ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

PROJECT TITLE:	Evaluation of Lower Snake River Compensation Plan Facilities in Oregon
PROJECT TITLE:	Evaluation of the Benefits Provided by Releasing Spring Chinook Salmon Presmolts in the Grande Ronde River and its Tributaries
PROJECT TITLE:	Evaluation of the Benefits Provided by Reprogramming Spring Chinook Salmon Smolts from Lower Columbia River Hatcheries
CONTRACT NUMBER:	14-16-0001-87513(RWG)
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SUMMARY

EVALUATION OF LOWER SNAKE RIVER COMPENSATION PLAN FACILITIES IN OREGON

Objectives for FY 1988

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 and the Imnaha River weir and for summer steelhead that return to the Big Canyon Creek 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. Mark (Ad+CWT) and cold brand the following groups of chinook salmon: Rapid River stock for subyearling smolt evaluation, time-of-release comparisons, and production survival estimates; and Imnaha stock for production survival estimates.

7. Mark (Ad+CWT) and cold brand the following groups of summer steelhead: Wallowa stock for size-at-release comparisons, direct stream release survival estimates, and production survival estimates; and Imnaha stock for production survival estimates.

8. Mark all Lookingglass stock spring chinook salmon smolts with left ventral clips for stock identification and potential selective fisheries.

9. Mark native Grande Ronde River stock summer steelhead with right ventral 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 1987-88 run year and chinook salmon adults in the 1987 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 1988

We accomplished all of our original objectives in FY 1988.

Findings in FY 1988

A total of 2,470 spring chinook salmon returned to Lookingglass Hatchery in 1987. We trapped 187 chinook salmon at the Imnaha River weir of which 21 were hatchery fish.

Run timing of Imnaha hatchery chinook salmon was substantially later than run timing of wild fish.

Low levels of infectious hematopoietic necrosis virus (IHNV) were detected in 1987 Lookingglass stock chinook salmon adults spawned at Lookingglass Hatchery and Rapid River stock adults spawned at Pahsimeroi Hatchery. No IHNV was detected in 1987 Imnaha stock chinook salmon adults . There was an epizootic of erythrocytic inclusion body syndrome (EIBS) in 1986 brood Imnaha stock spring chinook juveniles at Lookingglass Hatchery. Warm water therapy was applied and significant recovery was observed. Low levels of EIBS were detected in 1986 brood Lookingglass and Rapid River stock juveniles at Lookingglass Hatchery; however, there was no epizootic in either of these two stocks.

A total of 1,588 chinook salmon adults were outplanted from Lookingglass Hatchery in 1987. We estimated that 6.0% returned to Lookingglass Hatchery, 6.4% were harvested, 5.7% were recovered on spawning ground surveys, and the remaining 81.9% were unaccounted for.

A total of 2,073 summer steelhead adults returned to Wallowa Hatchery in 1988. We trapped 47 wild and 808 hatchery steelhead adults at Little Sheep Creek in 1988. At Big Canyon Creek we trapped 27 wild steelhead and 58 hatchery steelhead. All fish trapped at Big Canyon Creek were released above the weir.

No IHNV was detected in summer steelhead adults spawned at Wallowa Hatchery in 1988 but IHNV was found in 0.7% of the family groups spawned at Little Sheep Creek in 1988.

Smolt-to-adult survival rate (catch plus escapement) through 1-ocean returns for CWT Wallowa stock summer steelhead smolts released at 4.0 fish/lb and 5.4 fish/lb was 0.87% and 0.40% respectively, and the survival rate for Imnaha stock summer steelhead was 0.44%.

Smolt-to-adult survival rate (catch plus escapement) for 1982 brood chinook salmon released from Lookingglass Hatchery was low. Fish released in December, 1983, survived at 0.06% and fish released in March, 1984, returned at 0.10%. The survival rate for 1982 brood Imnaha chinook salmon was 0.11%. Smolt-to-adult survival rates through age 4 for all release groups of 1983 brood Carson stock chinook salmon released from Lookingglass Hatchery were poor. The highest survival rate was 0.12% for fish released in April.

The smolt passage index at Lower Granite Dam for chinook salmon released at Lookingglass Hatchery in the spring of 1987 was 13 times greater than the index for fish of the same brood released in the fall of 1986. Passage index for 1986 brood Wallowa stock steelhead released in spring 1987 at an average weight of 124.5 gr/fish was 5.5 times greater than the index for steelhead released at the same time and location at a size of 96.9 gr/fish. Migration success to Lower Granite Dam of summer steelhead and spring chinook in 1987 was well below the previous two years.

No marked fish were recovered on the Minam River survey and one marked fish was recovered on the Wenaha River.

Management Implications

1. If we continue to collect adults from the latter part of the run, run timing of Imnaha Hatchery chinook salmon will continue to be later than that of wild fish.

2. Warm water therapy appears to be effective in reducing the detrimental effects of the EIBS. Major changes in the water delivery systems will be required at Lookingglass Hatchery to allow well water delivery to all raceways.

3. Outplanting chinook salmon adults from Lookingglass Hatchery in May and June to increase natural production is ineffective.

4. Most of the adults that returned to Little Sheep Creek in 1988 were hatchery fish, therefore a low percentage of wild fish were used for broodstock.

5. Chinook salmon adult compensation goals have not been met because smolt-to-adult survival rates have been well below mitigation goals.

6. Although straying rates of hatchery chinook salmon destined for Lookingglass Hatchery have been low, the effect in the Minam and Wenaha rivers may be significant because they have low natural adult escapement.

Recommendations

1. The Imnaha River facility should be modified so that broodstock can be collected from the entire run.

2. We should continue EIBS investigations at Lookingglass Hatchery and monitor smolt-to-adult survival of EIBS infected fish to further our understanding of the affects of EIBS on smolt-to-adult survival.

3. If we continue to outplant chinook salmon adults from Lookingglass Hatchery to enhance natural production, the adults should be held until they are nearly mature. This will reduce the number of outplanted adults that return to Lookingglass Hatchery and increase spawning success.

4. We should continue to develop and implement broodstock management guidelines and spawning strategies for summer steelhead at Little Sheep Creek to ensure that wild fish are incorporated into the broodstock and that an adequate number of adults are passed above the weir to sustain a natural population.

5. We should develop alternate release strategies for Imnaha stock summer steelhead that will increase inbasin recreational harvest and reduce the number of surplus hatchery adults that return to the Little Sheep Creek facility.

6. Ineffective release strategies (presmolts) at Lookingglass Hatchery should be discontinued and alternative rearing and release strategies, which will help meet mitigation goals, should be developed.

7. Scale analysis techniques should be developed to determine the origin (hatchery or wild) of spring chinook salmon carcasses recovered on spawning ground surveys.

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

Objectives for FY 1988

Mark Ad+CWT 80,000 (replicate codes of 40,000) 1986 brood Lookingglass stock chinook salmon presmolts at Lookingglass Hatchery. Release marked fish into Lookingglass Creek and recover and decode tags from returning adults.

Accomplishments in FY 1988

The objectives were accomplished.

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

Objectives for FY 1988

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 1988

The objectives were accomplished.

GENERAL INTRODUCTION

The background of the Lower Snake River Compensation Plan (LSRCP) is given in Carmichael et al. (1986, 1987). 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 et al. (1987).

Three 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 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 5-year study plan (Carmichael 1987). In this report we present a review of our activities under all projects for the period 1 July 1987 to 30 June 1988. Previous annual progress reports were prepared by Carmichael and Wagner (1983), Carmichael and Messmer (1985), and Carmichael et al. (1986, 1987).

