Areal Distribution of Marked Columbia River Basin Spring Chinook Salmon Recovered in Fisheries and at Parent Hatcheries

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ABSTRACT—In 1971-73 approximately 4.1 million juvenile anadromous spring chinook salmon, Oncorhynchus tshawytscha, *of the 1970 and 1971 broods of 21 Columbia River Basin hatchery facilities were marked and released. Sampling for marked fish was conducted in 1972-77 in all major marine fisheries from Monterey, Calif., north along the Pacific coast of North America to Pelican, Alaska; in main-stem Columbia River fisheries; and at parent hatcheries. A total of 23,290 marked fish were recovered: 15,331 in marine fisheries, 2,400 in main-stem Columbia River fisheries, and 5,559 in parent hatcheries. In the aggregate, 93 percent of the fish recovered in marine fisheries were recovered north of the mouth of the Columbia River. However, the percentage of marked fish recovered in marine fisheries south of the Columbia River varied widely among hatchery areas: in the case of the Snake River hatchery area, for example, the proportion of marked 1970 brood fish recovered south of the Columbia River represented more than one-half of the marine recoveries.*

Introduction

Chinook salmon, *Oncorhynchus tshawytscha*, are the least abundant and largest of the Pacific salmon. Mature fish generally weigh from 10 to 50 pounds; lengths to 4 feet 10 inches and weights as high as 126 pounds have been recorded (Clemens and Wilby, 1961).

Chinook salmon are indigenous to streams of northwestern North America and northeastern Asia. In North America, chinook salmon spawn in streams ranging from the Sacramento River in central California northward along the Pacific coast to the Wulik River which empties into the Arctic Ocean; streams of the Aleutian, Kodiak, Queen Charlotte, and Vancouver Islands; and streams (with remnant runs) of the islands of southeastern Alaska. Chinook salmon spawn in Asian streams from the Anadyr River south along the east coast of the U.S.S.R. to the Amur River, including rivers of the continental coast of the Sea of Okhotsk, east and west coasts of the Kamchatka Peninsula, Komandorskie Islands, and the Japanese Island of Hokkaido (Major et al., 1978; Vronskiy, 1972; and Cleaver, 1969).

The world's largest populations of anadromous chinook salmon are produced in the Columbia River Basin (Fig. 1) which encompasses approxi-

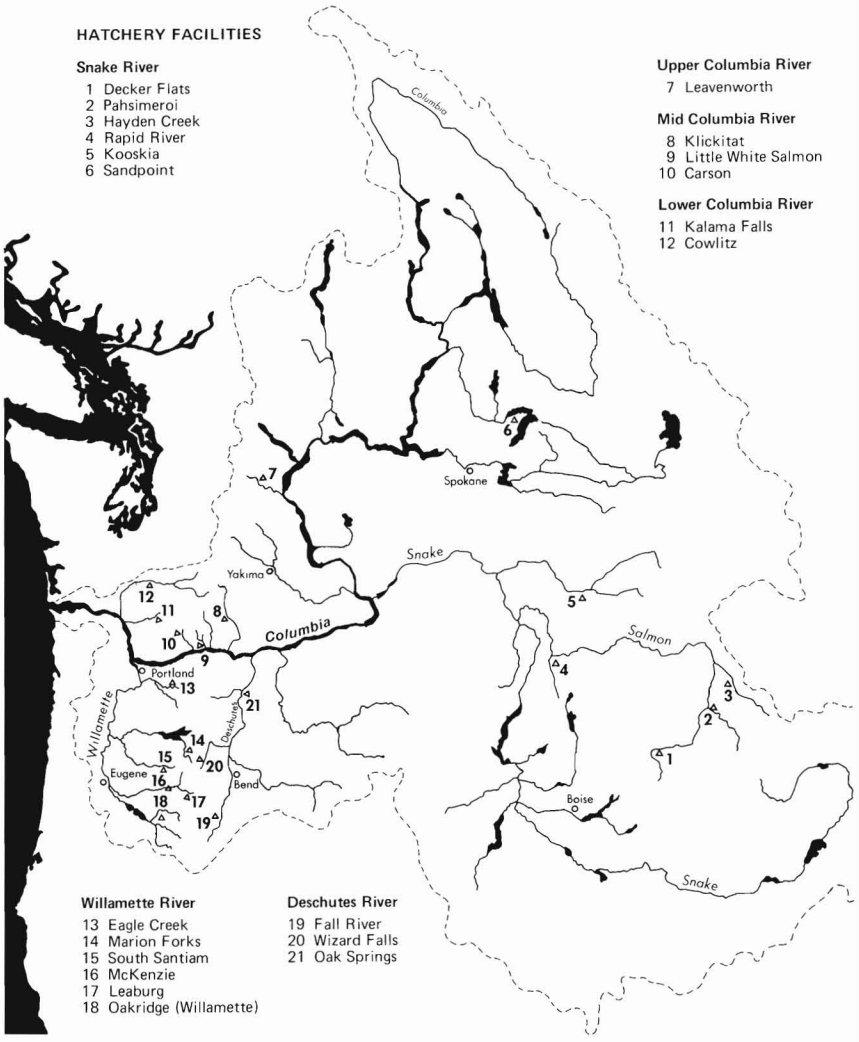
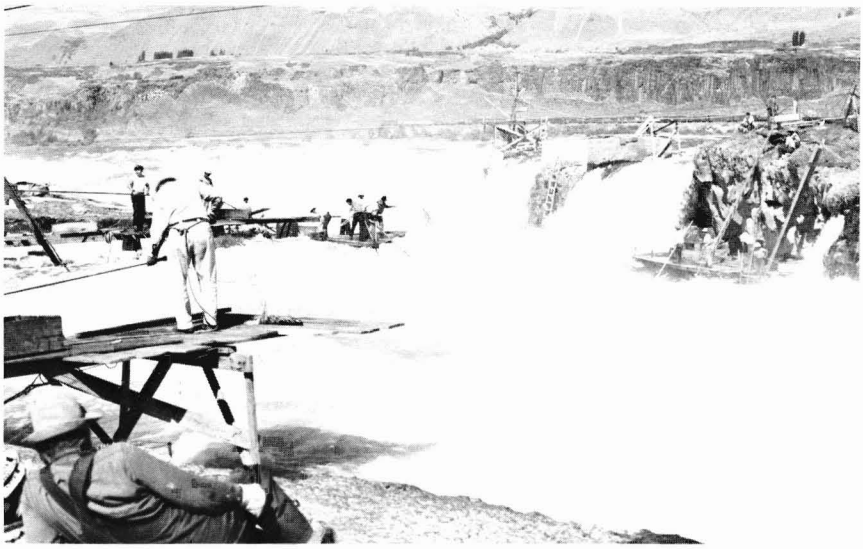


