

KING (CHINOOK) SALMON SPAWNING STOCKS IN CALIFORNIA'S CENTRAL VALLEY, 1966 ^{1/}

by

Marine Resources Branch and Regions 1, 2, and 4

Edited by
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SUMMARY

During 1966, the California Department of Fish and Game conducted its fourteenth annual king (chinook) salmon, O. tshawytscha, spawning stock inventory of the Sacramento-San Joaquin River System.

Counts of salmon carcasses, live fish, and redds were used as bases for spawning estimates. Counts and estimates were of fall-run salmon, although a few spring-run fish were included - some in separate counts and some unavoidably mixed with fall fish. No estimates of winter-run salmon were made.

During 1966, an estimated 196,000 (196,260) king salmon spawned in the Sacramento-San Joaquin River System as compared with an estimated 199,000 fish in 1965. Of these, 187,000 (95 percent) spawned in the Sacramento River and its tributaries from the American River north.

King salmon counts and population estimates for the Sacramento-San Joaquin River System were as follows:

| | |
|---|---------|
| Sacramento, Main Stem | 114,981 |
| Northern Sacramento River Tributaries (North of Chico Creek) | 16,200 |
| Southern Sacramento River Tributaries (Chico Creek and South) | 55,773 |
| San Joaquin River Tributaries (Including the Mokelumne and Cosumnes rivers) | 9,306 |
| Total | 196,260 |

(Complete report available upon request.)

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Marine Resources Administrative Report No. 67-13

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INTRODUCTION

This report covers the fourteenth annual Central Valley king (chinook) salmon (Oncorhynchus tshawytscha) spawning stock inventory. Estimates and counts were principally of fall-run stocks. 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. Winter-run salmon start entering the Upper Sacramento River just as the survey ends. These fish are almost entirely confined to the main stem of the Sacramento River. The winter-run spawning period extends from April into July, so no estimate was made of their number, and few if any were included in the counts. In 1966, the total spawning stock estimate of fall-run king salmon in the Central Valley was 196,000 which was slightly below last year's (1965) estimate of 199,000 fish.

ACKNOWLEDGMENTS

We wish to take this opportunity to acknowledge the excellent work done by Messrs. Charles Young, Fisheries Manager I in Region 2, and William Hodges, Fish and Game Seasonal Aid, Region 1. They have been conducting the Salmon Spawning Stock Surveys over the past several years in their regions. Their knowledge of the river, interest in the surveys, and willingness to work long hours under unfavorable conditions have contributed immensely to the continuity and overall success of these surveys.

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 state-wide programs. Dependability and accuracy of this method is based primarily on two factors. One factor is relationship to tag and recovery studies on selected streams. In a tag and 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. The other factor is 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 them 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 their individual reports. Marine Resources Branch served as liaison between Regions to assure uniformity of methods. The Branch also 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
Donald Weidlein - Region 1

This survey began October 4, 1966 and ended January 25, 1967.

Fall Run

Salmon spawning stock surveys in Region 1 required special consideration during 1966-67. This was due to the newly completed Red Bluff Diversion Dam and the beginning of fish counts at the dam early in the fall of 1966. We wanted to determine whether or not the Red Bluff Diversion Dam was blocking some of the upstream migrating salmon. We also wanted to be consistent with past years in order to compare our estimates with counts at the dam.

Salmon are migrating past the Red Bluff Dam and spawning in the Upper Sacramento River almost every month of the year. Counts at the dam will provide us with the number of fish passing this point at various periods of time. Our population estimates are based on dead fish counts, and are primarily for fall-run stocks. We hope to be able to separate out, with a fair degree of accuracy, fall-run fish from counts at the dam and then compare them to our population estimates based on carcass recoveries. These counts can also be used to make adjustments in our estimates for past years.

Spot checks were made in the main stem Sacramento River for spawning salmon and carcasses during last two weeks of September. Only an occasional spawning salmon was seen during this period. These were probably spring-run fish.

Flow releases from Keswick Dam were 7,500 cfs at the beginning of the survey period. Releases increased to 14,000 cfs by the last of November, then peaked at 52,000 cfs on December 8. The flow slowly decreased to 15,000 cfs and remained there until the end of December. It was then slowly reduced to a low of 4,000 cfs on January 12, 1967. The flow remained at this low level until the end of the survey period. Recovery conditions were good at the beginning of the survey, but turbid water was the rule after the first of December.

To estimate the 1966 fall-run salmon population, we computed the recovery rates which is the ratio of carcasses recovered to total estimated population for

the years 1959 to 1966. Table 1 shows this variation in recovery rates by river sections which reflects variation in recovery factors over the past seven years. Using this data, an appropriate recovery rate was computed for the 1966 season. We first corrected the historical average carcass recovery rate by the number of counting trips made in 1966 (obviously a higher percentage of carcasses should be counted when more counting trips are made and vice versa). We then made corrections for timing of the counting trips (more weight is given for trips made during peak of the run). The recovery rate was further corrected to compensate for the 1966 recovery conditions (turbidity, flow, etc.) that were different from historical average conditions. In the 1966 season recovery conditions were estimated to be slightly poorer than average by about 5 percent. Table 1 lists the fully adjusted recovery rates which were used to estimate the 1966 spawning population.

Based on data from the 1966 carcass recovery survey, there was no indication that the Red Bluff Diversion Dam adversely affected the Sacramento River fall-run spawning population. In the spawning area below the dam, we did not find an increase in dead salmon that might have been expected if some salmon were not passing the dam. The ratios of spent to part-spent and ripe carcasses in these two sections were about the same as in past years and were comparable to recoveries in areas above the dam. However, recoveries were not large because of high flows. Evaluation of effect of the dam on the salmon migration should be continued for a few more years.

On November 10, 1966, an aerial flight was made of the 80-mile stretch of river from the Anderson Cottonwood Irrigation Diversion Dam at Redding to the Squaw Hill Bridge just below the mouth of Deer Creek. Purpose of the flight was to record king salmon spawning areas, count live fish, and locate concentrations of carcasses. Weather was partly cloudy and visibility was fair-to-good; tributary streams were low and clear as the first heavy fall rains had not yet occurred.

During this flight, no concentrations of live salmon were observed just below the Red Bluff Diversion Dam and no evidence of concentrated spawning activity was noted in the spawning riffles downstream from the dam. Counts of live fish, with stream miles from Keswick Dam in parentheses, are shown in Table 2. These counts should not be interpreted as a total number of spawners in the river but rather an indication of where the major areas of spawning activity occurred.

Concentrations of carcasses were located in three areas on this flight: In the Kutrass Lake area, five to six stream miles from Keswick Dam; just below the Anderson Bridge, 19 stream miles from Keswick Dam, and at the mouth of Cow Creek, 22 stream miles from Keswick Dam.

During the flight, we mapped redds in the area from the Anderson Cottonwood Irrigation Diversion Dam at Redding to Red Bluff. These were plotted on a map for comparison with data collected in the 1964 season. Salmon spawning areas were about in the same locations both years with the exception of the area now inundated at the upper end of Red Bluff Lake.

Carcass recovery was terminated during the last part of January 1967 due to lack of personnel to carry on the survey. Recovery increased slightly during January, and we observed considerable spawning activity during the month.

There were 2,164 salmon carcasses examined on the main stem Sacramento River between Keswick Dam and Squaw Hill Bridge. The estimated number of spawners was 115,000 (114,981); this includes 3,981 fish trapped at Keswick Dam and trucked to Coleman Hatchery (Table 7).

