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DEPARTMENT OF FISH AND GAME

CHINOOK (KING) SALMON SPAWNING STOCKS IN CALIFORNIA'S CENTRAL VALLEY, 1977

Edited by

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ABSTRACT

This report covers the 25th 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 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 salmon.

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

Estimated 1977 escapement of fall-spawning (fall- plus spring-run) salmon in the Central Valley is 205,836 fish (204,125 in the Sacramento River system and 1,711 in the San Joaquin River system). This total is 71% of the historic (1953-1976) average of 291,000 and 93% of the 1976 estimate of 221,056.

Tables present fall- and spring-run spawning escapements by stream for 1977, and by major streams for the years 1964 through 1977.

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INTRODUCTION

This report covers the 25th annual California Central Valley chinook salmon, Oncorhynchus tshawytscha, spawning stock inventory.

The California Central Valley (Sacramento-San Joaquin River system) (Figures 1-3) is the principal producer of chinook salmon caught in California's ocean fisheries. Central Valley chinook salmon also contribute significantly to the ocean fisheries of Oregon and Washington.

Four different "runs" or "races" of chinook salmon are recognized in the Central Valley. These are:

(1) The late-fall run. These fish are largely confined to the upper part of the Sacramento's main stem and are usually larger than fish of either the fall or winter runs. Most spawn from January through March.

(2) The winter run. Most spawn in the Sacramento main stem above Red Bluff Dam from April into July.

(3) The spring run. Spring-run salmon were once widespread in the Valley but have disappeared from many of the streams they once utilized. Most spawn in September or early October.

(4) The fall run. These are the most numerous and widely distributed salmon in the Valley. Most Central Valley streams that have regular salmon runs of any type have an annual fall run. Most fall-run fish spawn from the middle of October through December.

Spring and fall runs in all principal Central Valley streams have been monitored annually since 1953. Regular monitoring of the late-fall and winter runs began in 1967, after construction of counting facilities at Red Bluff Diversion Dam. (Most Central Valley late-fall- and winter-run chinook salmon spawn above the dam.)

For this report, all Central Valley streams known to support sizeable salmon runs were either surveyed, or the numbers of spawners estimated by counting at some point downstream from the spawning areas. Survey effort was concentrated in areas known to support the largest runs.

METHODS

Sacramento River from Keswick Dam to Red Bluff Diversion Dam

Estimates of the total numbers of salmon utilizing the Sacramento River and its tributaries upstream from Red Bluff Diversion Dam during 1977 were based on daily counts made by the U. S. Fish and Wildlife Service at Red Bluff Diversion Dam. The counts were obtained by closed circuit television observations of salmon passing through the fishways.

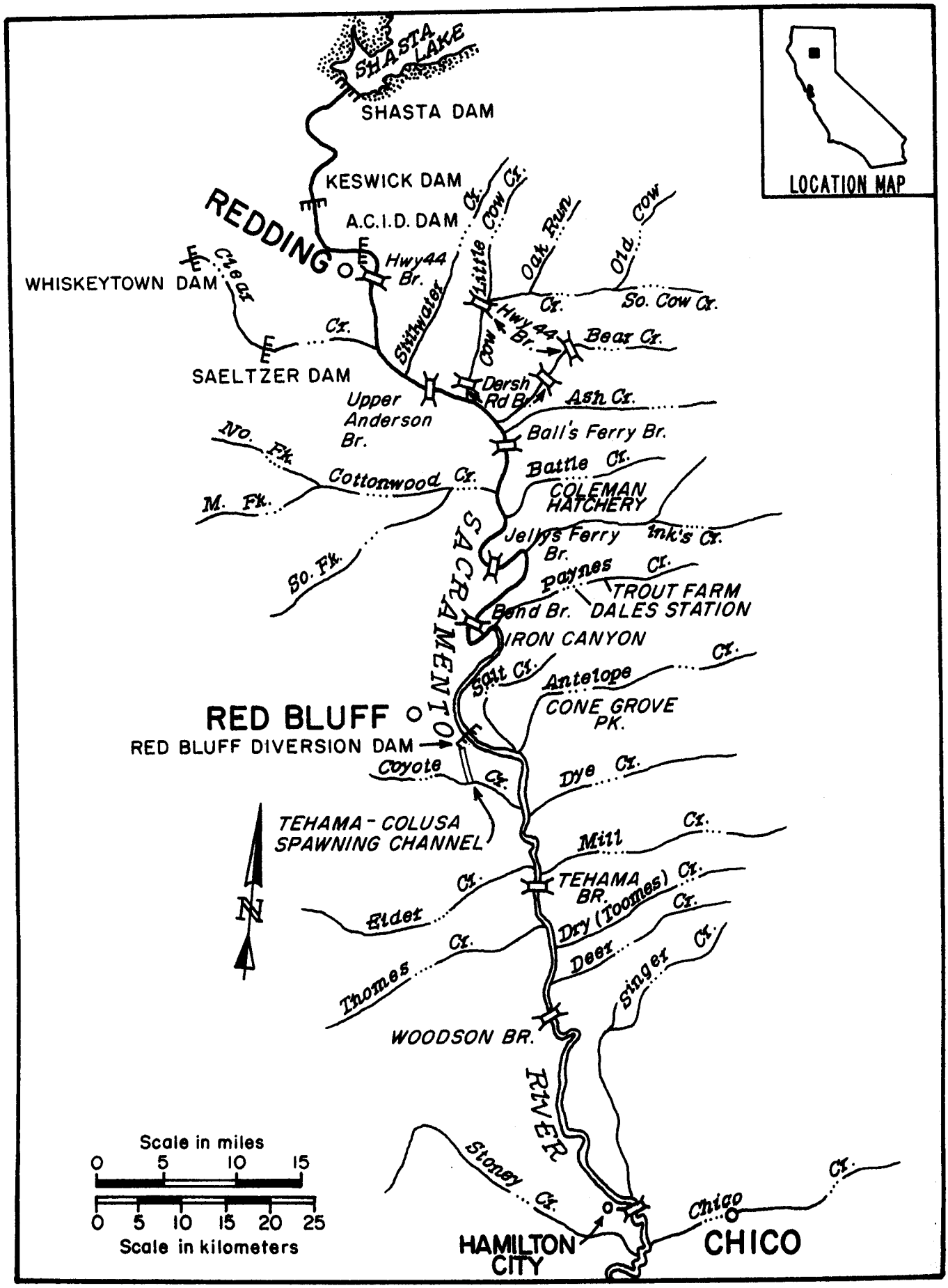

FIGURE 1. Upper Sacramento River and tributaries above Chico Creek.

