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PROJECT TITLE: Evaluation of the Benefits Provided by Releasing Spring Chinook Salmon Presmolts in the Grande Ronde River and Its Tributaries

PROJECT TITLE: Evaluation of the Benefits Provided by Reprogramming Spring Chinook Salmon Smolts from Lower Columbia River Hatcheries

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SUMMARY

EVALUATION OF LOWER SNAKE RIVER COMPENSATION PLAN FACILITIES IN OREGON

Objectives for FY 1990

1. Document egg take, egg-to-smolt survival, and growth of spring chinook salmon and summer steelhead reared and released at Lower Snake River Compensation Plan (LSRCP) facilities in Oregon.

2. Determine fin condition, degree of descaling, degree of smolting, and the prevalence of precocious development for Wallowa and Imnaha stock summer steelhead.

3. Document number, size, time, and release location for spring chinook salmon and summer steelhead produced at Lower Snake River Compensation Plan facilities in Oregon.

4. Determine sex ratio, run timing, and spawning timing for spring chinook salmon returning to Lookingglass Hatchery, the Big Canyon facility and the Imnaha River weir and for summer steelhead that return to the Big Canyon facility, Wallowa Hatchery, and the Little Sheep Creek facility.

5. Collect and analyze scales from spring chinook salmon and summer steelhead adults to determine age composition and length-age relationships.

6. Release 1988 brood Rapid River and Imnaha stock spring chinook salmon that were marked (Ad+CWT) and cold branded for size-at-release comparisons and production survival estimates.

7. Mark (Ad+CWT) and cold brand the following groups of 1989 brood chinook salmon: Rapid River stock for size at-release comparisons and production survival estimates; and Imnaha stock for size-at-release comparisons and production survival estimates.

8. Mark (AdLV+CWT), cold brand, and release the following groups of 1989 brood summer steelhead: Wallowa stock for size-at-release comparisons, acclimation evaluation, and production survival estimates; and Imnaha stock for production survival estimates.

9. Collect and decode coded-wire tags from marked spring chinook salmon and summer steelhead adults that return to adult collection facilities.

10. Summarize catch and escapement information for groups of coded-wire tagged spring chinook salmon and summer steelhead as information becomes available.

11. Summarize information from cold branded spring chinook salmon and summer steelhead smolts recovered at Snake River collection sites.

12. Conduct spring chinook salmon spawning ground surveys on the Minam and Wenaha rivers in cooperation with Oregon Department of Fish and Wildlife (ODFW) management personnel and recover carcasses of marked hatchery strays.

13. Participate in planning the production and management activities of anadromous fish in the Grande Ronde and Imnaha river basins.

14. Estimate angler effort, catch, harvest, and catch rates for summer steelhead in recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers.

15. Estimate the number of summer steelhead adults in the 1989-90 run year and spring chinook salmon adults in the 1989 run originating at Oregon's LSRCP facilities.

16. Estimate the number of spring chinook salmon adults outplanted from Lookingglass Hatchery in 1989 that returned back to the hatchery, that were recovered on spawning grounds, or that were harvested in tribal fisheries.

Accomplishments in FY 1990

We achieved all our objectives in FY 1990.

Findings in FY 1990

Fish Culture Monitoring

A total of 735 Carson stock, 216 Rapid River stock and 63 Imnaha stock (age 4) spring chinook salmon returned to Lookingglass Hatchery in 1989. Two left ventral fin marked Carson stock jacks (1986 brood) returned to Lookingglass Hatchery in 1989. These jacks were strays from direct stream releases into Catherine Creek or from Big Canyon facility releases. A total of 73 Carson stock chinook salmon returned to the Big Canyon facility including 11 left ventral fin marked jacks. At the Imnaha River weir, we trapped 386 chinook salmon, of which 122 were hatchery fish.

Run timing of marked Imnaha stock hatchery adults at Lower Granite Dam in 1989 was similar to that of the jacks in 1988. Over 90% of the marked fish passed Lower Granite Dam after 17 June, which classifies them as summer chinook.

In 1990, 953 summer steelhead adults returned to Wallowa Hatchery. We trapped 57 wild and 924 hatchery steelhead adults at the Little Sheep Creek facility in 1990. At the Big Canyon Creek facility we trapped 26 wild and 308 hatchery steelhead adults. The run timing of steelhead to Wallowa Hatchery in 1990 was compressed; a higher percentage of adults returned in a shorter time span than in previous years, and a relatively small percentage of the total returns were from late in the run.

A total of 169 Carson stock chinook salmon adults were outplanted from Lookingglass Hatchery in 1989. We estimated that 31.4% returned back to Lookingglass Hatchery, 7.7% were recovered or observed on spawning ground surveys, and the remaining 60.9% were unaccounted for. No outplanted fish were harvested in tribal fisheries.

Survival Studies

For 1986 brood coded-wire-tagged summer steelhead smolts acclimated and released from Wallowa Hatchery, the smolt-to-adult survival rates

were 1.04% for smolts averaging 124.5 grams/fish (4 fish/lb release group), and 1.08% for smolts averaging 96.9 grams/fish (5 fish/lb release group). Survival rates are calculated from catch plus escapement. Adults that returned from residual smolts that migrated in 1988 comprised 3% of the adult returns of the 4 fish/lb releases and 2% for the 5 fish/lb group. The smolt-to-adult survival rate for 1986 Wallowa stock steelhead released directly into Spring Creek at Wallowa Hatchery was 0.62%. Progeny of IHNV positive Wallowa stock steelhead (1986 brood) survived at a rate of 0.61%. The survival rate for 1986 brood Imnaha stock summer steelhead was 0.18%. We estimated that 38% of the adult returns from the 1986 brood Imnaha stock steelhead were from residual smolts that migrated to the ocean in 1988.

For coded-wire-tagged Carson stock chinook salmon of the 1984 brood released from Lookingglass Hatchery, smolt-to-adult survival rates were <0.01% for fish released in July, 0.02% for fish released in September, and 0.04% for fish released in November. Fish released in April of 1986 at an average weight of 29.8 and 51.5 grams/fish survived at 0.12% and 0.25% respectively. The 1984 brood Imnaha chinook salmon released in March of 1986 at an average weight of 42.0 grams/fish survived at 0.25%.

The smolt passage indices at Lower Granite Dam were 8.4% for fish that averaged 33.9 grams/fish and 10.4% for fish that averaged 22.4 grams/fish for Rapid River stock spring chinook salmon released at Lookingglass Hatchery in the spring of 1989. The passage index for the 1987 brood Rapid River spring chinook salmon smolts released in the fall was 0.3%. The smolt passage index for 1987 brood Imnaha chinook salmon smolts released in the spring of 1989 was 8.6%. Passage indices were lower in 1989 than in 1988 for all groups of chinook except the Rapid River stock subyearling chinook (1988 brood) released from Lookingglass Hatchery.

The smolt passage index at Lower Granite Dam for 1988 brood Wallowa stock summer steelhead released directly into Spring Creek at Wallowa Hatchery was 24.2% while the passage indices for groups of Wallowa stock summer steelhead acclimated at Wallowa Hatchery were 20.5% and 21.5% for fish released at 118 and 86 grams/fish respectively. The smolt passage index at Lower Granite Dam for 1988 brood Imnaha stock summer steelhead was 8.4%. Migration timing and duration were similar for Imnaha and Wallowa stock summer steelhead at Lower Granite dam in 1989.

Natural Escapement Monitoring

We observed one disk tagged hatchery fish on spawning ground surveys in the Minam River and recovered one disk tagged fish in the Lostine River. These disk tagged fish were Carson stock adults which were outplanted from Lookingglass Hatchery into the Wallowa River. No marked hatchery fish were recovered on the Wenaha River spawning ground surveys in 1989.

Disease Investigation

Infectious hematopoietic necrosis virus (IHNV) was detected at a 0.5% prevalence rate in Rapid River stock chinook and no IHNV was detected in Imnaha stock chinook salmon spawned at Lookingglass Hatchery in 1989. No erythrocytic inclusion body syndrome (EIBS) was detected in 1988 brood Lookingglass, Rapid River or Imnaha stock chinook salmon juveniles at Lookingglass Hatchery. This is the second consecutive year that no EIBS has been found in chinook salmon reared at Lookingglass Hatchery.

IHNV was detected at a 8.0% prevalence rate in Wallowa stock steelhead spawned at Wallowa Hatchery and the Big Canyon Creek facility and at a 1.4% prevalence rate for Imnaha stock steelhead spawned at the Little Sheep Creek facility in 1990. Progeny of IHNV positive parents did not show IHNV when they returned to Wallowa Hatchery as age 4 adults.

Management Implications

1. Run timing of Imnaha stock chinook salmon at Lower Granite Dam indicates that Imnaha stock chinook are primarily summer run fish, not spring run fish.

2. We will not be able to separate unmarked 1988 brood hatchery Imnaha chinook salmon returns from wild returns at the time of trapping in the 1991-93 run years. The presence of unmarked hatchery fish will complicate trapping and releasing operations and may jeopardize compliance with the wild fish policy guidelines.

3. Low numbers of wild steelhead adults returning to Little Sheep Creek will result in a low percentage of wild fish being incorporated into hatchery broodstock, and because of the ODFW wild fish policy guidelines, will limit the number of hatchery fish passed above the weir. At current production levels, there will likely be a substantial surplus of hatchery adults in the future if the wild population does not increase.

4. Shifts in run timing and duration of Wallowa stock summer steelhead at Wallowa Hatchery have been observed in the last 4 years. A higher proportion of the run is returning in a shorter time, and the peak of the run is occurring earlier than in previous years. This trend may be related to the increased sport harvest in tributary fisheries over the last 4 years.

5. Residual steelhead may substantially affect smolt-to-adult survival of Imnaha and possibly Wallowa stock summer steelhead. Residual steelhead may impact native fish populations as well.

Recommendations

1. Discriminant scale analysis should be used to distinguish the origins of unmarked Imnaha chinook returning in the 1991-93 return years. Broodstock collection and release strategies which will allow us to

comply with ODFW Wild Fish Policy and broodstock development guidelines need to be developed.

2. All hatchery chinook salmon smolts released into the Imnaha River basin should be marked for stock identification.

3. Harvest opportunities for hatchery Imnaha stock summer steelhead should be increased to reduce surplus hatchery fish returning to the Little Sheep Creek Facility.

4. Adult returns from the early and late segments of the Wallowa Hatchery run should be incorporated into hatchery broodstock at a level that will maintain the historic diversity in run timing at Wallowa Hatchery.

5. Feasibility of funding and constructing summer steelhead smolt acclimation and adult trapping facilities for all locations currently receiving direct stream releases should be investigated.

6. The feasibility of developing one or more local summer steelhead broodstocks for the Grande Ronde River and Catherine Creek should be evaluated.

EVALUATION OF THE BENEFITS PROVIDED BY RELEASING SPRING CHINOOK SALMON PRESMOLTS IN THE GRANDE RONDE RIVER AND ITS TRIBUTARIES

Objectives for FY 1990

Recover and decode coded-wire-tags from adults of the 1983-1986 broods that return to Lookingglass Hatchery. Update and summarize catch and escapement information for the 1983-1986 broods as data becomes available.

Accomplishments and Findings in FY 1990

The objectives were accomplished.

Management Implications and Recommendations

Presmolt releases in the Grande Ronde River basin have not been successful. The negative impacts presmolts are likely to have on native spring chinook populations would more than offset benefits from adult returns. Presmolts should be released only in areas where there will be no effects on the wild spring chinook populations.

