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PROJECT TITLE: Evaluation of Lower Snake River Compensation Plan Facilities in Oregon

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

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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 location of releases 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 that return 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 1989 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 1990 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 and acclimation evaluation.

8. Mark (AdLV+CWT), cold brand, and release the following groups of 1990 brood summer steelhead: Wallowa stock for size-at-release comparisons, production survival estimates, and acclimation evaluation (at Big Canyon facility); and Imnaha stock for production survival estimates and acclimation evaluation.

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 activities associated with anadromous fish production and management 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 total number of summer steelhead adults in the 1990-91 run year and spring chinook salmon adults in the 1990 and 1991 runs that resulted from smolts produced at Oregon's LSRCP facilities.

Accomplishments in FY 1991

We accomplished all of our original objectives in FY 1991.

Findings in FY 1991

Fish Culture Monitoring

In 1990, a total of 138 Carson stock, 490 Rapid River stock and 6 Imnaha stock (age 5) spring chinook salmon returned to Lookingglass Hatchery. Forty of the 138 Carson stock returns to Lookingglass Hatchery were left ventral fin marked strays from direct stream smolt releases into Catherine Creek or from Big Canyon facility releases. A total of 30 Rapid River stock spring chinook were trapped at Hell's Canyon Dam and hauled to Lookingglass hatchery for broodstock in 1990. A total of 210 Carson stock chinook salmon returned to the Big Canyon facility in 1990. We trapped 404 chinook salmon at the Imnaha River weir of which 221 were hatchery fish.

In 1991, a total of 72 Carson stock and 364 Rapid River stock spring chinook salmon returned to Lookingglass Hatchery. All of the Carson stock returns to Lookingglass Hatchery were left ventral fin marked strays from direct stream smolt releases into Catherine Creek or from Big Canyon facility releases. A total of 62 Rapid River stock spring chinook were trapped at Hell's Canyon Dam and hauled to Lookingglass hatchery for broodstock in 1991. A total of 35 Carson stock and 3 Rapid River stock jack chinook salmon returned to the Big Canyon facility in 1991. We trapped 505 chinook salmon at the Imnaha River weir of which 282 were hatchery fish. Jack returns to the Imnaha weir totalled 240 of which 138 were marked hatchery fish and 102 were unmarked fish. We estimated that 92 of the 102 unmarrked jacks were of hatchery origin.

A total of 478 summer steelhead adults returned to Wallowa Hatchery in 1991. Wallowa stock adults were also trapped at the Washington Department of Wildlife's Cottonwood facility on the lower Grande Ronde River. A total of 491 fish were collected and hauled to Wallowa Hatchery for spawning. We trapped 29 wild and 366 hatchery steelhead adults at the Little Sheep Creek facility in 1991. At the Big Canyon Creek facility we trapped 21 wild and 407 hatchery steelhead adults. Prespawning mortality of Wallowa stock summer steelhead at Wallowa Hatchery was 4.0% for females and 5.1% for males. Egg loss was 12.5% for Wallowa stock eggs collected from returns to Wallowa Hatchery and the Big Canyon Facility.

Survival Studies

Smolt-to-adult survival rate (catch plus escapement) for coded-wire-tagged Wallowa stock summer steelhead smolts of the 1987 brood that were acclimated and released at Wallowa Hatchery at an average weight of 104.8 grams/fish (4 fish/lb release group) and 96.6 grams/fish (5 fish/lb release group) was 0.72% and 0.74% respectively. The smolt-to-adult survival rate for 1987 Wallowa stock steelhead released directly into Spring Creek at Wallowa Hatchery was 0.53%. The hatchery return rates (percent of total recoveries which were recovered at Wallowa Hatchery) for 1987 brood Wallowa stock steelhead acclimated and released at Wallowa Hatchery was 0.15% compared to 0.11% for direct stream release groups. The survival rate for 1987 brood Imnaha stock summer steelhead was 0.56% with a hatchery return rate of 0.24%..

Smolt-to-adult survival rate (catch plus escapement) for coded-wire-tagged Carson stock chinook salmon of the 1985 brood that were released from Lookingglass Hatchery was <0.01%, 0.01% and 0.03% for fish released in July, September, and November of 1986 respectively. Carson stock chinook salmon released from the Big Canyon Facility at 45.3 grams/fish in April of 1987 survived at 0.10%. Carson stock chinook salmon released from Lookingglass Hatchery in April of 1987 at an average weight of 25.4 grams/fish survived at 0.17%. Rapid River stock (1985 brood) spring chinook salmon released from Lookingglass Hatchery in April of 1987 at 47.0 grams/fish survived at 0.04%. The survival rate for 1985 brood Imnaha chinook salmon was 0.12% for fish released in April of 1987 at an average weight of 53.8 grams/fish.

Smolt-to-adult survival rate (catch plus escapement) for coded-wire-tagged 1986 brood Carson stock chinook salmon released from Lookingglass Hatchery in July of 1987 at an average weight of 8.2 grams/fish was <0.01%. Rapid River stock (1986 brood) spring chinook salmon released from Lookingglass Hatchery in April of 1988 at 23.0 grams/fish survived at 0.27% and fish released at 42.3 grams/fish survived at 0.12%. The survival rate for 1986 brood Imnaha chinook salmon was 0.19% and 0.13% for fish released in March and April of 1988 respectively.

The smolt passage index at Lower Granite Dam for 1988 brood Rapid River stock spring chinook salmon released at Lookingglass Hatchery in the spring of 1990 at an average weight of 40.7 grams/fish and 22.8 grams/fish was 21.7% and 20.3% respectively. The smolt passage index for 1988 brood Imnaha chinook salmon smolts released in the spring of 1990 was 19.9%. Passage indices were higher in 1990 than in 1989 for all groups of chinook.

The smolt passage index at Lower Granite Dam for 1989 brood Rapid River stock spring chinook salmon released at Lookingglass Hatchery in the spring of 1991 at an average weight of 39.6 grams/fish and 23.2 grams/fish was 32.9% and 30.0% respectively. The smolt passage index for 1989 brood Imnaha chinook salmon smolts released in the spring of 1991 at 20.5 grams/fish was 22.6% and for fish released at 28.9 grams/fish was 22.6%. Passage indices were higher in 1991 than in 1990 for all groups of chinook.

The smolt passage index at Lower Granite Dam for 1989 brood Wallowa stock summer steelhead released directly into Spring Creek at Wallowa Hatchery was 22.5% while the passage index for groups of Wallowa stock summer steelhead acclimated and released at Wallowa Hatchery was 30.1% and 24.0% for fish released at 108.0 and 86.2 grams/fish respectively. The smolt passage index for Wallowa Stock steelhead released on the lower Grande Ronde River (at Wildcat Creek) was 26.3%. The smolt passage index at Lower Granite Dam for 1989 brood Imnaha stock summer steelhead was 9.1%.

The smolt passage index at Lower Granite Dam in 1991 for 1990 brood Wallowa stock summer steelhead acclimated and released at Wallowa Hatchery was 44.0% and 44.2% for fish released at 116.6 and 101.0 grams/fish respectively. The smolt passage index at Lower Granite Dam

for 1990 brood Wallowa stock summer steelhead released directly into Deer Creek at the Big Canyon Facility was 39.5% while the passage index for groups of Wallowa stock summer steelhead acclimated at the Big Canyon Facility was 53.2%. The smolt passage index for Wallowa Stock steelhead released on the lower Grande Ronde River (at Wildcat Creek) was 45.1%. The smolt passage index at Lower Granite Dam for 1990 brood Imnaha stock summer steelhead was 40.0% for fish released directly into Little Sheep Creek and 45.7% for acclimated fish. The 1990 brood summer steelhead passage indices at Lower Granite Dam in 1991 were 1.8, 4.4, and 1.5 times greater than 1990 passage indices for Wallowa acclimated releases, Little Sheep Creek acclimated releases, and Wildcat releases respectively. The passage indices for the Little Sheep Creek releases were the highest observed to date. The arrival timing of Little Sheep Creek summer steelhead smolts at Lower Granite Dam for the 1990 brood fish was two weeks later than for the 1989 brood.

Natural Escapement Monitoring

In 1990 there were 4 recoveries of left ventral fin marked spring chinook salmon on spawning ground surveys in the Minam River and one left ventral fin marked spring chinook was recovered in Hurricane Creek. One marked (Ad+CWT) Carson stock adult was recovered on the Lostine River. This fish was from the 1985 brood Carson stock released at the Big Canyon facility in 1987. No marked hatchery fish were recovered on the Wenaha River spawning ground surveys in 1990.

In 1991 there was a recovery of one left-ventral fin marked and one right ventral fin marked spring chinook salmon on spawning ground surveys in the Minam River. Five left ventral fin marked spring chinook was recovered on the Lostine River. Left ventral fin marked strays were from direct stream smolt releases into Catherine Creek or from Big Canyon facility releases and right-ventral fin marked fish are from releases of Rapid River stock chinook at Lookingglass Hatchery. No marked hatchery fish were recovered on the Wenaha River spawning ground surveys in 1991.

Disease Investigation

Infectious hematopoietic necrosis virus (IHNV) was not detected in any of the Rapid River or Imnaha stock chinook salmon adults spawned at Lookingglass Hatchery and at the Imnaha facility respectively in 1990. IHNV was not detected in any of the Rapid River stock adults spawned at Lookingglass Hatchery in 1991, and was detected at a 1.3% prevalence rate in Imnaha stock adults spawned at the Imnaha facility. No erythrocytic inclusion body syndrome (EIBS) was detected in any 1989 brood Imnaha or Rapid River stock chinook at Lookingglass Hatchery, but was detected at a 2.1% prevalence rate for 1989 brood Carson stock chinook.

IHNV was detected at a 1.7% prevalence rate in Wallowa stock steelhead spawned at Wallowa Hatchery and the Big Canyon facility and no IHNV was detected in Imnaha stock steelhead spawned at the Little Sheep Creek facility in 1991.

Management Implications

1. Adult returns from releases of spring chinook smolts in Catherine Creek and at the Big Canyon facility have strayed to Lookingglass Hatchery and have been recovered on spawning ground surveys on the Minam and Lostine Rivers.
2. Jack returns to the Imnaha weir in 1991 indicate that adult returns in 1992 will be predominantly marked and unmarked hatchery origin fish. Surplus hatchery adults may result if the wild component of the run is low because the number of hatchery fish can be released above the weir to spawn and retained for broodstock is dependent on the number of wild adults.
3. Acclimation release groups of summer steelhead smolts at Wallowa Hatchery have increased smolt-to-adult survival rates compared to direct stream releases. Hatchery return rates are also higher for acclimated release groups.

Recommendations

1. Spring chinook smolt releases into Catherine Creek should be uniquely marked in order to identify adult returns and to distinguish strays at Lookingglass Hatchery and on spawning ground surveys. Releases of spring chinook salmon have been discontinued at the Big Canyon facility.
2. The feasibility of developing spring chinook acclimation facilities on Catherine Creek should be investigated in order to reduce stray rates of chinook smolt releases.
3. Broodstock collection strategies should be developed which can deal with surplus hatchery origin chinook at the Imnaha weir.
4. Acclimation facilities should be developed for the Grande Ronde River and Catherine Creek in order to increase smolt-to-adult survival rates.

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

Objectives for FY 1991

Recover and decode coded-wire-tags from adults of the 1985-1986 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 1991

The objectives were accomplished. Adult returns from presmolt releases at Lookingglass Hatchery are complete with the 1991 returns.

Management Implications and Recommendations

Presmolt releases in the Grande Ronde River basin have not shown to be successful and therefore, any proposed releases should be carefully considered because of potential negative impacts to wild spring chinook populations in the basin.

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).

Two projects were conducted under LSRCP Oregon Evaluation Studies during this report period: (1) evaluation of Lower Snake River Compensation Plan facilities in Oregon; (2) evaluation of the benefits provided by releasing spring chinook salmon presmolt in the Grande Ronde River and its tributaries. 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 under all projects for the period 1 July 1990 to 31 December 1991. Future annual reports will cover activities for the period 1 January to 31 December. 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, 1990).

EVALUATION OF LOWER SNAKE RIVER COMPENSATION PLAN FACILITIES IN OREGON

Introduction

The evaluation of LSRCP facilities in Oregon began in the fall of 1983. Work conducted during 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. Work conducted under fish culture monitoring, survival studies, and creel surveys was a continuation of ongoing studies. We began comprehensive spring chinook spawning ground surveys 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. (1991).

Methods

Fish Culture Monitoring

Methods are described in the 1985-1990 annual reports (Carmichael and Messmer 1985; Carmichael et al. 1986a, 1987, 1988a; Messmer et al. 1989, 1990) and in the five-year study plan (Carmichael 1989). Pathological examinations were conducted by ODFW pathology staff and methods are reported in (Berry et al. 1991).

Estimates of the number of fish which passed the weir site before the weir was installed in 1990 and 1991 were made using a modified Peterson estimate (Ricker 1975). All fish released above the weir were marked with opercle punches. Carcasses were subsequently recovered on extensive and multiple spawning ground surveys that were conducted on 24, 31 August and 10 September, 1990 and 30 August, 6 and 16 September, 1991. Extensive surveys covered the lower 2.5 miles of the South Fork Imnaha River and the mainstem of the Imnaha river from the forks to the Imnaha Weir. Multiple surveys covered the area from Indian Crossing to Mac's Mine. In addition to spawning ground surveys, carcasses recovered on the Imnaha facility weir were examined for opercle punches.

