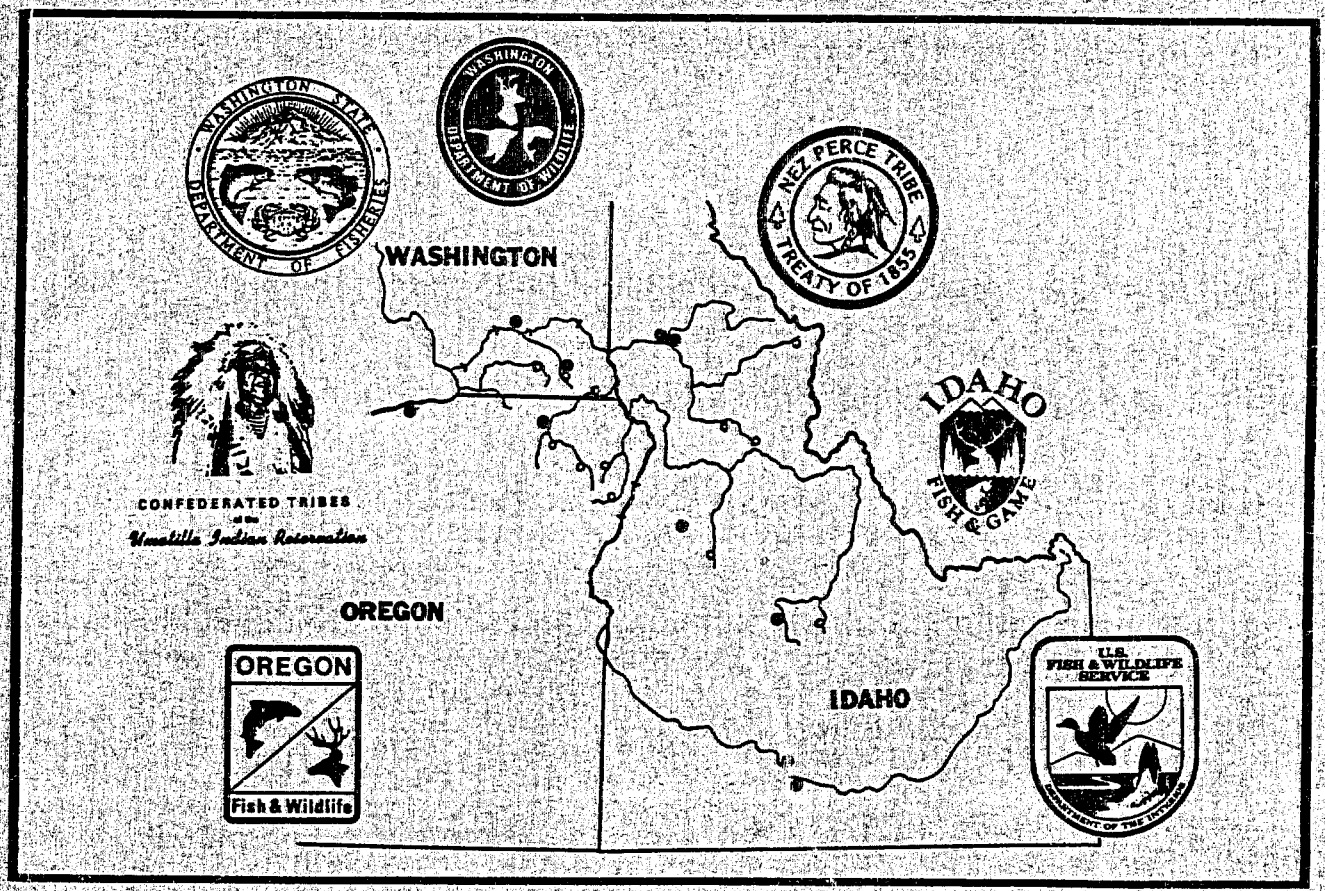
A REVIEW OF THE

LOWER SNAKE RIVER

COMPENSATION PLAN

HATCHERY PROGRAM



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Introduction

The purpose of this report is to document the status of the anadromous fish hatchery program of the Lower Snake River Compensation Plan (LSRCP) in Idaho, Oregon, and Washington. It will review the legislative history of the LSRCP, outline the method used to estimate the hatchery production needed to compensate for fish losses, review the various compensation goals for each fish species by hatchery facility, and review the status of the program in achieving its goal.

