Freshwater and Ocean Returns of Marked Winter-Run and Late Fall-Run Chinook Salmon, Oncorhynchus tshawytscha, From the Sacramento River[1/]

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Introduction

Four races of chinook salmon, Oncorhynchus tshawytscha, spawn each year in the upper Sacramento River (above the Feather River). In order of abundance they are designated as the fall-, winter-, late fall- and spring-runs. Fall-run salmon migrate into the upper Sacramento from July through November and spawn from early October through December. Winter-run salmon enter the Sacramento River from early January through mid-June and spawn between mid-April and mid-July. Late fall-run salmon migrate into the Sacramento from early November through February and spawn from January through March. Spring-run salmon enter the river system between March and July and spawn from late August through early October, but primarily in September.

Although the winter-run is second abundance, as late as 1969 there were no data on the contribution of this race to the ocean fisheries. The California Department of Fish and Game initiated a marking study in 1969 to obtain this information. Because winter-run chinook were not reared in any hatchery, it was necessary to capture wild juveniles in the Sacramento River for marking. At the time of year they were captured it was difficult to distinguish between late fall-run and winter-run juveniles. Consequently fish from both races were marked, and the results

apply to an unknown mixture of the two runs.

The objectives of this study were: 1) determine the contribution (return rate) of marked 1969, 1970 and 1971 brood year (BY) salmon to the ocean fisheries and spawning escapements; 2) determine the catch-escapement ratio for marked fish; 3) determine the distribution of catch for those marked fish caught at sea; 4) determine whether marked fish returned to the Sacramento River as other than winter-run or late fall-run adults.

Methods

Fingerling salmon were captured by seining along the shores of the Sacramento River immediately upstream from Red Bluff Diversion Dam during September and October of 1969, 1970 and 1971. They were transported to Coleman National Fish Hatchery on Battle Creek, and marked (fin-clipped). All marked salmon were then returned to the Sacramento River immediately below Red Bluff Diversion Dam. The average length of time between capture and release was five days in 1969, and three days in 1970 and 1971.

Because the winter-run was the race of primary interest, and because it was believed that very few winter-run juveniles would be greater than 45mm in length at the time of seining, most of the fish larger than 45mm were returned directly to the river upon capture, i.e., were not marked. Of those marked, 94% were between 26mm and 46mm in length; the

remainder ranged from 47mm to 84mm. Since many late fall-run juveniles exceeded 45mm, the late fall-run juveniles that were marked did not represent a random sample of the available late fall juveniles.

Two different fin marks were used; one for 1969 BY salmon and the other for 1970 BY and 1971 BY fish. Since the same mark was used for both 1970 BY and 1971 fish, assigning their mark returns to the correct brood year was accomplished by aging adults from their scales. A total of 720,000 marked fingerlings were released during the three years (Table 1).

Returns of marked salmon to the ocean commercial and sport fisheries of California, Oregon, and Washington were estimated by sampling the landings (Sholes and Hallock, 1979). Returns to the upper Sacramento River were estimated by sampling in the fish trapping facility at Red Bluff Diversion Dam, since it was believed that over 95% of winter-run and late fall-run chinook spawn above Red Bluff.

Results

For the three broods of marked salmon, the mean return to the ocean sport and commercial fisheries of California, Oregon, and Washington was 0.16% (standard error [s.e.] = 0.05%), and to the Sacramento River spawning stocks 0.22% (s.e. = 0.06%); a catch-escapement ratio of 0.7:1 (Table 2). This is equivalent to a harvest ratio of 41% with a standard error of 8%.

From the distributions of catch by brood, only 11% (s.e. = 5%) of the sport and commercial ocean catch was landed in Oregon and Washington; 89% was landed in California. Within California, 23% (s.e. = 7%) of the catch--again from distribution of catch by brood year--was landed at Crescent City, Eureka and Fort Bragg; while 77% (s.e. = 7%) of the catch was landed at San Francisco and Monterey (Table 3). The distributions of catch for the California sport and commercial fisheries were quite different; most sport caught fish were landed at San Francisco and Monterey, while most commercial caught fish were landed at Crescent City, Eureka and Fort Bragg. These cities refer to port sampling areas (O'Brien, Taylor and Jensen, 1970).

Based on time of year and estimated degree of maturity when passing Red Bluff Diversion Dam, 94% of the total adult marked salmon recovered at the dam were estimated to be winter- and late fall-run fish; 60% winter and 40% late fall. The 6% that were judged to be fall- or spring-run chinook may have been misidentified, or may have been the offspring of of fall- or spring-run chinook remaining in freshwater as juveniles through October and November. Although the offspring of winter-run adults may return as late fall-run adults and vice versa, it appears that they do not, and that both are true races.

Studies currently in progress should indicate more clearly whether or not this is true.

