# State of California The Resources Agency DEPARTMENT OF FISH AND GAME

# CHINOOK (KING) SALMON SPAWNING STOCKS IN CALIFORNIA' S CENTRAL VALLEY, 1978

Edited by

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Anadromous Fisheries Branch

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# CHINOOK (KING) SALMON SPAWNING STOCKS IN CALIFORNIA'S CENTRAL VALLEY, 19781/

Edited by

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#### ABSTRACT

This report covers the 26th annual inventory of chinook salmon (<u>Oncorhynchus</u> tshawytscha) spawning populations in the Sacramento-San Joaquin River system. It is a compilation of estimates of fall- and spring-run chinook salmon spawning populations for every stream in the Sacramento-San Joaquin system which supports a significant spawning run, and partial counts of late-fall- and winterrun chinook salmon.

Estimates are made from counts of fish entering hatcheries and spawning channels, fish migrating past dams, carcasses and live fish on spawning areas, and aerial redd counts.

The estimated 1978 escapement of fall-spawning (fall- plus spring-run) chinook salmon in the Central Valley is 165,088 fish. This figure is 57% of the historic (1953-1977) average of 290,000 and is 80% of the 1977 estimate of 205,836.

The total spawning escapement for all runs in the Central Valley was 202,452, which is only 58% of the average spawning escapement goal of 351,000. The lowest runs, in terms of percentage of the escapement goal achieved, were the Sacramento River spring run (27%), the Yuba River fall run (30%) and the San Joaquin River system fall run (30%). The upper Sacramento River fall run, which is the largest contributor to the Central Valley spawning runs, was 58% of the escapement goal.

The decline in 1978 escapement can be partly attributed to low spring flows during 1976 and 1977, which resulted in reduced nursery habitat for juvenile salmon.

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#### INTRODUCTION

This report covers the 26th annual chinook salmon spawning stock inventory for the California Central Valley (Figure 1). The Sacramento-San Joaquin River system, which flows through the Valley, is the principal producer of chinook salmon caught in California's ocean fisheries and also contributes significantly to the ocean fisheries of Oregon and Washington. Spring and fall runs in the Central Valley have been monitored since 1953, while late-fall and winter runs have been monitored since 1971. The four runs are described as follows:

- Late-fall run enters the upper Sacramento River from early November through February and spawns from January through March. These fish are usually larger in size than the fall and winter run fish.
- 2) <u>Winter run</u> enters the upper Sacramento River from early January through mid-June and spawns from April to July.
- 3) <u>Spring run</u> enters the upper Sacramento River from March to July and spawns from late August to early October. Spring-run salmon were once widespread in the Central Valley, but have disappeared from many of the streams they once utilized.
- 4) Fall run enters the upper Sacramento River from July through November and spawns from October through December. Of the four runs in the Central Valley, the fall run is the most abundant and widespread.

Monitoring of salmon spawning escapement in the Central Valley is an important component of the Department of Fish and Game's fishery management effort. A spawning escapement goal of 351,000 salmon has been set for the Central Valley by the Department to ensure that adequate numbers of salmon are allowed to spawn (Hallock 1978; Menchen 1978). Changes in ocean and river fishing regulations depend partly on whether these goals are being met. Specific objectives of the spawning stock surveys are to:

- a) Estimate the size of the spawning runs in Central Valley streams.
- b) Determine spawning distribution to see if any shifts have occurred.c) Recover tagged or marked salmon carcasses to determine the
- contribution of marked fish to river spawning escapement.
- d) Determine size and sex composition of the spawning population.
- e) Note changes in habitat conditions and whether corrective action is necessary to protect spawning habitat.

#### GENERAL METHODS

During 1978, spawning stock data were collected on all Central Valley streams known to support sizeable chinook salmon runs by observing potential spawners passing through fishways, conducting stream surveys where numbers of live fish, carcasses and redds were enumerated, and making aerial redd counts. In some streams, carcasses were tagged and released, and subsequent recovery rates of tagged carcasses were used in estimating spawning populations. The maximum number of survey trips that stream conditions, money and manpower allowed was made on each stream. Unless otherwise stated, all counted carcasses were cut in half or tagged to prevent recounting on subsequent trips. Specific methods and results are presented under individual stream headings.



FIGURE 1. Salmon streams in the California Central Valley.

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#### CHINOOK SALMON SPAWNING POPULATIONS FOR THE SACRAMENTO RIVER SYSTEM

Keswick Dam to Red Bluff Diversion Dam

by

#### Richard J. Hallock Anadromous Fisheries Branch

Spawning population estimates were made for the Sacramento River main stem using fish counts at Red Bluff Diversion Dam (Figure 2). In addition, fallrun estimates were made for three Sacramento River tributaries--Clear, Cottonwood and Battle Creeks--using carcass counts and returns to Coleman Hatchery. Aerial redd counts were conducted to determine spawning distribution in the Sacramento River main stem.

#### Sacramento River Main Stem

Total salmon spawning population estimates for the Sacramento River main stem and tributaries upstream from Red Bluff Diversion Dam were based on U. S. Fish and Wildlife Service daily counts of salmon passing through the Red Bluff Diversion Dam fishways. Observations were made by closed circuit television.

Weekly counts were made by summing the daily counts, but were adjusted for periods when the fishway remained open but no counts were made, such as when the river was turbid, when flood conditions made it necessary to open the gates of the dam, and during night hours. Count adjustments for daytime lapses were made by interpolation, while nighttime adjustments consisted of multiplying the 14-hour day counts by a "night factor" developed from weekly night counts.

The adjusted weekly counts were separated into numbers of late-fall-, winter-, spring-, and fall-run salmon by examining fish entering the trapping facility adjacent to the east bank fishway and estimating when they would spawn by their degree of ripeness. To convert the adjusted numbers of salmon in each of the four runs passing the dam into the numbers that actually spawned, the estimated number of salmon landed by anglers in the Sacramento River between Keswick Dam and Red Bluff was subtracted from each corresponding run. No attempt was made to measure any other forms of mortality in the upper river prior to spawning.

The estimated salmon sport catch was obtained by visiting all fishing resorts once every other week to obtain the number of salmon landed during the previous two weeks. To get the total catch, the resort catch was multiplied by 1.5944, a factor derived from sampling resorts and public boat-launching ramps in the area during the 8-year period, 1967-74. Practically all salmon caught in this section of the river are landed at either resorts or public boat-launching ramps. To break down the total catch into the numbers landed from each of the four runs, it was assumed that salmon from the various runs are caught in proportion to their abundance, as indicated by counts at Red Bluff Diversion Dam.

While a calendar-year count included total annual runs passing the dam for springand fall-run salmon, it represents only part of the total annual runs of late-falland winter-run fish, since both of these runs usually begin in one calendar year and finish in the next. Generally, a calendar-year count of the late-fall run



FIGURE 2. Upper Sacramento River and tributaries above Chico Creek.

will include approximately the latter half of one run during the first part of the year, and the first half of the next late-fall run at the end of the year. The same calendar year will usually include most of a winter run early in the year, and the first small portion of the subsequent winter run at the end of the year. To arrive at the total number of 1978 spawners in these two runs, it was necessary to add the appropriate portion of the 1977 calendar year count and delete that portion of the 1978 count which spawned in 1979.