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, 1990).

Natural Escapement Monitoring

Methods are described in the 1985-1990 annual reports (Carmichael and Messmer 1985; Carmichael et al. 1986a, 1987, 1988a, Messmer et al. 1989, 1990). Methods used for estimating straying chinook salmon levels were estimated using methods described in Messmer et al. (1989, 1990). 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 1990 and from 27 to 29 August and 09 September 1991, and on the Wenaha River from 3 to 5 September 1990 and from 2 to 4 September 1991. 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 involved with developing a habitat recovery plan for the Upper Grande Ronde River Watershed. (Rich update, ESA, NEOH, WEIRS)

Disease Investigations

Methods are described in 1987 and 1988 annual report (Carmichael et al. 1987, 1988a) and in ODFW pathology reports (Berry et al. 1991).

Results

Fish Culture Monitoring

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

Tim Whitesel will provide a description of bimodal length frequencies of Rapid River and Imnaha CHS release groups, Figures 1 and 2.

Survival Studies

Results related to survival studies of spring chinook salmon and summer steelhead appear in Tables 22-32. Results of summer steelhead creel surveys conducted on the Grande Ronde, Wallowa, and Imnaha rivers for the 1990-91 run year are presented in Carmichael et al. (1991).

Natural Escapement Monitoring

Four left ventral fin marked (age 4 Carson stock) spring chinook salmon were recovered in the Minam River in 1990. These fish were from direct stream smolt releases into Catherine Creek or from smolt releases at the Big Canyon facility. We examined 19 adult carcasses for marks which was estimated to be 12% of the spawning population. The four left ventral fin marked fish recovered on the Minam River surveys were estimated to be 21% of the spawning population.

No marked fish were recovered on the Wenaha River in 1990. We examined 12 adult carcasses for marks which was estimated to be only 6% of the spawning population.

The one marked fish (CWT 07-39-56, 1985 brood Carson stock spring release from the Big Canyon facility) was recovered on the Lostine River in 1990 expanded to 4 adults which was estimated to be 6% of the spawning population. We examined 15 adult carcasses for marks which was estimated to be 23% of the spawning population.

One left ventral (age 4 Carson stock) and one right-ventral (age 4 Rapid River stock) fin marked spring chinook salmon were recovered in the Minam River in 1991. The left ventral fin marked fish was from the direct stream smolt release into Catherine Creek or from smolt releases at the Big Canyon facility. The right ventral fin marked fish was from Rapid River stock releases at Lookingglass Hatchery. We examined 13 adult carcasses for marks which was estimated to be 10.8% of the spawning population. The two ventral fin marked fish recovered on the Minam River surveys were estimated to be 15.4% of the spawning population.

No marked fish were recovered on the Wenaha River in 1991. We examined 18 adult carcasses for marks which was estimated to be only 12.1% of the spawning population.

The 5 left ventral fin marked fish recovered on the Lostine River in 1991 was estimated to be 20.0% of the spawning population. We examined 25 adult carcasses for marks which was estimated to be 37.3% of the spawning population.

Planning

Drafts of the Grande Ronde and Imnaha river subbasin plans are in progress and when completed, will be 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 (Berry et al. 1991).

Table 1. Egg take and survival of spring chinook salmon at Lookingglass and Irrigon hatcheries, 1989, 1990 and 1991 broods.

Stock, brood year	Number of eggs taken or received	Egg loss (%)	Egg-to-fry survival (%)	Egg-to-smolt survival (%)
Imnaha:				
1989a	406,008	2.5	96.1	96.1b
1990	326,612	16.5	82.8	80.4

1991	193,206	14.4	84.1	C
Rapid River:				
1989	333,570	2.3	97.3	97.3b
1990	1,048,235d	2.5	96.8	90.7
1991	515,951	3.2	96.2e	c

- a Most fish held and spawned at Lookingglass Hatchery.
 b Egg-to-smolt survival based on coded-wire-tagging numbers and pond mortality after tagging.
 c 1991 brood smolts will be released in the spring of 1993.
 d Egg take includes 184,387 eggs received from Rapid River Hatchery.
 e Estimate does not include 26,694 eyed eggs shipped to Rapid River Hatchery.

Table 1b. Results of fecundity sampling of Imnaha stock chinook salmon, 1988 and 1991 brood years. Standard deviation is shown in parentheses.

Brood year, Origin	n	Age 4 Mean	Range	n	Age 5 Mean	Range
1988						
Wild	3	3,894 (286)	3,567-4,101	25	6,432 (889)	5,017-8,434
Hatchery	4	4,710 (768)	4,034-5,696	2	6,422 (950)	5,750-7,093
Combined	7	4,361 (716)	3,567-5,696	27	6,432 (874)	5,017-8,434
1991						
Wild	2	4,336 (483)	3,995-4,678	13	4,924 (667)	3,703-6,183
Hatchery	13	4,667 (864)	3,333-6,180	11	5,443 (904)	4,081-7,065
Combined	15	4,624 (818)	3,333-6,180	24	5,162 (810)	3,703-7,065

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, 1989 brood. Standard deviation is shown in parenthesis.

Release fork dates (mm)	Number released	Size (fish/lb) (mm)	Location released	N	Mean length
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RAPID RIVER STOCK

01 Apr 1991 123(7.2)	236,711	20.6	Lookingglass Creek	858
01 Apr 1991 143(22.2)	94,925	13.8	Lookingglass Creek	626

CARSON STOCK

02 Apr 1991a 125(7.1)	504,668	18.6	Lookingglass Creek	1,684
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IMNAHA STOCK

22 Mar 1991 121(5.5)	159,265	22.3	Imnaha River Facility	213
22 Mar 1991 134(16.1)	108,405	16.0	Imnaha River Facility	216
09 Apr 1991b 137(19.1)	49,669	14.8	Imnaha River Facility	225
09 Apr 1991b 124(6.2)	81,570	20.5	Imnaha River Facility	253

a 100% LV fin marked.

b 100% RV fin marked.

Table 3a. Vital statistics for spring chinook salmon that returned to the Big Canyon facility, Lookingglass Hatchery, and Imnaha River facility, 1990.

J = jacks, M = males, F = females.

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

BIG CANYON FACILITY

Carson: Hatchery 10.4	210	7	97	106	47	--	7.2
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LOOKINGGLASS HATCHERY

Carson:							
Hatchery	136a	0	70	66	50	--	7.1
13.6							

Rapid River:							
Hatchery	522b	5	269	248	239	0.0	3.7
2.8							

Imnaha:							
Hatchery	6	0	0	6	1	--	--
83.3c							

IMNAHA RIVER FACILITY

Imnaha:							
Wild	183	10	106	67	25	--	14.6
18.8							
Hatchery	221	45	82	94	48	6.7	13.0
11.1							

a Includes 27 male and 13 female age 4 left ventral fin-marked strays from Catherine Creek or Big Canyon Facility releases.

b Includes 13 males and 17 females trapped at Hell's Canyon trap, and 2 Carson stock females mistakenly identified as Rapid River stock.

c Includes 2 at Wallowa Hatchery, 2 at Imnaha River facility, and 1 at Lookingglass Hatchery.

Table 3b. Vital statistics for spring chinook salmon that returned to the Big Canyon facility, Lookingglass Hatchery, and Imnaha River facility, 1991.

J = jacks, M = males, F = females.

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

BIG CANYON FACILITY

Rapid River:							
Hatchery	3	3	--	--	--	--	--
--							

Carson:							
Hatchery	35	0	16	19	0	--	--
--							

LOOKINGGLASS HATCHERY

Carson:

Hatchery	72a	0	40	32	--	--	--

Rapid River:

Hatchery	364	114	123	127	124	0.0	6.5
2.4							
Hell's Canyonb	62	43	9	10	7	0.0	33.3
20.2							

IMNAHA RIVER FACILITY

Imnaha:

Wild	223	102c	71	50	15	0	7.1
11.8							
Hatchery	282	138	88	56	24	0	1.9
7.7							

a Left ventral fin-marked strays from Catherine Creek or Big Canyon Facility

releases.

b Fish trapped at the Hell's Canyon trap and transported to Lookingglass Hatchery for holding and spawning.

c Includes an estimated 92 unmarked hatchery jacks.

Table 4a. Run timing for spring chinook salmon that returned to Lookingglass Hatchery, Big Canyon facility, and Imnaha River facility, 1990.

Time	Lookingglass Hatcherya			Rapid River			Imnaha stock		
	Carson stock		Stock	Stock		Imnaha stock			
interval	Number	% of total	Number	% of total	Number	% of total	Number	% of total	
<hr/>									
07-13 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	156	31.8	0	0.0			
28 May-03 Jun	0	0.0	140	28.6	0	0.0			
04-10 Jun	60	44.1	59	12.0	0	0.0			
11-17 Jun	0	0.0	35	7.1	0	0.0			
18-24 Jun	29	21.3	28	5.7	0	0.0			
25 Jun-01 Jul	0	0.0	20	4.5	0	0.0			
02-08 Jul	23	16.9	8	1.6	0	0.0			

09-15	Jul	0	0.0	0	0.0	0	0.0
16-22	Jul	0	0.0	6	1.2	0	0.0
23-29	Jul	8	5.9	0	0.0	2	50.0
30	Jul-05	Aug	0	0.0	0	0.0	0
06-12	Aug	0	0.0	0	0.0	0	0.0
13-19	Aug	6	4.4	7	1.4	2	50.0
20-26	Aug	0	0.0	6	1.2	0	0.0
27	Aug-02	Sep	0	0.0	22	4.5	0
03-09	Sep	9	6.6	2	0.4	0	0.0
10-16	Sep	1	0.7	1	0.2	0	0.0

a Lookingglass Hatchery trap operated from 4 May to 11 September.

Table 4a. Extended.

fish Time interval	Big Canyon facility c			Imnaha River facilityb		
	Number	% of total	Wild fish	Number	% of total	Hatchery
07-13 May	--	--	--	--	--	--
14-20 May	--	--	--	--	--	--
21-27 May	25	11.9	--	--	--	--
28 May-03 Jun	43	20.5	--	--	--	--
04-10 Jun	63	30.0	--	--	--	--
11-17 Jun	13	6.2	--	--	--	--
18-24 Jun	29	13.8	--	--	--	--
25 Jun-01 Jul	16	7.6	0d	0.0	0d	0.0
02-08 Jul	4	1.9	0d	0.0	0d	0.0
09-15 Jul	9	4.3	56	30.6	77	34.8
16-22 Jul	0	0.0	37	20.2	26	11.8
23-29 Jul	3	1.4	14	7.7	22	10.0
30 Jul-05 Aug	1	0.5	9	4.9	19	8.6
06-12 Aug	4	1.9	0	0.0	0	0.0
13-19 Aug	--	--	15	8.2	25	11.3
20-26 Aug	--	--	15	8.2	10	4.5
27 Aug-02 Sep	--	--	21	11.5	24	10.9
03-09 Sep	--	--	14	7.7	16	7.2
10-16 Sep	--	--	2	1.1	1	0.5
17-23 Sep				0	0.0	1
						0.5

b Imnaha River facility trap operated from 28 June to 18 September.

c Big Canyon facility trap operated from 21 May to 12 August.

d Fish were observed in the trap during this time periods, but fish were not

counted until 09 July.

Table 4b. Run timing for spring chinook salmon that returned to Lookingglass Hatchery, Big Canyon facility, and Imnaha River facility, 1991.

Facility ^b	Lookingglass Hatchery ^a						Big Canyon		
	Time interval	Carson stock		Rapid River stock		Rapid River stock			
		Number	% of total	Number	% of total	Number	% of total		
01-06 May	0	0.0	0	0.0	0	0.0			
07-13 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	0	0.0	0	0.0	0	0.0			
04-10 Jun	2	2.7	5	1.4	0	0.0			
11-17 Jun	0	0.0	83	22.8	3	8.6			
18-24 Jun	31	42.5	75	20.6	11	31.4			
25 Jun-01 Jul	0	0.0	84	23.1	3	8.6			
02-08 Jul	28	38.4	41	11.2	0	0.0			
09-15 Jul	4	5.5	13	3.6	17	48.5			
16-22 Jul	3	4.1	9	2.5	1	2.9			
23-29 Jul	0	0.0	0	0.0	0	0.0			
30 Jul-05 Aug	0	0.0	2	0.5	0	0.0			
06-12 Aug	2	2.7	9	2.5	0	0.0			
13-19 Aug	0	0.0	0	0.0	--	--			
20-26 Aug	3	4.1	32	8.8	--	--			
27 Aug-02 Sep	c	c	7	1.9	--	--			
03-09 Sep	0	0.0	0	0.0	--	--			
10-16 Sep	0	0.0	4	1.1	--	--			

a Lookingglass Hatchery trap operated from 01 May to 16 September.

b Big Canyon facility trap operated from 21 May to 12 August.

c Fish were not taken from the trap and put into the adult holding ponds during this time period.