EVALUATION OF THE BENEFITS PROVIDED BY REPROGRAMMING SPRING CHINOOK SALMON SMOLTS FROM LOWER COLUMBIA RIVER HATCHERIES

Objectives for FY 1990

Recover and decode coded-wire-tags from marked adults of the 1983 and 1984 broods returning to Lookingglass Hatchery. Summarize catch and escapement information for the 1983 and 1984 broods as data becomes available.

Accomplishments and Findings in FY 1990

The objectives were accomplished.

Management Implications and Recommendations

Reprogramming spring chinook from lower Columbia River hatcheries has been discontinued.

GENERAL INTRODUCTION

The background of the Lower Snake River Compensation Plan (LSRCP) is given in the LSRCP five-year study plan (Carmichael 1989). Oregon's mitigation goals for adult salmonids are 5,820 spring chinook salmon and 9,184 summer steelhead for the Grande Ronde Basin, and 3,210 spring chinook salmon and 2,000 summer steelhead for the Imnaha River Basin (U.S. Army Corps of Engineers 1975).

The means of mitigation for Oregon's LSRCP is production and release of hatchery smolts. A complex of hatcheries and satellite facilities exists to produce spring chinook salmon and summer steelhead for release in the Grande Ronde and Imnaha river basins. A description of facilities is found in Carmichael (1989).

Three projects were conducted under LSRCP Oregon Evaluation Studies: (1) evaluation of Lower Snake River Compensation Plan facilities in Oregon; (2) evaluation of the benefits provided by releasing spring chinook salmon presmolts in the Grande Ronde River and its tributaries, and (3) evaluation of benefits provided by reprogramming spring chinook salmon smolts from lower Columbia River hatcheries. The long-term goals and objectives of these studies are outlined in the LSRCP five-year study plan (Carmichael 1989). In this report we present a review of our activities for these projects from 1 July 1989 to 30 June 1990. Previous annual progress reports include Carmichael and Wagner (1983), Carmichael and Messmer (1985), and Carmichael et al. (1986a, 1987, 1988a 1988b, 1989, 1990), and Messmer et al. (1989).

EVALUATION OF LOWER SNAKE RIVER COMPENSATION PLAN FACILITIES IN OREGON

Introduction

The evaluation of LSRCP facilities in Oregon began in the fall of 1983. The work in this report period encompassed six areas of study:

fish culture monitoring; survival studies; natural escapement monitoring; planning; creel surveys; and disease investigation. The specific objectives and tasks for this report period are reviewed in the five-year study plan (Carmichael 1989) and in the summary section of this report. Fish culture monitoring, survival studies, natural escapement monitoring, and creel surveys are ongoing studies. Comprehensive spring chinook spawning ground surveys began in 1986 because of the need for better escapement information for the Pacific Salmon Treaty. These surveys were funded in part with LSRCP and Pacific Salmon Commission funds. Results pertinent to straying of hatchery chinook salmon into the Minam and Wenaha rivers are presented in this report. Results of summer steelhead creel surveys are presented in Carmichael et al. (1990). Results of the comprehensive spring chinook spawning ground surveys will be presented in a completion report that will be prepared in 1992.

Methods

Fish Culture Monitoring

Methods are described in the 1985-1989 annual reports (Carmichael and Messmer 1985; Carmichael et al. 1986a, 1987, 1988a; Messmer et al. 1989) and in the five-year study plan (Carmichael 1989). Pathological examinations were conducted by ODFW pathology staff and methods are reported in (Christianson 1990).

Survival Studies

Methods are described in the 1985-1989 annual reports (Carmichael and Messmer 1985; Carmichael et al. 1986a, 1987, 1988a; Messmer et al. 1989).

Natural Escapement Monitoring

Methods are described in the 1985-1989 annual reports (Carmichael and Messmer 1985; Carmichael et al. 1986a, 1987, 1988a, Messmer et al. 1989).
Methods used for estimating straying chinook salmon levels were estimated using methods described in Messmer et al. (1989). Spawning population size was estimated as described in Carmichael et al. (1986b)

We conducted spawning ground surveys cooperatively with ODFW management personnel on the Minam River from 29 to 31 August and 14 September 1989 and on the Wenaha River from 5 to 7 September 1989. We examined all carcasses for fin marks and collected snouts from all adipose fin marked fish.

Planning

Planning activities consisted of continuation of work associated with preparation and review of Imnaha and Grande Ronde subbasin plans under the Northwest Power Planning Council system planning process. Project personnel provided extensive input and supervision for habitat and production modeling that was utilized to assess production capacity

and analyze benefits of proposed enhancement activities. We participated as members on the technical and management work groups for both the Imnaha and Grande Ronde subbasins. Project personnel participated as members of the Upper Grande Ronde River Task Force, which is developing a habitat recovery and monitoring plan for the Upper Grande Ronde River watershed.

Disease Investigations

Methods are described in 1987 and 1988 annual report (Carmichael et al. 1987, 1988a) and in ODFW pathology reports (Christianson et al. 1990).

Results

Fish Culture Monitoring

Results of fish culture monitoring for spring chinook salmon are presented in Tables 1-10 and for summer steelhead in Tables 11-21.

In 1989, run timing of Ad-LV fin marked Imnaha stock chinook salmon adults destined for Lookingglass Hatchery was monitored at Lower Granite Dam. Of the 47 marked adults observed, 72% passed over the dam after 17 June which classifies them as summer chinook. A comparison of the run timing of Imnaha stock chinook with spring and summer stocks of chinook at Lower Granite Dam showed that hatchery origin Imnaha stock chinook are primarily summer run fish (Figure 1).

Survival Studies

Results related to survival studies of spring chinook salmon and summer steelhead appear in Tables 22-32. The results of summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1989-90 run year are presented in Carmichael et al. (1990).

Natural Escapement Monitoring

One disk tagged chinook salmon was observed spawning in the Minam River in 1989. This fish, a Carson stock adult from the Lookingglass Hatchery outplanting of 12 June, was estimated to represented 6 hatchery fish or 6.6% of the spawning population. We examined 11 adult carcasses for marks which was estimated to be 12% of the spawning population.

No marked fish were recovered on the Wenaha River in 1989. The four unmarked carcasses we recovered were estimated to represent only 9% of the spawning population.

Figure 1. Run timing of Snake River spring and summer chinook salmon and Imnaha stock chinook salmon at Lower Granite Dam in 1989. Salmon passing Lower Granite Dam from 1 March to 17 June are classified as spring chinook and salmon passing from 18 June to 17 August are classified as summer chinook.

Planning

Drafts of the Grande Ronde and Imnaha river subbasin plans will be completed and reviewed in 1991 under the Northwest Power Planning Council (NWPPC) Columbia Basin system planning process. We will continue to work with the system planners throughout the development and implementation of the NWPPC subbasin plans and the development of the ODFW basin plans.

Disease Investigations

Results of pathology exams are presented in ODFW pathology reports (Christianson et al. 1990).

Table 1. Egg take and survival of spring chinook salmon at Lookingglass and Irrigon hatcheries, 1988 and 1989 broods.

Stock, brood year	Number of eggs taken or received	Egg loss (%)	Egg-to-fry survival (%)	Egg-to-smolt survival (%)
Imnaha:				
1988a	521,938	15.8	89.3	85.2
1989a	406,008	2.5	96.1	(b)
Carson:				
1988	1,402,704	7.0c	(d)	(d)
1989	1,145,784	13.4	75.9	(b)
Rapid River:				
1988	372,948e	38.4f	59.8	31.9
1988	1,102,729	13.4g	85.8	82.2
1989	333,570	2.3	97.3	(b)

a Most fish held and spawned at Lookingglass Hatchery.
b All 1989 brood smolts will be released in the spring of 1991.
c Egg loss estimate does not include the loss of 67,500 eggs that were destroyed because of the presence of IHNV in the parents, and does not include 461,760 eggs transferred out of the basin or destroyed as excess to program needs.
d All 1988 brood Carson stock eggs were transferred out of the basin.
e Eggs used in subyearling smolt program.
f Does not include 32,670 viable eggs destroyed because of IHNV in the parents.
g Does not include 72,304 viable eggs destroyed because of IHNV in the parents.

Table 2. Release information for spring chinook salmon reared at Lookingglass

and Irrigon fish hatcheries and released in the Grande Ronde and Imnaha river
basins, 1988 brood. Standard deviations are shown in parentheses.

Date released	Number released	Size (fish/lb)	Location released	N	Mean fork length (mm)
RAPID RIVER STOCK					
02 Apr 1990	516,796	18.9	Lookingglass Creek	1,372	126(7.9)
02 Apr 1990	102,843	12.6	Lookingglass Creek	639	144(13.0)
09 Apr 1990	70,002	19.9	Catherine Creek	--	--
09 Apr 1990	80,073	19.5	Upper Grande Ronde	--	--
10 Apr 1990	26,445	20.7	Hurricane Creek	298	124(6.9)
10 Apr 1990	26,445	20.7	Wallowa River	298	124(6.9)
31 Mar 1990	91,433	16.7	Big Canyon facility	321	128(8.3)
IMNAHA STOCK					
31 Mar 1990	249,835	15.3	Imnaha River	300	133(11.6)
02-04 Apr 1990	114,706	19.0	Imnaha River	549	128(7.6)
02 Apr 1990	79,953	18.4	Big Sheep Creek	562	128(7.6)

Table 3. Vital statistics for spring chinook salmon that returned to the Big Canyon facility, Lookingglass Hatchery, and Imnaha River weir, 1989. J = jacks, M = males, F = females.

Stock, origin	Total Number	Number of J	M	F	Number of females spawned	Prespawning mortality (%) J	M	F

BIG CANYON FACILITY							
Carson:							
Hatchery	73	11	31	31	23	0.0	12.9 22.6
LOOKINGGLASS HATCHERY							
Carson:							
Hatchery	735	9	353	373	235	50.0a	34.1a 20.3a
Rapid River:							
Hatchery	216	44	68	104	100	4.5	2.9 2.9
Imnaha:							
Hatchery	63b	c	31	32	29d	c	0.0 3.2
IMNAHA RIVER WEIR							
Imnaha:							
Wild	264	38	121	105	47	10.5	1.6 0.0
Hatchery	122	115	4	7	7	13.8	50.0 0.0

a Prespawning mortality for fish transferred to Wallowa Hatchery.
b Includes 5 fish, 2 males and 3 females, recovered in Lookingglass Creek on spawning ground surveys.
c No 1986 brood Imnaha stock chinook were released at Lookingglass Hatchery.
d Includes 2 LV marked age 5 Lookingglass stock fish mistakenly identified as Imnaha stock.

Table 4. Run timing for spring chinook salmon that returned to Lookingglass Hatchery, Big Canyon facility, and Imnaha River weir, 1989.