Spring Run

No separate estimate of the spring run was made. An unknown but small number of these fish may have been included in the fall-run count.

SACRAMENTO RIVER TRIBUTARIES NORTH OF CHICO CREEK (Figure 1)

by

Donald Weidlein, Millard Coots, and Terrance Healey - Region 1

The survey period was from October 10, 1966 to January 13, 1967.

Fall Run

As an aid in estimating the fall-run salmon populations in the upper Sacramento River tributary streams, we computed the percent of carcasses recovered to total estimated population to get recovery rate in each stream for years 1959 to 1966. Table 3 shows variation in recovery rates which reflects variation in recovery factors over past seven years. This information along with information on Clear Creek tagging study was used to estimate population for 1966 season.

Clear Creek

Fall Run

The flows in Clear Creek ranged from 39 to 55 cfs early in the fall at Igo Gaging Station. Between mid-November and mid-December, the 100 cfs releases from Whiskeytown Dam were significantly augmented by inflow from tributary streams below the dam as a result of heavy rain in this period. A maximum mean daily flow of 837 cfs for the season was recorded on December 5 at the Igo Gage.

The population estimate of fall-run kings was determined by a carcass tagging technique that was developed on the Kalama River (Wendler and Junge 1955), a tributary to Columbia River. Carcass tagging commenced on November 22 and continued each successive week to December 20. The tags were colored plastic strips which were secured to the jaws of the fish with hog rings. A different colored tag was used during each period of tagging. The lower six and one-half miles of stream below Saeltzner Dam was surveyed. The basic procedure was to tag every untagged carcass observed. The tagged carcasses were released in the current for subsequent relodgment. Recovered tagged carcasses were cut in half to avoid duplication in following surveys.

Table 4 presents tagging and recovery data for this study. Two-hundred-thirty carcasses (107 females, 104 large males, and 19 grilse) were tagged and 77 tagged carcasses were recovered. No attempt was made to recover carcasses on the last trip (black tags) due to general deteriorated condition of carcasses and lack of live fish in the stream after this period. On December 22, only three live salmon and 15 carcasses were observed below Saeltzner Dam on an aerial flight; no salmon were seen in the 11.5 mile stretch of stream between Whiskeytown Dam and Saeltzner Dam.

The fundamental assumption of the "Kalama River" method is that the recovery rate for the fish tagged at the beginning of any period is representative of the recovery rate on the fish dying during that period. The number of fish dying in any period was estimated (Table 5) by dividing the number of untagged fish taken at the end of the period by the recovery rate (percent recovered) of the tagged group released at the beginning of the period. No recovery rate was available for the fish dying before the first survey (November 22). Since the recovery conditions on November 22 were considered much poorer than those on November 29 when the tag recoveries indicated a 59.7 percent recovery rate, the recovery rate on the first survey was estimated at 25 percent.

From the tagging study, the population was estimated to be 744 fish during the survey period (Table 5). However, observation of the stream showed that salmon had spawned and died both before and after the tagging period. Most of these fish would not have been included in the tagging study. We, therefore, estimated the Clear Creek fall run was about 900 fish. Thus, the survey crews saw in effect 25.6 percent of the estimated population in five survey trips.

The 1966 recovery rate, estimated for Clear Creek, is lower than the estimate would have been without the tagging study. We, therefore, believe that previous estimates under controlled flow conditions were somewhat low and should be adjusted upward. The 1966 fall spawning population is one of the smallest on record since 1959. In past years, Clear Creek has received plants of salmon from the Coleman National Fish Hatchery, but the anticipated build-up of the run has not occurred.

The spawning potential of lower Clear Creek has degenerated over the past few years. Only three spawning riffles were noted in the lower two and one-half miles of stream this season. Loss of spawning grounds in this area can be attributed at least, in part, to gravel removal operations which have been moving upstream. Loss of spawning habitat downstream from Whiskeytown Dam is quite evident when present conditions are compared to the spawning gravel survey by Warner and Slater in 1956. This deterioration, resulting from sand deposition and encroaching vegetation in the stream channel, appears to be, in part, an aftereffect of the construction of Whiskeytown Dam.

Five survey trips were made on Clear Creek and 230 carcasses examined. An estimated 900 fall-run salmon spawned in the lower seven miles of Clear Creek below McCormick-Saeltzer Dam (Table 8).

Spring Run None.

Cow Creek

Fall Run

Two carcass recovery surveys were made by ground crews on Main Cow, South Cow, Old Cow, and North (Little) Cow creeks. These trips were made on various sections of the streams from November 30, 1966 to December 27, 1966, and recovery conditions ranged from poor to good.

An aerial survey of the Cow Creek drainage was made on December 16, 1966. The weather and water were clear. We counted 17 dead and 61 live salmon in Main Cow, two dead and seven live salmon in South Cow (no salmon were counted above the section surveyed by the ground crew), 41 dead and 61 live salmon in North

Cow (of these salmon, 33 dead and 48 live were above the section surveyed by the ground crew), 13 dead and 13 live salmon in Oak Run Creek (no ground surveys were made in Oak Run Creek), and no salmon in the lower 5 miles of Clover Creek. It, therefore, appears that about half of the salmon run occurred in sections not surveyed by the ground crews. This was taken into account when the spawning population was estimated.

Two survey trips were made on Cow Creek and 227 carcasses were recovered. An estimated spawning population of 7,600 fish was based on ground and aerial observations (Table 8).

Spring Run
No estimate.

Bear Creek

Fall Run

Ground surveys were made on Bear Creek on November 25, 1966 and January 6, 1967. The first trip was made from one mile above Dersch Road to the mouth, and the second trip was made from the Highway 44 Bridge to the mouth. Water conditions were low and clear on both trips.

On December 16, 1966, an aerial flight was made from Dersch Road to the mouth. Seven dead and 23 live salmon were counted. Both water and weather conditions were clear during the count.

Two survey trips were made on Bear Creek, and 42 carcasses were recovered. The run was estimated to be 400 fish (Table 8).

Spring Run
No estimate.

Cottonwood Creek

Fall Run

Low flows at the mouth prevented most salmon from entering Cottonwood Creek until the last part of November even though there were heavy rains during part of the month and good flows in upper sections of the stream. For example, the main stem of Cottonwood Creek had been rising for about a week before an increase in flow was noticed at the mouth of the South Fork. This fork had previously been dry with the exception of a few isolated pools of water. From about mid-November to mid-December, the water was very turbid.

Ground surveys began on December 20, 1966, and terminated on January 19, 1967. Recovery conditions improved steadily throughout the survey period. During the last survey, 64 dead and 50 live salmon were counted, indicating that spawning was still in progress.

On December 22, 1966, an aerial flight of Cottonwood Creek was made. At this time, a large percentage of live fish was observed above the sections on Cottonwood Creek that were surveyed by the ground crew (Table 6).

Three survey trips were made on South Fork, Middle Fork, and Main Fork of Cottonwood Creek; two trips were made on North Fork. On these trips, 162 carcasses were recovered. An estimated spawning population of 2,900 fish was based on aerial and ground observations (Table 8).

Spring Run - No estimate.

Paynes Creek

Fall Run

The only ground survey on Paynes Creek was made on December 31 from Lassen Trout Farm to Coleman Power Transmission Line crossing near Hog Lake; the stream was low and clear. On this trip five live salmon were counted.

