions for spawning existed in the section from Highway 59 Bridge to Bettencourt's Ranch. There is still poor spawning habitat in the river section from Bettencourt's Ranch to Cressey Bridge which encompasses almost all of the spawning area of previous years.

A flow of 500 cfs was released in the Merced River from mid-October to the first of November. This flow was successful in attracting salmon into the river. The flow during most of the remainder of the season was about 100 cfs (86 cfs measured at "G" Street Bridge in Snelling on November 18 and December 4); 100 cfs is the flow agreement with the Merced Irrigation District. The only exception to this flow was in late December when the river rose to 600 cfs for a short period but then dropped immediately to 200 cfs.

Spawning observation and carcass recovery was good this season from Crocker-Hoffman Dam to Highway 59 Bridge, due to low, clear water and a narrow channel. From Highway 59 Bridge downstream, carcass recovery conditions were worse due to muddy water from active gravel operations and large, deep pools. Two gravel companies, Standard Materials (below Highway 59 Bridge) and Turlock Rock (two miles above Cressey Bridge), were both operating in the river. Turlock Rock was also spilling a settling pond all season long, causing very poor visibility in the river below. Water clarity was poor in all sections on the last run (later in December) after a heavy rain.

This was the first year we were able to survey the entire spawning area by boat. In order to accomplish this, it was necessary to remove trees and brush from the channel. Downed trees and thick willow growth made much of the river unnavigable in past seasons.

Water hyacinths have increased and in some cases they block the river. So far it has been only a surface blockage, and salmon are still able to get through underneath. Fall Run (Merced River) continued

Poaching was light this year, probably due to the widely scattered spawning.

Three survey trips were made on the Merced River; 83 carcasses were recovered from an estimated spawning population of 550 fish (Table 6).

Spring Run: Extinct.

Planting of Yearlings

From October 22 to November 8, 1968, a total of 134,000 yearling king salmon (1967 brood Stanislaus River strain) was planted in the Merced River. Personnel from Moccasin Creek Fish Hatchery planted the young salmon in some old gravel pit pools in the river on the Bettencourt Ranch. Many of these fish were seen as late as mid-December in the planting area. Others were seen in pools several miles downstream and more than one mile upstream from the planting area. Increased water turbidity after December 25 hindered observation of planted salmon.

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LIST OF TABLES

MADTE	-	Comments Con Tecovia Nallow Kind Colors Commind Church	Page
TADLE	Ŧ	Estimates, Major Streams, 1953-1968 (in thousands of fish)	17
TABLE	2	Estimated Percent of Carcasses Recovered to Total Estimated Population and Number of Counting Trips made on Main Stem Sacramento by Sections.	18
TABLE	3	Percent of Total Estimated Salmon Run in the Main Stem Sacramento River for each River Section above Squaw Hill Bridge from 1958 through 1968.	19
TABLE	4	King Salmon Counts and Population Estimates Northern Sacramento River Tributaries (North of Chico Creek)	20
TABLE	5	King Salmon Counts and Population Estimates Southern Sacramento River Tributaries (Chico Creek and South) 1968-69.	21
TABLE	6	Fall-Run King Salmon Counts and Population Estimates San Joaquin River Tributaries, 1968-69.	22

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- 17 -

TABLE 1

Sacı	ramento	o-San Joaqu	in Vall	ley King	Salmon	
Spawning	Stock	Estimates,	Major	Streams,	, 1953 -	1968
-		(In thousan	ndsof	fish)		

