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DEPARTMENT OF FISH AND GAME

CHINOOK (KING) SALMON SPAWNING STOCKS IN
CALIFORNIA'S CENTRAL VALLEY, 1980

Edited by

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Anadromous Fisheries Branch

Anadromous Fisheries Branch
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ABSTRACT

This report covers the 28th annual inventory of chinook salmon (Oncorhynchus 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 winter-run 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 1980 escapement of fall spawning (fall- plus spring-run) chinook salmon in the Central Valley is 184,605 fish. This figure is 65% of the historic (1953-1979) average of 283,000 and is 80% of the 1979 estimate of 230,709.

The decline in 1980 escapement may be partly attributed to the 1976-77 drought. The continuing decline of recent years is probably caused by the exports of large amounts of water from the Sacramento-San Joaquin Delta. This results in screening problems and reduces the nursery area, and in turn greatly depresses survival of juvenile salmon migrating to the ocean.

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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INTRODUCTION

This report covers the 28th 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 coean fisheries and also contributes significantly to the ocean fisheries of Oregon and Washington. Spring and fall runs have been monitored since 1953, and late-fall and winter runs have been monitored since 1971. The four runs are described as follows:

- 1) Late-fall run. These fish are mainly confined to the upper Sacramento River, which they enter from early November through February and spawn from February through March. They are usually larger than the fall- and winter-run fish spawning in the same area.
- 2) Winter run. Most are confined to the upper Sacramento River, which they enter from early January through mid-June and then spawn from April to July.
- 3) Spring run. Once widespread in the Central Valley, these fish have disappeared from many of the streams as a result of dam construction. Spring run enter the Sacramento River from March to July and spawn from late August to early October.
- 4) Fall run. These are presently the most numerous and widely distributed salmon in the Central Valley. They enter the river from July through November and spawn from mid-October through early January.

Monitoring of salmon spawning escapement in the Central Valley is an important component of the Department of Fish and Game's fishery management effort. The primary objectives of this work are to determine size and sex composition of spawning populations, and to recover tagged or marked salmon to determine their contribution to river spawning escapement. Other objectives are to observe any changes in spawning distribution and habitat conditions that may adversely affect salmon, and determine if corrective action is necessary.

GENERAL METHODS

During 1980, 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. 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 the individual stream headings.

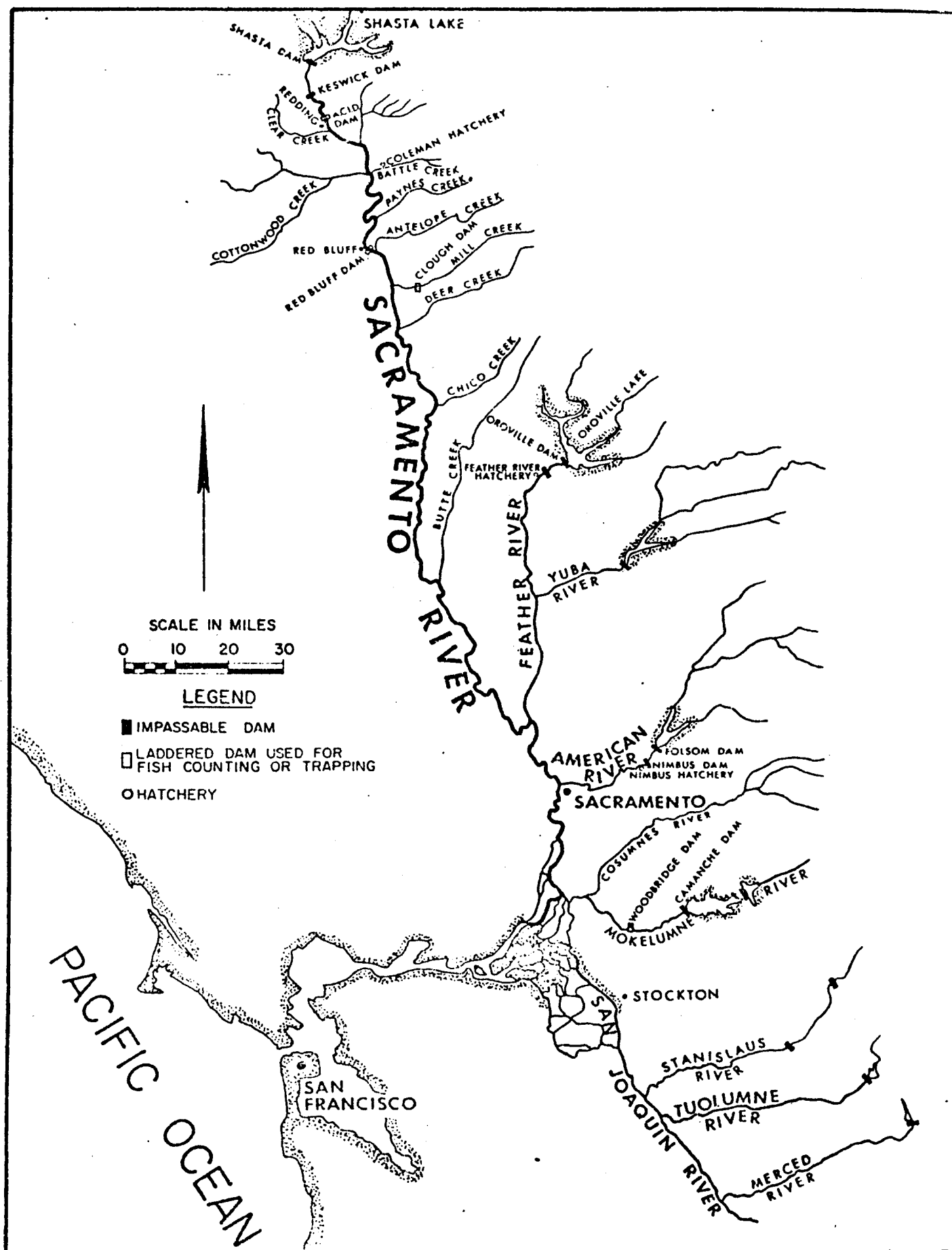


FIGURE 1. Salmon streams in the California Central Valley.

CHINOOK SALMON SPAWNING POPULATIONS FOR
THE SACRAMENTO RIVER SYSTEM

Keswick Dam to Red Bluff Diversion Dam

by

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Spawning population estimates were made for the Sacramento River main stem using fish counts at Red Bluff Diversion Dam (Figure 2). In addition, fall-run estimates were made for Battle Creek 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 adjustment 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 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 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 estimate 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, 1967-1974. 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 (Table 1).

