

**1993 and 1994 Fall Chinook  
Salmon Spawning Escapements  
in the Yuba River**

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## EXECUTIVE SUMMARY

From 1953 to 1989, the California Department of Fish and Game (DFG) conducted annual chinook salmon carcass surveys on the lower Yuba River to estimate fall chinook salmon spawning escapement (i.e., the number of salmon returning to spawn). Because of recent budget and personnel constraints, DFG suspended Yuba River salmon carcass surveys in 1990. In response, Yuba County Water Agency retained Jones & Stokes Associates to conduct the 1991 surveys. Since 1992, annual carcass surveys have been conducted jointly by DFG and Jones & Stokes Associates. This report presents the results of the 1993 and 1994 surveys. The 1991 and 1992 results, presented in two earlier reports, are summarized for purposes of comparison.

Annual salmon spawning escapement estimates in the lower Yuba River since 1991 were as follows:

- 1991 - 14,413 fish,
- 1992 - 6,323 fish,
- 1993 - 6,516 fish, and
- 1994 - 10,691 fish.

The 1994 spawning escapement estimate was lower than the long-term average spawning escapement (approximately 13,000 fish) but represented a significant increase over the relatively small runs in 1992 and 1993. Large numbers of 2-year-old salmon (grilse) were observed in 1994, suggesting the potential for a large run in 1995 when 3-year-olds return to the Yuba River. Average annual chinook salmon spawning escapement since the completion of New Bullards Bar Reservoir has remained at about 13,000 fish, the same level that existed before completion of the reservoir.

As observed in 1991, high, cold flows early in the spawning season trigger earlier upstream migration and spawning of chinook salmon than is observed in years with lower flows and higher water temperatures. Because salmon entering the Yuba River generally seek spawning areas with suitable water temperatures, the earliest spawning typically occurs in the uppermost spawning reach (above Parks Bar) and the latest spawning occurs in the lowermost reach (below Daguerre Point Dam). Such behavior would also explain the tendency for a larger fraction of the run to spawn above Daguerre Point Dam in years when lower flows delay the occurrence of suitable water temperatures below Daguerre Point Dam.

In 1994, salmon carcass surveys included the uppermost spawning reach in the Yuba River (Rose Bar reach), allowing a more accurate estimate of total spawning escapement than was possible in previous years. Before 1994, complete surveys were limited to the two lower reaches (Parks Bar and Daguerre Point reaches) and DFG developed total spawning escapement estimates by assuming that 15.5% of the run spawns in the Rose Bar reach. The actual estimate of spawners in the Rose Bar reach in 1994, however, was 37% of the total run or about 2,700 more salmon than would have been estimated otherwise.

Tagging of adult (age 3 years and older) and grilse (age 2 years) carcasses during weekly surveys in 1991 and 1994 revealed that recovery rates (i.e., percent of tagged carcasses that were recovered) of grilse carcasses are typically lower than those of adults. Therefore, DFG's practice of tagging only adults and estimating grilse based on the proportion of grilse carcasses has been a source of error in previous spawning escapement estimates. The accuracy of the estimate should be improved by tagging both adults and grilse and making separate estimates of each. Because differences in recovery rates can also occur between survey reaches, separate estimates of the number of spawners in each reach should continue unless large numbers of carcasses from one reach enter another reach. This did not appear to be a problem in 1994.

The following recommendations are made for future spawning escapement surveys:

- Continue separate surveys of the Rose Bar, Parks Bar, and Daguerre Point reaches to avoid potential bias caused by differences in recovery rates among reaches.
- Tag both adult and grilse carcasses and generate separate estimates of each to avoid potential bias caused by differences in adult and grilse recovery rates.
- Survey all reaches within a 2-day period (e.g., survey the Rose Bar and Parks Bar reaches on the same day and the Daguerre Point reach on the second day) so that direct comparisons of abundance and spawning time between survey reaches can be made.
- Tag all fresh carcasses in the Rose Bar reach with a distinctive color tag to monitor influx of carcasses into the Parks Bar reach.

## INTRODUCTION

From 1953 to 1989, DFG conducted annual chinook salmon carcass surveys on the lower Yuba River to estimate fall chinook salmon (*Oncorhynchus tshawytscha*) spawning escapement (i.e., the number of salmon returning to spawn each year). Because of recent budget and personnel constraints, DFG suspended Yuba River salmon carcass surveys in 1990. In response, Yuba County Water Agency (YCWA) retained Jones & Stokes Associates to conduct the 1991 surveys. Since 1992, annual carcass surveys have been conducted jointly by DFG and Jones & Stokes Associates.

This report presents the results of the 1993 and 1994 surveys. The 1991 and 1992 results, presented in two earlier reports (Jones & Stokes Associates 1992, 1994), are summarized for purposes of comparison.

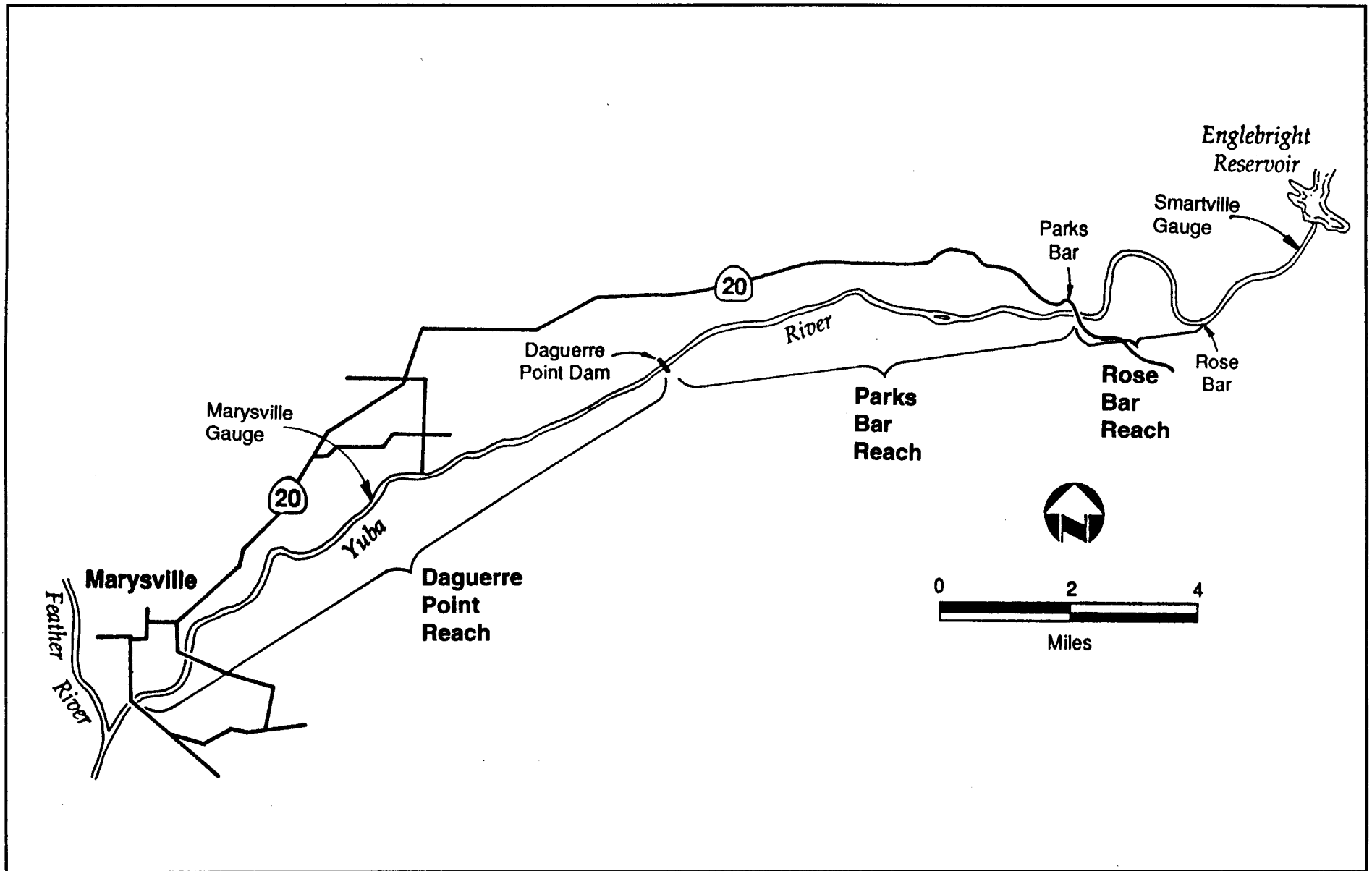
## METHODS

Since the 1970s, DFG estimated chinook salmon runs on the Yuba River using a modified form of the Schaefer mark-recovery method (Schaefer 1951). Weekly carcass surveys were conducted during the principal fall chinook salmon spawning season (early to mid-October through mid-December). During each survey, field personnel tagged fresh salmon carcasses and returned them to the river, chopped decomposing carcasses in half, and recovered carcasses tagged on previous survey dates. Weekly estimates were computed based on the proportion of tagged carcasses that were recovered relative to the total number of tagged carcasses at large and the total number of carcasses observed (tagged and untagged). Weekly estimates were summed to obtain the total spawning escapement estimate for the season. The sampling methodology is fully described in previous reports (Jones & Stokes Associates 1992, 1994).

