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1998 FALL-RUN CHINOOK SALMON SPAWNING ESCAPEMENT IN THE YUBA RIVER

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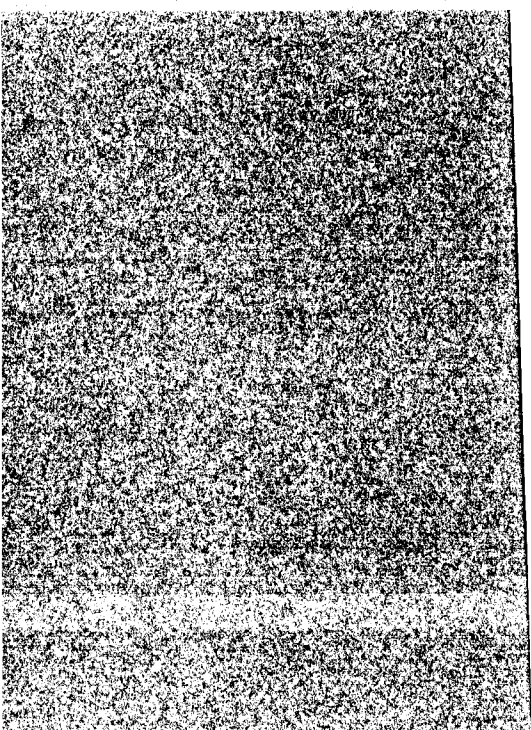
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INTRODUCTION

From 1953 to 1989, the California Department of Fish and Game (DFG) conducted annual surveys of chinook salmon carcasses on the lower Yuba River to estimate fall-run chinook salmon (*Oncorhynchus tshawytscha*) spawning escapement (i.e., the number of salmon that escape being caught and return to spawn each year). Because of budget and personnel cuts, DFG suspended its surveys of Yuba River salmon carcasses in 1990. In response, Yuba County Water Agency (YCWA) retained Jones & Stokes Associates to conduct the 1991 surveys. In 1992, 1993, and 1994, annual carcass surveys were conducted jointly by DFG and Jones & Stokes Associates. Jones & Stokes Associates continued to conduct carcass surveys from 1995 through 1998; DFG was unable to participate during those years.

This report presents the results of the 1998 surveys. The results of the 1991-1997 surveys were reported in previous documents (Jones & Stokes Associates 1992, 1994, 1995, 1996, 1997, 1998).

METHODS

Since the 1970s, DFG has used a modified form of the Schaefer mark-recovery method (Schaefer 1951) to estimate the number of chinook salmon spawning each year in the Yuba River. Weekly carcass surveys were conducted each year during the principal fall chinook salmon spawning season (October through mid-December). During these surveys, field personnel counted fresh and decomposed carcasses, tagged fresh salmon carcasses and returned them to the river, and counted carcasses tagged on previous survey dates. Weekly estimates were computed based on the proportion of tagged carcasses recovered compared to the total number of tagged carcasses at large and the total number of tagged and untagged carcasses observed. Weekly estimates were summed to obtain the total spawning escapement estimate. The sampling methods are described in more detail in previous reports (Jones & Stokes Associates 1992, 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 reach (Daguerre Point Dam to the Simpson Lane bridge in Marysville) (Figure 1) from October 6 to December 23, 1998. These reaches include nearly all of the spawning areas used by chinook salmon in the Yuba River; some fish may spawn between Rose Bar and Englebright Dam, although spawning gravels are relatively scarce in this reach. For many years, DFG did not survey the reach above Parks Bar. Instead, it assumed that 15.5% of the run spawned above Parks Bar, which is the average percent of total spawning escapement estimated for this reach from 1966-1971 (Konhoff pers. comm.). However, surveys in from 1994 and 1996 revealed that up to 37% of the run spawns in the Rose Bar reach.

The sampling methods used during the 1998 spawning escapement surveys on the Yuba River were generally consistent with those used by DFG during past surveys with a few modifications. DFG's practice has been to tag only adult (age 3 and older) carcasses and estimate the number of grilse (age 2) by multiplying the adult estimate by the ratio of fresh grilse carcasses to fresh adult

carcasses. This assumes that grilse carcasses are recovered at a rate similar to that of adult carcasses. However, by tagging both adults and grilse in recent years, Jones & Stokes Associates found that grilse are often recovered at significantly lower rates than those of adults. Boydston (1994) also made this observation, suggesting that grilse are more easily overlooked and disappear faster from the stream because of their smaller size. To avoid this potential bias, both adults and grilse were differentiated and tagged in 1998. Independent estimates of adults and grilse were also made for each reach because recovery rates can differ between reaches.

Salmon carcasses were classified as adults if they were greater than 25.5 inches long (fork length [FL]) or grilse if they were less than 25.5 inches long (FL). This cut-off length was determined from length-frequency data collected from chinook salmon that entered the Feather River Hatchery in October 1998, and was used to separate adults from grilse during carcass surveys on the Feather River in fall 1998 (Brown pers. comm.). Fork lengths of adults and grilse in the Yuba River were measured during the first 3 weeks of the 1998 survey (Figure 2). The length-frequency distribution indicated that the 25.5-inch cutoff length was a reasonable criterion, although there was apparently overlap in adult and grilse lengths.

RESULTS

River Conditions

Figures 3 and 4 present daily average Yuba River flows and water temperatures during the 1998 chinook salmon spawning season. Yuba River flows below Englebright Dam (Smartville gage) averaged 1,206 cubic feet per second (cfs) during most of October and 1,349 cfs through November 10, and increased to an average of 1,749 cfs through November 29. December flows averaged 2,550 cfs as a result of a large storm event. Yuba River flows near Marysville (Marysville gage) averaged 1,059 cfs during October and mid-November and then increased to an average of 1,512 cfs in the latter weeks of November (through November 29). December flows averaged 2,369 cfs. Local storm runoff resulted in a mean daily flow peak of over 4,000 cfs at both the Smartville and Marysville gages on November 30. Mean daily water temperatures at the Marysville gage were approximately 57°F in early October and declined to below 45°F by mid-December. Water visibility ranged from 1 to 10 feet during the spawning surveys.

Spawning Escapement

An estimated 30,802 chinook salmon (25,665 adults and 5,137 grilse) spawned in the Yuba River in fall 1998 (Table 1). The spreadsheets format used to compute the 1998 spawning escapement estimates are presented in Tables A-1 through A-12 in Appendix A.