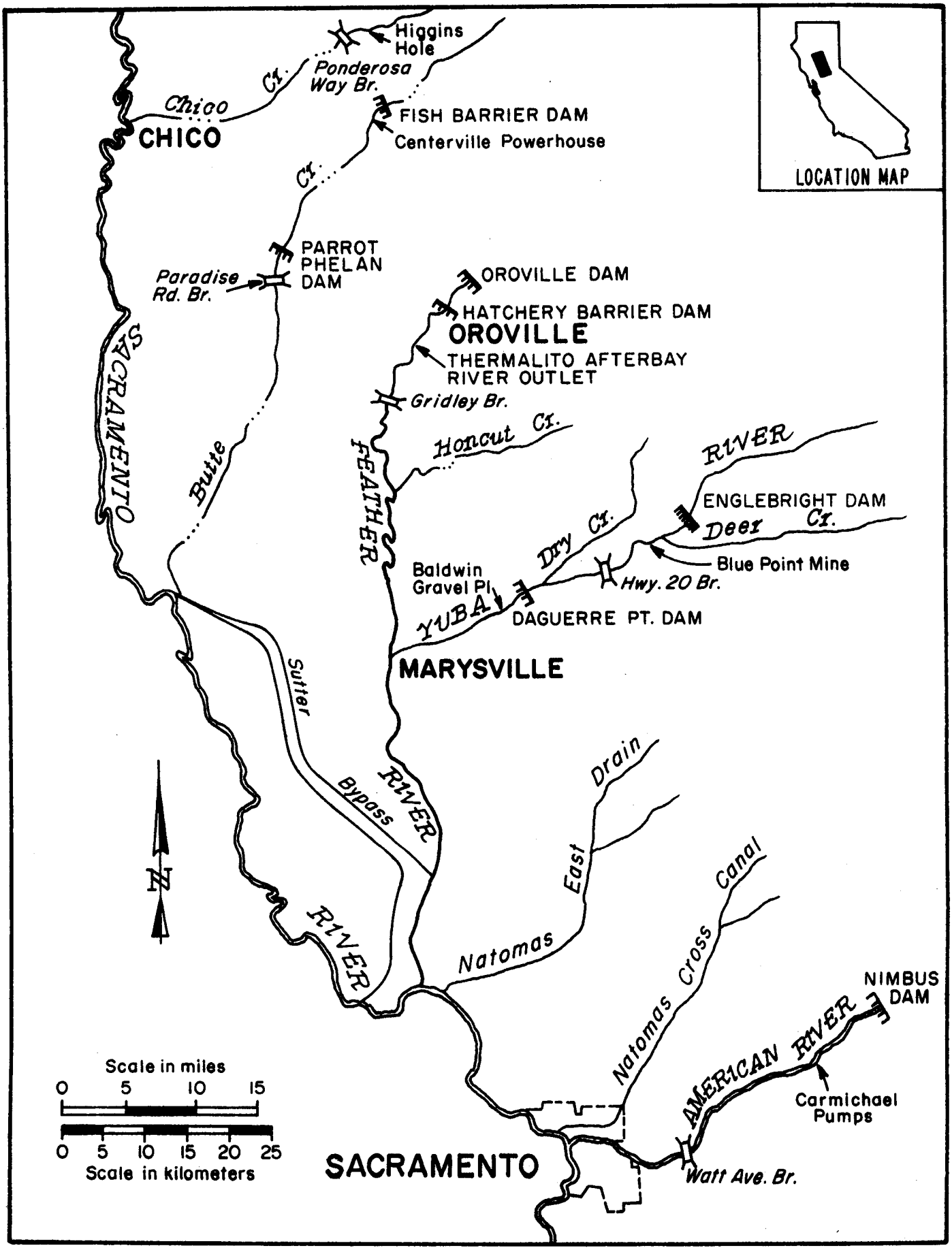

FIGURE 2. Sacramento River tributaries from Chico Creek south.

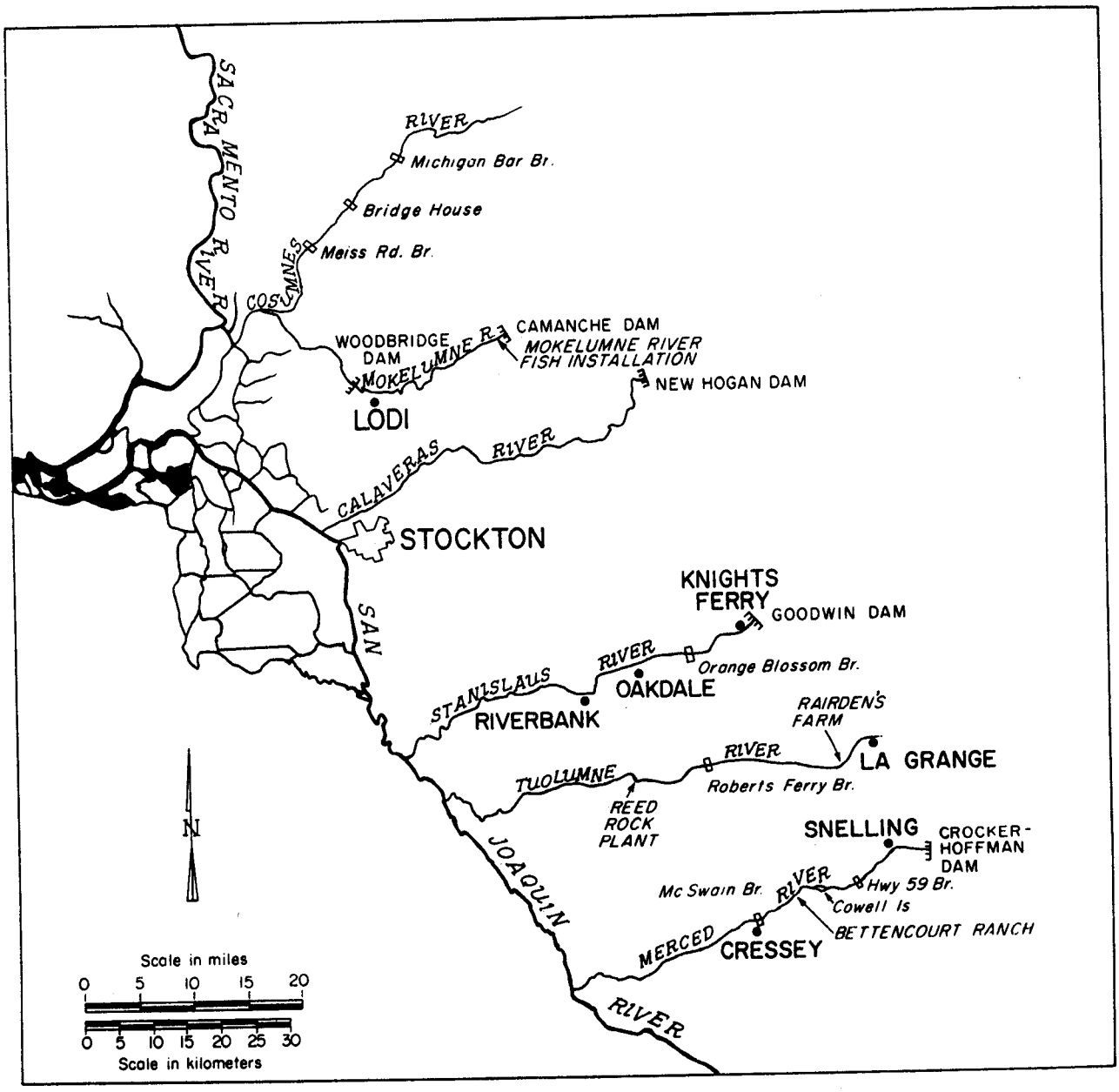

FIGURE 3. San Joaquin River tributaries.

Weekly counts were adjusted for periods when the fishways remained open but no counts were made: when the river was turbid, when flood conditions made it necessary to open the gates of the dam, and at night when no counts were made. Count adjustments for the daytime lapses were made by interpolation. Adjustment for the nighttime hours 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 according to data obtained at the trapping facility adjacent to the east bank fishway. Examined salmon were assigned to a particular run by 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 (spawning populations), the number of salmon landed by sportsmen 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.

While a calendar year count includes total annual runs passing the dam for spring-run 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 numbers of 1977 spawners in these two runs, it was necessary to add the appropriate portion of the 1976 calendar year count, and delete that portion of the 1977 count which spawned in 1978.

Moderate numbers of fall-run salmon spawn in tributaries upstream from Red Bluff. The larger tributary streams were surveyed in 1977, and spawners in other tributaries are included with the main stem estimates.

San Joaquin River Tributaries and the Sacramento River System below Red Bluff Diversion Dam

The 1977 fall- and spring-run chinook salmon spawning escapement estimates in the Sacramento River system south of Red Bluff Diversion Dam and in the San Joaquin system were based primarily on spawning bed surveys and carcass counts. In some streams, carcasses were marked and released, and subsequent recovery rates of marked carcasses were a consideration in estimating the populations. The maximum number of survey trips that money and manpower limitations permitted was made on each stream. Unless otherwise stated (or if only one survey trip was made), all counted carcasses were cut in half to prevent recounting on subsequent trips. Surveys were sometimes supplemented by aerial redd counts. Details and special methods are presented under individual stream headings.