To obtain the Sacramento main stem spawning population estimates above Red Bluff, estimates for surveyed tributaries were subtracted from the runs passing Red Bluff Dam. All unsurveyed tributaries are included in the main stem estimates.

Late-fall Run. An estimated 12,479 late-fall-run salmon spawned in the Sacramento River main stem above Red Bluff Diversion Dam during 1978 (Table 1), which is 65% of the 1971-77 historical average of 19,167 (excluding 1974 due to inaccurate counts caused by excessive flooding). Included in the 1978 total are 712 salmon trapped at Keswick Dam and transported to Coleman Hatchery for spawning. The estimated sport catch of 107 late-fall-run salmon was subtracted from the 12,586 late-fall-run salmon counted at Red Bluff Diversion Dam from October 30, 1977 to April 15, 1978.

Winter Run. An estimated 24,735 winter-run salmon spawned in the Sacramento River main stem above Red Bluff Diversion Dam during 1978 (Table 1), which is 84% of the 1971-77 historical average of 29,333 (excluding 1974). The estimated sport catch of 127 winter-run salmon landed above Red Bluff was subtracted from the 24,862 winter-run salmon counted at Red Bluff Diversion Dam from December 4, 1977 to July 29, 1978.

> ---

<u>Spring Run</u>. An estimated 5,669 spring-run salmon spawned in the Sacramento River main stem above Red Bluff Diversion Dam during 1978 (Table 1), which is 53% of the 1969-77 historical average of 10,667, the time period when spring and fall runs were separated at Red Bluff Diversion Dam. The estimated sport catch of 234 spring-run salmon landed above Red Bluff was subtracted from the 5,903 spring-run salmon counted at Red Bluff Diversion Dam from March 19 to October 7, 1978.

Fall Run. An estimated 34,320 fall-run salmon spawned in the Sacramento River main stem above Red Bluff Diversion Dam during 1978 (Table 1), which is 64% of the 1969-77 historical average of 53,600. This total includes 2,085 fall-run salmon trapped at Red Bluff Diversion Dam and hauled to the Tehama-Colusa Spawning Channel by the U. S. Fish and Wildlife Service. The estimated sport catch of 674 fall-run salmon landed above Red Bluff and 4,832 fish that spawned in Clear, Cottonwood, and Battle creeks were subtracted from the 39,826 fall-run salmon counted at Red Bluff Diversion Dam from July 16 to December 23, 1978.

#### Spawning Distribution

Five airplane flights were taken from October 18 to December 15, 1978 to determine the general redd distribution in the Sacramento River main stem (Figures 2 and 3). The redd counts showed that 44.5% of the main stem fall spawning activity occurred upstream from Red Bluff Diversion Dam (Table 2), which is lower than the 61.4% average from 1974-77, when redd counts both above and below the dam were conducted. The most heavily used area above the dam was between Balls Ferry and Jellys Ferry.

n cale L977	ndar year <u>1</u> / 1978	spawners (runs)	5	sport catch above dam2/		spawning populations
3,298	+ 9,288	= 12,586	· . . <del>-</del>	107	=	12,479
408	+ 24,454	= 24,862		127	=	24,735
0	+ 5,903	= 5,903	-	234	- =	5,669
0	+ 39,826	= 39,826		674	=	39,152 <sup><u>3</u>/</sup>
0	+ 2,280 <sup>4/</sup>	0		<u>4</u> /	-	0
0	+ 17 <sup><u>4</u>/</sup>	0		<u>4</u> /		0
3,706	81,768	83,177		1,142		82,035
	408 0 0 0 0 3,706	$3,298 + 9,288$ $408 + 24,454$ $0 + 5,903$ $0 + 39,826$ $0 + 2,280^{4/}$ $0 + 17^{4/}$ $3,706 81,768$	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	3,298 + 9,288 = 12,586 - 408 + 24,454 = 24,862 - 0 + 5,903 = 5,903 - 0 + 39,826 = 39,826 - 0 + 2,2804 0 - 0 + 174 0 - 0 + 174 0 - 0 + 174 0 - 0 + 174 0 - 0 + 174 - 0 - 0 + 176 - 0 - 0 + 176 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	$\frac{1977  1978  (runs)}{1978  (runs)} = \frac{1077  1978  (runs)}{above \ dam^2/}$ $3,298 + 9,288 = 12,586 - 107$ $408 + 24,454 = 24,862 - 127$ $0 + 5,903 = 5,903 - 234$ $0 + 39,826 = 39,826 - 674$ $0 + 2,280^{4/}  0 \qquad 4/$ $0 + 17^{4/}  0 \qquad 4/$ $3,706  81,768  83,177 \qquad 1,142$	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$

TABLE 1.	Calculation of Chinook Salmon Runs and Spawning Populati	ions,
	Sacramento River System above Red Bluff Diversion Dam, 1	1978

Includes 2,085 salmon hauled from Red Bluff Diversion Dam to the Tehama-<u>3</u>/ <u>4</u>/

Colusa Spawning Channel. This run started passing the dam late in 1978 but spawned in 1979. Additional salmon will be added to both the spawning run and sport catch in early 1979.



FIGURE 3. Sacramento River tributaries from Chico Creek south.

	Number of	Total	Average of r	number edds
Area	flights	redds	Number	Percent
Keswick Dam to			•	
A.C.T.D. Dam	5	41	8	0.7
A.C.T.D. Dam to				
Highway 44	5	120	24	2.0
Highway 44 to				
Upper Anderson Bridge	5	188	38	3.1
Upper Anderson Bridge to				
Balls Ferry	5	592	118	9.7
Balls Ferry to			11 - C. 2010	
Jellys Ferry	5	925	185	15.2
Jellys Ferry to				
Bend Bridge	5	609	121	9.9
Bend Bridge to				
Red Bluff Diversion Dam	5	237	47	3.9
Red Bluff Diversion Dam to				
Tehama	5	1,835	367	30.2
Tehama to				10.0
Woodson Bridge	5	813	162	13.3
Woodson Bridge to		000	04	
Hamilton City	3	282	94	1.1
Hamilton City to	^	80	20	2 5
Ord Ferry	3	89	30	2.3
Ord Ferry to	•	15	20	1 0
Butte City	2	45	22	1.0
TOTALS		5,776	1,216	100.0
1/		10.10	11 0 11 17	10 1 10 15

# TABLE 2. Estimated Redd Distribution of Fall Spawning Chinook Salmon, Main Stem of Sacramento River above Butte City, Based on Aerial Redd Counts, 1978<u>1</u>/

Flight dates: Keswick Dam to Woodson Bridge, 10-18, 11-2, 11-17, 12-1, 12-15; Woodson Bridge to Ord Ferry, 11-17, 12-1, 12-15; Ord Ferry to Butte City, 12-1, 12-15.

#### Clear Creek

Fall Run. Spawning stock surveys were made on Clear Creek on November 3 and December 29, 1978. Three salmon carcasses were recovered. In addition, eight redds were observed, some of which were probably counted more than once. Based on an estimated carcass recovery rate of 5%, the fall-run estimate was 60 fish, which is only 3% of the 1957-77 historic average of 2,030.

