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Facilities in Oregon

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

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Reprogramming Spring Chinook Salmon Smolts from  
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## SUMMARY

### EVALUATION OF LOWER SNAKE RIVER COMPENSATION PLAN FACILITIES IN OREGON

#### Objectives for FY 1989

1. Document egg-take, egg-to-smolt survival, growth, and disease profile of spring chinook salmon and summer steelhead reared and released at Lower Snake River Compensation Plan (LSRCP) facilities.
2. Determine fin condition, degree of descaling, degree of smolting, and percent precocious males for Wallowa and Imnaha stock summer steelhead.
3. Document number, size, time, and location of releases for chinook salmon and summer steelhead produced at Lower Snake River Compensation Plan facilities.
4. Determine sex ratio, run timing, and spawning timing for chinook salmon that return to Lookingglass Hatchery, Big Canyon facility, and the Imnaha River weir and for summer steelhead that return to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility.
5. Collect and analyze scales from chinook salmon and summer steelhead adults to determine age composition and length-age relationships.
6. Release the following groups of 1987 brood chinook salmon that were marked (Ad+CWT) and cold-branded: Rapid River stock for subyearling smolt evaluation, time-of-release comparisons, and production survival estimates; and Imnaha stock chinook for production survival estimates.
7. Mark (Ad+CWT) and cold brand the following groups of 1988 brood chinook salmon: Rapid River stock for subyearling smolt evaluation, size-at-release comparisons, and production survival estimates; and Imnaha stock for production survival estimates.
8. Mark (AdLV+CWT), cold brand and release the following groups of 1988 brood summer steelhead: Wallowa stock for size-at-release comparisons, acclimation evaluation, and production survival estimates; and Imnaha stock for production survival estimates.
9. Mark all 1987 brood Carson stock spring chinook salmon smolts with left ventral fin clips for stock identification.
10. Collect and decode coded-wire tags from marked adults that return to adult collection facilities.
11. Summarize catch and escapement information for groups of coded-wire tagged chinook salmon and summer steelhead as information becomes available.

12. Summarize information from cold-branded smolts recovered at Snake River collection sites.
13. Conduct chinook salmon spawning ground surveys in the Minam and Wenaha rivers in cooperation with Oregon Department of Fish and Wildlife (ODFW) management personnel to recover carcasses of marked hatchery strays.
14. Participate in planning activities associated with anadromous fish production and management in the Grande Ronde and Imnaha River basins.
15. Determine the number of summer steelhead caught, catch rates, and angling effort in recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers.
16. Estimate total number of summer steelhead adults in the 1988-89 run year and chinook salmon adults in the 1988 run that resulted from smolts produced at Oregon's LSRCP hatcheries.
17. Determine the number of chinook salmon adults outplanted from Lookingglass Hatchery that return back to the hatchery, are recovered on spawning grounds, and are harvested in tribal fisheries.

#### Accomplishments in FY 1989

We accomplished all of our original objectives in FY 1989.

#### Findings in FY 1989

A total of 2,392 Carson stock, 28 Rapid River stock (age 3) and 48 Imnaha stock (age 3) spring chinook salmon returned to Lookingglass Hatchery in 1988. We trapped 394 chinook salmon at the Imnaha River weir of which 36 were hatchery fish.

Run timing of marked Imnaha stock hatchery jacks at Lower Granite Dam in 1988 indicated that the Imnaha hatchery chinook are summer run fish.

Infectious hematopoietic necrosis virus (IHNV) was detected at a 8.2% prevalence rate in Carson stock and at a 1.0% prevalence rate in Imnaha stock spawned at Lookingglass Hatchery in 1988. IHNV was detected at a 2.4% prevalence rate in Rapid River stock spawned at Rapid River Hatchery.

No erythrocytic inclusion body syndrome (EIBS) was detected in 1987 brood Lookingglass, Rapid River or Imnaha stock juveniles at Lookingglass Hatchery.

A total of 1,220 summer steelhead adults returned to Wallowa Hatchery in 1989. We trapped 56 wild and 306 hatchery steelhead adults at the Little Sheep Creek facility in 1989. At the Big Canyon Creek facility we trapped 15 wild steelhead and 332 hatchery steelhead. A total of 242

hatchery and 13 wild steelhead were released above the Big Canyon facility weir to spawn.

IHNV was detected at a 0.8% prevalence rate in Wallowa stock steelhead spawned at Wallowa Hatchery and the Big Canyon Creek facility, and at a 0.8% prevalence rate for Imnaha stock steelhead spawned at the Little Sheep Creek facility in 1989.

Smolt-to-adult survival rate (catch plus escapement) for CWT 1985 brood Wallowa stock summer steelhead smolts released at an average weight of 112.7 grams and 84.0 grams was 1.93% and 1.06%, respectively. The survival rate for Imnaha stock summer steelhead released at an average size of 82.5 grams/fish was 0.81%.

Smolt-to-adult survival rate (catch plus escapement) for 1983 brood Carson stock chinook salmon released from Lookingglass Hatchery was low for all groups except those released in the spring. Fish released in July, September, and November of 1984 survived at 0.02%, 0.03% and 0.07%, respectively. Fish released in April survived at 0.36%, the highest survival observed to date for chinook released from Lookingglass Hatchery. The survival rate for 1983 brood Imnaha chinook salmon was 0.07% for fish released in September and 0.02% for fish released in March.

The smolt passage index at Lower Granite Dam for chinook salmon released at Lookingglass Hatchery in the spring of 1988 was 17.6 times greater than the index for similar sized fish of the same brood released in the fall of 1987. Few fish from the fall release group were recovered at Lower Granite Dam, but it appeared that migration timing was similar for the fall and spring release groups. The migration success of subyearling smolts was similar to the success of yearling smolts.

The smolt passage index for 1987 brood Wallowa stock steelhead released directly into Spring Creek at Wallowa Hatchery was 1.3 times greater than the passage index for groups of Wallowa stock summer steelhead acclimated at Wallowa Hatchery. The passage index for groups of Wallowa stock steelhead released for size-at-release comparisons (4 and 5 fish/pound) were similar. Migration timing for all groups of 1987 brood Wallowa stock steelhead was similar. The migration success to Lower Granite Dam for 1987 brood Imnaha stock summer steelhead was poorer than any group of Wallowa stock steelhead. The duration of migration of Imnaha stock steelhead was similar to Wallowa stock, but the majority of Imnaha stock migrated past Lower Granite Dam one week later.

A total of 1,688 Carson stock chinook salmon adults were outplanted from Lookingglass Hatchery in 1988. We estimated that 9.7% returned back to Lookingglass Hatchery, 4.6% were harvested in tribal fisheries, 11.7% were recovered on spawning ground surveys, and the remaining 74% were unaccounted for.

Two marked hatchery fish were recovered on spawning ground surveys on the Minam River and seven marked hatchery fish were recovered on the Wenaha River spawning ground surveys.

Management Implications

1. The use of fin marks on spring chinook salmon for broodstock identification will result in some level of reduced survival and will complicate between-year comparisons of survival rates.
2. Imnaha chinook smolt releases are producing adults that have a younger age at return than wild fish of the same brood year.
3. Spring chinook smolt-to-adult survival rates continue to be well below mitigation goals; compensation goals will not be met in the near future at current production levels.
4. Smolts acclimated at Wallowa Hatchery are subjected to periodic poor water quality conditions that may affect fish health and smolt-to-adult survival.
5. Even though total smolt-to-adult survival rates for summer steelhead have been good for some brood years, compensation goals may not be met because of high exploitation rates.
6. Implementing the ODFW Wild Fish Policy guideline that mandates that no more than 50% of a natural spawning population can be composed of hatchery fish will greatly reduce the number of hatchery fish that can be passed above the Little Sheep Creek weir.
7. There appears to be a significant loss of smolts between release sites and Lower Granite Dam in most years as indicated by the low percentage of branded smolts recovered at Lower Granite Dam.

#### Recommendations

1. Develop external marking methods that can be used to identify hatchery-origin spring chinook salmon without reducing smolt-to-adult survival.
2. Reduce the size at release for Imnaha chinook smolts in an attempt to produce hatchery adults with an age composition similar to wild fish.
3. Determine life history characteristics of wild Imnaha chinook salmon to provide guidance for hatchery rearing and release strategies that will produce the highest smolt-to-adult survival rates.
4. Identify sources of water quality problems at Wallowa Hatchery and develop water quality improvement measures.
5. Develop methods to provide pre-season estimates of wild steelhead returns to Little Sheep Creek. Estimates are needed so trapping and release guidelines can be developed that will comply with the ODFW Wild Fish Policy.

6. Initiate studies to determine the magnitude and sources of summer steelhead and spring chinook salmon smolt losses for hatchery and wild fish from production and release areas to Lower Granite Dam.

7. Continue multiple spawning ground surveys on the Minam River and begin multiple surveys on the Wenaha River to recover more chinook carcasses and provide a better estimate of straying rates.

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

##### Objectives for FY 1989

Recover and decode tags from adults of the 1983-1985 broods that return to Lookingglass Hatchery. Summarize catch and escapement information for the 1983-1986 broods as data becomes available.

##### Accomplishments in FY 1989

We accomplished all objectives.

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

##### Objectives for FY 1989

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

##### Accomplishments in FY 1989

We accomplished all objectives.



## 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 fish for release in the Grande Ronde and Imnaha river basins. A description of facilities is found in Carmichael (1989).