Figure 1.—Location of hatcheries included in the marking study of spring chinook salmon of the 1970 and 1971 broods.



Indian dipnet fisherman at Celilo Falls on the Columbia River. This fishery was conducted for spring chinook salmon as well as for other salmon, prior to the construction of The Dalles Dam which flooded the area.

mately 671,000 km^2 (259,000 miles^2) of the northwestern United States and southern British Columbia, Canada.

Anadromous chinook salmon annually enter the Columbia River to spawn as 3- to 7-year-old adults. The major spawning migration period extends from February through October. For management purposes, Columbia River Basin chinook salmon traditionally have been classified as spring-, summer-, and fall-run fish corresponding to discrete seasonal peaks in spawning migrations. Spring-run chinook salmon enter the Columbia River in abundance from February through May; summer-run chinook salmon from late May through July; fall-run chinook salmon from early August through October (Chaney and Perry, 1976).

Juvenile chinook salmon emigrate from the Columbia River throughout the year (Rich and Holmes, 1929); the major seaward migration coincides with peak spring runoff, generally April-May. Most juvenile spring chinook salmon live in fresh water for more than 1 year prior to migrating to the ocean. Some summer chinook salmon juveniles live in fresh water for a year or longer, and some migrate before they are 1 year old. Juvenile fall chinook salmon usually migrate after spending only a few months in fresh water.

There is a large body of information documenting the North Pacific Ocean distribution of chinook salmon without reference to areas of origin (Major et al., 1978). Recapture in Columbia River fisheries of chinook salmon tagged when they were maturing adults in the ocean has provided fragmentary insight into the ocean distribution of Columbia River Basin chinook salmon (Davidson and Hutchinson, 1938; Rich, 1939; Silliman, 1948; Parker and Kirkness, 1956; Milne, 1964; Wright, 1968; and Van Hyning, 1973).

Recovery in ocean fisheries of maturing chinook salmon marked when they were juveniles in Columbia River Basin hatcheries has provided additional, but very limited, information on ocean distribution of these stocks. Prior to 1961, most Columbia River Basin hatchery juvenile chinook salmon marking programs involved very small samples, were designed for other purposes, and were conducted in the absence of comprehensive ocean mark recovery programs (Wahle and Vreeland, 1978).

The first comprehensive marking and mark sampling program for Columbia River Basin hatchery-reared chinook salmon was initiated in 1961 and provided extensive information on ocean distribution of fall chinook salmon (Wahle and Vreeland, 1978). No comparable data were available for spring and summer chinook salmon.

In 1971-77 a comprehensive Columbia River Basin hatchery spring chinook salmon marking and mark recovery program was carried out.[1] Approximately 4.1 million juvenile spring chinook salmon of the 1970 and 1971 broods were marked and released in 1971-73. Catches in all major marine fisheries and main-stem Columbia River fisheries, and adults returning to parent hatcheries were sampled for marks in 1972-77.

The results of this study provided the first comprehensive perspective into marine distribution of Columbia River Basin hatchery-reared spring chinook salmon, as well as insight into the relationships among marine and freshwater catches and returns to parent hatcheries.

Description of the Program

Salmon Marking (1971-73)

The marking and mark recovery program for spring chinook salmon of the 1970 and 1971 broods included a random sample of juvenile fish from all 21 Columbia River Basin hatcheries rearing spring chinook salmon at the time of the study (Fig. 1). A total of 4,074,821 marked juvenile fish were released, including 2,015,569 juveniles representing approximately 12.5 percent of the 1970 brood and 2,059,252 juveniles representing approximately 13.1 percent of the 1971 brood. Table 1 identifies by hatchery the marks employed, the number of fish marked, and release dates and locations. To simplify the reporting of results, Table 2 and Figures 2 through 7 categorize hatcheries by geographic areas: Lower Columbia, Willamette, Mid-Columbia, Deschutes, Upper Columbia, and Snake River.