	Lookingglass Hatcherya					
	Carson stock		Rapid River stock		Imnaha stock	
Time interval	Number	% of total	Number	% of total	Number	% of total

12-13 May	0	0.0	0	0.0	0	0.0	
14-20 May	0	0.0	0	0.0	0	0.0	
21-27 May	0	0.0	0	0.0	0	0.0	
28 May-03 Jun	99	13.5	31	14.4	0	0.0	
04-10 Jun	228	31.1	93	43.2	2	3.5	
11-17 Jun	113	15.4	36	16.7	0	0.0	
18-24 Jun	76	10.4	23	10.7	1	1.7	
25 Jun-01 Jul	62	8.4	17	7.9	5	8.8	
02-08 Jul	37	5.0	4	1.9	13	22.8	
09-15 Jul	0	0.0	0	0.0	0	0.0	
16-22 Jul	25	3.4	3	1.4	11	19.3	
23-29 Jul	0	0.0	0	0.0	0	0.0	
30 Jul-05 Aug	11	1.5	1	0.5	5	8.8	
06-12 Aug	42	5.7	3	1.4	10	17.6	
13-19 Aug	5	0.7	1	0.5	1	1.7	
20-26 Aug	12	1.6	2	0.9	4	7.0	
27 Aug-02 Sep	8	1.1	1	0.5	2	3.5	
03-09 Sep	13	1.8	0	0.0	3	5.3	
10-16 Sep	3	0.4	0	0.0	0	0.0	

a Lookingglass Hatchery trap operated from 12 May to 14 September.

Table 4. Continued.

Time interval	Big Canyon facility[c] Number	% of total	Imnaha River weir[b] Wild fish Number	% of total	Hatchery fish Number	% of total
12-13 May	--	--	--	--	--	--
14-20 May	--	--	--	--	--	--
21-27 May	1	1.4	--	--	--	--
28 May-03 Jun	2	2.7	--	--	--	--
04-10 Jun	17	23.3	--	--	--	--
11-17 Jun	11	15.1	--	--	--	--
18-24 Jun	10	13.7	0	0.0	0	0.0
25 Jun-01 Jul	10	13.7	0	0.0	0	0.0
02-08 Jul	9	12.3	0	0.0	0	0.0
09-15 Jul	6	8.2	58	21.9	11	9.3
16-22 Jul	2	2.7	95	35.8	35	29.4
23-29 Jul	4	5.5	32	12.1	25	21.0
30 Jul-05 Aug	1	1.4	24	9.1	16	13.4
06-12 Aug	0	0.0	7	2.6	3	2.5
13-19 Aug	0	0.0	1	0.4	0	0.0
20-26 Aug	0	0.0	27	10.2	3	2.5
27 Aug-02 Sep	0	0.0	21	7.9	22	18.5
03-09 Sep	0	0.0	0	0.0	0	0.0
10-16 Sep	--	--	0	0.0	4	3.4

b Imnaha River weir operated from 19 June to 15 September.
c Big Canyon facility operated from 27 May to 06 September.
Carson stock returns.

Table 5. Spawn timing of female spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River weir, 1989.

Time interval	Carson stockb N	Carson stockb %	Rapid River stockc N	Rapid River stockc %	Imnaha stocka Wild fish N	Imnaha stocka Wild fish %	Imnaha stocka Hatchery fish N	Imnaha stocka Hatchery fish %
13-19 Aug	45	17.4	1	1.0	2	4.3	0	--
20-26 Aug	75	29.1	4	4.0	7	14.9	4	11.1
27 Aug-02 Sep	71	27.5	33	33.0	16	34.0	12	33.3
03-09 Sep	52	20.2	56	56.0	21	44.7	18	50.0
10-16 Sep	15	5.8	6	6.0	1	2.1	2	5.6

a Includes fish spawned at Lookingglass Hatchery and Imnaha River weir.
b Includes fish spawned at Lookingglass Hatchery, Wallowa Hatchery, and Big Canyon facility.
c All fish spawned at Lookingglass Hatchery.

Table 6. Wild spring chinook salmon trapped and released above the Imnaha River weir, 1989.

Time intervala	Number of fish released: Jack N	Jack %	Male N	Male %	Female N	Female %
09-15 Jul	10	29.4	29	46.0	30	53.5
16-22 Jul	4	11.8	8	12.7	7	12.5
23-29 Jul	3	8.8	9	14.3	7	12.5
30 Jul-05 Aug	7	20.6	3	4.8	6	10.7
06-12 Jul	2	5.9	3	4.8	2	3.6
13-19 Jul	0	0.0	1	1.6	0	0.0

20-26 Jul	1	2.9	4	6.3	2	3.6
27 Aug-02 Sept	7	20.6	6	9.5	2	3.6
Total	34		63		56	

a Imnaha River weir operated from 19 June to 15 September.

Table 7. Percent age composition of spring chinook salmon that returned to Lookingglass Hatchery, Big Canyon facility, and the Imnaha River weir, 1989. Age nomenclature is that of Gilbert and Rich (1927).

Age group,	Lookingglass Hatchery					
	Carson stock		Rapid River stock		Imnaha stock	
number	Male	Female	Male	Female	Male	Female
32	1.2	0.0	20.4	0.0	--	--
42	18.1	18.0	31.5	48.1	49.2	50.8
52	29.1	32.5	--	--	--	--
62	0.8	0.3	--	--	--	--
Number of fish	362	373	112	104	31	32

Age group,	Big Canyon facilitya		Imnaha River weir			
			Wild fish		Hatchery fish	
number	Male	Female	Male	Female	Male	Female
32	15.1	0.0	14.4	0.0	95.1	0.0
42	28.7	32.9	33.7	12.5	--	--
52	13.7	9.6	12.1	27.3	1.6	3.3
Number of fish	42	31	159	105	118	4

a Carson stock.

Table 8. Mean fork length (mm) for age-specific groups of adult spring chinook salmon that returned to LSRCP facilities in Oregon, 1989. Age nomenclature is that of Gilbert and Rich (1927). Standard deviations are shown in parentheses.

	Age 3				Age 4			
Stock,	Male		Female		Male		Female	
origin	N	Length	N	Length	N	Length	N	Length
LOOKINGGLASS HATCHERY								
Carson:	8	562(54)	0	--	119	735(50)	112	711(40)
Rapid River:	44	482(36)	0	--	68	706(40)	104	703(28)
Imnaha:	--	--	-	--	29	727(53)	31	788(33)
BIG CANYON FACILITY								
Carson:	10	517(45)	0	--	20	789(42)	23	748(21)
IMNAHA RIVER WEIR								
Imnaha:								
Wild	4	574(60)	0	--	44	756(47)	--	--
Hatchery	116	547(48)	-	--	--	--	--	--

	Age 5				Age 6			
Stock,	Male		Female		Male		Female	
origin	N	Length	N	Length	N	Length	N	Length
LOOKINGGLASS HATCHERY								
Carson:	167	961(67)	191	876(47)	5	1,029(50)	1	943

BIG CANYON FACILITY								
Carson:	9	902(81)	7	882(44)	0	--	0	--
IMNAHA RIVER WEIR								
Imnaha:								
Wild	11	1,008(54)	33	918(29)	1	1,220	0	--
Hatchery	2	869(129)	4	868(61)	0	--	0	--

Table 9. Degree of smolting for juvenile spring chinook salmon released into the Grande Ronde and Imnaha river basins, 1988 brood. Standard deviations are shown in parentheses.

Stock	Date released	N	Mean length (mm)	Degree of smolting[a] (%) Smolt	Inter-mediate	Parr
Rapid River	04/02/90	400	124(7.1)	0.7	99.3	0
	04/02/90	400	144(13.0)	4.0	96.0	0
	03/31/90	199	128(8.1)	1.5	98.5	0
Imnaha	03/31/90	300	133(11.6)	0.3	99.7	0

a Degree of smolting determined by visual inspection using the following criteria: Smolt = parr marks and spotting not visible, body color silver, and scales deciduous. Intermediate = parr marks and spotting present but not distinct, body color beginning to appear silver and scales not deciduous. Parr = parr marks and spotting prominent, body color not silver, and scales not deciduous.

Table 10. Release and recovery information for adult Carson stock spring chinook salmon outplanted from Lookingglass Hatchery into Catherine Creek and the Wallowa River, 1989. Expanded numbers of fish are shown in parentheses.

Outplanting location	Date out-planted	Number of fish released Tagged	Total	Outplanted fish recovered or observed Returned to Lookingglass Hatchery	Observed live or recovered on spawning ground surveys

Catherine Creek	06/09/89	52	81	12(19)	2(3)
Wallowa River	06/12/89	46	88	18(34)	6(10)a

a Recovery area includes Wallowa River and tributaries.

Table 11. Egg take and egg survival of Wallowa and Imnaha stock summer steelhead, 1989 and 1990 broods.

Stock, brood year	Eggs taken	Egg loss (%)	Egg-to-fry survival (%)	Egg-to-smolt survival (%)
Wallowa:				
1989	2,477,000a	28.2	68.4	57.9
1990	3,049,659a	15.5b	76.5c	(d)
Imnaha:				
1989	758,000	28.8	68.3	52.5
1990	849,432	32.9	64.7e	(d)

a Eggs taken includes eggs collected at the Big Canyon facility.
b Does not include 10,116 viable eggs dumped because of excess over program needs.
c Does not include 428,000 eyed eggs shipped to Lyons Ferry Hatchery, and 10,125 eyed eggs shipped to Oregon State University.
d 1990 brood smolts will be released in the spring of 1991.
e Does not include 20,468 eyed eggs and 77,347 fry destroyed because they were in excess over program needs.

Table 12. Vital statistics for juvenile summer steelhead released in the Grande Ronde and Imnaha river basins and the Snake River, 1989 brood year. All fish were adipose fin marked. Standard deviations are shown in parentheses.

Stock, date released	Number released	Size (fish/lb)	Location of release	N	Mean fork length (mm)
Wallowa:					
11/14/89a	9,025	72.2	Snake River	--	--
04/15-19/90	90,136	4.2	Wallowa Hatchery	200	218(17.5)
04/15-19/90	405,769	4.9	Wallowa Hatchery	525	208(17.9)
04/19/90	53,747	5.1	Spring Creek	308	197(23.8)

04/18-27/90	61,377	5.4	Upper Wallowa River	692	200(21.2)
04/12-17/90	199,013	4.9	Upper Grande Ronde River	--	--
04/18-20/90	85,212	5.3	Catherine Creek	242	206(20.5)
04/19/90	223,379	4.8	Big Canyon facility	400	205(15.9)
04/30/90	50,036	5.4	Big Canyon facility	--	--
04/24-26/90	94,393	5.4	Lower Grande Ronde River	1,097	202(20.1)
Imnaha:					
11/14/89a	18,893	67.0	Snake River	--	--
04/17/90	249,563	5.7	Little Sheep Creek	380	195(21.3)
04/25-26/90	81,902	6.7	Imnaha Riverb	482	186(19.7)
04/23/90	21,760	6.8	Wallowa River	284	188(20.2)
04/23/90	27,200	6.8	Catherine Creek	284	188(20.2)
04/26/90	3,212	6.7	Lower Grande Ronde River	247	186(21.1)

a Small fish graded off at Irrigon Hatchery and excess to program needs were released into the Snake River below Hells Canyon Dam.
b 41,404 released at the mouth of Horse Creek on the lower Imnaha River, the remainder released at the town of Imnaha.

Table 13. Vital statistics for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1990.

Location, origin	Total	Male	Female	Number of females spawned	Prespawning mortality (%) Male	Female
Big Canyon facility:						
Wild	26	18	8	7	9.1	12.5
Hatchery	308	111	197	112	10.7	3.4
Wallowa Hatchery:						
Hatchery	953	467	486	462	12.9	3.1
Little Sheep Creek:						
Wild	57	20	37	23	7.7	0
Hatchery	924	456	468	156	8.0	3.2

Table 14. Run timing for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1990.