Spawning Timing and Distribution

Weekly counts of fresh carcasses provide an approximation of the weekly distribution of spawning activity through the season (Figure 5). Weekly counts of fresh carcasses in the Rose Bar and Parks Bar reaches indicate that spawning began in early October when water temperatures at Parks Bar were approximately 57°F and reached a peak in mid-October and early-November when water temperatures ranged between 51°F and 54°F (Figure 4). Downstream of Daguerre Point Dam, spawning activity had started by mid-October, when water temperatures at the Marysville gage averaged approximately 55°F and peaked in mid-November when water temperatures had dropped to 48°F to 51°F. Spawning was nearly completed by late December.

An estimated 25% of the run spawned in the Rose Bar reach, 34% of the run spawned in the Parks Bar reach, and 41% spawned in the Daguerre reach.

Run Composition

Adult male and female salmon comprised 47% and 53%, respectively, of the fresh adult carcasses observed during the 1998 surveys (Table 1). Grilse salmon comprised 14% of the total number of fresh carcasses. The sex of grilse could not be reliably determined in the field but, typically, the majority of grilse are male.

Hatchery Fish

Two coded-wire-tagged salmon were recovered from the Yuba River during the 1998 surveys and delivered to DFG for decoding.

Recovery Rates

Weekly recovery rates of tagged adult salmon carcasses (i.e., percent of tagged carcasses that were recovered) averaged 30% in the Rose Bar reach, 32% in the Parks Bar reach, and 27% in the Daguerre reach, with an overall recovery rate of 29% for all reaches. The recovery rates of tagged grilse averaged 25% in the Rose Bar reach, 31% in the Parks Bar reach, and 25% in the Daguerre reach, with an overall recovery rate of 27% for all reaches.

Some females die before spawning each year, but a relatively high proportion of unspawned female carcasses (over 20%) were observed in the 1998 season. The females appeared to be in good condition and there were no apparent signs of trauma or physical injury.

RECENT TRENDS IN ABUNDANCE

Chinook salmon spawning escapement in the lower Yuba River from 1996 through 1998 was nearly twice the historical average and has increased substantially since 1993 (Table 2 and Figure 6). Annual spawning escapement before and after construction of New Bullards Bar reservoir has ranged from 1,000 fish in 1957 to over 39,000 in 1982 but has consistently averaged about 13,000 fish. The large spawning escapements in recent years raised the average to above 14,000 fish for the post-New Bullards Bar period (Table 2 and Figure 6).

Preliminary estimates of annual fall-run chinook salmon spawning escapement in the mainstem Sacramento River and its major tributaries (including the Yuba River) in recent years indicate a less-marked but similar trend since the early 1990s (Figure 7). Ocean commercial and sport landings of Central Valley chinook salmon have shown a general increase since 1990, but were relatively low in 1998 compared to previous years (Figure 8). Because ocean harvest rates (i.e., the proportion of the total number of salmon that were caught in the ocean) have not changed substantially since the early 1990s and decreased somewhat since 1996 (Figure 8), the increase in ocean landings and concurrent increase in spawning escapements in recent years indicate that there has been an overall increase in salmon abundance in the Central Valley since the early 1990s.

CITATIONS

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Personal Communications

Brown, J. Fishery biologist. California Department of Fish and Game, Rancho Cordova, CA. October 1998 - conversation regarding 1998 jack and adult length criteria.

Konnoff, D. L. Fishery biologist. California Department of Fish and Game, Rancho Cordova, CA. January 27, 1988 - memorandum to DFG files regarding 1987 Yuba River chinook salmon spawning stock estimate.

Table 1. 1998 Yuba River Chinook Salmon Spawning Escapement Estimates
by Reach and Age Class

Survey Reach	Adults	Grilse	Total
Rose Bar	6,443	1,354	7,797
Parks Bar	8,854	1,655	10,509
Daguerre	10,368	2,128	12,496
Total	25,665	5,137	30,802

Table 2. Annual Fall-Run Chinook Salmon Spawning Escapement in the Yuba River during Pre- (1953-1971) and Post- (1972-Present) New Bullards Bar Reservoir Periods

Year	Pre-Reservoir Escapement	Year	Post-Reservoir Escapement
53	6,000	72	9,258
54	5,000	73	24,119
55	2,000	74	17,809
56	5,000	75	5,641
57	1,000	76	3,779
58	8,000	77	8,722
59	10,000	78	7,416
60	20,000	79	12,430
61	9,000	80	12,406
62	34,000	81	14,025
63	37,000	82	39,367
64	35,000	83	14,256
65	10,000	84	9,965
66	8,000	85	13,066
67	23,500	86	19,406
68	7,000	87	18,510
69	5,230	88	8,501
70	13,830	89	9,837
71	5,650	90	--
		91	14,413
		92	6,361
		93	6,516
		94	10,691
		95	14,561
		96	27,520
		97	25,778
		98	30,802
Average	12,906	Average	14,265

-- No carcass surveys conducted

Sources: 1953-1966 Hallock (n.d.)
 1967-1989 Mills and Fisher (1994)
 1991-1996 Jones & Stokes Associates (1992, 1995, 1996, 1997)