[1]Marking was funded by the NMFS Columbia River Fishery Development Program (CRFDP) except at Wizard Falls, Oak Springs, Fall River, and Leaburg. Cooperating with CRFDP were the Canadian Department of Fisheries and Oceans, U.S. Fish and Wildlife Service, and fishery agencies of Oregon, Washington, Idaho, California, and Alaska.

Table 1.—Marked releases of spring chinook salmon from Columbia River hatcheries, 1970 and 1971 broods.

Brood year	Hatchery	Agency[1]	Mark[2]	No. marked (thousands)	Release date	Release location
1970	Decker Pond	IFG	D-An	66.0	9-10/71	Upper Salmon R.
	Pahsimeroi Pond		Ad-D-An	40.0	9/71	Pahsimeroi R.
	Hayden Creek Hatchery		Ad-D-LV	52.7	10/71	Lehmi R.
	Rapid River Hatchery		Ad-An	200.0	3-4/72	Rapid R.
			Ad-D-RV	46.0	3/72	Lochsa R.
	Sandpoint Hatchery		Ad-D-RV	42.7	3/72	
	Kooskia Hatchery	USFWS	Ad-An-LV	54.7	3/72	Clearwater R.
			Ad-CWT	41.3	3/72	
	Leavenworth Hatchery		Ad-CWT	97.0	3/72	Icicle R.
	Little White Salmon Hatchery		D-RV	48.7	1/72	Little White Salmon R.
	Carson Hatchery		D-RV	141.7	3-4/72	Wind R.
	Eagle Creek Hatchery		Ad-CWT	43.5	5/72	Eagle Cr. (Clackamas)
	Klickitat Hatchery	WDF	D-RV	57.7	11/71	Klickitat R.
			D-RV	53.8	3/72	
	Kalama Falls Hatchery		Ad-CWT	27.9	9/71	Kalama R.
			Ad-CWT	71.2	3/72	
	Cowlitz Salmon Hatchery		Ad-D	201.4	8/71	Cowlitz R.
			Ad-D	95.3	11/71	
			Ad-D	92.8	2/72	
	Wizard Falls Hatchery	ODFW	LV-RP	61.0	3/72	Deschutes R.
	Oak Springs Hatchery		RV-LP	52.7	3/72	
	Leaburg Hatchery		D-RP	100.5	3-4/72	McKenzie R.
	McKenzie Hatchery		D-LV	12.1	12/71	
			D-LV	17.0	3/72	
	South Santiam Hatchery		D-LV	23.5	11/71	South Santiam R.
			D-LP	20.8	11/71	
			D-RP	19.9	11/71	South Santiam (Foster Res.)
	Marion Forks Hatchery		D-LV	98.4	4/72	North Santiam R.
	Willamette Hatchery		D-LV	24.2	11/71	Willamette R.
	Dexter Holding Ponds		D-LV	111.1	3/72	
1971	Decker Pond	IFG	Ad-An-LV	30.0	9/72	Upper Salmon R.
			Ad-An-RV	30.0	10/72	
	Pahsimeroi Pond		An-LV	52.5	5/72	Pahsimeroi R.
			An-RV	45.8	10/72	
	Hayden Creek Hatchery		RV-LM	73.7	10/72	Lemhi R.
	Rapid River Hatchery		Ad-An	201.2	3/73	Rapid R.
	Kooskia Hatchery	USFWS	Ad-D-An	52.6	10/72	Clearwater R.
			D-An	101.3	3/73	
	Leavenworth Hatchery		Ad-D-RV	50.1	4/73	Icicle R.
			Ad-D-LV	49.3	4/73	
	Little White Salmon Hatchery		Ad-RV	123.4	4/73	Little White Salmon R.
	Carson Hatchery		Ad-LV	163.3	4/73	Wind R.
	Eagle Creek Hatchery		D-LV-RV	99.8	5/73	Eagle Cr. (Clackamas R.)
	Klickitat Hatchery	WDF	Ad-D	47.3	11/72	Klickitat R.
			Ad-D	43.6	3/73	
	Kalama Falls Hatchery		Ad-CWT	35.1	9/72	Kalama R.
			Ad-CWT	28.4	4/73	
	Cowlitz Hatchery		Ad-CWT	35.4	9/72	Cowlitz R.
			Ad-CWT	91.7	11/72	
			Ad-CWT	26.5	2/73	
			Ad-CWT	46.2	4/73	
	Fall River Hatchery	ODFW	LV-RV	117.9	3/73	Deschutes R.
	Leaburg Hatchery		RV-RM	100.0	4/73	McKenzie R.
	McKenzie Hatchery		D-RV	29.9	3/73	
	South Santiam Hatchery		D-LV	47.1	11-12/73	South Santiam R.
			D-RV	3.5	3/73	
	Marion Forks Hatchery		D-RV	102.5	4/73	North Santiam R.
	Willamette Hatchery		D-LV	54.8	1/73	Willamette R.
			D-RV	33.8	4/73	McKenzie R.
			D-RV	119.5	3/73	Willamette R.