#### Cottonwood Creek

Fall Run. Ten spawning stock survey trips were made on Cottonwood Creek from October 24, 1978 to January 9, 1979. A total of 86 carcasses were recovered from the confluence of the North and Middle Forks to the I-5 highway bridge, and 83 carcasses were recovered from the I-5 highway bridge to the confluence of Cottonwood Creek and the Sacramento River. Based on an estimated 15% carcass recovery rate, the fall runs in the upper and lower portions of Cottonwood Creek were 570 and 550, respectively, totaling 1,120, which is 42% of the 1957-77 historic average of 2,690.

#### Battle Creek

Late-fall, Winter and Spring Runs. Small numbers of all three runs are known to spawn in Battle Creek, but no surveys or population estimates were made during 1978. A total of 712 late-fall-run salmon was hauled from Keswick Dam to Coleman Hatchery and a few entered the hatchery from Battle Creek.

Fall Run. Seventeen spawning stock survey trips were made on lower Battle Creek between Coleman Hatchery and the confluence of Battle Creek with the Sacramento River from September 26, 1978 through January 3, 1979. Five trips were made to Gover's irrigation ditch from November 1 through November 28, 1978. Carcass recovery conditions were generally fair to good throughout the recovery period. A total of 703 carcasses was recovered (668 in Battle Creek and 35 in Gover's ditch). Based on an estimated carcass recovery rate of 40% in Battle Creek and 35% in Gover's ditch, the estimated spawning populations were 1,670 and 100, respectively, totaling 1,770. Adding this figure to the 1,882 salmon that entered Coleman Hatchery brings the total to 3,652 fall-run salmon that spawned in Battle Creek during 1978, which is 29% of the 1953-77 historic average of 12,400.

#### Red Bluff Diversion Dam to Butte City

by

# Richard J. Hallock Anadromous Fisheries Branch

Spawning populations in Sacramento River main stem were estimated by carcass count surveys and aerial redd counts. Carcass count surveys were also conducted on three tributary streams--Antelope Creek, Mill Creek and Deer Creek (Figure 2).

River flows in the Sacramento River main stem during the fall of 1978 were low and fairly constant, ranging from 107  $m^3/s$  (3,800 cfs) in October to 194  $m^3/s$ (6,900 cfs) in December at Red Bluff Diversion Dam. During the majority of the carcass recovery period (early October to mid-December), flows fluctuated between 141 and 170  $m^3/s$  (5,000 to 6,000 cfs). Due to below normal fall precipitation and runoff in the upper Sacramento Valley, low flows existed in many of the tributary streams. Tributaries which normally have small runs of fall-run salmon, such as Salt, Dye and Singer creeks, did not have sufficient flows during the early fall of 1978 to support spawning salmon.

In the larger tributaries, such as Antelope, Mill and Deer creeks, flows were far below normal and fall-run salmon numbers were small or nonexistent. Carcass recovery conditions were generally good.

#### Sacramento River Main Stem

Late-fall, Winter and Spring Runs. While it is likely that some fish from each of these three runs spawned in the main stem, no spawning population estimates were made. Any spring-run spawners are included in the fall-run total.

Fall Run. Between October 11, 1978 and January 3, 1979, 13 spawning stock survey trips were made from Red Bluff Diversion Dam to Tehama. A total of 664 salmon carcasses was recovered. Based on an estimated recovery rate of 2.5%, the spawning population estimate was 26,560. Adding the 2,052 salmon that entered the Tehama-Colusa Spawning Channel via Coyote Creek brings the total to 28,612.

Between October 12, 1978 and January 4, 1979, 13 spawning stock surveys were completed from Tehama to Woodson Bridge and 237 salmon carcasses were recovered. Based on river conditions, the carcass recovery rate was estimated to be 2.5%, which yields a spawning population estimate of 9,480.

While spawning in the area between Woodson Bridge and Butte City is often insignificant, three aerial redd counts in November and December 1978 showed that 12% of the fall main stem spawning below Red Bluff Diversion occurred in this section, or 9,881 fish.

A grand total of 47,973 chinook salmon spawned in the Sacramento River main stem from Red Bluff Dam to Butte City during 1978, which is 265% of the 1956-77 historical average of 18,078.

<u>Spawning Distribution</u>. Five airplane flights were taken from October 18 to December 15, 1978 to determine the general redd distribution in the main stem of the Sacramento River. Redd counts showed that 55.5% of the main stem fall spawning activity occurred downstream from Red Bluff Diversion Dam (Table 2), which is higher than the 38.6% average from 1974-77. The most heavily used area was between Red Bluff Diversion Dam and Tehama.

#### Antelope Creek

<u>Spring Run</u>. Spring-run salmon enter Antelope Creek regularly but the population size is unknown. No population estimate was made.

<u>Fall Run</u>. Several trips to Antelope Creek revealed that flows were insufficient for fall-run spawning. Since 1957, the average run has been 324 fish.

#### Mill Creek

Late-fall Run. A few late-fall-run salmon were observed in Mill Creek during February 1978, but no population estimate was made.

<u>Winter Run</u>. During previous years, small numbers of winter-run salmon have been observed between Ward and Clough dams, usually in June. No population estimate was made in 1978.

Spring Run. Between September 13 and October 10, 1978, eight spawning stock survey trips were made to upper Mill Creek from Highway 36 to Blackrock. A total of 37 carcasses and 76 redds was counted. Based on a 4% recovery rate, the spawning population estimate was 925, which is 54% of the 1953-77 historical average of 1,719.

Fall Run. Between November 17, 1978 and January 4, 1979 eight spawning stock survey trips were made on lower Mill Creek from the Los Molinos Mutual Water Company's upper diversion dam to its confluence with the Sacramento River. Based on a 20% recovery rate and 60 carcasses recovered, the spawning population estimate was 300, which is 16% of the 1953-77 historical average of 1,930.

#### Deer Creek

Spring Run. Between September 15 and October 5, 1978 five survey trips were made from upper Deer Creek Falls to the Ponderosa Way crossing. A total of 48 carcasses and 155 redds was counted. Based on an estimated 4% carcass recovery rate, the spawning population estimate was 1,200, which is 47% of the 1953-77 historical average of 2,533.

Fall Run. Between December 15, 1978 and January 4, 1979 three survey trips were made from the county road bridge, which is located about 3.2 km (2 miles) upstream from the Stanford-Vina Dam, to the confluence of Deer Creek with the Sacramento River. A total of 18 carcasses and 22 redds was counted. Based on an estimated 20% recovery rate, the spawning population estimate was 90, which is 11% of the 1953-77 historical average of 804.

#### Butte Creek to the American River

Salmon spawning populations in the Sacramento River tributaries from Butte Creek to the American River were estimated by counting carcasses, redds, live fish and hatchery returns. Tributaries surveyed were Butte Creek, Feather River, Yuba River and American River (Figure 3).

#### Butte Creek by Richard Flint, Region 2

Flows were constant throughout the winter and spring of 1978. Cool, wet spring weather delayed the onset of the irrigation season. Diversion dams were generally in place by May 1, but major rice field flooding did not begin until mid-May. All fish ladders operated through June.

