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CHINOOK (KING) SALMON SPAWNING STOCKS IN CALIFORNIA'S CENTRAL VALLEY, 1979

Edited by

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Anadromous Fisheries Branch

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ABSTRACT

This report covers the 27th 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, carcasses and live fish on spawning areas, aerial redd counts, and counts of fish migrating past Red Bluff Diversion Dam.

Estimated 1979 escapement of fall-spawning (fall- plus spring-run) chinook salmon in the Central Valley is 230,709 spawners (225,612 in the Sacramento River system and 5,097 in the San Joaquin River system). This figure approximates the previous 10-year average of 233,500 and is 81% of the 1953-1978 average of 285,000. Winter and spring runs in the upper Sacramento River were the lowest of record.

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.

[1/] Anadromous Fisheries Branch Administrative Report No. 81-4. Submitted for publication 1981.

INTRODUCTION

This report covers the 27th annual chinook salmon spawning stock inventory for the California Central Valley (Figure 1). The Sacramento-San Joaquin River system, which flows through the Valley, is the principal producer of chinook salmon caught in California's ocean fisheries and also contributes significantly to the ocean fisheries of Oregon and Washington. Spring and fall runs 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 January 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, but as a result of dam construction have disappeared from many of the streams they once utilized. 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 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 1979, 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 individual stream headings.

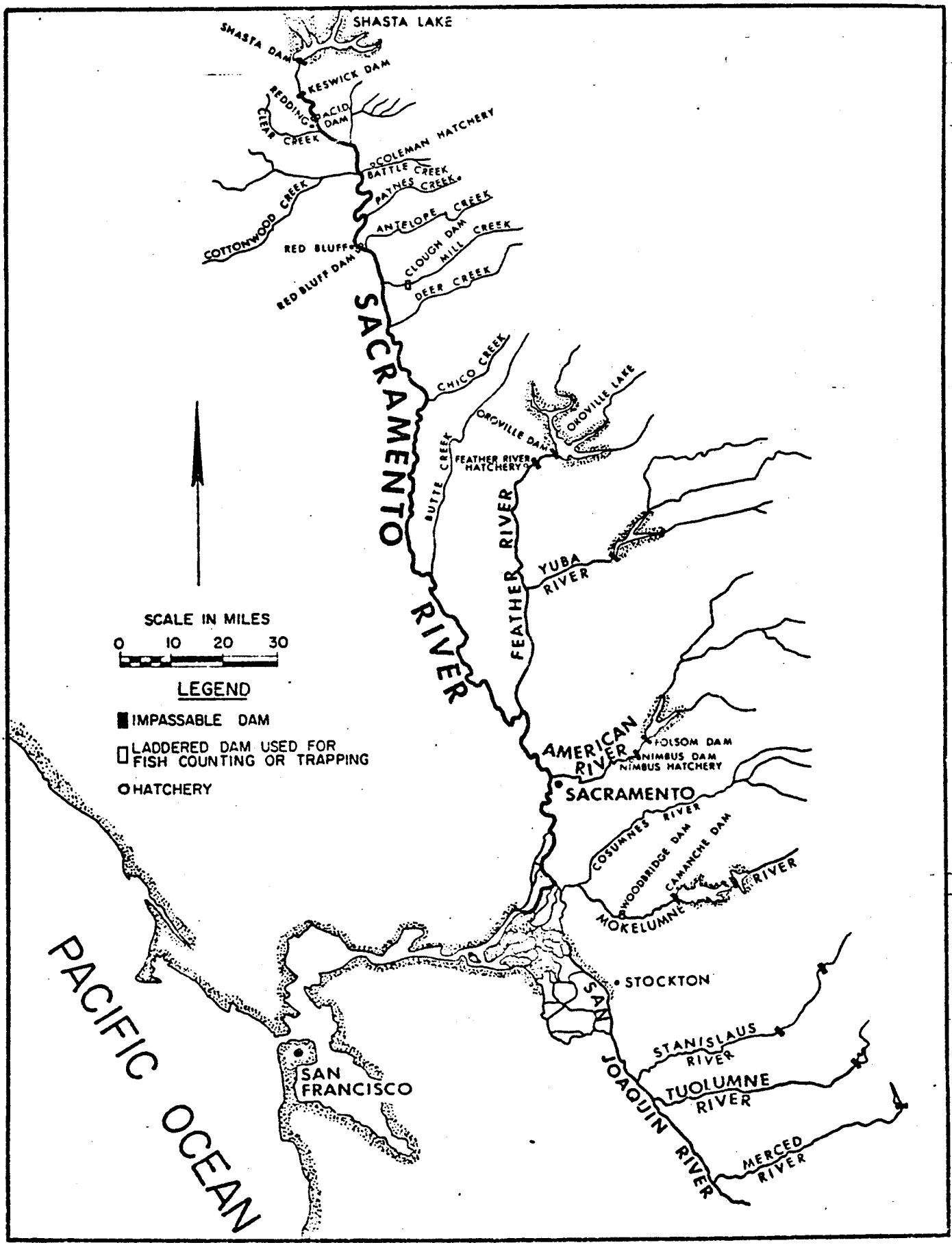

FIGURE 1. Salmon streams in the California Central Valley.

CHINOOK SALMON SPAWNING POPULATIONS FOR THE SACRAMENTO RIVER SYSTEM

Keswick Dam to Red Bluff Diversion Dam

by

Richard J. Hallock

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

Estimates of the total numbers of salmon utilizing the Sacramento River and its tributaries upstream from Red Bluff Diversion Dam during 1979 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 fishway.

Weekly counts were adjusted for periods when the fishway 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 during night hours 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 then 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 from its degree of ripeness when it would spawn (See Appendix Table 1). 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 the late-fall run is evenly divided between two calendar years, while one calendar year includes most of the winter run with a small portion migrating upstream at the end of the previous year. Accordingly, 11% of the 1979 late-fall run and one percent of the 1979 winter run occurred at the end of 1978. Therefore, to arrive at the total numbers of 1979 spawners in the late-fall and winter runs, it was necessary to add the appropriate portion of the 1978 calendar year count that would spawn in 1979 and delete that portion of the 1979 count which will spawn in 1980.

Moderate numbers of fall-run salmon spawn in tributaries upstream from Red Bluff. Battle, Clear, Cow, Inks, Paynes and Cottonwood creeks were surveyed in 1979; however, data were insufficient, except for Battle Creek, to make population estimates. Fall-run spawners in tributaries other than Battle Creek are included with the main stem estimates.