[1]Acronyms designate the following agencies: IFG, Idaho Fish and Game Department; USFWS, U.S. Fish and Wildlife Service; WDF, Washington Department of Fisheries; and ODFW, Oregon Department of Fish and Wildlife.
[2]Mark abbreviations are as follows: Ad, adipose; An, anal; LV, left ventral; RV, right ventral; LM, left maxillary; D, dorsal; CWT, coded wire tag; RM, right maxillary; RP, right pectoral; and LP, left pectoral fin.

Table 2.—Marine and Columbia River fisheries - hatchery recoveries of marked spring chinook salmon of the 1970 and 1971 broods, by hatchery area of release.

Brood year	Hatchery area of release	Recoveries: Marine No.	Marine Percent	Columbia River fishery No.	Columbia River fishery Percent	Hatchery No.	Hatchery Percent	Total
1970	Lower Columbia	6,942	77.9	662	7.4	1,306	14.7	8,910
	Willamette	413	33.2	420	33.8	410	33.0	1,243
	Mid-Columbia	42	19.8	98	46.2	72	34.0	212
	Deschutes	155	21.7	360	50.5	198	27.8	713
	Upper Columbia	60	6.9	593	68.5	213	24.6	866
	Snake River	264	65.2	43	10.6	98	24.2	405
	Total	7,876	—	2,176	—	2,297	—	12,349
	Average	—	63.8	—	17.6	—	18.6	—
1971	Lower Columbia	5,404	73.6	106	1.4	1,828	24.9	1,338
	Willamette	457	67.1	22	3.2	202	29.7	681
	Mid-Columbia	952	52.7	33	1.8	823	45.5	1,808
	Deschutes	377	87.9	37	8.6	15	3.5	429
	Upper Columbia	5	55.6	0	0	4	44.4	9
	Snake River	260	38.5	26	3.8	390	57.7	676
	Total	7,455	—	224	—	3,262	—	10,941
	Average	—	68.1	—	2.1	—	29.8	—

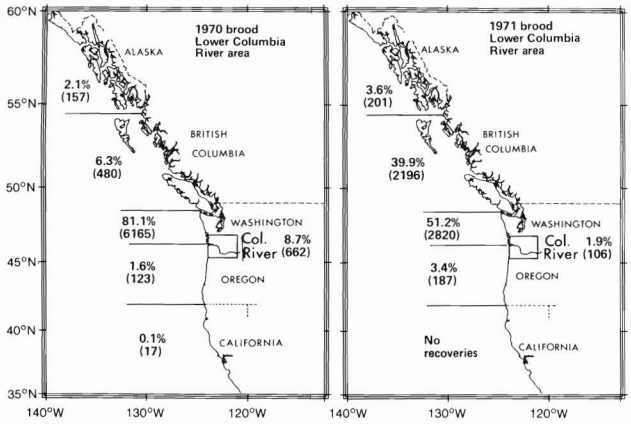


Figure 2.—The relative distribution, among major fisheries, of recovered, marked, spring chinook salmon released from the Lower Columbia hatchery area (number of recovered fish in parentheses).

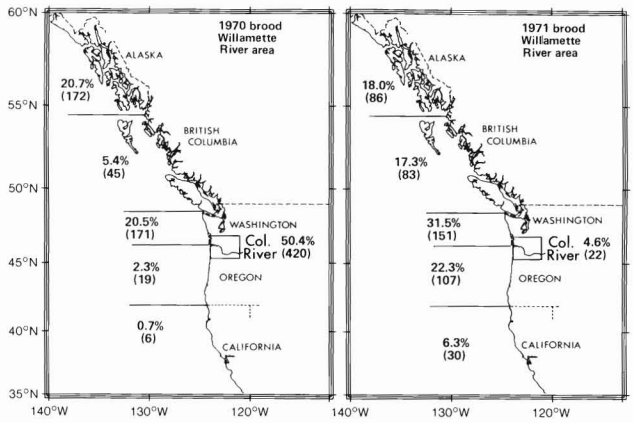


Figure 3.—The relative distribution, among major fisheries, of recovered, marked, spring chinook salmon released from the Willamette hatchery area (number of recovered fish in parentheses).

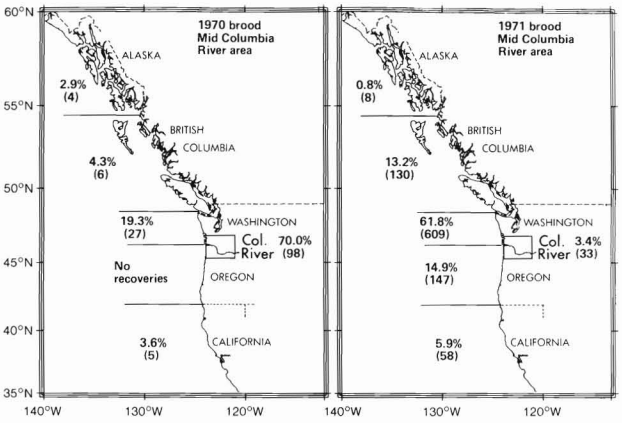


Figure 4.—The relative distribution, among major fisheries, of recovered, marked, spring chinook salmon released from the Mid-Columbia hatchery area (number of recovered fish in parentheses).