Late-fall Run. Late-fall-run salmon were reported spawning in Butte Creek upstream from the covered bridge in late January. No spawning population estimate was made. Spring Run. One spawning stock survey on Butte Creek was conducted between Centerville Powerhouse and the Skyway on October 3-4, 1978. Weather and recovery conditions were fair to good, but the spawning peak had occurred prior to the survey. A total of 14 live and 11 dead salmon was counted, yielding an absolute minimum run size of 25 fish. In addition, 49 multiple and 4 single redds were seen. The estimated spawning population was 128, which is 85% of the 1974 parent run estimate of 150, and 11% of the 1955-77 historical average of 1,187.

Fall Run. Only one fall-run salmon was seen during periodic ladder checks. The spawning population was probably less than 20, which is less than 3% of the historical average of 581 taken from 1971-77.

#### Feather River by Richard Flint, Region 2

Spring Run. Spawning stock surveys were conducted in the spawning channel (Moe's Ditch) and the Feather River adjacent to it on October 9 and 23. Two marked carcasses were recovered in Moe's Ditch on October 23. A total of 202 spawners entered Feather River Hatchery. Virtually all spring-run salmon are believed to have entered the hatchery, yielding a total population estimate of 204, which is 17% of the 1954-77 historical average of 1,168.

Fall Run. Carcass counts were conducted weekly in the spawning channel (Moe's Ditch) adjacent to Feather River Hatchery for eight weeks from October 9 to December 4, 1978. In addition, the large spawning riffle near Vance Avenue in the high flow section was checked periodically to determine if there was any major shift in salmon spawning distribution in the river.

A total of 544 carcasses was counted in Moe's Ditch. Based on historical data, about 1/60th of the total Feather River spawning run occurs in Moe's Ditch. Assuming a 100% recovery rate, the total estimated run in the river was 33,000 fish. A total of 4,759 fall-run salmon entered Feather River Hatchery, bringing the total Feather River run to 37,759, which is 85% of the 1953-77 historical average of 44,560. No major shift in spawning distribution occurred this year.

A total of 310 coded-wire-tagged fish was recovered at Feather River Hatchery. Of these, 297 were of Feather River Hatchery fall-run and spring-run origin and 13 were of Mokelumne River Hatchery fall-run origin (Appendix Table 6).

#### Yuba River by Ronald Rogers, Region 2

Fall Run. Eight weekly spawning stock surveys were conducted from October 23 to December 12, 1978 in the following river sections:

- I. Highway 20 Bridge to Daguerre Point Dam.
- II. Daguerre Point Dam to Hallwood Avenue.
- III. Hallwood Avenue to Marysville Dump.

During the week of November 5-11, only Section III was surveyed. A Schaefer model (Schaefer 1951), as modified by Taylor (1974b), was employed in making the population estimate. Male and female carcasses were given distinguishing tags to test relative recovery rates. Only fresh carcasses with clear eyes were tagged.

A total of 2,355 carcasses was recovered--848 in Section I, 1,060 in Section II, and 447 in Section III. Of the 343 carcasses tagged, 130 were recovered for an overall recovery rate of 38%. At the time of tagging, females were 1.6 times more abundant than males, whereas subsequent recoveries yielded 2.2 females for every male, indicating that the recovery rate for females was higher than for males. From all carcasses examined, 31.4% were adult males, 54.4% were adult females, 7.1% were male grilse, and 7.1% were female grilse.

Tag and recovery estimates indicate a run of 6,469 fish from the Highway 20 Bridge to the Marysville Dump (Tables 3 and 4). An additional 27 carcasses were seen on the first tagging period (October 23-24). Expanding this total by the 38% average recovery rate for the season yields 71 carcasses and a grand total of 6,540 for these three river sections.

To estimate the number of fish spawning upstream from the Highway 20 Bridge and during the last half of December, I used data from past years when applicable. In 1974 and 1975, an average of 5% of the run spawned upstream from the Highway 20 Bridge. Also, an average of 8% of the run spawned in the last half of December from 1975-77. Expanding by these percentages yields an estimated total escapement of 7,416, which is 59% of the 1953-77 historical average of 12,640.

American River by Robert Reavis, Region 2

<u>Fall Run</u>. Six spawning stock survey trips were made on the American River from November 15 to December 27. The river was divided into two sections:

I. Nimbus Racks to Rossmoor Bar.

II. Rossmoor Bar to Watt Avenue Bridge.

Both sections were surveyed weekly except for the week of December 18 when equipment breakdown resulted in postponement of the survey for one week. During the survey period, river flows were about 1,250 cfs and water clarity was greater than four feet.

The population was estimated by tagging fresh carcasses and returning them to running water for future recovery. A Schaefer model (Schaefer 1951), as modified by Taylor (1974b), for estimating a changing population was used.

Tag and recovery data with weekly population estimates are summarized in Tables 5 and 6. A total of 1,708 carcasses were recovered, producing a population estimate of 11,400 for these two river sections.

An additional 125 nonfresh carcasses were seen on the first tagging survey (November 15-17). Expanding this total by the 15% average recovery rate for the season yields 833 carcasses, and a grand total of 12,233 for the river below Nimbus Racks.

Above Nimbus Racks, 592 carcasses were recovered which expands to 696, assuming the 85% recovery rate of past years. A total of 8,162 spawners entered Nimbus Hatchery. Combining the river and hatchery estimates yields a total spawning escapement of 21,091, which is 58% of the 1953-77 historical average of 36,240.

	<u>.</u>		-		Tag	ging peri	od (1)	······································		Total tagged	Total fish	
			Oct.	Oct.	Nov.	Nov.	Nov.	Dec.	Dec.	fish recovered	recovered	
			23-24	30-31	8	14-15	20-22	28-29	4-5	(Rj)	(Cj)*	Cj/Rj
Recov	very period	(i)		· ·								
Oct.	30-31		12							12	405	33.75
Nov.	8			1						1	66	66.0
Nov.	14-15		1	14	4					19	627	33.0
Nov.	20-22			1	2	10				13	262	20.15
Nov.	28-29	•			1	15	10			26	398	15.30
Dec.	4–5			-	1	6	1	15		23	187	8.13
Dec.	11-12					14	1	10	11	36	513	14.25
	·	•		· · · · ·			<u> </u>			·		
TOTAL	L tagged fis	sh										
recov	vered (Ri)		13	16	8	45	12	25	11	130		
TOTAI	fish	1										
tagge	ed (M1)	1 - A	27	65	16	115	37	56	27	343		
Mi/R	1		2.08	4.06	2.0	2.56	3.08	2.24	2.45	►		

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# TABLE 3. Recoveries (Rij) of Tagged Chinook Salmon Carcasses in Successive Weeks after Tagging in the Yuba River, 1978

\* Includes tagged fish recovered.

Population estimate (N) =  $\xi$ (Rij  $\cdot \frac{Mi}{Ri} \cdot \frac{Cj}{Rj}$ ) -  $\xi_{i=2}^{n}$  Mi

		Tagging period (i)								
	Oct. Oct.	Nov.	Nov.	Nov.	Nov.	Dec.	population			
	23-24 30-31	8	14-15	20-22	28-29	4-5	estimate			
Recovery period (j)										
Oct. 30-31	842						842			
Nov. 8	268		-				268			
Nov. 14-15	69 1,876	264					2,209			
Nov. 20-22	82	81	516				679			
Nov. 28-29		31	588	471			1,090			
Dec. 4-5		16	125	25	273		439			
Dec. 11-12	$(1,1) = \sum_{i=1}^{n} (1,1) = \sum_{i=1}^{n} (1,1$		511	44	319	384	1,258			
				- -						
TOTAL				· · · · ·			6,785*			

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# TABLE 4. Computed Weekly Population Estimates of Chinook Salmonin the Yuba River, Using Schaefer's Method

\* Total tagged fish from the second week on must be subtracted 6,785 - 316 = 6,469.