Table 4b. Extended.

jacks	Imnaha River facility ^d			
	Wild adults	Hatchery adults	Unmarked jacks	Marked
	Time	% of	% of	% of
% of				

interval		Number	total	Number	total	Number	total	Number
total								
<hr/>								
28 Jun-01 Jul		0	0.0	0	0.0	0	0.0	0
02-08 Jul	0	0.0	0	0.0	2	2.0	0	0.0
09-15 Jul	21	17.3	15	10.1	5	4.9	2	1.5
16-22 Jul	18	14.9	23	15.5	4	3.9	6	4.5
23-29 Jul	52	43.0	32	21.6	29	28.4	31	23.1
30 Jul-05 Aug		8	6.6	37	25.0	13	12.7	48
06-12 Aug	4	3.3	8	5.4	13	12.7	15	11.2
13-19 Aug	2	1.7	6	4.1	10	9.8	13	9.7
20-26 Aug	10	8.3	10	6.8	11	10.8	13	9.7
27 Aug-02 Sep		4	3.3	5	3.4	2	2.0	0
03-09 Sep	1	0.8	8	5.4	6	5.9	2	1.5
10-16 Sep	1	0.8	4	2.7	7	6.9	4	3.0
17-18 Sep	0	0.0	0	0.0	0	0.0	0	0.0

a Imnaha River facility trap operated from 25 June to 16 September.

Table 5a. Spawning timing of female spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River facility, 1990.

Time interval	Rapid River stock ^b		Wild fish		Imnaha stock ^a	
	N	%	N	%	N	%
20-26 Aug	1	0.4	8	32.0	1	2.1
27 Aug-02 Sep	96	40.2	11	44.0	21	43.8
03-09 Sep	108	45.2	5	20.0	20	41.7
10-16 Sep	29	12.1	1	4.0	4	8.3
17-23 Sep	5	2.1	0	0.0	2	4.2

a Includes fish spawned at Lookingglass Hatchery and Imnaha River weir.

b Spawned at Lookingglass Hatchery.

Table 5b. Spawning timing of female spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River facility, 1991.

Time interval	Rapid River stock ^b		Wild fish		Imnaha stock ^a	
	N	%	N	%	N	%

20-26 Aug	1	0.4	2	32.0	2	2.1
27 Aug-02 Sep	96	40.2	7	44.0	7	43.8
03-09 Sep	108	45.2	4	20.0	14	41.7
10-16 Sep	29	12.1	1	4.0	1	8.3
17-23 Sep	5	2.1	1	0.0	0	4.2

a Spawning at the Imnaha River weir.

b Spawned at Lookingglass Hatchery.

Table 6. Pair matings of Imnaha chinook salmon spawned in 1990 and 1991. W=wild, H=hatchery, M=males, F=females, J=jacks.

Year,	Number of						Total fish spawned			
Spawn	family	Number of pair matings				Wild		Hatchery		
Date J	groups	HMxHF	HMxWF	WMxHF	WMxWF	M	F	J	M	F
<hr/>										
1990:										
23 Aug 1	10	2	4	2	2	4	6	0	5	4
28 Aug 2	32	6	11	14	1	14	13	0	16	19
04 Sep 2	25	7	2	13	3	16	5	0	7	20
11 Sep 1	5	1	1	3	0	3	1	0	1	4
18 Sep 0	2	0	0	2	0	2	0	0	0	2
Totals 6	74	16	18	34	6	39	25	0	29	49
1991:										
21 Aug	4	2	2	0	0	0	2	0	4	2
27 Aug	14	2	3	5	4	8	7	1	4	7
04 Sep	18	3	0	11	4	13	4	2	3	14
12 Sep	2	0	0	1	1	2	1	0	0	1
16 Sep	1	0	0	0	1	1	1	0	0	0
Totals	39	7	5	1 7	10	24	15	3	11	24

Table 7a. Number of spring chinook salmon that were trapped and then released above the Imnaha River weir, 1990.

Time interval ^a	Jack	Number of fish released			
		Wild fish		Hatchery fish	
		Male	Female	Male	Female
09-15 Jul	0	16	13	12	20
16-22 Jul	1	6	11	3	5
23-29 Jul	1	3	3	1	4
30 Jul-05 Aug	0	1	2	1	3
06-12 Aug	0	0	0	0	0
13-19 Aug	2	3	2	2	1
20-26 Aug	0	7	1	1	1
27 Aug-02 Sep	1	8	2	5	5
03-09 Sep	0	7	0	3	1
10-16 Sep	3	4	1	0	0
17-18 Sep	1	3	0	0	0
Totals	9	58	35	28	40

a Imnaha River weir operated from 28 June to 18 September.

Table 7b. Number of spring chinook salmon that were trapped and then released above the Imnaha River weir, 1991.

Time interval ^a	Jack	Number of fish released			
		Wild fish		Hatchery fish	
		Male	Female	Jack	Male
02-08 Jul	2	0	0	0	0
09-15 Jul	5	4	8	0	5
16-22 Jul	3	6	4	1	6
23-29 Jul	28	18	17	0	18
30 Jul-05 Aug	3	5	1	0	1
06-12 Aug	3	2	0	0	4
13-19 Aug	1	1	0	0	2
20-26 Aug	2	5	1	0	0
27 Aug-02 Sep	1	2	1	0	0
03-09 Sep	0	0	0	0	0
10-16 Sep	2	0	1	0	1
Totals	50	43	33	1	36

a Imnaha River weir operated from 25 June to 16 September.

Table 8a. Percent age composition of spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River facility, 1990. Age nomenclature is that of Gilbert and Rich (1927).

Age group, number	Carson stock		Lookingglass Hatchery		Imnaha Stock	
	Male	Female	Rapid River stock Male	Rapid River stock Female	Male	Female
32	0.0	0.0	1.0	0.0	--	--
42	33.1	29.4	50.4	44.2	--	--
52	18.4	19.1	1.3	3.1	0.0	100.0
Number of fish	70		66		274	248
					0	6

Age group, number	Big Canyon facility ^a		Imnaha River facility		Hatchery fish	
	Male	Female	Wild fish Male	Wild fish Female	Male	Female
32	3.3	0.0	5.5	0.0	20.4	0.0
42	42.4	48.6	51.4	14.2	37.1	42.5
52	3.8	1.9	6.5	22.4	0.0	0.0
Number of fish	104		106		116	67
					127	94

a Carson stock.

Table 8b. Percent age composition of spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River facility, 1991. Age nomenclature is that of Gilbert and Rich (1927).

Age group, number	Carson stock		Lookingglass Hatchery		Rapid River stock	
	Male	Female	Male	Female	Male	Female
32	--	--	31.3	0.0		
42	23.6	33.3	23.6	19.0		
52	32.0	11.1	10.2	15.9		

Number of fish		40	32			237	127		
Age group, number	Male	Big Canyon facility		Wild fish	Imnaha River facility		Hatchery fish	Male	Female
		Male	Female		Male	Female			
32	--	--	45.7	0.0	48.9	0.0			
42	8.6	17.2	26.5	4.9	29.4	13.1			
52	37.1	37.1	5.4	17.5	1.8	6.7			
Number of fish		16	19	173	50	226	56		

a Carson stock.

Table 9a. Mean fork length (mm) for age-specific groups of adult spring chinook salmon, 1990. Age nomenclature is that of Gilbert and Rich (1927). Standard deviation is shown in parenthesis.

LOOKINGGLASS HATCHERY

Carson:

Hatchery	0	--	0	--	35	757 (55)	37
728 (35) 22	904 (65)	24	829 (37)				

Rapid River:

Hatchery 5 461 (34) 0 -- 261 710 (52) 230
 710 (36) 7 836 (47) 16 814 (44)

Imnaha:

Hatchery -- -- -- -- -- -- -- -- --

BIG CANYON FACILITY

Carson:

Hatchery	0	--	0	--	44	757 (46)	55
728 (29)	8	960 (36)	4	881 (18)			

IMNAHA RIVER FACILITY

Imnaha:

Wild	9	541 (24)	0	--	54	751 (42)	12
777 (36)	6	869 (55)	20	914 (40)			
Hatchery	45	542 (32)	1	550	54	727 (55)	42
751 (42)	0	--	0	--			

Table 9b. Mean fork length (mm) for age-specific groups of adult spring chinook salmon, 1991. Age nomenclature is that of Gilbert and Rich (1927). Standard deviation is shown in parenthesis.

Stock, Male origin	Age 3				Age 4			
	Male		Female		Male		Female	
Length	N	Length	N	Length	N	Length	N	
Age 5								

LOOKINGGLASS HATCHERY

Carson:

Hatchery	a	--	a	--	17	726 (40)	23
891 (42)	22	714 (23)	9	850 (25)			

Rapid River:

Hatchery	113	486 (38)	0	--	85	717 (47)	69
697 (31)	37	837 (69)	58	801 (44)			

BIG CANYON FACILITY

Carson:

Hatchery	a	a	a	a	3	760 (35)	5
735 (24)	13	868 (31)	12	829 (33)			

Rapid River:

Hatchery	3	523 (55)	0	--	b	--	b	-
-	b	--	b	--				

IMNAHA RIVER FACILITY

Imnaha:

Wild		52	547 (51)	0	--	23	738 (48)	4
792 (54)	4	933 (40)	16	870 (46)	--			
Hatchery		136	559 (52)	0	--	54	735 (54)	14
773 (37)	6	858 (32)	11	854 (65)				

a No 1988 brood Carson stock released in the Grande Ronde River Basin.
 b The 1988 brood year was the first release of Rapid River stock at the Big Canyon Facility.

Table 10. Degree of smolting for juvenile spring chinook salmon released into the Grande Ronde and Imnaha river basins, 1989 brood. Standard deviation is shown in parenthesis.

Stock	Date released	N	Mean length (mm)	Degree of smoltinga (%)		
				Smolt	Intermediate	Parr
Rapid River	04/01/91	400	124 (6.8)	0.2	99.8	0
	04/01/91	400	144 (22.2)	12.5	87.5	0
Imnaha	03/20/91	213	121 (6.2)	0	100	0
	03/20/91	216	216 (16.9)	6.4	93.6	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.

Table 11. Egg take and egg survival of Wallowa and Imnaha stocks of summer steelhead, 1990 and 1991 broods.

Stock, brood year	Eggs taken	Egg loss (%)	Egg-to-fry survival (%)	Egg-to-smolt survival (%)
Wallowa:				
1990	3,049,659a	15.5	76.5b	59.3c
1991	4,230,357d	12.5e	82.6f	(g)
Imnaha:				
1990	849,432	32.9	64.7h	50.7i
1991	455,292	25.6	71.7	(g)

- a Total eggs collected includes eggs taken at the Big Canyon facility.
 b Does not include 10,116 viable eggs dumped because of excess program needs.
 c Does not include 9,025 presmolt released into the Snake River.
 d Total includes eggs taken at Big Canyon facility, and from females collected at Washington Department of Wildlife's Cottenwood facility.
 e Does not include 451,000 viable eggs dumped because of excess program needs.
 f Does not include 421,025 eyed eggs shipped to Lyons Ferry, 812,000 eggs shipped to Nigra Springs Hatchery, and 185,360 unpicked fry dumped because of excess program needs.
 g 1991 brood smolts will be released in the spring of 1992.
 h Does not include 20,468 eyed eggs and 77,347 fry destroyed because of excess program needs.
 i Does not include 18,893 presmolt released into the Snake River.

Table 12. Vital statistics for juvenile summer steelhead released in the Grande Ronde and Imnaha river basins and the Snake River, 1990 brood year. All fish were adipose fin marked. Standard deviation is shown in parenthesis.

Stock, date released	Number released	Size (fish/ lb)	Location of release	N	Mean fork length (mm)
<hr/>					
Wallowa:					
11/20/90a	140,787	53.8	Snake River	--	--
04/22/91	90,566	3.9	Wallowa Hatchery	215	
222(18.1)					
04/22/91	406,582	4.7	Wallowa Hatchery	506	
206(19.4)					
05/02/91	109,529	5.1	Wallowa Hatchery	313	
198(19.8)					
04/08-11/91	200,466	5.3	Upper Grande	982	
195(20.7)					
			Ronde River		
04/11-16/91	111,464	5.5	Catherine Creek	233	
193(18.3)					
04/26/91	221,785	5.0	Big Canyon facility	450	
207(16.0)					
05/06/91	47,187	5.4	Big Canyon facility	295	
202(16.6)					
04/26/91	52,487	5.3	Deer Creek	309	
195(17.1)					
04/30-5/01/91	98,783	5.4	Lower Grande	--	--
			Ronde River		
05/04/91	52,500	5.3	Lower Grande	--	--
			Ronde Riverb		

Imnaha:						
11/21/90a	71,698	57.1	Snake River	--	--	
04/23/91	192,401	5.1	Little Sheep	212		
209(17.7)						
04/23/91	50,581	6.4	Creek facility Little Sheep	300		
187(18.4)						
190(18.6)			Creek	454		
05/01-03/91	86,235	6.0	Imnaha River	--	--	

a Small fish graded off at Irrigon Hatchery and excess to program needs were released into the Snake River below Hells Canyon Dam.

b Reared at Lyon's Ferry Hatchery.