History

The LSRCP was authorized by the Water Resources Development Act of 1976, Public Law (P.L.) 94-587, to offset losses caused by the four Lower Snake River dam and navigation lock projects. Applicable portions of the Act read as follows:

> SECTION 102. "...The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted by the Secretary of the Army, acting through the Chief of Engineers, substantially in accordance with the plans and subject to the conditions recommended by the Chief of Engineers in the respective reports hereinafter designated..."
>
> COLUMBIA RIVER BASIN
> "...Fish and Wildlife Compensation Plan for the Lower Snake River, Washington and Idaho, substantially in accordance with a report on file with the Chief of Engineers, at an estimated cost of $58,400,000."

The "...report on file with the Chief of Engineers...," referred to in the second paragraph above, is the **SPECIAL REPORT, Lower Snake River Fish and Wildlife Compensation Plan, LOWER SNAKE RIVER, WASHINGTON AND IDAHO, JUNE 1975** (Corps of Engineers (Corps) 1975). This report was the basis for the development of the LSRCP and, as such, will be referred to extensively in this report as the **SPECIAL REPORT**.

The four lower Snake River projects (dams, powerplants, and locks) for which the LSRCP was developed were authorized by P.L. 74, 79th Congress, in March 1945. Each dam is approximately 100 feet high, and the four dams create a total of approximately 140 miles of reservoir from about 10 miles above the mouth of the Snake River upstream to Lewiston, Idaho. The lowermost dam, Ice Harbor, was completed in 1961; the uppermost and last dam built, Lower Granite, was closed in 1975. Neither P.L. 74 nor the plan presented in House Document 704 (75th Congress) mentioned fish and wildlife measures needed to prevent or offset losses. This fact is not too surprising since the more binding 1958 Fish and Wildlife Coordination Act (FWCA) amendments (P.L. 85-624) had not yet been enacted.

Development of a Compensation Plan

Between 1959 and 1963, the U.S. Fish and Wildlife Service (Service) conducted assessments and provided reports detailing the individual effects on fish and wildlife of the first three projects: Ice Harbor, Lower Monumental, and Little Goose. These reports were based on limited engineering and biological data and, as such, made only general recommendations regarding fish passage and artificial propagation. (Note: Some of the measures recommended in these reports were implemented during construction of the individual projects; and more recently, other more sophisticated measures, such as placement of traveling fish screens, have been implemented.) In a letter dated April 11, 1966, the Walla Walla Corps District Engineer requested that the Service produce a single report, rather than four separate reports, which would cover all the Lower Snake projects (including the yet to be constructed Lower Granite) and meet the latest FWCA requirements (i.e. the 1958 amendments).

Between 1971 and 1972 the Service, National Marine Fisheries Service (NMFS) and the five fish and wildlife agencies in Oregon, Washington, and Idaho collaborated to prepare several drafts of a report summarizing effects of the four projects. A final FWCA report was produced by the NMFS and the Service in September 1972 (a copy is included as Appendix A of the Corp's 1975

report). Subsequent to the report's release, meetings were held in which additional justification data were produced by the Oregon Fish Commission (Corps 1975). Tribal involvement in the development of the LSRCP was limited to comments made in their behalf by the Bureau of Indian Affairs (BIA) on the LSRCP Environment Impact Statement (EIS) in April 1975 (Corps 1976). Based on the detailed final FWCA Report, the EIS, and on additional supplemental reports, the Corps produced their SPECIAL REPORT in June 1975 and submitted it to Congress as justification for authorizing and funding the LSRCP.

As cited above, the Congress in 1976 authorized the Corps to design and construct the LSRCP "substantially in accordance" with their June 1975 SPECIAL REPORT. The SPECIAL REPORT stated that "...Operations and maintenance would be funded through future appropriations to the U.S. Fish and Wildlife Service or National Marine Fisheries Service." In 1977 an agreement was signed by the Corps, NMFS, and the Service stating that the Service would budget for and administer the operation and maintenance (O&M) of the LSRCP Program. A March 6, 1985 report by the Corps, which became law by P.L. 99-662 on November 17, 1986, reaffirmed the O&M agreement.