CHINOOK SALMON SPAWNING POPULATIONS
KESWICK DAM TO RED BLUFF DIVERSION DAM

Main Stem Sacramento River, and all Tributaries Except Clear and Cottonwood Creeks

by

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Because of drought-related poor water conditions in the upper main stem Sacramento River, 23,430 salmon were trapped at Keswick and Red Bluff Diversion dams and transported to hatcheries and streams where spawning conditions were more suitable than in the Sacramento River (Table 1). Since these fish normally would have spawned above Red Bluff dam, and for purposes of comparison with historical runs, all transported salmon are included in the Sacramento River main stem spawning population estimate above Red Bluff Dam.

TABLE 1. Relocation of Adult Chinook Salmon Trapped at Keswick and Red Bluff Diversion Dams, 1977

Destination	Origin	Date(s)	Number and run			
			Late-fall	Winter	Spring	Fall
Clear Creek	Keswick	7/12			158*	
	Red Bluff	10/16, 22				154
Battle Creek	Red Bluff	10/2, 29				6,163
Coleman Hatchery	Red Bluff	9/18, 10/8				7,351
	Keswick	12/7, 31				392
	Red Bluff	12/11, 31	532			
Sacramento River @ Bend	Red Bluff	10/12				69+
Tehama-Colusa Fish Facility	Red Bluff	10/30, 11/12				3,146
Mill Creek	Red Bluff	4/18, 6/17			528	
	Keswick	7/21			35*	
	Red Bluff	11/13, 19				138
Deer Creek	Red Bluff	4/20, 6/3			467	
Chico Creek	Red Bluff	5/20, 6/7			242	
	Keswick	7/14, 18			90*	
Butte Creek	Red Bluff	5/3, 6/6			388	
Feather River Hatchery	Red Bluff	7/14, 20				59‡
	Red Bluff	10/30, 11/12				3,518
TOTALS			532		1,908	20,990

* Includes some winter-run fish.
\+ Emergency release due to aerator failure.
‡ Trial hauling to determine feasibility.

Late-fall Run

An estimated 9,210 late-fall-run salmon spawned in the Sacramento River upstream from Red Bluff in 1977. This total includes 532 fish that were trapped at Red Bluff Diversion Dam and hauled to Coleman Hatchery for spawning (Table 1). The estimated sport catch of 478 late-fall-run salmon landed above Red Bluff and the 914 fish that entered Coleman Hatchery via Battle Creek were subtracted from the 10,602 late-fall-run salmon counted as they passed Red Bluff Diversion Dam between October 24, 1976 and April 9, 1977 (Tables 2, 3 and 4). Although some late-fall-run salmon usually spawn in tributaries to the Sacramento River, no spawning stock surveys were made in any tributaries upstream from Red Bluff and all late-fall-run salmon, other than those that entered Coleman Hatchery, are allocated to the Sacramento River.

Winter Run

An estimated 16,470 winter-run salmon spawned in the Sacramento River above Red Bluff in 1977. This total was arrived at by subtracting an estimated 744 winter-run salmon caught by sportsmen above Red Bluff Diversion Dam between January 1, 1977 and June 30, 1977 from the 17,214 counted as they passed Red Bluff Diversion Dam in 1977 (Tables 2-4). Although some winter-run salmon have been known to spawn in tributaries such as Battle Creek, this race spawns primarily in the main stem of the Sacramento River.

Spring Run

An estimated 13,453 spring-run salmon spawned in the Sacramento River above Red Bluff in 1977. This total includes 1,908 fish that were trapped at Keswick and Red Bluff Diversion dams and hauled to other streams (Table 1). The estimated sport catch of 277 spring-run salmon landed above Red Bluff was subtracted from the 13,730 spring-run salmon counted at Red Bluff Diversion Dam between March 20 and August 20, 1977 (Tables 2-4). There were no tributary surveys for spring-run salmon in 1977 and all spring-run salmon that spawned in the Sacramento River system above Red Bluff are allocated to the Sacramento River main stem.

Fall Run

An estimated 36,705 fall-run salmon spawned above Red Bluff in the main stem of the Sacramento River and tributaries other than Clear and Cottonwood Creeks in 1977. This total includes 20,990 fish that were trapped at Keswick and Red Bluff Diversion dams and hauled to other hatcheries and streams (Table 1). An estimated 865 salmon caught by sportsmen above Red Bluff, and 2,874 that spawned in Clear and Cottonwood creeks, were subtracted from the 40,444 fall-run salmon counted at Red Bluff Diversion Dam in 1977 (Tables 2-4).

Separate spawning stock estimates were made for the larger tributaries: Battle, Clear and Cottonwood creeks. No estimates were made for several smaller tributaries above Red Bluff which usually account for a minor portion of the fall-run escapement: Inks, Stillwater, Paynes, and Ash creeks.

TABLE 2. Calculation of Chinook Salmon Runs and Spawning Populations, Sacramento River System above Red Bluff Diversion Dam, 1977

	Fish passing dam in calendar year 1976		1977		Potention 1977 spawners (runs)		Estimated 1976-77 sport catch above dam		Estimated 1977 spawning populations: Prior to relocation	Estimated 1977 spawning populations: After relocation
Late-fall run 1976-77	7,120	+	3,482	=	10,602	-	478	=	10,124	10,124
Winter run 1976-77	0	+	17,214	=	17,214	-	744	=	16,470	16,470
Spring run 1977	0	+	13,730	=	13,730	-	277	=	13,453	11,703
Fall run	0	+	40,444	=	40,444	-	865	=	39,579	32,718
Late-fall run 1977-78	0	+	3,298*		0+		85*			
Winter run 1977-78	0	+	408*		0+		2*			
TOTALS	7,120		78,756		81,990		2,451		79,626	71,015

* This run started passing the dam late in 1977, but was not completed in 1977. Additional salmon will be added to both the run and sport catch in early 1978.

\+ Fish in this run spawn in 1978, not 1977.

TABLE 3. Red Bluff Diversion Dam Weekly Adjusted Salmon Counts
October 24, 1976 through September 3, 1977

Week	Adjusted salmon count	Number sampled	Late-fall run %	Late-fall run Number	Winter run %	Winter run Number	Spring run %	Spring run Number	Fall run %	Fall run Number
1976										
10/24-1/ 2/77	Runs in progress			7,120*						
1977										
1/ 3-1/ 8	748	33	69.7	521	30.3	227				
9- 15	1,577	250	33.6	530	66.4	1,047				
16- 22	2,181	140	15.7	342	84.3	1,839				
23- 29	1,066	112	14.3	152	85.7	914				
30-2/ 5	1,366	53	7.5	103	92.5	1,263				
2/ 6- 12	2,472	613	15.7	388	84.3	2,084				
13- 19	1,713	363	9.1	156	90.9	1,557				
20- 26	1,736	234	26.9	467	73.1	1,269				
27-3/ 5	1,616	94	21.3	344	78.7	1,272				
3/ 6- 12	1,199	86	16.3	195	83.7	1,004				
13- 19	875	138	23.9	209	76.1	666				
20- 26	1,478	246	2.8	41	90.7	1,341	6.5	96		
27-4/ 2	652	100	2.0	13	83.0	541	15.0	98		
4/3- 9	925	216	2.3	21	77.8	720	19.9	184		
10- 16	504	168			54.8	276	45.2	228		
17- 23	454	120			39.2	178	60.8	276		
24- 30	633	316		10,602	31.0	196	69.0	437		
5/ 1- 7	864	357			27.0	233	73.0	631		
8- 14	981	226			24.0	235	76.0	746		
15- 21	982	306			9.0	88	91.0	894		
22- 28	960	375			6.0	58	94.0	902		
29-6/ 4	948	302			8.3	79	91.7	869		
6/ 5- 11	851	184			8.0	68	92.0	783		
12- 18	598	152			0.7	4	99.3	594		
19- 25	899	198			0.5	4	99.5	895		
25-7/ 2	901	244			5.7	51	94.3	850		
7/ 3- 9	472	24				17,214	100.0	472		
10- 16	1,986	85					100.0	1,986		
17- 23	1,329	168					98.8	1,313	1.2	16
24- 30	701	24					100.0	701	0.0	0
31-8/ 6	1,332	236					38.6	514	61.4	818
8/ 7- 13	1,430	304					5.3	76	94.7	1,354
14- 20	1,852	304					5.3	98	94.7	1,754
21- 27	837	135					10.4	87	89.6	750
28-9/ 3	814	58						13,730	100.0	814