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 1987) 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. (1988). Results of the comprehensive spring chinook spawning ground surveys will be presented in a completion report that will be prepared in 1990-91.

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 1987). Pathological examinations were conducted by ODFW pathology staff and methods are reported in Bauer et al. 1988.

Survival Studies

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

The number of adult spring chinook salmon (1987 run year) and of summer steelhead (1987-88 run year) produced by releases from LSRCP facilities in Oregon were calculated as follows: For Grande Ronde basin chinook salmon releases, the number of adults produced was calculated using catch, escapement, and exploitation rate from marked (Ad+CWT) fish, and the marked-to-unmarked-adult-return ratios. Adults produced from unmarked fish released away from broodstock collection sites were calculated using catch and escapement rates of marked fish that were released at a similar size and time. All 1982 and 1983 brood Imnaha stock chinook salmon were marked; therefore, the total number of adults produced was determined as the sum of the estimated numbers of marked fish recovered.

For Wallowa stock summer steelhead, the total number of adults produced in the 1987-88 run year (1984 and 1985 brood years) was calculated using catch, escapement, and exploitation rate of marked fish (Ad-left ventral(LV)+CWT) and unmarked-to-marked-adult-return ratios of the 1985 brood year (there were no 1984 brood marked).

Natural Escapement Monitoring

We conducted spawning ground surveys cooperatively with ODFW management personnel on the Minam River from 25 to 28 August and 24 to 25 September 1987 and on the Wenaha River from 7 to 14 September 1987. We examined all carcasses for fin marks and collected snouts from all marked fish.

Planning

Planning activities consisted of work associated with preparation of Imnaha and Grande Ronde subbasin plans under the Northwest Power Planning Council system planning process. Project personnel provided extensive summaries of stock and production characteristics for hatchery and wild chinook salmon and summer steelhead. We provided input and supervision for habitat and production modeling that was utilized to assess production capacity and for analyzing benefits from future enhancement activities. We participated as members on the technical and management work groups for both the Imnaha and Grande Ronde subbasins.

Creel Surveys

Methods are presented in Carmichael et al. (1987, 1988).

Disease Investigations

Methods are described in 1987 annual report (Carmichael et al. 1987) and in ODFW pathology reports (Bauer et al. 1988).

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 (Bauer et al. 1988). Data related to survival studies of spring chinook salmon and summer steelhead appear in Tables 22-31.

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:				
1986	280,431	25.7	72.4	71.0
1987	187,395	23.9	75.3	(a)
Carson:				
1986	635,927	5.5[b]	94.5	89.1[c]
1987	1,223,104	2.6[d]	98.1[e]	(a)
Rapid River:				
1986	717,977[f]	0.8	94.8	89.3
1987	227,281	25.4	73.0	62.1
1987	802,547	22.0	75.0	(a)

a *Most 1987 brood smolts will be released in the spring of 1989.*
b *Does not include the loss of 12,000 eggs that were destroyed because of the presence of IHNV in the parents.*
c *Does not include presmolts.*
d *Does not include the loss of 60,000 eggs that were destroyed because of IHNV in the parents and 522,923 green eggs shipped to Wallowa Hatchery.*
e *Does not include 500,000 eyed eggs shipped to Oxbow Hatchery.*
f *83.8% of this group were received as eyed eggs from Pahsimeroi Hatchery in Idaho..*

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, 1986 and 1987 broods. Standard deviation is shown in parenthesis.

Stock, brood year, date released	Number released	Size (fish/lb)	Location released	*N*	Mean fork length(mm)
CARSON					
1986:					
07/20/87	100,918	58.3	Lookingglass Creek	304	85(5.5) CWT
03/30/88	136,675[a]	17.6	Big Canyon Creek	301	130(11.6)
04/08/88	49,634[a]	20.6	Big Canyon Creek	--	--
03/31-04/05/88	151,888[a]	20.6	Catherine Creek	--	--
RAPID RIVER					
1986:[b]					
09/18/87	81,902	22.6	Lookingglass Creek	353	113(13.6)
11/03/87	82,445	22.8	Lookingglass Creek	515	115(10.6)
04/01/88	40,551	7.0	Lookingglass Creek	--	--
04/01/88	131,580	14.8	Lookingglass Creek	--	--
04/01/88	87,382	13.2	Lookingglass Creek	400	143(21.4)
04/01/88	86,430	20.1	Lookingglass Creek	348	125(6.2)
1987:					
05/13/88	141,080	29.3	Lookingglass Creek	400	107(6.2)
IMNAHA					
1986:					
03/21-22/88	101,929	10.5	Imnaha River	423	150(21.0)
04/20-21/88	97,137	8.9	Imnaha River	400	161(21.0)

[a] *100% left ventral fin marked.*
[b] *100% right ventral fin marked.*

Table 3. Vital statistics for spring chinook salmon that returned to Lookingglass Hatchery and the Imnaha River weir, 1987. J = jacks, M = males, F = females.

Location, origin	Total	J	M	F	Number females spawned	Prespawning mortality (%) J	M	F
Lookingglass Hatchery:								
Hatchery	2,470	62	1,003	1,405	294	12.5	3.7	4.1
Imnaha River weir:								
Wild	165	4	96	65	38	0	12.5	9.3
Hatchery	22	17	3	2	1	11.8	3.3	50.0

Table 4. Run timing for adult spring chinook salmon that returned to Lookingglass Hatchery and the Imnaha River weir, 1987.

Time interval	Lookingglass Hatchery[a]		Imnaha River weir[b]			
			Wild		Hatchery	
	Number	% of total	Number	% of total	Number	% of total
06-13 May	0	0	--	--	--	--
14-20 May	0	0	--	--	--	--
21-27 May	357	13.9	--	--	--	--
28 May-03 Jun	1,004	39.2	--	--	--	--
04-10 Jun	495	19.3	--	--	--	--
11-17 Jun	255	10.0	--	--	--	--
18-24 Jun	178	6.9	0	0	0	0
25 Jun-01 Jul	0	0	45	27.3	3	13.7
02-08 Jul	88	3.4	44	26.7	1	4.5
09-15 Jul	0	0	31	18.8	2	9.1
16-22 Jul	0	0	0	0	0	0
23-29 Jul	0	0	19	11.5	5	22.7
30 Jul-05 Aug	24	0.9	0	0	0	0
06-12 Aug	11	0.4	3	1.8	2	9.1
13-19 Aug	7	0.3	4	2.4	1	4.5
20-26 Aug	107	4.2	9	5.5	2	9.1
27 Aug-02 Sep	29	1.1	6	3.6	4	18.2
03-09 Sep	9	0.4	1	0.6	2	9.1
10-16 Sep	--	--	3	1.8	0	0

2568 - 98 outplants counted twice = 2470

[a] *Lookingglass Hatchery trap operated from 4 May to 8 September.*
[b] *Imnaha River weir operated from 18 June to 15 September. Fish were allowed to pass the weir from 15 July to 18 July and from 28 July to 2 August.*

Table 5. Spawning timing of female spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River weir, 1987.

Time interval	Lookingglass Hatchery		Imnaha River weir			
			Wild		Hatchery	
	Number	% of total	Number	% of total	Number	% of total
13-19 Aug	0	0	3	7.9	0	0
20-26 Aug	124	42.2	13	34.2	0	0
27 Aug-02 Sep	135	45.9	16	42.1	1	100
03-09 Sep	35	11.9	4	10.5	0	0
10-16 Sep	0	0	2	5.3	0	0
17-23 Sep	0	0	0	0	0	0

Table 6. Number of spring chinook salmon trapped and released above the Imnaha River weir, 1987.