Table 13. Vital statistics for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1991. Also included are Wallowa Stock summer steelhead trapped at Washington Department of Wildlife's Cottonwood Facility and transported to Wallowa Hatchery for spawning.

Location, origin	Total	Male	Female	Number of females spawned		Prespawning mortality (%)	
				Male	Female	Male	Female
Big Canyon facility: Wild Hatchery	21 407	14 141	7 266	0 262	-- 0.7	-- 0.0	
Wallowa Hatchery: Hatchery	478	253	225	210	5.9	2.7	
Cottonwood facility: Hatchery	491	156	335	317	9.0	3.3	
Little Sheep Creek: Wild Hatchery	29 366	11 221	18 145	9 121	0.0 5.1	0.0 0.8	

Table 14. Run timing for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1991.

Time interval	Big Canyon facility ^a				Wallowa Hatchery ^b	
	Wild fish		Hatchery fish			
	Number	% of Total	Number	% of Total	Number	% of Total
01-04 Mar	0	0.0	0	0.0	0	0.0
05-11 Mar	3	14.3	12	2.9	11	2.3
12-18 Mar	0	0.0	2	0.5	10	2.1
19-25 Mar	0	0.0	16	3.9	41	8.6
26 Mar-01 Apr	3	14.3	67	16.5	39	8.2
02-08 Apr	2	9.5	149	36.6	55	11.5
09-15 Apr	0	0.0	19	4.7	153	32.0
16-22 Apr	6	28.5	76	18.7	47	9.8
23-29 Apr	3	14.3	39	9.6	69	14.5
30 Apr-06 May	3	14.3	19	4.7	26	5.4
07-13 May	1	4.8	5	1.2	24	5.0
14-20 May	0	0.0	3	0.7	3	0.6
<hr/>						
<hr/>						
Little Sheep Creek facility ^c						
Time interval	Wild fish		Hatchery fish			
	% of		% of			
	Number	Total	Number	Total	Number	Total
04-11 Mar	1	3.5	1	0.3		
12-18 Mar	0	0.0	0	0.0		
19-25 Mar	2	6.9	2	0.6		
26 Mar-01 Apr	2	6.9	11	3.0		
02-08 Apr	4	13.7	64	17.4		
09-15 Apr	4	13.7	33	9.0		
16-22 Apr	6	20.7	100	27.2		
23-29 Apr May	5	17.2	72	19.7		
30 Apr-06 May	2	6.9	55	14.9		
07-13 May	1	3.5	2	0.6		
14-20 May	1	3.5	20	5.6		
21-27 May	1	3.5	5	1.4		
28-31 May	0	0.0	1	0.3		

a Big Canyon facility trap operated from 1 March to 16 May 1991.

b Wallowa Hatchery trap operated from 1 March to 15 May 1991.

c Little Sheep Creek trap operated from 4 March to 31 May 1991.

Table 15. Time of spawning for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1991.

Big Canyon facility			Wallowa Hatchery		
Time interval	Number	% of total	Number	% of total	
19-25 Mar	5	1.9	15	7.1	
26 Mar-01 Apr	29	11.0	23	11.0	
02-08 Apr	35	13.4	20	9.5	
09-15 Apr	64	24.4	78	37.2	
16-22 Apr	35	13.4	30	14.3	
23-29 Apr	48	18.3	28	13.3	
30 Apr-06 May	22	8.4	8	3.8	
07-13 May	18	6.9	7	3.3	
14-20 May	6	2.3	1	0.5	
21-27 May	0	0.0	0	0.0	

Little Sheep Creek facility					
Wild fish		Hatchery fish			
Time interval	Number	% of total	Number	% of total	
02-08 Apr	0	0.0	0	0.0	
09-15 Apr	1	11.1	10	8.3	
16-22 Apr	2	22.2	12	9.9	
23-29 Apr	0	0.0	33	27.3	
30 Apr-06 May	0	0.0	29	24.0	
07-13 May	2	22.3	20	16.5	
14-20 May	1	11.1	8	6.6	
21-27 May	1	11.1	8	6.6	
28 May-03 Jun	2	22.2	1	0.8	

a Hatchery fish only, all wild fish were released above the weir.

Table 16. Percent age composition for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1991. Age is expressed as years spent in freshwater prior to ocean migration: years spent in ocean prior to spawning migration.

Age group, number	Big Canyon facility				Wallowa Hatchery	
	Wild fish		Hatchery fish		Male	Female
	Male	Female	Male	Female	Male	Female
1:1	0.0	0.0	20.5	9.7	36.0	8.4
1:2	0.0	0.0	13.6	55.6	14.8	38.3

2:1	66.7	33.3	0.2	0.2	1.9	0.2
2:2	0.0	0.0	0.0	0.2	0.2	0.2

Number of fish	14	7	139	266	253	225
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Age group, number	Little Sheep Creek facility			
	Wild fish		Hatchery fish	
	Male	Female ^b	Male	Female

1:1	0.0	0.0	60.3	32.1
1:2	0.0	0.0	0.3	6.8
2:1	35.7	25.0	0.0	0.5
2:2	3.6	35.7	0.0	0.0

Number of fish	11	17	221	145
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a Two age 3:0 males not included.

b One age 5:0 wild female not included

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, 1991. Standard deviation is shown in parenthesis.

Wallowa Hatchery	Big Canyon facility							
	Wild Fish				Hatchery Fish			
	Age	Male	Female		Male	Female		
	Male	Female	N	Length	N	Length	N	Length
group	N	N	Length	N	Length	N	Length	N
N	Length	N	Length	N	Length	N	Length	N
1:1	0	--	0	--	81	563 (27)	39	559 (20)
173	568 (27)	38	563 (20)					
1:2	0	--	0	--	54	740 (36)	223	702 (33)
73	723 (43)	179	695 (31)					
2:1	14a	--	7a	--	1	627	1	531
9	585 (31)	1	537					
2:2	--	--	--		0	--	1	668
1	750	1	684					

		Little Sheep Creek facility					
		Wild fish					
Hatchery fish		Male		Female		Male	
Age		N	Length	N	Length	N	Length
Female							
group							
N	Length						
1:1		0	--	0	--	101	550 (24)
197	555 (26)						
1:2		0	--	0	--	21	694 (56)
1	--						
2:1		10	547 (29)	7	562 (24)	0	--
16	615 (28)						
2:2		1	765	10	669 (25)	0	--
0	--						

a Fish were released above the weir, no lengths were taken. If fish were <630mm they were classified as age 2:1, and any fish >630mm would be classified as age 2:2..

Table 18. Number of wild adult summer steelhead trapped then released above the Big Canyon facility, 1991. No hatchery fish were released.

Trapping and release time period	Wild Fish	
	Male	Female
04-11 Mar	3	0
12-18 Mar	0	0
19-25 Mar	0	0
26 Mar-01 Apr	3	0
02-08 Apr	1	1
09-15 Apr	0	0
16-22 Apr	3	3
23-29 Apr	2	1
30 Apr-06 May	2	1
07-13 May	0	1
14-20 May	0	0
21-27 May	0	0
Total released	14	7

Table 19. Number of adult summer steelhead released above the Little Sheep Creek facility, 1991.

Trapping and release time period	Wild fish		Hatchery fish	
	Male	Female	Male	Female
05-11 March	1	0	0	1
12-18 March	0	0	0	0
19-25 March	0	1	0	0
26 March-01 Apr	1	0	4	0
02-08 Apr	1	1	12	7
09-15 Apr	0	2	0	3
16-22 Apr	3	2	3	4
23-29 Apr	0	1	3	3
30 Apr-06 May	0	0	0	0
07-13 May	0	0	0	0
14-20 May	0	1	1	0
21-22 May	0	0	0	0
Total released	6	8	23	18

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 1991, 1990 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	Mean fork length		Incidence (%) of Fin erosion						
	date	N	(mm)	D	LVa	RV	BV	LP	RP
Wallowa:									
15 Aprb	300	209(16.0)	97.7	0.0	0.3	4.7	6.3	12.7	2.3
15 Aprc	208	212(18.3)	99.0	4.2	0.0	3.2	27.4	9.1	4.8
15 Aprd	242	222(18.1)	99.6	0.0	0.4	0.0	27.7	5.0	0.4
17 Apre	200	188(15.4)	100	0.0	0.0	0.0	2.0	1.0	0.0
30 Aprf	200	206(17.6)	100	0.0	0.0	0.0	0.0	0.0	0.0
17 Aprg	200	198(20.4)	99.3	0.0	0.0	0.0	16.6	29.1	7.3
19 Aprh	300	206(18.2)	99.3	7.1	3.3	8.9	6.1	10.3	2.0
03 Mayi	200	200(16.4)	100	0.0	0.0	0.0	1.0	2.5	0.0
Imnaha:									
17 Aprj	200	189(18.5)	97.0	0.0	1.5	0.0	14.5	2.0	25.0
18 Aprk	438	202(16.8)	98.6	2.3	3.4	7.5	4.8	13.2	2.5

- 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, 5 fish/lb release group.
 d Final rearing in lower acclimation pond at Wallowa Hatchery, 4 fish/lb release group.
 e Wildcat Creek release.
 f Second acclimation at Wallowa Hatchery.
 g Direct stream release at Big Canyon Creek Facility.
 h Acclimated at Big Canyon Creek Facility.
 i Second acclimation at Big Canyon Creek Facility.
 j Direct stream release from Little Sheep Creek Facility.
 k Acclimated at Little Sheep Creek Facility.

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 1991, 1990 brood year. Standard deviation is shown in parenthesis.

Stock, De- sampling scaled date fish (%)	N	Mean length (mm)	Smolt	Inter- mediate	Parr	Degree of smolting (%) ^a	Pre- cocious males
Wallowa:							
15 Aprb	300	209(16.0)	17.7	82.3	0.0	0.0	1.0
15 Aprc	208	212(18.3)	8.2	91.8	0.0	0.0	1.4
15 Aprd	242	222(18.1)	14.9	85.1	0.0	0.0	0.8
17 Apre	200	188(15.4)	13.0	87.0	0.0	0.0	0.0
30 Aprf	200	206(17.6)	20.0	80.0	0.0	0.0	0.0
17 Aprg	200	198(20.4)	2.5	97.5	0.0	0.0	0.5
19 Aprh	300	206(18.2)	13.7	86.3	0.0	0.0	0.3
03 Mayi	200	200(16.4)	10.5	89.5	0.0	0.0	0.0
Imnaha:							
17 Aprj	200	189(18.5)	13.5	86.5	0.0	0.0	0.5
18 Aprk	438	202(16.8)	11.9	87.0	0.0	1.1	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, 5/lb fish.
 d Final rearing in lower acclimation pond at Wallowa Hatchery, 4/lb fish.
 e Wildcat Creek release.
 f Second acclimation at Wallowa Hatchery.
 g Direct stream release at Big Canyon Creek Facility.
 h Acclimated at Big Canyon Creek Facility.
 i Second acclimation at Big Canyon Creek Facility.
 j Direct stream release from Little Sheep Creek Facility.
 k Acclimated at Little Sheep Creek Facility.

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, 1989 brood. Standard deviation is shown in parenthesis.

Mean							
Stock, fork length of release (mm)	Mean location weight (g)	Release Mean group condition represented factor	CWT code	Date	Number	N	
Rapid River:							
Lookingglass 125(6.7)	Medium 24.1(5.0)	07 50 53 1.15(0.05)		04/01/91	42,705	331a	
Hatchery 124(6.9)	smolt 22.3(3.8)	07 50 54 1.15(0.09)		04/01/91	43,450	302b	
			Large 39.9(27.7)	07 50 51 1.19(0.07)	04/01/91	42,859	322c
			smolt 39.4(24.3)	07 50 48 1.18(0.07)	04/01/91	42,698	302d
Imnaha:							
Imnaha River 121(5.5)	Medium 20.5(3.1)	07 50 45 1.14(0.05)		03/22/91	42,804	104	
facility 121(5.6)	smolt 20.5(3.2)	07 50 46 1.14(0.04)		03/22/91	42,834	109	
			Large 28.0(13.3)	07 50 43 1.16(0.04)	03/22/91	40,770	105
			smolt 29.8(13.3)	07 50 40 1.16(0.05)	03/22/91	41,582	111

a N = 25 for mean weight and mean condition factor.
 b N = 34 for mean weight and mean condition factor.
 c N = 60 for mean weight and mean condition factor.
 d N = 67 for mean weight and mean condition factor.

Table 23a. 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, 1990. Standard deviation is shown in parenthesis.