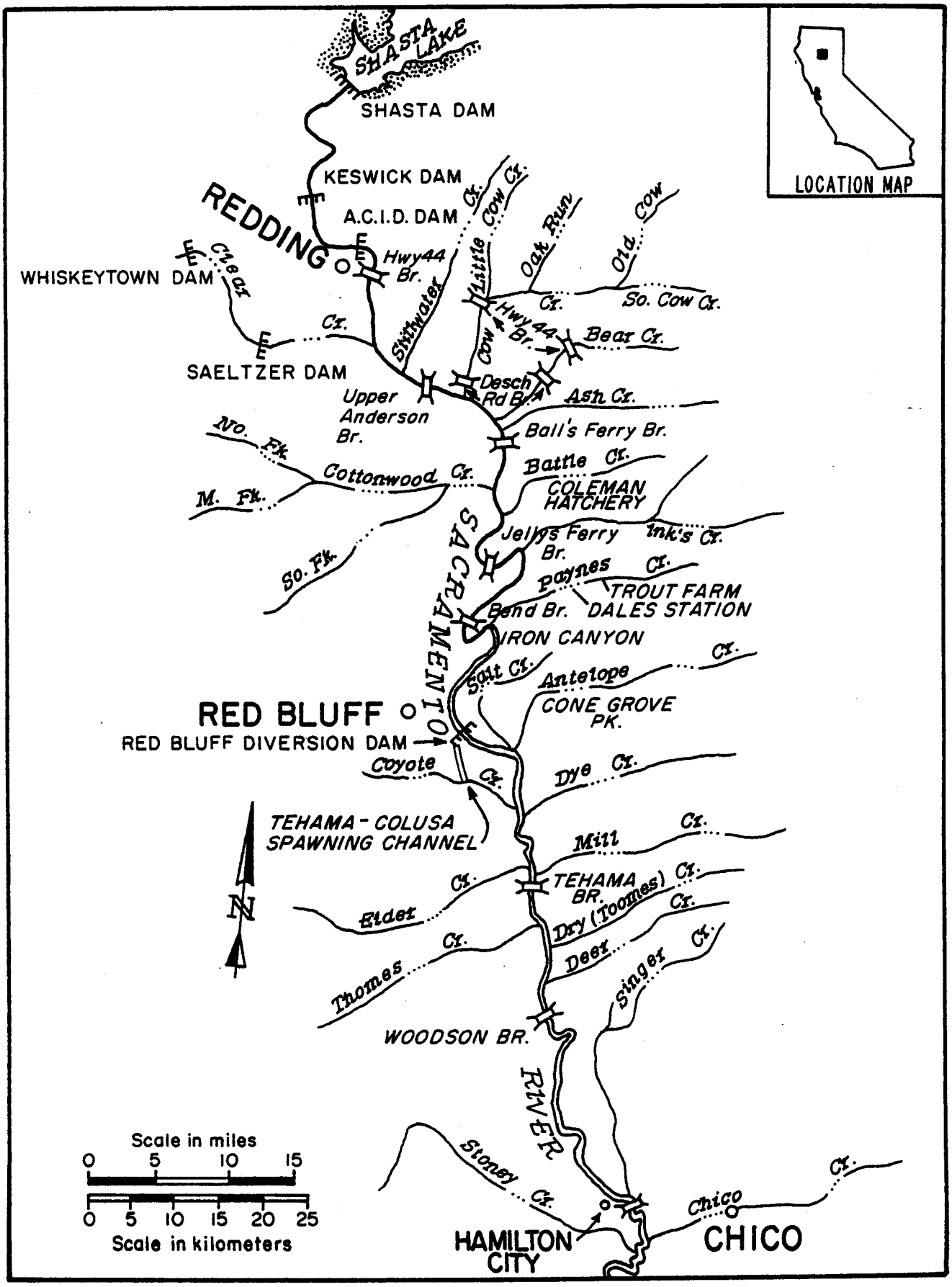

FIGURE 2. Upper Sacramento River and tributaries above Chico Creek.

To convert the adjusted numbers of salmon in each of the four runs passing the dam, into the numbers that actually spawned, the estimated number of salmon landed by sportsmen in the Sacramento River between Keswick Dam and Red Bluff was subtracted from each corresponding run (Table 1). The estimated salmon sport catch was obtained by visiting all fishing resorts once every other week to obtain the number of salmon landed during the previous two weeks. To 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 (Appendix Table 2). No attempt was made to measure any other forms of mortality in the upper river prior to spawning.

Late-fall Run. An estimated 10,398 late-fall run salmon reached Red Bluff Diversion Dam during 1978-79 and about 114 were later harvested upstream (Table 1) leaving 10,284 spawners. Of these, 712 were later trapped at Kewsick Dam and hauled to Coleman Hatchery. The 10,284 spawners is 51% of the 1971-1978 average of 19,882 (excluding 1974 when flooding caused inaccurate counts). The late-fall and winter runs were first counted separately starting in 1971.

Winter Run. An estimated 2,364 winter-run salmon reached Red Bluff Diversion Dam during 1979 season, and about 25 were harvested upstream by anglers (Table 1). The remaining 2,339 presumably spawned naturally. This was the lowest winter run of record and is only 8% of the 1971-1978 average of 29,963 (excluding 1974 when flooding caused inaccurate counts).

Spring Run. An estimated 2,900 spring-run salmon reached Red Bluff Diversion Dam in 1979 and about 44 of this total were later harvested by anglers. The remaining 2,856 presumably spawned naturally. This equals 28% of the 1969-1978 average of 10,195.

Fall Run. An estimated 62,108 fall-run salmon reached Red Bluff Diversion Dam in 1979 and about 1,138 were later caught by anglers prior to spawning (Table 1). Of the 60,970 spawners remaining, 8,729 entered Colemen Hatchery, an estimated 4,430 spawned in Battle Creek, and 53 were hauled from Red Bluff Diversion Dam to Tehama-Colusa Spawning Channel. The remaining 47,758 presumably spawned in the Sacramento River system above Red Bluff in areas other than Battle Creek (Appendix Table 3). The 47,758 total represents 88% of the 1969-1978 average of 54,364.

Spawning Distribution

Data on distribution of fall-spawning salmon in the Sacramento River system above Butte City were collected during three airplane flights on October 18, and November 1 and 15, 1979 (Table 2). The redds counts showed that 40.3% of the main stem fall spawning activity in the upper Sacramento system occurred upstream from Red Bluff Diversion Dam, which is lower than the 54.3% average from 1974-1979.

TABLE 1. Calculation of Chinook Salmon Runs and Spawning Populations, Sacramento River System Above Red Bluff Diversion Dam, 1979

Run	Fish Passing Dam in Calendar Year 1/ 1978		1979		Potential 1979 Spawners (Runs)		Estimated 1978-79 Sport Catch Above Dam 2/		Estimated 1979 Spawning Populations
Late Fall 1978-79	2,280	+	8,118	=	10,398	-	114	=	10,284
Winter 1978-79	17	+	2,347	=	2,364	-	25	=	2,339
Spring 1979	0	+	2,900	=	2,900	-	43	=	2,857
Fall 1979	0	+	62,108	=	62,108	-	1,128	=	60,980 3/
Late Fall 1979-80	0	+	3,875 4/		0		4/		0
Totals	2,297		79,348		77,770		1,310		76,460

1/ See Appendix Table 1 for weekly counts.
2/ See Appendix Table 2 for estimated monthly sport catches.
3/ Includes 53 salmon hauled from Red Bluff Diversion Dam to the Tehama-Colusa Spawning Channel.
4/ This run started passing the Dam in 1979 but spawned in 1980 and will be added to the 1980 spawning run and sport catch. Of these, 121 were trucked to the Tehama-Colusa Spawning Channel on December 19 and 21, 1979.