We conducted three projects under the 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 presmolts in the Grande Ronde River and its tributaries, and (3) evaluation of benefits provided by reprogramming spring chinook salmon smolts from lower Columbia River hatcheries. The long-term goals and objectives of these studies are outlined in the five-year study plan (Carmichael 1989). In this report we present a review of our activities under all projects from 1 July 1988 to 30 June 1989. Previous annual progress reports were prepared by Carmichael and Wagner (1983), Carmichael and Messmer (1985), and Carmichael et al. (1986a, 1987, 1988a, 1988b, 1989).

## EVALUATION OF LOWER SNAKE RIVER COMPENSATION PLAN FACILITIES IN OREGON

### Introduction

The evaluation of LSRCP facilities in Oregon began in the fall of 1983. 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 objectives and tasks for this report period are presented 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 work. 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. (1989). Results of the comprehensive spring chinook spawning ground surveys will be presented in a completion report that will be prepared in 1991.

## Methods

### Fish Culture Monitoring

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

### Survival Studies

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

For Wallowa stock summer steelhead, the total number of adults produced in the 1988-89 run year (1985 and 1986 brood years) was calculated using catch, escapement, and exploitation rate of marked fish {Ad-left ventral(LV)+CWT}.

### Natural Escapement Monitoring

We conducted spawning ground surveys cooperatively with ODFW management personnel on the Minam River from 24 to 25 August and 9 September 1988 and on the Wenaha River from 6 to 10 September 1988. We examined all carcasses for fin marks and collected snouts from all marked fish.

The number of hatchery strays and proportion of natural spawners that were hatchery strays in the Minam and Wenaha rivers in 1988 were calculated based on recovery of coded-wire tagged fish (adipose fin marked), marked to unmarked expansion factors at release, the number of carcasses recovered, and estimated spawning population size. Spawning population size was estimated as described in Carmichael et al. (1986b).

### Planning

Planning activities consisted of continuing 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 the habitat and production modeling used 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.

### Disease Investigations

Methods are described in the 1987 and 1988 annual reports (Carmichael et al. 1987, 1988a) and in ODFW pathology reports (Christianson et al. 1989).

## Results

Results of fish culture monitoring for chinook salmon are presented in Tables 1-10 and for summer steelhead in Tables 11-21. Results of pathology exams are presented in ODFW pathology reports (Christianson et al. 1989). Results related to survival studies of spring chinook salmon and summer steelhead appear in Tables 22-32.

In 1988, run timing of Ad-LV marked Imnaha chinook salmon jacks was monitored at Lower Granite Dam. These fish were returning to Lookingglass Hatchery. A total of 45 marked jacks were observed at Lower Granite Dam. The first observation was on 21 May; 80% of the marked fish passed the dam after 17 June. All chinook passing Lower Granite Dam after 17 June are classified as summer chinook. The first Ad-LV fin-marked fish returned to Lookingglass on 24 May. The majority of the 48 Imnaha jack returns to Lookingglass occurred from 9 June to 29 July.

Two marked hatchery fish were recovered on the Minam River in 1988. These fish were from smolts of 1983 and 1984 brood Carson stock chinook released from Lookingglass Hatchery. We examined 42 adult carcasses for marks, which was estimated to be 21% of the spawning population. The 2 marked hatchery strays recovered on the Minam River surveys represented 78 hatchery fish, an estimated 37.3% of the spawning population.

Seven marked fish were recovered on the Wenaha River in 1988. Six fish were from the 1984 brood and one from the 1983 brood spring chinook smolt releases from Lookingglass Hatchery. We examined 68 adult carcasses for marks, which was estimated to be 17% of the spawning population. The 7 marked hatchery strays recovered on the Wenaha surveys represented 203 hatchery fish, an estimated 52% of the spawning population.

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

Results of summer steelhead creel surveys conducted on the Grande Ronde, Wallowa, and Imnaha rivers for the 1988-89 run year are presented in Carmichael et al. (1989).

Table 1. Egg-take and survival of spring chinook salmon at Lookingglass and Irrigon hatcheries, 1987 and 1988 broods.

Stock, brood year	Number of eggs taken or received	Egg loss (%)	Egg-to-fry survival (%)	Egg-to-smolt survival (%)
Imnaha:				
1987	187,395	23.9	76.0	76.0
1988	521,938	15.8	83.8	(a)
Carson:				
1987	1,223,104	2.6b	98.1c	94.9d
1988	1,402,704	7.0e	(f)	(f)
Rapid River:				
1987	802,547	22.0	75.0	72.8g
1988	372,948h	38.4i	59.8	31.9
1988	1,102,729	13.4j	85.8	(a)

a Most 1985 brood smolts will be released in the spring of 1990.

b Does not include the loss of 60,000 viable eggs that were destroyed because of the presence of IHNV in the parents and 522,923 green eggs shipped to Wallowa Hatchery.

c Does not include 500,000 eggs shipped to Oxbow Hatchery.

d Includes 48,364 fry received from Oxbow Hatchery.

e Does not include 67,500 viable eggs destroyed because of IHNV in the parents.

f All 1988 brood Carson stock eggs were transferred out of basin.

g Does not include presmolts.

h Eggs used in subyearling smolt program.

i Does not include 32,670 viable eggs destroyed because of IHNV in the parents.

j Does not include 72,304 viable eggs destroyed because of IHNV in the parents.

Table 2. Release information for spring chinook salmon reared at Lookingglass and Irrigon fish hatcheries and released in the Grande Ronde and Imnaha river basins, 1987 and 1988 broods. Standard deviation is shown in parenthesis.

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Brood year, date released (mm)	Number released	Size (fish/lb)	Location released	N	Mean fork length
CARSON STOCK <sup>a</sup>					
1987:					
04 Apr 1989	83,160	13.2	Catherine Creek	326	136(15.2)
04 Apr 1989	89,102	14.9	Big Canyon Creek	334	135(15.9)
RAPID RIVER STOCK					
1987:					
23 Sep 1988	85,564	21.7	Lookingglass Creek	384	116(7.3)
01 Nov 1988	86,310	20.9	Lookingglass Creek	337	120(5.8)
03 Apr 1989	86,717	19.5	Lookingglass Creek	301	123(9.2)
03 Apr 1989	330,637	14.3	Lookingglass Creek	400	139(8.7)
1988:					
05 May 1989	126,700	36.2	Lookingglass Creek	300	102(6.1)
IMNAHA STOCK					
1987:					
05 Apr 1989	142,320	16.0	Imnaha River	530	132(7.8)

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a 100% left ventral fin marked.

Table 3. Vital statistics for spring chinook salmon that returned to the Big Canyon facility, Lookingglass Hatchery, and Imnaha River weir, 1988. J = jacks, M = males, F = females.

Stock, origin	Total	J	M	F	Number females spawned	Prespawning mortality (%)		
						J	M	F
BIG CANYON FACILITY								
Carson:								
Hatchery	116	1	35	80	0	--	--	--
LOOKINGGLASS HATCHERY								
Carson:								
Hatchery	2,392	29	1,084	1,279	292	8.3	5.2	11.3
Rapid River:								
Hatchery	28	28	--	--	--	--	--	--
Imnaha:								
Hatchery	48	48	--	--	--	--	--	--
IMNAHA RIVER WEIR								
Imnaha:								
Wild	358a	19	126	213	82	0	13.5	6.8
Hatchery	36b	--	10	26	10	--	0	8.3

a Includes one adipose-fin-clipped wild fish marked by U.S. National Marine Fisheries Service.

b Includes one Rapid River Hatchery stray.

Table 4. Run timing for spring chinook salmon that returned to Lookingglass Hatchery, Big Canyon facility, and Imnaha River weir, 1988.

Time interval	Lookingglass Hatchery <sup>a</sup>					
	Imnaha stock		Rapid River stock		Carson stock	
	Number	% of total	Number	% of total	Number	% of total
21-27 May	1	2.0	2	7.1	713	27.5
28 May-03 Jun	1	2.0	3	10.7	386	14.9
04-10 Jun	0	0	3	10.7	373	14.4
11-17 Jun	0	0	6	21.5	345	13.3
18-24 Jun	2	4.1	8	28.6	418	16.1
25 Jun-01 Jul	0	0	0	0	0	0
02-08 Jul	0	0	0	0	0	0
09-15 Jul	13	26.5	3	10.7	116	4.5
16-22 Jul	0	0	0	0	0	0
23-29 Jul	16	32.7	2	7.1	84	3.3
30 Jul-05 Aug	0	0	0	0	0	0
06-12 Aug	0	0	0	0	0	0
13-19 Aug	3	6.1	1	3.6	85	3.3
20-26 Aug	6	12.3	0	0	36	1.4
27 Aug-02 Sep	7	14.3	0	0	27	1.0
03-09 Sep	0	0	0	0	6	0.2
10-16 Sep	0	0	0	0	3	0.1

a Lookingglass Hatchery trap operated from 2 May to 13 September.

Table 4. Extended.