The sampling procedures used during the 1991-1994 spawning escapement surveys on the Yuba River were generally consistent with those used by DFG during past surveys. DFG, however, tagged adult (age 3 years and older) carcasses only and estimated the number of grilse (2-year-old salmon) based on the adult estimate and the ratio of adults to grilse observed among fresh carcasses. In 1991 and 1994, Jones & Stokes Associates tagged both adult and grilse carcasses and made independent estimates of adult and grilse populations, thus avoiding potential bias associated with differential recovery rates of adult and grilse carcasses (Boydston 1994).

In 1994, weekly carcass surveys were conducted in the Rose Bar reach (Rose Bar to Parks Bar), the Parks Bar reach (Parks Bar to Daguerre Point Dam) and the Daguerre Point reach (Daguerre Point Dam to the Highway 70 bridge in Marysville) (Figure 1). In past years, the reach above Parks Bar was usually not included in weekly surveys. In developing estimates of total spawning escapement, DFG assumed that 15.5% of the salmon run spawns above Parks Bar based on estimates made in 1966-1971 (Konhoff pers. comm.). Including the Rose Bar reach in 1994, however, permitted a nearly complete estimate of spawning escapement because Rose Bar is the first major salmon spawning area below Englebright Dam.

The influx of carcasses from one survey reach to another tends to inflate population estimates in the receiving reach. Daguerre Point Dam provides an effective barrier between the Parks Bar and Daguerre Point reaches. Because carcasses from the Rose Bar can disperse downstream and mix with carcasses in the Parks Bar reach, fresh carcasses in the Rose Bar reach were tagged with two jaw tags to distinguish them from carcasses tagged in the Parks Bar reach. The number of double-tagged carcasses recovered in the Parks Bar reach was recorded to determine the extent to which carcasses from the Rose Bar reach entered the Parks Bar reach.



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**Figure 1**  
**Lower Yuba River Chinook Salmon Spawning**  
**Escapement Survey Reaches**



## RESULTS

### River Conditions

Daily Yuba River flows and water temperatures during the 1991-1994 chinook salmon spawning seasons are shown in Figures 2 and 3.

### Spawning Escapement

Table 1 summarizes the results of the 1991-1994 salmon spawning escapement surveys. Annual spawning escapement estimates during this period were as follows:

- 1991 - 14,413 fish,
- 1992 - 6,323 fish,
- 1993 - 6,516 fish, and
- 1994 - 10,691 fish.

Spreadsheets used to compute the 1993 and 1994 spawning escapement estimates are presented in Tables A-1 through A-16 in Appendix A. The computation spreadsheets for the 1991 and 1992 runs can be found in previous reports (Jones & Stokes Associates 1992, 1994).

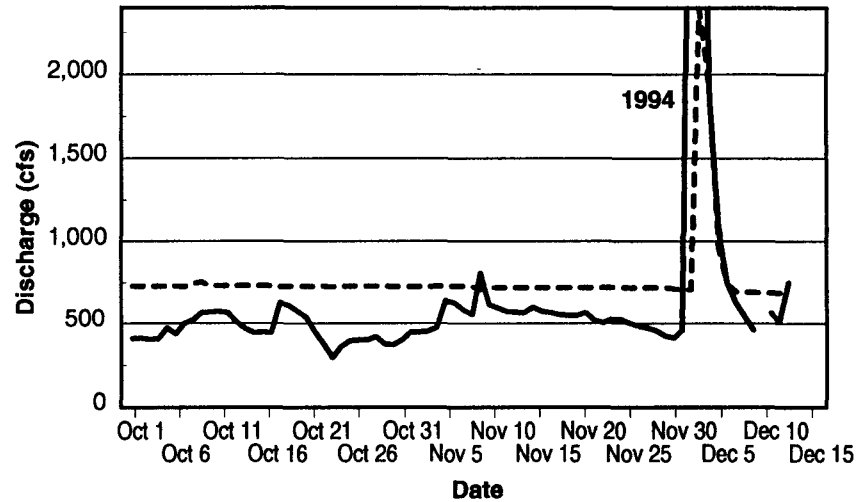
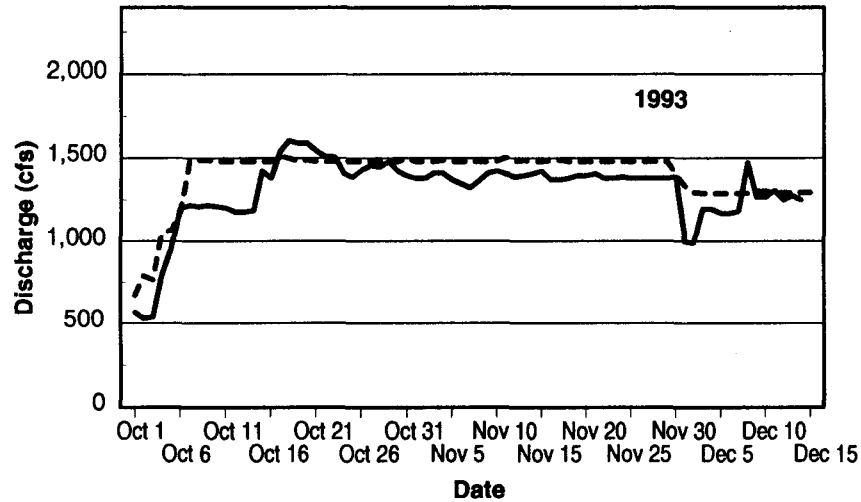
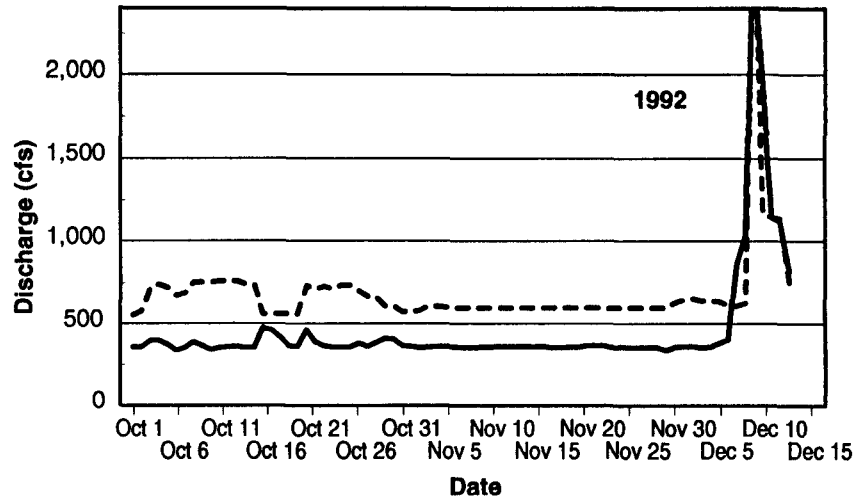
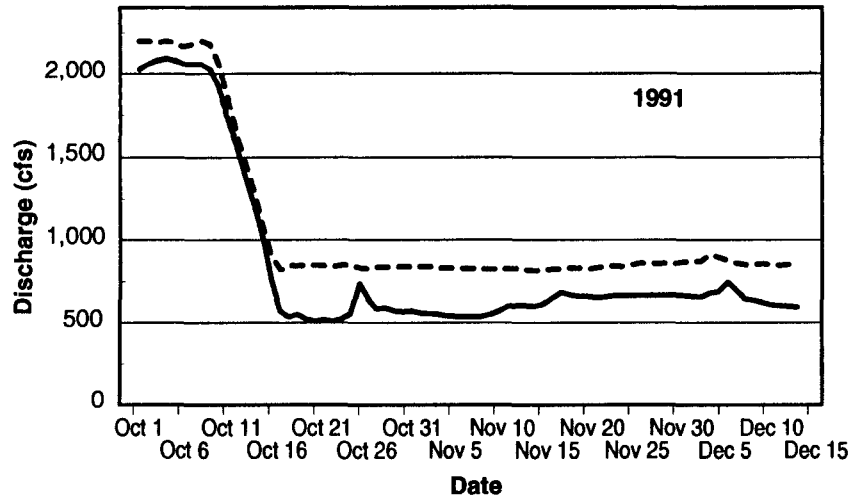
### Spawning Timing

The rate of decomposition of tagged carcasses recovered 1 or 2 weeks after tagging indicates that fresh carcasses represent fish that had died within a week before tagging. Therefore, weekly counts of fresh carcasses provide the best approximation of the weekly distribution of spawning activity through the season (Figures 4 and 5).