TABLE 2. Estimated Redd Distribution of Fall Spawning Chinook Salmon, Main Stem of Sacramento River Above Butte City, Based on Aerial Redd Counts, 1979[1/]

Area	No. of Flights	Total Redds	Average Number of Redds	
			Number	Percent
Keswick Dam to A.C.I.D. Dam	3	2	1	0.1
A.C.I.D. Dam to Hwy. 44	3	13	4	0.4
Hwy. 44 to Upper Anderson Bridge	3	188	63	6.6
Upper Anderson Bridge to Balls Ferry	3	284	95	10.0
Balls Ferry to Jellys Ferry	3	433	144	15.1
Jellys Ferry to Bend Bridge	3	150	50	5.2
Bend Bridge to Red Bluff Diversion Dam	3	85	28	2.9
Red Bluff Diversion Dam to Tehama	3	765	255	26.7
Tehama to Woodson Bridge	3	353	118	12.3
Woodson Bridge to Hamilton City	3	389	130	13.6
Hamilton City to Ord Ferry	2	89	45	4.7
Ord Ferry to Butte City	2	45	23	2.4
TOTALS		2,796	956	100.0

1/ Flight dates: Keswick Dam to Hamilton City, 10-18, 11-1, 11-15;
Hamilton City to Butte City, 11-1, 11-15.

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 1979. A total of 712 late-fall-run salmon were hauled from Keswick Dam to Coleman Hatchery and a few entered the hatchery from Battle Creek.

Fall Run. An estimated 13,159 fall-run salmon entered Battle Creek during 1979 (Appendix Table 3). This total includes 8,729 salmon that entered Coleman Hatchery and 4,430 that spawned in Battle Creek and Gover's Ditch between Coleman Hatchery and the Sacramento River. Carcass recovery data were used to estimate the numbers of salmon that spawned in Battle Creek below Coleman Hatchery. Thirteen trips were made on lower Battle Creek from October 16, 1979 through January 8, 1980, and seven on Gover's Irrigation Ditch from October 23 through December 17, 1979. Carcass recovery conditions were generally good throughout the survey period. A total of 1,334 carcasses was recovered (1,300 in Battle Creek and 34 in Gover's Ditch), at an estimated overall efficiency rate of 30% in Battle Creek and 35% in Gover's Ditch. The 13,159 total exceeds the previous 10-year average of 5,964.

Red Bluff Diversion Dam to Butte City

by

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Anadromous Fisheries Branch

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

River flows in the upper Sacramento River below Red Bluff during the fall of 1979 were low and fairly constant. Flows generally ranged from 85 m^3/s (3,000 cfs) and 170 m^3/s (6,000 cfs) from October through mid-December at Red Bluff Diversion Dam. It was not until late December, after most of the salmon carcass recovery effort had been completed, that flood conditions occurred and flows reached 198 m^3/s (7,000 cfs).

Due to normal fall precipitation and runoff in the upper Sacramento Valley, low flows existed in many of the tributary streams. Tributaries which normally have small numbers of fall-run salmon, such as Salt, Dye and Singer creeks, did not have sufficient flows during the fall of 1979 to support spawning salmon. In the larger tributaries, such as Antelope, Mill and Deer creeks, flows were below normal and fall-run salmon numbers were small or nonexistent. Carcass recovery conditions were generally good.

Sacramento River Main Stem

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

Fall Run. An estimated 32,400 fall-run salmon spawned in the main stem of the Sacramento River between Red Bluff Diversion Dam and Tehama during 1979. In addition, 2,456 salmon entered the Tehama-Colusa Spawning Channel via Coyote Creek bringing the total to 34,856. Spawning stock surveys in the main stem of

the Sacramento River between Red Bluff and Tehama began on October 4, 1979 and ended January 2, 1980. During this period, 14 complete trips were made and 810 salmon carcasses were recovered. Based on river conditions, carcass counts and total survey effort (including three airplane flights--Table 2) the carcass recovery rate was estimated to be 2.5%.

An estimated 11,320 fall-run salmon spawned in the main stem of the Sacramento River between Tehama and Woodson Bridge during 1979. Between October 3, 1979 and January 3, 1980, 14 surveys were completed and 283 salmon carcasses were recovered. Based on survey effort, river conditions and carcass counts, the carcass recovery rate was estimated to be 2.5%.

While spawning in the area between Woodson Bridge and Butte City has often been insignificant in the past, based on two aerial surveys in November 1979, the spawning population was estimated to be 21,212; Woodson Bridge to Hamilton City, 15,289; Hamilton City to Ord Ferry, 3,939; and Ord Ferry to Butte City, 1,984.

A grand total of 67,388 chinook salmon spawned in the Sacramento River main stem from Red Bluff Diversion Dam to Butte City during 1979, which is 234% of the 1970 through 1978 average of 28,772.

Spawning Distribution

Data collected during three airplane flights (October 18 and November 1 and 15, 1979) 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 on riffles above Butte City (Table 2). These counts showed that 59.7% of the main stem fall-spawning activity occurred between Red Bluff Diversion Dam and Butte City. This figure is higher than the 1974-1978 average of 45.7%. The most heavily used area was between Red Bluff Diversion Dam and Tehama.

Mill Creek

Late-fall, Winter, and Spring Runs. Small numbers of all three runs are known to spawn in Mill Creek but no population estimates were made for 1979.

Fall Run. Fourteen survey trips were made on lower Mill Creek, from Los Molinos Mutual Water Company's upper diversion dam to its confluence with the Sacramento River, between October 30, 1979 and December 28, 1979. A total of 162 carcasses were recovered. Based on a 20% recovery rate, the estimated fall run was 810.

Deer Creek

Spring Run. Two 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. Due to insufficient data, no estimate was made.

Fall Run. Nine survey trips were made on lower Deer Creek between October 30, 1979 and January 4, 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 156 salmon carcasses was recovered and 22 redds were counted. Based on a 20% recovery rate, the fall run was estimated at 780 spawners.

Butte Creek to 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

Winter-run Salmon. Some fresh salmon were reported near Little Butte Creek in late January, but no attempt was made to count them.

Spring-run King Salmon. With the start of the irrigation season and the setting of dam boards in place, fish passage up the ladders became difficult. Flows were of sufficient quanity to allow fish passage through May and were in conformance with the water rights decree of 1972. Butte Creek was surveyed by canoe on October 2nd and 3rd from Centerville Powerhouse to the Skyway. The water was extremely low and clear and provided the best recovery conditions in ten years on the creek. No dead or live salmon were seen, and only five multiple redds were observed. The total estimated run was only 10 fish, from a parent run of 650. This is the worst year on record, and was the result of low water and early diversions during the drought of 1976-77.

Fall-run Salmon. No fall-run salmon were seen in Butte Creek, but were reported in the Sutter Bypass.

Feather River - by Lynn Wixom

Spring Run. Both spring- and fall-run fish spawn during the fall. Unfortunately, they cannot be distinguished during the spawning period. It is assumed only a small fraction of the carcasses seen were spring run. A total of 250 did enter the Feather River Hatchery.