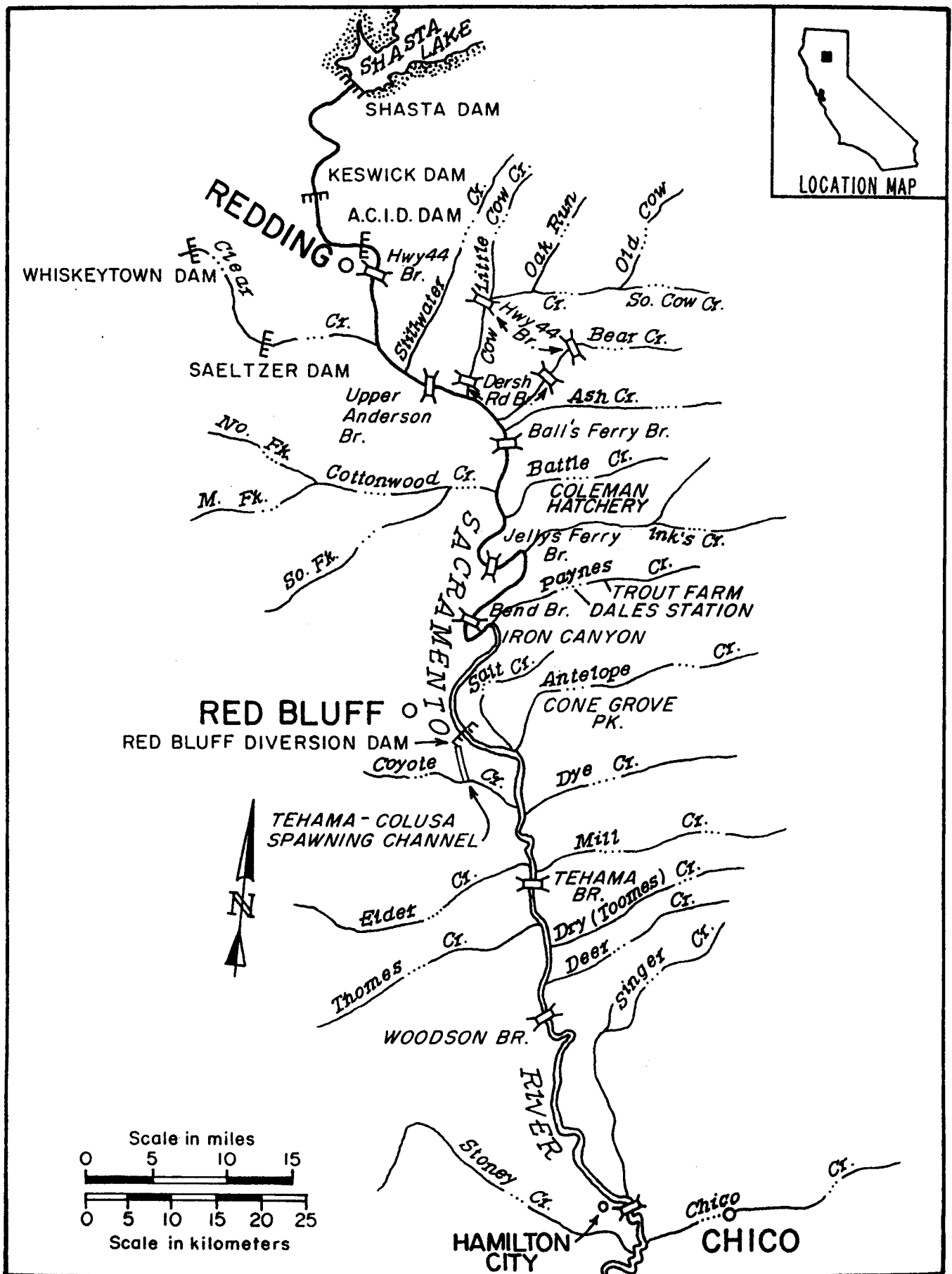


FIGURE 2. Upper Sacramento River and tributaries above Chico Creek.

TABLE 1. Calculation of Chinook Salmon Runs and Spawning Populations, Sacramento River System Above Red Bluff Diversion Dam, 1980.

Run	Fish Passing Dam		Potential 1980 Spawners (Runs)		Estimated 1979-80 Sport Catch Above Dam		Estimated 1980 Spawning Populations
	1979	1980					
Late Fall 1979-80	3,875	+	5,606 =	9,481	-	120	= 9,361
Winter 1979-80	0	+	1,156 =	1,156	-	14	= 1,142
Spring 1980	0	+	9,969 =	9,969	-	333	= 9,363
Fall 1980	0	+	37,610 =	37,610	-	1,031	= 36,579 ^{3/}
Late Fall 1980-81	0	+	2,841 =	0 ^{1/}		2 ^{2/}	
Winter 1980-81	0	+	83 =	0 ^{1/}		2 ^{2/}	
Totals	3,875		56,992	57,943		1,498	56,445

1/ Fish in this run spawn in 1981, not 1980.

2/ This run started passing the dam late in 1980, but was not completed in 1980. Additional salmon will be added to both the run and sport catch in early 1981.

3/ Includes 175 salmon hauled from Red Bluff Diversion Dam to the Tahama-Colusa spawning channel.

While a calendar year count includes total annual runs passing the dam for spring- and fall-run salmon, it represents only part of the total annual runs of late-fall- and 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 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 1980 spawners in these two runs, it was necessary to add the appropriate portion of the 1979 calendar year count and delete that portion of the 1980 count which spawned in 1981.

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

Late-fall run. An estimated 9,481 late-fall run salmon migrated to Red Bluff Diversion Dam. About 120 were caught upstream by anglers leaving 9,361 to spawn (Table 1). Of these, 746 were trapped at Keswick Dam and hauled to Coleman Hatchery; 147 entered Coleman Hatchery via Battle Creek, and 121 were hauled from Red Bluff Diversion Dam to the Tehama-Colusa Spawning Channel, leaving 8,522 to spawn naturally. The 9,361 spawners is 50% of the 1971-79 average of 18,682 (excluding 1974 when flooding resulted in inaccurate counts).

Winter run. An estimated 1,156 winter-run fish passed above Red Bluff Diversion Dam. Of these, about 14 were taken by anglers, leaving 1,142 to spawn naturally (Table 1). This total is only 4% of the 1971-79 average (excluding 1974) of 26,510 and is the lowest of record.

Spring run. An estimated 9,696 spring-run salmon passed above Red Bluff Diversion Dam. Of these, about 333 were caught by anglers leaving 9,363 to spawn naturally (Table 1). This slightly exceeds the 1969-1979 average of 8,480. Although some spring-run salmon spawn in tributaries of the Sacramento River, no surveys were made in these streams during the period of spawning. Therefore, all spring-run salmon above Red Bluff are included in the main stem (Appendix Table 3).

Fall run. An estimated 37,610 fall-run salmon migrated to Red Bluff Diversion Dam. Of these, 1,031 were caught by anglers upstream (Table 1); 14,433 entered Battle Creek; and 175 were hauled from Red Bluff Diversion Dam to Tehama-Colusa Spawning Channel. The remaining 21,961 are presumed to have spawned naturally in the Sacramento River system upstream from Red Bluff in areas other than Battle Creek. This total is 40% of the 1967-1979 average of 47,379.

Spawning Distribution

Data collected during four airplane flights (October 20 and 31, and November 12 and 26, 1980) over the main stem of the Sacramento River showed the general

salmon redd distribution of fall-spawning salmon, and indicated the relative number of salmon that spawned on the riffles above Princeton Ferry (Figures 2 and 3 and Table 2). Redd counts showed that 48.2% of the main stem fall spawning activity occurred upstream from Red Bluff Diversion Dam, which is lower than the 1974-79 average of 54.3% (1974 was the first year of aerial surveys). The most heavily used area was between Balls Ferry and Jellys Ferry.

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 1980. A total of 746 late-fall run were hauled from Keswick Dam to Coleman Hatchery.

Fall Run. Seventeen spawning stock survey trips were made on lower Battle Creek between Coleman Hatchery and the Sacramento River from October 17, 1980 through January 5, 1981. Carcass recovery conditions were generally good throughout the survey period. A total of 1,482 carcasses was recovered. Based on a recovery rate of 30%, the estimated number of fall-run fish spawning naturally in Battle Creek was 4,940. Adding this figure to the 9,503 salmon that entered the hatchery, brings the total to 14,443 fall-run salmon. This greatly exceeds the previous 10-year average of 6,697.

Red Bluff Diversion Dam to Princeton Ferry

by

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

Flows in the Sacramento River main stem below Red Bluff Diversion Dam were low and constant except for brief periods in early December when the river reached 227 m³/s (8,000 cfs), flows normally ranged between 113 m³/s (4,000 cfs), and 156 m³/s (5,500 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 1980 to support spawning salmon.

TABLE 2. Estimated Redd Distribution of Fall Spawning Chinook Salmon, Main Stem of Sacramento River Above Princeton Ferry, Based on Four Aerial Redd Counts, 1980 ^{1/}

Area	Total Redds	Average Number of Redds	
		Number	Percent
Keswick to A.C.I.D. Dam	145	36	3.5
A.C.I.D. Dam to Highway 44	80	20	1.9
Highway 44 to Upper Anderson Bridge	205	51	4.9
Upper Anderson Bridge to Balls Ferry	380	95	9.2
Balls Ferry to Jellys Ferry	787	197	19.0
Jellys Ferry to Bend Bridge	345	86	8.3
Bend Bridge to Red Bluff Diversion Dam	54	14	1.4
Red Bluff Diversion Dam to Tehama	1,368	342	33.0
Tehama to Woodson Bridge	532	133	12.9
Woodson Bridge to Hamilton City	191	48	4.6
Hamilton City to Ord Ferry	36	9	0.9
Ord Ferry to Princeton Ferry	15	4	0.4
TOTAL	4,138	1,035	100.0

^{1/} Flight dates: 10-20, 10-31, 11-12, 11-26.