Time interval[a]	Number of fish released		
	Jacks	Males	Females
18-24 Jun	0	0	0
25 Jun-01 Jul	0	10	8
02-08 Jul	1	19	11
09-15 Jul	2	18	0
16-22 Jul	0	0	0
23-29 Jul	0	6	1
30 Jul 05 Aug	0	0	0
06-12 Aug	0	0	0
13-19 Aug	0	1	0
20-26 Aug	0	1	1
27 Aug-02 Sep	1	1	1
Total released	4	56	22

[a] *Imnaha River weir operated from 18 June to 15 September. Fish were allowed to pass the weir from 15 July to 18 July and from 28 July to 2 August.*

Table 7. Percent age composition of spring chinook salmon that returned to Lookingglass Hatchery and the Imnaha River weir, 1987. Age nomenclature is that of Gilbert and Rich (1927).

Age group, number	Lookingglass Hatchery		Imnaha River weir			
			Wild		Hatchery	
	Males	Females	Males	Females	Males	Females
3_2	2.5	0.1	2.4	0	72.8	0
4_2	34.7	52.5	52.1	19.4	18.2	4.5
5_2	5.9	4.3	6.1	20.0	0	4.5
Number of fish	1,065	1,405	100	65	20	2

Table 8. Mean fork length (mm) for age-specific groups of adult spring chinook salmon, 1987. Age nomenclature is that of Gilbert and Rich (1927). Standard deviation is shown in parenthesis.

Location, origin	Age 3_2				Age 4_2			
	Males		Females		Males		Females	
	N	Length	*N*	Length	*N*	Length	*N*	Length
Lookingglass Hatchery:								
Hatchery	44	531(52)	1	594	279	790(56)	409	745(36)
Imnaha River weir:								
Wild	1	517	0	--	35	754(42)	21	819(41)
Hatchery	15	572(41)	0	--	4	721(43)	1	669

Location, origin	Age 5_2			
	Males		Females	
	N	Length	*N*	Length
Lookingglass Hatchery:				
Hatchery	49	941(65)	42	879(52)
Imnaha River weir:				
Wild	4	1,002(41)	22	923(36)
Hatchery	0	--	1	950

Table 9. Degree of smolting for juvenile spring chinook salmon released into the Grande Ronde and Imnaha river basins, 1986 and 1987 broods. Standard deviation is shown in parenthesis.

Brood year, stock	Release date	*N*	Mean length (mm)	Degree of smolting[a] (%) Smolt	Intermediate	Parr
1986:						
Carson	07/20/87	200	85(5.5)	0	0	100
	03/30/88	200	130(11.6)	1.0	99.0	0
Rapid River	09/18/87	200	113(13.6)	6.5	93.5	0
	11/03/87	200	115(10.6)	1.5	9.5	89.0
	04/01/88	400	143(21.4)	17.5	82.5	0
	04/01/88	200	125(6.2)	5.0	95.0	0
Imnaha	03/21-22/88	423	150(21.0)	6.0	93.5	0.5
	04/20-21/88	400	161(21.0)	75.3	24.7	0
1987:						
Rapid River[b]	05/13/88	400	107(6.2)	26.2	73.8	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 visable, body color silver, and scales deciduous.*

[b] *Reared at Irrigon Hatchery and released as accelerated subyearling smolts.*

Table 10. Release and recovery information for adult spring chinook salmon outplanted from Lookingglass Hatchery into some Grande Ronde River basin streams, 1987. Expanded numbers of fish are shown in parenthesis.

Outplanting location	Dates out-planted	Number of fish released Tagged	Total	Outplanted fish recovered and observed: Returned to Lookingglass Hatchery	Observed live or recovered on spawning ground surveys[a]	Taken in tribal fishery
Catherine Creek	05/27-30	164	700	6(26)	8(34)	16(68)
Upper Grande Ronde River	06/01-15	67	498	6(45)	7(52)	3(22)
Wallowa River	06/08	67	300	6(27)	2(9)[b]	0
Wallowa River[c]	08/25	0	90	--	--	--

[a] *Observed or recovered on the day of spawning ground index counts, inside and outside of index areas.*
[b] *Recovered in Hurricane Creek.*

Table 11. Egg take and egg survival of native Grande Ronde (Big Canyon Creek and Lookingglass Creek), Wallowa, and Imnaha stocks of summer steelhead, 1987 and 1988 broods.

Stock, brood year	Eggs taken	Egg loss (%)	Egg-to-fry survival (%)	Egg-to-smolt survival (%)
Native Grande Ronde:				
1987	59,700	34.0	58.9	49.3
Wallowa:				
1987	3,348,000	30.9	64.8[a]	64.0[b]
1988	3,027,000	24.5	66.3[c]	(d)
Imnaha:				
1987	695,000	35.4	58.9	52.6[e]
1988	827,000	33.8[f]	60.0[g]	(d)

[a] *Does not include 500,000 eyed eggs shipped to Lyons Ferry Hatchery.*
[b] *Does not include 300,731 presmolts released into the Snake River.*
[c] *Does not include 502,956 eyed eggs shipped to Lyons Ferry Hatchery.*
[d] *1988 brood smolts will be released in the spring of 1989.*
[e] *Does not include 37,943 presmolts released into the Snake River.*
[f] *Does not include 38,080 eggs that were destroyed because of the presence of IHNV in the parents and excess program needs.*
[g] *Does not include release of 35,698 fry in Little Sheep Creek.*

Table 12. Vital statistics for juvenile summer steelhead released in the Grande Ronde and Imnaha river basins and the Snake River, 1987 brood year. All fish were adipose fin marked unless indicated otherwise. Standard deviation is shown in parenthesis.

Stock, date released	Number released	Size (fish/lb)	Location of release	*N*	Mean fork length (mm)
Wallowa:					
11/23-30/87[a]	300,731	41.8	Snake River	--	--
04/16/88	372,741	5.0	Wallowa Hatchery	521	207(17.4)
04/16/88	88,821	4.3	Wallowa Hatchery	204	216(18.6)
04/16/88[b]	29,424	5.0	Wallowa Hatchery	--	--
04/18-19/88	60,863	4.8	Spring Creek	306	206(18.2)
04/13-05/02/88	113,403	5.6	Upper Wallowa River	690	196(17.8)
04/05-05/04/88	236,825	5.0	Upper Grande Ronde River	1,177	197(19.2)
04/04-08/88	62,520	4.9	Catherine Creek	684	201(16.8)
04/13/88	223,196	5.1	Big Canyon Creek	400	210(17.8)
04/16-05/02/88	149,985	5.1	Lower Grande Ronde River	400	202(18.8)
04/28/88[c]	50,640	6.0	Lower Grande Ronde River	193	196(15.3)
Imnaha:					
11/30/87[a]	37,943	62.1	Snake River	--	--
04/21-28/88	84,503	5.3	Imnaha River	258	195(18.3)
04/13/88	246,994	5.3	Little Sheep Creek Facility	300	202(19.1)

[a] *Small fish graded off at Irrigon Hatchery and excess to program needs were released into the Snake River below Hells Canyon Dam.*
[b] *Progeny from wild Lookingglass stock and Big Canyon stock. Adults 100% right ventral fin marked.*
[c] *Reared at Lyons Ferry Hatchery.*

Table 13. Vital statistics for adult summer steelhead that returned to Big Canyon Creek facility, Wallowa Hatchery, and Little Sheep Creek facility, 1988.