Fall Run. The 1979 Feather River fall-run king salmon spawning stock survey began October 17 and was complete by December 20, 1979. During the inventory, water clarity ranged from 1.5-2.4 m (5-8 ft) in the section of river from the Fish Barrier Dam at Oroville to the Thermalito River Outlet with a constant flow of 11.3 m^3/s (400 cfs) during the entire inventory. Water clarity in the river from Thermalito River Outlet to Gridley Bridge ranged from 0.6-1.5 m (2-5 ft) with flows of 51.0 m^3/s (1,800 cfs) until November 29, 62.3 m^3/s (2,200 cfs) until December 6, and 76.5 m^3/s (2,700 cfs) the remainder of the survey.

Spawning escapement for the section between Oroville Fish Barrier Dam and Thermalito Afterbay River Outlet was estimated at 13,481 using the method by Schaefer (1951) as reported by Taylor (1974b) (Table 3). Using the same method, it was estimated that escapement for the section between Thermalito Afterbay River Outlet and Gridley Bridge was 12,387 (Table 4).

The section of river from Gridley Bridge to Honcut Creek was not surveyed during 1979. Prior spawning escapement estimates for this section were found to average 14.91% of section between Thermalito Afterbay River Outlet and Gridley Bridge for the years 1968-1974 (Painter, 1977). Using this percentage, the

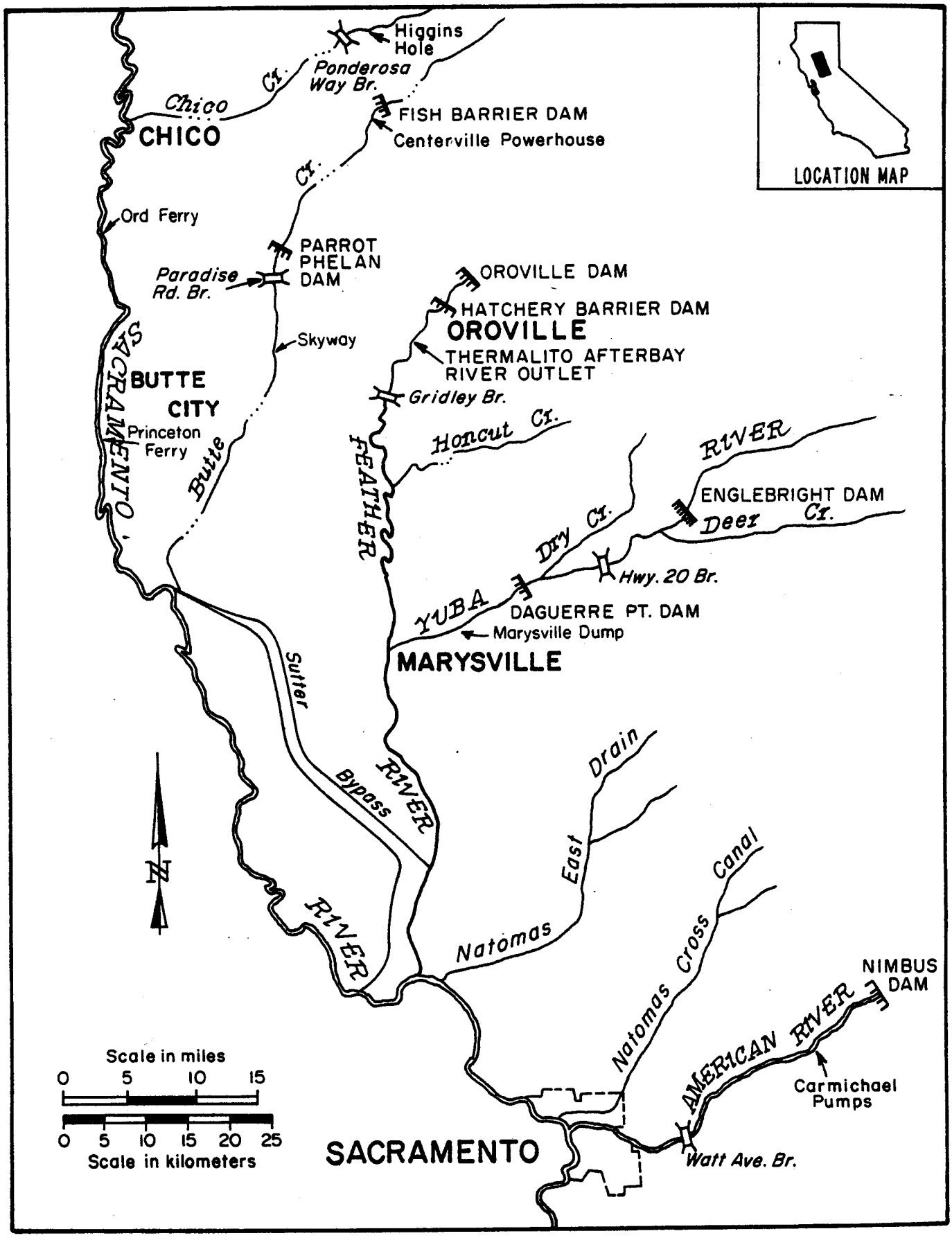

FIGURE 3. Sacramento River tributaries from Chico Creek south.

TABLE 3. Population Estimates of Chinook Salmon Based on Tag and Recovery Data for the Feather River from Oroville Dam to Thermalito Outlet Using Schaefer's Method, 1979.

Recovery Period (j)	Tagging Period (i) Oct.17	Oct.24	Oct.31	Nov.7	Nov.14	Nov.20	Nov.28	Dec.5	Dec.12	No. Tags Recovered (Rj)	Total Carcasses Counted (Cj)*	Weekly Population Estimate
Oct.24	20									20	454	766
Oct.31	12	47								59	904	1,584
Nov.7		10	71							81	1,250	2,113
Nov.14		6	16	81						103	1,761	2,859
Nov.20		2	4	17	89					112	1,402	2,382
Nov.28			2	5	41	54				102	1,021	1,806
Dec.5					8	24	50			82	705	1,207
Dec.12			1		4	7	23	33		68	543	1,002
Dec.16/17					3	7	26	25	42	103	511	982
No. Tags Recovered (Ri)	32	65	94	103	145	92	99	58	42	730	8,551	14,703**
Total Carcasses Tagged (Mi)	54	115	158	165	249	168	164	116	87			

* Includes tagged fish recovered.

** The number of tagged fish from period two on must be subtracted 14,703 - 1,222 = 13,481.

Population $\hat{N} = \Sigma(Rij \cdot \frac{Mi}{Ri} \cdot \frac{Cj}{Rj}) - \Sigma_{i=2}^{n} Mi$

TABLE 4. Population Estimates of Chinook Salmon Based on Tag and Recovery Data for the Feather River from Thermalito Outlet to Gridley Bridge, Using Schaefer's Method, 1979.

Recovery Period (j)	Tagging Period (i) Oct.18	Oct.25	Nov. 1	Nov.8	Nov.15	Nov.21	Nov.29	Dec.6	Dec.13	No. Tags Recovered (Rj)	Total Carcasses Counted (Cj)*	Weekly Population Estimate
Oct.25	1									1	43	172
Nov.1		6								6	205	527
Nov.8		1	14							15	537	1,280
Nov.15			9	47						56	906	2,066
Nov.21			4	10	46					60	973	3,069
Nov.29					15	30				45	763	2,810
Dec.6					3	10	21			34	473	1,485
Dec.13					1	6	12	22		41	396	1,115
Dec.19/20						3	7	4	10	24	233	690
No. Tags Recovered (Ri)	1	7	27	57	65	49	40	26	10	282	4,529	13,214**
Total Carcasses Tagged (Mi)	4	18	64	129	222	187	111	66	30			

* Includes tagged fish recovered.