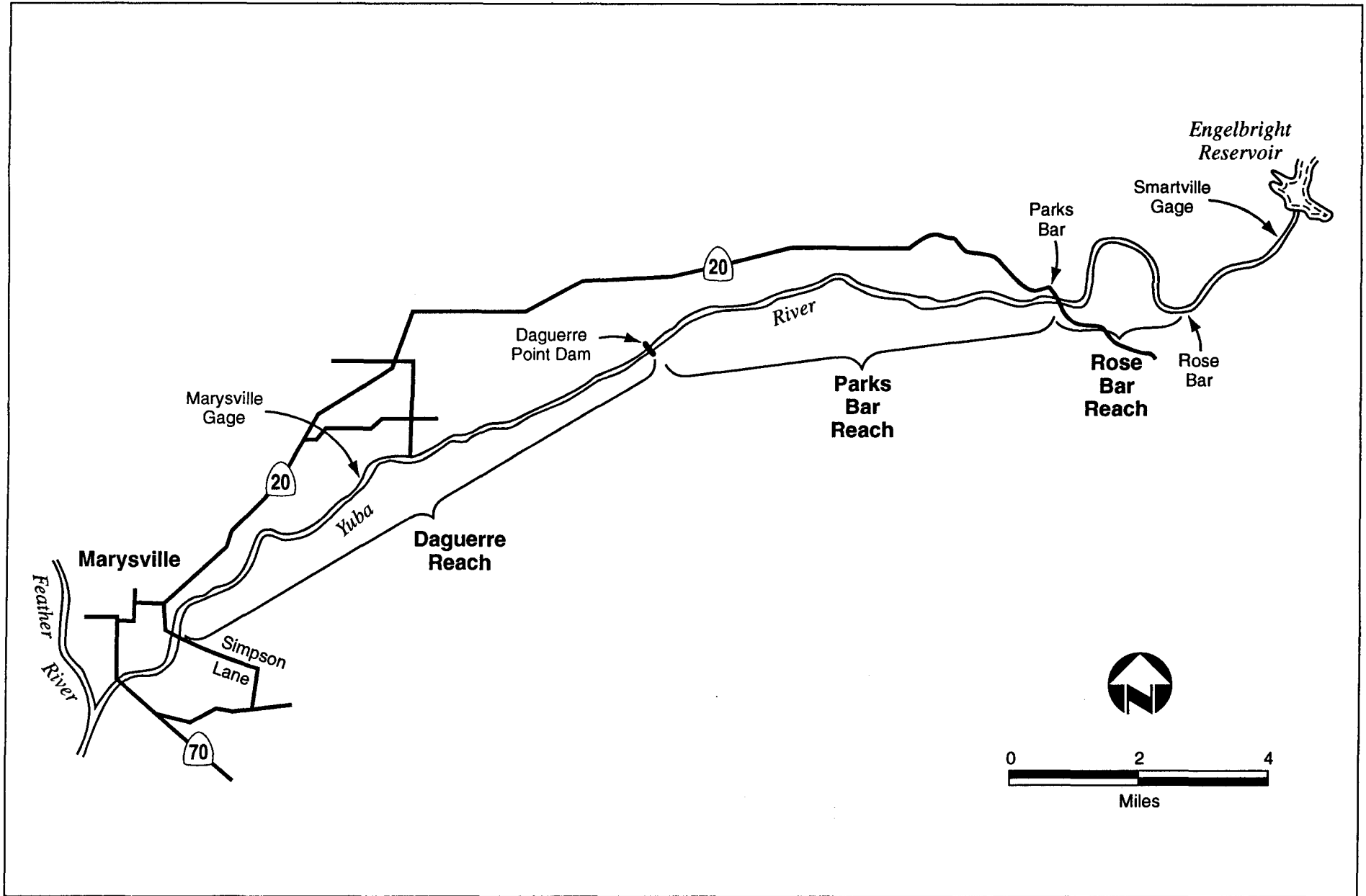


Figure 1
Lower Yuba River Chinook Salmon Spawning
Escapement Survey Reaches

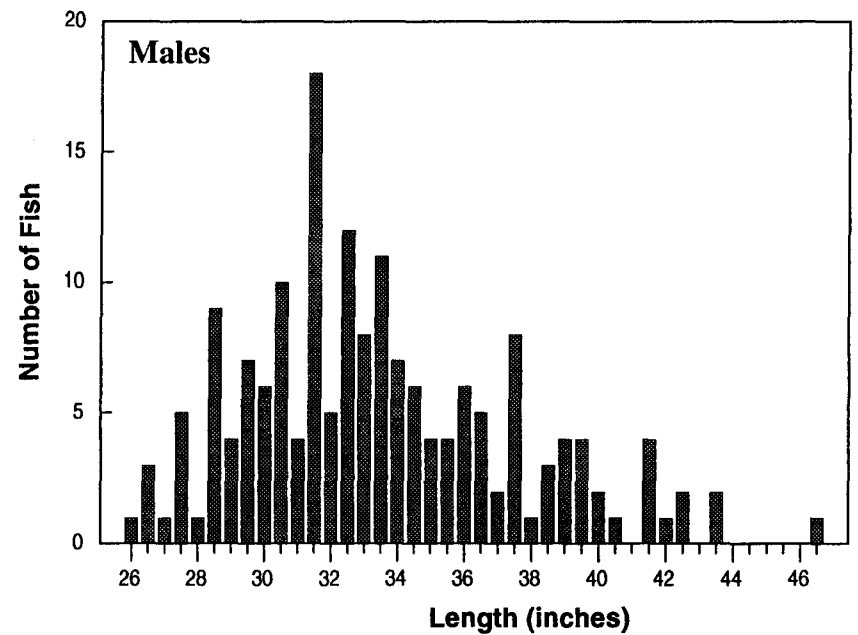
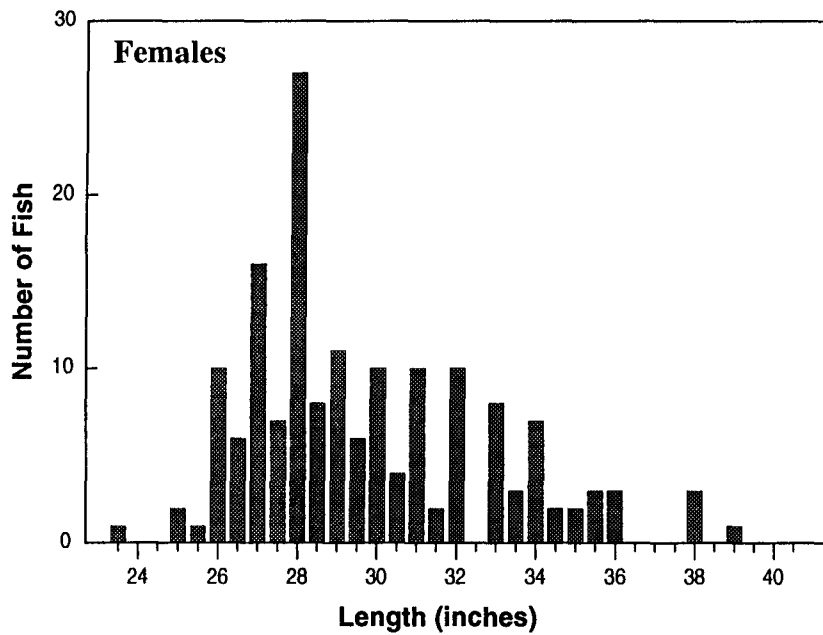
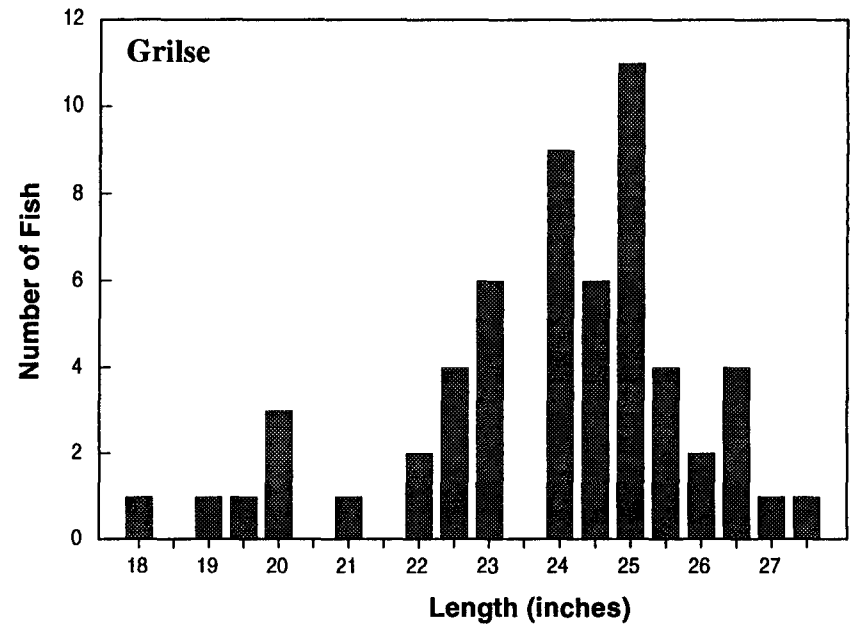
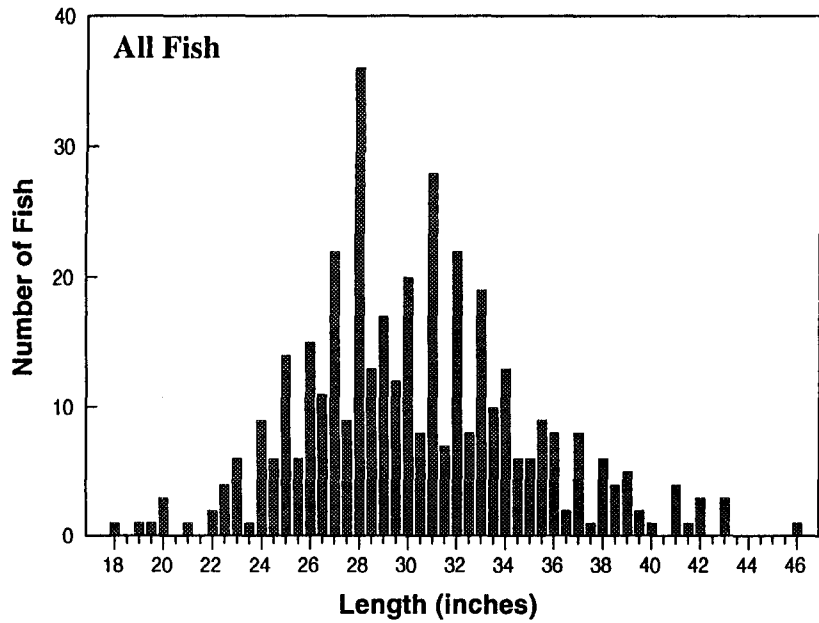


Figure 2
Length Frequencies of Fish Collected in the First Three Weeks of Surveys