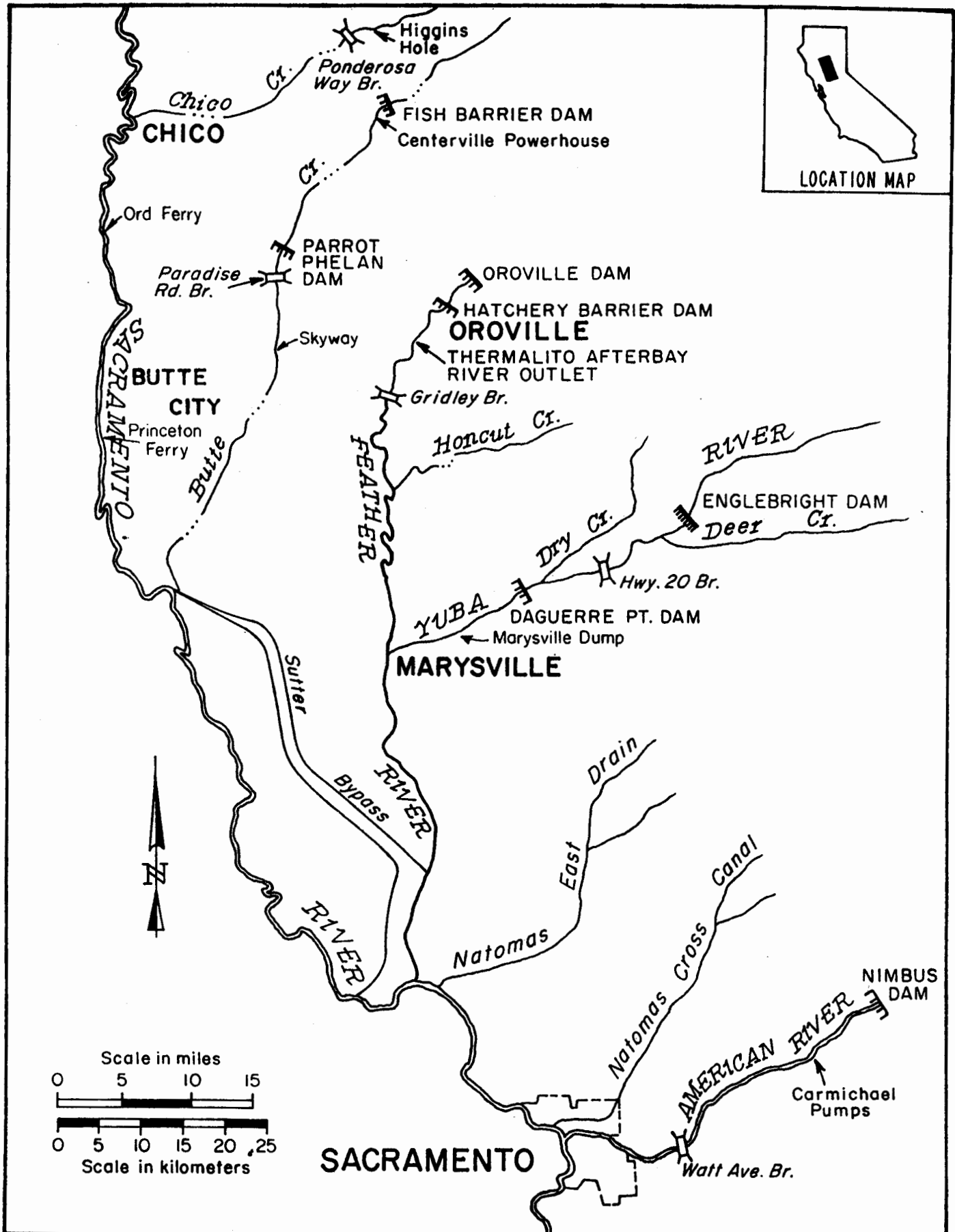


FIGURE 3. Sacramento River tributaries from Chico Creek south.

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 some fish from each of these runs spawned in the main stem, no spawning population estimates were made. Any spring-run spawners are included in the fall-run total except for the six that entered the Tehama-Colusa Spawning Channel via Coyote Creek.

Fall Run. Between October 9, 1980 and January 7, 1981, 14 survey trips were made from Red Bluff Diversion Dam to Tehama. A total of 279 salmon carcasses was recovered. Based on river conditions, the estimated recovery rate was 1.5% which results in an estimated spawning population of 18,600. There were 2,040 fall-run salmon that spawned at the Tehama-Colusa Spawning Channel (175 hauled from Red Bluff Diversion Dam, plus 1,865 that entered the spawning channel via Coyote Creek).

From October 10, 1980 through January 8, 1981, 14 survey trips were made between Tehama and Woodson Bridge and 101 salmon carcasses were recovered. Based on river conditions, the carcass recovery rate was 1.5%, resulting in an estimated spawning population of about 6,733.

While spawning in the area between Woodson Bridge and Butte City (Figures 2 and 3) is often insignificant, four aerial surveys during November and December 1980 showed that 3,080 salmon used this section.

A grand total of 30,453 chinook salmon spawned in the Sacramento River main stem from Red Bluff to Princeton Ferry, which is 94% of the 1970-79 average of 32,482.

Spawning Distribution

Four airplane flights were taken from October 20 through November 26, 1980 to determine redd distribution in the main stem of the Sacramento River (Table 2). Redd counts showed that 51.8% of the main stem fall-spawning activity occurred downstream from Red Bluff Diversion Dam, which is higher than the 45.7% average from 1974-79. The most heavily-used area was between Red Bluff Diversion Dam and Tehama.

Mill Creek

Late-fall and Winter Run. Although late-fall runs were observed and in past years winter run are known to have spawned in this stream, no estimates were made for 1980.

Spring Run. Three survey trips were made for spring-run salmon in upper Mill Creek. The area partially covered was from Highway 36 to Blackrock. Eleven redds and two live salmon were observed. It is estimated that 500 spring-run salmon spawned in Mill Creek.

Fall Run. Ten 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, between November 24, 1980 and January 2, 1981. A total of 32 carcasses was recovered. Based on a 5% recovery rate, the estimated spawning population was about 320.

Deer Creek

Spring Run. Seven survey trips were made for spring-run salmon on upper Deer Creek. The area partially covered was from upper Deer Creek Falls to the Ponderosa Way Road crossing. A total of 105 redds and 89 live salmon was observed. The spawning population was estimated to be 1,500.

Fall Run. Four survey trips were made on lower Deer Creek between October 24, and December 9, 1980. The area covered was from the mouth upstream to the county road bridge located about 3.2 km (2 miles) upstream from the Stanford-Vina Dam. A total of 21 salmon carcasses was recovered. The estimated fall run totaled 210 spawners.

Thomes Creek

Fall Run. Nine survey trips were made on Thomes Creek by Department of Fish and Game personnel under contract with the California Department of Water Resources. A salmon carcass mark and recovery procedure was used to estimate the spawning population in the creek downstream from Paskenta. A total of 59 salmon carcasses was recovered at an estimated efficiency of 39%. The spawning population, part of which was probably attracted to the creek by water spilling from the Tehama-Colusa Canal, was estimated to be 151.

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

Spring Run. Although there were no major flood flows down Butte Creek, conditions were good for upstream migration through May. The barrier normally installed at Centerville was not placed in the stream this year, allowing salmon access to the upstream canyon area. Surveys were conducted by canoe on October 1 and 2, 1980 from Centerville Powerhouse to the Skyway, and 106 live fish and 13 carcasses were observed. In addition, 3 single and 43 multiple redds were seen. Estimated spawning population was 226 salmon. Most spawning activity occurred below Parrot-Phelan Dam. Twenty-six dead fish were measured and examined for adipose fin clips on October 7, 1980. The minimum number of salmon accounted for was 119. No fin clips were observed. Fork lengths of the salmon measured were as follows: female, range 60-78 cm, mean = 68.8 cm; males, range 67-80 cm, mean = 72.4 cm.

The 1977 parent run for 3-year salmon consisted of 388 Sacramento River salmon and 70 Butte Creek salmon that, due to the drought, were rescued and transported to Butte Creek in the spring.

Fall Run. The Parrot-Phelan ladder was not operating during the fall count. Salmon were observed in lower Butte Creek in small numbers but low flows restricted migration and no spawning activity was observed.