TABLE 3. Red Bluff Diversion Dam Weekly Adjusted Salmon Counts, October 24, 1976 through December 31, 1977 (continued)

Week	Adjusted salmon count	Number sampled	Late-fall run %	Late-fall run Number	Winter run %	Winter run Number	Spring run %	Spring run Number	Fall run %	Fall run Number
1977										
9/ 4- 10	291	84							100.0	291
11- 17	659	504							100.0	659
18- 24	2,651	2,021							100.0	2,651
25-10/ 1	7,269	6,201							100.0	7,269
10/ 2- 8	5,258	4,389							100.0	5,258
9- 15	3,995	3,283							100.0	3,995
16- 22	3,915	3,474							100.0	3,915
23- 29	1,527	1,207							100.0	1,527
30-11/ 5	4,729	4,463	2.6	123					97.4	4,606
11/ 6- 12	1,537	1,321	12.0	184					88.0	1,353
13- 19	1,336	1,111	28.2	377					71.8	959
20- 26	620	362	29.8	185					70.2	435
27-12/ 3	1,679	1,301	21.6	363					78.4	1,316
12/ 4- 10	1,263	1,091	56.8	717	1.3	16			41.9	530
11- 17	993	793	62.0	616	27.9	277			10.1	100
18- 24	144	0+	71.5	103	19.6	28			8.9	13
25- 31	778	589	81.0	630	11.2	87			7.8	61
				3,298‡		408‡				40,444
Total 1977 (calendar year)	78,576	39,158		6,780		17,622		13,730		40,444

* Portion of run passing dam during 1976, and expected to spawn during 1977. For a weekly breakdown of numbers, see the 1976 Central Valley Spawning Stock Estimates (Hoopaugh 1978).

\+ No fish entered the trap this week; percentage composition was determined by averaging the week before and the week after for each run.

‡ Portions of run passing dam during 1977, expected to spawn in 1978.

Indicates the sizes of the salmon runs passing the dam with the potential of spawning during calendar year 1977.

TABLE 4. Estimated Monthly Sport Catches of the Four Runs of Chinook Salmon in the Sacramento River Between Keswick and Red Bluff Diversion Dams*

Year	Month	Catch	Late-fall run		Winter run		Spring run		Fall run	
			%	Number	%	Number	%	Number	%	Number
1976	Oct.	934	0.6	6					99.4	928
	Nov.	619	17.7	110					82.3	509
	Dec.	357	67.8	242					32.2	115
1977	Jan.	193	23.8	46	76.2	147				
	Feb.	172	18.0	31	82.0	141				
	Mar.	374	10.9	41	84.5	316	4.6	17		
	Apr.	229	0.9	2	59.9	137	39.2	90		
	May	17		478	18.5	3	81.5	14		
	June	4			4.5	-	95.5	4		
	July	161				744	85.7	138	14.3	23
	Aug.	264					5.3	14	94.7	250
	Sept.	233						277	100.0	233
	Oct.	262							99.4	262
	Nov.	175	44.4	78					55.4	97
	Dec.	9	74.1	7	19.7	2			6.2	865
1977 Total (calendar year)		2,093		205		746		277		865

* Assignment to specific runs based on sampling at Red Bluff Diversion Dam. Salmon hauled to the Tehama-Colusa Spawning Channel, salmon hatcheries and creeks were subtracted from the adjusted counts before percentages were calculated.

[ ] Total catch from run that spawned in 1977.

Data collected during two airplane flights (October 27 and November 3, 1977) over the main stem of the Sacramento River showed the general salmon redd distribution of fall-spawning salmon, and indicated the relative numbers of salmon that spawned in different river sections (Table 5).

TABLE 5. Redd Distribution of Fall Spawning Chinook Salmon, Main Stem Sacramento River Above Hamilton City, 1977

Area	Percent of redds in each area*
Keswick Dam to A.C.I.D. Dam	0
A.C.I.D. Dam to Highway 44	2.3
Highway 44 to Upper Anderson Bridge	15.2
Upper Anderson Bridge to Balls Ferry	9.7
Balls Ferry to Jellys Ferry	19.4
Jellys Ferry to Bend Bridge	6.0
Bend Bridge to Red Bluff Diversion Dam	0.9
Red Bluff Diversion Dam to Tehama	35.5
Tehama to Woodson Bridge	6.4
Woodson Bridge to Hamilton City	4.6
TOTAL	100.0

* Percent of 1,085 redds observed on two flights: October 27 and November 3, 1977.

CHINOOK SALMON SPAWNING POPULATIONS RED BLUFF DIVERSION DAM TO CHICO CREEK, 1977

Main Stem, Sacramento River

by

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River Conditions

River flows in the upper Sacramento River during the fall of 1977 were very low and fluctuated considerably. This resulted in carcass recovery conditions which were much better than the preceding year. Mean monthly flows in the Sacramento River at Bend Bridge ranged from 3,935 cfs in October to 5,608 cfs in November and 7,582 cfs in December. However, the daily flows fluctuated more than 2,100 cfs in October, 3,900 cfs in November and 18,000 cfs in December. These fluctuating flows, though detrimental to salmon spawning success, resulted in good recovery conditions, with many salmon carcasses being lodged in willows along the river bank.

Red Bluff Diversion Dam to Tehama

Late-fall Run

Some late-fall-run salmon usually spawn in this section of the river. No estimate was made in 1977.

Winter Run

In May and June, during past years, winter-run salmon have been observed spawning in this section of the Sacramento River. In June 1977, spawning salmon were observed in the first riffle immediately downstream from Red Bluff Diversion Dam. However, no estimate of the spawning population was made.

Spring Run

Some spring-run fish normally spawn in this section of the river, and are included in the fall-run salmon total.

Fall Run

An estimated 39,349 fall-run salmon spawned in the main stem of the Sacramento River between Red Bluff Diversion Dam and Tehama during 1977 (Table 6). This total included 1,669 salmon that entered the Tehama-Colusa Spawning Channel via Coyote Creek. An additional 3,146 fish were trapped at Red Bluff Dam and hauled to the Tehama-Colusa spawning channel (Table 1).

TABLE 6. Fall Spawning Chinook Salmon Population Estimates, Main Stem of Sacramento River Below Red Bluff Diversion Dam, 1977

Area	Estimated recovery rate (percent)	Counting trips	Carcasses recovered	Estimated spawning population
Red Bluff Diversion Dam to Tehama	2.5	11	942	37,680
Tehama-Colusa Fish Facility (via Coyote Creek)				1,669
Tehama to Woodson Bridge	2.5	10	93	3,720
Woodson Bridge to Hamilton City				2,674*
TOTAL				45,743

* Estimate based on two air flights made October 27 and November 3 showing 41.8% of redds in the section from Tehama to Hamilton City to be between Woodson Bridge and Hamilton City.

Spawning stock surveys on the main stem of the Sacramento River between Red Bluff and Tehama began on October 20, 1977 and ended January 4, 1978. During this period, 11 complete trips were made and 942 salmon carcasses were recovered. Based on river conditions, carcass counts and total survey effort (including two airplane flights), it is estimated that the carcass recovery rate was 2.5%.

Tehama to Woodson Bridge

Late-fall, Winter and Spring Runs

While it is likely that a few fish from these runs spawned in this river section, no estimate of their total numbers was made.