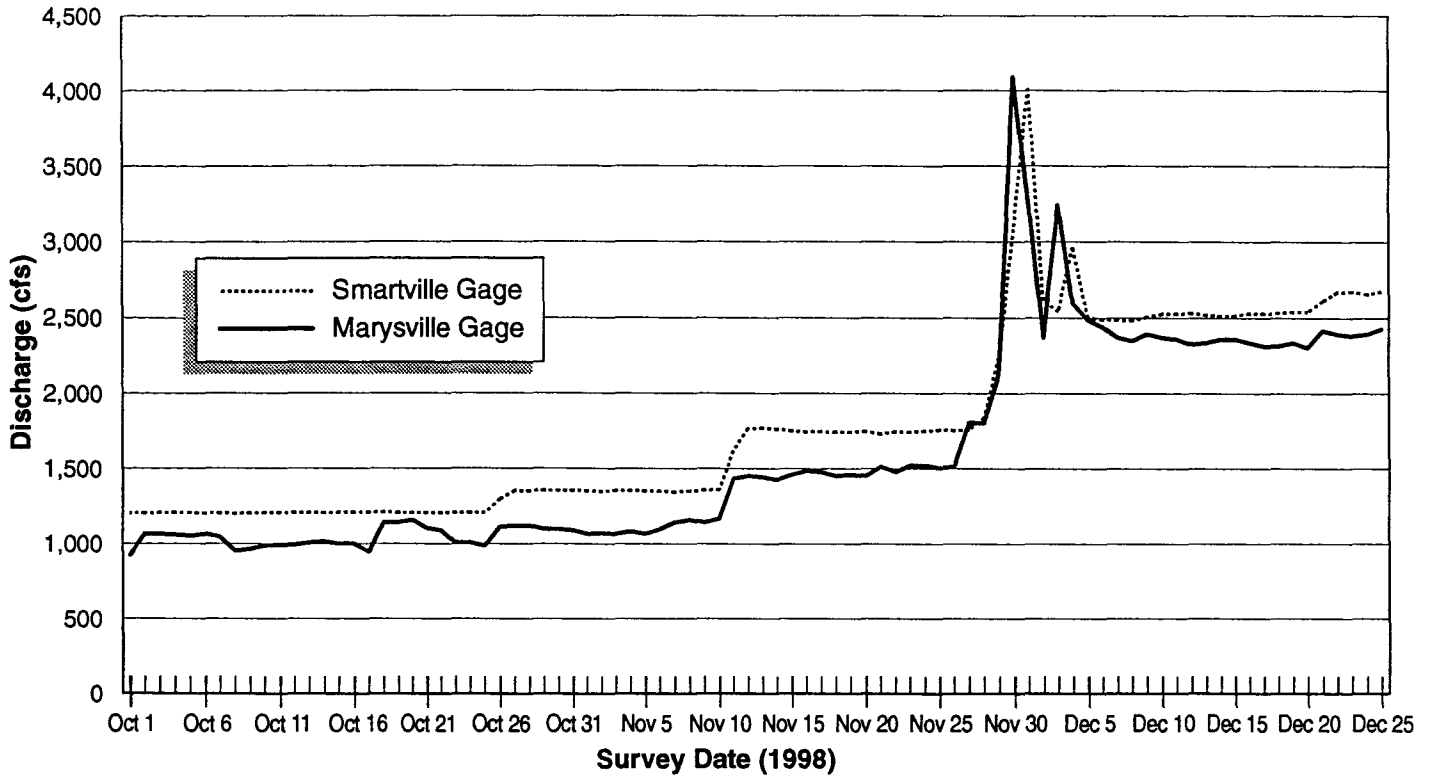


Figure 3
Daily Yuba River Flows Measured at the Smartville and Marysville Gages, October 1 - December 25, 1998

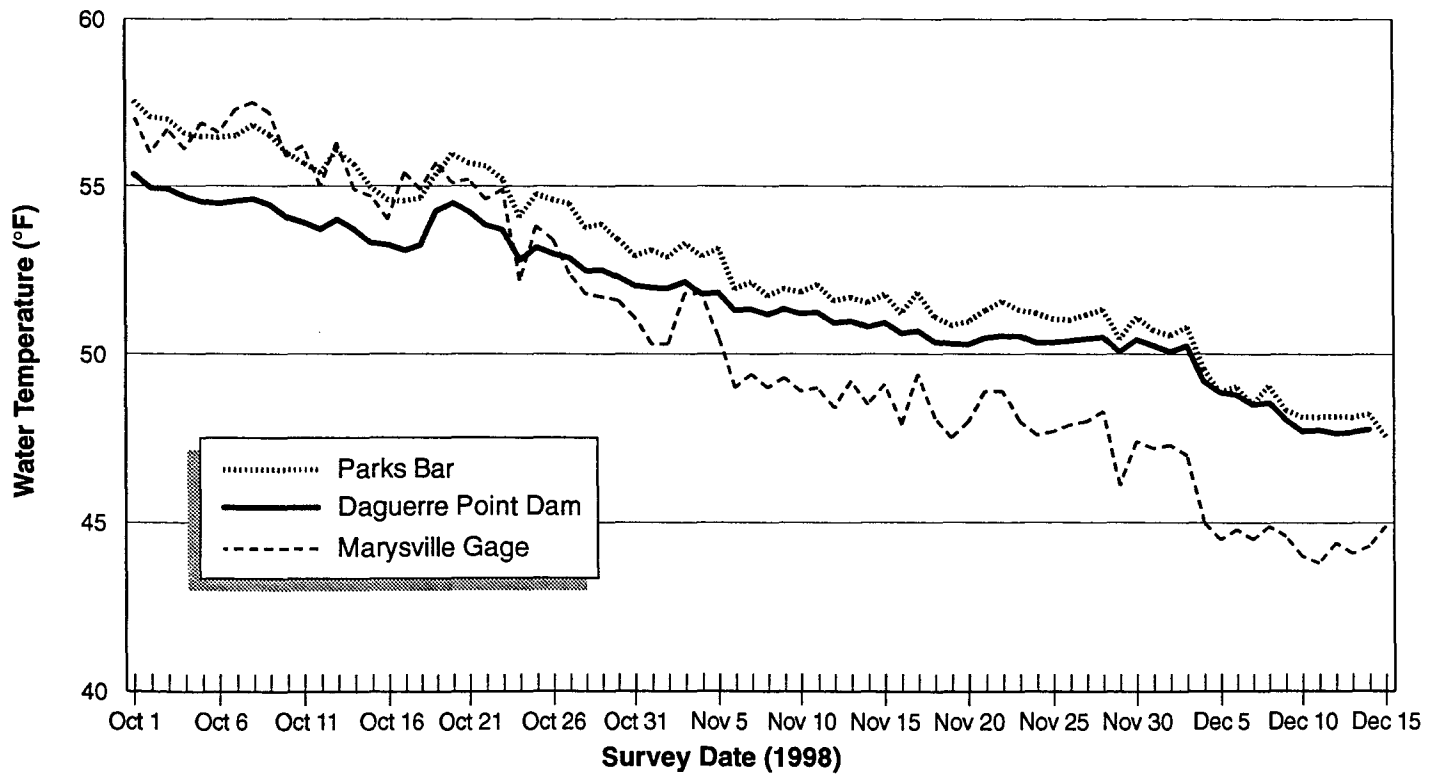


Figure 4
Mean Daily Yuba River Water Temperatures Measured at Parks Bar, Daguerre Dam, and the Marysville Gage, October 1 - December 15, 1998