Mitigation Computations

The LSRCP is somewhat unique among mitigation or compensation plans because of its focus on replacing losses of returning adult salmon and steelhead rather than on releasing a given number of smolts or pounds of smolts. The basis of the adult return goals for the LSRCP were estimates of the total run sizes to the Snake River basin prior to construction of the four lower Snake River dams. To estimate "without project" Snake River run sizes, the agencies selected the maximum counts of fall and spring-summer chinook and steelhead over McNary Dam during the 1954 to 1967 period and multiplied the run estimates by the maximum percentage of the McNary counts that passed over Ice Harbor Dam (completed in 1961) from 1962-1967 (Corps 1975). Several justifications were provided to show why the highest counts and maximum percentages should be used; these are discussed in the SPECIAL REPORT and its appendices (Corps 1975). The agencies only deviated from using the maximum

percentage with fall chinook. In that case, they choose the second highest percentage (33.5%) of McNary counts to pass over Ice Harbor Dam because the highest percentage (68%) was more than twice the second highest.

Once the theoretical run potential was estimated, the agencies had to estimate the proportion of the Snake River fish that would be lost (in fact, were being lost at the three completed dams) because of the project. Although a number of sources of losses were discussed in the FWCA Report (e.g. turbine injuries to juveniles, predation in reservoirs, smolt migration delays, nitrogen gas disease, adult migration injuries and straying, and inundation of spawning grounds), the plan for anadromous fish propagation facilities was based almost entirely on loss of juvenile migrants to turbine injuries (Corps 1975). The only other loss used to justify the LSRCP was the inundation and resultant loss of spawning area for 5,000 fall chinook. The losses due to turbine mortality were estimated to be 15 percent per facility, making a cumulative total loss of 48 percent for the four dams. Table 1 summarizes the loss estimates and computations for the LSRCP.

Table 1. Lower Snake River Compensation Plan computation of adult losses.

	Fall Chinook	Spring-Summer Chinook	Steelhead Trout
McNary Count (Year of Count)	97,500 (1958)	222,100 (1957)	172,600 (1962-63)
Maximum Percent over Ice Harbor	33.5%	55%	66.5%
Estimated Snake River run[1]	32,663	122,200	114,800
Lower Snake Project caused adult losses[2]	18,300	58,700	55,100

[1] McNary count times maximum percent over Ice Harbor.

[2] Estimated Snake R. run times 48% (total estimated turbine-related losses). Except for fall chinook, where adult loss = (Snake R. run - 5,000 adults) X 48% + 5000 adults. The 5,000 adults is credited for those that would have spawned in the immediate area. That loss was direct and therefore it's added in directly.

Hatchery Development Plans and Production Goals

As part of the process of analyzing adult losses, the agencies estimated the distribution of anadromous fish among Snake River basins (Corps 1975). These data were used by a 1974 hatchery siting subcommittee of the Columbia Basin Fisheries Technical Committee (CBFTC) to produce guidelines for allocating compensation of adults by state (Table 2). The subcommittee indicated that the distribution information was not to dictate specific release sites for the future hatcheries (Tollefson 1974).

Table 2. Allocation of compensation (adults) by river reach and State as noted by the CBFTC, November 2, 1973 (Corps 1975).

	Washington			Oregon		Idaho	
Area	Spring Chinook	Fall Chinook	Steelhead	Spring Chinook	Steelhead	Spr. & Sum Chinook	Steelhead
Snake River							
Below Lewiston	-	5,000					
Lewiston-Hells Canyon		9,728	2,208				
Hells Canyon Dam		3,648			1,368	1,200	1,368
Tucannon River	1,152		1,632			288	20,736
Clearwater River		68					
Asotin Creek			816				
Grande Ronde River				5,856	7,632	46,656	16,896
Salmon River							
Imnaha River		68		3,216	1,920		
Small tributaries					264	288	264
Totals	1,152	18,512[a]	4,656	9,072	11,184	48,432	39,264

[a] The subcommittee acknowledged that the fall chinook figure differed slightly from other estimates; 18,300 was adopted as the final number.

Using the estimated number of adults lost because of the juvenile turbine mortalities (Table 1), the subcommittee back-calculated to determine the hatchery capacity needed to rear the approximate number of smolts required for release (Table 3). In constructing this "model", they made survival assumptions about each life history stage of the fish, including eggs per female, survival of eggs to smolt, and survival of smolt to returning adult. The most important (and most difficult to determine) survival rate they estimated was the smolt-to-returning adult rate. There were sufficient data to make fairly accurate estimates of the other rates; whereas the