Time interval	Big Canyon facility <sup>b</sup>		Imnaha River weir <sup>c</sup>			
	Number	% of total	Wild fish Number	Wild fish % of total	Hatchery fish Number	Hatchery fish % of total
21-27 May	11	9.5	--	--	--	--
28 May-03 Jun	9	7.8	--	--	--	--
04-10 Jun	35	30.2	--	--	--	--
11-17 Jun	36	31.1	4	1.1	0	0
18-24 Jun	15	12.9	(d)	(d)	(d)	(d)
25 Jun-01 Jul	4	3.4	(d)	(d)	(d)	(d)
02-08 Jul	2	1.7	100	28.0	5	13.9
09-15 Jul	4	3.4	98	27.5	3	8.3
16-22 Jul	0	0	78	21.9	4	11.1
23-29 Jul	0	0	28	7.8	4	11.1
30 Jul-05 Aug	0	0	4	1.1	3	8.3
06-12 Aug	0	0	9	2.5	1	2.8
13-19 Aug	0	0	6	1.7	1	2.8
20-26 Aug	0	0	21	5.9	11	30.6
27 Aug-02 Sep	0	0	6	1.7	3	8.3
03-09 Sep	0	0	3	0.8	1	2.8
10-16 Sep	0	0	0	0	0	0

b Big Canyon Creek facility operated from 23 May to 19 September. Carson stock returns.

c Imnaha River weir operated from 15 June to 15 September. Fish were not trapped or counted from 26 to 28 August.

d The weir was washed out from 18 June to 1 July.



Table 5. Spawning timing of female spring chinook salmon that returned to Lookingglass Hatchery (Carson Stock) and Imnaha River weir, 1988.

Time interval	Lookingglass Hatchery		Imnaha River weir Wild		Hatchery	
	Number	% of total	Number	% of total	Number	% of total
06-12 Aug	0	0	2	2.4	1	10.0
13-19 Aug	0	0	5	6.1	0	0
20-26 Aug	120	41.1	23	28.0	2	20.0
27 Aug-02 Sep	142	48.6	41	50.0	5	50.0
03-09 Sep	30	10.3	8	9.8	2	20.0
10-16 Sep	0	0	3	3.7	0	0

Table 6. Number of spring chinook salmon that were trapped and then released above the Imnaha River weir, 1988.

Time interval <sup>a</sup>	Jack	Number of fish released			
		Wild fish		Hatchery fish	
		Male	Female	Male	Female
11-17 Jun	0	2	2	0	0
18 Jun-01 Jul	(b)	(b)	(b)	(b)	(b)
02-08 Jul	0	29	37	0	0
09-15 Jul	4	20	33	0	0
16-22 Jul	5	7	13	0	0
23-29 Jul	1	6	12	0	0
30 Jul-05 Aug	1	1	3	0	0
02-12 Aug	1	0	3	0	1
13-19 Aug	0	2	4	0	1
20-26 Aug	3	6	17	1	6
27 Aug-02 Sep	2	0	0	2	5
03-09 Sep	2	0	1	0	1
Total	19	73	125	3	14

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

Fish were not trapped or counted from 26-28 August.

b The weir was washed out from 18 June to 1 July.

Table 7. Percent age composition of spring chinook salmon that returned to Lookingglass Hatchery (Carson Stock) and the Imnaha River weir, 1988. Age nomenclature is that of Gilbert and Rich (1927).

Age group, number	Lookingglass Hatchery		Imnaha River weira <sup>a</sup>			
	Male	Female	Wild Fish		Hatchery Fish	
			Male	Female	Male	Female
32	1.2	0.1	5.3	0	0 <sup>b</sup>	0
42	18.0	23.6	10.4	7.0	16.3	35.1
52	27.0	29.6	24.6	52.7	13.5	35.1
62	0.3	0.2	0	0	0	0
Number of fish	1,113	1,279	144	213	11	26

a Includes wild fish released above the weir.

b 1985 brood Imnaha chinook salmon released at Lookingglass Hatchery; 48 jacks returned to Lookingglass Hatchery in 1988.

Table 8. Mean fork length (mm) for age-specific groups of adult spring chinook salmon, 1988. Age nomenclature is that of Gilbert and Rich (1927). Standard deviation is shown in parenthesis.

Location, origin	Age 32				Age 42			
	Male		Female		Male		Female	
	N	Length	N	Length	N	Length	N	Length
Lookingglass Hatchery:								
Hatcherya	11	558(51)	1	595	105	747(72)	184	739(34)
Imnaha River weir:								
Wild	0 <sup>b</sup>	--	0	--	15	789(47)	10	793(42)
Hatchery	48 <sup>c</sup>	551(54)	0	--	4	789(40)	6	743(64)
-----								
	Age 52				Age 62			
Location, origin	Male		Female		Male		Female	
	N	Length	N	Length	N	Length	N	Length
Lookingglass Hatchery:								
Hatcherya	163	938(59)	188	865(39)	2	1,046(48)	1	956
Imnaha River Weir:								
Wild	36	999(61)	76	921(39)	0	--	0	--
Hatchery	4	921(75)	6	881(25)	0	--	0	--

a Carson stock.

b No wild jacks retained for broodstock.

c Lookingglass Hatchery returns.

Table 9. Degree of smolting for juvenile spring chinook salmon released into the Grande Ronde and Imnaha River basins, 1987 and 1988 broods. Standard deviation is shown in parenthesis.

Brood year, stock	Date released	N	Mean length (mm)	Degree of smolting <sup>a</sup> (%)		
				Smolt	Inter- mediate	Parr
1987:						
Carson	04/03/89 <sup>b</sup>	200	137(15.2)	7.5	92.5	0
	04/03/89	200	135(15.9)	10.5	89.5	0
Rapid River	04/03/89	200	123(9.2)	0	99.5	0.5
	04/03/89	200	138(9.2)	2.5	97.5	0
	04/01/89	200	139(8.3)	6.5	93.5	0
Imnaha	04/05/89	209	133(8.2)	0	100	0
1988:						
Rapid River <sup>c</sup>	05/15/88	300	102(6.1)	7.3	92.7	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 Reared at Wallowa Hatchery from 5 February 1989 until released at the Big Canyon Facility.

c Subyearling smolts acclimated at Lookingglass Hatchery from 3 May 1989 until release.

Table 10. Release and recovery information for adult Carson stock spring chinook salmon outplanted from Lookingglass Hatchery into some Grande Ronde River Basin streams, 1988. Expanded numbers of fish are shown in parenthesis.

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Outplanted fish  
recovered or observed

Outplanting location	Dates out-planted	Number of fish released Tagged Total		Returned to Lookingglass Hatchery	Observed	Harvested in tribal fishery
					live or recovered on spawning ground surveys <sup>a</sup>	
Catherine Creek	05/23-07/26	218	712	32 (105)	17 (55)	6 (20)
Grande Ronde River	05/31-08/17	189	522	23 (64)	20 (55)	20 (55)
Wallowa River	07/11	37	91	0	5 (13) <sup>b</sup>	0
Wallowa River <sup>c</sup>	08/10	121	363	0	19 (57)	0

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a Spawning ground surveys conducted on the day of index counts, inside and outside of index areas.  
b Recovery area includes Wallowa River and tributaries.  
c Fish hauled from Lookingglass to Wallowa Hatchery from 6 to 17 June and held at Wallowa until release.

Table 11. Egg-take and egg survival of Wallowa and Imnaha stocks of summer steelhead, 1988 and 1989 broods.

Stock, brood year	Eggs taken	Egg loss (%)	Egg-to-fry survival (%)	Egg-to-smolt survival (%)
Wallowa:				
1988	3,027,000	24.5	66.3a	60.3b
1989	2,477,000	28.2	68.4	(c)
Imnaha:				
1988	827,000	33.8d	60.0e	48.4f
1989	758,000	28.8	68.3	(c)

a Does not include 502,956 eyed eggs shipped to Lyons Ferry Hatchery.

b Does not include 38,928 fry released into the Wallowa River and 52,263 presmolts released into the Snake River.

c 1989 brood smolts will be released in the spring of 1990.

d Does not include 38,080 eggs that were destroyed because of the presence of IHNV in the parents and excess program needs.

e Does not include release of 35,698 fry in Little Sheep Creek.

f Does not include 37,943 presmolts 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, 1988 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)
Wallowa:					
11/22/88a	52,263	48.5	Snake River	--	--
04/20-24/89	408,942	4.9	Wallowa Hatchery	516	207(17.6)
04/20-24/89	87,969	3.8	Wallowa Hatchery	207	223(19.7)
04/24/89	53,965	5.2	Spring Creek	300	205(20.0)
04/20-25/89	111,052	5.2	Upper Wallowa River	764	196(19.1)
04/10-22/89	234,516	5.4	Upper Grande Ronde River	1,519	194(22.1)
04/10-12/89	62,601	5.5	Catherine Creek	766	191(23.3)
04/27-29/89	273,496	5.0	Big Canyon facility	404	203(17.4)
04/25-27/89	109,603	5.2	Lower Grande Ronde River	50	202(21.4)
04/25-26/89b	50,410	5.2	Lower Grande Ronde River	--	--
Imnaha:					
11/22/88a	42,064	50.1	Snake River	--	--
04/24/89	249,456	5.3	Little Sheep Creek	441	201(18.4)
05/01-03/89	72,367	5.5	Imnaha River	447	197(19.3)

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 Lyons Ferry Hatchery.

Table 13. Vital statistics for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1989.

Location, origin	Total	Male	Female	Number of females spawned	Prespawning mortality (%)	
					Male	Female
Big Canyon facility:						
Wild	15	8	7	1	0	0
Hatchery	332	140	192	57	6.4	0
Wallowa Hatchery:						
Hatchery	1,220	615	605	400	39.8	19.9
Little Sheep Creek:						
Wild	56	19	37	20	44.9a	0
Hatchery	306	71	235	109	37.5a	14.3

a Prespawning mortality includes some males that were spawned and returned to the holding pond and then died.