Brood year, CWT code	Number recovered		Mean fork length (mm)		Mean weight (kg)	
	Male	Female	Male	Female	Male	Female
LOOKINGGLASS HATCHERY						
1985:						
07 38 04	1	0	884	--	--	--
07 38 05	5	2	903(49)	819(38)	6.7(0.7)	--
07 38 06	10	8	893(24)	833(24)	7.5(2.8)	6.0(0.7)
07 38 07	0	3	--	823(31)	--	5.9(1.3)
07 38 09	0	4	--	869(69)	--	6.4(1.4)
07 38 10	0	2	--	888(3)	--	6.8(1.0)
07 38 12	1	2	848	799(113)	5.5	6.1(2.4)
1986:						
07 40 14	20	12	710(64)	695(40)	4.1(0.9)	3.4(0.5)
07 40 15	18	20	699(70)	696(28)	3.5(0.9)	3.6(0.5)
07 40 18	5	9	695(86)	703(48)	3.7(1.5)	3.8(0.6)
07 40 19	6	6	718(36)	686(38)	3.6(0.4)	2.7(1.5)
07 40 20	34	18	724(38)	712(31)	3.9(0.7)	3.6(1.0)
07 40 21	40	30	709(48)	706(36)	3.6(0.7)	3.8(0.6)
07 40 22	0	1	--	680	--	3.2
07 43 28a	1	0	801	--	--	--
07 43 29a	1	0	678	--	--	--
1987:						
07 45 32	1	0	492	--	1.3	--
07 45 33	1	0	443	--	2.1	--

a Umatilla River stray.

Table 23a. Continued.

Number	Mean fork	Mean weight
--------	-----------	-------------

Brood year, CWT Code	recovered		length (mm)		Mean Weight (kg)	
	Male	Female	Male	Female	Male	Female
BIG CANYON CREEK FACILITY						
1985:						
07 39 56	4	1	952 (41)	880	7.1 (2.1)	5.9
07 39 57	4	3	968 (33)	882 (23)	8.0 (0.3)	5.9 (1.7)
1986:						
07 40 22b	1	0	722	--	3.2	--
IMNAHA RIVER WEIRc						
1986:						
07 42 60	9 (13)	15 (21)	722 (50)	762 (51)	3.6 (0.8)	4.6 (0.9)
07 42 63	17 (21)	11 (16)	744 (47)	752 (33)	4.2 (0.8)	4.3 (1.0)
07 43 01	17 (21)	9 (13)	726 (55)	734 (38)	3.3 (0.8)	3.9 (1.2)
07 43 02	16 (19)	17 (24)	712 (59)	748 (41)	3.6 (0.9)	4.4 (0.8)
1987:						
07 45 44	20	0	535 (31)	--	1.6 (0.3)	--
07 45 45	9	0	540 (23)	--	1.6 (0.3)	--
07 45 46	14	0	555 (36)	--	1.8 (0.5)	--
SPAWNING GROUND SURVEYS						
1985:						
07 39 56d	1	0	960	--	--	--
23 20 23d	0	1	--	830	--	--
1986:						
07 42 60e	1	2	650	760 (28)	--	--
07 42 63e	0	1	--	740	--	--
07 40 19f	1	0	--	--	--	--
1987:						
07 45 45e	1	0	530	--	--	--

b Lookingglass Hatchery stray.

c Imnaha River weir recoveries include adipose marked fish released above the weir. Observed recoveries (hatchery plus spawning ground survey recoveries) are shown under the number recovered column and expanded numbers (expanded for fish released and not recovered on spawning ground

surveys) are shown in parenthesis.

d Lostine River recovery.

e Imnaha River recovery.

f Lookingglass Creek recovery.

Table 23b. 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, 1991. Standard deviation is shown in parenthesis.

Brood year,	Number recovered		Mean fork length (mm)		Mean weight (kg)	
	CWT code	Male	Female	Male	Female	Male
LOOKINGGLASS HATCHERY						
1984:						
10 25 40	1	0	911	--	--	--
1986:						
07 40 14	2	0	794 (115)	--	4.9 (2.3)	--
07 40 15	2	6	880 (7)	798 (51)	6.7 (0.1)	5.2 (0.8)
07 40 19	1	0	880	--	6.6	--
07 40 20	6	8	850 (60)	816 (27)	5.8 (1.2)	5.7 (0.4)
07 40 21	7	11	859 (87)	797 (45)	5.8 (1.4)	5.0 (1.0)
07 40 23	1	0	940	--	--	--
1987:						
07 45 31	5	1	718 (41)	746	3.7 (1.0)	4.5
07 45 32	4	3	760 (18)	716 (16)	4.3 (0.3)	3.8 (0.3)
07 45 33	3	7	744 (9)	696 (17)	4.2 (0.1)	3.4 (0.3)
07 45 35	10	9	723 (32)	684 (59)	3.6 (0.6)	3.7 (0.7)
07 46 32	0	1	--	740	--	4.3
07 46 33	1	0	748	--	3.7	--
1988:						
07 47 39	3	0	486 (12)	--	1.4 (0.3)	--
07 47 40	5	0	472 (32)	--	1.5 (0.1)	--
07 47 43	14	0	478 (31)	--	1.3 (0.3)	--
07 47 45	18	0	492 (25)	--	1.4 (0.2)	--
IMNAHA RIVER WEIR						
1986:						
07 42 60	0	6 (8)	--	882 (38)	--	6.7 (1.9)
07 42 63	1 (2)	3 (4)	840	880 (49)	5.2	7.6 (1.5)
07 43 01	0	2 (2)	--	843 (25)	--	6.6 (0.2)
07 43 02	1 (1)	3 (4)	836	861 (28)	5.2	6.9 (1.2)

a Imnaha River weir recoveries include adipose marked fish released above the weir. Observed recoveries (hatchery plus spawning ground survey recoveries) are shown under the number recovered column and expanded numbers (expanded for fish released and not recovered on spawning ground surveys) are shown in parenthesis.

Table 23b. Continued.

Brood year, CWT Code	Number recovered		Mean fork length (mm)		Mean weight Mean Weight (kg)	
	Male	Female	Male	Female	Male	Female
IMNAHA RIVER WEIRacont.						
1987:						
07 45 44	17 (26)	6 (11)	746 (67)	758 (46)	4.6 (1.1)	4.8 (0.4)
07 45 45	13 (20)	6 (14)	755 (37)	790 (34)	3.8 (0.5)	4.8 (1.1)
07 45 46	20 (31)	5 (11)	731 (60)	764 (35)	4.0 (0.6)	5.0 (0.8)
1988:						
07 47 29	24 (24)	0	554 (72)	--	--	--
07 47 30	21 (21)	0	543 (60)	--	--	--
07 47 33	41 (41)	0	566 (43)	--	--	--
07 47 34	49 (50)	0	570 (48)	--	--	--
1987:						
10 31 51b	1	0	700	--	--	--
SPAWNING GROUND SURVEYS						
1986:						
07 43 01c	0	1	--	860	--	--
07 40 12d	1	0	450	--	--	--
07 40 17d	1	1	890	810	--	--
07 40 19d	1	0	890	--	--	--
07 40 20d	0	1	--	820	--	--
07 40 21d	1	0	890	--	--	--
1987:						
07 45 44c	2	1	750 (14)	770	--	--
07 45 45c	0	1	--	780	--	--
07 45 46c	0	1	--	765	--	--
07 45 24d	1	0	750	--	--	--
1988:						
07 47 30c	1	0	560	--	--	--
07 47 34c	1	0	530	--	--	--
07 47 43d	1	0	440	--	--	--

b Rapid River Hatchery stray.

c Imnaha River recovery.

d Lookingglass Creek Recovery.

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, 1990 brood year. Standard deviation is shown in parenthesis.

Mean Stock, fork location length of release (mm)	Mean Release weight group (g)	Mean CWT code condition replicates factor	Dates released	Number released	N
<hr/>					
Wallowa:					
Wallowa	Medium	07 54 43	04/22/91	28,815	111
210(19.0)	97.4(26.5)	1.03(0.06)			
Hatchery	smolt	07 54 44	04/22/91	28,738	96
214(17.4)	104.5(26.1)	1.04(0.06)			
	Large	07 53 59	04/22/91	25,868	111
223(18.3)	116.9(29.0)	1.03(0.05)			
smolt		07 53 60	04/22/91	28,018	104
221(18.0)	116.3(29.0)	1.05(0.06)			
	Big Canyon	Medium	07 53 51	26,259	101
209(16.2)	100.0(23.7)	1.08(0.05)			
Facility	smolt	07 53 52	04/26/91	27,267	110
211(15.6)	103.5(23.9)	1.08(0.06)			
	Direct	07 53 53	04/26/91	26,713	309a
195(17.1)	84.7(23.4)	1.06(0.07)			
stream		07 53 54	04/26/91	24,751	(b)
(b)	(b)	(b)			
Imnaha:					
Little Sheep	Medium	07 53 57	04/23/91	24,282	104
208(18.6)	99.2(25.3)	1.07(0.09)			
Creek	smolt	07 53 58	04/23/91	26,644	108
209(16.9)	100.7(25.4)	1.08(0.06)			
	Direct	07 53 55	04/23/91	23,948	300a
187(18.3)	77.4(25.8)	1.08(0.06)			
stream		07 53 56	04/23/91	19,516	(b)
(b)	(b)	(b)			

a N = 50 for mean weight and mean condition factor.

b 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, Big Canyon Facility, and Little Sheep Creek facility in 1991. Standard deviation is shown in parenthesis.

Brood year,	Number recovered		Mean fork length (mm)		Mean weight (kg)	
	CWT	Code	Male	Female	Male	Female
<hr/>						
WALLOWA HATCHERY						
1987:						
07 40 27	2	11	732 (9)	688 (25)	3.2 (0.3)	2.9 (0.3)
07 40 28	3	8	736 (15)	712 (22)	3.4 (0.3)	3.2 (0.4)
07 40 29	6	15	693 (76)	698 (35)	2.8 (0.4)	3.1 (0.4)
07 40 30	1	6	784	703 (32)	4.4	3.2 (0.3)
07 40 31	3	5	741 (36)	695 (33)	3.2 (0.5)	2.9 (0.5)
07 40 32	6	7	695 (52)	688 (28)	2.8 (0.9)	3.0 (0.5)
23 20 26	0	1	--	550	--	--
23 23 43	1	0	540	--	--	--
1988:						
07 45 42	8	4	583 (15)	557 (19)	1.6 (0.2)	1.7 (0.2)
07 45 43	8	1	546 (64)	578	1.5 (0.3)	1.7
07 46 50	10	2	569 (32)	555 (4)	1.5 (0.3)	1.4
07 46 51	4	1	573 (10)	601	1.6 (0.1)	1.8
07 46 52	6	2	566 (22)	553 (18)	1.4 (0.3)	1.5
07 46 55	3	1	581 (9)	555	1.7 (0.4)	--
BIG CANYON FACILITY						
23 20 27	1	0	563	--	1.6	--
LITTLE SHEEP CREEK FACILITY						
1987:						
07 40 34	0	2	--	794 (105)	--	3.0 (0.6)
1988:						
07 46 56	26	7	552 (37)	538 (26)	1.4 (0.3)	1.5 (0.3)
07 46 57	16	11	561 (32)	549 (28)	1.6 (0.3)	1.6 (0.4)

Table 26a. Recovery information for cold-branded downstream migrant Rapid River, and Imnaha stock spring chinook salmon smolts recaptured at Lower Granite Dam in 1990, 1988 brood year. Number of observed recoveries is shown in parenthesis.

Percent	Size at	Estimated
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Stock, number brand code released	Date of release	release (g)	Number observed	number recovered	of
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Rapid River:

LA-A-4	04/02/90	23.7 (5.4)	115	4,038	19.4
RA-A-4	04/02/90	22.0 (4.3)	131	4,382	21.0

LA-A-2	04/02/90	42.9 (19.5)	144	4,443	21.7
RA-A-2	04/02/90	38.6 (10.0)	122	4,511	21.6

Imnaha:

LA-A-1	03/31/90	35.5 (6.8)	65	2,864	13.7
RA-A-1	03/31/90	36.4 (6.0)	107	5,259	26.0

Stock, yeara□ brand code 24	Cumulative percent of recoveries by week of the year									
	14	15	16	17	18	19	20	21	22	23

Rapid River:

LA-A-4	0.0	20.9	78.5	99.3	100	--	--	--	--	--
RA-A-4	0.3	22.2	88.4	99.3	100	--	--	--	--	--

LA-A-2	0.0	31.6	87.0	96.6	98.6	100	--	--	--	--
RA-A-2	0.0	16.6	74.1	93.0	95.7	98.0	100	--	--	--

Imnaha:

LA-A-1	0.0	5.0	40.2	73.6	84.1	95.6	97.5	97.9	100	--
RA-A-1	0.0	2.4	37.7	88.6	94.9	97.4	99.5	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 26b. Recovery information for cold-branded downstream migrant Rapid River, and Imnaha stock spring chinook salmon smolts recaptured at Lower Granite Dam in 1991, 1989 brood year. Number of observed recoveries is shown in parenthesis.