Fall Run

An estimated 3,720 fall-run salmon spawned in the main stem of the Sacramento River between Tehama and Woodson Bridge during 1977 (Table 6). Spawning stock surveys on the main stem of the Sacramento River between Tehama and Woodson Bridge began on October 20, 1977 and ended on January 5, 1978. During this period, 10 trips were made and 93 salmon carcasses were recovered. Based on survey effort (including two airplane flights), river conditions and carcass counts, it is estimated that the carcass recovery rate was 2.5%.

Woodson Bridge to Hamilton City

Fall Run

Although no salmon stock surveys were conducted downstream from Woodson Bridge, from the aerial surveys of redd distribution we estimate that 2,674 fall-run salmon spawned in this river section (Tables 5 and 6).

CHINOOK SALMON SPAWNING POPULATIONS, SACRAMENTO RIVER TRIBUTARIES, KESWICK DAM TO CHICO CREEK

by

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Stream Conditions

Precipitation and runoff in the upper Sacramento Valley were below normal during the early fall of 1977. Near drought conditions existed in most drainages to the upper Sacramento River. Many tributaries that normally have a small fall run of chinook salmon were completely dry until late November.

In many of the smaller tributaries such as Salt, Thomes, Dye, and Singer creeks, the salmon runs fluctuate with the timing and amount of runoff. In the early fall of 1977 all of these streams had inadequate flows to support spawning salmon. In the larger tributaries such as Antelope, Mill, and Deer creeks flows were low and populations of fall-run salmon were smaller than in previous years. Carcass recovery conditions were generally good during fall 1977, especially prior to the increased runoff in late November.

Clear Creek

Spring Run

On July 12, 1977 a total of 158 spring-run salmon were hauled to Clear Creek from Keswick Dam. Although several redds and live fish were observed below Whiskeytown Dam in mid-August 1977, insufficient observations were made to estimate the spring-run spawning population.

Fall Run

On October 16 and 22, 1977, 154 fall-run salmon were hauled from Red Bluff Dam to Clear Creek. Between December 7, 1977 and January 27, 1978, five survey trips were made on Clear Creek, from 3 miles above Highway 99E to the Sacramento River. A total of 165 salmon carcasses was recovered. The total number of spawners was estimated to be 1,516. The natural fall run was estimated to be 1,362 (1,516-154).

Cottonwood Creek

Spring Run

No estimate.

Fall Run

Between November 18, 1977 and December 9, 1977, three survey trips were made on Cottonwood Creek from 6 miles above Highway I-5 to the Sacramento River. A total of 121 salmon carcasses was recovered and 30 redds were observed. The fall run in this lower portion of Cottonwood Creek was estimated to be 1,512.

Battle Creek

Late-fall Run

Some late-fall-run salmon usually spawn in Battle Creek but no estimate of their numbers was made in 1977. A total of 914 entered Coleman Hatchery via Battle Creek and 532 fish were hauled to Coleman Hatchery from Red Bluff Dam and spawned (Table 1).

Winter Run

In past years some winter-run salmon have been observed spawning downstream from Coleman Hatchery in June. No population estimate was made in 1977.

Spring Run

In high flow years a few spring-run salmon are usually observed on upper Battle Creek near Darrah Springs Fish Hatchery. No surveys were made in 1977 and no estimate of the spawning population was made.

Fall Run

A total of 13,906 fish was trapped at Kewsick and Red Bluff diversion dams and hauled to Battle Creek (Table 1). Of these, 7,743 were taken to Coleman Hatchery for spawning and 6,163 were planted in Battle Creek. Because of mortalities,

salmon escaping from the holding pond, and salmon entering the hatchery from Battle Creek, it was not possible to estimate the total number of fish that entered Battle Creek and the hatchery from the Sacramento River and these fish are included in the estimate for the main stem Sacramento River.

Carcass recovery data were used to estimate the number of salmon that spawned in Battle Creek below Coleman Hatchery. Nineteen survey trips were made on lower Battle Creek from October 24, 1977 through January 13, 1978, and one on Gover's irrigation ditch on October 28, 1977. Carcass recovery conditions were generally very good throughout most of the recovery period. A total of 2,772 carcasses was recovered (2,742 in Battle Creek and 30 in Gover's Ditch). Based on recovery rates of 50% in Battle Creek and 25% in Gover's ditch, an estimated 5,484 salmon spawned in Battle Creek and 120 in Gover's ditch for a total of 5,604.

In addition, 5,244 salmon were artificially spawned at Coleman Hatchery, yielding a total of 10,848 spawners for Battle Creek and the hatchery combined.

Salt Creek

Late-fall Run

Five survey trips were made on Salt Creek between January 12 and March 31, 1978. The area covered was from 2 miles above to 2 miles below the Tuscan Spring road crossing. A total of 27 salmon carcasses, 57 live salmon and 28 redds was observed. The spawning population was estimated at 245.

Antelope Creek

Spring Run

Spring-run salmon enter Antelope Creek regularly but the population size is unknown. No estimate was made.

Fall Run

Between December 6, 1977 and January 6, 1978 four survey trips were made on the main fork of Antelope Creek from Edward's Dam (Cone Ranch) to Highway 99-E. A total of 66 salmon carcasses and 95 redds was counted. The fall-run was estimated at 660 fish. No surveys were made on New or Craig Creeks.

Late-fall Run

One trip was made on Antelope Creek near Edward's Dam on February 1, 1978. Fourteen live salmon were observed on the spawning beds. No estimate was made.

Coyote Creek

Fall Run

Three survey trips were made on Coyote Creek in October and November, 1977 between the Tehama-Colusa Fish Facility outlet and the Sacramento River. Fifty live salmon were observed. The spawning population was estimated at 200.

Mill Creek

Late-fall Run

A few late-fall-run salmon were observed in Mill Creek during January and February 1977 but no estimate was made.

Winter Run

No estimate was made. During previous years small numbers of winter-run salmon have been observed spawning between Ward and Clough dams, usually in June.

Spring Run

It is assumed that no spring-run salmon were able to migrate into Mill Creek in spring 1977 due to drought conditions, and that the only ones in the creek were the 563 hauled there; 126 to Hole-in-the-Ground Campground (35 from Kewsick Dam and 91 from Red Bluff Dam) and 437 to Clough Dam on lower Mill Creek, from Red Bluff Dam (Table 1). Fifteen survey trips were made on upper Mill Creek between August 2 and October 10, 1977. The area covered was from Hole-in-the-Ground Campground, near Mineral, downstream to the mouth of Little Mill Creek. A total of 11 live salmon, 14 carcasses and 23 redds was noted, primarily between Blackrock and Hole-in-the-Ground Campground. The spawning population was estimated at 460.

Fall Run

On November 13 and 19, 1977, 138 fall-run salmon were hauled from Red Bluff Dam to Mill Creek (Table 1). Eleven 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 October 7, 1977 and January 27, 1978. A total of 114 salmon carcasses was recovered. The total number of spawners was estimated to be 456 salmon. The natural fall run was an estimated 318 fish (456-138).

Dry (Toomes) Creek

Late-fall Run

A small number of late-fall-run salmon often spawn in Dry Creek if water conditions are suitable. No estimate was made.

Fall Run

Four survey trips were made on Dry Creek in December 1977 and January 1978. The area covered was from Lone Pine to the Sacramento River. Six salmon carcasses were observed. It is estimated that 120 salmon spawned in Dry Creek.

Deer Creek

Late-fall Run

A few late-fall-run salmon usually spawn during January and February in lower Deer Creek. No estimate was made in 1977.

Spring Run

It is assumed that no spring-run salmon were able to migrate into Deer Creek in the spring of 1977 due to drought conditions, and that the only ones in the creek were the 467 hauled there from Red Bluff Diversion Dam (Table 1). Seven survey trips were made on upper Deer Creek between August 19 and September 30, 1977. The area covered was from upper Deer Creek Falls downstream to the Ponderosa Way Bridge. Totals of 3 salmon carcasses, 6 live salmon and 17 redds, were observed. The spawning population was estimated at 340.

Fall Run

Eight survey trips were made on lower Deer Creek between October 7, 1977 and January 3, 1978. The area covered was from the canyon mouth to the Sacramento River. A total of 44 salmon carcasses was recovered, and the estimated spawning population was 220.