Time interval	Big Canyon facilitya Wild fish Number	% of Total	Hatchery fish Number	% of Total	Wallowa Hatcheryb Number	% of Total
05-11 Mar	--	--	--	--	21	2.2
12-18 Mar	--	--	--	--	36	3.8
19-25 Mar	--	--	--	--	187	19.6
26 Mar-01 Apr	--	--	--	--	360	37.8
02-08 Apr	4	15.4	125	40.5	133	13.9
09-15 Apr	--	--	--	--	155	16.3
16-22 Apr	6	23.1	91	29.4	35	3.7
23-29 Apr	1	3.8	23	7.4	26	2.7
30 Apr-06 May	12	46.2	59	19.2	0	0.0
07-13 May	2	7.7	4	1.3	0	0.0
14-20 May	1	3.8	5	1.6	--	--
21-27 May	0	--	2	0.6	--	--

Time interval	Little Sheep Creek facilityc Wild fish Number	% of Total	Hatchery fish Number	% of Total
05-11 Mar	0	--	0	--
12-18 Mar	0	--	0	--
19-25 Mar	6	10.5	48	5.2
26 Mar-01 Apr	4	7.0	96	10.4
02-08 Apr	11	19.3	218	23.6
09-15 Apr	16	28.1	294	31.8
16-22 Apr	17	29.8	206	22.2
23-29 Apr May	1	1.8	22	2.4
30 Apr-06 May	0	0.0	31	3.4
07-13 May	2	3.5	7	0.8
14-20 May	0	--	2	0.2
21-27 May	0	--	0	--

a Big Canyon facility trap operated from 1-4 April and 17 April to 22 May 1990.
b Wallowa Hatchery trap operated from 2 March to 8 May 1990.
c Little Sheep Creek trap operated from 7 March to 22 May 1990.

Table 15. Time of spawning for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1990.

Time interval	Big Canyon facility: Wild fish Number	Wild fish % of total	Hatchery fish Number	Hatchery fish % of total	Wallowa Hatchery Number	Wallowa Hatchery % of total
26 Mar-01 Apr	0	--	0	--	68	14.8
02-08 Apr	0	--	0	--	84	18.3
09-15 Apr	0	--	26	23.2	168	36.5
16-22 Apr	0	--	2	1.8	68	14.8
23-29 Apr	3	42.9	33	29.5	58	12.6
30 Apr-06 May	0	--	14	12.5	10	2.2
07-13 May	3	42.9	17	15.2	4	0.8
14-20 May	0	--	12	10.7	--	--
21-27 May	1	14.2	8	7.1	--	--

Time interval	Little Sheep Creek facility: Wild fish Number	Wild fish % of total	Hatchery fish Number	Hatchery fish % of total
26 Mar-01 Apr				
02-08 Apr	2	9.5	19	12.0
09-15 Apr	3	14.3	35	22.2
16-22 Apr	0	--	36	22.8
23-29 Apr	1	4.7	32	20.2
30 Apr-06 May	3	14.3	19	12.0
07 13 May	6	28.6	8	5.1
14-20 May	6	28.6	6	3.8
21-27 May	0	--	3	1.9

Table 16. Percent age composition for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1990. Age group is expressed as years spent in freshwater prior to ocean migration: years spent in the ocean prior to the spawning migration.

Age group, number	Big Canyon facility: Wild fish Male	Wild fish Female	Hatchery fish Male	Hatchery fish Female	Wallowa Hatchery Male	Wallowa Hatchery Female

1:1	0.0	0.0	29.2	30.5	35.7	17.7
1:2	0.0	0.0	6.2	30.2	11.0	30.4
1:3	0.0	0.0	0.0	0.0	0.1	0.0
2:1	53.9	11.5	0.6	3.3	2.0	2.5
2:2	11.5	19.2	0.0	0.0	0.2	0.3
3:1	3.9	0.0	0.0	0.0	0.0	0.1
Number of fish	18	8	111	197	467	487

Age group, number	Little Sheep Creek facility			
	Wild fish		Hatchery fish	
	Male	Female	Male	Female
1:1	0.0	0.0	45.7	43.7
1:2	0.0	0.0	1.0	1.6
2:1	28.1	29.8	2.7	5.3
2:2	7.0	29.8	0.0	0.0
3:1	0.0	5.3	0.0	0.0
Number of fish	20	37	456	468

Table 17. Mean fork length (mm) by age group for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1990. Age group is expressed as years spent in freshwater prior to ocean migration: years spent in the ocean prior to the spawning migration. Standard deviations are shown in parentheses.

Age group	Big Canyon facility								Wallowa Hatchery	
	Wild Fish				Hatchery Fish					
	Male		Female		Male		Female		Male	Female
	N	Length	N	Length	N	Length	N	Length	N	N
1:1	0	--	0	--	42	600(28)	55	584(21)	272	169
1:2	0	--	0	--	10	747(43)	57	704(33)	105	290
1:3	0	--	0	--	0	--	0	--	1	0
									758	--

2:1	7	596(40)	3	619(14)	1	609	6	622(17)
15	649(46)	24	640(37)					
2:2	3	684(54)	5	654(22)	0	--	0	--
2	739(1)	3	726(50)					
3:1	1	640	0	--	0	--	0	--
0	--	1	576					

Little Sheep Creek facility

	Wild fish				Hatchery fish			
Age group	Male N	Male Length	Female N	Female Length	Male N	Male Length	Female N	Female Length
1:1	0	--	0	--	141	590(24)	133	583(25)
1:2	0	--	0	--	7	725(56)	12	684(27)
2:1	11	571(23)	11	567(24)	8	637(26)	16	615(28)
2:2	2	711(23)	13	688(20)	0	--	0	--
3:1	0	--	2	562(9)	0	--	0	--

Table 18. Number of adult summer steelhead trapped and released above the Big Canyon facility, 1990.

Trapping and release time period	Wild fish Male	Wild fish Female	Hatchery fish Male	Hatchery fish Female
02-08 Apr	2	0	22	38
09-15 Apr	0	0	0	0
16-22 Apr	0	0	15	30
23-29 Apr	0	0	4	0
30 Apr-06 May	0	0	1	0
07-13 May	1	0	18	0
14-20 May	3	0	7	10
21-22 May	1	0	0	1
Total released	7	0	67	79

Table 19. Number of adult summer steelhead trapped and released above the Little Sheep Creek facility, 1990.

Trapping and release time period	Wild fish Male	Wild fish Female	Hatchery fish Male	Hatchery fish Female
07-11 March	0	0	0	0
19-25 March	1	1	34	6
26 March-01 Apr	0	1	44	15
02-08 Apr	0	3	99	46
09-15 Apr	6	2	46	86
16-22 Apr	0	3	61	145a
23-29 Apr	0	0	4	6
30 Apr-06 May	0	1	5	1
07-13 May	0	0	0	0
14-20 May	0	0	0	0
21-22 May	0	0	0	0
Total released	7	11	293	305

a 53 of these fish were trapped in earlier time periods.

Table 20. Percent incidence of an eroded fin or fins on summer steelhead smolts reared at Irrigon Hatchery and released in the Grande Ronde and Imnaha river basins in 1990, 1989 brood year. D = dorsal, LV = left ventral, RV = right ventral, BV = both ventrals, LP = left pectoral, RP = right pectoral, BP = both pectorals. Standard deviation is shown in parenthesis.

Stock, sampling date	N	Mean fork length (mm)	Incidence (%) of Fin erosion D	LVa	RV	BV	LP	RP	BP
Wallowa:									
11 Aprb	200	210(16.9)	100	13.5	14.0	30.0	10.0	9.0	3.5
11 Aprc	412	210(19.6)	100	1.7	26.7	25.4	15.1	4.1	2.2
16 Aprd	400	192(27.0)	100	11.3	6.5	16.3	5.8	7.3	2.0
16 Apre	202	197(23.8)	100	5.9	35.6	17.6	14.4	10.9	5.4
18 Aprf	400	205(15.9)	100	14.5	10.5	27.5	6.3	5.0	1.8
Imnaha:									
13 Aprg	200	195(21.3)	100	5.7	18.0	36.9	9.5	14.0	7.0

a Adjusted for percentage of LV fin marked fish.
b Final rearing in upper acclimation pond at Wallowa Hatchery.
c Final rearing in lower acclimation pond at Wallowa Hatchery.
d Wildcat Creek release.
e Spring Creek release.
f Final rearing in Big Canyon facility acclimation ponds.
g Final rearing in Little Sheep Creek acclimation pond.

Table 21. Degree of smolting, precociousness, and descaling of summer steelhead smolts reared at Irrigon Hatchery and released into the Grande Ronde and Imnaha river basins in 1990, 1989 brood year. Standard deviations are shown in parentheses.

Stock, sampling date	N	Mean length (mm)	Degree of smolting (%)a Smolt	Inter-mediate	Parr	Pre-cocious males (%)	De-scaled fish (%)
Wallowa:							
11 Aprb	200	210(16.9)	38.5	61.5	0.0	0	0
11 Aprc	412	210(19.6)	20.6	79.1	0.3	0	0
16 Aprd	400	192(27.0)	7.5	92.5	0.0	0	0
16 Apre	202	197(23.8)	18.8	81.2	0.0	0	0
18 Aprf	400	205(15.9)	16.0	84.0	0.0	0	0
Imnaha:							
13 Aprg	200	195(21.3)	12.5	86.0	1.5	0	0

a Degree of smolting determined by visual inspection using the following criteria: Parr = parr marks and spotting prominent, body color not silver, and scales not deciduous. Intermediate = parr marks and spotting present but not distinct, body color beginning to appear silver and scales not deciduous. Smolt = parr marks and spotting not visible, body color silver, and scales deciduous.
b Final rearing in upper acclimation pond at Wallowa Hatchery.
c Final rearing in lower acclimation pond at Wallowa Hatchery.
d Wildcat Creek release.
e Spring Creek release.
f Final rearing in Big Canyon facility acclimation ponds.
g Final rearing in Little Sheep Creek acclimation pond.

Table 22. Release information for Ad+CWT marked spring chinook salmon reared at Lookingglass and Irrigon hatcheries and released in the Grande Ronde and Imnaha river basins, 1988 brood. Standard deviations are shown in parentheses.

Stock, location of release	CWT code	Date released	Number released	Na	Mean fork length (mm)	Mean weight (g)	Mean condition factor
Rapid River:							
Lookingglass Hatchery	07 47 39	04/02/90	42,187	342	124(6.9)	23.7(5.4)	1.15(0.05)
	07 47 40	04/02/90	41,780	314	124(7.3)	22.0(4.3)	1.14(0.05)
	07 47 43	04/02/90	43,788	306	144(13.1)	38.6(10.0)	1.24(0.11)
	07 47 45	04/02/90	43,479	333	145(12.9)	42.9(19.5)	1.20(0.05)
Imnaha:							
Imnaha River facility	07 47 33	03/31/90	56,514	200	124(7.5)	24.4(5.5)	1.22(0.05)
	07 47 34	03/31/90	56,681	200	124(6.7)	25.1(4.6)	1.24(0.05)
	07 47 29	03/31/90	51,597	200	141(9.1)	35.5(6.8)	1.25(0.06)
	07 47 30	03/31/90	51,281	228	141(8.6)	36.5(6.0)	1.24(0.05)

a Sample size for weight and condition factor is 25 fish.

Table 23. Recovery information for Ad+CWT marked spring chinook salmon that returned to Lookingglass Hatchery, Imnaha River weir, and that were recovered on Northeast Oregon spawning ground surveys, 1989. Standard deviations are shown in parentheses.