Table 1

Releases of Marked Salmon[1/]

Brood Year (BY)	Mark	Date Released	Size (Fork Length in mm) Number Measured	Range	Average	Number Released
1969	Ad-LP	9-29-69	495	28-53	36.20	19,731
		10- 1-69	485	30-49	35.20	19,146
		10- 2-69	246	29-55	36.02	24,475
		10- 3-69	211	29-57	37.58	71,098
		10- 6-69	237	30-59	36.31	34,301
		10-10-69	246	30-57	36.88	31,966
		10-14-69	225	30-57	37.64	33,604
		10-15-69	201	30-51	37.29	22,568
		10-17-69	437	32-63	39.66	23,911
		10-20-69	301	31-63	38.69	20,843
		BY Totals	3,178	23-63	Av. 37.16	301,643
1970	Ad-RP	9-15-70	206	31-61	37.31	18,322
		9-18-70	221	31-59	37.53	18,578
		9-24-70	298	31-64	38.16	14,407
		9-30-70	158	31-59	39.37	15,793
		10- 7-70	248	31-70	36.56	20,695
		10-16-70	126	31-51	37.68	11,537
		10-22-70	212	33-84	41.12	7,270
		11- 4-70	117	35-75	49.70	2,498
		BY Totals	1,586	31-84	Av. 39.05	109,100
1971	Ad-RP	9-22-71	227	33-55	40.92	11,972
		9-23-71	271	30-55	38.01	21,965
		9-24-71	215	32-50	38.00	22,107
		9-27-71	300	31-55	37.19	17,915
		9-27-71	240	32-49	37.35	22,743
		9-29-71	248	31-45	37.00	22,269
		9-30-71	263	32-50	37.41	21,864
		10- 1-71	203	31-45	36.64	24,055
		10- 4-71	271	26-55	35.96	22,861
		10- 6-71	222	31-46	36.72	23,563
		10- 7-71	248	32-53	37.02	22,025
		10- 7-71	365	29-78	38.26	22,571
		10-12-71	373	31-48	36.10	21,211
		10-13-71	261	31-53	36.24	19,263
		10-14-71	272	30-47	36.34	10,882
		BY Totals	3,989	26-78	Av. 37.10	309,266

1/ Average length of time between capture and release; 5 days for 1969 BY, and 3 days for 1970 and 1971 BY: between marking and release; 3 days for 1969 BY, and 2 days for 1970 and 1971 BY. All salmon were released in the Sacramento River immediately below

Table 2

Estimated Returns of Marked Salmon

Brood Year (BY)	Location	1971	1972	1973	1974	1975	Totals Number	Totals Percent
	Sacramento River. Red Bluff Diversion Dam, BY Totals	90	305	19	6		420	0.14
	Ocean							
	Calif. Commer. Troll	14	138	73			225	
	Ore. & Wash. Commer. Troll							
1969	Calif. Sport	247	27				274	
	Ore. & Wash. Sport		16				16	
	Col. River Sport & Commer.		6				6	
	BY Ocean Totals	261	187	73			521	0.17
	BY River and Ocean Totals	351	492	92	6		941	0.31
	Sacramento River. Red Bluff Diversion Dam, BY Totals		200	114	46		360	0.33
	Ocean							
	Calif. Commer. Troll		45	35			80	
	Ore. & Wash. Commer. Troll			8			8	
1970	Calif. Sport		151				151	
	Ore. & Wash. Sport			13			13	
	Col. River Sport & Commer.							
	BY Ocean Totals		196	56			252	0.23
	BY River and Ocean Totals		396	170	46		612	0.56
	Sacramento River. Red Bluff Diversion Dam, BY Totals			314	256	9	579	0.19
	Ocean							
	Calif. Commer Troll			12	37		49	
	Ore. & Wash. Commer. Troll				8	15	23	
1971	Calif. Sport			117			117	
	Ore. & Wash. Sport				17	5	22	
	Col. River Sport & Commer.							
	BY Ocean Totals			129	62	20	211	0.07
	BY River and Ocean Totals			443	318	29	790	0.26
Grand Total, unweighted means	River							0.22
	Ocean							0.16

Table 3

Proportion of California's Ocean Catch of Marked Salmon Landed in each Port Area

	Commercial Catch				Sport Catch				Total Catch			
	Brood				Brood				Brood			
Port Area 1/	1969	1970	1971	Mean (s.e.)	1969	1970	1971	Mean	1969	1970	1971	Mean (s.e.)
Crescent City	0.13	-	0.14	0.59 (0.10)	-	-	-	0.01	0.06	-	0.04	0.23 (0.07)
Eureka	0.31	0.51	-		0.03	-	-		0.15	0.18	-	
Fort Bragg	0.35	-	0.33		-	-	-		0.16	-	0.10	
San Francisco	0.14	0.44	0.53	0.41 (0.10)	0.73	0.80	-	0.99	0.46	0.68	0.16	0.77 (0.07)
Monterey	0.08	0.05	-		0.24	0.20	1.00		0.17	0.15	0.70	

1/ (O'Brien, Taylor, and Jensen, 1970)

Literature Cited

Sholes, W.H., and R.J. Hallock. 1979. An evaluation of rearing fall-run chinnok salmon, Oncorhynchys tshawytscha, to yearlings at Feather River Hatchery, with a comparison of returns from hatchery and downstream releases. California Fish and Game 65(4):239-255.

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