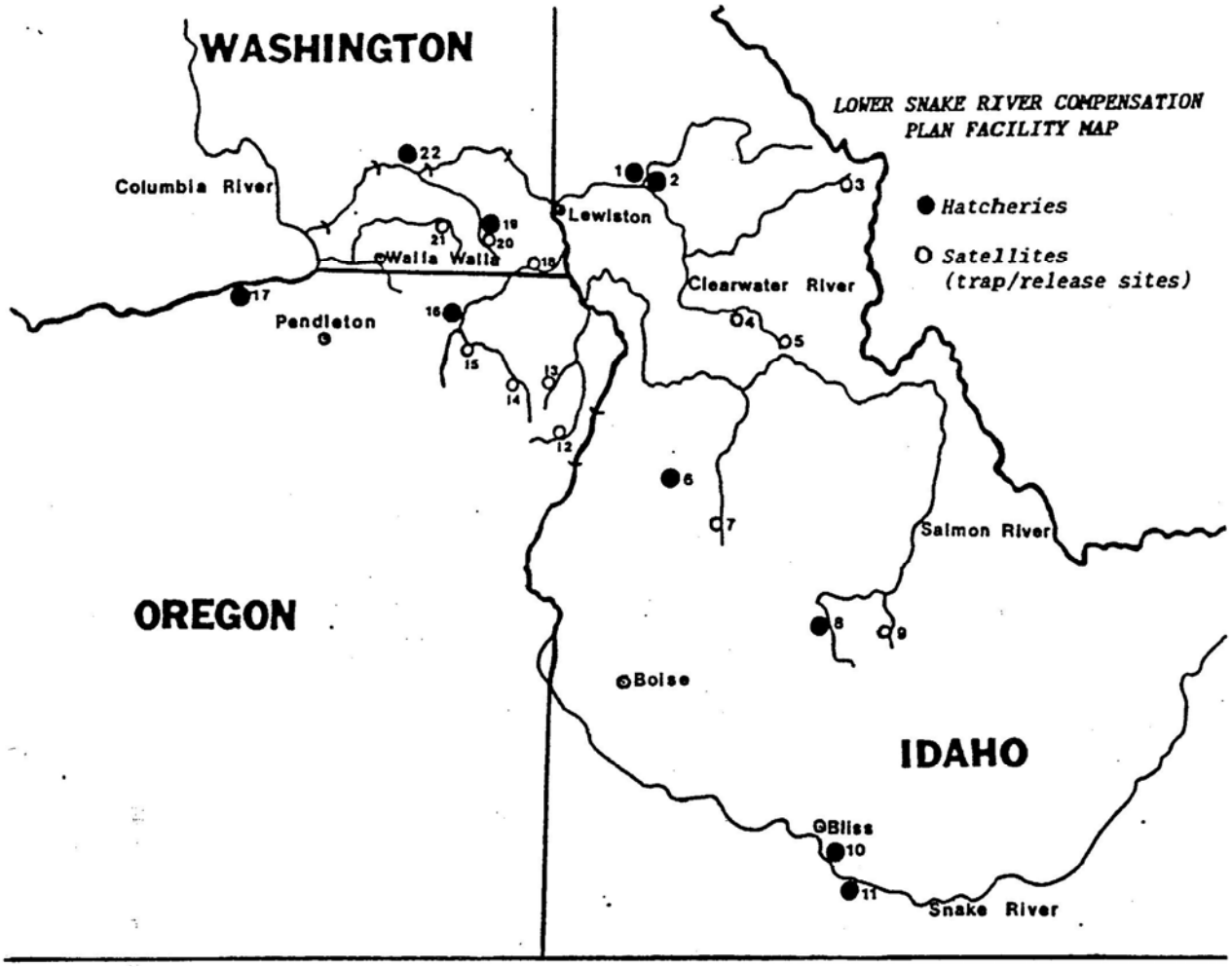
smolt-to-adult rates were at that time, and continue to be, highly variable among hatcheries and subject to many uncontrollable natural events or conditions.

Table 3. LSRCP hatchery production necessary to return the required numbers of adult chinook salmon and steelhead trout (Corps 1975).

	Fall Chinook	Spr. & Sum. Chinook	Summer Steelhead
Adult Loss Level for Basing Hatchery Size	18,300	58,700	55,100
Percent Survival, Smolt to Adults	0.20	0.87	0.50
Number of Smolts	9,160,000	6,750,000	11,020,000
Smolts per Pound	90	15	8
Pounds of Smolts	101,800	450,000	1,377,500
Percent Survival, Eggs to Smolts	80	70	65
Number of Eggs Needed	11,450,000	9,650,000	16,950,000
Eggs per Female	5,000	4,500	5,000
Number of Females Needed	2,290	2,145	3,390

Cowley et al. (1987) did a literature search of the methods used by the CBFTC to estimate the smolt-to-adult rates and found that they were based on returns to various operating hatcheries. The fall chinook rate was based on fall chinook returns to Lower Columbia River facilities, whereas the spring/summer chinook and steelhead return rates were based on hatchery returns to Rapid River and other hatcheries in Idaho. The return rate for spring/summer chinook of 0.87 percent appears to be quite optimistic while rates for fall chinook and particularly steelhead may be realistic or, in the case of steelhead, perhaps lower than is achievable.