Feather River - by Lynn Wixom, Region 2

Spring Run. Twenty-six coded wire tagged spring-run salmon from Feather River Hatchery were found during the weekly surveys. The total run entering the hatchery prior to September 26, 1980 assumed to be spring run was 269 fish. The estimated number of spring run spawning in the river was 400 fish for a total spring-run salmon population of 669 fish, unfortunately, spring- and fall-run fish cannot be distinguished during the spawning period.

Fall Run. Eleven weekly spawning stock surveys were conducted from October 15, 1980 to January 6, 1981 in the following river sections:

- I. Oroville Fish Barrier to Thermalito River Outlet
- II. Thermalito River Outlet to Gridley Bridge
- III. Gridley Bridge to Honcut Creek

Conditions were ideal for recovery of carcasses, with transparency ranging from 1.8-3.0 m (6-10 ft) in Section I and 0.9-1.8 m (3-6 ft) in Sections II and III. River flows were 11.3 m³/s (400 cfs) in Section I and 48.1 m³/s (1,700 cfs) in Sections II and III.

A Schaefer Model (Schaefer 1951), as modified by Taylor (1974b) was employed in making the population estimate (Tables 3-5). Fresh carcasses (clear eyed) were tagged and returned to the water for future recovery.

Section I contained 12,563 (Table 3) fish plus 3,690 that went to the hatchery. Section II contained 17,020 fish (Table 4) and Section III contained 2,022 (Table 5). Section III was surveyed only 4 times (compared to 11 and 12 times for the other sections) and the estimate derived from tag-recapture was judged to represent one-half of the population.

The total estimated fall run for the Feather River, including the hatchery count of 3,690 was 35,295 which is 74% of the previous 10-year average of 51,666.

Sex composition for the 1980 fall run was as follows:

TABLE 3. Population Estimates of Chinook Salmon Based on Tag and Recovery Data for the Feather River from Oroville Fish Barrier to Thermolito River Outlet, Using Schaefer's Method, 1980

Recovery Period (j)	Tagging Period (i)											No. Tagged Observed (Rj)	Total No. Carcasses Counted* (Cj)	Population Estimate
	Oct. 15	Oct. 22	Oct. 29	Nov. 5	Nov. 12	Nov. 19	Nov. 26	Dec. 3	Dec. 10	Dec. 17	Dec. 24			
Oct. 22	9											9	251	369
Oct. 29	5	39										44	457	655
Nov. 5	2	13	92									107	925	1,291
Nov. 12	1	6	17	82								110	1,124	1,751
Nov. 19		2	3	29	130							164	1,443	2,106
Nov. 26			1	8	35	139						183	1,573	2,740
Dec. 3					6	26	89					121	941	1,635
Dec. 10			1		1	9	62	83				156	882	1,414
Dec. 17					1	3	30	25	47			106	650	1,079
Dec. 24							4	10	21	39		74	413	717
Jan. 5								1	3	18	27	27	272	612
TOTAL Tagged Fish Recovered (Ri)	17	60	114	123	173	177	185	119	71	57	27			14,369**
TOTAL Fish Tagged (Mi)	25	86	158	197	248	324	320	177	121	104	71			

* Includes tagged fish recovered.

** Total tagged fish from second week on must be subtracted 14,369 - 1,806 = 12,563.

$$\text{Population Estimate (N)} = \left\{ (R_{ij} \cdot \frac{M_i}{R_i} \cdot \frac{C_j}{R_j} \right\} \sum_i^n = 2 M_i$$

TABLE 4. Population Estimate of Chinook Salmon Based on Tag and Recovery Data for the Feather River from Thermolito River Outlet to Gridley Bridge, Using Schaefer's Method, 1980

Recovery Period (j)	Tagging Period (i)									No. Tagged Observed (Rj)	Total No. Carcasses Counted* (Cj)	Population Estimate
	Oct. 23	Oct. 30	Nov. 6	Nov. 13	Nov. 20	Dec. 4	Dec. 11	Dec. 18	Dec. 26			
Oct. 30	1									1	142	994
Nov. 6	1	18								19	329	968
Nov. 13		3	22							25	744	2,018
Nov. 23		1	12	47						60	821	2,289
Dec. 4				10	51					61	1,542	5,055
Dec. 11			1	2	14	67				84	1,233	2,615
Dec. 18					5	24	39			68	912	1,966
Dec. 26						7	22	27		56	525	1,427
Jan. 6					1	2	5	11	7	26	222	735
TOTAL Tagged Fish Recovered (Ri)	2	22	35	59	71	100	66	38	7			18,067**
TOTAL Fish Tagged (Mi)	14	60	95	166	239	183	145	128	31			

* Includes tagged fish recovered.

** Total tagged fish from second week on must be subtracted 18,067 - 1,047 = 17,020.

$$\text{Population Estimate (N)} = \sum (R_{ij} \cdot \frac{M_i}{R_i} \cdot \frac{C_j}{R_j}) - \sum_i^n = 2 M_i$$

TABLE 5. Population Estimate of Chinook Salmon Based on Tag and Recovery Data for the Feather River from Gridley Bridge to Honcut Creek, Using Schaefer's Method, 1980

Recovery Period(j)	Tagging Period (i)			Total Tagged Fish Observed (Rj)	Total Fish Recovered (Cj)*	Population Estimate
	Oct. 31	Nov. 7	Nov. 14			
Nov. 7	2			2	62	465
Nov. 14		9		9	103	196
Nov. 21		1	8	9	116	398
TOTAL Tagged Fish Recovered (Ri)	2	10	8			1,059**
TOTAL Fish Tagged (Mi)	15	19	29			

* Includes tagged fish recovered.

** Total tagged fish from second week on must be subtracted $1,059 - 48 = 1,011 \times 2 = 2,022$.

$$\text{Population Estimate (N)} = \sum (R_{ij} \cdot \frac{M_i}{R_i} \cdot \frac{C_j}{R_j}) - \sum_i^n = 2M_i$$

Section	Males FL		Females FL	
	≥60.2 cm (23.9")	<60.2 cm	≥60.2 cm	<60.2 cm
Hatchery	53.6		46.4	
I.	34.6	3.6	61.0	0.8
II.	36.4	8.9	53.5	1.2
III.	50.0	13.3	36.7	

Sixty-three fish or 2.1% of the 3,003 fresh carcasses examined were adipose fin clipped: 49 from Section I and 14 from Section II. Fresh fish examined made up 3,003/31,608 of the river run or about 10%. Therefore, each adipose fin-clipped fish recovered represents ten in the spawning population.

Yuba River - By Lynn Wixom, Region 2

Spring Run. Fourteen coded wire tags from Feather River Hatchery spring-run salmon were observed in the Yuba River. From these returns the estimated number of Feather River spring run spawning in Yuba River is 200 fish.

Fall Run. The 1980 Yuba River fall-run salmon spawning inventory began on October 20, and was completed on December 23. During the inventory, conditions were ideal for recovery of carcasses. Transparency ranged from 2.4-3.0 m (8-10 ft), except during the week of November 4. Water clarity on that day was zero from Daguerre Point Dam downstream because of muddy water released from the Yuba Gold Fields Mining Operation. Flows were 28.3 m³/s (1,000 cfs) each week except in the first week in which river flow was 17.0 m³/s (600 cfs).

During 1980, only the sections of river between Highway 20 Bridge and the Marysville Dump were surveyed. The spawning escapement for these sections was estimated to be 10,843 using the method by Schaefer (1951) as reported by Taylor (1974b) (Table 6). Assuming the sections inventoried comprised 84.5% of the total run (from previous surveys, 1966-1971), the estimated total escapement was 12,406 which is greater than the 1970-79 average of 10,865. Based on the estimated percent of salmon spawning by stream section from the tagging and survey data, the following distribution of fish was determined:

<u>Section</u>	<u>Percent</u>	<u>Number</u>
I. Blue Point Mine to Highway 20 Bridge	15.5	1,922
II. Highway 20 Bridge to Daguerre Pt. Dam	47.0	5,831
III. Daguerre Pt. Dam to Hallwood Blvd.	26.9	3,338
IV. Hallwood Blvd, to Marysville Dump	10.6	1,315

TABLE 6 Population Estimate of Chinook Salmon Based on Tag and Recovery Data for the Yuba River from Highway 20 Bridge to Marysville Dump, Using Schaefer's Method, 1980

Recovery Period (j)	Oct. 21	Oct. 28	Nov. 4	Nov. 11	Nov. 18	Nov. 25	Dec. 2	Dec. 9	Dec. 12	No. Tagged Observed (Rj)	Total No. Carcasses Counted* (Cj)	Population Estimate
Oct. 28	28									28	254	612
Nov. 4	4	29								33	379	857
Nov. 11	9	9	50							68	637	1,443
Nov. 18	1	8	17	85						111	930	1,842
Nov. 25	2	1	9	29	138					179	1,071	2,076
Dec. 2				9	51	189				249	1,168	2,134
Dec. 9			2	1	13	27	92			135	800	1,674
Dec. 16				1		11	31	50		93	479	1,241
Dec. 23				1	3	4	16	16	34	74	337	889
TOTAL Tagged Fish Recovered (Ri)	44	45	78	126	205	231	139	66	34			12,768**
TOTAL Fish Tagged (Mi)	106	101	175	239	393	415	306	199	97			

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* Includes tagged fish recovered.