Brood year, CWT code	Number recovered		Mean fork length (mm)		Mean weight (kg)	
	Male	Female	Male	Female	Male	Female

Brood year, CWT Code	Number recovered Male	Number recovered Female	Mean fork length (mm) Male	Mean fork length (mm) Female	Mean Weight (kg) Male	Mean Weight (kg) Female
LOOKINGGLASS HATCHERY						
1984:						
07 33 16	1	5	988	827(40)	8.8	5.4(1.2)
07 33 57	1	0	818	--	5.1	--
07 33 58	1	2	839	840(35)	4.6	6.0(1.1)
07 33 59	4	1	832(179)	828	5.1(3.7)	5.7
07 33 60	2	0	844(93)	--	6.4(1.4)	--
07 33 61	8	7	873(109)	861(83)	6.6(2.5)	7.4(3.2)
07 33 62	8	6	946(73)	834(58)	8.2(1.5)	5.6(1.1)
07 34 01	0	1	--	715	--	--
23 19 19	0	1	--	859	--	5.7
1985:						
07 38 03	1	2	720	718(33)	3.7	3.8(0.6)
07 38 04	2	1	751(46)	691	4.6(0.8)	3.7
07 38 05	35	19	727(64)	709(34)	4.0(0.9)	3.8(0.6)
07 38 06	24	29	747(38)	714(30)	4.4(0.8)	3.9(0.6)
07 38 07	7	5	696(84)	701(53)	3.2(1.0)	3.8(0.8)
07 38 08	2	2	738(52)	677(62)	4.5(0.5)	3.4(0.7)
07 38 09a	10	14	736(51)	774(31)	4.0(0.9)	5.0(0.8)
07 38 10a	12	9	740(53)	802(31)	4.0(0.8)	5.9(0.8)
07 38 11	7	11	720(32)	702(26)	3.7(0.6)	3.8(0.4)
07 38 12	5	5	726(37)	702(23)	3.7(0.4)	3.8(0.4)
07 39 55	1	0	780	--	4.3	
07 39 56b	0	2	--	729(27)	--	3.7
07 39 57b	1	0	815	--	--	--
23 19 44	1	0	743	--	4.0	--
23 19 47	1	0	692	--	3.4	--
1986:						
07 40 14	5	0	456(9)	--	1.1(0.1)	--
07 40 15	5	0	507(62)	--	1.1(0.8)	--
07 40 21	3	0	501(21)	--	1.6(0.3)	--

a Imnaha stock released at Lookingglass Hatchery.
b Big Canyon facility strays.

Table 23. Continued.

Brood year, CWT Code	Number recovered Male	Number recovered Female	Mean fork length (mm) Male	Mean fork length (mm) Female	Mean Weight (kg) Male	Mean Weight (kg) Female
BIG CANYON CREEK FACILITY						
1985:						
07 39 56	9	13	803(51)	742(17)	4.6(0.6)	3.8(0.5)
07 39 57	10	10	768(16)	756(24)	--	--

IMNAHA RIVER WEIR						
1984:						
07 33 63	2	3	869(129)	867(74)	6.3(1.4)	7.8(2.0)
23 19 03	1	0	980	--	8.6	--
23 19 18	0	1	--	964	--	10.3
1985:						
07 38 05c	0	1	--	750	--	--
23 19 43	0	1	--	810	--	6.1
23 19 46	1	0	650	--	2.5	--
1986:						
07 42 60	28	0	535(56)	--	1.7(0.5)	--
07 42 63	22	0	542(50)	--	1.8(0.5)	--
07 43 01	19	0	533(44)	--	1.7(0.5)	--
07 43 02	35	0	550(36)	--	1.8(0.4)	--
SPAWNING GROUND SURVEYS						
1985:						
07 38 08d	0	1	--	730	--	--
07 38 10d	0	1	--	770	--	--

c Lookingglass Hatchery Stray.
d Recovered in Lookingglass Creek.

Table 24. Release information for Ad-LV+CWT marked summer steelhead reared at Irrigon hatchery and released in the Grande Ronde and Imnaha river basins, 1989 brood year. Standard deviations are shown in parentheses.

Stock, location of release	CWT code replicates	Dates released	Number released	N	Mean fork length (mm)	Mean weight (g)	Mean condition factor
Wallowa:							
Wallowa Hatchery	07 51 22	04/15-19/90	26,771	88	196(17.5)	77.5(20.9)	1.00(0.05)
	07 51 23		26,326	111	208(18.0)	94.9(24.8)	1.04(0.05)
	07 51 20		26,347	98	219(19.4)	105.7(27.2)	1.00(0.09)
	07 51 21		26,473	102	218(16.9)	110.3(27.3)	1.04(0.06)

Spring		07 51 18	04/19/90	25,961	308a					
197(23.8)	96.3(31.4)	1.09(0.07)								
Creekb		07 51 19	04/19/90	26,231	c	c	c	c		
Imnaha:										
Little Sheep		07 51 24	04/16/90	26,363	380a					
195(21.3)	77.7(28.3)	1.03(0.07)								
Creek		07 51 25	04/16/90	26,164	c	c	c	c		

a Sample size for weight and condition factor is 50 fish.
b Direct stream release Group
c Sample size, mean length, mean weight, and mean condition factor are the same as the replicate release group.

Table 25. Recovery information for Ad-LV+CWT marked summer steelhead that returned to Wallowa Hatchery and Little Sheep Creek facility in 1990. Standard deviation is shown in parenthesis. R1 = replicate one, R2 = replicate two.

Brood year, CWT Code	Number recovered		Mean fork length(mm)		Mean weight (kg)	
	Male	Female	Male	Female	Male	Female
WALLOW HATCHERY						
1986:						
07 40 25	6	3	705(39)	695(29)	--	3.3
07 40 26	7	8	723(55)	721(21)	3.0(0.6)	3.5(0.3)
07 41 25R1	2	19	758(17)	706(33)	3.8(0.6)	3.4(0.4)
07 41 25R2	7	7	713(35)	702(28)	3.2(0.6)	3.2(0.4)
07 41 26R1	6	18	745(26)	687(42)	3.5(0.4)	3.2(0.4)
07 41 26R2	8	18	733(25)	687(30)	3.4(0.4)	3.0(0.3)
07 41 28R1	0	2	--	671(45)	--	2.9(0.6)
07 41 28R2	1	1	672	717	2.7	--
1987:						
07 40 27	15	8	592(35)	592(16)	1.9(0.3)	2.2(0.4)
07 40 28	21	8	608(29)	586(42)	2.1(0.2)	2.2(0.2)
07 40 29	23	10	579(24)	590(14)	1.7(0.2)	1.9(0.3)
07 40 30	18	6	595(33)	594(25)	1.8(0.3)	2.2(0.4)
07 40 31	9	5	598(32)	576(40)	1.9(0.2)	1.8(0.3)
07 40 32	15	5	593(29)	578(7)	1.9(0.2)	1.8(0.3)
LITTLE SHEEP CREEK FACILITY						
1985:						

07 37 61	0	1	--	705	--	2.8
1986:						
07 41 22R1	3	7	692(66)	664(34)	3.0(0.7)	2.8(0.4)
07 41 22R2	3	12	672(76)	628(34)	2.8	2.4(0.4)
07 41 25R1a	1	0	680	--	3.0	--
1987:						
07 40 29a	1	0	620	--	--	--
07 40 31a	0	1	--	585	--	2.1
07 40 33	29	42	594(24)	576(27)	1.9(0.3)	1.9(0.3)
07 40 34	31	29	586(24)	586(26)	1.9(0.2)	1.9(0.3)

a Wallowa Hatchery stray.

Table 26. Recovery information for cold-branded downstream migrant Rapid River, and Imnaha stock spring chinook salmon smolts recaptured at Lower Granite Dam in 1989, 1987 brood year. Number of observed recoveries is shown in parentheses.

Stock, Yeara brand code	Date released	Estimated number recovered	Percent of number released	Cumulative percent of recoveries by week of the 14	15	16	17	18
Rapid River:								
LD-J-1	09/23/88	9(3)	0.1	33.3	66.8	100	--	--
RD-J-1	09/23/88	123(8)	0.6	0.0	20.3	23.6	91.1	91.1
LD-J-3b	04/03/89	1,123(181)	6.0	0.0	12.6	48.4	91.8	100
RD-J-3	04/03/89	1,894(258)	9.9	0.0	9.6	34.6	93.8	100
LD-J-2c	04/03/89	2,114(380)	10.6	0.0	15.5	70.1	91.9	97.6
RD-J-2	04/03/89	2,062(295)	10.0	0.0	10.0	50.8	91.5	94.9
LA-J-1d	05/15/89	5,976(589)	26.2	--	--	--	--	--
RA-J-1	05/15/89	5,501(549)	24.8	--	--	--	--	--

IMNAHA:												
LD-J-4	04/05/89	1,199(134)	6.0	0.0	1.3	25.8	77.7	96.0				
RD-J-4	04/05/89	2,275(210)	11.2	0.0	0.1	20.0	60.0	90.9				

Stock, brand code	Cumulative percent of recoveries by week of the year[a]									
	19	20	21	22	23	24	25	26	27	28	29
Rapid River:											
RD-J-1	91.1	91.1	91.9	91.9	91.9	91.9	91.9	91.9	100	--	--
LD-J-2	100	--	--	--	--	--	--	--	--	--	--
RD-J-2	99.4	99.4	99.4	99.4	100	--	--	--	--	--	--
LA-J-1	0.0	0.0	1.9	5.6	22.3	83.3	96.3	99.4	99.6	99.8	100
RA-J-1	0.0	0.0	0.3	2.6	20.4	82.9	95.6	99.2	99.6	99.8	100
Imnaha:											
LD J 4	99.4	99.4	100	--	--	--	--	--	--	--	--
RD-J-4	98.5	99.6	99.6	100	--	--	--	--	--	--	--

a Week 1 of the year is 1-7 January and week 52 of the year is 24-31 December.
Weeks 2-51 are 7 day intervals except in leap years when week 9 is 8 days.
b Large smolts at 33.9 grams/fish.
c Small smolts at 22.4 grams/fish.
d Subyearling smolts, 1988 brood.

Table 27. Recovery information for cold-branded downstream migrant Wallowa and Imnaha stock summer steelhead recaptured at Lower Granite Dam in 1989, 1988 brood year. Standard deviation of weight is shown in parentheses.