It should be pointed out and emphasized that the LSRCP adult return goals are either <u>to</u> the project area for fall chinook (i.e. above Ice Harbor Dam) or <u>above</u> the project area for spring and summer chinook and steelhead (i.e. above Lower Granite Dam) and <u>not</u> just to the hatchery. Therefore, to measure the LSRCP's success, an estimate must be made of the sum of returns to the various Snake River basin fisheries, to the hatchery of origin, and to natural spawning areas in the basin.



Operating Agencies

Idaho Department of Fish & Game

1. Clearwater FH
3. Powell
4. Crooked River
5. Red River
6. McCall FH
7. South Fork Salmon River
8. Sawtooth FH
9. East Fork Salmon River
11. Magic Valley FH

U.S. Fish and Wildlife Service

2. Dworshak NFH Expansion
10. Hagerman NFH

Oregon Department of Fish & Wildlife

12. Imnaha
13. Sheep Creek
14. Wallowa FH
15. Big Canyon
16. Lookingglass FH
17. Irrigon FH

Washington Department of Fisheries

22. Lyons Ferry FH - Salmon

Washington Department of Wildlife

18. Cottonwood Creek
19. Tucannon FH
20. Curl Lake
21. Dayton Pond
22. Lyons Ferry FH - Steelhead

Figure 1. Lower Snake River Compensation Plan Program facilities in Washington, Oregon, and Idaho.

Using the estimated poundage required for the total smolt releases, the CBFTC subcommittee recommended the construction of eight hatcheries to produce sufficient numbers of juvenile fish to compensate for the losses resulting from dam construction and operations (Tollefson 1974). From this initial list of proposed sites, and from numerous field siting studies by the Corps, came the list of ten major hatcheries we now have in the LSRCP program. Table 4 is a list of completed and proposed LSRCP facilities, including their satellites, actual or estimated costs, and completion dates. Figure 1 shows the location of the facilities.

The following sections summarize the history and current status of the production and adult return goals of each species and race of fish to be compensated for by the LSRCP. LSRCP hatcheries are addressed individually within each species section. Each hatchery's contribution to the Snake River adult return goal is discussed. The differences between the original model's sizes and survival rates (Table 3) and those adopted for each hatchery are explained.

Fall Chinook

After the LSRCP program was authorized and it was apparent that it would be some time before any facilities would be designed or built, an egg bank program was started to ensure that enough fall chinook would be available from the depleted Snake River "bright" stock when a fall chinook hatchery was built. From 1977 to 1984 fall chinook were trapped at Ice Harbor and transported to either Dworshak NFH or Tucannon Fish Hatchery for spawning and early incubation to begin the egg bank. The average number of fish transferred was 456 adults and 60 jacks (Table 5). The eggs were eventually transferred to and reared at either Hagerman NFH or Kalama Falls (a Washington Department of Fisheries ((WDF) hatchery on the Lower Columbia River). Those reared at Hagerman NFH in Idaho were released into the Snake River, whereas those reared at Kalama Falls were released from the hatchery.

Table 4. ~~Pertinent~~ Data for Lower Snake River Fish and Wil~~dlife~~ Compensation Plan Fish Hatchery Facilities.