In 1993, spawning in the Parks Bar reach had started by October 12 and reached a peak by October 25 (Figure 4). Downstream of Daguerre Point Dam, significant spawning activity was not evident until October 26. Spawning activity subsequently increased and reached peak levels in the first week of November.

In 1994, spawning in the Parks Bar reach started about the same time as that observed in 1993 but did not peak until the first week of November (Figure 5). Downstream of Daguerre Point Dam, spawning probably did not start until mid-October and peaked 2 weeks later than in the Parks Bar reach.

The earliest spawning observed during the 1991-1994 spawning seasons occurred in 1991 (Figure 4). Spawning started by the first week of October and peaked by October 23.

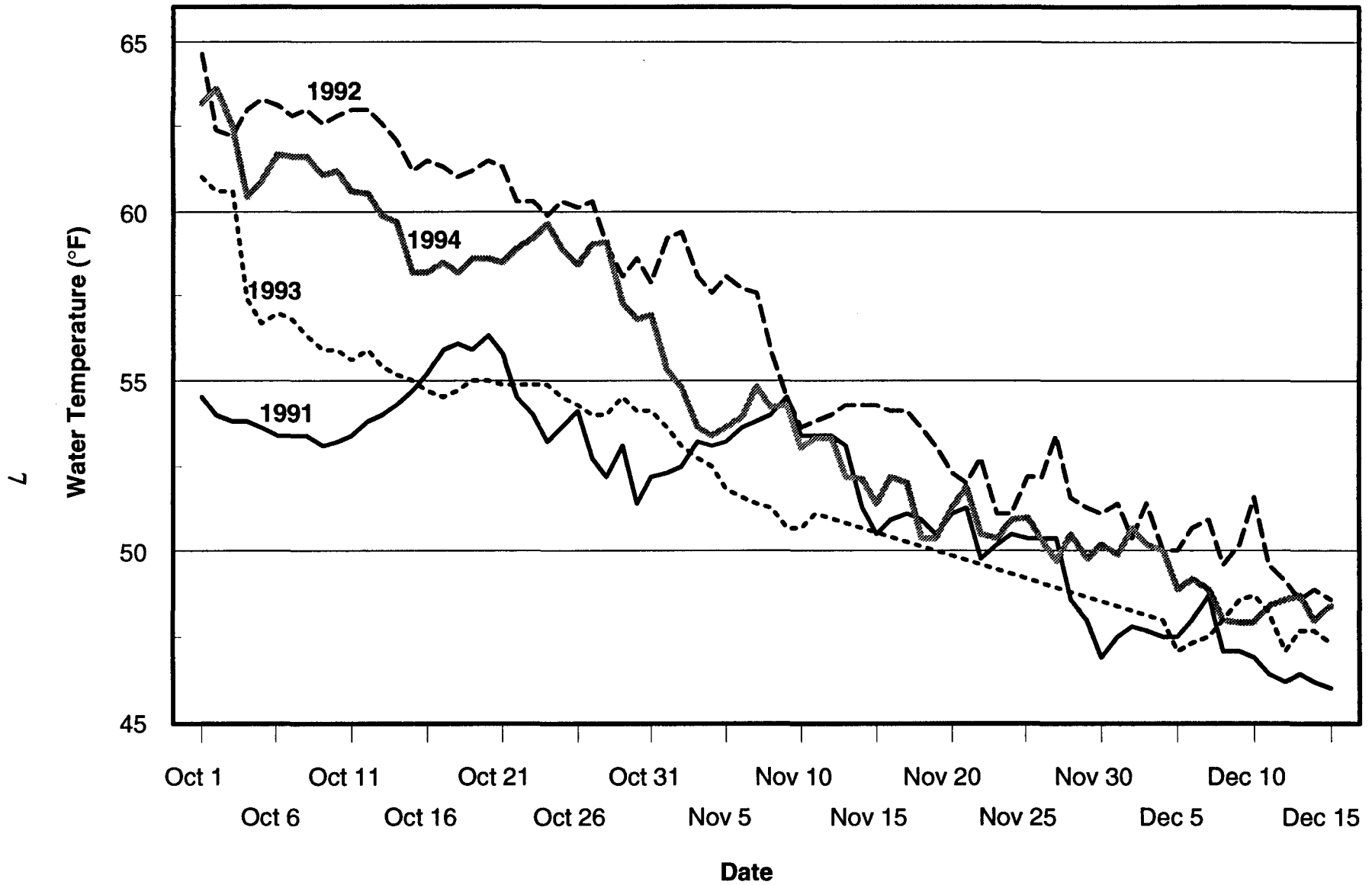


Marysville — Smartville ---



Jones & Stokes Associates, Inc.

**Figure 2**  
**Daily Yuba River Flows Measured at the Smartville and**  
**Marysville Gauges, October 1-December 15, 1991-1994**