Stock, brand code	Date of release	Size at release (g)	Number observed	Estimated number recovered	Percent of number released
Wallowa:					
LA-J-4	04/25-27/89	90.8(28.9)	308	7,292	28.6
RA-J-4	04/25-27/89	89.0(32.4)	321	7,750	31.6
LA-J-2	04/24/89	102.8(38.8)	302	6,138	24.0
RA-J-2	04/24/89	102.8(38.8)	308	6,223	24.4
LA-J-3	04/24/89	85.4(21.6)	281	5,215	20.8
RA-J-3	04/24/89	87.4(25.7)	296	5,669	22.8
LA-J-1	04/20-24/89	120.9(31.0)	219	4,781	19.1
RA-J-1	04/20-24/89	115.4(20.5)	235	5,392	21.6
Imnaha:					
LD-J-1	04/21-24/89	94.8(29.0)	107	1,912	7.2
RD-J-1	04/21-24/89	94.8(29.0)	126	2,520	9.6

Stock, brand code	Cumulative percent of recoveries by week of the year[a]												
	17	18	19	20	21	22	23	24	25	26	27	28	29
Wallowa:													
LA-J-4	1.0	36.4	79.5	90.8	96.4	98.2	99.2	99.7	99.8	100	--	--	--
RA-J 4	--	36.3	75.3	90.0	94.8	96.7	98.1	98.9	99.6	99.9	99.9	100	--
LA-J-2	--	22.0	53.9	77.3	87.4	89.5	93.4	96.6	99.5	99.8	99.8	100	--
RA-J 2	0.1	23.1	57.0	75.6	84.1	86.3	92.7	96.6	98.9	99.6	99.6	100	--
LA-J-3	1.1	11.2	40.0	68.9	75.7	79.9	87.0	91.9	98.7	99.8	99.8	100	--

RA-J 3	2.2	12.8	47.4	73.0	79.5	82.9	87.2	93.7	98.0	99.6	99.6	100
--												
LA-J-1	1.6	16.9	58.3	78.4	87.4	90.7	94.6	97.1	99.8	99.8	99.8	99.8
100												
RA-J 1	3.0	19.0	59.5	82.3	88.1	91.0	96.7	98.6	100	--	--	--
--												
Imnaha:												
LD-J-1	19.2	47.2	70.7	81.7	87.9	90.3	95.0	96.7	99.4	99.4	99.4	100
--												
RD-J-1	15.6	33.5	73.7	82.8	86.2	89.5	93.7	96.5	99.1	99.6	99.6	100
--												

a Week 1 of the year is 1-7 January and week 52 of the year is 24-31 December.

Weeks 2-51 are 7 day intervals except in leap years when week 9 is 8 days.

Table 28. Release information for cold-branded spring chinook salmon juveniles released in the Grande Ronde and Imnaha river basins, 1988 brood. Standard deviations are shown in parentheses.

Stock, location of release	Date released	Brand replicates	Number released	Na	Mean fork length (mm)	Mean weight (g)	Mean condition factor
Rapid River:							
Lookingglass facility	04/02/90	LA-A-4	20,738	342	124(6.9)	23.7(5.4)	1.15(0.05)
	04/02/90	RA-A-4	20,801	314	124(7.3)	22.0(4.3)	1.14(0.05)
	04/02/90	LA-A-2	20,406	333	145(12.9)	42.9(19.5)	1.20(0.05)
	04/02/90	RA-A-2	20,841	306	144(13.1)	38.6(10.0)	1.24(0.11)
Imnaha:							
Imnaha River facility	03/31/90	LA-A-1	20,815	200	141(9.1)	35.5(6.8)	1.25(0.06)
	03/31/90	RA-A-1	20,170	228	141(8.6)	36.5(6.0)	1.24(0.05)

a Sample size for weight and condition factor is 25 fish.

Table 29. Release information for cold-branded summer steelhead juveniles released in the Grande Ronde and Imnaha river basins, 1989 brood year. Standard deviations are shown in parentheses.

Stock, location of release	Date released	Brand rep-licates	Number released	N	Mean fork length (mm)	Mean weight (g)	Mean condition factor
Wallowa:							
Wallowa Hatchery	04/15-19/90	LD-A-3	24,903	88	196(17.5)	77.4(20.9)	1.00(0.05)
		RD-A-3	25,426	111	208(18.0)	94.9(24.8)	1.04(0.08)
	04/15-19/90	LD-A-1	24,233	98	219(19.4)	105.7(27.2)	1.00(0.09)
		RD-A-1	25,478	102	218(16.9)	110.3(27.3)	1.04(0.06)
Spring Creek[b]	04/19/90	LD-A-2	24,569	308[a]	197(23.8)	96.3(31.4)	1.09(0.07)
		RD-A-2	24,228	308[a]	197(23.8)	96.3(31.4)	1.09(0.07)
Grande Ronde River[d]	04/24-26/90	LD-A-4	24,739	200[c]	191(27.1)	86.1(34.7)	1.12(0.07)
		RD-A-4	22,983	200[c]	193(26.9)	107.7(46.9)	1.12(0.19)
Imnaha:							
Little Sheep Creek	04/16-17/90	LD-J-3	26,522	106	196(19.3)	78.6(21.8)	1.02(0.07)
		RD-J-3	24,500	111	197(20.7)	81.8(27.0)	1.03(0.06)

a Sample size for weight and condition factor is 50 fish.
b Direct stream release group.
c Sample size for weight and condition factor is 25 fish.
d Released at Wildcat Creek.

Table 30. Total catch, escapement and survival of coded-wire-tagged spring chinook salmon released in the Grande Ronde and Imnaha river basins, 1984 and 1985 broods. Recoveries are complete for the 1984 brood year. Total strays includes catch, trap, and escapement recoveries from areas other than river-of-release. Col. River = Columbia River.

Brood year, stock, CWT code	Month of release	Catch Ocean	Catch Col. River	Spawning escapement	Total strays	Hatchery return rate (% of release)	Total survival rate (% of release)
1984:							
Carson:							
07 33 13	Jul	0	0	1	1	<0.01	<0.01
07 33 14	Jul	0	0	3	0	<0.01	<0.01
07 33 57	Sep	0	0	5	0	0.01	0.01
07 33 58	Sep	0	4	9	0	0.02	0.03
07 33 59	Nov	7	2	15	0	0.03	0.05
07 33 60	Nov	0	3	8	0	0.02	0.02
07 33 15	Nova	0	0	2	0	<0.01	<0.01
07 33 16	Apr	5	20	84	3	0.17	0.23
07 33 61	Apr	9	16	29	7	0.06	0.13
07 33 62	Apr	12	5	35	4	0.07	0.11
Lookingglass:							
07 34 01	Apr	0	0	42	3	0.10	0.11
Imnaha:							
07 33 63	Mar	0	42	40	4	0.11	0.22
1985:							
Carson:							
07-39-54	Jul	0	0	0	0	0.00	0.00
07-39-55	Jul	0	0	1	0	<0.01	<0.01
07-38-03	Sep	0	0	3	0	<0.01	<0.01
07-38-04	Sep	0	0	3	0	<0.01	<0.01
07-38-07	Nov	0	0	13	0	0.02	0.02
07-38-08	Nov	1	3	5	0	0.01	0.02
07-38-05	Apr	0	6	56	1	0.10	0.14
07-38-06	Apr	0	9	54	0	0.10	0.12
07-39-56b	Mar	0	7	22	2	0.06	0.08
07-39-57b	Mar	0	9	20	2	0.05	0.08
Rapid River:							
07-38-11	Apr	0	2	21	0	0.04	0.05
07-38-12	Apr	0	0	13	0	0.03	0.03
Imnaha:							

07-38-09	Apr	0	19	44	0	0.08	0.12
07-38-10	Apr	0	24	38	2	0.07	0.12

a Released during ice-up.
b Big Canyon facility release.

Table 31. Recovery information for coded-wire-tagged Wallowa and Imnaha stock summer steelhead, 1986 and 1987 brood years. Recoveries are complete for the 1986 brood year, but include only age 3 recoveries for the 1987 brood year. R1 = replicate one, R2 = replicate two.

Brood year, stock, CWT Code	Size at release (mean fork length mm)	N	Total exploitation rate(%)a	Hatchery return rate (% of release)	Total survival rate (% of release)
1986:					
Wallowa:					
07 40 25b	214(20.0)	166	83.7	0.11	0.65
07 40 26b	214(20.0)	154	75.3	0.14	0.59
07 41 26R1	214(20.0)	324	82.1	0.23	1.30
07 41 26R2	214(20.0)	216	67.6	0.28	0.86
07 41 25R1	231(18.7)	246	81.3	0.19	1.06
07 41 25R2	231(18.7)	237	75.1	0.25	1.02
07 41 28R1c	215(18.6)	167	89.3	0.07	0.67
07 41 28R2c	215(18.6)	144	85.4	0.08	0.57
Imnaha:					
07 41 22R1	201(18.0)	38	65.8	0.05	0.12
07 41 22R2	201(18.0)	55	58.2	0.10	0.23
1987:					
Wallowa:					
07-40-27	210(18.2)	109	78.0	0.09	0.40
07-40-28	210(18.2)	160	81.9	0.11	0.58
07-40-29	216(18.6)	129	73.6	0.12	0.48
07-40-30	216(18.6)	100	76.0	0.09	0.38
07-40-31c	206(18.2)	78	79.5	0.06	0.31
07-40-32c	206(18.2)	80	75.0	0.08	0.31
Imnaha:					
07-40-33	202(19.1)	121	41.3	0.26	0.44
07-40-34	202(19.1)	151	60.3	0.22	0.55

a Exploitation includes all Deschutes River recoveries.
b Progeny from IHNV positive parents.
c Direct stream release group.

Table 31. Continued.

Brood year, stock, Hatchery CWT code	Ocean catch	Columbia River Treaty net	Number of fish observed: Deschutes River Sport	Deschutes River Sport	Deschutes River Trapd	Snake River Sport	Trib-utary Sporte returns
1986:							
Wallowa:							
07 40 25	0	64	38	2	10	14	11 27
07 40 26	0	41	20	5	6	20	24 38f
07 41 26R1	0	153	19	0	2	55	37 58
07 41 26R2	0	100	17	0	5	15	9 70f
07 41 25R1	0	117	17	6	4	13	43 46g
07 41 25R2	0	114	24	0	4	25	11 59
07 41 28R1	0	68	27	0	2	53	0 18f
07 41 28R2	0	67	15	0	3	32	6 21
Imnaha:							
07 41 22R1	0	10	11	0	0	0	4 13
07 41 22R2	0	23	0	3	0	6	0 23
1987:							
Wallowa:							
07 40 27	0	17	0	6	10	42	10 24f
07 40 28	0	7	0	6	6	99h	13 29

07 40 29	0	27	0	0	4	44	20
34g							
07 40 30	0	27	16	6	7	15	5
24							
07 40 31	2	20	0	6	13	22	0
16fg							
07 40 32	0	26	0	3	8	17	6
20							
Imnaha:							
07 40 33	0	23	21	6	0	0	0
71							
07 40 34	2	34	0	9	5	33	8
60							

d Rounde Butte Hatchery and Warm Springs Hatchery recoveries.
e Includes Grande Ronde and Wallowa Rivers for Wallowa stock and Imnaha River for Imnaha stock.
f Includes one fish recovered in the Umatilla River trap.
g Includes one fish recovered in the Little Sheep Creek trap.
h One of the 6 recoveries expanded to 63 fish.

Table 32. Number of adult summer steelhead (1989-90 run year) and spring chinook salmon (1989 run year) originating from Lower Snake River Compensation Plan facility releases in Oregon.

Stock, brood year	Ocean catch	Columbia River Neta	Columbia River Sport	Deschutes Riverb	Tributary sportc	Spawning escapementd	Total recoveries
SUMMER STEELHEAD							
Wallowa:							
1986	0	1,922	680	265	1,886	862	5,615
1987	15	968	124	581	2,271	1,138	5,097
Stock total	15	2,890	804	846	4,157	2,000	10,712
Imnaha:							
1986	0	67	43	12	4	98	224
1987	15	427	138	147	298	953	1,978
Stock total	15	494	181	159	302	1,051	2,202
Species total	30	3,384	985	1,005	4,459	3,051	12,914
SPRING CHINOOK SALMON							
Carson:							
1983	0	4	0	0	--	8	12
1984	0	246	10	0	--	506	762
1985	0	89	3	0	--	495	587
Stock total	0	339	13	0	--	1,009	1,361

Imnaha:							
1984	0	3	0	2	--	6	11
1985	0	0	0	0	--	63	63
Stock total	0	3	0	2	--	69	74
Rapid River:							
1985	0	12	0	0	--	172	184
Species total	0	354	13	2	--	1,250	1,619

a Includes zone 6 tribal harvest for summer steelhead and winter gill net,
Columbia River test fisheries, and ceremonial and subsistence fisheries for spring chinook salmon.
b Includes sport and tribal harvest, as well as recoveries from the Pelton
trap and Warm Springs Hatchery
c Includes sport harvest in the Snake, Grande Ronde, and Wallowa rivers for
Wallowa stock and Snake and Imnaha rivers for Imnaha stock.
d Includes in-basin strays for spring chinook salmon.