				•	•		•		<u></u>	÷
Year	Main Stem Sacramento River	Clear Creek	Cow Creek	Bear Creek	Cottonwood Creek	Battle Creek	Antelope Creek	Mill Creek	Deer Creek	Chico Creek
1953	408 a + 8 c	- b	- b	- b	- b	16 b + 2 c	- b	10 b + 3 c	4 b + 2 c	- c
1.954	276 a + 9 c	- b	– b	- b	– b	12 b + 2 c	- b	7 b + 2 c	3 b + 2 c	- c
1955	231 a + 17 c	– b	- b	- b	- b	26 b + 2 c	- b	3 b + 3 c	* +3 c	- c
1956	94 a + 7 c	- b	- b	- b	- b	21 b + 2 c	- b	0.9b+2 c	0.1 b + 3 c	- c
1957	68 a + - c	0.3 Ъ	0.7 b	* ь	0.4 b	5b+-c	0.8 b	5 b + 1 c	2 b + - c	0.1 c
1958	128 a + - c	1.6 b	3 b	0.2 b	0.6 b	29 b + - c	0.4 b	4 b + 2 c	1.3 b + - c	1 c
1959	267 a + - c	0.8 b	0.7Ъ	* ь	3 Ъ	30 b + - c	- b	0.8 b + 1.6 c	* b+- c	0.2 c
1960	233 a + - c	0.9 b	0.6 b	0.1 b	0.4 b	24 b + - c	0.2 b	0.9 b + 2 c	0.8b+- c	- c
1961	150 a + - c	- b	- b	- b	1.5 b	20 b + - c	- b	1.7 b + 1 c	- b + - c	- c
1962	139 a + - c	5 Ъ	1.5 b	- b	6 b	13 b + - c	0.8 b	4 b + 2 c	2 b+- c	0.2 c
1963	146a + - c	10 ь	- b	- b	4 ь	17 b + - c	0.3 b	1.3 b + 1.3 c	1.2 b + 1.7 c	0.5 c
1964	148 a + - c	2 b	1 b	0.1 b	3 b	16 b + - c	0.1 b	0.4 b + 1.5 c	0.1 b + 3 c	0.1 c
1965	103 a + - c	2 Ъ	1 ь	0.4 b	0.9Ъ	9 b + - c	0.1 b	0.2 b + - c	0.2 b + - c	0.1 c
1966	115 a + - c	0.9 b	8 b	0.4 b	3 b	3 b + - c	0.2 b	0.5 b + - c	0.1b + - c	0.1 c
1967	92 a + - c	0.4 Ъ	0.5 Ъ	* Ъ	0.6 b	5 b + - c	0.1 b	0.5b + - c	0.1b + - c	0.2 c
1968	110 a + - c	0.8 b	8 b	0.3 b	8 b	6 b + - c	0.1 b	0.8b + - c	0.3b + - c	0.2 c

u	Butte Creek	Feather River	Yuba River	American River	Cosumnes River	Mokelumne River	Stanislaus River	Tuolumne River	Merced River	Others	Total
_∍53	- c	28 a + - c	6 b	28 b	2 b	2 b	35 b	45 b	-b	13	612
1954	- c	68 a + 3 c	5 b	29 b	5 b	4 b	22 b	40 b	4 b	12	505
1955	0.4 c	86 a + 1 c	2 b	17 b	2 b	2 b	7 b	20 b	-b	4	426
1956	3 c	18 a + 2 c	5 b	6 b	1 b	0.5 b	5 b	6 b	0.0 b	9	185
1957	2 c	10 a + 0.5 c	1 b	8 b	1 b	2 b	4 b	8 b	0.4 b	0.2	120
1958	1 c	31 a + 3 d	8 b	27 b	1 b	7 b	6 b	32 b	0.5 b	0.2	288
1959	0.5 с	76a+4 d	10 Ъ	31 b	0.0 b	2 b	4 b	46 b	0.4 b	1 *	479
1960	7 с	80a+4 d	20 Ъ	54 b	1 b	2 b	8 b	45 b	0.4 b		4 84
1961	3 с	44 a + - c	9 b	25 b	- b	0.1 b	2 b	0.5 b	0.05 b	1 -	259
1962	2 с	19 a + - c	34 b	27 b	1 b	0.2 b	0.3 b	0.2 b	0.06 b		257
1963	5 c	34 a + 0.6 c	37 b	41 b	1 b	0.5 b	0.2 b	0.1 b	0.02 b	0.5	303
1964	0.6 c	38 a + 3 c	35 b	59 b	2 b	2 b	4 b	2 b	0.04 b	1	322
1965	l c	23 a + 0.7 c	10 b	39 b	0.8 b	1.3 b	2 b	3 b	0.09 b	0,2	198
1966	0.1 c	21 a + 0.3 c	8 b	27 b	0.6 b	0.7 b	3 b	5 b	0.04 b	0.3	197
1967	0.2 c	12 a + 0.1 c	24 b	23 b	0.5 b	3 b	12 b	7 b	0.6 b	0.1	182
1968	0.3 c	18 a + 0.2 c	7 b	31 b	1.5 b	1.7 b	6 b	9 b	0.5 b		210

a Mostly fall-run; a few spring-run fish may have been included.

b Fall-run only.

c Spring-run only.

d Mostly spring-run but may include some fall-run fish.

No estimate.

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Less than 50 fish.