		Ī	agging per	iod (i)		Total tagged	Total fish	
	Nov.	Nov.	Nov. 30-	Dec.	Dec.	fish recovered	recove <b>re</b> d	
	15-17	22-24	Dec. 1	6-8	14-15	(Rj)	(Cj)*	Cj/Rj
Recovery period (j)		· · · ·						
Nov. 22-24	12	1				12	309	25.75
Nov. 30-Dec. 1	2	13				15	407	27.13
Dec. 6-8		4	12			16	353	22.06
Dec. 14-15		1	1	.3		5	325	65.00
Dec. 26-27				3	15	18	277	15.39
TOTAL tagged fish	<u> </u>				·			
recovered (Ri)	14	18	13	6	15	66		
TOTAL fish								
tagged (mi)	103	98	86	71	83	441		
Mi/Ri	7.36	5.44	6.62	11.83	5.53			

TABLE 5.	Recoveries	(Rij) of	T <b>agg</b> ed (	Chinook	Salmon	Carcasses	in	Successive	Weeks
		after	Tagging	g in the	Americ	an River,	197	78	

\* Includes tagged fish recovered.

Population estimate =  $\xi$  (Rij " $\frac{\text{Mi}}{\text{Ri}}$ " $\frac{\text{Cj}}{\text{Rj}}$ ) -  $\xi_{i=2}^{n}$  Mi

TABLE	6.	Computed Weekly Population	Estimates of Chinook Salmon in the
		American River.	using Schaefer's Method

		Tag	Weekly			
	Nov. 15-17	Nov. 22-24	Nov. 30- Dec. 1	Dec. 6-8	Dec. 14-15	population estimate
Recovery period (j)						2 274
Nov. 22-24	2,274					2,274
Nov. $30-\text{Dec.}$ 1	399	1,919				2,318
Nov: 50 2001 -		480	1.752			2,232
Dec. 0-0		354	430	2.307		3,091
Dec. 14-15				546	1 277	1 823
Dec. 25-27				540	1,277	1,025
momAT				<u></u>		11,738*

\* Total tagged fish from the second week on must be subtracted 11,738 - 338 = 11,400

### CHINOOK SALMON SPAWNING POPULATIONS FOR THE SAN JOAQUIN RIVER SYSTEM

Salmon spawning populations in the San Joaquin River triburaries were estimated by counting carcasses, redds, live fish, and hatchery returns. Streams surveyed were the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers (Figure 4).

Cosumnes River to the Calaveras River

Cosumnes River by Robert Reavis, Region 2

<u>Fall Run</u>. Except for brief periods of rain, flows were low resulting in few spawners migrating upstream. The upper section between Michigan Bar and Bridgehouse was surveyed on December 5, and four live fish were seen. The lower section between Bridgehouse and Sloughhouse was surveyed on December 12, and 15 live fish were seen. No carcasses were seen in either survey. Based on the low numbers of fish seen on the above dates that normally would be late in the spawnseason, I concluded the total seasonal run was very low and continuing low flow conditions made additional surveys unnecessary.

Low flows and clear water made observation conditions good. I assumed a 20% recovery rate and estimated the total escapement to be approximately 100 fish, which is 8% of the 1953-77 historical average of 1,208.

Mokelumne River by Marcus Sazaki and Robert Reavis, Region 2

Fall Run. Beginning on November 7, five successive salmon surveys were made weekly on the Mokelumme River between Camanche Dam and Elliot Road Bridge. Flows were 500 cfs during the first two weeks and 400 cfs thereafter. Water clarity was 3-4 ft during the first three survey trips and 10 and 6 ft on the remaining trips.

A total of 108 carcasses was examined and 322 live fish observed during the survey. Sixteen fresh carcasses were tagged and none were recovered. Based on a historical average recovery rate of 18%, an estimated 600 spawners used the Mokelumne River. Another 486 entered the spawning channel making the total estimated run about 1,100 fish, which is 53% of the 1953-77 historical average of 2,088.

Calaveras River by Marcus Sazaki, Region 2

<u>Winter Run</u>. Winter-run salmon were observed trying to negotiate the Bellota Weir on March 3, 1978, but none were seen after that date. In mid-May and early June, surveys were conducted to determine if salmon were spawning within a mile below New Hogan Dam, near Jenny Lind. None were observed.

Based upon survey results and conversations with Stockton Irrigation District personnel, the 1978 spawning run was probably about 150 fish.



FIGURE 4. San Joaquin River tributaries.

1

#### Stanislaus River to Merced River

by

#### Maurice Fjelstad Region 4

#### Stanislaus River

<u>Fall Run</u>. Three carcass surveys were done on this river between November 17 and December 13, 1978. The survey was divided into the traditional four sections as follows:

- I. Goodwin Dam to Knights Ferry.
- II. Knights Ferry to Orange Blossom Bridge.
- III. Orange Blossom Bridge to Oakdale.

IV. Oakdale to Riverbank.

In spite of the previous wet year and apparently because of confusion over who owned the water behind the New Melones Dam, no significant salmon flows were released until mid-November. Flows were increased to 1.13 m<sup>3</sup>/s (40 cfs) during the third week of November. On November 22, the Oakdale and South San Joaquin Irrigation districts approved the release of  $5.95 \text{ m}^3/\text{s}$  (210 cfs) into the Stanislaus River. The mean flows in October, November and December were 0.13 m<sup>3</sup>/s (4.6 cfs), 2.4 m<sup>3</sup>/s (86 cfs) and 8.5 m<sup>3</sup>/s (300 cfs), respectively.

Ten carcasses were found, five fresh carcasses tagged and none recovered. Observations were generally good. Since 1975, 20% of the fresh carcasses tagged have been recovered. Expanding by this factor brings the total 1978 spawning escapement to 50 fish, which is 1% of the 1953-77 historical average of 6,532.

#### Tuolumne River

<u>Fall Run</u>. Five complete survey trips were made between November 6 and December 19, 1978. The salmon survey sections have traditionally been partitioned as follows:

- I. La Grange to Rairden's Ranch.
- II. Rairden's Ranch to Roberts Ferry Bridge.
- III. Roberts Ferry Bridge to Reed Rock Plant.

With the small runs of the last several years, the three sections have been combined into two sections for this year's survey as follows:

- I. La Grange to Turlock Lake State Recreation Area (Section I and upper part of Section II).
- II. Turlock Lake State Recreation Area to Reed Rock Plant (lower part of Section II and all of Section III).

Normal year minimum flow releases of 10.9  $m^3/s$  (385 cfs) were in effect this year. Observation conditions were generally good.

A total of 116 carcasses was examined; 35 fresh carcasses were tagged and 2 recovered. Since the sample size was very small, this year's recapture data was combined with 1975 data to produce an average carcass recovery rate of 9%. Expanding by this factor yields a total spawning population estimate of approximately 1,300 fish, which is 9% of the 1953-77 historical average of 14,104.