Discussion

Fish Culture Monitoring

For 1989 brood Imnaha stock chinook salmon, we took 406,008 green eggs. Egg loss was only 2.9%, the lowest egg loss to date for Imnaha stock chinook salmon. Imnaha stock prespawning mortality was the lowest since the hatchery program began. No loss of females occurred and only 1.6% and 2.5% mortality for wild and hatchery adult males respectively. Holding and spawning adults at Lookingglass Hatchery has reduced egg loss and prespawning mortality substantially. We expect similar levels of prespawning mortality when we hold adults at the new Imnaha River facility, but egg loss will probably increase because eggs will be transported to Lookingglass Hatchery for incubation.

The 116 hatchery jacks trapped at the Imnaha weir in 1989 was the highest number of hatchery jacks that returned since the hatchery program started in 1982. The hatchery return was from a release of 142,320 smolts. The age composition for the 1982-84 brood years of hatchery produced fish was different from that of the wild origin fish (Figure 2). The hatchery fish returned at a younger age compared to wild fish, and most of the hatchery males returned as jacks. The differences in age at return for hatchery and wild fish has been attributed to the large release size of the hatchery smolts. It also may be that the diversified life history strategies of wild smolts (Gaumer 1968) may result in a higher percentage of older age adult returns.

The Imnaha weir was installed on 19 June, one day later than the earliest installation date in the past (18 June, 1987), but the first

fish was not trapped until almost 3 weeks after the weir went in. The run timing curve for Imnaha chinook salmon that returned to the Imnaha River weir in 1989 indicates that we installed the weir before the peak of the run arrived at the weir site. Also, hatchery and wild chinook run timing were more similar to each other than they were in any previous year (Figure 3) even though most hatchery returns were jacks. This similarity was likely a result of better broodstock collection strategies for the 1986 brood year, when we collected adults from earlier in the run than in previous years. We do not know what proportion of the run passed the weir before installation or what percentage of this component of the run was hatchery fish. The electric weir (Smith Root Graduated Field Fish Barrier, part of the permanent Imnaha River facility which was completed in 1990) has not been adequately tested and was not used in 1989. We need to have the ability to trap fish from early in the run in order to attempt to maintain hatchery fish that have the same genotypic variation and life history characteristics as the wild Imnaha chinook salmon. If we continue to remove a large percentage of the later component of the run for hatchery broodstock, we may change the run timing of wild fish. The earlier brood years of hatchery fish produced few adults, but the numbers of hatchery adults and the percentage of hatchery fish in the run are increasing annually. The risk of altering the wild run will increase with increasing hatchery returns if proper broodstock collection strategies are not employed.

Figure 2. Age composition of Imnaha stock spring chinook salmon, 1982-84 brood years. Samples are from fish trapped at the Imnaha River weir.

Figure 3. Run timing of Imnaha stock chinook salmon at the Imnaha River weir for the 1988 and 1989 run years.

Rapid River stock age 4 returns provided 333,570 eggs for Lookingglass Hatchery. This egg take was only 22.2% of our goal of 1.5 million eggs for the Grande Ronde Basin program. We were unable to obtain Rapid River stock chinook salmon eggs from Idaho in 1989, and therefore we could not meet smolt production goals. We will continue to need Rapid River stock eggs from Idaho until 1992 in order to meet chinook smolt production goals and develop a hatchery broodstock for the Grande Ronde Basin.

Two left-ventral fin marked Carson stock chinook salmon jacks returned to Lookingglass hatchery in 1989. These stray jacks were from the 1986 brood smolts released into Catherine Creek or the Big Canyon facility. The stray jacks were probably from the Catherine Creek releases because these fish were not acclimated and returning fish must swim past the mouth of Lookingglass Creek to return to Catherine Creek. Big Canyon facility releases are acclimated and returning adults do not pass by Lookingglass Creek. Previous releases into Catherine Creek are likely to have strayed into Lookingglass Hatchery, however these fish were the first Catherine Creek releases that were marked.

Lookingglass Hatchery produced 51,196 lbs of 1988 brood Rapid River stock smolts, exceeding the mitigation goal of 45,000 lbs for the Grande Ronde Basin. The hatchery also produced 26,695 lbs of Imnaha stock chinook salmon smolts, exceeding the mitigation goal of 24,500 lbs for the Imnaha Basin. This was the first year release goals (in pounds) have been achieved for Rapid River and Imnaha stock chinook salmon.

In 1989, Lookingglass Hatchery returns of Carson stock spring chinook salmon adults not used for broodstock were outplanted into the

Wallowa River and Catherine Creek to enhance natural production. Based on recovery of disk tagged adults, we accounted for only 39.7% of the outplanted fish. The fish were outplanted in mid June as they arrived at Lookingglass hatchery because no adult holding ponds were available to hold fish until they were nearer to spawning. The early outplanting resulted in a return of 31.4% of the outplanted fish back to Lookingglass Hatchery. This return rate was higher than observed in 1988 (13.5%) for fish outplanted in June into Catherine Creek and the upper Grande Ronde River. Disk tagged fish also strayed into the Minam and Lostine Rivers. Fish outplanted later in summer have not been observed in these streams because of thermal barriers and low flows present in late summer.

We were slightly below the program goal of 1.35 million smolts (1989 brood year) for the Wallowa stock steelhead program. We released 1,263,062 smolts of Wallowa stock and 30,412 smolts of Imnaha stock into the Grande Ronde River Basin in 1990. No Imnaha stock smolts were released from broodstock collection facilities in the Grande Ronde Basin and therefore they will not be incorporated into the Wallowa broodstock when they return as adults. Imnaha stock summer steelhead adults may reproduce naturally in the Grande Ronde basin, but we do not know the potential impact to native populations of summer steelhead. Releases of Imnaha smolts into the lower Grande Ronde River and Catherine Creek will probably result in returns of some adults to the Grande Ronde Basin later in the spring because Imnaha stock steelhead have a later run timing than Wallowa stock steelhead. A total of 9,025 Wallowa stock presmolts were released into the Snake River.

We achieved the smolt production goal of 330,000 smolts in 1990 by releasing 331,465 smolts from the 1989 brood into the Imnaha Basin. We released 41,404 of these smolts into the lower Imnaha River (at Cow Creek) to increase sport harvest opportunities. A total of 18,893 Imnaha stock were graded off as presmolts and released into the Snake River.

The tributary sport harvest of Wallowa stock summer steelhead has increased every year since the 1986-1987 run year (Carmichael et al. 1990). We estimated that 52% of the hatchery run escaping into the Oregon section of the Grande Ronde River was harvested in sport fisheries. The hatchery run estimate is based on the Oregon sport catch (Grande Ronde and Wallowa rivers) plus hatchery escapement. The majority of the harvest occurred in the spring of 1990 in the Wallowa River (Carmichael et al. 1990). These high harvest rates could affect run timing of fish to Wallowa Hatchery and therefore affect broodstock selection. Figure 4 compares the run timing of Wallowa stock summer steelhead returning to Wallowa Hatchery at three levels of sport harvest. A trend appears in which heavily exploited runs return in a relatively short time, peak early in the run timing, and consist of relatively few early and late run fish. This trend may have resulted from harvest of the early and later portion of the run at a rate higher than that of the harvest of the central proportion. If we do not incorporate adequate numbers of both early and late run fish into the Wallowa broodstock, the run timing of Wallowa stock steelhead may become compressed. This will result in fewer fish from the early and late segments of the run being available for sport harvest and broodstock.

The large return of hatchery steelhead to Little Sheep Creek in 1990 provided ample adult broodstock. We exceeded goals for the egg take and the adult escapement above the weir. Hatchery returns were predominantly age 3 fish from the 1987 brood year. The wild component of the Little Sheep Creek run was low, primarily because we removed a large portion of the wild fish for hatchery broodstock in past years. Only 10% of the fish spawned for hatchery broodstock were of wild origin and only 3% of the fish released above the weir were wild. It is important to continue incorporating wild fish into hatchery broodstock to maintain genotypic variation and life history characteristics of the hatchery fish similar to the wild population. We will try to incorporate more wild fish into the broodstock in the future but opportunities to do so will be limited unless the numbers of wild adults increase.

A study of egg incubation mortality of Wallowa stock summer steelhead was conducted in 1990 to determine the causes of high egg mortality in Wallowa stock summer steelhead eggs incubated at Wallowa Hatchery and to attempt to correct the problem. Study methods and results are reported in Walters et al. (1990). The study showed no difference in incubation mortality among the treatment and control groups, however, there was high variation in egg mortality of individual females within test groups. In general, better care was taken in the handling of adults used for broodstock in 1990 because of the study. Females were spawned as early as possible instead of being held until they were overripe. Egg loss appears to be minimized by employing good adult broodstock handling procedures and by spawning females as soon as possible.

Figure 4. Run timing of Wallowa stock summer steelhead to Wallowa Hatchery during three different time periods. Levels of tributary (Grande Ronde and Wallowa Rivers) sport harvest varied during these periods. Harvest rate was <5% from 1984-86, 26% from 1987-89, and 52% for 1990.

Survival Studies

The second brood year (1987 brood) of cold branded Rapid River stock spring chinook salmon was released from Lookingglass Hatchery in 1989 for evaluation of their outmigration performance and survival. The passage index (percentage of the brand release group estimated to have gone through the juvenile bypass system at Lower Granite Dam) for yearling spring chinook smolts released at 22.4 grams/fish in the spring was 34 times greater than the index for fish released at 29.0 grams/fish in the fall. Few fish from the fall release group were recovered and the groups differed widely with regard to numbers and times when they were recovered (Table 26). The passage index for yearling smolts released in the spring at an average weight of 22.4 grams/fish was 24% greater than smolts released at an average weight of 33.9 grams/fish (Table 26). The passage index in 1989 was only 39% of the passage index in 1988 for Rapid River yearling smolt releases, but 25% greater for subyearling smolts. The subyearling smolts did not migrate as quickly after release as yearling smolts and migrated past Lower Granite Dam up to 8 weeks later. Over 60% of the yearling smolts which were recovered at Lower Granite Dam were observed two weeks after release, but 60% of the recoveries of subyearling smolts were not observed until five weeks after release. The subyearling smolt passage index in 1989 was the highest observed to date.

The third brood year (1987 brood) of cold branded Imnaha chinook salmon smolts was released in the Imnaha River in 1989. The passage index at Lower Granite Dam was similar to the passage index of Rapid River stock smolts released at Lookingglass Hatchery at the same time. The passage index at Lower Granite Dam in 1989 was two-fold lower than the passage index for the 1986 brood released in 1988. For the 1987 and 1988 migration year, Imnaha chinook smolts tended to migrate past Lower Granite Dam up to two weeks later than Rapid River stock chinook smolts released from Lookingglass Hatchery.