An aerial survey was made on December 16 when water and weather conditions were clear; five dead and 18 live salmon were counted.

One survey trip was made on Paynes Creek and 24 carcasses recovered. An estimated spawning population of 300 fish was based on ground and aerial observations (Table 8).

Spring Run - None.

Battle Creek

Fall Run

The first carcass recovery trip on Battle Creek was made on October 10, 1966, and the last on January 13, 1967. Battle Creek is still essentially one riffle extending from a short distance below Coleman Hatchery to a point about one mile below the Jellys Ferry Road Bridge. This is a result of Corps of Engineers channelization work done in the summer of 1965. This three-mile section includes almost all of the spawning area in Battle Creek. There are only six shallow pools left in this section. Salmon spawning is fairly well distributed throughout this three-mile section. Water was clear and recovery conditions excellent on six of the nine trips; on two trips, the water was murky and on one trip it was muddy.

Salmon spawned at Coleman hatchery were obtained from one trap at the hatchery and another at Keswick Dam. This season, about 10 percent of these fish escaped into Battle Creek. This made it necessary to subtract about 10 percent of the estimated number of fish spawning naturally below the hatchery as they were already included in the Keswick and hatchery counts.

Nine survey trips were made on Battle Creek and 1,473 carcasses recovered. The run was estimated to be 3,300 fish including 900 fish taken at Coleman hatchery (Table 8).

Spring Run - No estimate.

Antelope Creek

Fall Run

Two survey trips were made on Antelope Creek - the first on December 14 and the second on December 31, 1966. The water was clear and relatively low on both trips.

Twenty carcasses were recovered. The fall run was estimated to be 200 fish (Table 8).

Spring Run - No estimate.

Mill Creek

Fall Run

The first ground survey on Mill Creek was made on December 7 and a second one was made on December 29, 1966. The water was slightly turbid on the first

trip and clear on the second one. The stream was surveyed from one mile above Clough Dam to the Sacramento River.

On December 16, an aerial survey was made of Mill Creek. The water was clear and in spite of foggy weather, we counted 14 dead and 10 live salmon.

Two survey trips were made on Mill Creek and 46 carcasses recovered. The run was estimated to be 500 fish (Table 8).

Spring Run - No estimate.

Deer Creek

Fall Run

The first ground survey was made on December 15 and 16, and the second survey on December 28, 1966; water was clear on both trips; area covered was from the diversion dam in section 22 to Highway 99E Bridge, a distance of about eight miles.

On December 16, an aerial survey was made of Deer Creek. Eight dead and 15 live salmon were counted in essentially the same section covered by the ground crew.

Two survey trips were made on Deer Creek; 22 carcasses were recovered. The run was estimated to be 100 fish (Table 8).

Spring Run - No estimate.

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

by
William White - Region 2

The survey period was from September 27, 1966 to January 12, 1967.

Chico Creek

Fall Run - No estimate made.

Spring Run

One survey trip was made on Chico Creek from Ponderosa Way to Higgins Hole. Seven live fish were observed in Higgins Hole and two redds were located in the first riffle below the pool. Based on this survey, the population of spring-run fish was estimated to be 50 fish (Table 9).

Butte Creek

Fall Run - None.

Spring Run

The peak of spawning occurred about the beginning of the fourth week in September. Two aerial and two ground surveys were made on Butte Creek; 28 carcasses were recovered from Centerville Powerhouse to Paradise Highway Bridge. Spawning population was estimated to be 80 fish, which is the poorest spawning run on record in Butte Creek.

Feather River

Fall Run

Heavy rains made flows high and muddy from shortly after the peak of spawning until the end of the season, making carcass recovery extremely difficult.

Six survey trips were made on the Feather River between Oroville and Honcut Creek, and 381 carcasses were recovered. Estimated spawning population in this section was 19,000 fish. There were 1,850 fall-run salmon transported above Oroville Dam. The total fall run was estimated to be 20,850 fish.

Spring Run

The number of spring-run salmon hauled above Oroville Dam was 297 fish. This was the last season for transporting salmon above Oroville Dam.

The total fall-run and spring-run salmon in the Feather River was estimated to be 21,100 (21,147) fish (Table 9).

Yuba River

Fall Run

High and muddy water throughout most of the season made carcass recovery very difficult and also made anything better than a crude estimate impossible.

Five survey trips were made on the Yuba River, and 78 carcasses were recovered. The estimated spawning population was 7,800 fish (Table 9).

Spring Run

No estimate was made.

American River

Fall Run

At the beginning of the survey, flows were about 500 cfs, increasing to over 10,000 cfs in mid-season, then dropping down to 1,700 cfs. Visibility was very good during much of the season. The crew recovered a few kokanee salmon carcasses below Nimbus Dam this season.

Nine survey trips were made and 4,319 king salmon carcasses were recovered from the Nimbus Racks to Watt Avenue Bridge. The estimated spawning population in this section was 17,200 fish. Above Nimbus Racks 1,116 carcasses were recovered for a population estimate of 1,400 fish. Adding to the above estimates the 8,096 fish that entered Nimbus Hatchery, the total American River spawning population was estimated to be 26,700 (26,696) fish (Table 9).

Spring Run - No estimate was made.

Other Sacramento River Tributaries, South of Chico Creek

Tributaries to Natomas East Drain and Natomas Cross Canal

Fall Run

Two survey trips were made on Secret Ravine, Miner's Ravine, Antelope Creek, Auburn Ravine, Doty Ravine, and Coon Creek; no carcasses were recovered, and very few redds were seen. No estimate of spawning population was made.

Spring Run - None.

LOWER SAN JOAQUIN RIVER TRIBUTARIES
(Figure 3)

by
William White - Region 2

The survey period was from December 14, 1966 to January 10, 1967.

Cosumnes River

Fall Run

Recovery conditions were good throughout most of the survey period. Three survey trips were made from Michigan Bar Bridge downstream to Meiss Road Bridge, and 151 carcasses recovered from an estimated spawning population of 600 fish (Table 10).

Spring Run - None.

Mokelumne River

Fall Run

Repairs to Woodbridge Dam and fishway presented several problems to the upstream salmon migration in 1966. Because fish could not get over the dam early in the season, a trap was installed in the river about three miles below the dam at the Steffon Ranch. On November 10, the trap in the fishway of the dam was put into operation and the trap at the Steffon Ranch was removed. Most of the female salmon and a few males were hauled from the trapping sites directly to Mokelumne River Spawning Channel. During the season, about 20 females and most of the males were released just above the dam to continue their journey upstream. Releasing most of the males at the dam facilitated handling of the fish. This was done only after it was found that a sufficient number of them would make a fast journey to join the females that had been hauled to the channel.

Total count in the Mokelumne River was 689 fish (Table 10).

Spring Run - None.

UPPER SAN JOAQUIN RIVER TRIBUTARIES
(Figure 3)

by
Jerry Goertzen - Region 4

The survey was started on November 7, 1966 and terminated on January 18, 1967.

Stanislaus River

Fall Run

The salmon run in the Stanislaus River was later this year than last, probably because of a low flow (about 60 cfs) in the river early in the season. We counted a high proportion of live fish and redds during the early part of the spawning season when water was low and clear. The flow had slowly increased to 200 cfs by the end of November. By the third survey trip, heavy rains had caused high muddy water, and we could not make accurate live fish or redd counts again until the last survey. The flow peaked at 4,000 cfs on December 6. By the time we made the last survey trip, flows had been reduced to 200 cfs which helped to increase carcass recovery efficiency. No spawning activity was observed on the last survey trip.