** The number of tagged fish from period two on must be subtracted 13,214 - 827 = 12,387.

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

the estimated adult spawning population was 1,847. The estimate of the total escapement in the river was 27,715. Combining this estimate with the 4,090 fish entering the Feather River Fish Hatchery, and the 700 fish in Moe's Ditch, gives a total fall-run estimate of 32,522, which is 60% of the previous 10-year average of 54,471.

A total of 54 fin-clipped fish was recovered during the inventory. These marks were recorded only from fresh or clear-eyed fish (2,107 fish) that were used in the carcass tag and recovery phase of the survey. The majority of the marks were recovered in upper sections where 51 Ad marks and 1 RV-LP mark were found. Two Ad marks were recovered in lower sections.

Only fresh clear-eyed carcasses were used to determine the sex composition during the survey. Adult females (≥60.7 cm FL or 24 in. FL) composed 50% of the sample; 39% were adult males, while 11% of both sexes were "jacks" (<60.7 or 24 in. FL).

Yuba River - by Ron Rogers

Fall Run. Eight weekly surveys were made between Highway 20 Bridge and Marysville Dump (located about 6.4 km or 4 miles from the merging of the Yuba River into the Feather River). Three surveys were made between Rose Bar (located about 4.8 km or 3 miles below Engelbright Dam) and Highway 20 Bridge. All surveys were conducted from October 22 through December 11, 1979.

The water was fairly clear all season and flowing about 56.6 m^3/s (2,000 cfs) with about 8.5 m^3/s (300 cfs) being taken for irrigation at Daguerre Point Dam and other locations. The water was high enough to conduct all surveys from boats except for the section from Rose Bar to 0.8 km (1/2 mile) downstream.

From a total of 3,798 carcasses observed, 890 were fresh enough to tag. These were released back into flowing water and 295 were later found, producing a recovery rate of 0.33. The total number of carcasses observed was divided by the recovery rate to obtain an estimated spawning population of 11,509. This figure was expanded by 8% to compensate for fish that spawned after December 11, the 8% figure was the average proportion of fish spawning in the second half of December from 1975 through 1977. The result is an estimated total population of 12,430, which is 22% greater than the previous 10-year average of 10,145.

The clear-eyed fresh carcasses used for tagging were sexed and examined for adipose fin marks. Adult females (≥60.7 cm FL or 24 in. FL) made up 40% of the population; adult males composed 44% and "jacks" <60.7 cm FL or 24 in. FL) made up 16%. Seven salmon were found prior to November 5 with adipose fin clips, indicating the presence of a coded-wire tag.

American River - by Bob Reavis

Fall Run. The salmon survey was started on November 8, and completed on December 14, 1979. Six weekly surveys were made during this period. The river was divided into two sections; the upper section was located between the Nimbus Racks and Rossmoor Bar and the lower section included the portion

of stream between Rossmoor Bar and Grist Mill Dam. Flows were 70.8 m^3/s (2,500 cfs) when the survey started, but dropped to 56.6 m^3/s (2,000 cfs) prior to the December 6 survey where they remained for the survey period.

The Schaefer Model (Schaefer 1951) as modified by Taylor (1974b) was employed in making the population estimate. Fresh carcasses with clear eyes were tagged and released back into fast water for later recapture to determine recovery rates. An estimated 32,639 salmon spawned in the American River below the Nimbus Hatchery weir (Table 5). A total of 10,351 salmon entered Nimbus Hatchery. An estimated 4,676 fish passed the Nimbus Racks; this figure is based on an 85% recovery rate for the 3,975 carcasses removed from the weir. The total estimaed run for American River was 47,666 which is 5% greater than the previous 10-year average of 45,492.

Of the 667 fish fresh enough to sex, 56% were adult males (≥60.5 cm FL or 24 in. FL) and 2% were "jacks" (<60.5 cm FL or 24 in. FL). The remaining 42% were adult females. The breakdown of the salmon entering Nimbus Hatchery was: 42% adult males, 32% male jacks, 15% adult females, and 11% female grilse.

CHINOOK SALMON SPAWNING POPULATIONS FOR THE SAN JOAQUIN RIVER SYSTEM

Cosumnes River to Calaveras River

by

Bob Reavis
Region II

Salmon spawning populations in the San Joaquin River tributaries are 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. This is the fourth year in a row that the flows were either very low or nonexistent during the salmon migration period. Flows this year rarely exceeded .8 m^3/s (30 cfs). Four partial survey trips (November 12, 13 and 27; and December 11) were conducted and only 41 live fish and 11 carcasses were seen. Total spawning run was estimated at 150 fish, which is 16% of the previous 10-year average of 911.

Mokelumne River

Fall Run. Five weekly surveys were conducted this year on the Mokelumne River. Four surveys (November 14, 20 and 28; and December 12) were made between the hatchery and Elliott Road and one (December 5) was made between the hatchery and Mackville Road. Surveys were started on November 14 and completed on December 12, 1979. Flows were 11.3 m^3/s (400 cfs) throughout the survey period. A total of 53 carcasses and 314 live spawners was counted in the river. Assuming a 5% recovery rate, the estimated run in the river was about 1,000. This figure plus the 507 spawners in the Mokelumne River Fish Installation brings the total escapement to 1,507 which is 69% of the previous 10-year average of 2,172.

TABLE 5. Population Estimates of Chinook Salmon Based on Tag and Recovery Data for the American River Using Schaefer's Method, 1979

Recovery Period (j)	Nov. 8-9	Nov. 15-16	Nov. 20	Nov. 29-30	Dec. 6-7	Total Tagged Fish Recovered (Rj)	Total Fish Recovered (Cj)*	Weekly Population Estimate
Nov.15-16	4					4	451	2,526
Nov.20		4				4	519	11,418
Nov.29-30			6			6	547	4,584
Dec.6-7	1		2	1		4	440	7,630
Dec.14-15					1	1	164	6,724
No. Tags Recovered (Ri)	5	4	8	1	1	19	2,121	32,882**
Total Carcasses Tagged (Mi)	28	88	67	47	41			

* Includes tagged fish recovered.