Percent Stock, number brand code released	Date of release	Size at release (g)	Estimated		
			Number observed	number recovered	of
<hr/>					
Rapid River:					
RD-J-1	04/01/91	24.1(5.0)	246	6,449	31.0
LD-J-1	04/01/91	22.3(3.8)	236	6,057	29.1
RD-J-3	04/01/91	39.9(27.7)	283	8,072	36.6
LD-J-3	04/01/91	39.4(24.3)	213	5,667	29.3
Imnaha:					
RD-J-2	03/22/91	20.5(3.1)	119	4,542	22.2
LD-J-2	03/22/91	20.5(3.2)	124	4,755	23.0
RD-J-4	03/22/91	28.0(13.3)	127	5,085	24.6
LD-J-4	03/22/91	29.8(13.3)	121	4,256	20.5
<hr/>					
<hr/>					
<hr/>					
Stock, year□ brand code	14	15	16	17	Cumulative percent of recoveries by week of the year
24					
Rapid River:					
RD-J-1	0.0	3.1	17.0	72.1	88.7
--					97.0
LD-J-1	0.0	4.0	16.7	74.1	94.6
100					97.6
--					99.2
RD-J-3	0.0	2.4	12.2	69.9	92.1
--					97.8
LD-J-3	0.0	2.8	15.3	63.8	93.4
--					99.7
					99.7
					100

Imnaha:											
RD-J-2	0.0	0.9	3.4	50.5	76.7	89.0	97.8	100	--	--	
--											
LD-J-2	0.0	0.0	4.5	49.7	68.6	87.4	97.9	100	--	--	
--											
RD-J-4	0.0	0.0	2.7	49.9	76.8	95.2	98.4	99.7	99.7	99.7	
100											
LD-J-4	0.0	1.2	8.4	46.3	63.2	89.4	93.2	98.6	99.3	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 27a. Recovery information for cold-branded downstream migrant Wallowa and Imnaha stock summer steelhead recaptured at Lower Granite Dam in 1990, 1989 brood year. Standard deviation of weight is shown in parenthesis.

Percent Stock, number brand code released	Date of release release	Size at release (g)	Estimated		
			Number observed	number recovered	of
<hr/>					
Wallowa:					
LD-A-3	04/15-19/90	77.4 (20.9)	159	5,783	23.2
RD-A-3	04/15-19/90	94.9 (24.8)	182	6,292	24.7
LD-A-1	04/15-19/90	105.7 (27.2)	240	8,057	33.2
RD-A-1	04/15-19/90	110.3 (27.3)	196	6,843	26.8
LD-A-2	04/19/90	96.3 (31.4)	144	4,777	19.4
RD-A-2	04/19/90	96.3 (31.4)	214	6,174	25.4
LD-A-4	04/24-26/90	86.1 (34.7)	184	5,502	22.2
RD-A-4	04/24-26/90	107.7 (46.9)	209	6,968	30.3
<hr/>					
Imnaha:					
LD-J-3	04/17/90	78.6 (21.8)	66	2,199	8.3
RD-J-3	04/17/90	81.8 (27.0)	61	2,408	9.8

Stock, Cumulative percent of recoveries by week of the yeara□

brand code	16	17	18	19	20	21	22	23	24	25	26	27
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Wallowa:

LD-A-3	0.0	36.4	64.4	72.1	77.4	80.9	97.0	98.8	99.8	100	--	--
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RD-A-3	0.0	31.8	61.4	72.5	78.1	83.2	95.6	98.1	98.9	99.8	100	--
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LD-A-1	0.0	28.1	54.2	63.1	68.1	77.9	91.1	97.5	99.2	100	--	--
--------	-----	------	------	------	------	------	------	------	------	-----	----	----

RD-A-1	0.0	28.0	58.7	72.5	77.2	82.4	96.5	98.6	99.6	99.8	100	--
--------	-----	------	------	------	------	------	------	------	------	------	-----	----

LD-A-2	0.0	21.9	55.8	77.6	78.6	83.8	94.7	96.7	99.7	99.7	100	--
--------	-----	------	------	------	------	------	------	------	------	------	-----	----

RD-A-2	0.0	15.7	48.3	66.4	73.1	79.3	90.7	95.3	98.8	100	--	--
--------	-----	------	------	------	------	------	------	------	------	-----	----	----

LD-A-4	0.0	3.9	56.8	78.8	82.8	87.4	94.9	98.5	100	--	--	--
--------	-----	-----	------	------	------	------	------	------	-----	----	----	----

RD-A-4	0.0	0.7	43.3	82.6	85.5	91.0	97.8	98.5	100	--	--	--
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Imnaha:

LD-J-3	15.9	36.7	51.7	61.7	66.6	68.3	91.0	96.7	98.9	99.5	99.5	100
--------	------	------	------	------	------	------	------	------	------	------	------	-----

RD-J-3	0.0	39.5	65.7	70.7	75.5	84.4	98.5	100	--	--	--	--
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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 27b. Recovery information for cold-branded downstream migrant Wallowa and Imnaha stock summer steelhead recaptured at Lower Granite Dam in 1991, 1990 brood year. Standard deviation of weight is shown in parenthesis.

Percent Stock, number brand code released	Date of release	Size at release (g)	Number observed	Estimated number of recovered
<hr/>				
Wallowa:				
RA-J-3	04/22/90	97.4(26.5)	164	8,526 42.4
LA-J-3	04/22/90	104.5(26.1)	209	9,615 45.8
RA-J-1	04/22/90	116.9(29.0)	166	9,980 49.5
LA-J-1	04/22/90	116.3(29.0)	146	8,050 38.7
RA-J-2	04/26/90	100.0(23.7)	178	10,580 51.2
LA-J-2	04/26/90	103.5(23.9)	177	11,570 55.2
RA-J-4	04/26/90	84.7(23.4)	124	7,674 37.8
LA-J-4	04/26/90	84.7(23.4)	129	8,552 41.1
RA-A-2	04/30/90	72.4(18.5)	178	13,046 48.2
LA-A-2	04/30/90	77.2(17.0)	151	10,953 41.9
Imnaha:				
RA-A-3	04/23/90	99.2(25.3)	242	7,938 39.8
LA-A-3	04/23/90	100.7(25.4)	292	10,534 51.4
RA-A-1	04/23/90	77.4(25.8)	183	7,274 36.4
LA-A-1	04/23/90	77.4(25.8)	226	8,668 43.6
<hr/>				

Table 27a. cont.

Stock, brand code	17	18	19	20	21	22	23	24	25	26	27	28	Cumulative percent of recoveries by week of the yeara□
<hr/>													
Wallowa:													
RA-J-3	0.0	10.0	24.6	57.9	84.2	92.6	94.9	97.1	97.9	98.3	99.6	100	
LA-J-3	0.6	11.9	24.9	55.0	78.2	89.4	93.7	97.1	98.1	98.6	99.3	100	
RA-J-1	0.6	14.4	34.5	56.3	89.9	95.4	97.6	99.1	99.4	99.6	100	--	
LA-J-1	0.0	16.4	30.3	49.2	89.1	94.7	96.6	98.7	99.1	99.6	99.7	100	
RA-J-2	0.0	4.5	18.9	55.7	86.8	95.7	97.2	99.0	99.6	99.9	99.9	100	

LA-J-2	0.0	5.2	23.1	59.8	91.3	97.3	98.6	99.3	99.7	99.7	99.9	100
--------	-----	-----	------	------	------	------	------	------	------	------	------	-----

RA-J-4	0.0	20.5	46.1	73.2	93.5	96.7	97.8	99.2	99.3	99.7	99.8	100
LA-J-4	0.7	22.5	48.6	85.1	95.5	98.4	98.7	99.2	99.5	99.8	99.9	100

RA-A-2	0.0	0.5	35.1	69.5	96.3	98.6	99.4	99.8	99.8	99.8	100	--
LA-A-2	0.0	1.1	36.9	69.8	94.3	98.3	99.5	99.8	99.8	99.8	99.9	100

Imnaha:

RA-A-3	0.0	0.0	2.7	20.6	60.4	78.1	88.7	92.8	96.9	98.5	99.7	100
LA-A-3	0.0	0.0	4.9	32.8	68.1	82.7	87.9	93.0	96.2	98.3	99.0	100

RA-A-1	0.0	8.2	18.3	54.6	75.9	85.2	89.4	92.9	96.0	98.2	99.7	100
LA-A-1	0.0	6.2	17.4	44.2	73.7	83.2	90.3	93.8	95.5	97.9	99.0	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, 1989 brood. Standard deviation is shown in parenthesis.

Stock, fork length release (mm)	Mean location of weight release (g)	Mean Release condition group factor	Date released	Brand	Number replicates	Mean released	N
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Rapid River:

Lookingglass	Medium	04/01/91	RD-J-1	20,799	331a
125(6.7)	24.1(5.0)	1.15(0.05)			

Hatchery	smolt	04/01/91	LD-J-1	20,819	302b
124(6.9)	22.3(3.8)	1.15(0.09)			

	Large	04/01/91	RD-J-3	22,083	322c
143(20.6)	39.9(27.7)	1.19(0.07)			

	smolt	04/01/91	LD-J-3	19,375	302d
146(23.7)	39.4(24.3)	1.18(0.17)			

Imnaha:

Imnaha River	Medium	03/22/91	RD-J-2	20,441	104
121(5.5)	20.5(3.1)	1.14(0.05)			

facility	smolt	03/22/91	LD-J-2	20,676	109
121(5.6)	20.5(3.2)	1.14(0.04)			

		Large	03/22/91	RD-J-4	20,668	105
132(16.3)	28.0(13.3)	1.16(0.04) smolt	03/22/91	LD-J-4	20,777	111
135(15.8)	29.8(13.3)	1.16(0.05)				

a N = 25 for mean weight and mean condition factor.

b N = 34 for mean weight and mean condition factor.

c N = 60 for mean weight and mean condition factor.

d N = 67 for mean weight and mean condition factor.

Table 29. Release information for cold-branded summer steelhead juveniles released in the Grande Ronde and Imnaha river basins, 1990 brood year. Standard deviation is shown in parenthesis.

Stock, Mean location weight of release (g)	Mean condition factor	Release group	Date released	Brand rep- licates	Number released	N	Mean fork length (mm)
Wallowa:							
Wallowa	Medium		04/22/91	RA-J-3	20,100	111	210(19.0)
97.4(26.5)	1.03(0.06)						
Hatchery	smolt		04/22/91	LA-J-3	20,989	96	214(17.4)
104.5(26.1)	1.04(0.06)						
	Large		04/22/91	RA-J-1	20,161	111	223(18.3)
116.9(29.0)	1.03(0.05)						
	smolt		04/22/91	LA-J-1	20,777	104	221(18.0)
116.3(29.0)	1.05(0.06)						
Big Canyon	Medium		04/26/91	RA-J-2	20,654	101	209(16.2)
100.0(23.7)	1.08(0.05)						
facility	smolt		04/26/91	LA-J-2	20,946	110	211(15.6)
103.5(23.9)	1.08(0.06)						
	Direct		04/26/91	RA-J-4	20,289	309a	195(17.1)
84.7(23.4)	1.06(0.07)						
	stream		04/26/91	LA-J-4	20,798	(b)	(b)
(b)	(b)						
Grande Ronde	Wildcat		04/30/91	RA-A-2	27,055	150c	186(16.7)
72.4(18.5)	1.11(0.10)						
River	Creek		04/30/91	LA-A-2	26,124	152a	188(20.1)
77.2(17.0)	1.10(0.06)						

Imnaha:

Little Sheep	Medium	04/23/91	RA-A-3	19,953	104	208 (18.6)
99.2(25.3)	1.07(0.09)					
Creek	smolt	04/23/91	LA-A-3	20,499	108	209 (16.9)
100.7(25.4)	1.08(0.06)					
Direct		04/23/91	RA-A-1	20,000	300a	187 (18.3)
77.4(25.8)	1.08(0.06)					
stream		04/23/91	LA-A-1	19,890	(b)	(b)
(b)	(b)					

a N = 50 for mean weight and mean condition factor.

b Sample size, mean length, mean weight, and mean condition factor are the same for the replicate release group.

c N=54 for mean weight and mean condition factor.

Table 30. Total catch, escapement and survival of coded-wire-tagged spring chinook salmon released in the Grande Ronde and Imnaha river basins, 1985-1987 brood years and 1988 brood subyearlings. Recoveries are complete for the 1985 and 1986 brood years (age 3-5). Total strays includes Deschutes River catch and trap recoveries, and catch and trap recoveries from areas other than river-of-release (excluding the mainstem Columbia River). Col. River = Columbia River.

Brood year, stock, CWT code	Month of re- lease	Catch Col. Ocean	Catch Rivera	Spawn- ing escape- ment	Total strays	Return rate (% of release)	Total survival rate (% of release)
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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	3	3	0	<0.01	0.01
07 38 04	Sep	0	0	4	0	<0.01	<0.01
07 38 07	Nov	0	0	16	0	0.03	0.03
07 38 08	Nov	1	3	5	0	0.01	0.02
07 38 05	Apr	0	31	64	1	0.12	0.18
07 38 06	Apr	0	11	72	1	0.14	0.16
07 39 56b	Mar	0	9	27	3	0.07	0.10
07 39 57b	Mar	0	12	27	2	0.07	0.10

Rapid River:

07 38 11	Apr	0	2	21	0	0.04	0.05
07 38 12	Apr	0	0	16	0	0.03	0.03

Imnaha:

07 38 09	Apr	0	19	48	0	0.09	0.13
07 38 10	Apr	0	26	40	0	0.05	0.12

1986:

Carson:

07 40 22	Jul	0	0	4	1	0.01	0.01
07 40 23	Jul	0	0	0	0	0.00	0.00

Rapid River:

07 40 11	May	0	0	0	0	0.00	0.00
07 40 12	May	0	0	0	0	0.00	0.00
07 40 13	May	0	0	0	0	0.00	0.00
07 40 16	Sep	0	0	0	0	0.00	0.00
07 40 17	Sep	0	2	2	0	<0.01	0.01
07 40 18	Nov	0	2	14	0	0.04	0.04
07 40 19	Nov	0	14	15	2	0.03	0.08
07 40 20	Apr	0	15	67	2	0.16	0.20
07 40 21	Apr	0	50	92	0	0.22	0.33
07 40 14	Apr	0	3	40	0	0.09	0.10
07 40 15	Apr	0	11	51	0	0.12	0.15

a Includes winter gill net, Columbia River test fisheries, and ceremonial and subsistence fisheries.

b Big Canyon Creek release.