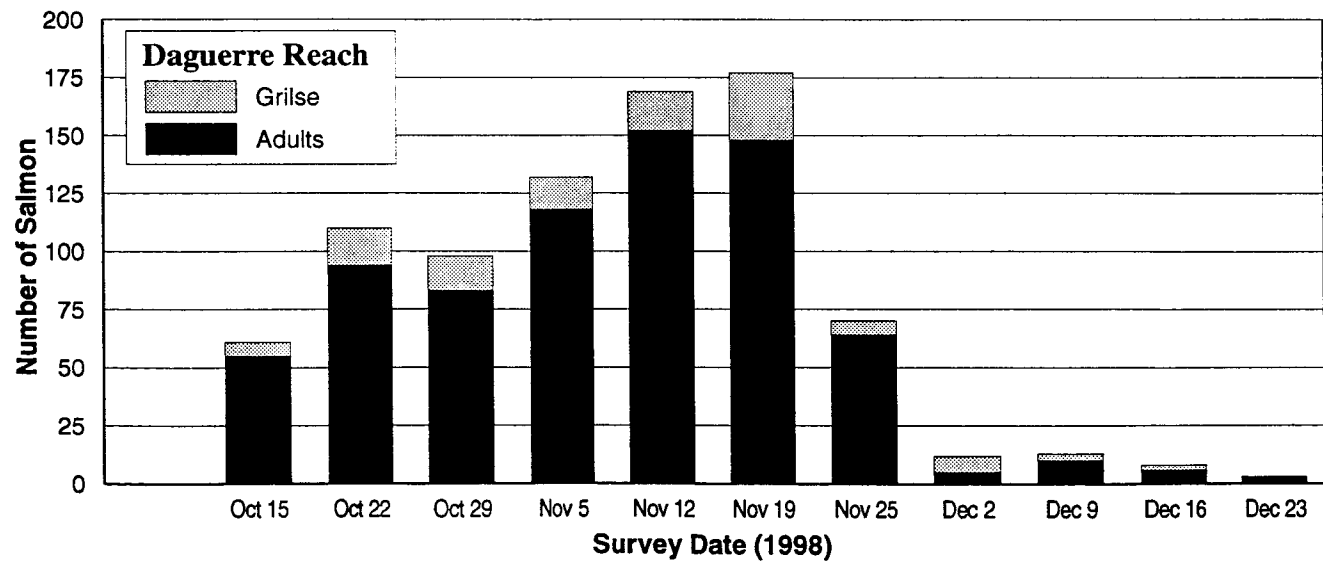
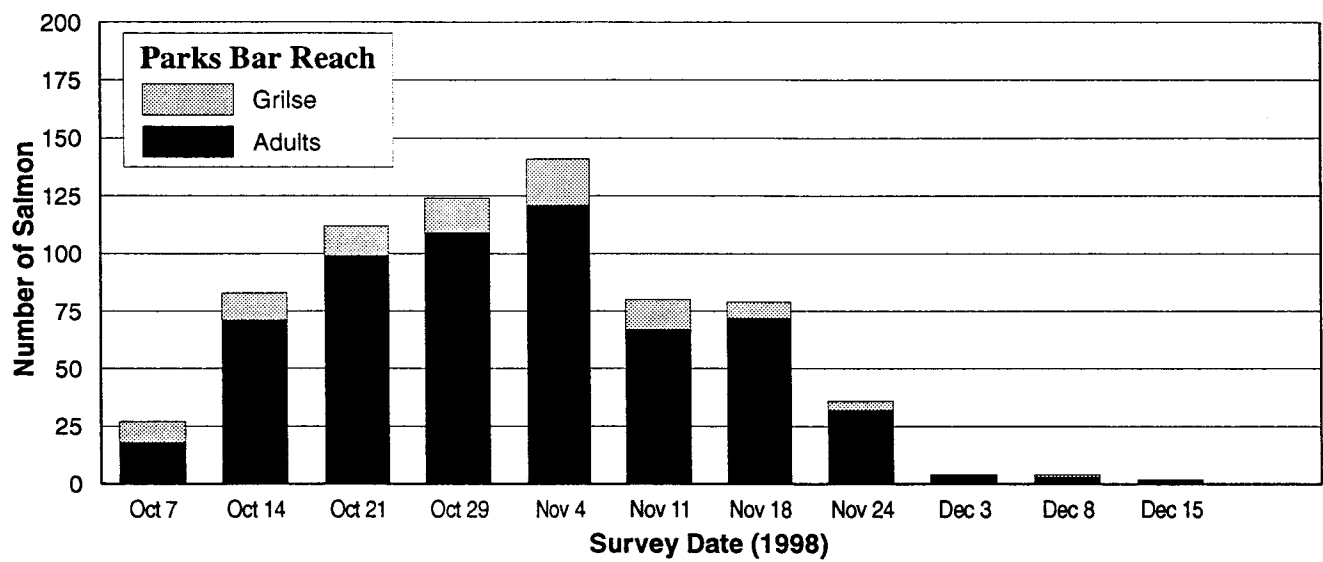