** The number of fish tagged from the second week on must be subtracted 32,882 - 243 = 32,639.

Population $\hat{N} = \{(Rij \cdot \frac{Mi}{Ri} \cdot \frac{Ci}{Rj}) - \{_{i}^{n} = 2^{Mi}$

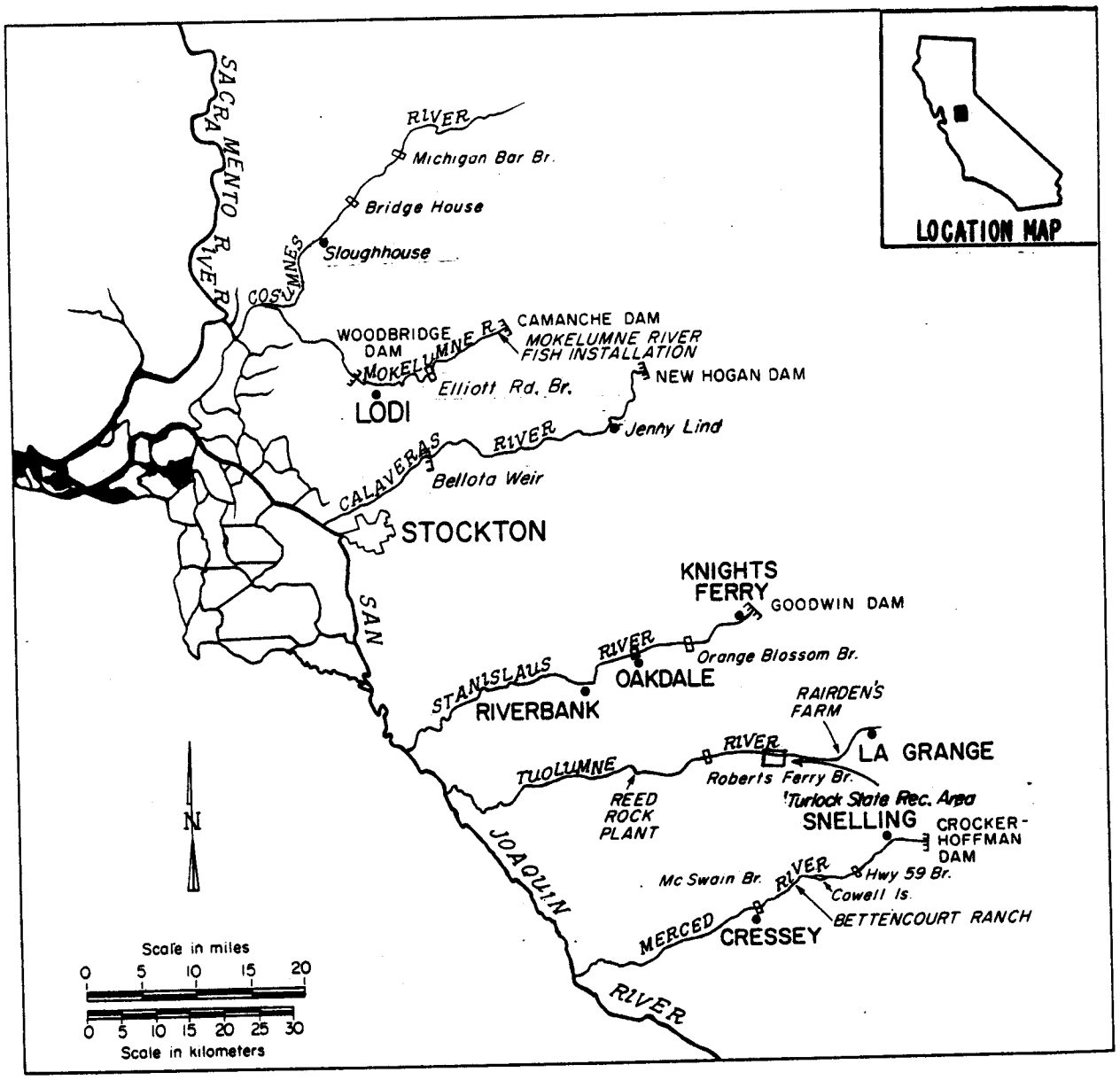

FIGURE 4. San Joaquin River tributaries.

Calaveras River

Winter Run. No fish were observed this spring in the Calaveras River during several inspection trips by the Department of Fish and Game personnel and the caretaker for the water district who lives 100 yd from Bellota Dam (where salmon are usually blocked to upstream migration) reported he did not see a fish. There was probably no spawning escapement this year.

Stanislaus River to Merced River

by

Maurice Fjelstad
Region 4

Stanislaus River

Fall Run. The most heavily-used portions of the Stanislaus River spawning areas were surveyed by boat six times from October 31 through December 5, 1979 (Figure 4). The survey was divided into the traditional four sections as follows:

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

Confusion still exists over most aspects of the New Melones Dam Project, including flow releases for salmon. However, the U.S. Bureau of Reclamation agreed to a Department request for a minimum flow of 2.8 m^3/s (100 cfs) during October through December with higher flows in the spring months.

Run size was estimated by dividing the total number of carcasses observed during the season by the estimated recovery rate. Fresh carcasses (clear-eyed) were tagged and then dropped into the current; the fraction of tags recaptured later was used as the recovery rate.

During the season, a total of 41 carcasses was examined. Eleven carcasses were tagged, and 4 were later recaptured, producing an estimated recovery rate of 0.36. An estimated 110 salmon spawned in the Stanislaus River which is only 3% of the previous 10-year average of 4,338.

Tuolumne River

Fall Run. Six complete trips were made from November 5 through December 17, 1979. After December 19 of each year, the Federal Energy Regulatory Agency license for the Don Pedro Project allows the water districts to release peaking hydroelectric flows into the river up to 127.4 m^3/s (4,500 cfs). Observation conditions at these high flows were very poor and surveys were terminated.

Flow releases were 10.9 m^3/s (385 cfs) during most of the spawning season. Observation conditions were good. The seven day interval between trips allowed a higher recovery rate than in most previous years.

The salmon survey was divided into three sections as follows:

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

The Schaefer Model (Schaefer 1951) as modified by Taylor (1974b) was used to make the population estimate (Table 6). From the 305 carcasses examined, 75 were tagged and of these, 20 were later recaptured. The total estimated run for the river was 1,183 which is 14% of the previous 10-year average of 8,577.

Merced River

Fall Run. Eight survey trips were conducted during the November 14 through December 21, 1979 period in the following sections of stream:

I. Crocker-Huffman Dam (Merced River Fish Facility) to Highway 59 Bridge
II. Highway 59 Bridge to Bettencourt Ranch
III. Bettencourt Ranch to Cressey

Six trips were made in the upper section and one trip was made in each of the two lower sections.

The population was estimated as follows:

1) The total number of carcasses counted (137) in Section I was divided by the recovery rate (0.14) of tagged carcasses. The result was an estimated 979 fish spawning in Section I.
2) This figure was expanded to estimate the total number of spawners in the river by dividing by the fraction (0.15) of spawning activity in Section I as determined from redd counts. The estimated spawning population in the river was 1,920.

Combining the river estimate with the number counted into Merced River Fish Facility of 227, yields a total river population of 2,147, which is 6% greater than the previous 10-year average of 2,015.

SUMMARY

During 1979, the California Department of Fish and Game conducted its 27th annual chinook salmon spawning stock inventory of the Sacramento-San Joaquin River system.