A trap for capturing adult salmon was installed and operated by Region 4 personnel just below the Orange Blossom Bridge again this year. The trap was put into operation on October 18, 1966. On December 3, the facility was removed when high flows, caused by heavy rains, threatened to wash it out. During the time the trap was being operated, most salmon spawning activity took place from the trap site downstream to Riverbank. A few salmon escaped the trap and were joined by some surplus males that were released above the trap.

Most of the salmon seen on the spawning grounds from the trap site upstream to Goodwin Dam while the trap was being operated were small males. Salmon were entering the trap the day the facility was being removed; rising water was evidently attracting the fish upstream at the time. After the trap had been removed, salmon moved into the spawning area above the trap site; several large females were observed between the trap site and Knights Ferry.

Water plants continue to be a major problem, especially in the lower spawning area. Water plants grow on the riffles during low summer flows. During fall and winter flows, the plants filter out sediment which fills the interspaces of gravel beds. This problem is increased even more in the spawning area between Oakdale and Riverbank because of the Standard Materials gravel operations in the river. Almost all spawning gravel in the river below their operations has been covered with silt and eliminated for spawning purposes.

Very little poaching was noted this season in the Stanislaus River.

Five survey trips were made on the Stanislaus River; 216 carcasses were examined. The population was estimated to be 2,872 fish of which 272 were trapped at the weir near Orange Blossom Bridge (Table 10).

Spring Run - None.

Tuolumne River

Fall Run

The first salmon of the 1966 season were reported seen near Modesto by fishermen on October 25.

During the first run of the river (November 8-11), most of the salmon observed were still moving upstream, except for a few which had just started spawning. The run was about a week later than last year, probably due to lower attraction flows in October of this year.

The flow was about 600 cfs on October 19 and did not vary much until the heavy rains the first week of December. By December 9, the flow had increased to about 7,000 cfs, then decreased gradually to about 800 cfs by early January. The flow fluctuated daily, and on occasions the flow releases were "shut off" completely at Don Pedro Dam when there was no power demand.

Visibility in the river was generally good at both beginning and end of the season; however, water was too high and murky during the spawning peak to obtain a complete count of redds.

Carcass recovery was more successful on the last two trips when the flow dropped to 800 cfs. Most spawning seemed to be completed by the first of January; however, on the last trip (January 16-18, 1967), we observed some fresh-run salmon on new redds but could not determine if this was the start of another run or just a few late spawners.

Willows and alders continue to be a major problem, especially from La Grange downstream to Roberts Ferry Bridge. The willows are encroaching more and more on riffles, causing a shift in the river channel. From Rairden's Farm to Reed Rock Plant, elodea and other water plants are growing in most of the spawning gravel, creating other problems. When the flow was increased, large amounts of plant material broke loose from the bottom and washed against the willows. This "pileup", in combination with high flows, causes the river to change direction and in some places washes away good spawning gravel. Recovery of carcasses was difficult because many of them were covered with plant growth. There were no water hyacinths in the spawning area this season, but they were very abundant in the river below. During the high flow period in December, hyacinths piled up against bridges, blocking large surface areas of the river, but there was no apparent hindrance to the salmon migration. "Pileups" were physically removed where they presented a hazard to bridges.

Some poaching occurred in the Tuolumne River this year when the flow was severely reduced during periods of little or no power demand. Most of the flow-drop occurred on weekends in November when spawning was heaviest.

Six survey trips were made on the Tuolumne River and 365 carcasses were examined from an estimated spawning population of 5,100 fish (Table 10).

Spring Run - None.

Merced River

Fall Run

The Merced River spawning run this season was small, probably because the flow was too low to attract salmon upstream. The flow at the lower end of the spawning area ranged from 21 to 95 cfs during the season; most of this was return water from Ingalsbe Slough. The flow at Cowell Island (2.5 miles above Shaffer Bridge) was only 3 to 5 cfs. Visibility was good most of the season except below the Turlock Rock Plant (2 miles below Shaffer Bridge). About an equal number of fish spawned in the river from McSwain to Shaffer bridges as from Shaffer Bridge to one-mile upstream. Salmon could use only about one mile of river above McSwain Bridge because low flows and beaver dams blocked their migration.

Water primrose and elodea are still a problem in the river, especially with low flows this season. In some places the water plants extended from bank to bank.

There was no evidence of poaching in the Merced River this season.

Three survey trips were made on the Merced River, and four carcasses were examined from an estimated spawning population of 45 fish (Table 10).

Spring Run - None.