Table 30. continued.

Brood year, stock, CWT code	Month of re- lease	Catch Col.	Catch Ocean	Catch River	Spawn- ing escape- ment	Total strays	Return rate (% of release)	Total survival rate (% of release)
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Imnaha:

07 42 60	Mar	2	3	73	11	0.16	0.20
07 42 63	Apr	0	4	45	1	0.10	0.11
07 43 01	Apr	0	5	56	3	0.12	0.14
07 43 02	Mar	0	4	83	3	0.17	0.18

1987:

Rapid River:

07 45 23	May	0	0	0	0	0.00	0.00
07 45 24	May	0	0	1	0	<0.01	<0.01
07 45 25	May	0	0	0	0	0.00	0.00

07 46 30	Sep	0	0	0	0.00	0.00
07 46 31	Sep	0	0	0	0.00	0.00
07 46 32	Nov	0	0	1	<0.01	<0.01
07 46 33	Nov	0	0	1	<0.01	<0.01
07 45 31	Apr	0	2	6	0.01	0.02
07 45 32	Apr	0	1	8	0.02	0.02
07 45 33	Apr	0	1	11	0.03	0.03
07 45 35	Apr	0	2	19	0.04	0.05

Imnaha:

07 45 44	Apr	0	0	60	2	0.13	0.14
07 45 45	Apr	0	0	30	0	0.07	0.07
07 45 46	Apr	0	0	57	4	0.13	0.14

1988:

Rapid River:

07 47 36	May	0	0	0	0	0.00	0.00
07 45 34	May	0	0	0	0	0.00	0.00
07 45 46	May	0	0	0	0	0.00	0.00

Table 31. Recovery information for coded-wire-tagged Wallowa and Imnaha stock summer steelhead, 1987 and 1988 brood years. Recoveries are complete for the 1987 brood year, but only include age 3 recoveries for the 1988 brood year.

Brood year, stock, CWT Code	release group	N	Total exploi- tation rate(%)	Hatchery return rate (% of of release)	Total survival rate (% of release)
<hr/>					
1987:					
Wallowa:					
07-40-27	Medium	165	77.0	0.13	0.61
07-40-28	smolts	235	83.0	0.15	0.86
07-40-29	Large	194	72.2	0.20	0.72
07-40-30	smolts	193	83.9	0.12	0.73
07-40-31	Direct	127	82.7	0.09	0.50
07-40-32	stream	140	76.4	0.13	0.55
Imnaha:					
07-40-33	Imnaha	132	46.2	0.26	0.48
07-40-34	smolts	174	64.4	0.23	0.63
<hr/>					
1988:					
Wallowa:					

07	46	50	Medium	21	42.9	0.04	0.08
07	46	51	smolts	18	72.2	0.02	0.07
07	45	42	Large	30	60.0	0.05	0.11
07	45	43	smolts	35	74.3	0.03	0.13
07	46	55	Direct	11	54.5	0.02	0.04
07	46	52	stream	17	52.9	0.03	0.07

Table 31. Extended.

	07	46	50	0	6	0	0	2	0	0	12
1	07	46	51	0	5	0	6	2	0	0	5
0											
	07	45	42	0	15d	0	0	2	0	0	12
1	07	45	43	0	17	0	3	6	0	0	9
0											
	07	46	55	0	2	0	3	1	0	0	5
0	07	46	52	0	5	0	3	1	0	0	8
0											
	Imnaha:										
1	07	46	56	0	6	2	8	0	0	0	33
2	07	46	57	0	18	0	3	0	0	0	27

a Includes Deschutes tribal fishery recoveries.

b Round Butte Hatchery and Warm Springs Hatchery recoveries.

c Includes Grande Ronde and Wallowa Rivers for Wallowa stock and Imnaha River for Imnaha stock.

d Includes one test fishery recovery.

Table 32. Number of adult (age 3 and 4) summer steelhead in the 1990-91 run year and adult (age 4 and 5) spring chinook salmon in the 1990 and 1991 run years produced by releases from Lower Snake River Compensation Plan facilities in Oregon.

Run Year, Stock, brood year	Ocean catch	Columbia River Neta Sport	Des- chutes Riverb	Trib- utary sportc	Spawning escape- mentd	Total recov- eries
SUMMER STEELHEAD						
1990-91 Run Year:						
Wallowa:						
1987	27	2,241	356	505	126	806
1988	0	443	0	256	0	468
Stock total	27	2,684	356	761	126	1,274
						5,228
Imnaha:						
1987	0	124	0	171	218	31
1988	0	145	12	66	0	380
Stock total	0	269	12	237	218	411
Species total	27	2,953	368	998	344	1,685
						6,375

SPRING CHINOOK

1990 Run Year:

Carson:

1985	0	19	20	0	--	64	103
1986	0	27	37	0	--	346	410
Stock total	0	46	57	0	--	410	513

Rapid River:

1985	0	0	0	0	--	22	22
1986	0	23	45	0	--	465	533
Stock total	0	23	45	0	--	487	555

Imnaha:

1985	0	0	0	0	--	6	6
1986	2	10	0	8	--	270	290
Stock total	0	10	0	0	--	276	296

Species total 2 79 102 8 -- 1,173 1,364

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 and trap recoveries.

c Includes Snake, Grande Ronde, and Wallowa rivers for Wallowa stock summer

steelhead and Snake and Imnaha rivers for Imnaha stock summer steelhead.

d Includes in basin strays.

Table 32. cont.

Run Year, Stock, brood year	Ocean catch	Columbia River Neta Sport	Des- chutes Riverb	Trib- utary sportc	Spawning escape- mentd	Total recov- eries
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SPRING CHINOOK

1991 Run Year:

Carson:

1986	0	16	13	2	--	48	79
1987	0	7	0	0	--	53	60
Stock total	0	23		2	--	101	139

Rapid River:

1986	0	37	26	4	--	110	177
1987	0	21	0	0	--	159	180
Stock total	0	58		4	--	269	357

Imnaha:

1986	0	3	0	0	--	23	26
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1987	0	0	0	5	--	119	124
Stock total	0	3	0	5	--	142	150
Species total	0	84	39	11	--	512	646

Discussion

Fish Culture Monitoring

For 1990 brood Imnaha stock chinook, we achieved an egg take of 326,612 green eggs. The production goal for the Imnaha program has been reduced from 655,000 green eggs used to produce 490,000 smolts to 400,000 eggs which will be used to produce 300,000 smolts. At this level of production we will be able to evaluate the effectiveness of the hatchery supplementation program by conducting size-at-release comparisons (15 and 25 fish/lb) for acclimated release groups, and direct stream vs. acclimated release groups (25 fish/lb) and still be able to maintain desired levels of natural production above the weir. The production levels were reduced primarily because of poor survival of previous hatchery broods, new restraints caused by the ODFW Wild Fish Policy, and concern for the genetic integrity of the wild fish. Egg loss was 16.5% which was greater than for the 1989 brood (2.9%). In 1989 Imnaha stock adults were transported to Lookingglass Hatchery and held there until they were spawned. The new Imnaha facility was used to hold and spawn adults in 1990, and therefore water-hardened eggs were transferred to Lookingglass Hatchery. This additional handling of eggs was most likely responsible for the higher egg loss in 1990. Prespawning mortality was 18.8% and 11.1% for wild and hatchery females respectively, and 14.6% and 13.0% for wild and hatchery adult males respectively. Most of the adult loss occurred because of fish jumping out of the fish ladder and trap. Covers were placed over the fish ladder and trap to help prevent jump-outs.

For 1991 brood Imnaha stock chinook, we achieved an egg take of 193,206 green eggs. The production goal for the Imnaha program was dependent on the number of returning hatchery and wild origin adults. The broodstock collection guidelines were to keep 2 of 3 returning hatchery fish by sex, and 1 of 2 wild fish by sex. We also kept 100% of returning hatchery jacks, and kept 1 of 10 wild jacks so we could incorporate jacks into the hatchery broodstock. At this level of production we will be able to evaluate the effectiveness of the hatchery supplementation program by conducting size are release (15 and 25 fish/lb release groups) and still maintain natural production above the weir. Egg loss was 14.4% which was less than the 1990 brood. Prespawning mortality was 11.8% and 7.7% for wild and hatchery females respectively, and 7.1% and 1.9% for wild and hatchery adult males respectively. Adult losses were reduced in 1991 primarily by reducing the incidence of fish jumping out of the fish ladder and trap.

Fecundity sampling conducted in 1988 and 1991 showed no differences in mean fecundity between hatchery and wild origin females of the same

age. We will continue fecundity sampling in the future as part of the hatchery evaluation program.

A total of 45 hatchery and 10 wild chinook salmon jacks were trapped at the Imnaha weir in 1990. The age composition for the 1985 brood year was similar to that observed for the 1982-84 broods in that hatchery produced fish returned at a younger age as compared to wild fish, and the majority 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. We have reduced the size-at-release for the 1990 brood to 15 and 25 fish/lb in a attempt to shift age at return to that of the wild fish. 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. More information is needed on the survival and age at return of different life history strategies employed by the wild fish. We also need to determine if these strategies can be incorporated into the hatchery program to help meet management and mitigation goals.

A record number of jacks were trapped at the Imnaha River weir in 1991. Of a total of 240 jacks trapped, 138 were adipose fin marked, and 102 were unmarked. We estimated that 92 of the unmarked jacks were of hatchery origin and 10 of the jacks were of wild origin. Estimates were based on the marked to unmarked release ratio of the 1989 brood.

In 1990, the Imnaha weir was installed on 28 June. The run timing curve for Imnaha chinook salmon returning to the Imnaha River weir in previous years indicated that the early portion of the run passed the weir site before the weir was installed (Figure 1). We determined that 43% of the Imnaha run passed the weir site before the weir was installed and that 73% of this segment of the run was wild fish compared to 83% of the run which was trapped being wild fish. This indicates that the hatchery component of the run returned later than the wild component.

In 1991, the Imnaha weir was installed on 25 June. We estimated that only 13% of the Imnaha run passed the weir site before the weir was installed and that 55% of this section of the run was wild fish compared to 46% of the run which was trapped being wild fish. The hatchery and wild chinook run timing in 1990 and 1991 was more similar to each other than in any previous year (Figure 1).

In 1990, a total of 863,848 Rapid River stock eggs were collected from returns to Lookingglass Hatchery and 184,387 Rapid River stock eggs were received form Rapid River Hatchery in Idaho.

In 1991, a total of 515,951 Rapid River stock eggs were collected from returns to Lookingglass Hatchery and adults collected at Hell's Canyon Dam trap and hauled to Lookingglass Hatchery. A total of 26,694 eyed eggs were shipped to Idaho Department of Fish and Game. This was the number of eggs calculated to have been from the Hell's Canyon fish.

Forty left ventral fin marked Carson stock chinook salmon (age 4 adults) returned to Lookingglass hatchery in 1990 and 72 left-ventral fin marked Carson stock chinook salmon (age 4 and 5) adults returned to

Lookingglass hatchery in 1991. These adults were from the 1986 and 1987 brood smolt releases into Catherine Creek or at the Big Canyon Facility. These stray adults were probably from the Catherine Creek releases because these fish were unacclimated and must swim past the mouth of Lookingglass Creek on their way to Catherine Creek. It is likely that previous releases into Catherine Creek have strayed it Lookingglass

Figure 1. Run timing of hatchery and wild origin Imnaha stock chinook salmon at the Imnaha River weir, 1988-1991.

Hatchery, however this was the first Catherine Creek release group that was marked.

Lookingglass Hatchery produced a total of 18,399 lbs of 1989 brood Rapid River stock smolts and 27,089 lbs of Carson stock smolts for the Grande Ronde Basin which was 100% of the mitigation goal of 45,000 lbs, and 21,216 lbs of Imnaha stock chinook salmon for the Imnaha Basin which 86.6% of the mitigation goal of 24,500 lbs.

Tim's discussion on bimodal length frequencies. Figure 2 and 3.

Figure 2. Length frequency distributions of 1989 brood Rapid River stock spring chinook salmon released at Lookingglass hatchery on 1 April 1991 at 23.2 grams/fish (20 fish/lb release group) n=663, and 39.7 grams/fish (12 fish/lb release group) n=624.

Figure 3. Length frequency distributions of 1989 brood Imnaha chinook salmon released at the Imnaha River Facility on 22 March 1991 at 20.5 grams/fish (25 fish/lb release group) n=400, and 28.9 grams/fish (15 fish/lb release group) n=452.