Location, origin	Total	Males	Females	Number of females spawned	Prespawning mortality (%) Males	Females
Big Canyon Creek:						
Wild	27	11	16	0	--	--
Hatchery	58	27	31	0	--	--
Wallowa Hatchery:						
Hatchery	2,073	697	1,376	551	31.1	37.7
Little Sheep Creek:						
Wild	47	21	26	6	0	0
Hatchery	808	366	442	165	9.2	8.4

Table 14. Run timing for adult summer steelhead that returned to the Big Canyon Creek facility, Wallowa Hatchery, and Little Sheep Creek facility, 1988.

Time interval	Big Canyon Creek facility[a] Wild Number	Wild % of Total	Hatchery Number	Hatchery % of Total	Wallowa Hatchery[b] Number	Wallowa Hatchery % of Total
01-04 Mar	--	--	--	--	--	--
05-11 Mar	--	--	--	--	106	5.1
12-18 Mar	--	--	--	--	285	13.7
19-25 Mar	--	--	--	--	326	15.7
25 Mar-01 Apr	0		2	3.4	222	10.7
02-08 Apr	4	14.8	14	24.1	323	15.6
09-15 Apr	5	18.5	12	20.7	569	27.5
16-22 Apr	1	3.7	11	19.0	169	8.2
23-29 Apr	6	22.2	7	12.1	46	2.2
30 Apr-06 May	2	7.4	1	1.7	25	1.2
07-13 May	8	29.7	8	13.8	0	0
14-20 May	1	3.7	3	5.2	2	0.1
21-27 May	0	0	0	0	0	0

Time interval	Little Sheep Creek facility[c] Wild Number	Wild % of Total	Hatchery Number	Hatchery % of Total
01-04 Mar	0	0	1	0.1
05-11 Mar	0	0	5	0.6
12-18 Mar	0	0	1	0.1
19-25 Mar	0	0	11	1.4
25 Mar-01 Apr	0	0	15	1.9
02-08 Apr	1	1.7	65	8.2
09-15 Apr	27	45.8	360	45.2
16-22 Apr	22	37.3	197	24.7
23-29 Apr	9	15.2	59	7.4
30 Apr-06 May	0	0	8	1.0
07-13 May	0	0	49	6.2
14-20 May	0	0	23	2.9
21-27 May	0	0	2	0.3

[a] *Big Canyon Creek trap operated from 1 April to 23 May 1988.*
[b] *Wallowa Hatchery trap operated from 3 March to 23 May 1988.*
[c] *Little Sheep Creek trap operated from 1 March to 23 May 1988.*

Table 15. Time of spawning for adult summer steelhead that returned to Wallowa Hatchery and Little Sheep Creek facility, 1988.

Time interval	Wallowa Hatchery		Little Sheep Creek facility			
			Wild		Hatchery	
	Number	% of total	Number	% of total	Number	% of total
02-08 Apr	0	0	0	0	0	0
09-15 Apr	132	23.9	2	28.5	28	17.1
16-22 Apr	216	39.2	3	42.9	45	27.4
23-29 Apr	180	32.7	1	14.3	47	28.7
30 Apr-06 Jun	23	4.2	0	0	21	12.8
07-13 Jun	0	0	1	14.3	11	6.7
14-20 Jun	0	0	0	0	12	7.3

Table 16. Percent age composition of adult summer steelhead trapped at Wallowa Hatchery and Little Sheep Creek facility, 1987 and 1988. Age is expressed as years spent in freshwater prior to ocean migration:years spent in ocean prior to spawning migration.

Year, age group, number	Wallowa Hatchery		Little Sheep Creek facility			
			Wild fish		Hatchery fish	
	Male	Female	Male	Female	Male	Female
1987:						
1:1	34.2	26.2	0	0	41.2	58.5
1:2	11.2	27.4	0	5.3	0	0
2:1	0.3	0.2	42.1	31.5	0.3	0
2:2	0	0.5	0	5.3	0	0
Number of fish	1,763	2,092	9	10	122	172
1988:						
1:1	19.6	16.6	0	0	42.6	42.7
1:2	13.8	48.5	0	6.4	2.5	10.8
2:1	0.1	0.9	38.3	21.3	0.2	0.5
2:2	0.1	0.3	6.4	27.6	0	0
1:3	0	0.1	0	0	0	0.7[a]
Number of fish	697	1,376	21	26	366	442

[a] *Unmarked hatchery strays, n = 6.*

Table 17. Mean fork length (mm) by age group for adult summer steelhead that returned to Wallowa Hatchery and the Little Sheep Creek facility, 1987 and 1988. Standard deviation is shown in parenthesis. Age is expressed as years spent in freshwater prior to ocean migration:years spent in ocean prior to spawning migration.

Year, age group	Wallowa Hatchery			
	Males		Females	
	N	Length	*N*	Length
1987:				
1:1	137	589(38)	110	577(28)
1:2	59	743(53)	183	715(37)
2:1	1	652	1	577
2:2	0	--	3	718(15)
1988:				
1:1	238	601(31)	153	592(28)
1:2	98	726(39)	318	697(33)
2:1	1	585	8	606(48)
2:2	1	836	2	690(64)
1:3	0	--	2	768(18)

Year, age group	Little Sheep Creek Facility							
	Wild Fish				Hatchery Fish			
	Males		Females		Males		Females	
	N	Length	*N*	Length	*N*	Length	*N*	Length
1987:								
1:1	1	598	2	579(4)	115	593(26)	147	580(25)
1:2	0	--	1	692	0	--	0	--
2:1	8	587(24)	6	585(28)	1	575	0	--
2:2	0	--	1	644	0	--	0	--
1988:								
1:1	0	--	0	--	140	595(27)	163	577(22)
1:2	0	--	1	711	8	729(37)	41	689(37)
2:1	5	618(29)	3	570(20)	1	593	2	607(67)
2:2	1	692	4	713(17)	0	--	0	--
1:3	0	--	0	--	0	--	3	706(16)

Table 18. Adult summer steelhead outplanted from Wallowa Hatchery, 1988.

Location of outplanting	Number outplanted	
	Males	Females
Wallowa River tributaries:		
Hurricane Creek	24	27
Prairie Creek	50	51
Fishing ponds:		
Marr pond	0	70
Victor pond	0	35
Wallowa pond	0	50
Total	74	233

Table 19. Number of adult summer steelhead trapped and released from Little Sheep Creek facility, 1988.

Outplanting location, trapping and release time period	Wild fish		Hatchery fish	
	Males	Females	Males	Females
Little Sheep Creek:				
19-25 Mar	0	0	5	3
26 Mar-01 Apr	0	0	7	0
02-08 Apr	0	0	26	10
09-15 Apr	7	6	84	86
16-22 Apr	6	9	28	59
23-29 Apr	1	1	1	13
30 Apr-06 May	0	0	1	2
07-13 May	0	0	2	17
14-20 May	0	0	5	5
Gumboot Creek:				
23-29 Apr[a]	0	0	30	30
Total released	14	16	189	225

[a] *Includes fish trapped earlier than this time period.*

Table 20. 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 1988, 1987 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)	Fin erosion (%)						
			D	LV[a]	RV	BV	LP	RP	BP
Wallowa:									
11 Apr[b]	200	206(18.2)	99.5	--	0.5	--	20.5	28.5	7.5
11 Apr[c]	400	202(18.8)	98.5	3.8	18.8	11.0	11.0	4.3	2.5
12 Apr[d]	400	210(17.8)	98.8	4.8	2.8	5.8	11.0	3.8	0.3
15 Apr[e]	304	205(16.8)	100	12.2	3.6	12.2	7.2	4.6	0
15 Apr[f]	421	213(18.3)	100	1.7	22.2	5.0	12.4	5.7	0
Imnaha:									
13 Apr[g]	300	202(19.1)	100	2.2	3.3	11.7	10.0	4.3	3.3

[a] *Adjusted for percentage of LV fin marked fish.*
[b] *Reared at Irrigon Hatchery, released in Spring Creek.*
[c] *Reared at Irrigon Hatchery, released in Grande Ronde River at Wildcat Creek.*
[d] *Final rearing in Big Canyon Creek acclimation ponds.*
[e] *Final rearing in lower acclimation pond at Wallowa Hatchery.*
[f] *Final rearing in upper acclimation pond at Wallowa Hatchery.*
[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 1988, 1987 brood year. Standard deviation is shown in parenthesis.