Table 14. Run timing for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1989.

Time interval	Big Canyon facility <sup>a</sup>		Wallowa Hatchery <sup>b</sup>	
	Number	% of Total	Number	% of Total
12-18 Mar	--	--	--	--
19-25 Mar	--	--	35	2.9
26 Mar-01 Apr	--	--	386	31.6
02-08 Apr	--	--	476	39.0
09-15 Apr	151	43.5	179	14.7
16-22 Apr	123	35.5	92	7.5
23-29 Apr	19	5.5	27	2.2
30-Apr-06 May	27	7.8	18	1.5
07-13 May	14	4.0	7	0.6
14-20 May	6	1.7	0	0
21-27 May	5	1.4	--	--
28 May-03 Jun	2	0.6	--	--

Time interval	Little Sheep Creek Facility <sup>c</sup>		Wild fish		Hatchery fish	
	Number	% of Total	Number	% of Total	Number	% of Total
12-18 Mar	0	0	3	1.0		
19-25 Mar	0	0	2	0.7		
26 Mar-01 Apr	2	3.0	13	4.4		
02-08 Apr	7	10.6	33	11.2		
09-15 Apr	15	22.7	87	29.4		
16-22 Apr	27	40.9	117	39.5		
23-29 Apr	3	4.6	14	4.7		
30 Apr-06 May	3	4.6	16	5.4		
07-13 May	5	7.6	5	1.7		
14-20 May	4	6.0	3	1.0		
21-27 May	0	0	3	1.0		
28 May-03 Jun	--	--	--	--		

a Big Canyon Creek trap operated from 15 April to 30 May 1989.

b Wallowa Hatchery trap operated from 1 March to 17 May 1989.

c Little Sheep Creek trap operated from 16 March to 26 May 1989.

Table 15. Time of spawning for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1989.

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Time interval	Big Canyon facility		Wallowa Hatchery		Little Sheep Creek			
	facility		Hatchery		Wild fish		Hatchery	
	Number	% of total	Number	% of total	Number	% of total	Number	% of total
09-15 Apr	--	--	107	26.8	--	--	--	--
16-22 Apr	--	--	168	42.0	1	5.0	23	21.1
23-29 Apr	14	24.1	100	25.0	4	20.0	31	28.4
30 Apr-06 May	18	31.0	15	3.8	5	25.0	28	25.7
07-13 May	11	19.0	7	1.7	4	20.0	13	11.9
14-24 May	5	8.6	3	0.7	4	20.0	10	9.2
21-27 May	7	12.1	0	0	2	10.0	4	3.7
28-May-03 Jun	3	5.2	0	0	0	0	0	0

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Table 16. Percent age composition for adult summer steelhead that returned to the Big Canyon facility, Wallowa Hatchery, and Little Sheep Creek facility, 1989. Age is expressed as years spent in fresh water 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		
1:1	0	0	42.2	57.8	41.9	17.9
1:2	0	0	0	0	7.7	31.4
2:1	33.4	13.2	0	0	0.7	0.2
2:2	20.0	33.4	0	0	0.1	0.1
Number of fish	8	7	140	192	614	603

Age group, number	Little Sheep Creek facility			
	Wild fish		Hatchery fish	
	Male	Female	Male	Female
1:1	0	0	7.5	7.2
1:2	0	0	15.7	69.6
2:1	26.8	32.2	0	0
2:2	7.1	33.9	0	0
Number of fish	19	37	71	235

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, 1989. Standard deviation is shown in parenthesis.

		Big Canyon facility								
		Wild fish				Hatchery fish				
Wallowa Age Male group Length	Hatchery Age Female group Length	Male		Female		Male		Female		N
		N	Length	N	Length	N	Length	N	Length	
1:1	0	--	0	--	30	595 (26.3)	59	574 (21.2)	247	
593 (27.9)	135	580 (22.8)								
1:2	0	--	0	--	0	--	0	--	39	
726 (45.1)	221	693 (30.3)								
2:1	1	645	1	618	0	--	0	--	4	
618 (57.1)	1	656								
2:2	0	--	0	--	0	--	0	--	1 732	
1 725										
-----										
-----										
-----										
-----										
fish		Little Sheep Creek facility				Hatchery				
Age Female group N	Age Male group Length	Wild fish		Hatchery						
		Male	Female	Male	Female					
N	Length	N	Length	N	Length					
1:1	0	--	0	--	9	585 (23.7)				
10	577 (18.1)									
1:2	0	--	0	--	29	727 (34.2)				
104	689 (30.1)									
2:1	6	616 (24.6)	10	570 (26.6)	0	--				
0	--									
2:2	2	742 (53.0)	11	672 (23.2)	0	--				
0	--									

Table 18. Adult summer steelhead outplanted from Wallowa Hatchery into Wallowa Valley fishing ponds, 1989.

Location of outplanting	Number outplanted	
	Male	Female
Marr pond	24	22
Victor pond	35	15
Wallowa pond	56	44
Total	115	81

Table 19. Number of adult summer steelhead released above the Little Sheep Creek facility, 1989.

Trapping and release time period	Wild fish		Hatchery fish	
	Male	Female	Male	Female
04-08 Apr	3	5	18	49
15-21-Apr	3	6	6	56
22-28 Apr	0	2	2	9
29 Apr-05 May	1	1	2	2
06-12 May	0	2	1	2
13-19 May	0	0	1	0
20-26 May	3	0	1	3
Total released	10	16	31	121

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 1989, 1988 brood year. D = dorsal, LV = left ventral, RV = right ventral, BV = both ventrals, LP = left pectoral, RP = right pectoral, BP = both pectorals. Standard deviation is shown in parenthesis.

Stock, sampling date	N	Mean fork length (mm)	D	Incidence (%) of fin erosion					
				LVa	RV	BV	LP	RP	BP
Wallowa:									
19 Aprb	200	209(17.1)	100	3.0	6.5	11.0	1.5	3.5	1.0
19 Aprc	419	225(18.9)	100	2.1	34.2	25.6	9.1	4.8	0.5
21 Aprd	200	202(21.4)	100	4.5	6.5	45.0	13.0	4.0	3.0
25 Apre	300	205(20.0)	100	0	22.5	0.5	10.5	23.5	4.5
26 Aprf	404	203(17.4)	100	13.4	4.0	23.3	5.0	4.5	0.5
Imnaha:									
20 Aprg	300	201(18.4)	99.3	8.2	17.3	54.5	15.7	8.7	1.7

a Adjusted for percentage of LV fin marked fish.

b Final rearing in upper acclimation pond at Wallowa Hatchery.

c Final rearing in lower acclimation pond at Wallowa Hatchery.

d Wildcat Creek release.

e Spring Creek release.

f Final rearing in Big Canyon facility acclimation ponds.

g Final rearing in Little Sheep Creek acclimation pond.

Table 21. Degree of smolting, precociousness, and descaling of summer steelhead smolts reared at Irrigon Hatchery and released into the Grande Ronde and Imnaha River basins in 1989, 1988 brood year. Standard deviation is shown in parenthesis.

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Stock, sampling date (%)	N	Mean length (mm)	Degree of smolting (%) <sup>a</sup>			Pre- cocious males (%)	De- scaled fish
			Smolt	Inter- mediate	Parr		
<hr/>							
Wallowa:							
19 Apr <sup>b</sup>	200	209 (17.1)	22.5	76.5	0	1.0	0
19 Apr <sup>c</sup>	419	225 (18.9)	21.0	79.0	0	0	0
21 Apr <sup>d</sup>	200	202 (21.4)	15.5	84.5	0	0	0
25 Apr <sup>e</sup>	200	205 (20.0)	33.0	67.0	0	0	0
26 Apr <sup>f</sup>	404	203 (17.4)	30.7	69.3	0	0	0
Imnaha:							
20 Apr <sup>g</sup>	300	201 (18.4)	66.0	33.0	0.3	0.7	0

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

Table 22. Release information for Ad+CWT marked spring chinook salmon reared at Lookingglass and Irrigon hatcheries and released in the Grande Ronde and Imnaha River basins, 1987 and 1988 broods. Standard deviation is shown in parenthesis.