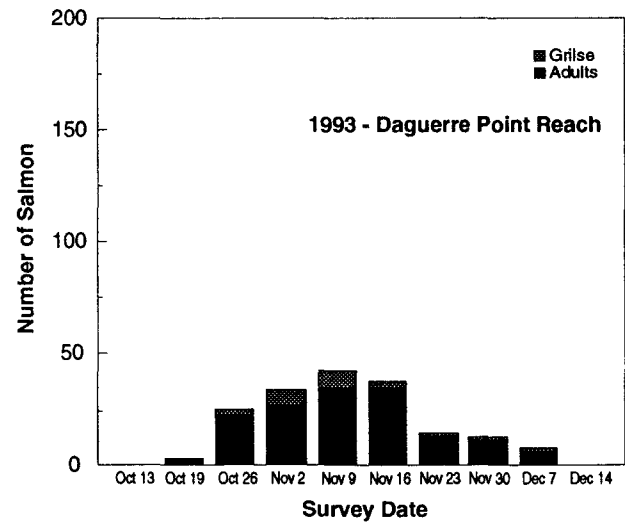
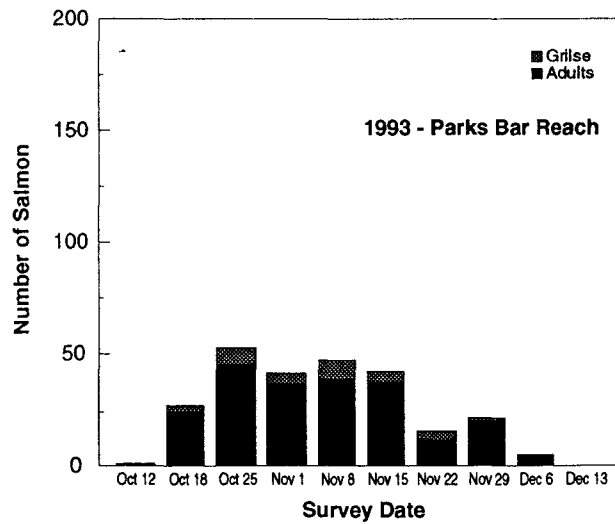
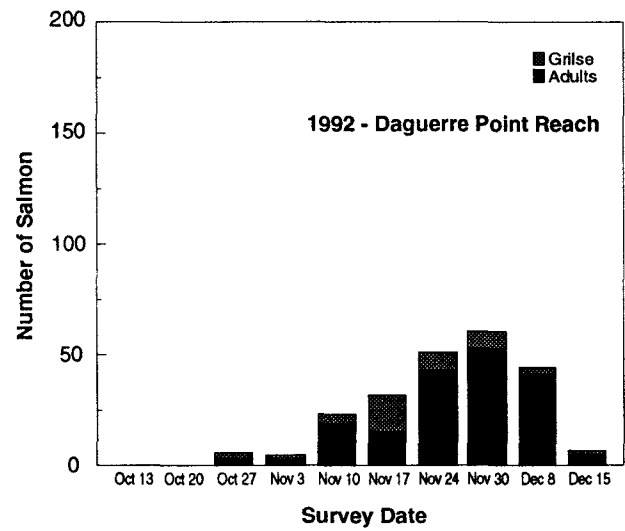
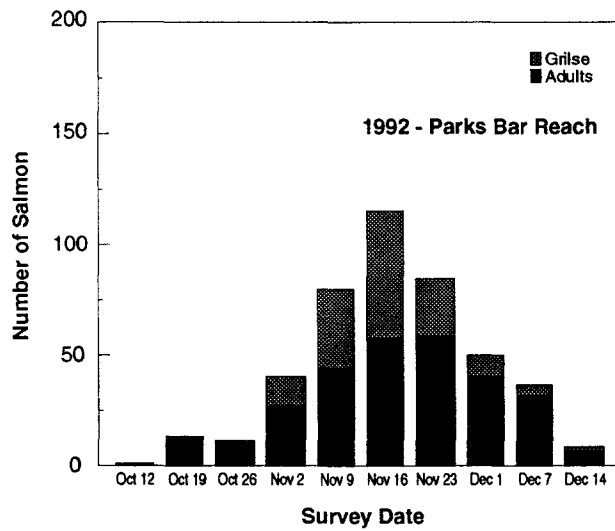
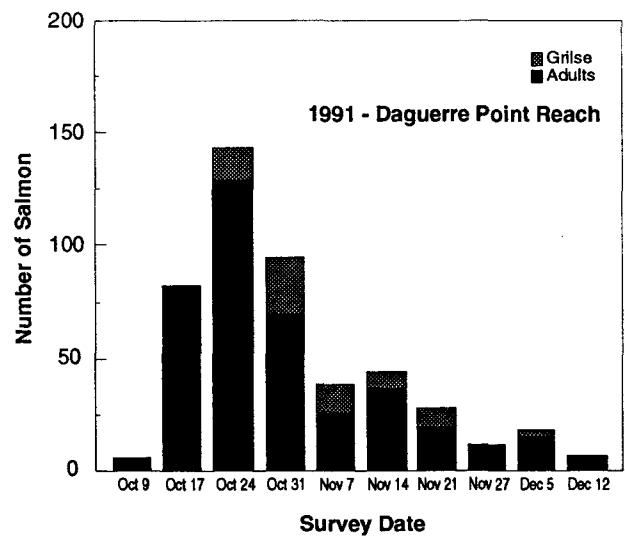
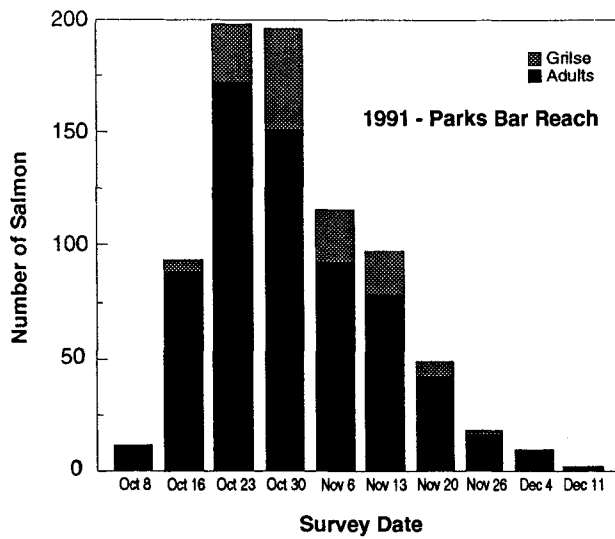


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**Figure 3**  
**Mean Daily Yuba River Water Temperatures Measured at the**  
**Marysville Gauge, October 1-December 15, 1991-1994**

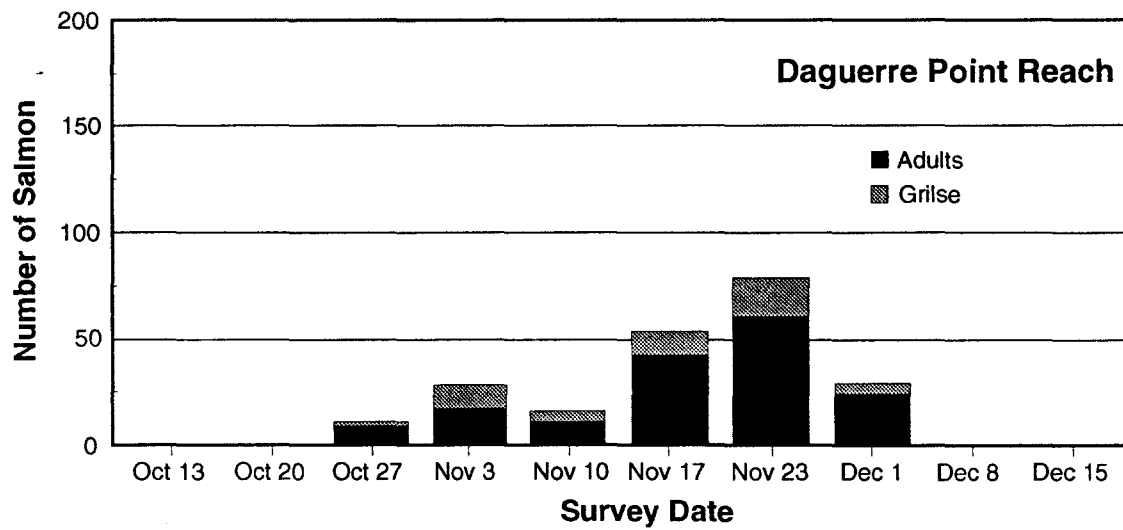
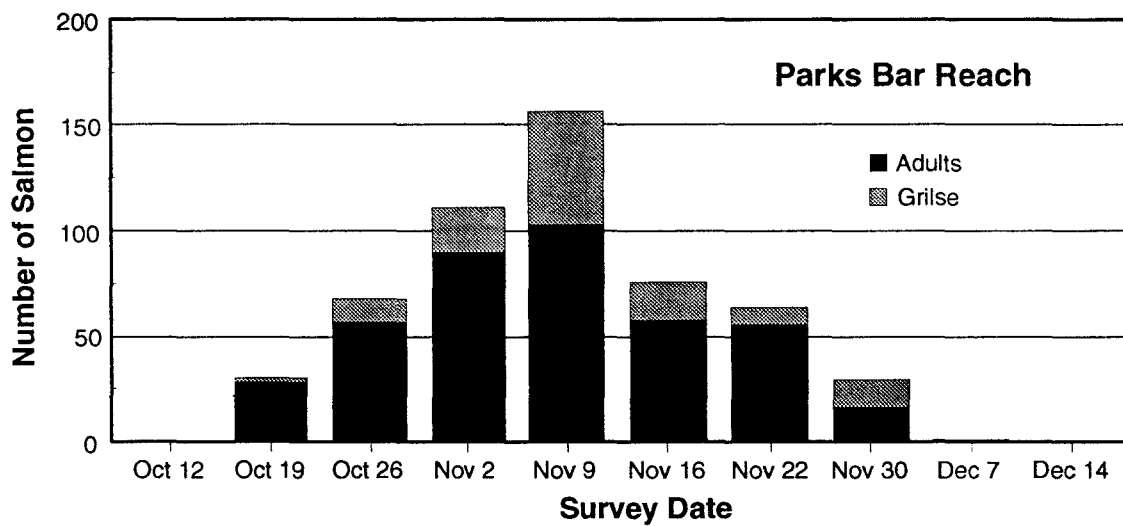
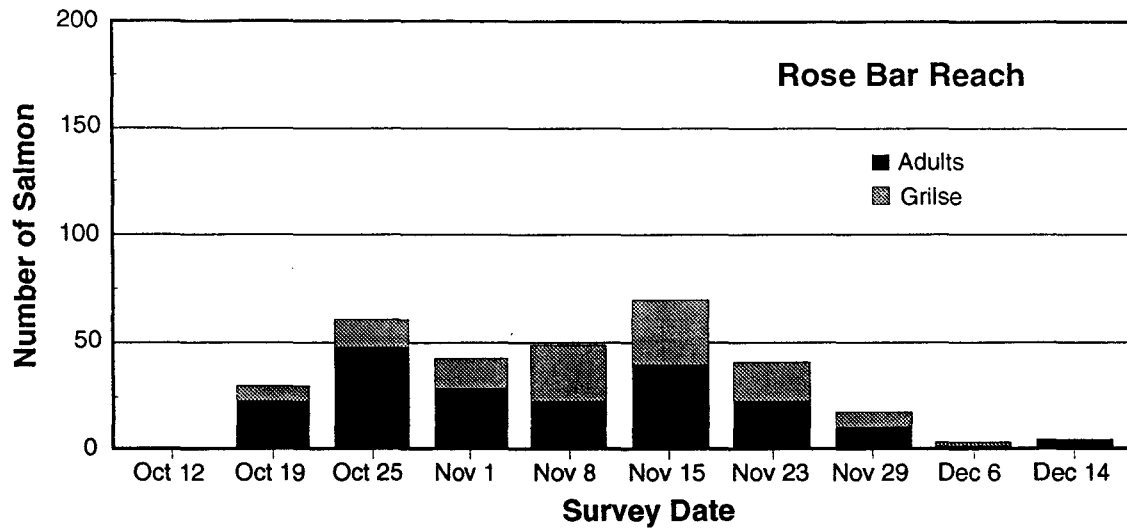
Table 1. Yuba River Chinook Salmon Spawning Escapement Estimates, 1991-1994