Stock, sampling date	*N*	Mean length (mm)	Degree of smolting (%) Smolt	Inter-mediate	Parr	Pre-cocious males (%)	Descaled fish (%)
Wallowa:							
11 Apr[a]	200	206(18.2)	5.0	95.0	0	0	0
11 Apr[b]	400	202(18.8)	5.0	94.7	0.3	0	0
12 Apr[c]	400	210(17.8)	7.2	92.8	0	0	0
15 Apr[d]	304	205(16.8)	32.9	67.1	0	0	0.3
15 Apr[e]	421	213(18.3)	39.4	60.6	0	0	0
22 Apr[f]	193	196(18.8)	65.3	28.0	2.1	4.6	--
Imnaha:							
13 Apr	300	202(19.1)	27.0	70.7	1.0	1.3	0

[a] *Released in Spring Creek.*
[b] *Released in the Grande Ronde River at Wildcat Creek.*
[c] *Released in Big Canyon Creek.*
[d] *Final rearing and release from Wallowa lower acclimation pond.*
[e] *Final rearing and release from Wallowa upper acclimation pond.*
[f] *Reared at Lyons Ferry Hatchery, released at Wildcat Creek.*

Table 22. Release information for Ad+CWT marked spring chinook salmon juveniles reared at Lookinglass and Irrigon hatcheries and released in the Grande Ronde and Imnaha river basins, 1986 and 1987 broods. Standard deviation is shown in parenthesis.

Stock, location of release	Group represented	CWT replicates	Date released	Number released	*N*	Mean fork length (mm)	Mean weight (g)	Mean condition factor[a]
Rapid River:								
Lookingglass Hatchery	September release	07 40 16	09/18/87	38,378				
		07 40 17	09/18/87	41,232	353	113(13.6)	19.1(8.4)	1.33(0.09)
	November release	07 40 18	11/03/87	38,501				
		07 40 19	11/03/87	39,188	515	114(10.6)	19.5(4.2)	1.30(0.07)
	Medium smolt	07 40 20	04/01/88	41,266				
		07 40 21	04/01/88	42,744	348	125(6.2)	23.0(4.6)	1.18(0.06)
	Large smolt	07 40 14	04/01/88	42,339	200	145(22.5)	43.6(21.4)	1.14(0.06)
		07 40 15	04/01/88	42,057	200	142(20.2)	41.0(22.8)	1.19(0.08)
	Subyearling smolt (87 brood)	07 45 23	05/13/88	42,697				
		07 45 24	05/13/88	41,703				
		07 45 25	05/13/88	41,524	400	107(6.2)	15.1(3.1)	1.19(0.08)
Carson:								
Lookingglass Hatchery	presmolt release	07 40 22	07/20/87	43,086				
		07 40 23	07/20/87	43,127	305	85(5.3)	8.2(1.8)	1.24(0.07)
Imnaha:								
Imnaha River	Imnaha smolts	07 42 60	03/21/88	46,760	223	149(21.1)	46.6(21.1)	1.21(0.09)
		07 42 63	04/21/88	44,536	224	159(23.0)	--	--
		07 43 01	04/20/88	45,343	208	152(21.7)	--	--
		07 43 02	03/22/88	49,711	200	152(20.7)	40.1(16.7)	1.15(0.05)

[a] *Fulton's condition factor,* $weight(g)/Length^3(cm)(100)$.

Table 23. Recovery information for Ad+CWT marked spring chinook salmon that returned to Lookingglass Hatchery and Imnaha River weir, and from northeast Oregon spawning ground surveys, 1987. Standard deviation is shown in parenthesis.

Recovery location, CWT code	Number recovered		Mean fork length(mm)		Mean weight (kg)	
	Male	Female	Male	Female	Male	Female
Lookingglass Hatchery:						
07 28 60	0	2	--	866(42)	--	7.4(0.83)
07 28 61	6	10	928(68)	885(50)	7.8(1.84)	7.4(1.27)
07 28 62	8	6	922(66)	927(48)	7.6(1.44)	8.4(0.74)
07 30 01	0	1	--	804	--	5.1
07 30 02	2	1	878(53)	778	6.0(1.67)	5.0
07 31 18	0	1	--	753	--	5.0
07 31 49	0	1	--	791	--	5.5
07 31 50	2	2	818(11)	718(3)	5.3(0.81)	3.6(0.04)
07 31 51	2	2	794(25)	797(47)	4.7(0.16)	5.6(1.12)
07 31 52	1	0	830	--	5.0	--
07 31 53	5	5	737(92)	727(44)	4.2(1.71)	4.1(0.57)
07 31 54	1	0	910	--	6.8	--
07 31 55	19	19	786(56)	755(37)	4.6(0.93)	4.3(0.76)
07 31 56	24	28	784(61)	753(40)	4.7(1.28)	4.8(0.82)
07 31 58	0	1	--	751	--	4.8
07 33 15	1	0	568	--	2.0	--
07 33 16	11	0	561(34)	--	1.9(0.40)	--
07 33 57	2	0	528(24)	--	1.5(0.38)	--
07 33 58	1	0	518	--	1.4	--
07 33 59	1	0	520	--	1.4	--
07 33 61	1	0	555	--	2.0	--
07 33 62	5	0	501(49)	--	1.3(0.37)	--
07 34 01	4	0	465(43)	--	1.1(0.22)	--
07 38 61	1	0	1,068	--	10.2	--
23 18 08	1	2	734	751(70)	3.8	4.7(1.40)
23 18 14	1	1	852	594	6.4	2.0
23 18 15	0	1	--	720	--	4.1
Imnaha River weir:						
07 28 20	0	1	--	950	--	8.4
07 30 12	4	0	721(43)	--	3.6(0.60)	--
07 30 13	0	1	--	669	--	3.1
07 33 63	~~12~~16	0	572(41)	--	1.4(0.60)	--

Table 23, continued.

Recovery location, CWT code	Number recovered		Mean fork length(mm)		Mean weight (kg)	
	Male	Female	Male	Female	Male	Female
Grande Ronde River:[a]						
07 30 04	0	2	--	725	--	--
Catherine Creek:[a]						
23 18 15	1	0	645	--	--	--
Wenaha River:[a]						
07 31 55	0	1	--	749	--	--

[a] *Recovered on spawning ground surveys.*

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, 1987 brood year. Standard deviation is shown in parenthesis.