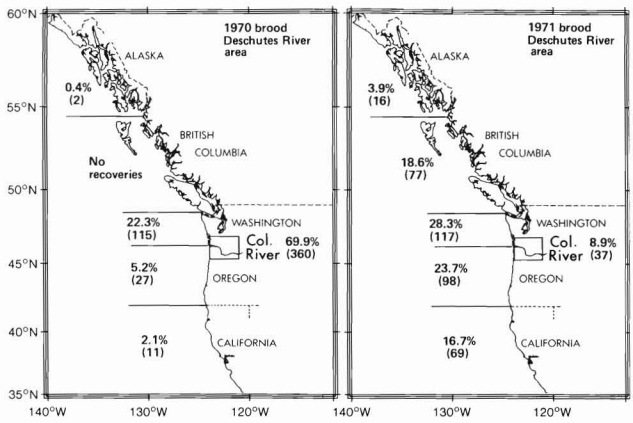


Figure 5.—The relative distribution, among major fisheries, of recovered, marked, spring chinook salmon released from the Deschutes River hatchery area (number of recovered fish in parentheses).

Recovery of Marked Fish (1972-77)

Catches in all major marine sport and commercial fisheries from Monterey, Calif., north to Pelican, Alaska (including Puget Sound fisheries), were sampled for marks as were catches in main-stem Columbia River fisheries and returns to hatcheries. The recovery phase of this study (1972-77) resulted in the recovery of a total of 23,290 1970 and 1971 brood marked fish: 15,331 in marine fisheries, 2,400 in main-stem Columbia River fisheries, and 5,559 at parent hatcheries (Table 2). A total of 12,349 1970 brood marked fish were recovered: 7,876 in marine fisheries, 2,176 in main-stem Columbia River fisheries, and 2,297 at parent hatcheries.

Figures 2 through 7 display by geographic area of origin the number and percentage of 1970 and 1971 brood marked fish recovered in major marine and main-stem Columbia River fisheries. Of the 1970 brood, 10,052 marked fish were recovered in fisheries (Table 3); the largest number, 6,606, was recovered in catches sampled in marine ports and zones of the State of Washington (Fig. 8). The smallest number, 84, was recovered in catches sampled at marine ports in the State of California.

Table 2 summarizes by geographic area of origin the number and percentage of the total 1970 brood marked fish

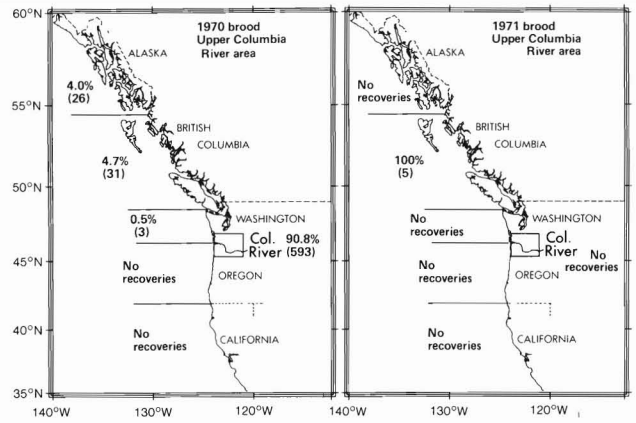


Figure 6.—The relative distribution, among major fisheries, of recovered, marked, spring chinook salmon released from the Upper Columbia River hatchery area (number of recovered fish in parentheses).

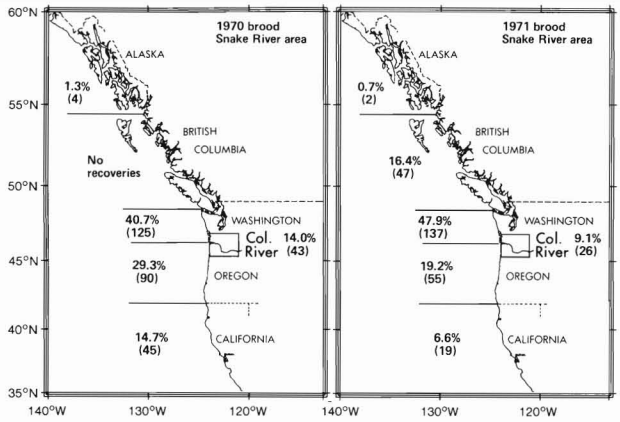


Figure 7.—The relative distribution, among major fisheries, of recovered, marked, spring chinook salmon released from the Snake River hatchery area (number of recovered fish in parentheses).

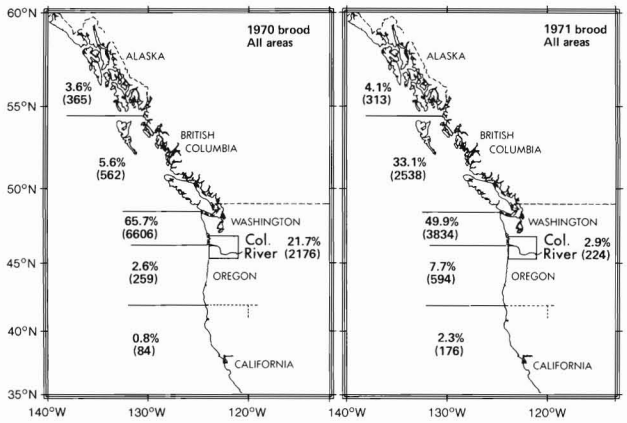


Figure 8.—The relative distribution, among major fisheries, of recovered, marked, spring chinook salmon released from all hatchery areas (number of recovered fish in parentheses).