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

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

TABLE 6. Population Estimates of Chinook Salmon Based on Tag and Recovery Data for the Tuolumne River Using Schaefer's Method, 1979

Recovery Period (j)	Nov. 5-6	Nov. 12-13	Nov. 19-20	Nov. 26-27	Dec. 3-4	Dec. 10-11	Total Tagged Fish Recovered (Rj)	Total Fish Recovered (Cj)*	Weekly Population Estimate
Nov.12-13	1						1	1	11
Nov. 19-20		3					3	11	64
Nov. 26-27			4				4	64	315
Dec. 3-4			1	6			7	105	448
Dec. 10-11		1			4		5	112	380
Dec. 17						2	2	76	39
No. Tags Recovered (Ri)	1	4	5	6	4	2	22	369	1,257**
Total Carcasses Tagged (Mi)	1	4	15	25	24	6			

* Includes tagged fish recovered.

** The number of tagged fish from the second week on must be subtracted 1,257 - 74 = 1,183.

Population $\hat{N} = \{(Rij \cdot \frac{Mi}{Ri} \cdot \frac{Ci}{Rj}) - \{_{i}^{n} = 2^{Mi}$

The estimated 1979 Central Valley chinook salmon spawning escapement for all races was 243,332 fish (Table 7), which is only 70% of the 1953-1978 average spawning escapement. It is possible that low water conditions during the 1976-77 drought affected adult returns in 1979.

TABLE 7. Sacramento-San Joaquin System Chinook Salmon Spawning Populations, 1979

Spawning area	Late-fall run	Winter run	Spring run	Fall run	Combined
Sacramento Main Stem	10,284	2,339	2,856	115,146	130,625
Sacramento tributaries			260	107,350	107,610
San Joaquin tributaries				5,097	5,097
TOTALS	10,284	2,339	3,116	227,593	243,332

The 1979 fall-spawning (fall- plus spring-run) population in California's Central Valley was 230,709 fish. This figure is 81% of the historic (1953-1978) average of 285,000 and is up from last year's estimate of 165,088 (Knutson 1980).

Above Red Bluff Diversion Dam, the fall-spawning escapement was 60,917. This was the eighth consecutive year that fall-spawning runs were far below the 1964-69 average of 129,000 taken prior to the construction of Red Bluff Diversion Dam.

As in recent years, the lesser escapement above Red Bluff was partially offset by increasing spawning escapements in the lower Sacramento River. The estimated 67,388 chinook salmon which spawned in the Sacramento River system from Red Bluff to Butte City was the highest number recorded since 1956. The combined estimations for fall-spawning salmon in the upper Sacramento River for above and below Red Bluff Diversion Dam are still only 68% of the 1964-69 average. Fall-run spawning escapements in the Yuba and American rivers were up from 1978 levels.

The fall run in the San Joaquin system totaled 5,097 fish, up from last year's run of 3,311, but only 28% of the 1969-1978 average of 17,959.

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

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APPENDIX TABLE 1. Red Bluff Diversion Dam Weekly Adjusted Chinook Salmon Counts October 15, 1978 through August 4, 1979.

Week	Adjusted Salmon Count	Number Sampled	Late-fall run Percent	Late-fall run Number	Winter run Percent	Winter run Number	Spring run Percent	Spring run Number	Fall run Percent	Fall run Number
1978										
10/15-12/30	2 runs in progress			2,280[1]		17[1]				
1979										
12/31- 1/ 6	2,404	51	66.7	1,603	33.3	801				
1/ 7- 13	2,664	71	76.1	2,027	23.9	637				
14- 20	186	23	87.0	162	13.0	24				
21- 27	222	38	97.3	216	2.7	6				
28- 2/ 3	333	96	85.3	284	14.7	49				
2/ 4- 10	1,048	220	92.7	971	7.3	77				
11- 17	681[2]	98	100.0	681[2]	0.0	-				
18- 24	567[2]	37	100.0	567[2]	0.0	-				
25- 3/ 3	613	87	92.0	564	8.0	49				
3/ 4- 10	679	143	85.3	579	14.7	100				
11- 17	170	18	72.4	123	27.6	47				
18- 24	181	32	90.6	164	6.1	11	3.3	6		
25- 31	44	7	86.4	38	13.6	6	0.0	-		
4/ 1- 4/ 7	51	23	60.8	31	35.3	18	3.9	2		
8- 14	162	12	66.7	108	25.0	41	8.3	13		
15- 21	90	5			100.0	90	0.0	-		
22- 28	94	22		10,398	91.5	86	8.5	8		
29- 5/ 5	98	5			80.6	79	19.4	19		
5/ 6- 12	40	no sample			72.5[3]	29	27.5[3]	11		
13- 19	68	" "			67.6[3]	46	32.4[3]	22		
20- 26	49	12			24.5	12	75.5	37		
27- 6/ 2	60	17			46.7	28	53.3	32		
6/ 3- 9	37	21			13.5	5	86.5	32		
10- 16	38	1			18.4	7	81.6	31		
17- 23	55	26			14.5	8	85.5	47		
24- 30	169	75			21.3	36	78.7	133		
7/ 1- 7	203	106			3.9	8	96.1	195		
8- 14	210	78			1.3	3	98.7	207		
15- 21	138	96			28.3	39	71.7	99		
22- 28	57	33			0.0	-	100.0	57		
29 8/ 4	109	24			4.6	5	90.8	99	4.6	5
						2,364				

APPENDIX TABLE 1. Red Bluff Diversion Dam Weekly Adjusted Chinook Salmon Counts October 15, 1978 through August 4, 1979.

	Adjusted Salmon Count	Number Sampled	Late-fall run Percent	Late-fall run Number	Winter run Percent	Winter run Number	Spring run Percent	Spring run Number	Fall run Percent	Fall run Number
1979										
8/ 5- 8/11	269	39					85.0	229	14.9	40
12- 18	1,183	278					47.5	562	52.5	621
19- 25	1,350	106					20.8	281	79.2	1,069
26- 9/ 1	1,029	60					28.3	291	71.7	738
9/ 2- 8	2,501	204					11.3	283	88.7	2,218
9- 15	2,769	161					3.7	102	96.3	2,667
16- 22	3,557	153					0.0	-	100.0	3,557
23- 29	5,766	328					0.0	-	100.0	5,766
31-10/ 6	7,839	235					1.3	102	98.7	7,737
10/ 7- 13	5,063	93						2,900	100.0	5,063
14- 20	10,912	204							100.0	10,912
21- 28	5,432	233							100.0	5,432
29-11/ 3	4,375	215							100.0	4,375
11/ 4- 11	3,958	176							100.0	3,958
12- 17	1,547	170	5.3	82					94.7	1,465
18- 24	2,083	268	9.0	187					91.0	1,896
25-12/ 1	1,478	117	10.3	152					89.7	1,326
12/ 2- 8	2,180	180	25.0	545					75.0	1,635
9- 15	1,237	82	18.3	226					81.7	1,011
16- 22	1,881	287	67.2	1,264[4]					32.8	617[5]
23- 29	1,419	10	100.0	1,419						
										62,108
Total 1979 (Calendar Year)	79,348	5,091		11,993		2,347		2,900		62,108

1/ Portion of run passing dam during 1978 and expected to spawn during 1979. For a weekly breakdown of numbers, see the 1978 Central Valley Spawning Stock Estimates (Knutson, 1980).
2/ Total adjusted salmon count was based on previous 6 year average. Turbid water prevented accurate counts during this period (February 11-25).
3/ Trap was closed due to mechanical breakdown; fractional estimate was based on previous 6-year average.
4/ Includes 121 salmon trucked to Tehama-Colusa Fish Facility.
5/ Includes 53 fin-clipped salmon trucked to Tehama-Colusa Fish Facility.