Stock, location of release	Group represented	CWT code replicates	Date released	Number released	*N*	Mean fork length (mm)	Mean weight (g)	Mean condition factor
Wallowa:								
Wallowa Hatchery	Medium smolt	07 40 27	04/18/88	26,986				
		07 40 28	04/18/88	27,442	217	210(18.2)	96.6(22.4)	1.02(0.06)
	Large smolt	07 40 29	04/18/88	27,110				
		07 40 30	04/18/88	26,310	204	216(18.6)	104.8(27.8)	1.02(0.07)
Spring Creek	Direct stream release	07 40 31	04/19/88	25,436				
		07 40 32	04/19/88	25,425	306	206(18.2)	91.1(24.1)	1.08(0.06)
Imnaha:								
Little Sheep Creek	Imnaha smolts	07 40 33	04/14/88	27,329				
		07 40 34	04/14/88	27,545	300	202(19.1)	87.6(17.8)	1.03(0.05)

Table 25. Recovery information for Ad-LV+CWT marked summer steelhead adults that returned to Wallowa Hatchery and Little Sheep Creek facility in 1988. Standard deviation is shown in parenthesis.

Recovery location, CWT code	Number recovered		Mean fork length(mm)		Mean weight (kg)	
	Male	Female	Male	Female	Male	Female
Wallowa Hatchery:						
07 37 62	42	28	608(26)	603(26)	1.9(0.2)	2.0(0.2)
07 37 63	52	33	597(50)	594(20)	1.9(0.4)	2.0(0.2)
07 38 01	32	10	590(31)	590(39)	1.8(0.3)	1.8(0.3)
07 38 02	29	14	597(31)	588(53)	1.9(0.3)	1.9(0.4)
23 18 11	0	1	--	715	--	3.5
23 18 12	0	3	--	706(4)	--	3.2(0.3)
23 18 13	2	1	680(28)	700	2.5	2.6
Little Sheep Creek:						
07 37 60	38	41	599(26)	581(18)	1.9(0.3)	1.9(0.2)
07 37 61	39	49	593(26)	576(22)	1.9(0.3)	1.8(0.2)

Table 26. Recovery information for cold-branded downstream migrant Carson and Imnaha stock spring chinook salmon (1985 brood) and Rapid River stock (1986 brood) spring chinook salmon recaptured at Lower Granite Dam in 1987.

Stock, brand	Date released	Estimated number recovered (observed)	Percent of number released	Cumulative percent by week of the year[a] 15	16	17	18
Carson:							
LA-J-1	09/24/86	169(14)	0.8	68.6	80.5	80.5	100
LA-J-3	09/24/86	224(19)	1.1	28.6	78.6	86.6	98.2
LA-J-2	04/01/87	2,488(152)	12.3	2.9	47.2	87.5	100
LA-J-4	04/01/87	2,531(137)	12.4	2.1	37.0	80.4	100
Imnaha:							
LD-J-1	04/20/87	899(30)	4.3	--	--	22.6	99.1
LD-J-3	04/20/87	1,012(35)	4.8	--	--	15.6	98.5
Rapid River:							
LD-J-2	05/20/87	1,929(171)	9.5				
LD-J-4	05/20/87	1,919(173)	9.4				

Stock, brand	Cumulative percent by week of the year (cont.) 19	20	21	22	23	24	25	26	27
Carson:									
LA-J-3	98.2	98.2	100						
Imnaha:									
LD-J-1	100								
LD-J-3	100								
Rapid River:									
LD-J-2	--	--	--	11.2	41.4	74.0	87.2	100	
LD-J-4	--	--	--	9.7	28.3	57.4	69.9	96.6	100

[a] *Week 1 of the year is 1-7 January and week 52 of the year is 24-31 December. Weeks 2-51 are 7-day intervals except in leap years when week 9 is 8 days.*

Table 27. Recovery information for cold-branded downstream migrant Wallowa and Imnaha stock summer steelhead recaptured at Lower Granite Dam in 1987, 1986 brood.

Stock, brand	Date of release	Size at release (g)	Estimated number recovered (observed)	Percent of number released
Wallowa:				
RD-J-1	04/25-27/87	126.5	482(21)	3.3
LD-J-1	04/25-27/87	122.0	489(16)	3.3
RD-J-3	04/25-27/87	95.0	0	0
LD-J-3	04/25-27/87	97.4	169(6)	1.2
Imnaha:				
RD-J-4	05/01-04/87	89.9	0	0
LD-J-4	05/01-04/87	89.9	36(3)	0.2

Stock, brand	Cumulative percent by week of the year[a]								
	18	19	20	21	22	23	24	25	26
Wallowa:									
RD-J-1	82.6	96.3	97.7	97.7	100				
LD-J-1	83.6	100							
RD-J-3									
LD-J-3	87.0	87.0	87.0	87.0	93.5	93.5	93.5	100	
Imnaha:									
RD-J-4									
LD-J-4					30.6	30.6	69.4	69.4	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 1986 and 1987 brood spring chinook salmon released in the Grande Ronde and Imnaha river basins. Standard deviation is shown in parenthesis.

Stock, location of release	Group represented	Date released	Brand replicates	Number released	*N*	Mean fork length (mm)	Mean weight (g)	Mean condition factor
Rapid River:								
Lookingglass Hatchery	September release	09/18/87	RA-IF-1	20,030	49	111(11.4)	19.1(8.4)	1.33(0.09)
		09/18/87	LA-IF-1	20,076	43	111(10.2)	(a)	(a)
	Large smolt	04/01/88	RA-IM-1	20,155	107	145(23.6)	41.9(22.2)	1.17(0.08)
		04/01/88	LA-IM-1	20,128	109	144(22.1)	(a)	(a)
	Medium smolt	04/01/88	RA-IF-3	21,659	101	124(6.8)	23.0(4.6)	1.18(0.06)
		04/01/88	LA-IF-3	21,731	117	125(5.9)	(a)	(a)
	Subyearling smolt[b]	05/13/88	LA-UT-1	20,473	114	106(5.9)	15.1(3.1)	1.19(0.08)
		05/13/88	LA-UO-1	21,019	121	107(5.6)	(a)	(a)
Imnaha:								
Imnaha River	Imnaha spring release	04/20/88	RA-IM-3	20,602	100	149(20.8)	--	--
		03/22/88	LA-IM-3	20,440	100	151(20.5)	40.1(16.7)	1.15(0.05)

[a] *Mean weight and condition factor is the same as the replicate release group.*
[b] *1987 brood year.*

Table 29. Release information for cold-branded summer steelhead released in the Grande Ronde and Imnaha river basins, 1987 brood. Standard deviation is shown in parenthesis.

Stock, location of release	Group represented	Date released	Brand replicates	Number released	*N*	Mean fork length (mm)	Mean weight (g)	Mean condition factor
Wallowa:								
Wallowa Hatchery	Medium smolt	04/18/88	LA-IM-1	25,268	100	210(18.0)	95.2(25.1)	1.01(0.06)
		04/18/88	LA-IF-1	25,452	117	211(18.3)	97.7(26.1)	1.02(0.05)
	Large smolt	04/18/88	LA-IM-3	25,131	102	216(19.4)	105.4(28.7)	1.01(0.08)
		04/18/88	LA-IF-3	25,182	102	216(17.9)	104.3(26.8)	1.02(0.05)
	Direct stream release	04/19/88	RA-IM-3	25,604	110	206(17.4)	91.1(24.4)	1.08(0.06)
		04/19/88	RA-IF-3	24,980	108	208(17.6)	(a)	(a)
Grande Ronde River	Wildcat Creek release	04/26/88	RA-IM-1	49,100	137	203(17.0)	94.9(28.9)	1.11(0.06)
		04/26/88	RA-IF-1	50,555	144	200(18.2)	(a)	(a)
Imnaha:								
Little Sheep Creek	Imnaha spring release	04/14/88	LA-IM-2	24,026	119	198(16.9)	82.0(22.0)	1.03(0.06)
		04/14/88	LA-IF-2	26,023	92	200(20.3)	84.6(28.7)	1.02(0.06)

[a] *Mean weight and condition factor is the same as the replicate release group.*

Table 30. Total catch, escapement and survival of coded wire tagged 1982 and 1983 brood spring chinook released in the Grande Ronde and Imnaha river basins. Recoveries are complete for the 1982 brood year. Recoveries of 1983 brood do not include 1988 ocean catch. Total strays includes all catch and escapement recoveries out of mainstem Columbia River and river-of-release.