#### Merced River

Fall Run. Between November 11, 1978 and December 30, 1978, five survey trips were made in each of the two sections of river from Crocker-Huffman Dam to Highway 59 Bridge (Section I) and from there downstream to Bettencourt Ranch (Section II). On January 2, 1979, one survey trip was made from Bettencourt Ranch to Cressy (Section III).

Flows were considerably higher than normal at the beginning of the season and then dropped to lower than normal (but still above the required minimum 180 cfs) for most of November. The flow reduction, from about 62.3 m<sup>3</sup>/s (2,200 cfs) down to 7.1 m<sup>3</sup>/s (250 cfs) was made over a 7-day period. No sign of redd stranding was seen.

A total of 84 carcasses was examined, 23 fresh carcasses tagged and 6 recovered. Due to the small sample size, 1975 tag and recovery data were combined with 1978 data to produce an average recovery rate of 16%. Expanding by this factor yields a spawning population estimate of 525 fish. An additional 100 spawners entered the spawning channel at the Merced River Fish Facility for a grand total of 625, which is 53% of the 1953-77 historical average of 1,187.

#### SPAWNING ESCAPEMENT GOALS

During 1978, an estimated 202,452 chinook salmon spawned in Central Valley streams. This total is only 58% of the average spawning escapement goal of 351,000 set by the Department of Fish and Game (Table 7).

Run	1978 spawning escapement	Escapement goal	% of goal attained
Late-fall	12,479	25,000	50%
Winter	24,735	40,000	62%
Spring	7,922	29,000	27%
Fall	87,535	150,000	58%
Spring	204	1,000	20%
Fall	37,759	40,000	94%
Fall	7.416	25,000	30%
Fall	21.091	30,000	70%
Fall	3,311	11,000	30%
	202,452	351,000	58%
	Run Late-fall Winter Spring Fall Spring Fall Fall Fall Fall Fall	1978 spawning escapementRunescapementLate-fall12,479 WinterWinter24,735 SpringSpring7,922 FallFall87,535 SpringSpring204 FallFall37,759 FallFall7,416 FallFall21,091 FallFall3,311202,452202,452	1978 spawning escapementEscapement goalRunescapementgoalLate-fall12,47925,000Winter24,73540,000Spring7,92229,000Fall87,535150,000Spring2041,000Fall37,75940,000Fall7,41625,000Fall3,31111,000Fall3,31111,000

TABLE 7. Percentages of Spawning Escapement Goals Attained During 1978 for Central Valley Streams

 $\frac{1}{1}$  Includes streams north of the Feather River.

The upper Sacramento River spring run, Feather River spring run, Yuba River fall run, and San Joaquin River fall run were the most depressed. The Feather River fall run came the closest (94%) to reaching the escapement goal.

The failure of all Central Valley streams to produce runs equal to the spawning escapement goals during 1978 may in part be due to low water conditions during the 1976-77 drought. On several streams, flows were not high enough during 1976 for adult spawners to enter. Also, low spring outflows during 1976 and 1977 probably reduced the nursery habitat available to young salmon and their survival rates during outmigration.

#### SUMMARY

During 1978, the California Department of Fish and Game conducted its 26th annual chinook salmon spawning stock inventory of the Sacramento-San Joaquin River system.

This report deals with the four races of chinook salmon recognized in the Central Valley: late-fall, winter, spring and fall runs.

In the San Joaquin system and the lower Sacramento River system, spawning stock estimates were done by the California Department of Fish and Game. These estimates were based on carcass, redd and live fish counts. Estimates for the Sacramento River above Red Bluff Diversion Dam were based on U. S. Fish and Wildlife Service counts of fish passing the dam, and on Department of Fish and Game sampling at the dam.

The estimated 1978 Central Valley chinook salmon spawning escapement was 202,452 fish (Table 8), which is only 58% of the average spawning escapement goal of 351,000 fish. It is probable that low water conditions during the 1976-77 drought was largely responsible for the poor adult returns in 1978.

Spawning area	Late-fall ru	m Winter run	Spring run	Fall run	Combined
Sacramento River main stem	12,479	24,735	5,669	82,293	125,176
Sacramento River tributaries			2,457	71,508	73,965
San Joaquin River tributaries				3,161	3,311
TOTALS	12,479	24,735	8,126	156,962	202,452

FABLE 8	3.	Sacramento-San	Joaquin	System	Chinook
		Salmon Spawn	Ing Popu	lation.	1978

Fall- and spring-run salmon spawn at about the same time; hence, the two races are indistinguishable on the spawning grounds. However, estimates for the combined fall and spring runs are available for comparison of all years since 1953 (Taylor 1974a). The 1978 fall-spawning (fall- plus spring-run) population in California's Central Valley was 165,088 fish. This figure is 57% of the historic (1953-77) average of 290,000 and is down from last year's estimate of 205,836 (Hoopaugh and Knutson 1979).

Above Red Bluff Diversion Dam, the fall-spawning escapement of 44,821 was 85% of last year's run and the eighth consecutive year that fall-spawning runs were far below the 1964-69 average of 129,000 taken prior to the construction of Red Bluff Diversion Dam.

As in recent years, the lesser escapement above Red Bluff was partially offset by increasing spawning escapements in the lower Sacramento River. The estimated 50,488 chinook salmon which spawned in the Sacramento River system from Red Bluff to Butte City (including 1,669 which entered the Tehama-Colusa Spawning Channel via Coyote Creek) was the highest number recorded since 1956.

Fall-run spawning escapements in the Feather, Yuba and American rivers were down 19%, 15% and 53%, respectively, from 1977 levels and also down 15%, 41% and 42%, respectively, from 1953-77 historical averages.

The fall run in the San Joaquin system totaled 3,311 fish, up from last year's run of 1,561, but only 14% of the 1953-77 historical average of 24,213.

Salmon counts at Red Bluff Diversion Dam and sport catches above the dam are shown in Appendix Tables 1 and 2, respectively. Spawning populations for all Central Valley streams are summarized in Appendix Tables 3-5. Fin mark and coded-wire-tag recoveries are presented in Appendix Tables 6 and 7.

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APPENDIX TABLE 1. Red Bluff Diversion Dam Weekly Adjusted Salmon Counts, October 30, 1977 through August 5, 1978