Troller off Noyes Island, Alaska, a northern recovery location for some Columbia River spring chinook salmon.

recovered in all marine and main-stem Columbia River fisheries and at parent hatcheries. Table 3 presents by hatchery of origin the number of 1970 brood marked fish recovered in major fisheries and at parent hatcheries.

A total of 10,941 1971 brood marked fish were recovered: 7,455 in marine fisheries, 224 in main-stem Columbia River fisheries, and 3,262 at parent hatcheries. Of the 7,679 fish recovered in fisheries the largest number, 3,837, was recovered in catches sampled in marine ports and zones of the State of Washington (Fig. 8). The smallest number, 176, was recovered in catches sampled at marine ports in California.

Table 2 summarizes by geographic area of origin the number and percentage of the total 1971 brood marked fish recovered in all marine and main-stem Columbia River fisheries and at parent hatcheries. Table 4 presents by hatchery of origin the number of 1971 brood fish recovered in major fisheries and at parent hatcheries.

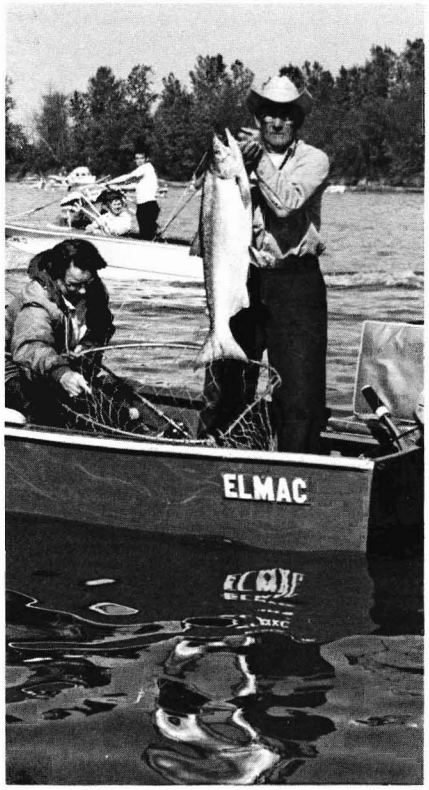
Factors That Limit Use of Data

The data obtained as the result of this marking and mark recovery program provided the most comprehensive perspective available to date on ocean distribution of Columbia River Basin hatchery-reared spring chinook salmon as well as insight into the relationships

Table 3.—Mark recoveries of 1970 brood spring chinook salmon, by hatchery and fishery area.

Hatchery	Date released from hatchery	Marine fishery area					Columbia River fishery	Hatchery returns	Total
		Alaska	B.C.	Wash.	Oregon	Calif.			
		Number of fish							
Lower Columbia									
Cowlitz	8/71, 11/71, 2/72	78	38	3,084	80	17	364	900	4,561
Kalama Falls	9/71	62	405	2,968	43	0	245	386	4,109
Kalama Falls	3/72	17	37	113	0	0	53	20	204
Willamette River									
Common mark[1] from 5 stations	11/71, 3/72, 4/72	138	0	117	10	2	279	309	855
South Santiam and Leaburg	11/71, 3/72, 4/72	2	0	9	5	0	12	34	62
South Santiam	11/71	2	0	26	0	0	53	34	115
Eagle Creek	5/72	30	45	19	4	4	76	15	193
Mid-Columbia									
Common mark[2] 3 hatcheries	11/71, 3/72, 4/72, 7/72	4	6	27	0	5	98	72	212
Deschutes River									
Oak Springs	3/72	0	0	109	27	11	236	112	495
Wizard Falls	3/72	2	0	6	0	0	124	86	218
Upper Columbia									
Leavenworth	3/72	26	31	3	0	0	593	213	866
Snake River									
Lochsa	3/72	0	0	0	0	0	0	0	0
Kooskia	3/72	0	0	13	6	27	2	0	48
Rapid River	3-4/72	4	0	78	84	18	37	82	303
Hayden Creek	10/71	0	0	0	0	0	4	4	8
Pahsimeroi Pond	9/71	0	0	0	0	0	0	2	2
Decker Pond	9-10/72	0	0	34	0	0	0	10	44
Total		365	562	6,606	259	84	2,176	2,279	12,331

[1]McKenzie, South Santiam, Marion Forks, Willamette, and Dexter
[2]Carson, Little White Salmon, and Klickitat.



Boat anglers with a spring chinook salmon taken in Multnomah Channel at the mouth of the Willamette River.

Table 4.—Mark recoveries of 1971 brood spring chinook salmon, by hatchery and fishery area.