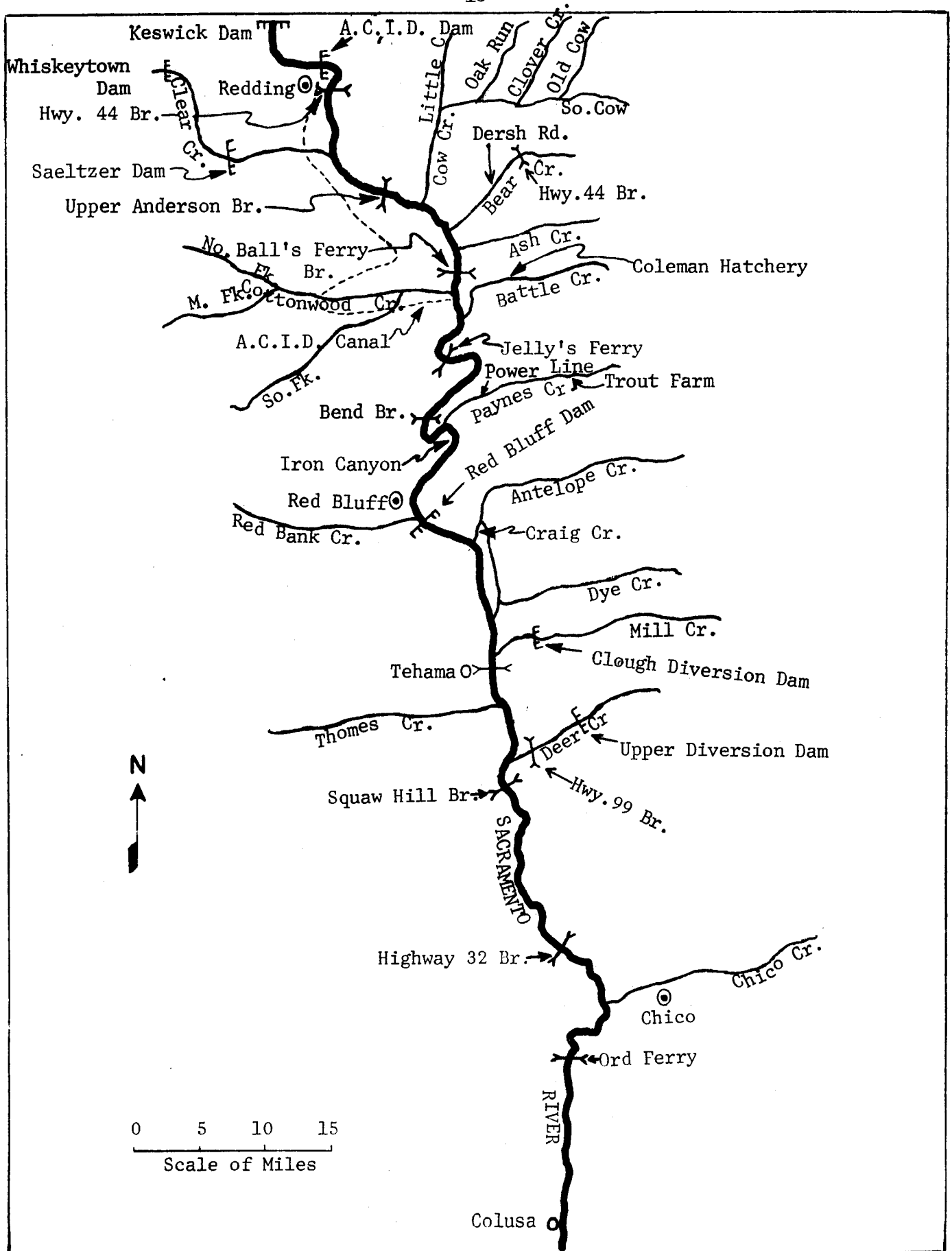


Figure 1. Upper Sacramento River and Tributaries above Chico Creek covered during the 1966 King Salmon Spawning Survey.

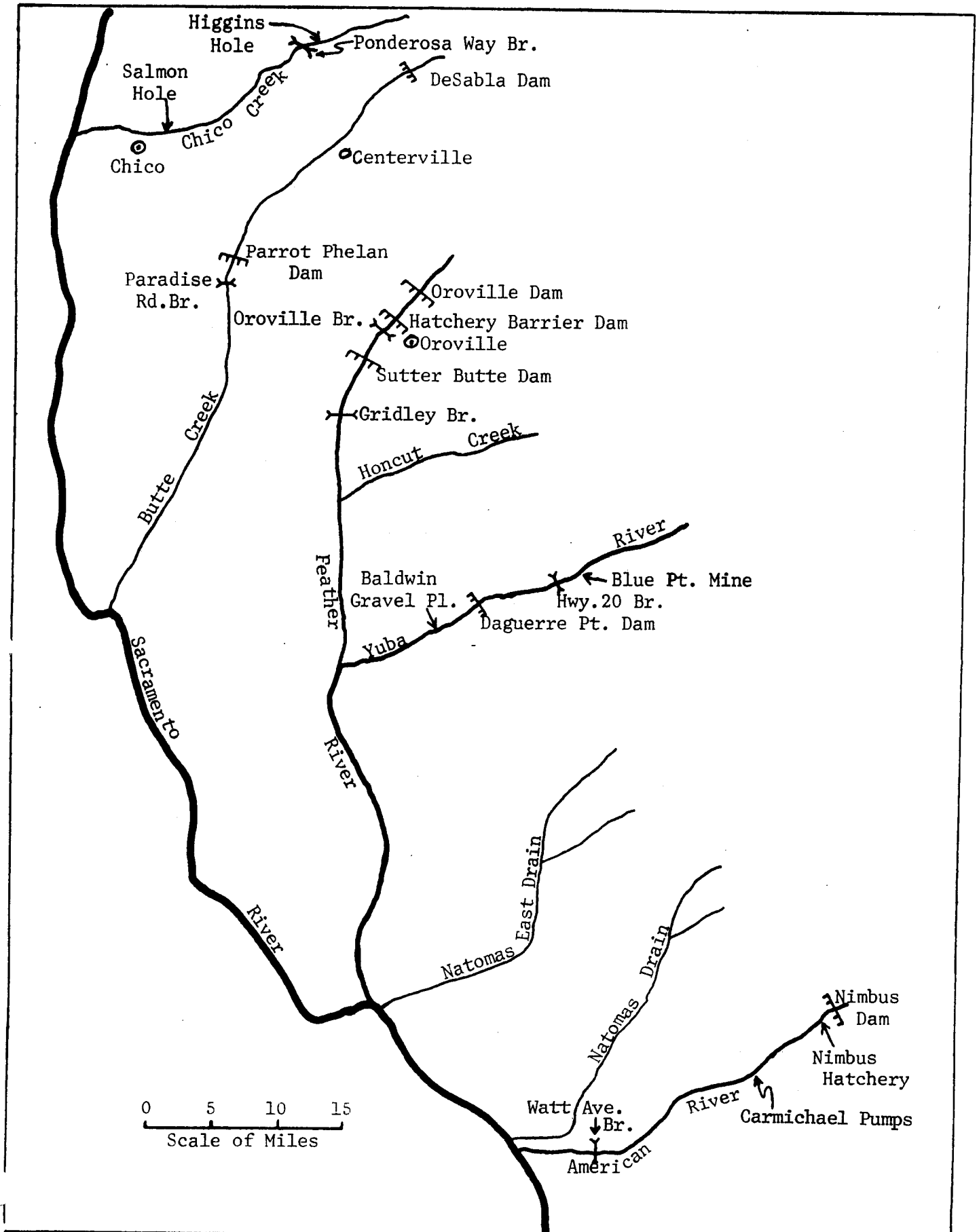


Figure 2. Sacramento River Tributaries from Chico Creek, south, covered during the 1966 Spawning Area Survey.