CHINOOK SALMON SPAWNING POPULATIONS, SACRAMENTO RIVER TRIBUTARIES, CHICO CREEK TO AMERICAN RIVER

Chico Creek

Spring Run

Three hundred thirty-two Sacramento River spring-run salmon were hauled from Red Bluff and planted in Chico Creek (Table 1). Substantial mortalities occurred during the summer. Numerous observations during late summer and fall indicate that approximately 100 fish survived to spawn.

Fall Run

No counts or estimates were made.

Butte Creek

by

Richard Flint

Region 2

General Information

In this extremely dry year the water picture on Butte Creek was very bleak. Parrott-Phelan Irrigation District began diverting water January 26. Howard Slough and McGowan Brothers dams were in place and diverting by March 9. By April 12, Quandt's Dam had been closed, and a dozen dead salmon were noted just below it. The creek was essentially dry. Some spring run had probably migrated to the Centerville area, but most were still well downstream. Rescue efforts at the Sutter Refuge Weir delivered 70 fish upstream, and 388 Sacramento River salmon were hauled in from Red Bluff Diversion Dam (Table 1).

Spring Run

The total spring-run escapement probably did not exceed 100 fish.

Fall Run

Two fall-run fish were counted, along with one redd, on December 6. Thereafter heavy rains brought poor recovery conditions, and attempted counts on December 22 and 28 yielded no additional fish. No estimate of fall spawners was attempted, although they were recorded in the system in the Sutter Bypass before the rains.

Feather River

by

Richard Flint
Region 2

Spring Run

One carcass from a spring-run fish marked LV-LP in 1973 was recovered in the river. No estimate was made of the number of spring-run salmon spawning in the river. Feather River Hatchery received 185 spring-run salmon.

Fall Run

Salmon carcasses were counted in the Feather River from the hatchery downstream to the Gridley boat ramp from October 17 through December 2.

The Department of Water Resources released cold water from the bottom of Oroville Dam to attain cooler river and hatchery temperatures. The low flow section, which normally flows at 400 cfs, carried 750 cfs of this colder water until mid-November, then was step-reduced to 600 cfs and 400 cfs over a 3-day period. The higher flow caused some small changes in gravel utilization; areas usually unused were used, and some of the normally used gravel was unused. There was little total change. The reduction to 400 cfs did not leave any redds out of water, although the tops of a few were exposed.

The high flow section remained at only 900 cfs throughout the spawning season, and this reduction from the more normal 2,000 left large gravel areas dry or too shallow for fish use.

The difference in flow regimes in 1977 for both low and high flow sections required independent estimates of spawning stock, instead of the usually employed method of comparison with a base year. Carcass mark and recovery was used to assist in the estimates. Spawning was extremely heavy in the river near the hatchery, but the high flow section was lightly used.

A total of 6,646 carcasses was counted. The estimated low flow spawning population was 23,272 and the high flow estimate was 14,396. The Feather River Hatchery received 8,784 fall-run salmon. The total run was 46,452. An additional 3,577 fish were hauled to Feather River Hatchery from Red Bluff Diversion Dam (Table 1).

Yuba River

by

Ronald Rogers
Region 2

The 1977 Yuba River survey incorporated two methods. The number of salmon spawning between Daguerre Point Dam and Marysville Dump was estimated from the carcass marking and recovery technique used since 1973. Weekly surveys began October 25 and ended December 13. Salmon spawning above Daguerre Point Dam were counted in the fish ladder with an electronic fish counter. U. S. Army Corps of Engineers ran the counter continuously from September 26 to December 30. It was usually checked two times per day for five days each week. Several visual checks of the counter indicated high accuracy of the unit.

The peak of fish counted through the ladder occurred during the first week of November and the peak in carcass recovery occurred during the third week.

Water level was especially low this year, being 250 cfs during the entire survey.

Below Daguerre Point Dam 2,375 carcasses were checked and 382 of these were tagged. Subsequently, 212 tagged carcasses were recovered for a 55% recovery rate. I estimate 4,228 salmon spawned below Daguerre Point Dam during the carcass survey period (Table 7).

TABLE 7. Yuba River Tag and Recovery Data from Daguerre Point to Marysville Dump, 1977

Recovery period		Tagging period								Recoveries		
Number	Week	1	2	3	4	5	6	7	8	Tags	Fish checked*	Population estimate
1	10/24-30	Tagging only									5	5
2	10/31-11/6	2								2	66	165
3	11/7-13		14							14	302	460
4	11/14-20		6	26						32	505	850
5	11/21-27		1	3	40					44	610	1,035
6	11/28-12/4			2	13	44				59	554	1,040
7	12/5-11			1	6	3	28			38	322	543
8	12/12-18				1	1	4	17		23	223	507
No. tags observed		2	21	32	60	48	32	17	0	212	2,587	4,605+
TOTAL TAGGED		5	32	55	102	93	53	42	0			

* Includes tagged fish recovered.

\+ Number of fish tagged from period two on must be subtracted: 4,605 - 377 = 4,228.

At Daguerre Point Dam the count was 3,683 salmon. To relate this to the carcass survey section, the fish spawning below the dam after December 13 should be estimated. This was done by taking the ratio of fish below the dam to fish above the dam while both surveys were running. This ratio, 1.7:1, was multiplied by the number of fish counted electronically from December 14 to December 30 for an estimate of 811 fish. The total spawning escapement is estimated to be 8,722 with 42% spawning above the dam and 58% spawning below the dam.

American River

by

Robert Reavis
Region 2

Fall Run

The salmon survey began on November 3, 1977 and was completed on January 11, 1978. As a result of drought conditions, water releases in the lower American River were only 250 cfs. Good weather and water conditions permitted approximately 20% of the carcasses to be recovered.

The estimated number of spawners using the river between the Nimbus Racks and the Grist Mill was 41,016 (Table 8). This estimate was obtained by combining a tagging study with the carcass survey.

The calculations were based on data developed from Schaefer's Model (Taylor 1974b).

A total of 6,868 spawners entered the hatchery. An estimated 589 fish passed the Nimbus Racks, based on 501 carcasses counted and an assumed 85% recovery rate. The estimated total American River run in 1977-78 was 48,473.

CHINOOK SALMON SPAWNING POPULATIONS, SAN JOAQUIN RIVER TRIBUTARIES, COSUMNES RIVER TO CALAVERAS RIVER

Cosumnes River

by

Robert Reavis
Region 2

Fall Run

Since there was no water in the lower Cosumnes River until mid-December, salmon were not able to enter the stream until late in the season. No counts were made because of prolonged high flows from mid-December through January. There were reports of few fish going over the ladder at Granlee's Dam. Due to the lateness of the run, the total number of spawners migrating upstream was probably small.

TABLE 8. American River Tag and Recovery Data

Recovery period	Tagging period: Nov. 3-4	Nov. 9-10	Nov. 17-18	Nov. 23-24	Dec. 1-2	Dec. 15-16	Dec. 22-23	Dec. 29-30	No. tags observed	Total no. carcasses counted	Population estimate
11/ 3- 4										14	14
11/ 9-10	0								0	101	101
11/17-18		1							1	688	3,440
11/23-24		1	18						19	869	2,341
12/ 1- 2			5	11					16	1,729	6,789
12/15-16					8				8	1,596	14,164
12/22-23						13			13	864	2,189
12/29-30						2	9		11	1,040	4,450
1/ 5 & 11								1	1	178	7,832
No. tags observed	0	2	23	11	8	15	9	1	69	7,079	41,320*
Total tagged	0	10	59	50	71	38	42	44			

* The number of fish tagged from period two on must be subtracted: 41,320 - 304 = 41,016.

Mokelumne River

by

Marcus Sazaki
Region 2

Fall Run

On November 16, salmon attraction flows of 150 cfs were begun in the river which was dry for at least half its length between tidewater and Camanche Dam. Fourteen days later the flow reached tidewater and salmon were observed moving upstream. On the sixth of December the flows were reduced to approximately 95 cfs and the first carcass survey was conducted.