	Adjusted	1				· · · · · · · · · · · · · · · · · · ·				
	salmon	Number	Late-fa	<u>11 run</u>	Winter	run	Spring	run	Fall	run
Week	count	sampled	Percent	Number	Percent	Number	Percent	Number	Percent	Number
1077										
19//				2 200	1/	(00]	./			
10/30-12/31	3 Runs	in progress	3	3,298	<b></b> `	408-	-			
1978										
1/ 3- 1/ 7	1,152	No sample	59.0	680	41.0	472				
8- 14	1,439	11	51.6	743	48.4	696				
15- 21	1,247	11	22.2	277	77.8	970				
22- 28	823	. 11	27.5	226	72.5	597				
29-2/4	2,408	35	62.9	1,515	37.1	893				
3/5-11	1.647	No sample	32.1	529	67.9	1,118				
12- 18	757	80	82.5	625	17.5	132				
19- 25	3 261	472	42.6	1.389	57.4	1.872				
26 - 3/h	/ 130	174	31 0	1 283	69 0	2 856				
20- 37 4	4,133	1/4	51.0	1,205	07.0	2,050				
3/5- 11	1,895	No sample	23.9	453	76.1	1,442				
12- 18	1,134	65	21.0	189	79.0	945				
19- 25	1,900	173	15.7	298	83.7	1,590	0.6	12		
26-4/1	3,634	664	18.6	676	79.8	2,900	1.6	58		
4/2- 8	1,001	134	27.0	270	70.0	701	3.0	30		
9- 15	760	202	17.8	135	79.2	602	3.0	23		
16- 22	609	92			,93.5	569	6.5	40		
23- 29	1.728	583		12,586	2/94.2	1,441	5.8	287		
30-5/6	310	71		I	87.3	271	12.7	39		
5/7_ 13	1 207	154			877	1 225	12.3	172		
$1/- 10^{-10}$	1 327	154			85 1	1 129	14 9	198		
14 - 20	1,005	102			69.6	600	30 4	306		
21 - 21	1 216	161			70.2	854	20.4	362		
20-0/5	1,210	14 I	$p = \frac{1}{2} $		10.2	0,04	29.0	502		
6/4- 10	326	6			83.3	272	16.7	54		
11- 17	114	16			56.2	64	43.8	50		
18- 24	143	39		· · · ·	15.4	22	84.6	121		
25- 7/ 1	215	116	· · ·		24.1	52	75.9	163		
7/2- 8	377	68			12,5	47	87.5	330		
9- 15	333	No sample			4.8	16	95.2	317		
16- 22	315	11			1.8	6	86.4	272	11.8	37
23- 29	148				0.5	1	81.1	120	18.4	27
30 - 8/5	421	189					65.1	274	34.9	147
JJ J, J	.~+					1 24 862				

(continued on next page)

APPENDIX TABLE 1 (continued). Red Bluff Diversion Dam Weekly Adjusted Salmon Counts, August 6, 1978 through December 30, 1978

		Adjusted		T				G		D - 1 1	
•		salmon	Number	Late-fa	<u>ll run</u>	Winter	run	Spring	run	Fall	run
Week		count	sampled	Percent	Number	Percent	Number	Percent	Number	Percent	Number
<u>1978</u>											
8/6-	12	396	110					40.9	162	59.1	234
13-	19	341	70					12.9	44	87.1	297
20-	26	574	182					31.9	183	68.1	391
27- 9	9/2	434	80					32.5	141	67.5	293
9/3-	9	2,466	250					29.2	720	70.8	1,746
10-	16	3,962	162					17.3	685	82.7	3,277
17-	23	531	62		· · · ·	•		25.8	137	74.2	394
24-	30	1,937	200			· ·		27.5	533	72.5	1,404
10/ 1-10	0/7	2,421	420					2.9	70	97.1	2,351
8-	14	3,287	789						<b>F</b> 000	100.0	3,287
15-	21	5,183	1,389	2.4	124		<b>.</b> .		5,903	97.6	5,059
22-	28	2.624	779	2.8	73		i de la composición d			97.2	2,551
29-11	1/4	3,725	366	1.4	52					98.6	3,673
11/ 5-	11	2,949	289	2.8	83					97.2	2,866
12-	18	2,534	231	5.2	132					94.8	2,402
19-	25	4.562	109	6.4	292					93.6	4,270
26-12	2/2	1,125	96	15.6	175					84.4	950
12/ 3-	9	428	46	23.9	102				· ·	76.1	326
10-	16	2.704	94	6.4	173					93.6	2,53
17-	23	1,382	20	5.0	69					95.0	1,313
24-	30	1,022	58	98.3	1.005	1.7	17	•.			00 000
24	30	1,012	50		2,000						39,820
		<u> </u>					·			<u></u>	
TOTAL 19	978	•									
(carend)	ar	81,768	9.532		11.568		24,471		5,903		39,826

Indicates the size of the salmon run passing the dam which will spawn during the 1978 calendar year. 2/

<u>3</u>/ Includes 2,085 salmon trucked to Tehama-Colusa spawning channel.

# APPENDIX TABLE 2. Estimated Monthly Sport Catches of the Four Runs of Sacramento River Chinook Salmon between Keswick and Red Bluff Diversion Dams1/

	-		Late-fal	1 run	Winter	Winter run		run	Fall r	un
Year	Month	Catch	Percent	Catch	Percent	Catch	Percent	Catch	Percent	Catch
	_									
1977	Oct.	262							99.4	262
	Nov.	175	44.4	78					55.4	97
	Dec.	9	74.1	7	19.7	2			6.2	
1978	Jan.	0	77.6		22.4					
	Feb.	11	54.9	6	45.1	5				
	Mar.	27	21.5	. 6	77.7	21	0.8			
	Apr.	86	12.3	10	83.4	72	4.3	4		
	Mav	24		2	/ 81.6	20	18.4	4		
	June	16		10/1-	27.5	4	72.5	12		
	July	35			8.8	3	91.2	32		
	Aug.	268				[107]	41.4	111	58.6	1.57
	Sept.	277				[127]	25.4	70	74.6	207
	Oct.	185	1.6	3			0.5	1	97.9	181
	Nov.	108	4.3	5				234	95.7	103
	Dec.	40	34.4	14	0.5				65.1	26
								· • · · · · · · · · · · · · ·		674
2978	TOTAL									(7)
Caler	ndar year	1,077		44		125		234		0/4

<u>1</u>/ Assignment to specific runs was based on sampling at Red Bluff Diversion Dam. Salmon hauled to the Tehama-Colusa Spawning Channel were subtracted from the adjusted counts before percentages were calculated.

 $\frac{2}{2}$  Total catch from run that spawned in 1978.

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	Late-	······································			······································
Area	fall run	Winter run	Spring run	Fall run	Total
Keswick Dam to Red Bluff ,,					
Sacramento River Main Stem <sup>1</sup> /	12,479	24,735	5,669	34,320	77,203
Clear Creek	-			60	60
Cottonwood Creek				1,120	1,120
Battle Creek (Total)		•		(3,652)	
Coleman Hatchery				1,882	1,882
Below Hatchery				1,770	1,770
Jerow nacencry					
FOTAL, Keswick Dam					
to Red Bluff	12,479	24,735	5,669	39,152	.82,035
Red Bluff to Deer Creek				•	
Sacramento River Main Stem (1	'otal)	1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 -		(47,973)	
Red Bluff to Tehama				26,560	26,560
Tehama to Woodson Bridge				9,480	9,480
Woodson Bridge to Butte City	• · · ·			9.881	9,881
Tehama-Colusa Spawning Chann	el			2,052	2,052
			21	0	
Antelope Creek	21	2/	<u>2/</u> 025	300	1 225
Mill Creek	<u> </u>	<u>-</u> 21	1 200	300	1 290
Deer Creek			1,200	30	1,200
TOTAL, Red Bluff					
to Butte City			2,125	48,363	50,488
Butte Creek to American River	•				
Butte Creek	-		128	20	148
Feather River (Total)	and the second second		(204)	(37,759)	
Hatchery	en e		202	4,759	4,961
Below Hatchery			2	33,000	33,002
Yuha River				7,416	7,416
American River (Total)				(21,091)	
Hatchery				8,162	8,162
Below Nimbus Racks				12,233	12,233
Above Nimbus Racks				696	696
ADOVE MILLIDUS MACKS					
TOTAL, Butte Creek to					(( (10
American River			332	66,286	66,618
GRAND TOTAL, SACRAMENTO				· · · · · · · · · · · · · · · · ·	
RIVER SYSTEM	12.479	24,735	8,125	153,801	199,141

 $\frac{2}{No}$  estimate made.