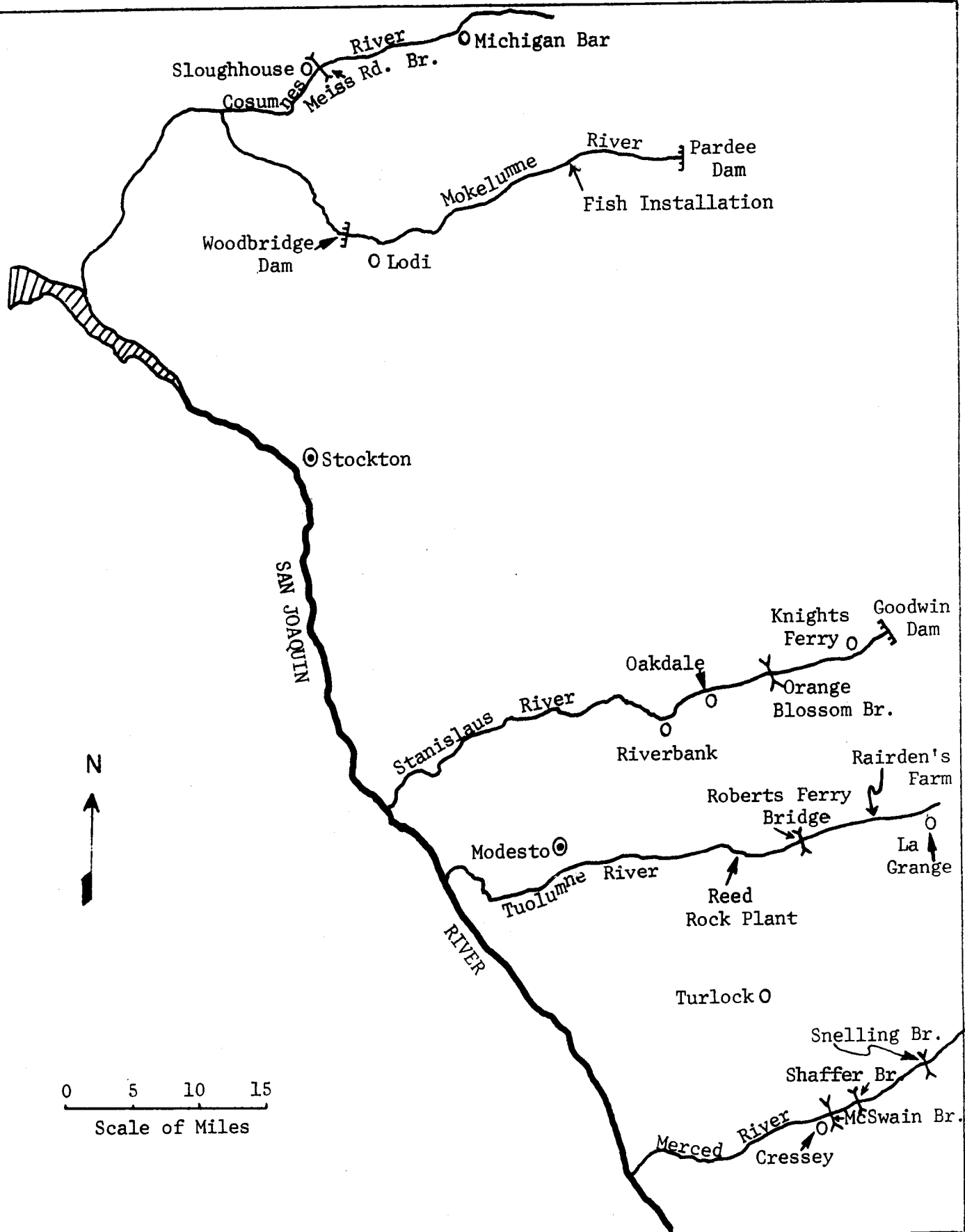


Figure 3. San Joaquin River Tributaries covered during 1966 Spawning Area Survey.

APPENDIX

TABLES 1 - 6 Other than spawning stock estimates.

TABLES 7 -12 Spawning Stock Estimates.

TABLE 1

Percent of Carcasses Recovered to Total Estimated Population and
Number of Counting Trips Made on Main Stem Sacramento, by Sections. 1959 to 1966*

| River sections | 1959 | | 1960 | | 1961 | | 1962 | | 1963 | | 1964 | | 1965 | | 1959 to 1965 Average Annual | | 1966 | |
|--|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|--------------------------------|-----------------------------|----------------------------|-----------------------------|
| | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips |
| A.C.I.D. to Hwy. 44 Bridge | 5.0 | 14 | 4.9 | 13 | 4.0 | 16 | 1.9 | 15 | 3.6 | 14 | 3.1 | 7 | 2.7 | 11 | 4.0 | 12.9 | 2.4 | 10 |
| Hwy. 44 Br. to Upper Anderson Bridge | 3.9 | 14 | 3.2 | 12 | 2.1 | 14 | 1.1 | 15 | 2.1 | 14 | 1.8 | 7 | 2.0 | 11 | 2.6 | 12.4 | 1.7 | 10 |
| Upper Anderson Bridge to Balls Ferry | 4.0 | 13 | 3.3 | 12 | 2.9 | 14 | 1.4 | 13 | 2.9 | 14 | 3.2 | 7 | 7.2 | 10 | 3.5 | 11.9 | 2.7 | 10 |
| Balls Ferry to Jellys Ferry | 2.0 | 12 | 1.5 | 11 | 1.3 | 12 | 0.6 | 12 | 1.5 | 14 | 1.1 | 7 | 0.9 | 10 | 1.3 | 11.1 | 1.1 | 9 |
| Jellys Ferry to Bend Br. | 0.25 | 4 | 1.1 | 4 | 0.4 | 4 | 0.3 | 6 | 0.4 | 4 | 0.9 | 6 | 0.2 | 4 | 0.5 | 4.6 | 0.7 | 6 |
| Bend Bridge to Red Bluff ** | 0.5 | 4 | 0.5 | 4 | 0.7 | 5 | 0.4 | 5 | 0.6 | 4 | 0.6 | 3 | 2.3 | 4 | 0.6 | 4.1 | 1.3 | 4 |
| Red Bluff to Tehama Br. | 0.7 | 7 | 0.8 | 6 | 0.2 | 7 | 0.8 | 7 | 1.0 | 4 | 0.6 | 2 | 2.1 | 3 | 0.7 | 5.1 | 1.0 | 5 |
| Tehama Br. to Squaw Hill Br. | 0.5 | 5 | 0.4 | 3 | 0.2 | 5 | 1.0 | 5 | - | 0 | 1.3 | 2 | - | 3 | 0.7 | 3.3 | 0.8 | 5 |

* Data from annual Marine Resources Administrative Reports 6/1/60, 62-1, 62-5, 63-3, 64-3, 65-2, and 66-6.

** Until 1964, this section was conducted from Bend Bridge to Red Bank Creek, which is approximately 1 mile below Red Bluff.

TABLE 2

Number of Live King Salmon Counted on an Aerial Flight on
November 10, 1966 - Main Stem Sacramento River

| From | | To | | Number of live spawners |
|-------------------|----------------------------|-------------------|----------------------------|-------------------------------|
| Location | Miles below Keswick Dam | Location | Miles below Keswick Dam | |
| A.C.I.D. Dam | (3.2) | Wintu Pumps | (5.2) | 316 |
| Wintu Pumps | (5.2) | Hwy. 44 Bridge | (7.3) | 417 |
| Highway 44 Bridge | (7.3) | Clear Creek | (12.8) | 482 |
| Clear Creek | (12.8) | Churn Creek | (17.5) | 221 |
| Churn Creek | (17.5) | Cow Creek | (22.0) | 173 |
| Cow Creek | (22.0) | Cottonwood Creek | (28.5) | 52 |
| Cottonwood Cr. | (28.5) | Battle Creek | (31.6) | 22 |
| Battle Creek | (31.6) | Big Bend Bridge | (44.6) | 110 |
| Big Bend Bridge | (44.6) | Red Bluff Lake | (52.0) | 1 |
| Red Bluff Dam | (59.0) | Squaw Hill Bridge | (84.0) | 119 |
| Total | | | | <u>1,913</u> |

TABLE 4

Clear Creek Tagging and Recovery Data by Weekly
Periods - November 22 to December 20, 1966.

| Date fish were tagged | Color of tag | Number of fish tagged | Number of tags recovered the week following |
|--------------------------|--------------------|-----------------------------|---|
| November 22 | Red | 57 | 34 |
| November 29 | Pink | 57 | 9 |
| December 6 | Blue | 35 | 20 |
| December 13 | Green | 54 | 14 |
| December 20 | Black | 27 | - |
| Totals | | 230 | 77 |