** Total tagged fish from second week on must be subtracted 12,768 - 1,925 = 10,843.

$$\text{Population Estimates (N)} = \sum (R_{ij} \cdot \frac{M_i}{R_i} \cdot \frac{C_j}{R_j}) - \sum_i^n - 2M_i$$

Twenty-three adipose clipped (indicating presence of coded wire tag) fish were observed among the 2,095 fresh carcasses seen during the inventory. Eighteen were recovered during the first three trips; five in the seven trips during the remainder of the season. Fresh fish examined made up 2,095/12,800 of the river run or about 1/6, therefore, each fish with adipose fin clip recovered represents six fish in the river run. ⁴⁰⁰

From the 2,095 fresh carcasses examined, 35.3% were adult males, 47.4% were adult females, 14.6% were male grilse, and 2.7% were female grilse.

American River by Robert L. Reavis, Jr., Region 2

Fall Run. Eleven spawning stock survey trips were made on the American River from November 3, 1980 through January 14, 1981. The river was divided into the following two sections which were surveyed weekly:

- I. Nimbus Racks to Rossmoor Bar
- II. Rossmoor Bar to Grist Mill Dam Access

River flows ranged from 42.5 to 56.6 m³/s (1,500 to 2,500 cfs) and water clarify was always greater than 4 ft.

The king salmon population was estimated by tagging fresh carcasses with colored ribbon that was attached to the jaw with a hog ring. The carcass was then placed into running water for future recovery. A Schaefer Model (Schaefer 1951), as modified by Taylor (1974b) for estimating a changing population, was used (Table 7). A total of 7,637 carcasses was recovered and the estimated number of spawners for both sections, based on the model was 32,057. No ribbon tags were recovered until the third week of the survey. Therefore, to estimate the number of spawners migrating into the river during this period, the 75 carcasses chopped during the first two weekly surveys were included in the third week's recovery total.

There were 1,872 carcasses counted upstream from the Nimbus Racks. Assuming an 85% recovery rate, the estimated total run in this upstream section was 2,202. A total of 15,543 salmon spawners entered Nimbus Hatchery. Combining the river estimates with the hatchery counts yields a total spawning escapement of 49,802, which exceeds the previous 10-year average of 45,535.

From 1,968 fresh carcasses used for the tag-recovery estimate, 53.4% were adult males, 40.8% were adult females, 2.8% were male grilse, and 3.0% were female grilse.

Five of the 1,968 fresh carcasses examined had adipose fin clips indicating the presence of a coded-wire tag. The relationship of the fresh carcasses seen to the estimated total river run of 32,000 is 16:1, therefore, each salmon with a missing adipose which was collected in the carcass survey represents 16 in the run.

TABLE 7. Population Estimate of Chinook Salmon Based on Tag and Recovery Data for the American River from Nimbus Racks to Griest Mill Dam Access, Using Schaefer's Method, 1980

Recovery Period (j)	Tagging Period (i)									No. Tagged Observed (Rj)	Total No. Carcasses Counted* Population Estimate	
	Nov. 10-11	Nov. 17-18	Nov. 24-25	Dec. 1-2	Dec. 8-9	Dec. 15-16	Dec. 22-23	Dec. 29-30	Jan. 5-6		(Cj)	
Nov. 17-18	5									5	239	1,673
Nov. 24-25	2	7								9	695	3,205
Dec. 1-2		5	41							46	1,053	3,791
Dec. 8-9		3	3	34						40	1,004	7,255
Dec. 15-16			2	8	33					43	1,326	6,550
Dec. 22-23				3	14	58				75	1,202	3,791
Dec. 29-30					9	34	41			84	1,301	3,791
Jan. 5-6					1	7	11	19		38	578	2,298
Jan. 13-14						1	3	8	7	19	239	1,119
TOTAL Tagged Fish Recovered (Ri)	7	15	46	45	57	100	55	27	7			33,473**
TOTAL Fish Tagged (Mi)	49	59	164	353	246	263	156	138	37			

* Includes tagged fish recovered.

** Total tagged fish from second week on must be subtracted 33,473 - 1,416 = 32,057.

$$\text{Population Estimate (N)} = \sum (R_{ij} \cdot \frac{M_i}{R_i} \cdot \frac{C_j}{R_j}) - \sum_i^n = 2M_i$$

CHINOOK SALMON POPULATIONS FOR
THE SAN JOAQUIN SYSTEM

Cosumnes to the Calaveras River

by

Robert Reavis, Jr.

Salmon spawning populations in the San Joaquin River tributaries 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

Fall Run. Flows were of insufficient quantity to allow passage of fish for most of the fall migration period. A brief period of rain did provide enough water on December 10, 1980 for a few spawners to migrate upstream.

Two partial surveys (December 12 and 29) were made. One of the surveys between Michigan Bar and Bridgehouse and the other between Granlees' Dam and Bridgehouse (Figure 4). No salmon were seen above Granlees' Dam. A total of 21 live fish and 14 carcasses was counted between Granlees' Dam and Highway 16 in the two surveys. The estimated run for this stream is less than 200 salmon. The previous 10-year average is 486.

Mokelumne River

Fall Run. Seven survey trips were conducted on the Mokelumne River from November 12 to December 24, 1980. Four trips were made from the Mokelumne River Fish Installation to Elliot Road Bridge and three trips were made from the Mokelumne River Fish Installation to Mackville Road Bridge.

Flows during the early part of the survey were $17.0 \text{ m}^3/\text{s}$ (600 cfs) and thereafter decreased to $5.7 \text{ m}^3/\text{s}$ (200 cfs). Water clarity was less than one foot during the first survey trip, but increased to 6 ft as the season progressed.

Three hundred and eleven carcasses were counted. Based on the recovery of fresh carcasses that were tagged and placed back in the stream, the seasonal recovery rate was 12%. This resulted in an estimated total of 2,592 fish spawning naturally. Combining this figure with the 639 counted into the Mokelumne River Fish Installation yields a total of 3,231 spawners in the river. This exceeds the previous ten-year average of 2,054.

From the 91 fresh carcasses examined, 24.2% were adult males, 56.0% were adult females, 13.2% were male grilse, and 6.6% were female grilse. Two of the carcasses examined had no adipose fin but neither possessed a coded-wire tag. Both were females and apparently had lost their adipose fins in digging the redd and subsequent fin rot.