We nearly achieved the program goal of 1.35 million smolts (1990 brood year) for the Wallowa stock steelhead program. We released a total of 1,338,849 smolts of Wallowa stock into the Grande Ronde River Basin in 1991. A total of 9,025 Wallowa stock presmolt were released into the Snake River. Direct stream releases were limited to Catherine Creek and the upper and lower Grande Ronde River because results from acclimation studies to date at Wallowa Hatchery have shown that acclimated fish have a higher total smolt-to-adult survival rate. Acclimation studies were initiated at the Big Canyon facility and Little Sheep Creek facility with the 1991 smolt releases (1990 brood).

We were just short of the smolt production goal of 330,000 smolts of 1990 brood Imnaha stock steelhead with a release of 329,217 summer steelhead smolts into the Imnaha Basin in 1991. Smolts were released into the lower Imnaha River (at Cow Creek) to increase sport harvest opportunities. A total of 71,698 Imnaha stock were graded off as presmolt and released into the Snake River.

Because of anticipated shortages of Wallowa broodstock at Wallowa Hatchery and the Big Canyon Facility in 1991, the tributary sport harvest of Wallowa stock summer steelhead in the Wallowa River and the Oregon section of the lower Grande Ronde River was closed on 15 November 1990. Catch-and-release seasons remained open in these areas. Exploitation of hatchery run that entered the Oregon section of the Grande Ronde River in 1989-90 was estimated to be 52%, with the majority of the harvest occurring in the spring of 1990 in the Wallowa River (Carmichael et al. 1990). Therefore, by closing the spring fishery, we could expect to double the numbers of adult returns to broodstock collection facilities. As a measure of the increase in adult returns from harvest closure, we examined adult returns to Wallowa Hatchery and the Big Canyon facility for hook marks and found that 14% and 33% of the fish had been hooked that returned to Wallowa Hatchery and the Big Canyon facility respectively. The catch rate on the Wallowa River in the spring of 1991 was 6.1 hour/fish (Carmichael 1991). We do not know the mortality rate associated with the catch and release fishery.

The run timing of Wallowa stock summer steelhead returning to Wallowa Hatchery in 1991 was similar runs prior to high tributary sport harvest (Figure 4). It appears that the early and especially late segments of the run returned at a higher rate than observed for heavily exploited runs.

Figure 4. Run timing of Wallowa stock summer steelhead to Wallowa Hatchery during four different time periods. Levels of tributary (Grande Ronde and Wallowa Rivers) sport harvest varied during these periods. Harvest rate was <5% from 1984-86 and 1991, 26% from 1987-1989, and 52% for 1990.

The return of hatchery steelhead to Little Sheep Creek in 1991 did not provide enough adult broodstock to meet the egg take goal of 750,000 green eggs and therefore we only achieved 61% of the egg take goal. We expect the smolt production goal to be above 61% because of lower than expected egg loss. Adult escapement above the weir was also low due to low numbers of adult returns. Only 4.9% of the fish spawned for hatchery broodstock were of wild origin and 25.5% of the fish released above the weir were wild. Hatchery returns were predominantly age 3 fish from the 1988 brood year. The wild component of the Little Cheep Creek run was low, even though 38 wild and 186 hatchery females were released above the

weir in 1987. Progeny from these releases migrated to the ocean in 1989 and it appears that migration success was very poor, at least for the hatchery origin fish (Messmer et al 1990).

Survival Studies

The third brood year (1988 brood) of cold branded Rapid River stock spring chinook salmon was released from Lookingglass Hatchery in 1990 for evaluation of out migration performance and survival. The passage index at Lower Granite Dam for yearling smolts released in the spring at an average weight of 22.8 grams/fish was 6.9% lower (21.7% vs. 20.3%) than the passage indexes for smolts released at an average weight of 40.7 grams/fish. (Table 26a).

The fourth brood year (1989 brood) of cold branded Rapid River stock spring chinook salmon was released from Lookingglass Hatchery in 1991 for evaluation of out migration performance and survival. The passage index at Lower Granite Dam for yearling smolts released in the spring at an average weight of 23.2 grams/fish was 9.7% lower (30.0% vs. 32.9%) than the passage indexes for smolts released at an average weight of 39.7 grams/fish. (Table 2
6b). The passage index in 1991 was only 50% greater than the passage index in 1990 for Rapid River yearling smolt releases.

The fourth brood year (1988 brood) of cold branded Imnaha chinook salmon smolts was released in the Imnaha River in 1990. The passage index at Lower Granite Dam (19.8%) was similar to the passage index of Rapid River stock smolts (21.0%) released at Lookingglass Hatchery at the same time. The passage index at Lower Granite Dam in 1990 was 130% greater than the passage index for the 1987 brood released in 1989. In the 1990 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 (Table 26a).

The fifth brood year (1989 brood) of cold branded Imnaha chinook salmon smolts was released in the Imnaha River in 1991. Smolts released for size-at-release comparisons at 20.5 and 28.6 grams/fish had equal passage indices (22.6%). The passage indices in 1991 were equal to the passage indices in 1990, but it appears that the fish migrated past Lower Granite Dam 1 week later in 1991.

The 1991 releases of AdLV+CTW marked 1990 brood summer steelhead smolts at Wallowa Hatchery represented the sixth and final year of size-at-release comparisons. The mean weights of summer steelhead release groups used in size-at-release release comparisons were larger than the target size because of additional growth in the acclimation ponds than observed in the previous years. Size differences between release groups were caused by shortages of water at Irrigon Hatchery which did not allow fish to reach desired size, and the fish in acclimation ponds had more growth than expected due to warmer water temperatures. Fish targeted for 113 grams/fish (4 fish/lb) at release averaged 116 grams/fish (3.9 fish/lb) and fish targeted for 91 grams/fish (5 fish/lb) at release averaged 101 grams/fish (4.5 fish/lb). Acclimation studies were initiated at the Big Canyon and Little Sheep Creek facilities in 1991.

There were differences in release sizes between acclimated and direct stream release groups at both locations. Acclimated fish averaged 101.7 (4.5 fish/lb) and 100.0 grams/fish (4.5 fish/lb) at Big Canyon and Little Sheep facilities respectively, but direct stream releases were smaller averaging 84.7 (5.4 fish/lb) and 77.4 grams/fish (5.9 fish/lb) at Big Canyon and Little Sheep Creek facilities respectively.

The passage indexes at Lower Granite Dam for cold branded 1989 brood summer steelhead smolts released at Wallowa Hatchery and at the Little Sheep Creek facility in spring of 1990 were similar to the 1988 brood released in 1989. The average passage index for Wallowa stock steelhead smolts acclimated and released at Wallowa Hatchery in 1989 was 27.2 % compared to a passage index of 27.6% for acclimated smolts released in 1990. The average passage index for Imnaha stock steelhead smolts released in 1990 (1989 brood year) was 9.1%, compared to only 8.4% for 1988 brood released in 1989. The lower Grande Ronde River release group (Wildcat Creek) was 26.3% in 1990 compared to 20.3% in 1989 (Table 27a).

The 1991 passage indices for 1990 brood summer steelhead at Lower Granite Dam were the highest observed to date. The passage index for or Wallowa stock steelhead released at Wallowa hatchery was 44.2%, 1.6 times greater than the passage index in 1990. The passage index for releases of acclimated fish at the Big Canyon Facility was 53.2%, which was 35% greater than the passage index (39.5%) for the direct stream release group. The passage index for the lower Grande Ronde River (at Wildcat Creek) release group was 45.1%, 1.5 times greater than the 1990 release. The passage indices for groups of Imnaha stock summer steelhead released at the Little Sheep Creek Facility were 45.7% for acclimated fish, and 40.0% for direct stream releases. The passage index for Little Sheep acclimated releases in 1991 was 4.4 times greater than the 1990 releases, and is by far the best passage observed for releases of summer steelhead at the Little Sheep Creek. If the increase in smolt survival to Lower Granite Dam translate the same magnitude of increase in adult returns, there will be a substantial number of surpluss hatchery adults returning to the Little Sheep Creek facility in 1993.

Returns are complete for the 1987 brood Wallowa stock summer steelhead released for size-at-release comparisons. The fish released at an average weight of 104.8 grams/fish (4 fish/lb release group) survived at a 0.72% and fish released at an average weight of 96.6 grams/fish (5 fish/lb release group) survived at 0.74%. (Table 31). Total survival (catch and escapement) of the 1987 broods of summer steelhead released for size-at-release comparisons (4 and 5 fish/lb) was less than the 1985 and 1986 brood years. The 4 fish/lb release group survived at 1.94% and 1.04% for the 1985 and 1986 broods respectively and the 5 fish/lb release groups survived at 1.06% and 1.08% for the 1985 and 1986 broods respectively. The 1987 brood Wallowa stock direct stream release group survived at 0.53% compared to the acclimated release group survival of 0.74%, a 40% increase in survival from acclimation. The hatchery return rate for the 1987 brood summer steelhead acclimated at Wallowa Hatchery was 27% greater than the direct stream release group which may indicate better imprinting or homing ability with acclimation or higher exploitation of direct stream release groups. 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 due to poor water quality. Acclimation studies were initiated at the Little Sheep Creek facility and the Big Canyon facility with the 1991 releases.

Returns are complete for the 1987 brood Imnaha summer steelhead. Total survival (catch and escapement) was 0.56% compared to only 0.19% for the 1986 brood year and 0.81% for the 1985 brood year.

The exploitation rates (not corrected for unaccountable losses) of 1987 brood Wallowa and Imnaha stock summer steelhead which returned in the 1989-90 and 1990-91 run years averaged 79% and 55% respectively (Table 31).

Spring chinook adult returns to the LSRCP compensation area in 1990 and 1991 were only 11.8% and 6.4% respectively for the mitigation goal of 5,820 adults for the Grande Ronde Basin (Table 32). We were only able to release 74% (44% for Rapid River stock only) of the mitigation goal of 900,000 yearling smolts for the Grande Ronde Basin for the 1985 brood year and 76% of the mitigation goal for the 1986 brood year.

We estimated that only 276 hatchery Imnaha chinook salmon adults returned to the LSRCP compensation area in 1990, and 142 in 1991 which represented only 8.6% and 4.4% respectively of Oregon's mitigation goal of 3,210 chinook for the Imnaha Basin. Adults that returned in the 1990 run year were from releases of the 1985 and 1986 broods which were only 25.2% and 40.6% respectively of the yearly mitigation goal of 490,000 smolts (Table 32). Adults that returned in the 1991 run year were from releases of the 1986 and 1987 broods which were only 40.6% and 29.0% respectively of the yearly mitigation goal of 490,000 smolts (Table 32).

We estimated that 1,400 Wallowa stock summer steelhead returned to the LSRCP compensation area in the 1990-91 run year, which was 15% of the mitigation goal of 9,184 adults for the Grande Ronde Basin (Table 32). Smolt releases that produced the 1990-91 run were 100% of the mitigation goal for the 1987 and 1988 brood years. Of the total fish we could account for in the 1990-91 run year, 73% were harvested below Lower Granite Dam. A total of 70% of this harvest occurred in the Columbia River Net fishery.

A total of 629 hatchery stock Imnaha summer steelhead returned to the LSRCP compensation area in the 1990-91 run year, which represented 31% of the mitigation goal of 2,000 steelhead for the Imnaha Basin. Smolt releases that produced adults in the 1990-91 run year were 100% of the mitigation goal of 330,000 smolts for the Imnaha Basin for the 1986 and 1987 brood years, respectively (Table 32). Of the total fish we could account for in the 1990-91 run year, 45% were harvested below Lower Granite Dam. A total of 23% of this harvest occurred in the Columbia River Net fishery.

We were only able to recover and examine 11.8% and 6.0% of the estimated adult spring chinook spawning population in the Minam and Wenaha rivers respectively in 1990 and 10.8% and 12.1% in the Minam and Wenaha rivers respectively in 1991. These recovery rates are among the lowest observed on N.E. Oregon spring chinook spawning ground surveys. Expansions of numbers of hatchery strays from such low recovery rates may not reflect actual stray rates. The 1992 chinook releases (1990 brood) were 100% adipose fin or ventral fin marked so all hatchery strays will be identifiable on spawning ground surveys.

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 in fish prior to release as well as to determine if incubation and rearing strategies affected the incidence of EIBS, alternate incubation and rearing strategies were developed for the 1988 and 1989 broods of Imnaha chinook salmon (Messmer et al. 1989). No EIBS was detected in any of the 1988 or 1989 broods of chinook salmon at Lookingglass Hatchery (Christianson et al. 1990, Berry et al. 1991).

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 and in most years 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 will be requesting 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 were initiated to determine if presmolt can be used to effectively return adults to compensation areas. This release strategy would help maximize numbers of returning adults with facilities and fish that are available. Surplus Carson stock chinook were released as presmolt from 1984 through 1987. In 1984 we released presmolt into Catherine Creek, the upper Grande Ronde River, and Lookingglass Creek. In 1985, 1986, and 1987 presmolt were released only into Lookingglass Creek. We marked (Ad+CWT) presmolt 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 1985 and 1986 brood presmolts released at Lookingglass Creek in July of 1986 and 1987 respectively. Total survival (catch plus escapement) for these release groups was less than 0.01%. This annual report will conclude the reporting of the presmolt study, but coded-wire-tag recovery tables in the 1992 annual report will update the 1987 brood recoveries through age 5.

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