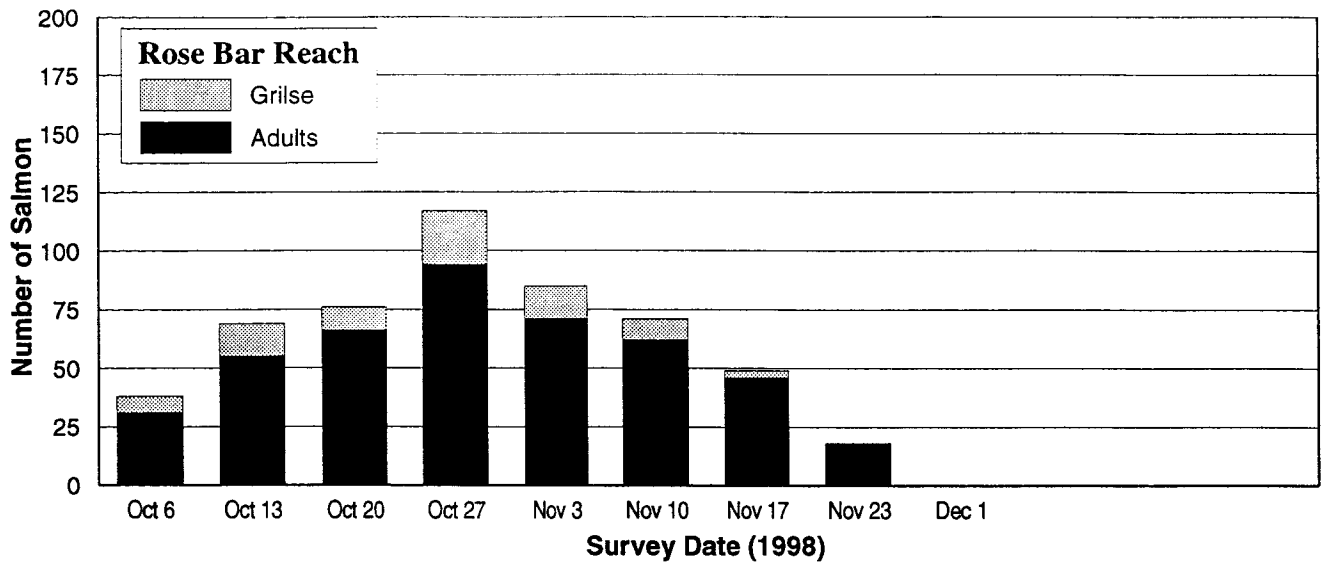
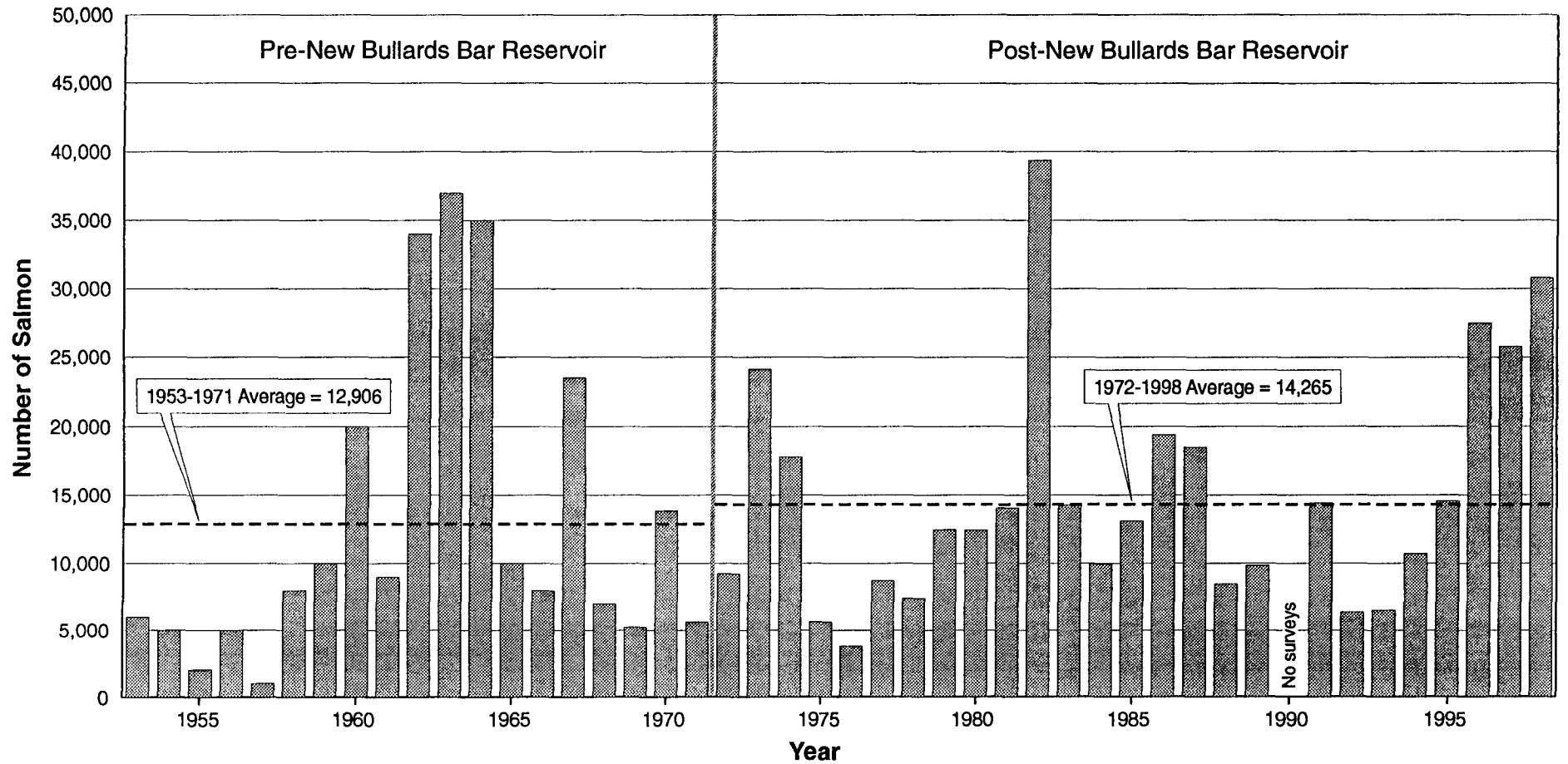