Reach	Reach Length (miles)	1991			1992			1993			1994		
		Adults	Grilse	Total	Adults	Grilse	Total	Adults	Grilse	Total	Adults	Grilse	Total
Rose Bar	3.5	1,775	459	2,234	700	286	986	870	140	1,010	1,711	2,201	3,912
Parks Bar	7.5	5,771	1,450	7,221	2,333	953	3,286	1,985	294	2,279	3,745	1,144	4,889
Daguerre	<u>11.0</u>	<u>3,904</u>	<u>1,054</u>	<u>4,958</u>	<u>1,483</u>	<u>606</u>	<u>2,089</u>	<u>2,759</u>	<u>468</u>	<u>3,227</u>	<u>1,522</u>	<u>368</u>	<u>1,890</u>
Total	22.0	11,450	2,963	14,413	4,516	1,845	6,361	5,614	902	6,516	6,978	3,713	10,691



Jones & Stokes Associates, Inc.

**Figure 4**  
**Weekly Counts of Fresh Salmon Carcasses by**  
**Survey Reach, 1991-1993**



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**Figure 5**  
**Weekly Counts of Fresh Salmon Carcasses by**  
**Survey Reach, 1994**

No major differences in spawning timing between the Parks Bar and Daguerre Point reaches were evident. The pattern in 1992 was most similar to 1994, but peak spawning occurred approximately 1 week later in both the Parks Bar and Daguerre Point reaches.

### Spawning Distribution

Figure 6 shows the distribution of adult and grilse salmon by reach for the 1991-1994 spawning seasons. The percentage of adults and grilse in the Rose Bar reach in 1991, 1992, and 1993 was assumed to be 15.5%. Actual estimates of the adult and grilse populations in the Rose Bar reach were made in 1994. A surprising result was that about 25% of the adults and 59% of the grilse spawned above Parks Bar in 1994. Overall, 37% of the 1994 run spawned in the Rose Bar reach, 46% spawned in the Parks Bar reach, and 18% spawned in the Daguerre Point reach. In 1991, 1992, and 1993, the proportion of spawners in the Parks Bar reach ranged from 35% to 52% and the proportion of spawners in the Daguerre Point reach ranged from 33% to 50%, assuming 15.5% of the run spawned above Parks Bar.

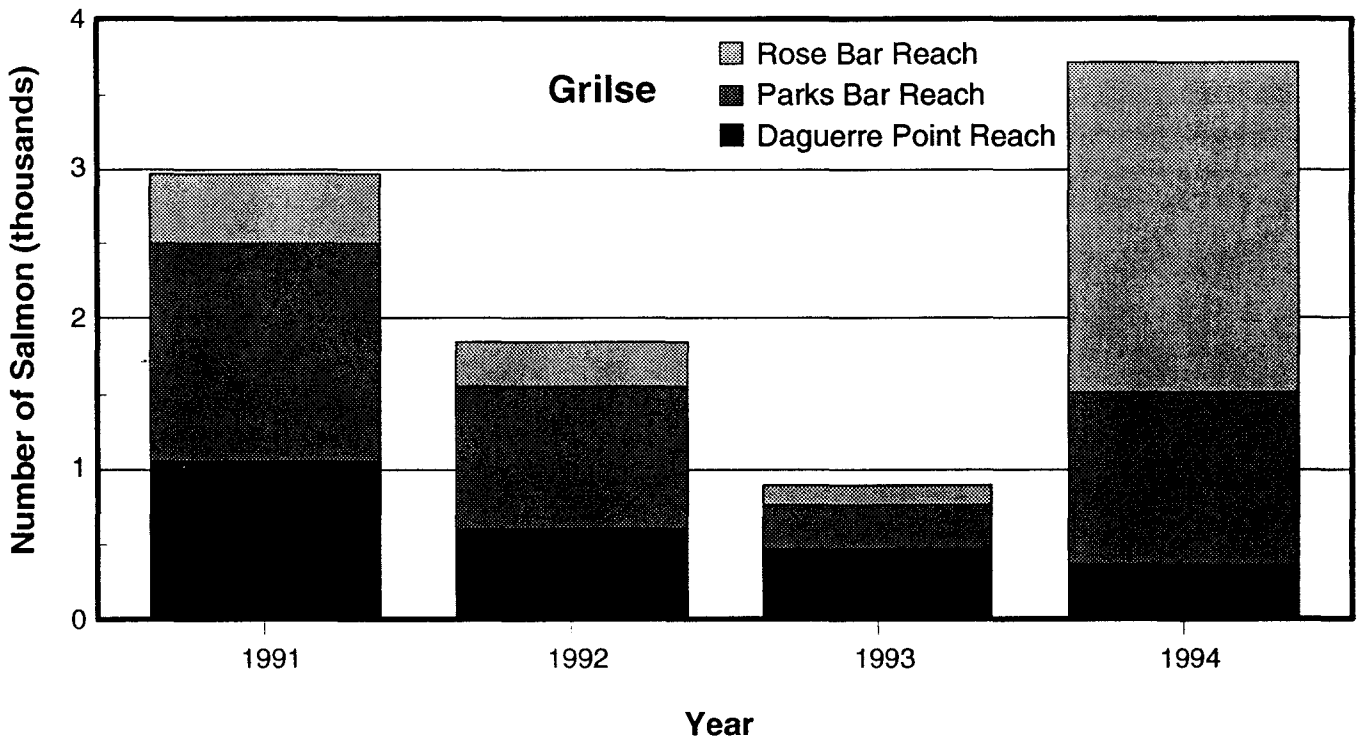
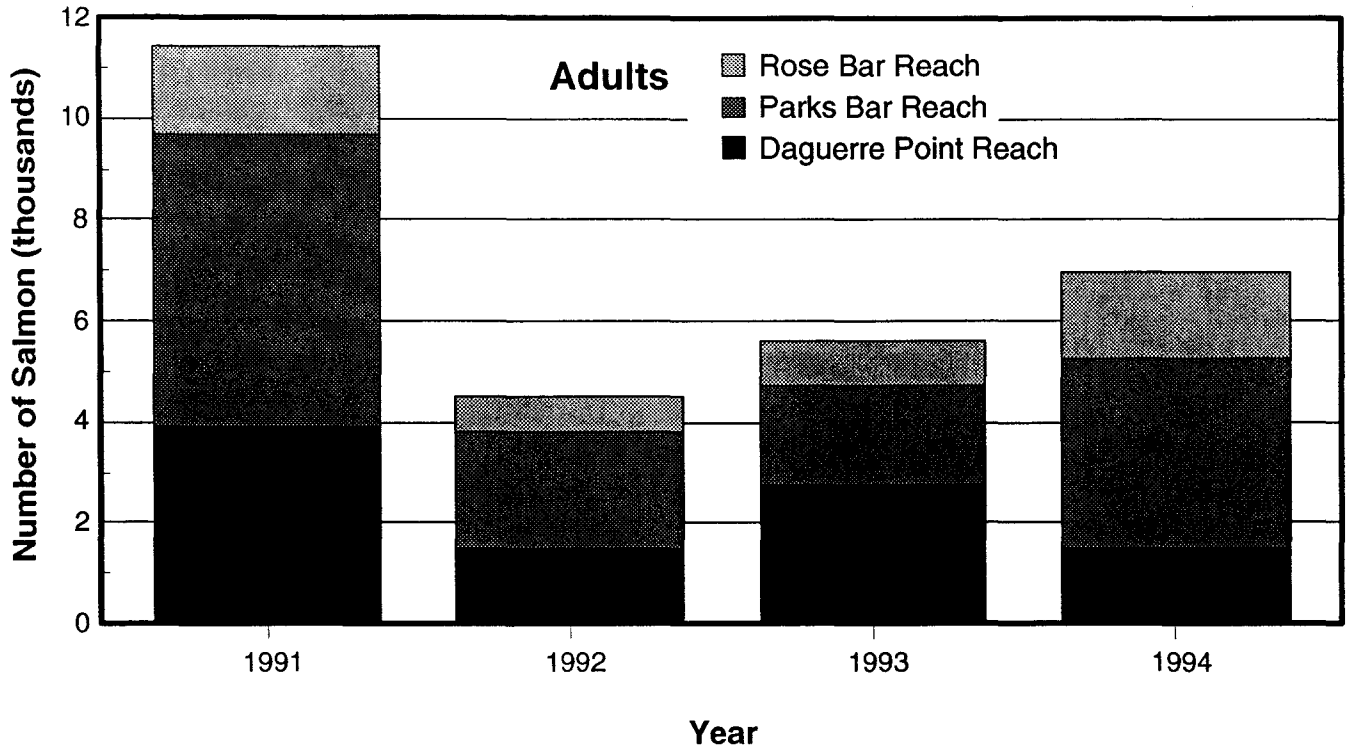
During the 1991-1993 spawning seasons, estimated spawner densities (number of salmon per river mile) were highest in the Parks Bar reach, assuming 15.5% of the run spawned above Parks Bar. In 1994, actual estimates showed that spawner densities were highest in the Rose Bar reach. Spawner densities in the Daguerre Point reach, Parks Bar reach, and Rose Bar reach were 171, 652, and 1,118 salmon per mile, respectively.