Mean Stock, fork location length of release (mm)	Mean Release weight (g)	Mean condition factor	CWT code replicates	Date released	Number released	N
<b>Rapid River:</b>						
Lookingglass 116(7.3)	September 20.9(9.6)	1.34(0.01)	07 46 30	09/23/88	43,220	384
Hatchery (a)	release (a)	(a)	07 46 31	09/23/88	40,399	(a)
	November 22.5(11.4)	1.30(0.01)	07 46 32	11/01/88	42,837	377
120(5.8)	release (a)	(a)	07 46 33	11/01/88	42,796	(a)
	Small 22.4(6.1)	1.14(0.05)	07 45 31	04/03/89	43,390	301
123(9.2)	smolt (a)	(a)	07 45 32	04/03/89	42,987	(a)
	Large 33.8(5.1)	1.21(0.06)	07 45 33	04/03/89	43,287	200
139(8.3)	smolt (a)	(a)	07 45 35	04/03/89	43,283	200
138(9.2)		1.21(0.08)				
	Subyearling 12.5(2.3)	1.16(0.08)	07 47 36	05/15/89	40,234	300
102(6.1)	smolt (a)	(a)	07 46 34	05/15/89	41,267	(a)
(a)	(88 brood) (a)	(a)	07 45 34	05/15/89	41,667	(a)
(a)						
<b>Imnaha:</b>						
Imnaha River 132(7.9)	Production 28.5(6.3)	1.19(0.05)	07 45 44	04/05/89	45,195	208
facility 131(7.7)		1.19(0.01)	07 45 45	04/05/89	45,394	200
			07 45 46	04/05/89	44,002	214
131(9.6)	28.2(6.0)	1.17(0.05)				



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

Table 23. Recovery information for Ad+CWT marked spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River weir and that were recovered on Northeast Oregon spawning ground surveys, 1988. 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						
1983:						
07 30 01	0	4	--	857(57)	--	7.3(1.0)
07 30 02	0	1	--	840	--	6.4
07 30 03	1	1	985	880	8.7	6.9
07 30 04	1	0	1,010	--	10.0	--
07 31 49	0	2	--	926(28)	--	8.6(0.6)
07 31 50	4	0	986()	--	9.6(1.1)	--
07 31 51	2	5	941(66)	895(16)	7.5(1.5)	6.7(1.5)
07 31 52	0	1	--	931	--	8.4
07 31 53	4	2	934(26)	906(38)	8.1(0.8)	9.0(1.6)
07 31 54	2	4	936(43)	897(21)	7.9(1.6)	7.7(0.6)
07 31 55	26	25	916(69)	859(47)	7.5(1.8)	6.6(1.4)
07 31 56	18	21	940(47)	872(44)	8.0(1.5)	6.7(0.8)
07 34 09a	1	0	819	--	7.6	--
23 18 08	1	0	1,005	--	8.7	--
23 18 14	0	1	--	856	--	6.4
1984:						
07 33 13	0	1	--	835	--	5.7
07 33 14	0	3	--	756(30)	--	4.4(0.5)
07 33 15	1	0	774	--	4.7	--
07 33 16	24	41	791(49)	747(31)	4.9(0.8)	4.3(0.6)
07 33 57	0	2	--	723(88)	--	5.7
07 33 58	2	3	685(50)	815(73)	3.3(0.9)	5.8(1.7)
07 33 59	5	4	724(96)	736(31)	3.9(1.6)	4.3(0.4)
07 33 60	5	1	702(73)	728	3.8(1.2)	4.0
07 33 61	7	6	713(63)	750(37)	3.7(0.8)	4.7(0.4)
07 33 62	11	5	693(98)	773(27)	3.6(1.4)	4.9(0.5)
07 34 01	13	24	658(40)	695(40)	3.0(0.2)	3.7(0.7)
07 31 37a	0	1	--	742	--	4.7
23 18 63	0	1	--	734	--	4.1
23 19 15	0	1	--	706	--	3.4
23 19 18	0	1	--	708	--	3.6
23 19 20	0	1	--	714	--	3.7

a Cole Rivers Hatchery stray.

Table 23. Continued.

Brood year, CWT Code	Number recovered		Mean fork length (mm)		Mean Weight (kg)	
	Male	Female	Male	Female	Male	Female
LOOKINGGLASS HATCHERY						
1985:						
07 38 05	2	0	545 (3)	--	1.9 (0.1)	--
07 38 06	1	0	468	--	--	--
07 38 07	1	0	520	--	1.8	--
07 38 11	3	0	471 (30)	--	1.2 (0.2)	--
07 38 12	3	0	490 (45)	--	1.5 (0.5)	--
07 38 09b	20	0	551 (44)	--	1.7 (0.4)	--
07 38 10b	16	0	548 (42)	--	1.7 (0.5)	--
IMNAHA RIVER WEIR						
1983:						
07 30 12	0	3	--	893 (30)	--	7.1 (1.0)
07 30 13	2	0	902 (125)	--	6.9 (2.0)	--
07 30 16	1	1	935	885	7.4	7.5
07 30 17	1	1	943	878	7.9	7.2
1984:						
07 33 63	3	5	798 (43)	757 (61)	5.1 (0.8)	5.0 (1.0)
10 30 15c	0	1	--	676	--	3.1
23 18 63	1	0	760	--	3.9	--
SPAWNING GROUND SURVEYS						
1983:d						
07 30 01	1	0	960	--	--	--
07 31 55	0	3	--	883 (46)	--	--
1984:d						
07 33 16	0	2	--	743 (39)	--	--
1983:e						
07 30 04	0	1	--	840	--	--
1983:f						
07 31 55	1	0	950	--	--	--
1984:f						
07 33 62	1	0	720	--	--	--

b Imnaha stock released at Lookingglass Hatchery.

c Rapid River Hatchery stray.

d Recovered in Lookingglass Creek.

e Recovered in the Grande Ronde River.

f Recovered in the Minam River.

Table 23. Continued.

Brood year, CWT Code	Number recovered		Mean fork length (mm)		Mean weight (kg)	
	Male	Female	Male	Female	Male	Female
SPAWNING GROUND SURVEYS						
1983:g						
07 31 56	0	1	--	840	--	--
1984:g						
07 33 16	1	2	820	730 (42)	--	--
07 33 62	2	0	753 (25)	--	--	--
07 34 01	0	1	--	630	--	--
23 19 07	0	1	--	710	--	--
1983:h						
07 30 12	0	1	--	900	--	--
1984:h						
07 33 63	0	2	--	733 (11)	--	--

g Recovered in the Wenaha River.

h Recovered in the Imnaha River.

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, 1988 brood year. Standard deviation is shown in parenthesis.

Stock, Mean location weight of release (g)	Mean Release condition group factor	CWT code replicates	Dates re- leased	Number re- leased	N	Mean fork length (mm)
Wallowa:						
Wallowa 203(18.3)	Medium 87.4(25.7)	07 46 50 1.01(.06)	04/20-	26,922	102	
Hatchery 202(17.1)	smolt 85.4(21.6)	07 46 51 1.02(.06)	24/89	26,526	110	
	Large 115.4(29.6)	07 45 42 1.03(.07)	04/20-	26,303	100	
221(20.5)	smolt 120.9(31.0)	07 45 43 1.04(.09)	24/89	26,718	107	
225(18.9)						
Spring 205(20.0)	Direct 102.8(38.8)	07 46 55 1.01(.06)	04/24-	24,924	300	
Creek (a)	stream (a)	07 46 52	25/89	25,622	(a)	(a)
Imnaha:						
Little Sheep 201(18.4)	Production 94.8(29.0)	07 46 56 1.07(.06)	04/21-	27,461	441	
Creek (a)	(a)	07 46 57	24/89	27,235	(a)	(a)

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

Table 25. Recovery information for Ad-LV+CWT marked summer steelhead that returned to Wallowa Hatchery and Little Sheep Creek facility in 1989. Standard deviation is shown in parenthesis. R1 = replicate one, R2 = replicate two.

Brood year, CWT Code	Number recovered		Mean fork length (mm)		Mean weight Mean weight (kg)	
	Male	Female	Male	Female	Male	Female
WALLOWA HATCHERY						
1985:						
07 37 62	10	45	731 (38.3)	687 (41.1)	3.4 (0.4)	3.1 (0.5)
07 37 63	10	40	722 (41.7)	691 (28.3)	3.3 (0.5)	3.0 (0.5)
07 38 01	10	35	741 (51.4)	690 (28.3)	3.8 (0.5)	3.0 (0.4)
07 38 02	7	33	675 (68.4)	682 (34.9)	2.8 (0.7)	3.0 (0.4)
1986:						
07 40 25	11	7	592 (31.3)	572 (20.5)	1.7 (0.2)	1.7
07 40 26	16	6	599 (22.8)	580 (16.7)	1.9 (0.2)	2.0
07 41 25R1	18	6	595 (39.4)	579 (19.8)	1.8 (0.2)	1.8 (0.2)
07 41 25R2	34	11	594 (36.1)	583 (25.6)	2.0 (0.3)	1.9 (0.2)
07 41 26R1	25	9	581 (25.0)	575 (14.3)	1.8 (0.3)	2.3
07 41 26R2	33	10	591 (24.4)	573 (16.4)	1.8 (0.3)	1.8 (0)
07 41 28R1	9	6	582 (17.4)	580 (25.9)	1.9 (0.1)	1.8 (0.1)
07 41 28R2	17	2	593 (36.7)	556 (5.7)	1.9 (0.2)	--
LITTLE SHEEP CREEK						
1985:						
07 37 60	8	24	741 (29.0)	691 (30.8)	3.4 (0.3)	3.0 (0.5)
07 37 61	5	24	733 (47.2)	685 (29.6)	4.0 (0.4)	3.0 (0.4)
1986:						
07 41 22R1	2	1	561 (27.6)	572	1.4 (0.1)	--
07 41 22R2	5	3	588 (21.2)	565 (27.8)	1.6 (0.2)	1.6 (0.3)
23 19 48	1	0	592	--	2.0	--

Table 26. Recovery information for cold-branded downstream migrant Rapid River, and Imnaha stock spring chinook salmon smolts recaptured at Lower Granite Dam in 1988, 1986 brood year. Number of observed recoveries is shown in parenthesis.