Figure 5
Weekly Counts of Fresh Salmon Carcasses
by Survey Reach, 1998



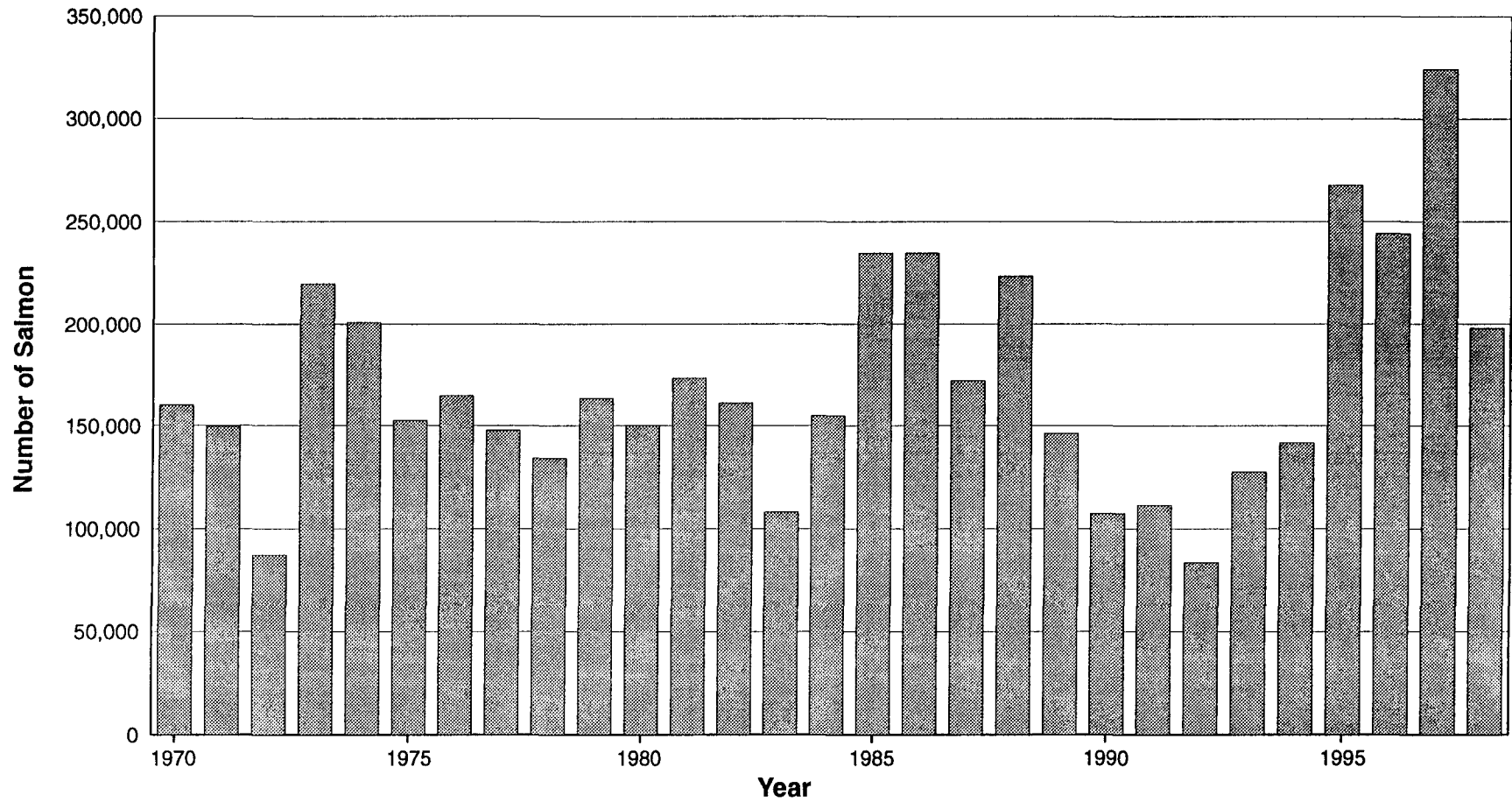
SOURCES:

1953-1966: Hallock (n.d.)
 1967-1989: Mills and Fisher (1994)
 1991-1995: Jones & Stokes Associates (1992, 1994, 1995, 1996, 1997, 1998).



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Figure 6
Annual Fall-Run Chinook Salmon Spawning Escapement in the Lower Yuba River during Pre- (1953-1971) and Post- (1972-1998) New Bullards Bar Reservoir Periods

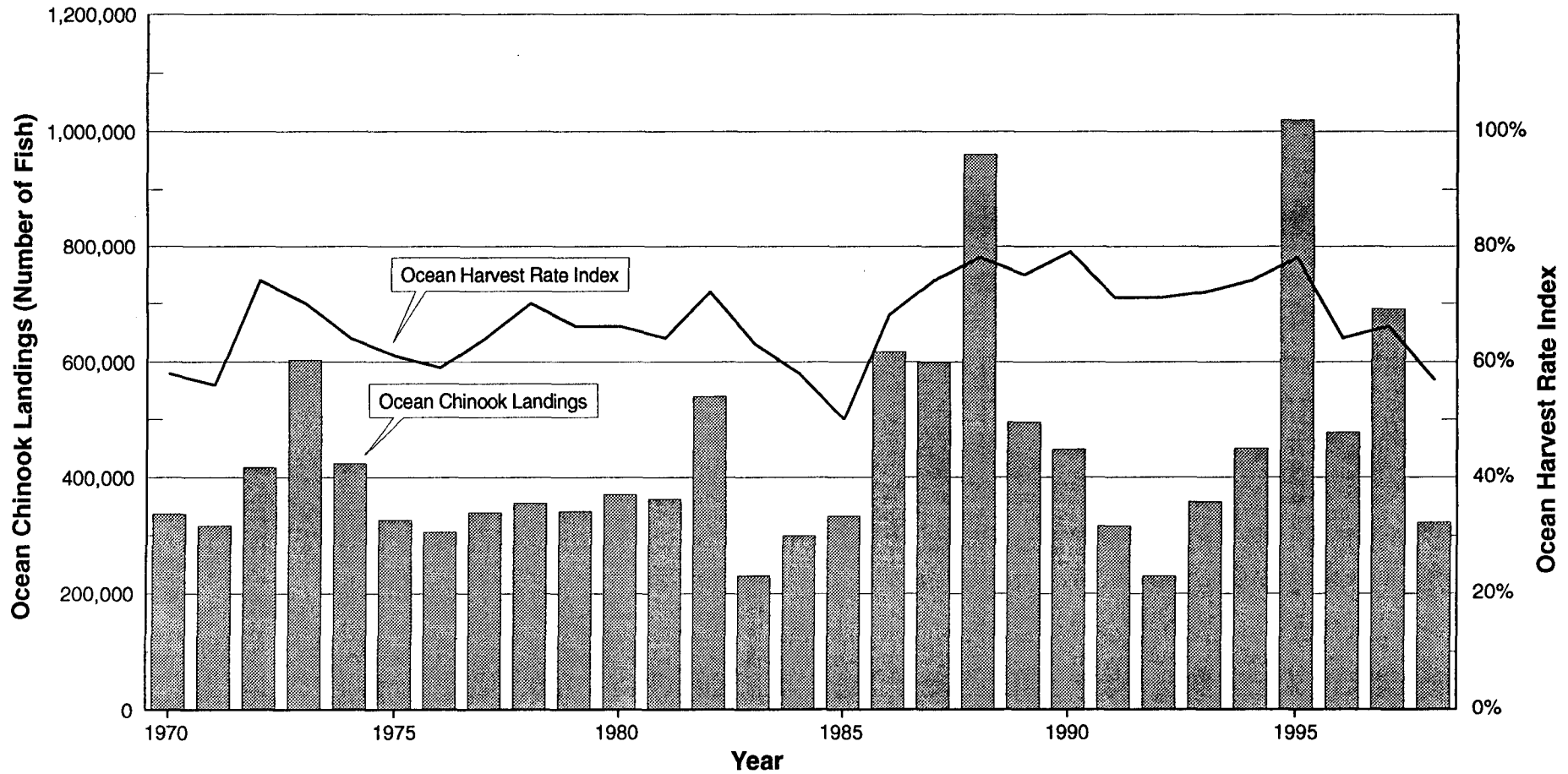


SOURCE:
Pacific Fishery Management Council (1999)



Jones & Stokes Associates, Inc.

Figure 7
Annual Hatchery and Natural Spawning Escapement
of Sacramento River Chinook Salmon



SOURCE:
Pacific Fishery Management Council (1999)



Jones & Stokes Associates, Inc.

Figure 8
Annual Ocean Landings of Central Valley Chinook Salmon
(Total Commercial and Sport Landings South of Point Arena)
and Ocean Harvest Rate Index

Appendix A