A total of four successive weekly surveys were run during December. Although flows were consistent and low, visibility was poor because of high water turbidity. A total of 131 live salmon was observed and 49 carcasses examined. No carcasses were tagged for recovery estimates.

Based on the relatively short period attraction flows were available to migrating salmon, the number of live and dead salmon observed, and the general character of the river, the spawning escapement for 1977 was estimated at 250.

Calaveras River

by

Marcus Sazaki
Region 2

Winter Run

Drought conditions and early installation of irrigation dams on the lower Calaveras River system made it impossible for upstream migration of salmon spawners.

Less than a dozen fish were reported observed below the lowermost dams and no fish were rescued although provision was made for that activity if necessary.

Consequently, no salmon were able to spawn this year in the Calaveras River.

SAN JOAQUIN RIVER TRIBUTARIES
STANISLAUS RIVER TO MERCED RIVER

General

The two year drought preceding the 1977 salmon spawning season in the San Joaquin River basin left very little water in the drainage dependably available for the entire reproductive cycle.

In mid-1977 the decision was made to attempt to trap the entire run of migrating adult salmon bound for the Stanislaus, Tuolumne, and Merced Rivers. It was initially planned to take up to 1 million eggs and rear the young to the 90/lb and/or yearling stages for release into the system under favorable water conditions.

A salmon trap was constructed in the main San Joaquin River just upstream from the Banta Carbona Irrigation District canal entrance, near Tracy, San Joaquin County. During the period of salmon trap operation from November 1, 1977 to December 15, 1977, 661 adult chinook salmon were captured, of which 462 were females and 199 were males (Table 9). Some 1,046,130 eggs were spawned from 197 females and 45 males, and transported to Silverado Field Operations Base. The Merced River Fish Facility received by truck, 248 females and 141 males. Twenty-three salmon, 12 females and 11 males, died before spawning. Five females and two males were released into the San Joaquin River above the trap. All trucked and released fish were marked with a hog ring in the jaw.

Before the trap went into operation on November 1, migrating salmon were observed upstream from the site. Other salmon were able to bypass the trap via beaver holes in the net and also during the frequent hyacinth removal operations. Some of these fish, numbering approximately 500, successfully made their way to spawning gravels on the Tuolumne and Merced Rivers. No salmon were observed or reported in the Stanislaus River.

Due to low outflow of the San Joaquin River, the dissolved oxygen block at Stockton did not dissipate until November 21, 1977. Two rather low "peaks" of trapping occurred, one on November 8 with 44 salmon caught and another on November 26 with 52 salmon in the trap.

Only limited surveys were made in the spawning areas. Included are the results of these surveys with rough estimates of the number of fish spawning in each stream.

The sex ratio of carcasses examined on the Tuolumne and Merced Rivers was 61% females and 39% males. None of the carcasses examined on the river surveys were under 23.9 in. (51.3 cm) fork length.

Combining the number of salmon trapped with the estimates of natural spawning produces an estimate that approximately 1,500 salmon attempted to spawn in the upper San Joaquin River tributaries in 1977.

Stanislaus River

by

Maurice Fjelstad
Region 4

Upstream reservoirs were nearly empty. No flows were released for salmon. Only groundwater seepage contributed to river flows which averaged 14 cfs during November and December at Orange Blossom Bridge.

TABLE 9. Daily Count of Salmon Captured at Trap in San Joaquin River

Date	Number caught	Sum to date	Stockton D.O.(ppm)	Date	Number caught	Sum to date	Stockton D.O.(ppm)
1977							
11/ 1	5	5	-	11/24	47	395	7.4
2	0	5	-	25	44	439	-
3	3	8	-	26	52	491	-
4	8	16	-	27	14	505	-
5	7	23	-	28	13	518	-
6	1	24	-	29	8	526	-
7	19	43	-	30	23	549	-
8	44	87	-	12/ 1	11	560	-
9	43	130	-	2	11	571	-
10	15	145	3.6	3	7	578	-
11	18	163	2.8	4	8	586	-
12	29	192	2.8	5	6	592	-
13	18	210	3.6	6	11	603	-
14	14	224	2.9	7	6	609	-
15	17	241	3.4	8	11	620	-
16	6	247	4.5	9	4	624	-
17	39	286	3.7	10	12	636	-
18	10	296	3.8	11	7	643	-
19	2	298	-	12	6	649	-
20	1	299	4.5	13	3	652	-
21	0	299	5.5	14	3	655	-
22	18	317	6.3	15	6	661	-
23	31	348	-				

Three of the four sections of the river, Knights Ferry to Riverbank, were surveyed on single trips each on December 9, 13 and 14, 1977. The survey has been traditionally divided as follows:

Section 1 - Goodwin Dam to Knights Ferry
2 - Knights Ferry to Orange Blossom Bridge
3 - Orange Blossom Bridge to Oakdale Bridge
4 - Oakdale Bridge to Riverbank

Although no sign of salmon was seen on the three one-day surveys, heavy rains with resultant increased streamflows may have allowed for successful migration and spawning in January 1978 or later. Flows at Orange Blossom Bridge averaged 426 cfs in January and about 2,800 cfs from February through June 1978.

Tuolumne River

by

Maurice Fjelstad
Region 4

A dry year provision in the FERC license for the Don Pedro Project allowed only about 31,200 acre-feet of water for salmon this season, approximately 25% of normal. On Department request, the Turlock and Modesto Irrigation Districts agreed to release only 3 cfs from La Grange Dam during all months of the season except for March and April 1978 when it was hoped that both hatchery- and naturally-reared outmigrants would benefit.

Releases from La Grange Dam averaged 10 cfs from October 1977 through February 1978. Incremental water below Turlock Lake State Recreation Area (below Rairden's Ranch) allowed for some spawning in and below this area. Flows at the Hickman stream gage averaged as follows:

	Oct.'77	Nov.	Dec.	Jan.'78	Feb.	Mar.	Apr.	May	June
Mean (cfs)	55	67	76	110	137	335	1,216	2,820	321

Only foot surveys were made above Turlock Lake State Recreation Area and no salmon were seen. Two complete trips and one partial trip were made from the recreation area to Fox Grove. Recovery conditions were good and 45 carcasses were examined.

Based on a historical recovery rate of 10% for tagged fresh carcasses, the 1977 Tuolumne River salmon run was estimated to be approximately 450 fish.

Merced River

by

Maurice Fjelstad
Region 4

The Davis-Grunsky Contract with Merced Irrigation District has no dry year provision and normal releases were to be in effect throughout the season.

The survey was conducted only on three days, December 2, 15 and 16, and because of water hyacinth blocks, only Section 1 (Crocker-Huffman Dam to Highway 59 Bridge) was surveyed. In the three days of survey, 24 carcasses were examined. Based on a historical recovery rate of 13% for tagged fresh carcasses, an estimated 185 salmon spawned in Section 1 during 1977. Redd counts during recent years have shown that 52% of the spawning occurs in Section 1. Expanding from this percentage yields a total 1977 spawning population estimate of 350 fish for the Merced River.

No salmon entered the spawning channel from the Merced River this year. However, 380 fish were trapped in the San Joaquin River near Tracy and planted in the channel.

SUMMARY

During 1977 the California Department of Fish and Game conducted its 25th 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 1977 Central Valley chinook salmon spawning escapement was 232,675 fish (Table 10).

TABLE 10. Sacramento-San Joaquin System Chinook Salmon Spawning Population, 1977

Spawning area	Late-fall run	Winter run	Spring run	Fall run	Combined
Sacramento main stem*	9,210	16,470	13,453	82,448	121,581
Sacramento tributaries	1,159		185	108,039	109,383
San Joaquin tributaries				1,711	1,711
TOTALS	10,369	16,470	13,638	192,198	232,675

* Includes some fish spawning in tributaries above Red Bluff Dam.