Stock, brand code	Date released	Estimated number recovered	Percent of number released	Cumulative percent of recoveries by week of the year <sup>a</sup>			
				15	16	17	18
Rapid River:							
LA-IF-1	09/18/87	152 (5)	0.8	0.0	78.3	78.3	100
RA-IF-1	09/18/87	422 (11)	2.1	5.2	28.9	35.3	100
LA-IF-3	04/01/88	5,228 (120)	24.1	0.0	60.1	85.2	93.4
RA-IF-3	04/01/88	6,192 (135)	28.6	0.2	64.6	90.1	93.6
LA-IM-1	04/01/88	4,807 (122)	23.9	1.1	52.4	80.7	88.1
RA-IM-1	04/01/88	4,135 (102)	20.5	1.6	48.6	79.8	88.7
LA-UT-1	05/13/88	3,973 (310)	19.4	--	--	--	--
LA-UO-1	05/13/88	3,913 (293)	18.6	--	--	--	--
Imnaha:							
LA-IM-3	03/22/88	3,788 (91)	18.5	0.0	47.0	79.0	87.5
RA-IM-3	04/20/88	3,623 (74)	17.6	0.0	0.0	4.9	15.1

Stock, brand code	Cumulative percent of recoveries by week of the year									
	19	20	21	22	23	24	25	26	27	28
Rapid River:										
LA-IF-3	98.0	99.6	99.6	100	--	--	--	--	--	--
RA-IF-3	99.4	100	--	--	--	--	--	--	--	--
LA-IM 1	97.7	100	--	--	--	--	--	--	--	--
RA-IM 1	97.0	100	--	--	--	--	--	--	--	--
LA-UT-1	--	0.0	0.0	11.1	41.1	67.6	84.7	96.1	99.5	100
LA-UO-1	--	0.0	3.1	12.9	46.3	68.4	85.4	96.6	99.2	100
Imnaha:										
LA-IM-3	93.8	99.7	99.7	99.7	100	--	--	--	--	--
RA-IM-3	74.7	92.9	98.9	98.9	99.7	99.7	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 27. Recovery information for cold-branded downstream migrant Wallowa and Imnaha stock summer steelhead recaptured at Lower Granite Dam in 1988, 1987 brood year. Standard deviation of weight is shown in parenthesis.

Stock, number brand code	Date of release	Size at release (g)	Number observed	Estimated number recovered	Percent of released
Wallowa:					
LA-IM-1	04/16-18/88	95.2(25.1)	115	3,799	15.0
LA-IF-1	04/16-18/88	97.7(26.1)	143	4,912	19.3
LA-IM-3	04/16-18/88	105.4(28.7)	126	4,030	16.0
LA-IF-3	04/16-18/88	104.3(26.8)	124	3,865	15.3
RA-IM-1	04/20-26/88	94.9(28.9)	377	13,749	28.0
RA-IF-1	04/20-26/88	(a)	417	14,820	29.3
RA-IM-3	04/18-19/88	91.1(24.4)	160	5,060	19.8
RA-IF-3	04/18-19/88	(a)	189	6,502	26.0
Imnaha:					
LA-IM-2	04/14/88	82.0(22.0)	14	440	1.8
LA-IF-2	04/14/88	84.6(28.7)	37	1,032	4.0

Stock, brand code	Cumulative percent of recoveries by week of the year <sup>b</sup>											
	17	18	19	20	21	22	23	24	25	26	27	28
29												

Wallowa:												
LA-IM-1	15.1	28.3	44.1	61.1	82.0	90.0	95.6	97.2	97.7	97.7	97.7	100
LA-IF-1	6.3	24.2	41.3	56.8	84.0	89.9	96.1	96.9	97.3	98.9	100	
LA-IM-3	16.1	31.0	45.4	61.4	79.6	89.6	96.3	97.5	99.5	99.7	100	
LA-IF-3	17.1	46.1	55.4	61.4	78.9	88.6	96.2	96.9	97.7	98.9	99.4	99.7
100												
RA-IM-1	3.2	22.7	51.7	70.0	87.1	93.0	96.2	97.7	98.3	99.4	99.8	99.9
100												
RA-IF-1	6.2	27.9	54.8	71.5	84.7	92.1	96.4	97.8	98.8	99.5	100	

RA-IM-3	6.8	37.0	50.0	64.2	82.4	89.7	95.6	96.3	97.6	99.1	100
RA-IF-3	12.0	43.1	61.9	72.0	89.0	92.8	97.1	98.5	99.2	100	

Imnaha:

LA-IM-2	21.1	25.9	39.6	39.6	67.7	89.1	94.6	97.5	100		
LA-IF-2	8.2	16.1	21.9	25.6	40.4	76.9	90.1	93.6	96.8	97.9	100

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a Size of release is the same as the replicate release group.

b 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, 1987 and 1988 broods. Standard deviation is shown in parenthesis.

Stock, fork location of length release (g)	Mean weight factor	Mean Release condition group	Date released	Brand replicates	Number released	N	Mean (mm)
Rapid River:							
Lookingglass 116(7.3)	20.9(9.6)	September 1.34(0.01)	09/23/88	LD-J-1	20,341	384	
Hatchery (a)	(a)	release	09/23/88	RD-J-1	20,248	(a)	(a)
		Small	04/03/89	LD-J-2	19,817	301	
123(9.2)	22.4(6.1)	1.14(0.05)					
		smolt	04/03/89	RD-J-2	20,419	(a)	(a)
(a)	(a)						
		Large	04/03/89	LD-J-3	18,623	200	
139(8.3)	33.8(5.1)	1.21(0.06)					
		smolt	04/03/89	RD-J-3	17,197	200	
138(9.2)	34.1(7.6)	1.21(0.08)					
		Subyearling	05/15/89	LA-J-1	22,757	99	
102(6.0)	12.6(2.4)	1.17(0.08)					
		smoltb	05/15/89	RA-J-1	22,106	100	
102(5.1)	12.3(2.3)	1.14(0.07)					
Imnaha:							
Imnaha River 132(8.0)	28.5(6.3)	Production 1.19(0.05)	04/05/89	LD-J-4	20,065	208	
facility			04/05/89	RD-J-4	20,153	200	
131(7.7)	28.4(5.8)	1.19(0.01)					

a Mean weight, mean length, and mean condition factor are the same for the replicate release group.

b 1988 brood year.

Table 29. Release information for cold-branded summer steelhead juveniles released in the Grande Ronde and Imnaha River basins, 1988 brood year. Standard deviation is shown in parenthesis.

Stock, Mean location weight of release (g)	Mean Release condition group factor	Date released	Brand rep- licates	Number released	N	Mean fork length (mm)
Wallowa:						
Wallowa	Medium	04/20-	LA-J-3	25,089	110	202 (17.1)
85.4 (21.6)	1.02 (0.06)					
Hatchery	smolt	24/89	RA-J-3	24,868	102	203 (18.3)
87.4 (25.7)	1.01 (0.06)					
	Large	04/20-	LA-J-1	25,037	107	225 (18.9)
120.9 (31.0)	1.04 (0.09)					
	smolt	24/89	RA-J-1	24,951	100	221 (20.5)
115.4 (20.5)	1.03 (0.07)					
Spring	Direct	04/24/89	LA-J-2	25,557	300	205 (20.0)
102.8 (38.8)	1.01 (0.06)					
Creek	stream	04/24/89	RA-J-2	25,463	(a)	(a)
(a)	(a)					
Grande Ronde	Wildcat	04/25-	LA-J-4	25,458	209	202 (17.4)
90.8 (28.9)	1.06 (0.06)					
River	Creek	27/89	RA-J-4	24,554	345	200 (19.1)
89.0 (32.4)	1.04 (0.07)					
Imnaha:						
Little Sheep	Production	04/24/89	LD-J-1	26,637	441	210 (18.4)
94.8 (29.0)	1.07 (0.06)					
Creek		04/24/89	RD-J-1	26,209	441	(a)
(a)	(a)					

a Mean weight, mean length, and mean condition factor are the same for the replicate release group.

Table 30. Total catch, escapement, and survival of coded-wire-tagged spring chinook salmon released in the Grande Ronde and Imnaha River basins, 1983 and 1984 broods. Recoveries are complete for the 1983 brood year and through age four for the 1984 brood year. Total strays includes all catch, trap, and escapement recoveries from areas other than river-of-release. Col. River = Columbia River.

Brood year, stock, CWT code	Month of re- lease	Catch Ocean	Col. River	Spawn- ing escape- ment	Total strays	Hatchery return rate (% of release)	Total survival rate (% of release)
1983:							
Carson:							
07 30 01	Jul	0	0	6	0	0.01	0.01
07 30 02	Jul	0	5	5	1	0.01	0.02
07 30 03	Jul	0	12	2	1	<0.01	0.03
07 30 04	Jul	0	12	4	0	<0.01	0.03
07 31 49	Sep	6	4	3	0	0.01	0.04
07 31 50	Sep	0	0	8	0	0.02	0.02
07 31 51	Sep	0	8	11	1	0.03	0.05
07 31 52	Sep	0	3	2	0	0.01	0.01
07 31 53	Nov	5	5	18	1	0.05	0.09
07 31 54	Nov	0	8	7	0	0.02	0.05
07 31 55	Apr	2	37	93	4	0.24	0.36
07 31 56	Apr	0	37	93	3	0.25	0.35
07 31 57	Sep	0	2	0	0	0	0.01
07 31 58	Sep	0	0	1	0	<0.01	<0.01
Imnaha:							
07 30 12	Sep	8	4	11	0	0.04	0.08
07 30 13	Sep	4	0	8	2	0.03	0.05
07 30 16	Mar	0	0	4	1	0.02	0.02
07 30 17	Mar	0	0	3	1	0.01	0.01
1984:							
Carson:							
07 33 13	Jul	0	0	1	0	<0.01	<0.01
07 33 14	Jul	0	0	4	0	0.01	0.01
07 33 57	Sep	0	0	6	0	0.01	0.01
07 33 58	Sep	0	4	9	0	0.01	0.02
07 33 59	Nov	8	0	10	0	0.02	0.04
07 33 60	Nov	0	0	6	0	0.01	0.01
07 33 15	Nov	0	0	2	0	<0.01	<0.01
07 33 16	Apr	5	13	67	3	0.14	0.18
07 33 61	Apr	9	0	14	3	0.03	0.05
07 33 62	Apr	6	0	21	4	0.04	0.06

Lookingglass:

07 34 01	Apr	0	0	41	2	0.10	0.10
Imnaha:							
07 33 63	Mar	28	0	34	4	0.10	0.19

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Table 31. Recovery information for coded-wire-tagged Wallowa and Imnaha stock summer steelhead, 1985 and 1986 broods. Recoveries are complete for the 1985 brood year, but only include age-3 recoveries for the 1986 brood year. R1 = replicate one, R2 = replicate two.