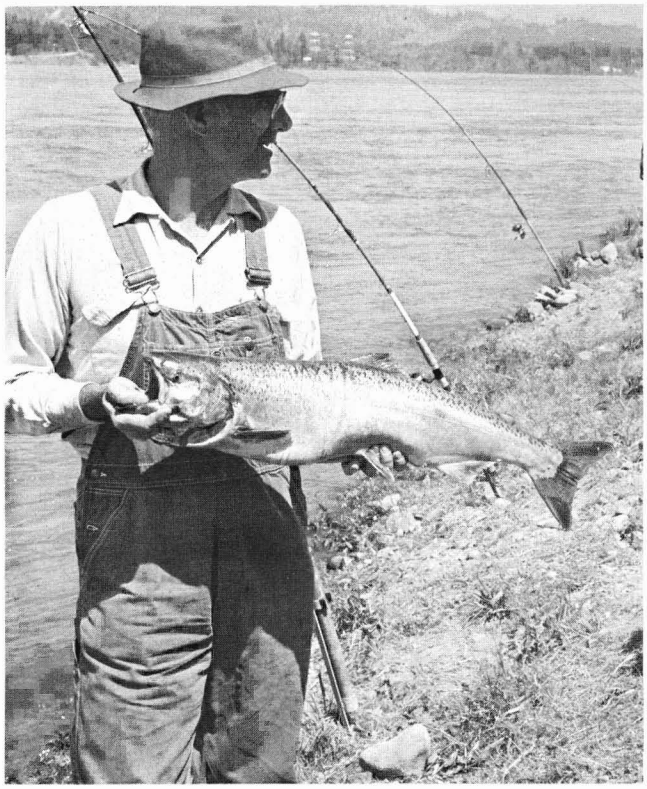
Hatchery	Date released from hatchery	Marine fishery area					Columbia River fishery	Hatchery returns	Total
		Alaska	B.C.	Wash.	Oregon	Calif.			
		Number of fish							
Lower Columbia									
Cowlitz	9/72	13	105	76	7	0	26	78	305
Cowlitz	11/72	17	70	139	4	0	2	113	345
Cowlitz	2/73	24	517	725	21	0	10	388	1,685
Cowlitz	4/73	37	834	1,713	155	0	29	768	3,536
Kalama Falls	9/72	28	93	39	0	0	26	67	253
Kalama Falls	4/73	82	577	128	0	0	13	414	1,214
Willamette River									
Common mark[1] 4 hatcheries	3-4/73	23	0	9	16	0	2	48	98
Willamette and So. Santiam	11-12/72	61	76	130	43	17	13	135	475
Leaburg	4/73	0	7	3	37	13	0	0	60
Eagle Creek	4/73	2	0	9	11	0	7	19	48
Mid-Columbia									
Carson	4/73	4	3	200	67	38	19	299	630
Little White Salmon	4/73	2	0	168	44	20	2	502	738
Klickitat	11/72, 3/73	2	127	241	36	0	12	22	440
Upper Columbia									
Leavenworth	4/73	0	5	0	0	0	0	4	9
Deschutes River									
Fall River	3/73	16	77	117	98	69	37	15	429
Snake River									
Kooskia	10/72, 3/73	0	0	0	0	0	0	53	53
Rapid River	3/73	2	9	42	7	0	26	292	378
Hayden Creek	10/72	0	4	24	33	9	0	9	79
Pahsimeroi Pond	5/72, 9/72	0	28	50	6	0	0	36	120
Decker Pond	9-10/72	0	6	21	9	10	0	0	46
Total		313	2,538	3,834	594	176	224	3,262	10,941

[1]McKenzie, South Santiam, Marion Forks, and Willamette.

among marine and freshwater catches and returns to parent facilities. Several factors severely limit use of the data for other purposes:

1) The large number and variety of marks employed (both finclips and the newer coded wire tags were used) significantly complicated mark recovery sampling and may have affected the reliability of sampling.

2) The 1970 brood Kalama Falls fish were the first Columbia River Basin salmon marked with binary numbered, coded wire tags; the 1970 brood Leavenworth, Kooskia, and Eagle Creek fish were the first marked with color coded wire with the intent of having them recovered in marine fisheries. During the first year of the mark recovery program only the State of Washington was organized to sample effectively for these tags; sampling for these tags was organized coastwide during the second year of the mark recovery program but un-



Bank anglers fishing for spring chinook salmon in the Columbia River near Bonneville Dam.

Columbia River gillnetter with a spring chinook salmon taken near Puget Island, Wash.

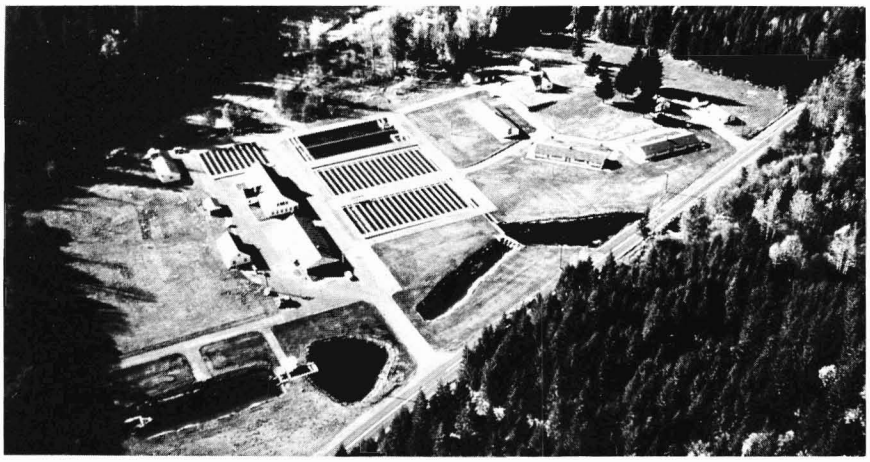
doubtedly suffered problems typical of first-year programs.