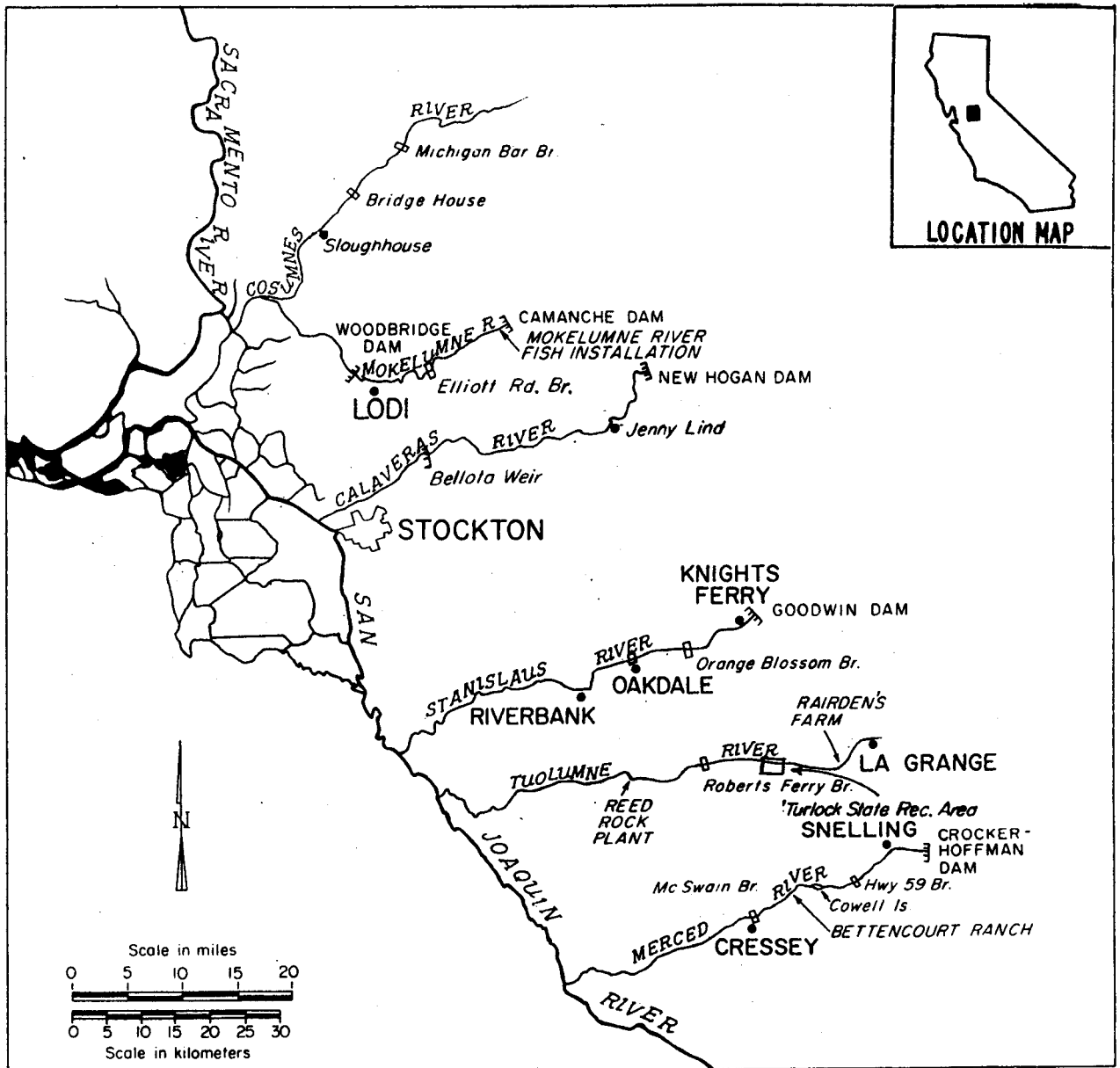


FIGURE 4. San Joaquin River tributaries.

Calaveras River

Winter Run. Normally this run migrates into the river during April. There were periods of high flow that would have permitted movement over Bellota Weir, which in past years has been a barrier to upstream migration of adult salmon. Construction workers at this site during April reported several large fish (20-30") above the weir. No fish were observed by Department personnel. An estimate of the annual run was not made.

Stanislaus to Merced River

by

Maurice Fjelstad

Stanislaus River

Fall Run. Four complete trips were made in the spawning areas during the season. Traditionally, the survey has been divided into four sections as follows:

- I. Goodwin Dam to Knights Ferry - foot check at Two Mile Bar only.
- II. Knights Ferry to Orange Blossom Bridge - boated.
- III. Orange Blossom Bridge to Oakdale Bridge - boated.
- IV. Oakdale Bridge to Riverbank Bridge - boated.

Because of the very low run in 1980, Sections III and IV were combined into a one-day trip and as in the recent past, Section II was surveyed on the same day as Section I. At the Department's request, the U. S. Bureau of Reclamation agreed to release 5.7 m³/s (200 cfs) from October 1 through November 30 and 2.8 m³/s (100 cfs) thereafter until the flow would be increased for the out-migration period.

Observation conditions were excellent throughout the season, however, only 15 carcasses were observed, five of which were tagged. No tagged carcasses were recovered. The estimate of the run size was made by examination of the spawning areas.

Less than 100 salmon were estimated to have reached Stanislaus River spawning areas in 1980, which is only 3% of the previous 10-year average of 3,116.

Tuolumne River

Fall Run. Six complete trips were made from November 12 through December 18, 1980. During most of this period, flow released were 10.9 m³/s (385 cfs) and observation conditions were good. After December 19 each year, the Federal Energy Regulation Agency (FERC) license for the Don Pedro Project allows the Districts to release peaking hydroelectric flows into the river up to 127.4 m³/s (4,500 cfs) which results in poor observation conditions and termination of the survey.

The salmon survey has traditionally been divided into three sections 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 above three sections have been combined into two sections: La Grange to Turlock Lake State Recreation Area (Sections I and II) and Turlock Lake State Recreation Area to Reed Rock Plant (Sections II and III). During the survey trips in 1980, we examined 248 carcasses and tagged 47.

The Schaefer Method was used to estimate the run size (Table 8). The total number of salmon spawning in the Tuolumne River in 1980 was estimated to be 559, which is 10% of the previous 10-year average of 5,476.

Merced River

Fall Run. The spawning stock surveys in the Merced River were conducted from November 6 through December 17, 1980. Traditionally, the river has been divided into three sections as follows:

- I. Crocker Huffman Dam to Highway 59 Bridge (10 miles).
- II. Highway 59 Bridge to Bettencourt Ranch (7.5 miles).
- III. Bettencourt Ranch to Cressey (7 miles).

Because of unsafe boating conditions (high flows, brush-choked channels) in Sections II and III, only Section I was regularly surveyed. Seven trips were made during the season in Section I; four trips in Section II and one trip in Section III. Observation conditions were generally good, in spite of the higher than normal flows.

Because relatively complete information was available only from Section I, the spawning population for this reach was first estimated from tag returns and then expanded by means of redd counts, to arrive at a total estimated run for the entire river. The simple Petersen Method was used to estimate the Section I run as follows:

$$N_1 = \frac{M_1 C_1}{R_1}$$

where: N_1 = run size Section I

M_1 = number of tagged carcasses

C_1 = number of carcasses examined

R_1 = number of tags recovered

TABLE 8. Population Estimate of Chinook Salmon Based on Tag and Recovery Data for the Tuolumne River from LaGrange to Reed Rock Plant, Using Schaefer's Method, 1980

Recovery Period (j)	Tagging Period (i)					Total Tagged Fish Recovered (Rj)	Total Fish Recovered (Cj)*	Population Estimate
	Nov. 12-13	Nov. 19-20	Nov. 26 & Dec. 2	Dec. 6-7	Dec. 10-12			
Nov. 12 & 13		Tagging only					33	13
Nov. 19-20	3					3	56	120
Nov. 26 & Dec. 2	2	3				5	47	147
Dec. 6-7	2	4	7			13	55	142
Dec. 10-12			2	4		6	45	93
Dec. 17-18					3	3	40	93
TOTAL Tagged Fish Recovered (Ri)	7	7	9	4	3			618**
TOTAL Fish Tagged (Mi)	15	24	20	8	7			

* Includes tagged fish recovered.

** Total tagged fish from second week on must be subtracted 618-59 = 559.

$$\text{Population estimate (N)} = \sum (R_{ij} \cdot \frac{M_i}{R_i} \cdot \frac{C_j}{R_j}) - \sum_1^n = 2M_i$$

Actual computations were as follows:

$$N_1 = \frac{(88)(347)}{18} = 1,696 \text{ salmon}$$

The run for the entire river was estimated as follows:

$$N = \frac{N_1 P_t}{P_1}$$

where: N = total run for river

N_1 = section run size

P_t = all sections, total redd count

P_1 = Section I, total redd count

$$N = \frac{(1,696)(267)}{159} = 2,849 \text{ salmon}$$

The Merced River salmon run was estimated at 3,008 spawners including 157 fish artificially spawned at the Merced River Fish Facilities (MRFF). This exceeds the previous 10-year average of 2,169.