### Run Composition

Grilse salmon constituted an estimated 35% of the 1994 run (Table 1). Although direct estimates were not possible, grilse made up 16%, 29%, and 14% of total fresh carcasses observed in 1991, 1992, and 1993, respectively. Male adult salmon made up 53%, 42%, 43%, and 50% of the total fresh adults observed in 1991, 1992, 1993, and 1994, respectively (grilse were excluded because gender could not be readily determined in the field).

### Hatchery Fish

One coded wire-tagged salmon was recovered from the Parks Bar reach on October 18, 1993. It was an adult female (66 centimeters [cm] long) from the Mokelumne River Fish Installation that was released as a fingerling in the Mokelumne River at New Hope Landing on April 23, 1991 (Nelson pers. comm.).



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**Figure 6**  
**Distributions of Adult and Grilse Spawners in the**  
**Lower Yuba River, 1991-1994**



Two fresh carcasses (both males, 76 and 78 cm long) with clipped adipose fins were found in the Rose Bar reach on October 25 and November 15, 1994. DFG has not yet determined whether coded wire tags are present in these individuals.

### Recovery Rates

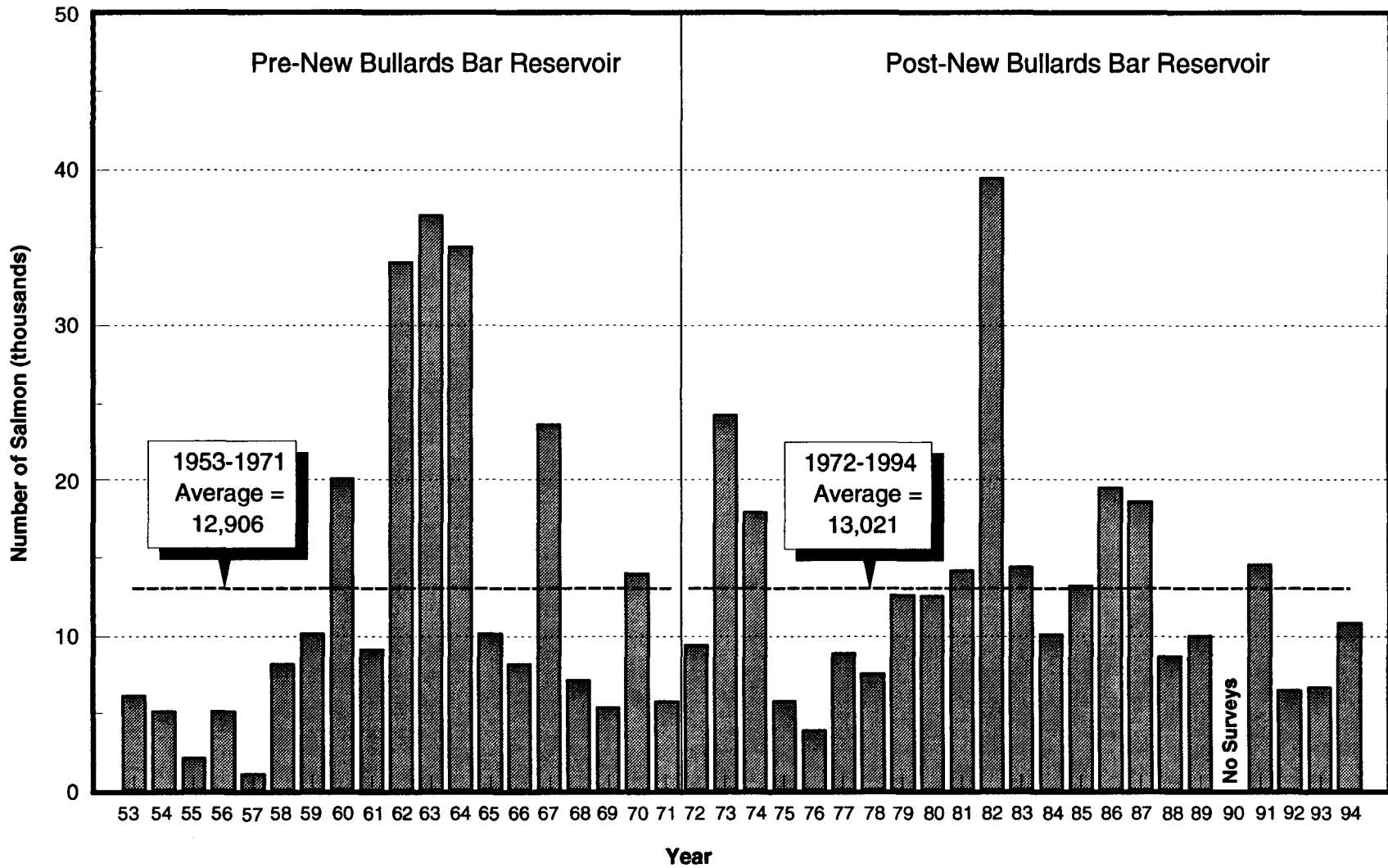
Tagging of adult and grilse carcasses in 1991 and 1994 revealed that recovery rates (i.e., percent of tagged carcasses that were recovered) of grilse carcasses are typically lower than those of adults. Overall recovery rates of grilse carcasses in 1991 and 1994 were 36% and 24%, respectively, compared to adult recovery rates of 44% and 37%. In 1994, grilse carcasses were recovered in the Rose Bar reach at only half the rate of adult recoveries. Differences in recovery rates were also observed between survey reaches. In 1994, adult recovery rates in the Rose Bar, Parks Bar, and Daguerre Point reaches were 54%, 34%, and 24%, respectively.

Recovery rates also varied with flow. Overall recovery rates of adult carcasses ranged from 34% to 44% at Yuba River flows ranging from 600 cubic feet per second (cfs) to 1,000 cfs (1991, 1992, and 1994), but were only 20% at a flow of 1,500 cfs (1993). Weekly recovery rates declined to zero following a sharp increase in flow and turbidity levels in early December 1994.

In 1994, two adult and two grilse carcasses tagged in the Rose Bar reach were subsequently recovered in the Parks Bar reach. Because recovery rates of tagged carcasses differed between the Rose Bar and Parks Bar reaches, combining the mark-recovery results from these two reaches to account for mixing of carcasses would have introduced bias into the total spawning escapement estimate. Therefore, the total number of carcasses entering the Parks Bar reach from the Rose Bar reach was approximated by calculating for each reach the average number of fish estimated in the population for each tagged carcass recovered. For example, 10 adult carcasses tagged in the Rose Bar reach on November 1, 1994, were recovered on November 8, resulting in an estimate of 157 fish (see Table A-1 in Appendix A). Therefore, each carcass recovered on November 8 represented about 16 adults. The average number of adults per tagged carcass recovered during the 1994 spawning season was 24. In the Parks Bar reach, the average number of adults per tagged carcass recovered was 67. Similar calculations for grilse resulted in 103 and 50 grilse per recovery for the Rose Bar and Parks Bar reaches, respectively. Therefore, the two adult and two grilse carcasses recovered in the Parks Bar reach represented 48-134 adults and 100-206 grilse from the Rose Bar reach.

### DISCUSSION

Annual chinook salmon spawning escapement in the lower Yuba River in 1994 was about 18% lower than the long-term average run size (approximately 13,000 fish) but represented a significant increase over the relatively small runs in 1992 and 1993 (Figure 7).