The release of AdLV+CWT marked 1989 brood summer steelhead smolts at Wallowa Hatchery represented the fourth year of releases comparing acclimated and direct stream releases and the fifth year comparing size-at-release groups. The mean weights of summer steelhead release groups used in size-at-release release comparisons were closer to the target size than in the previous year. The average weight of fish targeted for release at 113 grams/fish (4 fish/lb) was 105 fish/gram (4.2 fish/lb), and the average weight of fish targeted for release at 91 grams/fish (5 fish/lb) was 87 grams/fish (5.2 fish/lb). The direct stream release group targeted for 91 grams/fish (5 fish/lb) averaged 96 grams/fish (4.7 fish/lb).

The passage indexes at Lower Granite Dam for cold branded 1988 brood summer steelhead smolts released at Wallowa Hatchery and at the Little Sheep Creek facility in spring of 1989 were higher than the passage indexes of the 1987 brood released in 1988. The average passage index for Wallowa stock steelhead smolts acclimated and released at Wallowa Hatchery in 1988 was only 78% of the passage index for acclimated smolts released in 1989. The average passage index for Imnaha stock steelhead smolts released in 1989 (1988 brood year) was 8.4%, compared to only 2.9% for 1987 brood released in 1988 (Table 27).

Returns are complete for the 1986 brood Wallowa stock summer steelhead released for size-at-release comparisons. The fish released at an average weight of 124.5 grams/fish survived at a similar rate as the fish released at an average weight of 96.9 grams/fish (Table 31). Total survival (catch and escapement) of the 1986 brood released at 4 fish/lb was lower than the 1985 brood year 4 fish/lb release group, but the 1986 and 1985 broods released at 5 fish/lb had similar survival rates. The 4 fish/lb release group survived at 1.94% for the 1985 brood and 1.04% for the 1986 brood. The 5 fish/lb release groups survived at 1.06% for the 1985 brood and 1.08% for the 1986 brood. The 1986 brood Wallowa stock direct stream release group survived at 0.62% compared to the acclimated release at 1.08%. There appears to be substantial increases in smolt-to-adult survival from acclimating smolts at Wallowa Hatchery, even though acclimation conditions at Wallowa Hatchery are less than ideal because of periodic episodes of poor water quality. Acclimation studies will be initiated at the Little Sheep Creek facility and the Big Canyon facility starting with the 1991 releases.

Large numbers of residual summer steelhead residuals were caught in trout fisheries on the Wallowa River and lower Grande Ronde River from late May until the end of October. Residual smolts migrating the following year composed 3% of the adult returns of the 4 fish/lb releases and 2% of the adult returns of the 5 fish/lb releases. We do not know how many smolts 1986 brood smolts did not migrate to the ocean after release, which release groups they were from, or what the smolt-to-adult survival rate was for the residual smolts. No estimates were made of seasonal abundance or distribution of residual smolts in the Grande Ronde basin. In some years large numbers of summer steelhead smolts do residualize and may affect native fish populations in the basin. Further

investigation is needed to evaluate residualism rates and effects on native fish.

Returns are complete for the 1986 brood Imnaha summer steelhead. Total survival (catch and escapement) was only 0.2% compared to 0.8% for the 1985 brood year. Residual smolts migrating to the ocean in 1987 made up 38% of the adult returns from the 1986 brood year. The smolt passage index at Lower Granite Dam for branded 1986 brood Imnaha summer steelhead (1987 migration year) was only 0.1%.

The exploitation rates (not corrected for unaccountable losses) averaged 80% for 1986 brood Wallowa stock steelhead returning in the 1988-89 and 1989-90 run years. Wallowa stock steelhead are harvested in many fisheries throughout the Columbia River basin. An estimated 44% of the CWT recoveries of 1986 brood Wallowa stock summer steelhead occurred in the Zone 6 fishery. The exploitation rate of the 1986 Imnaha stock summer steelhead was 56%, and most of the harvest (58%) occurred in the Zone 6 fishery. The overall exploitation rate was lower for Imnaha stock primarily because of lower tributary sport harvest (Table 31). Exploitation rates of Wallowa and Imnaha steelhead, are substantially greater than rates estimated for the group A run as a whole. This is most likely attributable to unaccounted adult losses of coded-wire-tagged Imnaha and Wallowa stock adults. Further investigation is needed to determine causes, location, and magnitude of adult losses.

We compared ratios of juvenile migration success (based on percentage recovery of branded fish at Lower Granite Dam) with ratios of total adult survival (catch plus escapement) for the 1986 brood Wallowa stock summer steelhead that were released for size at release comparisons. The migration success of the larger smolts was 5.5 times higher than the smaller smolts, however the smolt-to-adult survival was similar for these release groups. Passage indexes for the 1986 brood year migrating in 1987 were very poor and may have been the result of lower than average peak flows in the Grande Ronde and Snake rivers during migration.

Spring chinook adult returns to the LSRCP compensation area in 1989 were only 18.5% of the mitigation goal of 5,820 adults for the Grande Ronde Basin (Table 32). We estimated that only 69 hatchery Imnaha chinook salmon adults returned to the LSRCP compensation area in 1989, which represented only 2.1% of Oregon's mitigation goal of 3,210 chinook for the Imnaha Basin (Table 32). Adults that returned in the 1989 run year were from releases of the 1984 and 1985 broods which were only 7.2% and 25.2% respectively of the annual mitigation goal of 490,000 smolts.

We estimated that 6,157 Wallowa stock summer steelhead returned to the LSRCP compensation area in the 1989-90 run year, which was 67% of the mitigation goal of 9,184 adults for the Grande Ronde Basin (Table 32). Smolt releases that produced the 1989-90 run were 100% of the mitigation goal for the 1986 and 1987 brood years. A total of 1,353 hatchery stock Imnaha summer steelhead returned to the LSRCP compensation area in the 1989-90 run year, which represented 68% of the mitigation goal of 2,000 steelhead for the Imnaha Basin (Table 32). Smolt releases that produced adults in the 1989-90 run year were 28.4% and 100% of the mitigation goal

of 330,000 smolts for the Imnaha Basin for the 1986 and 1987 brood years, respectively.

Natural Escapement Monitoring

We recovered and examined only 12% of the estimated adult spring chinook salmon spawning population in the Minam River and 9% in the Wenaha River. These recovery rates were the lowest on northeast Oregon spring chinook spawning ground surveys in 1989. Fewer surveys were conducted on these streams because their locations are in wilderness areas that have limited access. Also, removal of carcasses by bears and other scavengers reduced the recovery rate. The one disk tagged hatchery stray, observed on the Minam River surveys, expanded to 6 hatchery strays which was estimated to be 6.6% of the spawning population.

Discriminant scale analysis models are being developed to identify unmarked hatchery fish so that we can determine the number of hatchery strays in the Minam, Lostine, and Imnaha rivers. These models will help determine the level of straying in the Imnaha and Grande Ronde river basins.

Disease Investigation

In November of 1987, erythrocytic inclusion body syndrome (EIBS) was detected in the 1986 brood Imnaha chinook salmon juveniles at Lookingglass Hatchery. In an attempt to reduce the incidence of EIBS prior to release as well as to determine if incubation and rearing strategies affected the incidence of EIBS, we developed alternate incubation and rearing strategies for the 1988 brood Imnaha chinook salmon (Messmer et al. 1989). No EIBS has been detected in any of the 1988 brood chinook salmon at Lookingglass Hatchery (Christianson et al. 1990). We plan to continue this incubation and rearing experiment with the 1989 brood.

Returns are complete for the 1986 brood Wallowa stock summer steelhead release group which were progeny of IHNV positive parents. No IHNV was detected in any of the adult returns sampled at Wallowa Hatchery in the 1988-89 and 1989-90 run years.

EVALUATION OF THE BENEFITS PROVIDED BY RELEASING SPRING CHINOOK SALMON PRESMOLTS IN THE GRANDE RONDE RIVER AND ITS TRIBUTARIES

Introduction

Surplus chinook salmon eggs are taken each year, if available, to assure that smolt production goals are achieved at Lookingglass Hatchery. The surplus is used to cover loss and unexpected mortality. In most years the surplus will produce 500,000-700,000 fish in excess of the rearing capacity at Lookingglass Hatchery. Now that we are switching broodstock from Carson stock to Rapid River stock, we request eggs from

Idaho to meet production goals for the Grande Ronde Basin. Additional surpluses of Carson stock spring chinook will be available during the stock transition.

Presmolt studies began to determine if presmolts can be effectively used to return adults to compensation areas. Presmolt releases would help maximize numbers of returning adults with facilities and fish that are available. Surplus Carson stock chinook were released as presmolts from 1984 through 1987. In 1984 we released presmolts into Catherine Creek, the upper Grande Ronde River, and Lookingglass Creek. In 1985, 1986, and 1987 presmolts were released only into Lookingglass Creek. We marked (Ad+CWT) presmolts each year to estimate survival rates and adult catch and escapement.

The objectives and tasks are described in the summary section of this report and in the five-year study plan (Carmichael 1989).

Methods

Methods are described in the LSRCP annual reports (Carmichael and Messmer 1985, Carmichael et al. 1986a, 1987, 1988a).

Results and Discussion

Catch and escapement recoveries are complete for the 1984 brood presmolts released at Lookingglass Creek in July of 1985. Total survival (catch plus escapement) for this release group was less than 0.01%. The low survival rates and the potential competition with wild chinook stocks suggests that presmolt releases are ineffective as a release strategy at this time. More information will become available on the success of presmolt releases when returns of the 1985-1987 brood years are complete.

EVALUATION OF THE BENEFITS PROVIDED BY REPROGRAMMING SPRING CHINOOK SALMON SMOLTS FROM LOWER COLUMBIA RIVER HATCHERIES

Introduction

In 1984 plans were developed to reprogram lower Columbia River hatcheries to produce spring chinook salmon smolts for release in upriver areas. The plan was never fully implemented. Few chinook salmon smolts were reared at lower Columbia River hatcheries and released in upriver areas. In Oregon, Carson stock spring chinook salmon of the 1983, 1984, and 1985 broods were reared at Bonneville and Oxbow hatcheries and were released in the Grande Ronde basin. This program was discontinued after the 1985 brood, and there are no immediate plans to begin the program again. New hatchery facilities, in addition to LSRCP hatcheries, may be constructed in the future to provide additional chinook salmon production for northeast Oregon streams.

We are evaluating the contribution of smolts that were reprogrammed to LSRCP areas to determine the effectiveness of releasing smolts from

lower river hatcheries into upriver areas. The objectives of this study are described in the five-year study plan (Carmichael 1989).

Methods

Methods are described in the LSRCP annual reports (Carmichael and Messmer 1985, Carmichael et al. 1986a, 1987, 1988a). Coded-wire tags were recovered and decoded from all marked adults that were recovered at adult collection sites and on the spawning grounds.

Results and Discussion

Adult returns are complete for the 1984 brood releases. The 1984 brood released in the spring of 1986 from Lookingglass survived at 0.23%, one of the highest survivals for Lookingglass Hatchery. Fish released in November 1985 during the ice-up at Lookingglass Hatchery survived at less than 0.01%. We recovered three age 4 strays from the spring release group in the Wenaha River in 1988. These recoveries represented 3.5% of the adult escapement for the 1984 CWT groups. This stray rate is of concern, especially when natural escapements are at such very low levels. Reprogramming spring chinook salmon smolts from Lower Columbia River hatcheries has showed limited success. Return rates and total survival of the 1984 brood releases were among the highest of any release group at Lookingglass Hatchery, but were still poor. Future work on this project will involve recovering marked adults and summarizing catch and escapement information.

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