Estimated Percent of Carcasses Recovered to Total Estimated Population and Number of Counting Trips made on Main Stem Sacramento by Sections

		1959 - 1965			1	968	Estimated spawning population by sections 8,200 26,200 26,400 14,300 11,700 5,200			
	Stream	Average estimated recovery rate (Car- casses to population	Average number	Number of	Number of carcasses and skeletons re-	Estimated recovery rate	Estimated spawning population			
River Section	miles	estimate) (percent)	of trips	trips	covered	(percent)	by sections			
Keswick Dam to ACID Canal	4.5	No Survey		2	155	1.9	8,200			
ACID to Highway 44	4.0	4.0	12.9	10	1,021	3.9	26,200			
Highway 44 Bridge to Upper Anderson Bridge	10.5	2.6	12.4	10	686	2.6	26,400			
Upp er Ander son Bridge to Balls Ferry	8.0	3.5	11.9	10	529	3.7	14,300			
Balls Ferry to Jellys Ferry	9.5	1.3	11.3	10	164	1.4	11,700			
Jellys Ferry to Bend Bridge	8.5	0.5	4.6	4	26	0.5	5,200			
Bend Bridge to Red Bluff	12.0	0.6	4.1	3	18	0.5	3,600			
Red Bluff to Tehama Bridge	15.0	0.7	5.1	4	62	0.7	8,900			
Te hama Bridge to Squaw Hill Bridge	14.5	0.7	3.3	4	32	1.1	2,900			
ACID Fish Trap	-	-	-	-	-	-	1,455 *			
Keswick Dam Fish Trap	-	-	-	-	-	-	1,374 **			
TOTAL Sacramento Main Stem	86.5				2,693		110,229			
* This figure incl that all of the from the ACID tr	* This figure includes fish trapped from October 9, 1968 to November 13, 1968. This total also assumes that all of the 921 salmon that escaped downstream from the Coleman hatchery holding facilities came from the ACID trap.									
I This figure incl	udes fis	an trapped from Novembe	т то ј таод	ro neceu	10er 2/, 1900.					

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Percent of Total Estimated Salmon Run in the Main Stem Sacramento River for each River Section above Squaw Hill Bridge from 1958 through 1968

River Section	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Average
Keswick Trap	6	3	4	4	11	2	1	3	3	5	1	3.9
ACID Trap	-	-	-	-	-	-	-	-	•	-	1	1.0 **
Keswick to ACID Dam	No	estimate	No	estimate	No	estimate	*	*	*	4	7	2.2 **
ACID Dam to Hwy. 44 Bridge	15	28	28	22	17	23	23	24	31	16	24	22.8
Hwy. 44 Bridge to Upper Anderson Br.	23	38	37	42	32	34	37	39	21	25	24	32.0
Upper Anderson Bridge to Balls Ferry	21	16	16	13	10	10	12	13	19	16	13	14.4
Balls Ferry to Jellys Ferry	11	9	9	11	12	14	15	15	16	14	11	12.4
Jellys Ferry to Bend Bridge (Iron Canyon)	3	2	2	2	8	5	3	4	4	6	5	4.0
Bend Bridge (Iron Canyon) to Red Bluff	6	1	1	2	4	7	4	l	2	3	3	3.1
Red Bluff to Tehama	12	3	4	4	5	4	3	1	1	9	8	4.9
Tehama to Squaw Hill Bridge	3	0	1	1	1	1	l	0	l	2	3	1.3
* Less than one-h	nalf of	1%.										

** Average of those years in which the facility was used or in which an estimate was made.

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King Salmon Counts and Population Estimates Northern Sacramento River Tributaries (North of Chico Creek)

	1959-	1965	1968						
	Average	Annual	Estimated Number of Estimated						
-	Recovery	Number of	recovery	Number of	carcasses	Spawn	ing Popula	tion	
Stream or	rate	counting	rate	counting	and skeletons	Spring	Fall	Total	
Stream Section	(percent)	trips	(percent)	trips	recovered	run	run	run	
CLEAR CREEK	18.0	3.8	35	5	280	None	800	800	
COW CREEK (total)	12.8	2.2			430	None	7,540	7,540	
South Cow			6	2	(51)		(850)		
Old Cow			6	2	(39)		(6 50)		
Oak Run			4	1	(44)		(1,100)		
Little (North) Cow			6	2	(76)		(1,270)		
Main Stem			6	2	(220)		(3,670)		
COTTONWOOD CREEK (total)	13.3	2.6			297	None	8,540	8,540	
Main Stem			3	1	(235)	None	(7,830)		
North_Fork			10	2	(17)	None	(170)		
Middle Fork			10	2	(36)	No est.	(360)		
South Fork			5	2	(9)	No est.	(180)		
PAYNES CREEK		1.0		0	0	None	No est.	No est.	
BEAR CREEK	16.5	2.5	8	3	25	None	310	310	
BATTLE CREEK (total)						No est.	6,476	6,476	
Coleman hatchery	~	-	-	-	-		(3,526)*		
Below hatchery	21.1	11.0	60	10	1,769		(2,950)		
ANTELOPE CREEK	13.3	2.0	6	2	5	No est.	80	80	
MILL CREEK	7.3	2.4	4	3	30	No est.	750	750	
DEER CREEK	19.2	2.3	6	2	16	No est.	270	270	
Total Northern Sacramento	River Trib	outaries			2,852			24,766	
* Battle Creek trap total	for operat	ion from 10,	2/68 to 12/3	31/68.					