Sources: 1953-1966 Hallock (N.d.)  
 1967-1989 Mills and Fisher (1994)  
 1991-1994 Jones & Stokes Associates (1992, 1994, 1995)



Jones & Stokes Associates, Inc.

**Figure 7**  
**Annual Fall Chinook Salmon Spawning Escapement in the Lower Yuba River during Pre- (1953-1971) and Post- (1972-1994) New Bullards Bar Reservoir Periods**

Average annual chinook salmon spawning escapement since the completion of New Bullards Bar Reservoir has remained at about 13,000 fish, the same level that existed before completion of the reservoir.

Central Valley chinook salmon runs were expected to increase in 1994 based on reports of increased fishing success in the California ocean and inland sport fisheries. Sport catches in 1994 included a large number of 2-year-old fish, reflecting good survival and production of the 1992 year class (i.e., salmon produced by spawners in 1992). Similarly, 2-year-old salmon (grilse) made a large contribution to Yuba River spawning escapement in 1994; the estimated number and proportion of grilse in the 1994 Yuba River run were the largest since 1991. This suggests the potential for a large run in 1995 when 3-year-olds from the 1992 year class return to the Yuba River.

In 1994, salmon carcass surveys included the reach above Parks Bar, marking the first time in many years that a complete spawning escapement estimate could be made for the Yuba River. Surprisingly, the Rose Bar reach supported over one-third of the spawning population in 1994. If 15.5% of the run was assumed to have spawned there in 1994, as was done in previous years, the run would have been underestimated by approximately 2,700 fish, or 25% of total spawning escapement. Spawning escapement estimates by survey reach in 1994 indicated that over 80% of the run spawned above Daguerre Point Dam and that the highest spawner densities (number of spawners per river mile) occurred in the Rose Bar reach.

The influence of flow and water temperature on the timing of chinook salmon spawning in the Yuba River is evident from the 1991-1994 spawning escapement data. Yuba River flows above and below Daguerre Point Dam during the 1992 and 1994 spawning seasons were similar, although daily water temperatures were generally several degrees warmer during October and November 1992 in response to warmer ambient air temperatures. Whereas spawning started at about the same time (mid-October) in 1992 and 1994, peak spawning occurred about a week later in 1992. High, cold flows in September and early October 1991 resulted in early upstream migration and spawning of chinook salmon in the lower Yuba River; the majority of spawning took place in October rather than in November. Despite relatively high flows throughout most of the 1993 spawning season, the timing of upstream migration and onset of spawning were similar to those in 1992 and 1994 because of similar flows and water temperatures at the beginning of the spawning season. Peak spawning, however, was 2-3 weeks earlier in 1993 than in 1992 and 1994 in response to cooler water temperatures later in the season.

The lag in spawning time observed below Daguerre Point Dam is related to the timing of suitable spawning temperatures. Water temperature modeling by Bookman-Edmonston Engineering (Salmon pers. comm.) shows that declining water temperatures in the lower Yuba River in October are generally 1-4°F higher at the Marysville gauge than at Parks Bar depending on flows and weather conditions. Consequently, daily water temperatures below Daguerre Point Dam reach suitable levels for spawning later in the season than above the dam. This explains the 2-week shift in spawning times between the Parks Bar and Daguerre Point reaches in 1992 and 1994. It is likely that salmon entering the Yuba River early in the season continue their upstream migration to areas with suitable

spawning temperatures, whereas those arriving later in the season encounter suitable temperatures soon after entering the river and spawn in the lower reaches. Such behavior would explain the tendency for a larger fraction of the run to spawn above Daguerre Point Dam in years when lower flows delay the occurrence of suitable water temperatures in the Daguerre Point reach.

The influx of carcasses from the Rose Bar to the Parks Bar reach in 1994 was probably less than 250 fish. No correction to the Parks Bar escapement estimate was necessary because the potential bias resulting from the addition of these carcasses was considered minor and within the estimation error of the method. Furthermore, the introduction of these carcasses offset, to some extent, the inability to make weekly population estimates at the end of the spawning season due to poor survey conditions.

### RECOMMENDATIONS

The results of the 1994 chinook salmon spawning escapement surveys demonstrated that assuming 15.5% of the run spawns above Parks Bar can cause substantial error in estimating total spawning escapement in the lower Yuba River. It appears that applying 15.5% has consistently underestimated the run or that the variability around this average from year to year is considerable. In any case, including the Rose Bar reach in future survey efforts will improve spawning escapement estimates and provide a more accurate picture of spawner abundance and distribution throughout the Yuba River.

Lower recovery rates of grilse carcasses compared to adult carcasses in 1994 further demonstrated the need for independent estimates of adults and grilse. Boydstun (1994) found that the grilse recovery rate on Bogus Creek, a tributary of the Klamath River, was 63% of the adult recovery rate. He attributed the lower recovery rates of grilse to their smaller size, suggesting that smaller salmon are less visible and disappear faster than larger salmon. Because differences in recovery rates also occurred between survey reaches on the Yuba River, separate estimates of the number of spawners in each reach is warranted. An effort should be made to conduct weekly surveys as close in time as possible, however, so that direct comparisons of spawning time and abundance between survey reaches can be made.

During each weekly survey in 1994, all fresh carcasses were tagged with the same color tag although carcasses in the Rose Bar reach were tagged with two tags. Field personnel working in the Parks Bar reach found it easy to overlook the second tag and recommended that a different color tag be applied to carcasses in the Rose Bar reach.

The following recommendations are made for future spawning escapement surveys:

- continue separate surveys of the Rose Bar, Parks Bar, and Daguerre Point reaches;
- tag both fresh adult and grilse carcasses and generate separate estimates of each;

- survey all reaches within a 2-day period (e.g., survey the Rose Bar and Parks Bar reaches on the same day and the Daguerre Point reach on the second day); and
- tag all fresh carcasses in the Rose Bar reach with a distinctive color tag.

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**Appendix A. Weekly Recoveries of Tagged Salmon  
Carcasses and Population Estimates by  
Survey Reach, 1993 and 1994**

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Table A-1. Weekly Recoveries of Adult Salmon Carcasses in the Parks Bar Reach, 1993

Week of Recovery (j)	Week of Tagging (i)								Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 12	Oct 18	Oct 25	Nov 1	Nov 8	Nov 15	Nov 22	Nov 29		
Oct 18	0								0	46
Oct 25	0	0							0	68
Nov 1	0	0	3						3	79
Nov 8	0	1	2	5					8	102
Nov 15	0	0	2	6	7				15	110
Nov 22	0	0	1	2	3	5			11	59
Nov 29	0	0	0	0	1	0	2		3	42
Dec 6	0	0	0	0	0	0	0	3	3	26
Tagged Carcasses Recovered (Ri)	0	1	8	13	11	5	2	3	43	532
Total Carcasses Tagged (Mi)	1	24	46	37	39	38	12	21	218	

Table A-2. Weekly Population Estimates of Adult Salmon in the Parks Bar Reach, 1993

Week of Recovery (j)	Week of Tagging (i)								Total
	Oct 12	Oct 18	Oct 25	Nov 1	Nov 8	Nov 15	Nov 22	Nov 29	
Oct 18	0								0
Oct 25	0	0							0
Nov 1	0	0	454						454
Nov 8	0	306	147	181					634
Nov 15	0	0	84	125	182				391
Nov 22	0	0	31	31	57	204			323
Nov 29	0	0	0	0	50	0	168		218
Dec 6	0	0	0	0	0	0	0	182	182
Total	0	306	716	337	289	204	168	182	2,202
Adj. Total									1,985



Table A-3. Weekly Recoveries of Adult Salmon Carcasses in the Daguerre Point Reach, 1993

Week of Recovery (j)	Week of Tagging (i)							Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 19	Oct 26	Nov 2	Nov 9	Nov 16	Nov 23	Nov 30		
Oct 26	0							0	37
Nov 2	1	4						5	62
Nov 9	0	0	4					4	74
Nov 16	0	0	1	2				3	81
Nov 23	0	0	0	0	0			0	22
Nov 30	0	0	0	0	0	1		1	35
Dec 7	0	0	0	0	1	0	1	2	23
Tagged Carcasses Recovered (Ri)	1	4	5	2	1	1	1	15	334
Total Carcasses Tagged (Mi)	3	23	27	35	45	13	11	157	

Table A-4. Weekly Population Estimates of Adult Salmon in the Daguerre Point Reach, 1993