[ ] Indicates the size of salmon run passing dam with the potential of spawning during calendar year 1979.

APPENDIX TABLE 2. Estimated Monthly Salmon Sport Catch of the Four Runs in the Sacramento River Between Keswick and Red Bluff Diversion Dams, 1979*.

Year	Month	Catch	Late Fall Run		Winter Run		Spring Run		Fall Run	
			Percent	Catch	Percent	Catch	Percent	Catch	Percent	Catch
1978	Oct.	185	1.6	3	-	-	0.5	1	97.9	181
	Nov.	108	4.6	5	-	-	-	-	95.4	103
	Dec.	40	35.0	14	-	-	-	-	65.0	26
1979	Jan.	73	80.8	59	19.2	14	-	-	-	-
	Feb.	17	94.1	16	5.9	1	-	-	-	-
	Mar.	15	86.7	13	13.3	2	1.0	-	-	-
	Apr.	11	36.4	4	54.5	6	9.1	1	-	-
	May	0	-	114	-	-	-	-	-	-
	June	0	-	-	-	-	-	-	-	-
	July	19	-	-	10.5	2	89.5	17	-	-
	Aug.	26	-	-	-	25	42.2	11	57.8	15
	Sept.	458	-	-	-	-	3.0	14	97.0	444
	Oct.	381	-	-	-	-	-	-	100.0	381
	Nov.	279	6.2	17	-	-	-	-	93.8	261
	Dec.	49	47.0	23	-	-	-	-	53.0	26
1979 (Calendar Year)	Total	1,328		132		25		44		1,138

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

[ ] = Total catch from run that spawned in 1979.

APPENDIX TABLE 3. Summary of Chinook Salmon Spawning Population Estimates for the Sacramento River System 1979.

Area	Late-Fall Run	Winter Run	Spring Run	Fall Run	Total
Keswick Dam[1] to Red Bluff					
Sacramento River Main Stem	10,284	2,339	2,856	47,758	63,237
Battle Creek (Total)				(13,159)	
Coleman Hatchery				8,729	8,729
Below Coleman				4,430	4,430
TOTAL, Keswick Dam to Red Bluff	10,284	2,339	2,856	60,917	76,396
Red Bluff to Butte City					
Sacramento River Main Stem(Total)				(67,388)	
Red Bluff to Tehama				32,400	32,400
Tehama to Woodson Bridge				11,320	11,320
Woodson Bridge to Butte City				21,212	21,212
Tehama-Colusa Spawning Channel				2,456	2,456
Mill Creek		2/	2/	810	810
Deer Creek			2/	780	780
TOTAL, Red Bluff to Butte City				68,978	68,978
Butte Creek to American River					
Butte Creek		2/	10	2/	10
Feather River (Total)			(250)	(32,505)	
Hatchery			250	4,090	4,340
Below Hatchery				28,415	28,415
[illegible] River				12,430	12,430
American River(Total)				(47,666)	
Hatchery				10,351	10,351
Below Nimbus Racks				32,639	32,639
Above Nimbus Racks				4,676	4,676
TOTAL, Butte Creek to American River			260	92,601	92,861
TOTAL, SACRAMENTO RIVER SYSTEM	10,284	2,339	3,116	222,496	238,235

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, 1979.

Area	Winter Run	Fall Run	Total
Cosumnes River		150	150
Mokelumne River (Total)		(1,507)	
Hatchery		507	507
Below Hatchery		1,000	1,000
Calaveras River	-0-		-0-
Stanislaus River		110	110
Tuolumne River		1,183	1,183
Merced River		(2,147)	
Spawning Channel		227	227
Below Spawning Channel		1,920	1,920
GRAND TOTAL, SAN JOAQUIN RIVER SYSTEM		5,097	5,097

APPENDIX TABLE 5. Sacramento-San Joaquin Valley Chinook Salmon Spawning Stock Estimates, 1964-1979, 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	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

[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. Marked Chinook Salmon Recovered from Central Valley Streams North of the Feather River, 1979.

CWT Code	Hatchery of Origin	Number of Recoveries by Location						
		Coyote Creek	Battle Creek	Mill Creek	Sacto. River	Red Bluff	Coleman Hatchery	Total
6-3-3	Coleman						14	14
6-3-4	Coleman						10	10
6-3-5	Coleman		1				9	10
6-3-7	Coleman						2	2
6-60-8	Coleman						15	15
6-60-9	Coleman	4				1	39	44
6-60-10	Coleman	7					40	47
6-60-11	Coleman						9	9
6-60-12	Coleman	8				23	84	115
6-60-13	Coleman					2	4	6
6-60-14	Coleman	2						2
6-60-15	Coleman	1				1	3	5
5-3-20	Tehama-Colusa	21			1		2	24
5-48-1	Tehama-Colusa	37				1		38
14-13-10	Tehama-Colusa	33	1			1	1	36
14-14-10	Tehama-Colusa	2						2
6-2-5	Mokelumne	2						2
6-2-6	Mokelumne	1				1		2
6-48-7	Mokelumne	6						6
6-48-9	Mokelumne	1						1
6-48-10	Mokelumne	4						4
6-3-2	Feather River	2				1		3
6-3-6	Feather River	1						1
6-41-1	Feather River	5						5
6-41-2	Feather River	19					3	22
6-58-10	Feather River	2						2
6-58-12	Feather River	1				3		4
6-58-13	Feather River	5				1		6
6-62-3	Feather River	24		4			2	30
TOTALS		188	2	4	1	35	237	467

APPENDIX TABLE 7. Marked King Salmon Recovered from the Central Valley Streams from the Feather River and South, 1979.

CWT Code or Mark	Hatchery of Origin	Number of Recoveries by Location						
		Numbus Hatchery	Mokelumne River	Merced River	Feather River Hatchery	Feather River	Yuba River	Total
6-1-5	Feather R.							0
6-1-6	Feather R.							0
6-1-7	Feather R.				84	16	1	101
6-1-8	Feather R.				48	7		55
6-3-2	Feather R.	3		2	3	1		9
6-3-6	Feather R.	1			1			2
6-41-2	Feather R.	6	1		12			19
6-41-6	Feather R.				1			1
6-58-9	Feather R.				56	8	3	67
6-58-10	Feather R.	2			119	11	1	133
6-58-11	Feather R.				1			1
6-58-12	Feather R.	1			25			26
6-58-13	Feather R.	1	1		4			6
6-62-2	Feather R.							0
6-62-3	Feather R.	2			12		1	15
RV-LP	Feather R.				2			2
RP	Feather R.				3			3
6-2-3	Mokelumne							0
6-2-4	Mokelumne							0
6-2-5	Mokelumne	4		1				5
6-2-6	Mokelumne	5	2					7
6-48-7	Mokelumne	2	1		1			4
6-48-8	Mokelumne	1						1
6-48-9	Mokelumne	1	8					9
6-48-10	Mokelumne		1		1			2
6-46-10	Merced Rearing Pond			9	1			10
TOTALS		29	14	12	374	43	6	478