3) There was significant, but unquantified, induced mortality associated with marking; the differential mortality associated with various marks makes it impossible either to reach meaningful conclusions about survival of marked fish and their contribution to fisheries or to make meaningful comparisons among lots of fish bearing different marks.

4) There have been major changes in ocean fishing seasons during and subsequent to the mark recovery phase of this program. These changes could affect the reliability of directly extrapolating the results of this study to the present time.

5) Juvenile salmon and steelhead migrants originating in production areas above Bonneville Dam at river mile 146.1 incur extensive mortalities at main-stem hydroelectric projects; there was a significant, but unquantified, vari-

Anglers on a "hog line" fishing for spring chinook salmon in the Willamette River near Oregon City.



Carson National Fish Hatchery on the Wind River in Washington.

Kalama Falls Hatchery (operated by the Washington Department of Fisheries) on the Kalama River

Marion Forks Hatchery (operated by the Oregon Department of Fish and Wildlife) on the North Santiam River.

ance in mortalities imposed upon the 1970 and 1971 brood juvenile hatchery spring chinook originating from areas above Bonneville Dam (i.e., Mid-Columbia, Deschutes River, Upper Columbia, and Snake River production areas). Varying mortality rates at mainstem hydroelectric projects in subsequent years make it impossible to extrapolate meaningfully to date the relative survival and contribution to fisheries of hatchery spring chinook salmon from these areas or to make meaningful comparisons between these production areas and the Lower Columbia and Willamette production areas.

6) Adult salmon and steelhead migrants originating in production areas above Bonneville Dam also suffer extensive mortalities at main-stem hydroelectric projects. In addition, in-river straying of adult fish is known to occur, but the significance of this phenomenon to the results of this study is not known. Both factors reduce to an unknown extent the number of marked fish recovered in-river and, thereby, inflate to an unknown extent the percentage of the total marked fish recovered in marine fisheries.

Individually and collectively, these six factors would 1) significantly affect the reliability of the mark recovery data in this report for purposes other than general perspective on the relative ocean distribution of Columbia River Basin hatchery spring chinook salmon and 2) affect insights into the relationships among marine and freshwater catches and adult returns to parent hatcheries at the time of the study. Nonetheless, these mark recovery data provide the basis for additional general observations of potential value to fishery managers and researchers.

Marine Distribution North and South of Columbia River

The majority of the marked fish recovered in marine fisheries were taken off Alaska, British Columbia, and Washington (Fig. 8). This distribution is consistent with the traditional view that Columbia River Basin spring chinook salmon generally distribute themselves predominantly north of the Columbia River mouth, at least during the time

they are most susceptible to marine fisheries.

Expressed as a percentage of the total number of marked fish recovered in marine fisheries, recoveries south of the Columbia River (i.e., off California and Oregon) were 4.4 percent for marked fish of the 1970 brood and 10.3 percent for marked fish of the 1971 brood (Fig. 8).

When the mark recoveries are disaggregated by area of origin (Fig. 2-7), however, some hatchery production areas evince a contribution to marine fisheries south of the Columbia River mouth which contrasts rather sharply with the traditional generalized view. For example, in Figure 7, the total number of 1970 brood Snake River marked fish recovered off Oregon and California represents 51 percent of the total 1970 brood Snake River marks recovered in marine fisheries. The total number of 1971 brood Deschutes marks recovered in Oregon and California marine fisheries represents 44 percent of total 1971 brood Deschutes marks recovered in marine fisheries (Fig. 5).

Marine, River, and Hatchery Recoveries

Table 2 lists by geographic area of origin the total number of marked fish of the 1970 and 1971 broods recovered in marine fisheries, main-stem Columbia River fisheries, and at parent hatchery facilities. In the aggregate, 63.8 percent of the total 1970 brood marked fish and 68.1 percent of the total 1971 brood marked fish recovered were taken in marine fisheries. These data suggest that at the time of the mark recovery program, the majority of Columbia River Basin hatchery spring chinook salmon contributed to marine fisheries at a significantly higher rate than traditionally believed.[2]

The percentage of marked fish recovered in marine fisheries as compared to the in-river fishery and hatchery returns varied greatly among major hatchery production areas; the range was from 6.9 percent for the Upper Columbia 1970 brood to 87.9 percent for the 1971 brood Deschutes River marked fish recovered. This wide variance suggests significant potential for hatchery stock selection to distribute strategically Columbia River Basin hatchery spring chinook salmon between marine and in-river fisheries.

The percentage of marked fish recovered in marine fisheries north and south of the Columbia River also varied among major hatchery production areas. This variance suggests potential for hatchery stock selection to distribute strategically Columbia River Basin hatchery spring chinook salmon among marine fisheries.

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[2]Reflecting the prevailing lack of data, a 1980 poll of State and Federal fishery agencies operating within the Columbia River Basin found estimated marine catch rates (all fisheries) on Columbia River spring chinook salmon ranging from 12.5 to 50 percent of the total catch plus hatchery returns.