King Salmon Counts and Population Estimates Southern Sacramento River Tributaries (Chico Creek and South) 1968-69

	Number	Carcasses	Estimated	Spawning Pop	oulation
Official and the second s	of	and			መርመለተ
Stream Section	counting	skeletons	Spring Run	Fall Run	RIN
Stream Section		counted	opi ing Kun		
CHICO CREEK	1	0	175	No est.	175
BUTTE_CREEK	2	20	280	No est.	280
FEATHER RIVER (total)	8	3,445	208	18,144	18,352
Oroville Barrier to <u>Thermalito Outlet</u>	(8)	(2,595)	No est.	(6,500)	
Thermalito Outlet to Gridley Bridge	(8)	(684)	No est.	(4,600)	
Gridley Bridge to Honcut Creek	(8)	(166)	No est.	(1,100)	
Oroville Hatchery	-	-	(208)	(5,944)	
BA RIVER (total)	6	742	Extinct	7,000	7,000
Blue Pt. Mine to Hwy. 20 Bridge	(6)	(80)	Extinct	(1,600)	
Hwy. 20 Bridge to Daguerre Pt. Dam	(6)	(310)	Extinct	(3,100)	
Daguerre Pt. Dam to Baldwin Gravel Pl.	(6)	(352)	Extinct	(2,300)	
AMERICAN RIVER (total)	11	8,942	Extinct	31,333	31,333
Nimbus Racks to Carmichael Pumps	(11)	(5,760)	Extinct	(19,200)	
Carmichael Pumps to Watt Ave. Bridge	(11)	(1,328)	Extinct	(4,400)	
Above Nimbus Racks Nimbus Hatchery	-	(1,854)	Extinct Extinct	(2,500) (5,233)	
NATOMAS DRAINAGE	1	0	None	100	100
Total, Southern Sacrament River Tributaries	0	13,149	663	56,577	57,240

Fall-Rum King Salmon Counts and Population Estimates San Joaquin River Tributaries* 1968-69

Stream or Stream Section	Number of counting trips	Number of carcasses and skeletons counted	Estimated spawning population
COSUMNES RIVER (total)	8	439	1,500
Michigan Bar to			
Bridge House	(8)	(257)	(900)
Bridge House to Meiss			
Road Bridge	(7)	(182)	(600)
MOKELUMNE RIVER	1	62	1,707 **
STANISLAUS RIVER (total)	5	1,054	6,385
Goodwin Dam to	(-)		(
Knights Ferry	(5)	(5)	(50)
Rangents Ferry to Orange	(5)	(151)	(750)
Orange Blossom Bridge	(3)	(131)	(730)
to Oakdale	(5)	(829)	(4.100)
Oakdale to Riverbank	(5)	(69)	(1.000)
Trap near Orange Blos.Br.	-	(0))	(485)***
TUOLUMNE RIVER (total)	4	1,261	8,600
La Grange to Kairden's	(A)	(501)	(2, 200)
Rairden's Farm to Roberts	(4)	(301)	(2,000)
Ferry Bridge	(4)	(601)	(3,800)
Roberts Ferry Bridge to	······		
Reed Rock Plant	(4)	(159)	(2,000)
	•		
MERCED RIVER (total)	3	83	550
Crocker-Hoffman Dam to	(0)	(47)	(050)
Highway 59 Bridge	(3)	(47)	(250)
Rettencourt's Ranch	(3)	(31)	(250)
Bettencourt's Ranch to	(0)	(01)	(200)
Cressey Bridge (McSwain)	(3)	(5)	(50)
Total, San Joaquin River Trib	utaries	2,899	18,742

* No spring-run fish entered these streams.

- ** This figure is the count made at Woodbridge Dam. The one survey trip was not used for population estimation.
- *** These fish were trapped near Orange Blossom Bridge, and the fish were spawned and their progeny reared to yearling size at Moccasin Creek Hatchery.