Brood year, stock, CWT code	Month of release	Total catch	Spawning escapement	Total strays	Hatchery return rate (% of release)	Total survival rate (% of release)
1982:						
Lookingglass:						
07 28 60	Apr	8	32	0	0.07	0.10
Carson:						
07 28 61	Dec[a]	10	22	3	0.04	0.07
07 28 62	Dec[a]	0	24	0	0.05	0.05
Imnaha:						
07 28 20	Mar	0	25	4	0.10	0.12
1983:						
Carson:						
07 30 01	Jul	0	6	0	0.01	0.01
07 30 02	Jul	5	5	1	0.01	0.02
07 30 03	Jul	12	2	1	<0.01	0.03
07 30 04	Jul	9	4	0	<0.01	0.03
07 31 49	Sep	12	3	0	0.01	0.04
07 31 50	Sep	0	8	0	0.02	0.02
07 31 51	Sep	8	11	1	0.03	0.05
07 31 52	Sep	3	2	0	0.01	0.01
07 31 53	Nov	5	18	1	0.05	0.07
07 31 54	Nov	7	7	0	0.02	0.05
07 31 55	Apr	36	95	2	0.24	0.35
07 31 56	Apr	39	94	0	0.25	0.35
07 31 57	Sep[b]	2	0	0	0	0.01
07 31 58	Sep[b]	0	1	0	<0.01	<0.01
Imnaha:						
07 30 12	Sep	6	9	0	0.03	0.05
07 30 13	Sep	7	6	0	0.02	0.05
07 30 16	Mar	0	3	1	0.01	0.02
07 30 17	Mar	5	2	1	0.01	0.03

[a] *Released during ice-up.*
[b] *Big Canyon Creek release.*

Table 31. Numbers of adult summer steelhead (1987-88 run year) and spring chinook salmon (1987 run year) produced by releases from Lower Snake River Compensation Plan facilities in Oregon.

Stock, brood year	Ocean catch	Columbia River Net[a]	Columbia River Sport	Deschutes River[b]	Tributary sport[c]	Spawning escapement[d]	Total recoveries
SUMMER STEELHEAD							
Wallowa:							
1984	0	1,896	75	93	336	1,312	3,712
1985	0	344	58	72	259	749 -	1,482
Stock total	0	2,240	133	165	595	2,061	5,194
Imnaha:							
1984	0	68	0	0	0	113	181
1985	0	100	14	7	2	689	812
Stock total	0	168	14	7	2	802	993
Species total	0	2,408	147	172	597	2,863	6,187
SPRING CHINOOK							
Lookingglass:							
1982	0	0	0	0	--	253	253
1983	0	557	0	2	--	2,172	2,731
Stock total	0	557	0	2	--	2,425	2,984
Imnaha:							
1982	0	0	0	4	--	1	5
1983	16	3	0	2	--	5	26
Stock total	16	3	0	6	--	6	31
Species total	16	560	0	8	--	2,431	3,015

[a] *Includes zone 6 tribal harvest for summer steelhead and winter gillnet, Columbia River test fisheries, and ceremonial and subsistence 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.*

Results of comprehensive chinook salmon spawning ground surveys conducted in the Grande Ronde and Imnaha River basins in 1987 were distributed in tables in 1988 and will be presented in a completion report in 1991. Results of monitoring chinook salmon strays in the Minam and Wenaha rivers are presented in this report. No marked fish were recovered on the Minam River. One marked fish was recovered on the Wenaha River. This fish was from the 1983 brood Carson stock released at Lookingglass Hatchery in the spring of 1985.

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

Results of summer steelhead creel surveys conducted on the Grande Ronde, Wallowa, and Imnaha rivers for the 1987-88 run year are presented in Carmichael et al. (1988).

Discussion

Fish Culture Monitoring

Low adult returns and high egg loss (24%) for the 1987 brood Imnaha chinook salmon (Table 1) prevented achievement of smolt production goals.

We did not have as high of adult prespawning mortality in 1987 as we have had in previous years. Prespawning mortality was reduced by holding the fish at Lookingglass Hatchery instead of the Imnaha temporary holding pond. We expect the prespawning mortality at the new Imnaha facility to be similar to the prespawning mortality at Lookingglass Hatchery.

In 1987, the Imnaha weir was installed one week earlier than in any previous year, but the run timing curve indicated that fish passed the weir site prior to installation. A high percentage of the total fish captured were trapped in the first two weeks of trapping. As in 1986, hatchery fish returned later than wild fish. By 5 August 84.3% of the wild fish had been trapped while only 50.0% of the hatchery fish had been trapped. It is important that we be able to trap and hold fish from early in the run in order to develop a hatchery broodstock that has the same genotypic variation and life history characteristics as the wild stock.

In 1987 we obtained 1,029,828 eggs of Rapid River stock spring chinook salmon from Pahsimeroi Hatchery. We will need to obtain Rapid River stock eggs through the 1990 brood year in order to meet chinook smolt production goals for the Grande Ronde basin and to develop a hatchery broodstock for the Grande Ronde basin.

For the second 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. We will have to accelerate maturation of adults to provide eggs early enough to achieve 23.0 g/fish by 1 May.

The 1986 brood presmolts released into Lookingglass Creek represented the last release of Carson stock at Lookingglass Hatchery. Carson stock will continue to be used for outplanting in the Grande Ronde Basin until 1990 at which time we will switch completly to Rapid River stock.

Lookingglass Hatchery produced a total of 55,238 lbs of 1986 brood smolts for the Grande Ronde Basin which exceeded the mitigation goal of 45,000 lbs and 20,702 lbs for the Imnaha Basin which was slightly below the mitigation goal of 24,500 lbs.

The 1986 brood Imnaha chinook salmon incubated and reared at Lookingglass Hatchery were diagnosed with EIBS in November 1987. Infection was diagnosed by the appearance of easinophilic inclusions in the cytoplasm of red blood cells (Bauer, et al. 1988). On 1 January 1988, ODFW pathology and hatchery personnel set up a test in which 50 fish that were infected were placed in a 3-foot circular tank inside the hatchery building. The tank was supplied with well water at 54°F and river water at 35°F. The water temperature in the tank was raised from 35°F to 54°F by increasing at a rate of 5°F every 48 hours. The test fish showed significant recovery from EIBS after three weeks of warm water treatment. An entire raceway was then treated with well water and fish showed significant recovery after 12 days of treatment at an average temperature of 49°F.

The 1987 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 to Rapid River. Excess spring chinook salmon adults were outplanted to enhance natural production in Catherine Creek, upper Grande Ronde River, and the Wallowa River. Based on recovery of disk tagged adults we could only account for 18.1% 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).