TABLE 3

Percent of Carcasses Recovered to Total Estimated Population and
Number of Counting Trips Made on Northern Sacramento River Tributaries - 1959 to 1966*

| Stream | 1959 | | 1960 | | 1961 | | 1962 | | 1963 | | 1964 | | 1965 | | 1959 to 1965 Average annual | | 1966 | |
|----------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------|-----------------------------------|-----------------------------|----------------------------|-----------------------------|
| | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips | Recovery rate (percent) | Number of counting trips |
| Clear Creek | 8.0 | 4 | 12.9 | 6 | | | 19.8 | 2 | 11.7 | 6 | 28.7 | 3 | 33.7 | 2 | 18.0 | 3.8 | 25.6 | 5 |
| Cow Creek | 6.0 | 3 | 4.0 | 3 | | | | | | | 19.0 | 1 | 16.8 | 2 | 12.8 | 2.2 | 3.0 | 2 |
| Bear Creek | - | 2 | 14.0 | 3 | | | | | | | - | 1 | 16.8 | 2 | 16.5 | 2.5 | 10.0 | 2 |
| Cottonwood Cr. | 20.2 | 4 | 9.7 | 3 | 13.5 | 3 | | | | | 8.3 | 2 | 4.6 | 1 | 13.3 | 2.6 | 5.6 | 3 |
| Battle Creek | 26.9 | 14 | 19.9 | 3 | 15.9 | 12 | 16.0 | 12 | 20.3 | 12 | 13.6 | 7 | 39.6 | 12 | 21.1 | 11.0 | 50.0 | 9 |
| Paynes Creek | | | | | | | | | | | | | - | 1 | - | 1.0 | 7.5 | 1 |
| Antelope Cr.** | | | 6.8 | 4 | | | 14.4 | 2 | 14.0 | 1 | - | 1 | 21.7 | 1 | 13.3 | 2.0 | 10.0 | 2 |
| Mill Creek ** | 8.0 | 4 | 6.1 | 4 | 3.2 | 1 | 10.0 | 3 | 6.2 | 1 | 6.8 | 1 | 6.0 | 3 | 7.3 | 2.4 | 10.0 | 2 |
| Deer Creek ** | 10.0 | 3 | 7.1 | 4 | | | 30.5 | 3 | 9.8 | 1 | 12.0 | 1 | 15.0 | 2 | 19.2 | 2.3 | 20.0 | 2 |

* Data from annual Marine Resources Administrative Reports 6/1/60, 62-1, 62-5, 63-3, 64-3, 65-2, and 66-6.

** Salmon counted at counting stations are not included in these figures.

TABLE 5

Estimate of Spawning Escapement in Clear Creek from the Mouth to McCormick-Saeltzer Dam, from November 22 to December 20, 1966.

| Date | Number tagged | Recovered | | Water** condition | Population estimate | Cumulative estimate |
|---------|---------------|-----------|---------|-------------------|---------------------|---------------------|
| | | *Number | Percent | | | |
| Nov. 22 | 57 | -- | 25.0 | 190 cfs turbid | 228 | 228 |
| Nov. 29 | 57 | 34 | 59.7 | 120 cfs turbid | 95 | 323 |
| Dec. 6 | 35 | 9 | 15.8 | 277 cfs turbid | 222 | 545 |
| Dec. 13 | 54 | 20 | 57.1 | 186 cfs turbid | 95 | 640 |
| Dec. 20 | 27 | 14 | 25.9 | 125 cfs clear | 104 | 744 |

* From previous week's tagging.

** Mean daily flow at the Igo Gage, 11 miles from the mouth.

TABLE 6

Number of Live and Dead Fish Counted on an Aerial Flight on December 22, 1966 - Cottonwood Creek

| Section | Water conditions | Salmon count | |
|--|------------------|--------------|------|
| | | Live | Dead |
| North Fork - Ono to Sullivan Ranch* | Murky | 0 | 3 |
| North Fork - Sullivan Ranch to Mouth** | Murky | 0 | 1 |
| Middle Fork - Bland to Hickman Ranch* | Clear | 0 | 0 |
| Middle Fork - Hickman Ranch to Mouth** | Clear | 14 | 2 |
| South Fork - Oxbow Bridge to Farquhar Rd.* | Clear | 12 | 5 |
| South Fork - Farquhar Rd. to Mouth** | Murky | 0 | 6 |
| Main Stem - Mouth NF to Mouth Main Stem* | Murky | 3 | 3 |

* Above section surveyed by ground crews

** In section surveyed by ground crews.

TABLE 7

Fall-Run King Salmon Counts and Population Estimates
for the Main Stem of the Sacramento River, 1966

| <u>River section</u> | <u>Stream miles</u> | <u>Number of counting trips</u> | <u>Number of carcasses & skeletons counted</u> | <u>Estimated spawning population</u> |
|---|---------------------|---------------------------------|--|--------------------------------------|
| Keswick Dam Fish Trap* | | | | 3,981** |
| Keswick Dam to A.C.I.D. Dam | 4.5 | | | 400 |
| A.C.I.D. Dam to Hwy. 44 Br. | 4.0 | 10 | 858 | 35,700 |
| Hwy. 44 Bridge to Upper Anderson Bridge | 10.5 | 10 | 413 | 24,300 |
| Upper Anderson Bridge to Ball's Ferry | 8.0 | 10 | 601 | 22,300 |
| Ball's Ferry to Jellys Ferry | 9.5 | 9 | 198 | 18,000 |
| Jellys Ferry to Bend Bridge | 8.5 | 6 | 33 | 4,700 |
| Bend Bridge to Red Bluff | 12.0 | 4 | 33 | 2,500 |
| Red Bluff to Tehama Bridge | 15.0 | 5 | 17 | 1,700 |
| Tehama Bridge to Squaw Hill Bridge | <u>14.5</u> | 5 | <u>11</u> | <u>1,400</u> |
| Total Sacramento Main Stem | 86.5 | | 2,164 | 114,981 |

*Keswick trap counts. This count includes fish taken from November 7, 1966 to March 27, 1967.

**About 10% of these fish escaped from Coleman Hatchery into Battle Creek and were recovered by the Battle Creek survey crew. However, the estimate in Battle Creek (below hatchery) has been reduced proportionately to compensate for this escapement, and the count of the number of fish hauled to the hatchery from Keswick Dam remained unchanged.

TABLE 8

King Salmon Counts and Population Estimates
Northern Sacramento River Tributaries (North of Chico Creek)
1966

| Stream or stream section | Number of counting trips | Carcasses and skeletons counted | Estimated Spawning Population | | |
|---|--------------------------------|--|-------------------------------|-------------|--------------|
| | | | Spring run | Fall run | Total run |
| CLEAR CREEK | 5 | 230 | None | 900 | 900 |
| COW CREEK | 2 | 227 | None | 7,600 | 7,600 |
| BEAR CREEK | 2 | 42 | None | 400 | 400 |
| COTTONWOOD CR.(Total) | | 162 | No est. | 2,900 | 2,900 |
| Main Stem | 3 | (71) | | (1,400) | |
| North Fork | 2 | (8) | | (100) | |
| Middle Fork | 3 | (26) | | (300) | |
| South Fork | 3 | (57) | | (1,100) | |
| PAYNES CREEK | 1 | 24 | No est. | 300 | 300 |
| BATTLE CREEK(Total) | | | | 3,300 | 3,300 |
| Coleman Hatchery* | | | | (900)** | |
| Below Hatchery | 9 | 1,473 | No est. | (2,400)*** | |
| ANTELOPE CREEK | 2 | 20 | No est. | 200 | 200 |
| MILL CREEK | 2 | 46 | No est. | 500 | 500 |
| DEER CREEK | 2 | 22 | No est. | 100 | 100 |
| Total, Northern Sacramento River Tributaries | | 2,246 | | 16,200 | 16,200 |

* Based on trap counts from October 17, 1966 to March 27, 1967.

** About 10% of these fish escaped back into Battle Creek.

*** Five-hundred fish were subtracted from the original estimate to get this figure because this number of fish, some hauled from Keswick Dam Fish Trap and some trapped in Battle Creek, had escaped to the river from hatchery holding area. The count of the number of fish at the hatchery remained unchanged.