Week of Recovery (j)	Week of Tagging (i)							Total
	Oct 19	Oct 26	Nov 2	Nov 9	Nov 16	Nov 23	Nov 30	
Oct 26	0							0
Nov 2	37	285						322
Nov 9	0	0	400					400
Nov 16	0	0	146	945				1,091
Nov 23	0	0	0	0	0			0
Nov 30	0	0	0	0	0	455		455
Dec 7	0	0	0	0	518	0	127	645
Total	37	285	546	945	518	455	127	2,913
Adj. Total								2,759

Table A-5. Weekly Recoveries of Adult Salmon Carcasses in the Rose Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 19	Oct 25	Nov 1	Nov 8	Nov 15	Nov 23	Nov 29	Dec 6		
Oct 25	8								8	148
Nov 1	2	29							31	195
Nov 8	2	2	10						14	159
Nov 15	0	1	9	8					18	213
Nov 23	0	0	1	0	15				16	129
Nov 29	0	0	1	0	3	11			15	97
Dec 6	0	0	0	0	1	1	1		3	34
Dec 14	0	0	0	0	0	1	0	0	1	18
Tagged Carcasses Recovered (Ri)	12	32	21	8	19	13	1	0	106	993
Total Carcasses Tagged (Mi)	23	48	29	23	40	23	10	1	197	

Table A-6. Weekly Population Estimates of Adult Salmon in the Rose Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Total
	Oct 19	Oct 25	Nov 1	Nov 8	Nov 15	Nov 23	Nov 29	Dec 6	
Oct 25	284								284
Nov 1	24	274							298
Nov 8	44	34	157						235
Nov 15	0	18	147	272					437
Nov 23	0	0	11	0	255				266
Nov 29	0	0	9	0	41	126			176
Dec 6	0	0	0	0	24	20	113		157
Dec 14	0	0	0	0	0	32	0	0	32
Total	352	326	324	272	320	178	113	0	1,885
Adj. Total									1,711

Table A-7. Weekly Recoveries of Grilse Salmon Carcasses in the Rose Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 19	Oct 25	Nov 1	Nov 8	Nov 15	Nov 23	Nov 29	Dec 6		
Oct 25	1								1	32
Nov 1	0	6							6	67
Nov 8	0	0	3						3	84
Nov 15	0	0	1	7					8	144
Nov 23	0	0	0	1	7				8	101
Nov 29	0	0	0	0	0	2			2	74
Dec 6	0	0	0	0	1	0	0		1	16
Dec 14	0	0	0	0	0	0	1	0	1	11
Tagged Carcasses Recovered (Ri)	1	6	4	8	8	2	1	0	30	529
Total Carcasses Tagged (Mi)	7	13	14	26	30	18	7	2	117	

Table A-8. Weekly Population Estimates of Grilse Salmon in the Rose Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Total
	Oct 19	Oct 25	Nov 1	Nov 8	Nov 15	Nov 23	Nov 29	Dec 6	
Oct 25	224								224
Nov 1	0	145							145
Nov 8	0	0	294						294
Nov 15	0	0	63	410					473
Nov 23	0	0	0	41	331				372
Nov 29	0	0	0	0	0	666			666
Dec 6	0	0	0	0	60	0	0		60
Dec 14	0	0	0	0	0	0	77	0	77
Total	224	145	357	451	391	666	77	0	2,311
Adj. Total									2,201

Table A-9. Weekly Recoveries of Adult Salmon Carcasses in the Parks Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 19	Oct 26	Nov 2	Nov 9	Nov 16	Nov 22	Nov 30	Dec 7		
Oct 26	8								8	130
Nov 2	2	2							4	194
Nov 9	0	3	15						18	213
Nov 16	0	1	12	33					46	304
Nov 22	0	0	2	10	12				24	178
Nov 30	0	0	1	11	9	17			38	199
Dec 7	0	0	0	0	0	0	0		0	5
Dec 14	0	0	0	0	0	0	0	0	0	5
Tagged Carcasses Recovered (Ri)	10	6	30	54	21	17	0	0	138	1,228
Total Carcasses Tagged (Mi)	28	57	90	103	58	56	16	1	409	

Table A-10. Weekly Population Estimates of Adult Salmon in the Parks Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Total
	Oct 19	Oct 26	Nov 2	Nov 9	Nov 16	Nov 22	Nov 30	Dec 7	
Oct 26	364								364
Nov 2	272	922							1,194
Nov 9	0	337	533						870
Nov 16	0	63	238	416					717
Nov 22	0	0	45	141	246				432
Nov 30	0	0	16	110	130	293			549
Dec 7	0	0	0	0	0	0	0		0
Dec 14	0	0	0	0	0	0	0	0	0
Total	636	1322	832	667	376	293	0	0	4,126
Adj. Total									3,745

Table A-11. Weekly Recoveries of Grilse Salmon Carcasses in the Parks Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 19	Oct 26	Nov 2	Nov 9	Nov 16	Nov 22	Nov 30	Dec 7		
Oct 26	0								0	20
Nov 2	0	0							0	36
Nov 9	0	0	2						2	100
Nov 16	0	0	4	7					11	121
Nov 22	0	0	2	1	0				3	28
Nov 30	0	0	0	4	3	7			14	147
Dec 7	0	0	0	0	0	0	0		0	2
Dec 14	0	0	0	0	0	0	0	0	0	2
Tagged Carcasses Recovered (Ri)	0	0	8	12	3	7	0	0	30	456
Total Carcasses Tagged (Mi)	2	11	21	53	18	8	13	0	126	

Table A-12. Weekly Population Estimates of Grilse Salmon in the Parks Bar Reach, 1994

Week of Recovery (j)	Week of Tagging (i)								Total
	Oct 19	Oct 25	Nov 2	Nov 9	Nov 16	Nov 22	Nov 30	Dec 7	
Oct 26	0								0
Nov 2	0	0							0
Nov 9	0	0	263						263
Nov 16	0	0	116	340					456
Nov 22	0	0	49	41	0				90
Nov 30	0	0	0	186	189	84			459
Dec 7	0	0	0	0	0	0	0		0
Dec 14	0	0	0	0	0	0	0	0	0
Total	0	0	428	567	189	84	0	0	1,268
Adj. Total									1,144

Table A-13. Weekly Recoveries of Adult Salmon Carcasses in the Daguerre Point Reach, 1994

Week of Recovery (j)	Week of Tagging (i)						Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 27	Nov 4	Nov 10	Nov 17	Nov 23	Dec 1		
Nov 4	1						1	29
Nov 10	0	0					0	17
Nov 17	0	1	2				3	120
Nov 23	0	2	3	16			21	163
Dec 1	0	0	0	2	12		14	123
Dec 15	0	0	0	0	0	0	0	0
Tagged Carcasses Recovered (Ri)	1	3	5	18	12	0	39	452
Total Carcasses Tagged (Mi)	9	17	11	43	61	24	165	

Table A-14. Weekly Population Estimates of Adult Salmon in the Daguerre Point Reach, 1994

Week of Recovery (j)	Week of Tagging (i)						Total
	Oct 27	Nov 4	Nov 10	Nov 17	Nov 23	Dec 1	
Nov 4	261						261
Nov 10	0	0					0
Nov 17	0	227	176				403
Nov 23	0	88	51	297			436
Dec 1	0	0	0	42	536		578
Dec 15	0	0	0	0	0	0	0
Total	261	315	227	339	536	0	1,678
Adj. Total							1,522

Table A-15. Weekly Recoveries of Grilse Salmon Carcasses in the Daguerre Point Reach, 1994

Week of Recovery (j)	Week of Tagging (i)						Tagged Carcasses Recovered (Rj)	Total Carcasses Recovered (Cj)
	Oct 27	Nov 4	Nov 10	Nov 17	Nov 23	Dec 1		
Nov 4	0						0	12
Nov 10	0	0					0	16
Nov 17	0	0	0				0	29
Nov 23	0	1	0	3			4	60
Dec 1	0	0	0	0	4		4	39
Dec 15	0	0	0	0	0	0	0	1
Tagged Carcasses Recovered (Ri)	0	1	0	3	4	0	8	157
Total Carcasses Tagged (Mi)	2	11	5	11	8	5	42	

Table A-16. Weekly Population Estimates of Grilse Salmon in the Daguerre Point Reach, 1994

Week of Recovery (j)	Week of Tagging (i)						Total
	Oct 27	Nov 4	Nov 10	Nov 17	Nov 23	Dec 1	
Nov 4	0						0
Nov 10	0	0					0
Nov 17	0	0	0				0
Nov 23	0	165	0	165			330
Dec 1	0	0	0	0	78		78
Dec 15	0	0	0	0	0	0	0
Total	0	165	0	165	78	0	408
Adj. Total							368