Area	Winter run	Fall run	Total
		100	100
Cosumnes River		100	100
Mokelumne River (Total)		(1,086)	
Spawning channel		486	486
Below spawning channel		600	600
Calaveras River	150		150
Stanislaus River		50	50
Tuolumne River		1,300	1,300
Merced River (Total)		(625)	
Spawning channel		100	100
Below spawning channel		525	525
GRAND TOTAL, SAN JOAQUIN	150	3 161	3 311

# APPENDIX TABLE 4. Summary of Chinook Salmon Spawning Population Estimates for the San Joaquin River System, 1978

	Sacra	mento Ri	ver syst	en	Battle	Sacramento	Feathe		Yuba	American	Cosimnes	Mokelumne	Stanislaus	Tuolumne	Merced	
	exclu	ding Bat	tle Cree	k	creek	below Red Bluf	f River	<b>.</b>	River	River	River	River	River	River	River	Others <sup>a</sup>
ear	Late- fall	Winter	Spring	Fall	Fall	Fall	Spring	Fall	Fall	Fall	Fall	Fall	Fall	Fall	Fall	All races combined
64	<u>b</u> /	<u>b</u> /	<u>b</u> /	150 <u>c</u> /	16	6	3	38 <u>c</u> /	35	59	2	2	4	2	0.04	7
65	<u>b</u> /	<u>b</u> /	<u>b</u> /	107 <u>č</u> /	9	2	0.7	23 <sup>c</sup> /	10	39	0.8	1.3	.2	3	0.09	2
66	<u>b</u> /	<u>b</u> /	<u>b</u> /	124 <u>c</u> /	3	3	0.3	21 <sup>c/</sup>	8	27	0.6	0.7	3	5	0.04	1
67	<u>b</u> /	<u>b</u> /	<u>ь</u> /	/ <sub>84</sub> 2	.5	9	0.1	12 <u>c</u> /	24	23	0.5	3	12	7	0.6	1
68	<u>b</u> /	<u>b</u> /	<u>b</u> /	116 <u>c</u> /	6	12	0.2	18 <u>c</u> /	7	31	1.5	1.7	6	9	0.5	2
69	<u>b</u> /	<u>в</u> / т	20	130	6	18	0.3	61 <u>c</u> /	5	47	. 4	3	12	32	0.6	5
70	<u>b</u> /	<u>b</u> /	4 -	70	7	6	0.2	62 <u>c</u> /	13	37	0.6	5	9	18	5	5
71	17	53	6	59	5	23	0.5	47 <u>c</u> /	6	52 _	0.5	5	14	22	4	5
72	33	28	7	36	5	15	0.3	47 <u>c</u> /	9	25	1.6	1.1	4	5	3	3
73	22	23	7	44	8	17	0.2	74 <u>c</u> /	24	95	0.9	3	1.2	2	1.1	6
74	6	19	. 4	49	4	28	0.2	66	18	62	0.3	1.4	0.8	1.1	2	8
75	18	23	10	55	5	36	0.7	43	6	40	0.7	1.9	1.2	1.6	2.4	15
76	16	33	25	57	5	36	0.7	62	4	28	0	0.5	0.6	1.7	1.9	1
77	9	16	13	40 <u>d</u> /	<u>ь</u> /	46	0.2	46	9	48	0	0.3	0	0.4	0.4	3
78	12	25	6	35	4	48	0.2	38	7	21	0.1	1.1	0.05	1.3	0.6	- 3

APPENDIX TABLE 5. Sacramento-San Joaquin Valley Chinook Salmon Spawning Stock Estimates, 1964-1978, in Thousands of Fish. Spawning Stock Estimates from 1953-1963 Can Be Found in Taylor (1974a)

This includes streams which a few hundred chinook salmon enter most years (e.g., Mill, Deer and Dye creeks) as well as streams which chinook salmon , enter only in wet years (e.g., Dry and Singer creeks and the Calaveras River).

b/ No estimate. c/ Some springd/ Includes Bati

, Some spring-run fish may have been included in the fall-run estimate.

' Includes Battle Creek.

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	Hatchery	Number of	recoveries	by location	· · · · · · · · · · · · · · · · · · ·	
CWT	of	Red Bluff	Coyote	Coleman	Battle	
code	origin	Diversion Dam	Creek	Hatchery	Creek	Total
,				•.		
5-7-10	Tehama-Colusa	3	18			21
5-48-1	Tehama-Colusa	3	11			141/
14-13-10	Tehama-Colusa	11	69			80 <u>1</u> /
14-14-10	Tehama-Colusa	5	6	1		12
6-3-1	Coleman	2		3		5
6-3-3	Coleman	·	3	8	1	12
6-3-4	Coleman	2	8	11		21
6-3-5	Coleman	5	7	10		22
6-3-7	Coleman			6		6
6-60-8	Coleman	2	2			4
6-60-9	Coleman	2	4	8		14
6-60-10	Coleman	5	4	7		16
6-60-11	Coleman			1		1
6-60-12	Coleman	4		4		8
6-2-3	Mokelumne		1			. 1
6-2-5	Mokelumne	1	5	1		7
6-2-6	Mokelumne		7	1		8
6-1-6	Feather		1			1
6-3-2	Feather	1 <b>1</b>	5			6
6-3-6	Feather	2	. 1			3
TOTALS		48	152	61	1	262

# APPENDIX TABLE 6. Marked Chinook Salmon Recovered from Central Valley Streams North of the Feather River

 $\frac{1}{2}$  The total of 80 is correct; the distribution between Red Bluff Diversion Dam and Coyote Creek is subject to revision.

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CWT			Number of	Recoveries by Lo	ocation		
code or mark	Hatchery of origin	Nimbus Hatchery	Mokelumne River Facility	Feather River Hatchery	Merced River	Tuolumne River	Total
4 2 1 5	Fostbor	1		6			7
6 1 6	Feather	<b>L</b>		ŭ		•	, 4
6-1-6	Feather			34			34
0-1-/	Feather			104			104
6-1-8	Feather	-		104			11
6-3-2	Feather		1	9			3
6-3-6	reather			2			2
6-58-9	reather	0		/.Q			50
6-58-10	Feather	2		40			20
RV-LP	Feather			90 2			90
LV-LP	Feather			3			<b>.</b>
6-2-3	Mokelumne	23	3	3			29
6-2-5	Mokelumpe	11	1	3		•	15
6-2-5	Mokelumne	37	ī	4	3	1	52
6-2-5	Mokalumna	31	8	2	2	2	45
6 10 7	Mokolumno		ž	1			3
0-40-/	HOKETUIIIIE		<b>#</b>				
TOTALS		112	22	310	5	3	452

Sauce

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# APPENDIX TABLE 7. Marked Chinook Salmon Recovered from Central Valley Streams from the Feather River and South