Fall- and spring-run spawning times partly overlap; hence when the two races spawned in the same area they were indistinguishable. However, estimates for the combined fall and spring runs are available for the comparison of all years since 1953 (Taylor 1974a). The 1977 fall-spawning (fall- plus spring-run) population in California's Central Valley was 205,836 fish. This figure is 71% of the historic (1953-76) average of 291,000 and is down 7% from last year's estimate of 221,056.

Above Red Bluff Diversion Dam, the fall-spawning escapement of 53,032 was 61% of last year's run and the eighth consecutive year that fall-spawning runs were far below (41%) the 1964-69 average of 129,000 (Appendix Table 5).

As in recent years, the lesser escapement above Red Bluff was partially offset by increasing spawning escapements below Red Bluff. The estimated 45,743 chinook salmon which spawned in the Sacramento River main stem from Red Bluff to Hamilton City (including 1,669 which entered the Tehama-Colusa Spawning Channel via Coyote Creek) was 27% higher than last year's run of 36,100 and 451% higher than the 1964-69 average of 8,300.

Spawning escapements in the Yuba and American rivers were up 125% and 71%, respectively, from 1976 levels. Feather River escapements were down approximately 25%.

Runs in the San Joaquin River system totaled 1,711 fish, considerably below last year's level of 4,700 and the 18,851 average for the previous 13 years.

APPENDIX TABLE 1. Summary of Chinook Salmon Spawning Population Estimates for the Sacramento River System, Keswick Dam to Hamilton City, 1977

Area	Late-fall run	Winter run	Spring run	Fall run	Total
Keswick Dam to Red Bluff					
Sacramento River main stem[a]	9,210[b]	16,470	13,453	36,705	75,838
Coleman Hatchery	914[b]			No est.[b]	914
Surveyed tributaries			No est.[b]	2,874[b]	2,874
Total, Keswick Dam to Red Bluff	10,124	16,470	13,453	39,579	79,626
Red Bluff to Hamilton City					
Sacramento River main stem					45,743
Red Bluff to Tehama				37,680	
Tehama to Woodson Bridge				3,720	
Woodson Bridge to Hamilton City				2,674[b]	
Tehama-Colusa Fish Facility				1,669[b]	
Tributaries	245		0[b]	1,518[b]	1,763
Total, Red Bluff to Hamilton City	245			47,261	47,506
TOTAL, KESWICK DAM TO HAMILTON CITY	10,369	16,470	13,453	86,840	127,132

[a] Spawning population equals total run (adjusted Red Bluff Dam count) minus the sport catch and estimates of surveyed tributaries. Includes salmon hauled from Red Bluff and Keswick dams to other locations.

[b] Natural run only. Additional fish were hauled in from Keswick and/or Red Bluff Diversion dams (see Table 1 for details).

APPENDIX TABLE 2. Computation of Chinook Salmon Spawning Population Estimates for Major Sacramento River Tributaries Above Chico Creek, 1977

Area/Stream	Recovery rate (percent)	Number of counting trips	Number of carcasses counted	Estimated natural spawning population	Number of transported fish[a/]	Total estimated spawning population
Keswick Dam to Red Bluff						
Clear Creek (Total)				(1,362)	(312)	(1,674)
Spring run				No est.	158	No est.
Fall run	10	5	165	1,362	154	1,516
Cottonwood Creek (Total)				(1,512)	(0)	(1,512)
Fall run	8	3	121	1,512	0	1,512
Battle Creek (Total)				(914)	(14,438)	(12,294)
Late-fall run						
Coleman Hatchery				914	532	1,446
Fall run						
Coleman Hatchery				No est.	7,743	5,244
Below Coleman Hatchery	50	19	2,742	No est.	6,163	5,484
Gover's Ditch	25	1	30	No est.	0	120
Red Bluff to Woodson Bridge						
Salt Creek (Total)				(245)	(0)	(245)
Late-fall run	11	5	27(57 live) (28 redds)	245	0	245
Antelope Creek (Total)				(660)	(0)	(660)
Fall run	10	4	66 (95 redds)	660	0	660
Coyote Creek (Total)				(200)	(0)	(200)
Fall run	-	3	(50 live)	200	0	200

(continued on next page)

APPENDIX TABLE 2 (continued). Computation of Chinook Salmon Spawning Population Estimates for Major Sacramento River Tributaries above Chico Creek, 1977

Area/Stream	Recovery rate (percent)	Number of counting trips	Number of carcasses counted	Estimated natural spawning population	Number of transported fish[a/]	Total estimated spawning population
Mill Creek (Total)				(318)	(701)	(916)
Spring run	10[b/]	15	14(11 live) (23 redds)	0	563	460
Fall run	25	11	115	318	138	456
Dry (Toomes) Creek (Total)				(120)	(0)	(120)
Fall run	5	4	6(10 live)	120	0	120
Deer Creek (Total)				(220)	(467)	(560)
Spring run	10[b/]	7	3(6 live) (17 redds)	0	467	340
Fall run	20	8	44	220	0	220
TOTAL, Sacramento River tributaries above Chico Creek				5,551	15,918	18,181

a/ Number of fish hauled in from Keswick and/or Red Bluff Diversion dams (See text for details).
b/ Estimated percent of redds observed. Spawning population estimated at two salmon per redd.

APPENDIX TABLE 3. Fall and Spring-run Chinook Salmon Counts and Spawning Population Estimates, Lower Sacramento River Tributaries from Chico Creek South, 1977

Stream or Stream Section	Number of counting trips	Number of carcasses counted	Estimated natural spawning population	Number of transported fish[a]	Total estimated spawning population
Chico Creek (Total)			(No Est.)	(332)	(100)
Spring run			No Est.	332	100
Fall run			No Est.	0	No Est.
Butte Creek (Total)			(No Est.)	(388)	(100)
Spring run	1	12 (70 live)	No Est.	388	100
Fall run	3	2 (1 redd)	No Est.	0	No Est.
Feather River (Total)			(46,637)	(3,577)	(50,214)
Spring run					
Feather River Hatchery			185	0	185
Below Hatchery		1	No Est.	0	No Est.
Fall run					
Feather River Hatchery			8,784	3,577	12,361
Below Hatchery	5	6,646	37,668	0	37,668
Yuba River (Total)			(8,722)	(0)	(8,722)
Fall run					
Above Daguerre Pt. Dam			3,683	0	3,683
Below Daguerre Pt. Dam			5,039	0	5,039
American River (Total)			(48,473)	(0)	(48,473)
Fall run					
Nimbus Hatchery			6,868	0	6,868
Above Hatchery Racks		501	589	0	589
Below Hatchery	9	7,079	41,016	0	41,016
TOTAL, Sacramento River Tributaries from Chico Creek South			103,832	4,297	107,609

[a] Number of fish hauled in from Kewsick and/or Red Bluff dams (See text for details).

APPENDIX TABLE 4. Chinook Salmon Counts and Populations Estimates, San Joaquin River Tributaries, 1977

River	Number of counting trips	Number of carcasses counted	Estimated spawning population
Consumnes River (Total)			(No est.)
Fall run	0	0	No est.
Mokelumne River (Total)			(250)
Fall run			
Fish Installation			0
Below Installation	4	49	250
Calaveras River (Total)			(0)
Winter run		0	0
Stanislaus River (Total)			(0)
Fall run	1	0	0
Tuolumne River (Total)			(450)
Fall run	3	45	450
Merced River (Total)			(350)
Fall run			
Spawning Channel			a/
Below Spawning Channel	3	24	350
TOTAL, San Joaquin Tributaries			1,050a/

a/ An additional 661 chinook salmon were trapped in the lower San Joaquin River and distributed as follows: 7 released in the San Joaquin River above the trap, 389 planted in the Merced River Spawning Channel, 242 spawned and eggs delivered to Silverado Field Operations Base. Twenty-three died before spawning.

APPENDIX TABLE 5. Sacramento-San Joaquin Valley Chinook Salmon Spawning Stock Estimates, 1964-1977, in Thousands of Fish

	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	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

[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.