In order to provide young salmon for the Merced River yearling program, a trap and incubation facility were installed at MRFF prior to the 1980 season. During the season, a total of 157 adult salmon (106 females and 51 males) were captured and spawned. Two salmon, sex unknown, escaped from the trap into the spawning channel. Approximately 449,400 eggs were taken. The young will be raised to yearling size and released in late 1981.

SUMMARY

During 1980 the California Department of Fish and Game conducted its 28th 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 River system and the Sacramento River system downstream from Red Bluff, spawning stock estimates were made by the California Department of Fish and Game. These estimates were based on carcass counts, aerial redd counts, and live fish counts. Estimates for the Sacramento River system above Red Bluff were based primarily on U. S. Fish and Wildlife Service counts of fish passing Red Bluff Diversion Dam, and on Department of Fish and Game sampling at the dam.

The estimated 1980 Central Valley chinook salmon spawning escapement was 195,422 fish (Table 9).

TABLE 9. Sacramento-San Joaquin System Chinook
Salmon Spawning Population 1980

Spawning area	Late-fall Run	Winter Run	Spring Run	Fall Run	Combined
Sacramento main stem	9,361	1,142	9,369	52,414	72,286
Sacramento tributaries			3,095	112,627	116,159
San Joaquin tributaries				7,100	7,100
TOTALS	9,361	1,142	12,464	172,141	195,108

The average annual fall salmon run spawning population size has decreased in the upper Sacramento and San Joaquin river systems and have increased in the Feather and American rivers. During the 1953 through 1959 period, the average fall run-size in the upper Sacramento River system was 147,000. In the 1960-69 period, it was 114,000 and in the 1970-79 period, it was 81,000. This is a decrease of 45% between the 1950's and 1970's.

A more dramatic decline occurred in the San Joaquin River system. During the 1950's the mean run was 45,000; in the 1960's, it dropped to 18,000; and in the 1970's it was 13,000 or 28% of the 1950's average.

In the Feather River the above averages were 45,000 (1950's), 35,000 (1960's), and 52,000 (1970's) and in the American, the averages were 21,000, 37,000 and 45,000, respectively.

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APPENDIX TABLE 1. Red Bluff Diversion Dam Adjusted Salmon Counts
November 12, 1979 through January 3, 1981

Week	Adjusted Salmon Count	Number Sampled	Late-fall run Percent	Number	Winter run Percent	Number	Spring run Percent	Number	Fall run Percent	Number
1979										
11/12-12/29	Runs in Progress			3,875*						
1980										
12/30-1/5	1,620	108	99.1	1,605	.9	15				
1/6-12	505	148	98.6	498	1.4	7				
1/13-19	504	no sample	99.31/	500	.71/	4				
1/20-26	497	79	100.0	497	-	-				
1/27-2/2	289	16	100.0	289	-	-				
2/3-9	492	182	99.6	490	.4	2				
2/10-16	428	136	96.3	412	3.7	16				
2/17-23	6022/	no sample	98.0	5902/	2.0	122/				
2/24-3/1	6082/	no sample	96.9	5892/	3.1	192/				
3-8	28	10	100.0	28	-	-				
3/9-15	61	8	100.0	61	-	-				
3/16-22	17	2	100.0	17	-	-				
3/23-29	52	18	21.2	11	78.8	41				
3/30-4/5	96	30	10.4	10	86.4	83	3.1	3		
4/6-12	200	106	2.0	4	94.0	188	4.0	8		
4/13-19	244	48	2.0	5	73.0	178	25.0	61		
4/20-26	198	39			25.8	51	74.2	147		
4/27-5/3	148	40	9,481		22.2	33	77.8	115		
5/4-10	215	48			20.9	45	79.1	170		
5/11-17	214	63			39.7	85	60.3	129		
5/18-24	187	58			22.4	42	77.6	145		
5/25-31	233	48			37.3	87	62.7	146		
6/1-7/7	186	43			16.1	30	83.9	156		
6/8-14	197	54			31.5	62	68.5	135		
6/15-21	180	43			23.3	42	76.7	138		
6/22-28	194	no sample			15.53/	30	84.53/	164		
6/29-7/5	246	no sample			6.03/	15	94.03/	231		
7/6-12	364	no sample			9.13/	33	90.93/	331		
7/13-19	545	no sample			3.33/	18	95.93/	523	.8	4
7/20-26	548	no sample			3.33/	18	29.33/	161	67.4	369
7-7-8/2	513	142					67.6	347	32.4	166
					1,156					

(continued on next page)

APPENDIX TABLE 1. Red Bluff Diversion Dam Adjusted Salmon Counts
November 12, 1979 through January 3, 1981 (continued)

Week	Adjusted Salmon Count	Number Sampled	Late-fall run Percent Number	Winter run Percent Number	Spring run Percent Number	Fall run Percent Number
8/3-9	315	148			73.0 230	27.0 85
8/10-16	525	199			65.7 345	34.3 180
8/17-23	1,136	82			81.7 928	18.3 208
8/24-30	1,559	97			77.3 1,205	22.7 354
8/31-9/6	1,330	101			77.2 1,027	22.8 303
9/7-13	2,284	396			65.7 1,501	34.3 783
9/14-20	3,011	329			23.7 714	76.3 2,297
9/21-27	3,027	295			12.2 369	87.8 2,658
9/28-10/4	3,103	257			8.6 267	91.4 2,836
10/5-11	4,204	360				100.0 4,204
10/12-18	4,516	163			9,696	100.0 4,516
10/19-25	4,093	351	3.1	127		96.9 3,964
10/26-11/1	3,503	331	4.8	168		95.2 3,354
11/2-8	5,049	422	5.0	252		95.0 4,794
11/9-15	1,952	78	12.8	250		87.2 1,702
11/16-22	2,154	143	9.1	196		90.9 1,958
11/23-29	1,827	144	21.5	393		78.5 1,434
11/30-12/6	1,110	112	27.7	307		72.3 803
12/7-13	396	56	58.8	233		54.2 163
12/14-20	534	261	38.8	207		61.2 327
12/21-27	572	113	69.0	395	5.3 30	25.7 147
12/28-1/3	381	50	82.2	313	13.9 53	3.9 15
						37,610
Total 1980 Calendar Year	56,992	5,957	8,447	1,239	9,696	37,610

Portion of run passing RBDD during 1979, and expected to spawn during 1980. For a weekly breakdown of numbers, see the 1979 Central Valley Spawning Stock Estimates, (Reavis, 1981).

Indicates the size of the salmon run passing RBDD with the potential of spawning during calendar year 1980.

1/ Averaged percent (week before-week after)

2/ Number passing dam is based on five-year (1971-73, 1975-76) average percent of total run passing dam during corresponding week.

3/ Five-year average (1975-79)

4/ Includes a total of 175 fish trucked to Tehama-Colusa Fish Facility.

APPENDIX TABLE 2. Estimated Monthly Chinook Salmon Sport Catch in the Sacramento River Between Keswick Dam and Red Bluff Diversion Dam, Divided into Landings from the Four Runs that Spawned There in 1980 Based on Their Percentages (occurrence) in the Counts at Red Bluff Diversion Dam.

Year	Month	Catch	Late-fall run		Winter run		Spring run		Fall run	
			Percent	Catch	Percent	Catch	Percent	Catch	Percent	Catch
1979	Nov.	279	6.2	17	-	-	-	-	93.8	262
	Dec.	49	47.0	23	-	-	-	-	53.0	26
1980	Jan.	81	98.8	80	1.2	1	-	-	-	-
	Feb.	0	-	120	-	-	-	-	-	-
	Mar.	0	-	-	-	-	-	-	-	-
	Apr.	16	2.3	-	68.7	11	31.3	5	-	-
	May	3	-	-	33.3	1	66.7	2	-	-
	June	6	-	-	16.7	1	83.3	5	-	-
	July	2	-	-	-	14	50.0	1	50.0	1
	Aug.	120	-	-	-	-	72.5	87	27.5	33
	Sept.	561	-	-	-	-	40.3	226	59.7	335
	Oct.	438	1.8	8	-	-	1.6	7	96.6	423
	Nov.	254	9.4	24	-	-	-	-	90.6	230
	Dec.	18	44.4	8	5.6	1	-	-	50.0	9
1980 Total		1,499		120		15		333		1,031
(Calendar Year)										

 = Total catch from run that spawned in 1980.