Brood year, stock, CWT code	Release group	N	Total exploit- tation rate(%)	Hatchery return rate (% of of release)	Total survival rate (% of release)
1985:					
Wallowa:					
07 38 01	Medium	246	64.6	0.33	0.93
07 38 02	smolt	308	73.1	0.32	1.18
07 37 62	Large	510	75.3	0.46	1.90
07 37 63	smolt	553	75.6	0.48	1.97
Imnaha:					
07 37 60	Imnaha	239	54.0	0.41	0.88
07 37 61	smolts	198	40.9	0.43	0.73
1986:					
Wallowa:					
07 40 25	IHNVa	86	79.1	0.07	0.34
07 40 26	IHNVa	83	72.3	0.09	0.32
07 41 26R1	Medium	179	81.0	0.14	0.72
07 41 26R2	smolts	124	64.5	0.18	0.50
07 41 25R1	Large	131	81.7	0.10	0.56
07 41 25R2	smolts	142	68.3	0.19	0.61
07 41 28R1	Direct	102	85.3	0.06	0.40
07 41 28R2	stream	92	79.4	0.08	0.37
Imnaha:					
07 41 22R1	Production	10	70.0	0.01	0.04
07 41 22R2		26	69.2	0.03	0.11

a Progeny from IHNV positive parents.

Table 31. Extended.

Brood year, stock, CWT code	Estimated number of fish harvested						Hatchery returns
	Columbia River Treaty net	River Sport	Deschutes River Sport	Trap <sup>b</sup>	Snake River sport	Trib- utary sport <sup>c</sup>	
1985:							
Wallowa:							
07 38 01	76	0	7	4	36	36	87
07 38 02	127	12	16	3	27	40	83
07 37 62	177	41	22	15	60	69	126
07 37 63	232	44	32	16	33	61	135
Imnaha:							
07 37 60	101	15	2	0	5	6	110
07 37 61	45	13	4	0	16	3	117
1986:							
Wallowa:							
07 40 25	49	7	2	5	0	5	18
07 40 26	16	20	2	3	11	8	23 <sup>d</sup>
07 41 26R1	101	19	0	0	3	22	34
07 41 26R2	55	7	0	0	9	9	44 <sup>d</sup>
07 41 25R1	82	14	0	1	5	5	24
07 41 25R2	68	14	0	1	8	6	45
07 41 28R1	50	19	0	0	18	0	15
07 41 28R2	57	7	0	0	9	0	19
Imnaha:							
07 41 22R1	3	0	0	0	0	4	3
07 41 22R2	13	0	0	0	5	0	8

b Rounde Butte Hatchery and Umatilla River trap recoveries.

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

d Includes one fish recovered in the Umatilla River trap.



Table 32. Number of adult summer steelhead (1988-89 run year) and spring chinook salmon (1988 run year) produced by releases from Lower Snake River Compensation Plan facilities in Oregon.

Stock, brood year	Ocean catch	Columbia Neta	River Sport	Des- chutes River <sup>b</sup>	Trib- utary sport <sup>c</sup>	Spawning escape- ment <sup>d</sup>	Total recov- eries
SUMMER STEELHEAD							
Wallowa:							
1985	2	676	102	25	261	485	1,551
1986	0	3,700	828	108	914	1,718	7,268
Stock total	2	4,376	930	133	1,175	2,203	8,819
Imnaha:							
1985	0	240	73	0	110	261	684
1986	0	66	0	0	37	45	148
Stock total	0	306	73	0	147	306	832
Species total	2	4,682	1,003	133	1,322	2,509	9,651
SPRING CHINOOK							
Carson:							
1983	54	853	0	0	--	1,374	2,281
1984	83	89	30	24	--	995	1,221
Stock total	137	942	30	24	--	2,369	3,502
Imnaha:							
1983	0	2	0	0	--	16	18
1984	0	0	0	0	--	18	18
Stock total	0	2	0	0	--	34	36
Species total	137	944	30	24	--	2,403	3,538

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 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 for spring chinook salmon.

## Discussion

### Fish Culture Monitoring

A strong return of wild Imnaha chinook salmon enabled us to achieve the highest egg-take since the program started. A total of 521,938 eggs were taken with only a 15.8% egg loss. We will achieve the highest smolt release to date with the 1988 brood year. Imnaha stock prespawning mortality was reduced by holding broodstock at Lookingglass Hatchery instead of the Imnaha temporary holding pond. Prespawning mortality was the lowest since we began the hatchery program.

In 1988, the Imnaha weir was installed earlier than in any previous year. However three days after installation, the flow increased and toppled the weir over. The weir was reinstalled on 2 July. A high percentage of the total fish captured were trapped in the first three weeks of trapping. As in 1986 and 1987, hatchery fish returned later than wild fish. By 5 August, 86.3% of the wild fish had been trapped while only 52.7% of the hatchery fish had been trapped. It is important that we be able to trap fish from early in the run to develop hatchery fish that have the same genotypic variation and life history characteristics as the wild stock.

In 1988 we again obtained eggs of Rapid River stock chinook salmon from Rapid River Hatchery in Idaho. A total of 372,948 of these eggs were used for the subyearling smolt program at Irrigon Hatchery. We will continue to need Rapid River stock eggs from Idaho to meet chinook smolt production goals and develop a hatchery broodstock for the Grande Ronde Basin.

For the third, year the subyearling chinook salmon smolts that were reared at Irrigon Hatchery did not achieve the target size of 23.0 grams by 1 May. The subyearling smolts were released at a size of 12.5 grams/fish. We have not recovered any jacks or adults from subyearling smolt releases even though the first adults (1986 brood year) were expected to return to Lookingglass Hatchery in 1989.

Lookingglass Hatchery produced a total of 47,869 lbs of 1987 brood smolts for the Grande Ronde Basin, which exceeded the mitigation goal of 45,000 lbs, and 8,895 lbs for the Imnaha Basin which, was only 36.3% of the mitigation goal of 24,500 lbs.

The 1988 returns of spring chinook salmon to Lookingglass Hatchery exceeded program needs due to large numbers of juvenile releases and changing of hatchery broodstock from Carson stock to Rapid River stock. Excess Carson stock chinook salmon adults were outplanted to enhance natural production in Catherine Creek, the upper Grande Ronde River, and the Wallowa River. Based on recovery of disk-tagged adults, we could only account for 26.0% of the outplanted fish. Possible causes of unaccounted fish losses include poaching, early prespawning mortality, unreported tribal harvest, incomplete carcass recovery, and tag loss (Table 10). Only 18.1% of the outplanted adults were accounted for in 1987.

We met the program goal of 1.35 million smolts (1988 brood year) for the Wallowa stock steelhead program. In addition, 50,410 Wallowa stock steelhead smolts raised at Lyons Ferry Hatchery in Washington were released in the lower Grande Ronde River in Oregon. We released a total of 52,263 Wallowa stock presmolts into the Snake River.

We nearly achieved the smolt production goal of 330,000 smolts with the 1988 brood Imnaha stock steelhead. We released 321,823 summer steelhead smolts into the Imnaha Basin in 1989. A total of 42,064 Imnaha stock were graded off as presmolts and released into the Snake River.

The number of eggs taken for the 1989 brood Wallowa stock summer steelhead was short of our program needs. As in previous years, we experienced high prespawning mortality and high egg losses. Surplus Imnaha stock summer steelhead eggs were used in the Grande Ronde program to make up for shortages of Wallowa stock. The large return of hatchery steelhead to Little Sheep Creek in 1989 provided ample broodstock and we exceeded the egg-take goal and escapement goal for above the weir. The hatchery returns were predominantly age-4 fish from the 1985 brood year. We were forced to spawn some males more than once because males only composed 33% of the return. The wild component of the Little Sheep Creek run was low, primarily because we removed a large portion of the wild fish for hatchery broodstock in past years. Only 18% of the fish spawned were of wild origin. It is important to continue incorporating wild fish into hatchery broodstock to maintain genotypic variation and life history characteristics similar to the wild population. We will try to incorporate more wild fish into the broodstock in the future.

In 1989, the ODFW pathology staff and the Oregon Department of Environmental Quality conducted an extensive investigation of the causes of the Wallowa acclimation pond syndrome (WAPS), which occurred in 1988. Water quality and fish health were assessed throughout the entire acclimation period. The ODFW pathology staff attributed the major fish health problems and mortality of smolts in the acclimation ponds to two factors: (1) acute physiological stress caused by extreme temperature differences, which were a result of transferring fish from Irrigon Hatchery to the Wallowa acclimation ponds in late February and early March; and (2) from poor water quality created by agricultural practices on Alder Slope.