TABLE 9

King Salmon Counts and Population Estimates

Southern Sacramento River Tributaries (Chico Creek and South)

1966

| <u>Stream or stream section</u> | <u>Number of counting trips</u> | <u>Carcasses and skeletons counted</u> | <u>Estimated Spring run</u> | <u>Spawning Fall run</u> | <u>Population Total run</u> |
|---|---|--|-------------------------------------|----------------------------------|-------------------------------------|
| CHICO CREEK | 1 | 0 | 50 | No. est. | 50 |
| BUTTE CREEK | 2 | 28 | 80 | None | 80 |
| FEATHER RIVER (Total) | | 381 | 297 | 20,850 | 21,147 |
| Oroville Fish Trap | - | - | - | (1,850) | |
| Oroville Bridge to Sutter Butte Dam | (6) | (61) | No est. | (3,000) | |
| Sutter Butte Dam to Gridley Bridge | (6) | (245) | No est. | (12,200) | |
| Gridley Bridge to Honcut Creek | (5) | (75) | No est. | (3,800) | |
| YUBA RIVER (Total) | | 78 | No est. | 7,800 | 7,800 |
| Blue Pt. Mine to Hwy. 20 Bridge | (5) | (11) | No est. | (1,100) | |
| Hwy. 20 Br. to Daguerre Pt. Dam | (4) | (37) | No est. | (3,700) | |
| Daguerre Pt. Dam to Baldwin Gr. Pl. | (4) | (30) | No est. | (3,000) | |
| AMERICAN RIVER (Total) | | 5,435 | No est. | 26,696 | 26,696 |
| Nimbus Racks to Carmichael Pump | (9) | (3,387) | No est. | (13,500) | |
| Carmichael Pump to Watt Ave. Br. | (8) | (932) | No est. | (3,700) | |
| Above Nimbus Racks | | (1,116) | No est. | (1,400) | |
| Nimbus Hatchery | | - | No est. | (8,096) | |
| NATOMAS DRAINAGE | 2 | None | No est. | No est. | |
| Total, Southern Sacramento River Tributaries | | 5,922 | 427 | 55,346 | 55,773 |

TABLE 10

Fall-run King Salmon Counts and Population Estimates*

San Joaquin River Tributaries, 1966

| <u>Stream or stream section</u> | <u>Number of counting trips</u> | <u>Carcasses and skeletons counted</u> | <u>Estimated spawning population</u> |
|--|---|--|--|
| COSUMNES RIVER | | | |
| Michigan Bar to Meiss Road Bridge | 3 | 151 | 600 |
| MOKELUMNE RIVER | | | |
| Woodbridge Dam Counting Station and Lower River Fish Trap | - | - | 689** |
| STANISLAUS RIVER | | | |
| Goodwin Dam to Riverbank | 5 | 216 | 2,872*** |
| TUOLUMNE RIVER | | | |
| LaGrange to Reed Rock Plant | 6 | 365 | 5,100 |
| MERCED RIVER | | | |
| Snelling Bridge to McSwain Bridge | 3 | 4 | 45 |
| Total, San Joaquin River Tributaries | | 736 | 9,306 |

*No spring-run fish entered any of these streams this year.

**Most of these fish were trapped and trucked to Mokelumne River Spawning Channel.

***This includes 272 fish trapped at the weir near Orange Blossom Bridge and spawned at Moccasin Creek Hatchery.

TABLE 11

Sacramento-San Joaquin Valley King Salmon

Spawning Stock Estimates, Major Streams 1953 - 1966

(In thousands of fish)

| Year | Main Stem Sacramento River (a) | Battle Cr. (b) | Butte Cr. (c) | Feather River(a) | Yuba River(b) | American River(b) | Cosummes River(b) | Mokelumne River (b) | Stanislaus River (b) | Tuolumne River(b) |
|---------|--------------------------------------|-------------------|------------------|---------------------|------------------|----------------------|----------------------|------------------------|-------------------------|----------------------|
| 1953 | 408 | 16 | - | 28 | 6 | 28 | 2 | 2 | 35 | 45 |
| 1954 | 276 | 12 | - | 71 | 5 | 29 | 5 | 4 | 22 | 40 |
| 1955 | 231 | 26 | 1 | 87 | 2 | 17 | 2 | 2 | 7 | 20 |
| 1956 | 94 | 21 | 3 | 20 | 5 | 6 | 1 | 0.5 | 5 | 6 |
| 1957 | 68 | 5 | 2 | 11 | 1 | 8 | 1 | 2 | 4 | 3 |
| 1958 | 128 | 29 | 1 | 35 | 8 | 27 | 1 | 7 | 6 | 32 |
| 1959 | 267 | 30 | 0.5 | 80 | 10 | 31 | 0 | 2 | 4 | 46 |
| 1960 | 233 | 24 | 7 | 83 | 20 | 54 | 1 | 2 | 8 | 45 |
| 1961 | 149 | 20 | 3 | 41 | 9 | 25 | - | 0.1 | 2 | 0.5 |
| 1962 | 139 | 13 | 2 | 19 | 34 | 27 | 1 | 0.2 | 0.3 | 0.2 |
| 1963 | 146 | 17 | 5 | 35 | 37 | 41 | 1 | 0.5 | 0.2 | 0.1 |
| 1964 | 148 | 16 | 0.6 | 41 | 35 | 59 | 2 | 2 | 4 | 2 |
| 1965 | 103 | 9 | 1 | 24 | 10 | 39 | 0.8 | 1.3 | 2.2 | 3.2 |
| 1966 | 115 | 3 | 0.1 | 21 | 8 | 27 | 0.6 | 0.7 | 2.9 | 5 |
| Average | 179 | 17 | 2.2 | 43 | 14 | 30 | 1.4 | 1.9 | 7.3 | 18.1 |

(a) Mostly fall-run.

(b) Fall run-only.

(c) Spring run-only.

TABLE 12
Sacramento-San Joaquin Salmon Spawning Stocks

1953 - 1966

(In Thousands of Fish)

| <u>Year</u> | <u>Sacramento Valley</u> | <u>San Joaquin Valley</u> | <u>Grand total Central Valley</u> | <u>Status* (% of Base No.)</u> |
|--------------------|------------------------------|-------------------------------|---------------------------------------|------------------------------------|
| 1953 | 513 | 84 | 597 | 119 |
| 1954 | 412 | 75 | 487 | 97 |
| 1955 | 369 | 31 | 400 | 80 |
| 1956 | 153 | 12 | 165 | 33 |
| 1957 | 102 | 15 | 117 | 23 |
| 1958 | 237 | 46 | 283 | 57 |
| 1959 | 421 | 52 | 473 | 95 |
| 1960 | 415 | 56 | 471 | 94 |
| 1961 | 247 | 2 | 249 | 50 |
| 1962 | 252 | 2 | 254 | 51 |
| 1963 | 301 | 2 | 303 | 61 |
| 1964 | 313 | 10 | 323 | 65 |
| 1965 | 192 | 7 | 199 | 40 |
| 1966 | 187 | 9 | 196 | 39 |
| 14-year average | 294 | 29 | 322 | 64 |

Sources: Marine Resources Branch, Salmon/Steelhead Program, Sacramento.

* Base number is 500,000 fall-run salmon. This quantity will fully utilize available spawning areas. Other runs spawn at different times.