The smolt-to-adult return rate for the 1982 brood hatchery releases of Imnaha chinook salmon was well below the mitigation goal of 0.65%. Hatchery fish are returning at a much earlier average age than the wild fish. As predicted from jack returns in 1986, the 1987 adult chinook salmon return to Lookingglass Hatchery was the highest since the hatchery was constructed.

The number of eggs taken for the 1988 brood Wallowa stock summer steelhead exceeded our program goals. As in previous years we experienced high egg losses. The large return of hatchery steelhead to Little Sheep Creek in 1988 provided ample broodstock, and the egg take exceeded program needs. The wild component of the Little Sheep Creek run was low, primarily due to past broodstock collection strategies, and therefore only 4% of the total 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, but we do not expect a strong return of wild (natural) fish until the 1990-91 run year (1987 brood).

We met the program goal of 1.35 million smolts for the Wallowa stock steelhead program. In addition, 50,640 Wallowa stock steelhead smolts, raised at Lyons Ferry Hatchery in Washington, were released in the Lower Grande Ronde River in Oregon. A total of 300,731 Wallowa stock presmolts were released into the Snake River.

There were 331,497 summer steelhead smolts from 1987 brood Imnaha stock released into Little Sheep Creek in 1988. This met the program goal of 330,000 smolts. This was the first year smolts were acclimated and released

from the Little Sheep Creek facility. A total of 37,943 Imnaha stock presmolts were released into the Snake River.

Adult prespawning mortality at Wallowa Hatchery was higher in 1988 than in 1987 even though fewer fish were handled in 1988. Reasons for the high mortality included holding pond flow fluctuations, holding over ripe fish, and warm water temperatures.

The 1987 brood summer steelhead smolts acclimated at Wallowa Hatchery in the spring of 1988 experienced unusually high mortality prior to release. This loss, referred to as the Wallowa Acclimation Pond Syndrome (WAPS), was mainly attributed to poor water quality. The Wallowa acclimation ponds are located immediately downhill from major cattle feedlots. During the spring thaw, an entire winter's accumulation of animal and agricultural wastes enter water sources for the acclimation ponds. Further investigation of the impact of water quality at Wallowa Hatchery on smolt quality and smolt-to-adult survival is needed.

Survival Studies

The second brood year of cold branded spring chinook salmon (Carson stock) was released from Lookingglass Hatchery in 1987 for evaluation of outmigration performance and survival. The cumulative passage index at Lower Granite Dam for chinook smolts released in the spring was 13 times greater than the index for fish released in the fall. Migration timing past Lower Granite Dam was similar for fish released in the fall and spring (Table 26).

The first brood year of cold branded Imnaha chinook salmon was released in the Imnaha River in 1987. The passage index at Lower Granite Dam was 2.7 times less than the spring release of Carson stock at Lookingglass Hatchery.

The release of marked 1987 brood summer steelhead smolts at Wallowa Hatchery represents the second year of acclimation versus direct stream release comparisons and the third year of size-at-release comparisons. The passage indexes at Lower Granite Dam for cold branded 1986 brood summer steelhead smolts released at Wallowa Hatchery in spring of 1987 were low. The index for Wallowa stock smolts released at an average size of 124.0 gr/fish (4 fish/lb) was 5.5 times greater than the passage index for fish released at 96.2 gr/fish (5 fish/lb).

The passage index for the 1986 brood cold branded Imnaha stock summer steelhead was very low. Only 0.2% of the branded fish were recovered (Table 27). Many of the brands on the Imnaha fish were marginal at release and probably deteriorated to the point of being unreadable when they passed Lower Granite Dam.

An estimated 2,224 Carson stock spring chinook adults passed Lower Granite Dam in 1987. This is only 38.2% of the mitigation goal of 5,820 adults for the Grande Ronde Basin. The majority of the chinook salmon were age 4 fish from the 1983 brood year (Table 31).

We estimated that only six hatchery Imnaha chinook salmon adults passed Lower Granite Dam in 1987. These six fish represent less than 1% of Oregon's mitigation goal of 3,210 spring chinook for the Imnaha Basin. Most of the adults returning in the 1987 run year were from the 1983 brood. Releases of

this brood was only 23.6% of the mitigation goal of 490,000 smolts for the Imnaha Basin. The remaining adults were from the 1982 brood year. Releases of this brood year only accounted for 5.1% of the mitigation goal.

We estimated that 2,656 Wallowa stock summer steelhead passed Lower Granite Dam in the 1987-88 run year, which is only 28.9% of the mitigation goal of 9,184 adults for the Grande Ronde Basin. Smolt releases that produced the 1987-88 run were only 55.0% and 14.4% of the mitigation goal for the 1984 and 1985 brood years, respectively.

A total of 804 hatchery stock Imnaha summer steelhead passed Lower Granite Dam in the 1987-88 run year. This accounts for 40.2% of the mitigation goal of 2,000 steelhead for the Imnaha Basin. Smolt releases that produced adults returning in the 1987-88 run year were only 24.0% and 35.0% of the mitigation goal for the 1984 and 1985 brood years, respectively.

Natural Escapement Monitoring

No marked fish were recovered on the Minam River surveys in 1987, however, only 5 carcasses were recovered. Multiple surveys will be conducted in the future to provide a larger sample size.

One marked fish was recovered on the Wenaha River in 1987. This fish was from the 1983 brood Carson stock release from Lookingglass Hatchery in the spring of 1988. This fish was estimated to represent 19 hatchery fish, which was 36% of the carcasses recovered. We need to develop scale analysis techniques to determine the actual number of hatchery strays in the Minam, Wenaha, and Lostine rivers. Expansions from low numbers of marked fish may be inaccurately estimating the level of hatchery straying.

Disease Investigation

In November of 1987, 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, alternate incubation and rearing strategies were developed for the 1988 brood Imnaha chinook salmon. We plan to use the following strategies:

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.

These rearing strategies are compatible with size-at-release experiments that will be represented by cold branded and coded-wire tagged release groups.

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, we will be requesting eggs from Idaho to meet full program 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 fish 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 determine if they contribute to catch and escapement. The objectives and tasks are described in the summary section of this report and in the five-year study plan (Carmichael 1987).

Methods

Replicate groups of 1986 brood Carson stock presmolts were marked Ad+CWT and released into Lookingglass Creek to determine catch contribution and smolt-to-adult survival rates. Tags were recovered and decoded from all marked adults that returned to adult collection sites and spawning areas. We obtained catch information from agencies monitoring ocean and Columbia River fisheries.

Results and Discussion

We released 100,918 Carson stock presmolts on 20 July into Lookingglass Creek (*see* Table 2 page 8). These fish were progeny of adults that returned to Lookingglass Hatchery in 1986. Release information for marked fish that were released in Lookingglass Creek was presented in Table 22 (page 25). Four marked adults from the 1983 brood presmolts returned to Lookingglass Hatchery in 1987. Two marked adults from 1983 brood presmolts released in the upper Grande Ronde River were recovered on Grande Ronde River spawning ground surveys in 1987. No marked jacks from the 1984 brood presmolts were recovered.

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 1987).

Methods

Replicate groups of the 1983, 1984, and 1985 brood chinook salmon smolts were marked (AD+CWT) and released at Lookingglass Hatchery in 1985 and 1986 and at the Big Canyon facility in 1987. Smolts from marked fish were recovered at Lookingglass Hatchery and at Big Canyon and were decoded.

Results and Discussion

We recovered 5 tagged fish from the 1983 brood and 11 from the 1984 brood at Lookingglass Hatchery. Future work on this project will involve recovering marked adults and summarizing catch and escapement information.

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