#### Survival Studies

The first brood year of cold-branded Rapid River stock chinook salmon was released from Lookingglass Hatchery in 1988 for evaluation of outmigration performance and survival. The cumulative passage index at Lower Granite Dam for chinook smolts released in the spring was 17.6 times greater than the index for fish released in the fall. Few fish from the fall release group were recovered. The cumulative passage index was similar for smolts released at an average weight of 41.9 grams/fish and 23.0 grams/fish (Table 26).

The cumulative passage index for subyearling smolt releases was similar to yearling smolt releases, but the subyearlings migrated past Lower Granite

Dam up to eight weeks later. The subyearling smolts did not migrate as quickly as yearling smolts released in the spring. Over 60% of the yearling smolts that were recovered at Lower Granite Dam were recovered two weeks after release, but 60% of the recoveries of subyearling smolts were not observed until five weeks after release.

The second brood year of cold-branded Imnaha chinook salmon was released in the Imnaha River in 1988. The passage index at Lower Granite Dam was 1.3 times less than the passage index of Rapid River stock smolts released at Lookingglass Hatchery at the same time. The passage index at Lower Granite Dam in 1988 (1986 brood year) was 4 times greater than the passage index in 1987 (1985 brood year).

The release of marked 1988 brood summer steelhead smolts at Wallowa Hatchery represented the third year of releases to compare acclimation versus direct stream releases and the fourth year of size-at-release comparisons. The mean weights of summer steelhead release groups used in size-at-release comparisons were closer in size than in the previous year. Fish targeted for 114 grams/fish at release averaged 105 grams/fish; fish targeted for 91 grams/fish at release averaged 96 grams/fish.

The passage indexes at Lower Granite Dam for cold-branded 1987 brood summer steelhead smolts released at Wallowa Hatchery and in Little Sheep Creek in spring of 1988 were much higher than the passage indexes for fish released in 1987. The average passage index for Wallowa stock steelhead smolts released at Wallowa Hatchery was only 2.0% in 1987 and 16.4% in 1988. The average passage index for Imnaha stock steelhead smolts released in 1987 was very poor at only 0.1%, but was 2.9% in 1988 (Table 27). There may be problems in the readability of Imnaha steelhead brands at Lower Granite Dam because of poor brand quality.

Returns are complete for the 1985 brood Wallowa stock summer steelhead size-at-release comparisons. Total survival (catch and escapement) was good for both release groups. The fish released at an average weight of 115 grams survived at a 44% higher rate than the fish released at an average weight of 84 grams, but produced a higher proportion of age-3 (1-salt) adults (Table 31).

The exploitation rates (not corrected for unaccounted losses) of 1985 brood Wallowa stock steelhead that returned in the 1987-88 and 1988-89 run years averaged 72%. The exploitation rate of the 1985 brood Imnaha stock summer steelhead was 48% with most of the harvest occurring in the Columbia River treaty net fishery (Table 31).

We compared ratios of juvenile migration success (based on percent recovery of brands at Lower Granite Dam) with ratios of total adult survival (catch plus escapement) for 1985 brood Wallowa stock summer steelhead that were released for size-at-release comparisons. The migration success for the larger smolts (average weight of 115 grams/fish) was 2.3 times better than the smaller (average weight of 84 grams/fish) smolts; smolt-to-adult survival was 1.8 times better for the larger smolts.

Spring chinook adult returns to the LSRCP mitigation area were only 40.7% of the mitigation goal of 5,820 adults for the Grande Ronde Basin. The majority of the chinook salmon were age-5 fish from the 1983 brood year (Table 32).

We estimated that only 34 hatchery Imnaha chinook salmon adults returned to the LSRCP mitigation area in 1988, which represented only 1.1% of Oregon's mitigation goal of 3,210 chinook for the Imnaha Basin. Adults that returned in the 1988 run year were from releases of the 1983 and 1984 broods, which were only 23.6% and 7.2%, respectively, of the 490,000 smolt mitigation goal (Table 32).

We estimated that 3,378 Wallowa stock summer steelhead returned to the LSRCP mitigation area in the 1988-89 run year, which was only 36.8% of the mitigation goal of 9,184 adults for the Grande Ronde Basin. Smolt releases that produced the 1988-89 run were 14.4% and 100% of the mitigation goal for the 1985 and 1986 brood years, respectively (Table 32).

A total of 453 hatchery stock Imnaha summer steelhead returned to the LSRCP mitigation area in the 1988-89 run year, which represented 22.7% of the mitigation goal of 2,000 steelhead for the Imnaha Basin. Smolt releases that produced adults in the 1988-89 run year were only 35.0% and 28.4% of the mitigation goal of 330,000 smolts for the 1985 and 1986 brood years, respectively.

#### Natural Escapement Monitoring

We were only able to examine 21% and 17% of the adult spring chinook spawning population on the Minam and Wenaha rivers, respectively. The 2 marked hatchery strays recovered on the Minam River surveys expanded to 78 marked and unmarked hatchery strays; an estimated 37% of the spawning population. The 7 marked hatchery strays recovered on the Wenaha River surveys expanded to 203 marked and unmarked hatchery strays, which was estimated to be 52% of the spawning population.

We are developing discriminant scale analysis models to help determine the actual number of hatchery strays in the Minam, Wenaha, and Lostine rivers. Expansions from low numbers of marked-fish recoveries and low percentages of carcasses sampled may be inaccurately estimating the level of hatchery straying. We need to conduct multiple surveys on the Wenaha River in the future to recover and examine a higher percentage of adult carcasses. Also, hatchery strays may exhibit different spawning timing, which could result in hatchery fish being recovered at a higher or lower rate depending on when the spawning ground surveys are conducted.

#### Disease Investigation

In November of 1987, erythrocytic inclusion body syndrome (EIBS) was detected in the 1986 brood Imnaha chinook salmon juveniles at Lookingglass Hatchery. To reduce the incidence of EIBS in fish prior to release and to determine if incubation and rearing strategies affected the incidence of

EIBS, alternate incubation and rearing strategies were developed for the 1988 brood Imnaha chinook salmon. The following incubation strategies were used:

1. Incubation with chilled well water, early rearing on river and well water, and late rearing (15 February to 1 April) on river and well water.
2. Incubation and early rearing on river and well water and late rearing on river water.

No EIBS has been detected in any of the 1988 brood chinook salmon at Lookingglass Hatchery. This incubation and rearing experiment is planned to continue with the 1989 brood.

## 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 to assure that smolt production goals are achieved at Lookingglass Hatchery. Now that we are attempting to switch broodstock from Carson stock to Rapid River stock, we will be requesting eggs from Idaho to meet production goals for the Grande Ronde Basin. We will continue to take enough eggs from returning adults at Lookingglass to meet full production in case Idaho is not able to meet our request. Surplus Carson stock chinook were released as presmolts from 1984 through 1987. In 1984 we released presmolts into Catherine Creek, the upper Grande Ronde River, and Lookingglass Creek. In 1985, 1986, and 1987 presmolts were released only into Lookingglass Creek. We marked (Ad+CWT) presmolts each year to estimate survival rates and adult catch and escapement. The objectives and tasks are described in the summary section of this report and in the five-year study plan (Carmichael 1989).

### Methods

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

### Results and Discussion

Catch and escapement recoveries are complete for the 1983 brood presmolts released in the upper Grande Ronde River and Lookingglass Creek in July of 1984. Total survival (catch plus escapement) was poor for both release groups. Presmolts released in the upper Grande Ronde River survived at 0.02%; presmolts released in the Lookingglass Creek survived at 0.03%. The majority of the recoveries (77.5%) of the upper Grande Ronde River release group were in Columbia River fisheries (Table 30). Presmolt releases tended to produce a high percent of age-5 (3-salt) fish. The upper Grande Ronde River presmolts produced 90% age-5 adults; Lookingglass Creek produced 53% age-5 adults. We recovered only four age-4 adults from presmolt releases at Lookingglass Hatchery in 1988.

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

### Introduction

In 1984 plans were developed to reprogram lower Columbia River hatcheries to produce spring chinook salmon smolts for release in upriver areas. The plan was never implemented and few chinook salmon smolts were reared at lower Columbia River hatcheries and released in upriver areas. In Oregon, Carson stock chinook salmon of the 1983, 1984, and 1985 broods were reared at Bonneville or Oxbow hatcheries and were released in the

Grande Ronde basin. This program was discontinued after the 1985 brood, and we have no immediate plans to begin the program again. New hatchery facilities, in addition to LSRCP hatcheries, may be constructed in the future to provide additional chinook salmon production for northeast Oregon streams.

We are evaluating the contribution of smolts that were reprogrammed to LSRCP areas to determine if LSRCP hatcheries have met mitigation goals and to determine the effectiveness of releasing smolts from lower river hatcheries into upriver areas. The objectives of this study are described in the five-year study plan (Carmichael 1989).

#### Methods

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

#### Results and Discussion

Adult returns are complete for the 1983 brood releases. Fish released in September survived at only 0.03%. The 1984 brood released in the spring of 1986 from Lookingglass survived at 0.18% through age-4. Future work on this project will involve recovering marked adults and summarizing catch and escapement information.



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