APPENDIX TABLE 3. Summary of Chinook Salmon Spawning Population Estimates for the Sacramento River System, 1980.

	Late- fall run	Winter run	Spring run	Fall run	Total
<u>Keswick Dam to Red Bluff</u> ^{1/}					
Sacramento River main stem	9,361	1,142	9,363	21,961 (14,443)	41,827
Battle Creek (Total)				9,503	9,503
Coleman Hatchery				4,940	4,338
Below Hatchery					
<u>TOTAL Keswick Dam</u>					
to Red Bluff	9,361	1,142	9,363	36,404	56,270
<u>Red Bluff to Princeton Ferry</u>					
Sacramento River main stem				(30,453)	
Red Bluff to Tehama				18,600	18,600
Tehama to Woodson Bridge				6,733	6,733
Woodson Bridge to Princeton Ferry				3,080	3,080
Tehama-Colusa spawning channel			6	2,040	2,046
Mill Creek			500	320	820
Deer Creek			1,500	210	1,710
Thomes Creek				151	151
<u>TOTAL, Red Bluff</u>					
to Princeton Ferry			2,006	31,134	33,140
<u>Butte Creek to American River</u>					
Butte Creek			226		226
Feather River (Total)			(669)	(35,295)	
Hatchery			269	3,690	3,959
Below Hatchery			400	31,605	32,005
Yuba River			200	12,406	12,606
American River (Total)				(49,802)	
Hatchery				15,543	15,543
Below Nimbus Racks				32,057	32,057
Above Nimbus Racks				2,202	2,202
<u>TOTAL, Butte Creek to</u>					
to American River			1,095	97,503	98,598
<u>GRAND TOTAL, SACRAMENTO</u>					
RIVER SYSTEM	9,361	1,142	12,464	165,041	188,008

^{1/} Includes other tributaries except Battle, Clear and Cottonwood creeks.

^{2/} No estimate made.

APPENDIX TABLE 4. Summary of Chinook Salmon Spawning Population
Estimates for the San Joaquin River System, 1980

Area	Winter Run	Fall Run	Total
Cosumnes River		200	200
Mokelumne River (Total)		(3,231)	
Hatchery		639	639
Below Hatchery		2,592	2,592
Calaveras River	0		0
Stanislaus River		100	100
Tuolumne River		559	559
Merced River (Total)		(3,010)	
Spawning Channel		161	161
Below Hatchery		2,849	2,849
TOTALS		7,100	7,100

APPENDIX TABLE 5. Sacramento-San Joaquin Valley Chinook Salmon Spawning Stock Estimates, 1964-1980. in Thousands of Fish. Spawning Stock Estimates from 1953-1963 Can Be Found in Taylor (1974a)

	Sacramento River system above Red Bluff, excluding Battle Creek				Battle creek	Sacramento main stem below Red Bluff	Feather River	Yuba River	American River	Cosumnes River	Mokelumne River	Stanislaus River	Tuolumne River	Merced River	Others ^{a/}	
Year	Late- fall	Winter	Spring	Fall	Fall	Fall	Spring	Fall	Fall	Fall	Fall	Fall	Fall	Fall	All races combined	
1964	b/	b/	b/	150 ^{c/}	16	6	3	38 ^{c/}	35	59	2	2	4	2	0.04	7
1965	b/	b/	b/	107 ^{c/}	9	2	0.7	23 ^{c/}	10	39	0.8	1.3	2	3	0.09	2
1966	b/	b/	b/	124 ^{c/}	3	3	0.3	21 ^{c/}	8	27	0.6	0.7	3	5	0.04	1
1967	b/	b/	b/	84 ^{c/}	5	9	0.1	12 ^{c/}	24	23	0.5	3	12	7	0.6	1
1968	b/	b/	b/	116 ^{c/}	6	12	0.2	18 ^{c/}	7	31	1.5	1.7	6	9	0.5	2
1969	b/	b/	20	130	6	18	0.3	61 ^{c/}	5	47	4	3	12	32	0.6	5
1970	b/	b/	4	70	7	6	0.2	62 ^{c/}	13	37	0.6	5	9	18	5	5
1971	17	53	6	59	5	23	0.5	47 ^{c/}	6	52	0.5	5	14	22	4	5
1972	33	28	7	36	5	15	0.3	47 ^{c/}	9	25	1.6	1.1	4	5	3	3
1973	22	23	7	44	8	17	0.2	74 ^{c/}	24	95	0.9	3	1.2	2	1.1	6
1974	6	19	4	49	4	28	0.2	66	18	62	0.3	1.4	0.8	1.1	2	8
1975	18	23	10	55	5	36	0.7	43	6	40	0.7	1.9	1.2	1.6	2.4	15
1976	16	33	25	57	5	36	0.7	62	4	28	0	0.5	0.6	1.7	1.9	1
1977	9	16	13	40 ^{d/}	b/	46	0.2	46	9	48	0	0.3	0	0.4	0.4	3
1978	12	25	6	35	4	48	0.2	38	7	21	0.1	1.1	0.05	1.3	0.6	3
1979	10	2	3	48	13	67	0.25	33	12	48	0.15	1.5	0.11	1.2	2.1	2
1980	9	1	9	22	14	30	0.7	35	13	50	0.2	3.2	0.1	0.5	2.8	2

^{a/} 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 spring-run fish may have been included in the fall-run estimate.

^{d/} Includes Battle Creek.

APPENDIX TABLE 6. Mark Chinook Salmon Recovered from Central Valley
Streams North of the Feather River, 1980.

CWT Code	Hatchery of Origin	Number of Recoveries by Location						Total
		Coleman	Tehama-Colusa	Battle Creek	Mill Creek	Sacramento River	Unknown	
5-1-3	USF&WS		1					1
5-3-20	USF&WS	6	28	2				36
5-48-1	USF&WS		1					1
6-41-1	Feather R.		4					4
6-41-2	Feather R.	2	17		1			20
6-41-4	Feather R.		1					1
6-41-8	Feather R.		1					1
6-58-9	Feather R.		1					1
6-58-10	Feather R.		1					1
6-58-11	Feather R.		1					1
6-58-12	Feather R.	1	5					6
6-58-13	Feather R.	1	78				1	80
6-58-16	Feather R.		2					2
6-62-3	Feather R.		41			1	1	43
6-62-6	Feather R.		1					1
6-48-10	Mokelumne R.		19				1	20
6-48-12	Mokelumne R.		1					1
6-60-8	Coleman			1				1
6-60-11	Coleman	1						1
6-60-12	Coleman	28	3	5				36
6-60-13	Coleman	17						17
6-60-14	Coleman	9	1					10
6-60-15	Coleman	10	1				1	12
6-60-22	Coleman	4	1					5
6-60-23	Coleman	4						4
TOTALS		83	209	8	1	1	4	306

APPENDIX TABLE 7. Mark Chinook Salmon Recovered from Central Valley Streams from the Feather River and South, 1980

CWT Code	Hatchery of Origin	Number of Recoveries by Location									Total
		Feather R. H.	Nimbus H.	Mokelumne R. Instl.	Merced River	Tuolumne River	Stanislaus River	Feather River	Yuba River	American River	
6-1-7	Feather R.	1									1
6-41-1	Feather R.	2	2								4
6-41-2	Feather R.	16	1					2			19
6-41-3	Feather R.	1		1							2
6-41-4	Feather R.	1		1							2
6-41-5	Feather R.	1									1
6-41-7	Feather R.			1							1
6-41-8	Feather R.			1							1
6-58-9	Feather R.	58						23	13		94
6-58-10	Feather R.	22						7	2		31
6-58-11	Feather R.	10							1		11
6-58-12	Feather R.	56						3		1	60
6-58-13	Feather R.	43	31	9		1		2	1		87
6-62-2	Feather R.	1									1
6-62-3	Feather R.	22	3	4			2			1	32
6-62-5	Feather R.		1								1
6-62-6	Feather R.		1								1
6-46-10	Merced	1			22						23
6-46-11	Merced				3						3
6-48-9	Mokelumne	2	5	20							27
6-48-10	Mokelumne	5	35	3						3	46
6-48-11	Mokelumne			11							11
6-48-12	Mokelumne	3		1							4
6-61-1	Trinity R.		1								1
TOTALS		245	80	52	25	1	2	37	17	5	464