Hatchery (Operator)[a]	Fish Type	Pound	Total Cost ($1,000)	Satellite Facilities	Date of Completion
Lookingglass (ODFW)	Spring Chinook	69,600	$ 8,993		Nov. 82
			$ 2,763	Big Canyon Ck.	Apr. 87
			$ 1,525	Imnaha	Jul. 89
Irrigon/Wallowa (ODFW)	Steelhead	279,600	$15,646		Oct. 85
			$ 3,230	(Wallowa)[b]	May 85
			$ 2,545	Little Sheep Ck (Big Canyon Ck)	Aug. 87
Lyons Ferry:			$31,831[c]		
Phase I (WDW)	Steelhead	116,400			Nov. 83
	Trout	45,000			
			$ 801	Cottonwood	Feb. 85
			$ 1,182	Dayton Pond	Oct. 86
	Trout	41,000	$ 4,235	Tucannon FH	Nov. 84
			$ 230	Curl Lake	Feb. 85
Phase II (WDF)	Fall Chinook	101,800			Nov. 84
	Spring Chinook	8,800			
Sawtooth (IDFG)	Spring Chinook	149,000	$13,543		Jan. 85
			$ 2,067	E.Fk. Salmon R.	Nov. 83
Dworshak (FWS)	Spring Chinook	70,000	$ 2,234		Nov. 82
Clearwater (IDFG)	Steelhead	350,000	$37,128		Dec. 91
	Spring Chinook	91,300			
			$ 1,651	Red River	Nov. 86
			$ 2,054	Crooked River	May 90
			$ 2,320	Powell	Aug. 89
Magic Valley (IDFG)	Steelhead	291,500	$19,520		Aug. 87
				(Sawtooth) (East Fork)	
Hagerman (FWS)	Steelhead	340,000	$ 9,801		Apr. 84
				(Sawtooth) (East Fork)	
McCall (IDFG)	Summer Chinook	61,300	$ 5,741		Sep. 81
			$ 1,149	S.Fk. Salmon R.	Jul. 80
Eagle Lab (IDFG)	Disease Diagnostic		$ 1,300		Apr. 89

[a] ODFW - Oregon Department of Fish and Wildlife
WDW - Washington Department of Wildlife
WDF - Washington Department of Fisheries
IDFG - Idaho Department of Fish and Game
FWS - U.S. Fish and Wildlife Service

[b] Parentheses used when dual-use hatchery/satellite is listed a second or third time.

[c] Total cost of Lyons Ferry Phases I and II

Table 5. Snake River adult (2-salt or more) fall chinook returns and trapping success for the Lyons Ferry FH program (jack count in parentheses) (Jensen 1988 and Seidel et al. 1988).

Year	Ice Harbor Dam Count[1]	Ice Harbor Dam Trapped[2]	Lyons Ferry Ladder
1977	1,200 (540)	395	
1978	1,100 (500)	368	
1979	1,200 (810)	439	
1980	1,200 (590)	394	
1981	770 (1,300)	407 (98)	
1982	1,600 (1,900)	473 (122)	
1983	1,800 (900)	619 (150)	
1984	1,700 (800)	663 (97)	
1985	2,000 (7,100)	589 (90)	6 (4,070)
1986	3,100 (2,700)	212 (23)	245 (1,125)
1987	6,800 (1,600)	1,613 (47)	1,654 (543)
1988	2,900 (1,500)	1,076 (6)	327 (1,753)
1989	4,640 (1,340)	1,179 (0)	704 (670)

[1] Counting only took place during daylight hours (numbers are rounded).
[2] Some jacks (less than 24 inches long) with ad-clips were trapped after 1980 for CWT studies.

Lyons Ferry FH. In 1984 Phase II of the Lyons Ferry Fish Hatchery (FH), the salmon rearing facility to be operated by WDF, was completed. It is located on the north shore of the Lower Monumental Dam pool just below the mouth of the Palouse River (Figure 1). The facility was built to produce 9,162,000 fall chinook smolts at 90 fish per pound (fpp) for a total of 101,800 pounds of production (Table 4). At the estimated return rate of 0.2 percent (Table 3), the facility was designed to meet the entire 18,300 adult return goal (Table 1). Since the completion of Phase II, all eggs from adult fall chinook females trapped at Ice Harbor and returning directly to the hatchery ladder and all eggs from "brights" returning to Kalama Hatchery have been incubated and the resultant fry reared at Lyons Ferry.

Tables 6 and 7 summarize fall chinook release and return data to date. The program is just getting underway and is far from reaching its goal. Presently, the WDF is experimenting with varying the size and age of release and with barging fish to the mouth of the Snake River versus a direct river releases from the hatchery. The zero-age releases are between 55 to 95 fpp and yearling releases are 7 to 10 fpp (Seidel et al. 1988). Depending on the outcome of the experiments, the original plans for releasing 9.16 million

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smolts at 90 per pound may be modified. The first year for adult returns from Lyons Ferry FH releases was 1987; therefore, results of various rearing regimes and release strategies will not be known for several years. Preliminary results based on the 1983 brood year (BY) (Table 7) indicate the adult return goal is attainable (Seidel et al. 1988); however, returns from 1984 and 1985 are not as encouraging.

Table 6. Fall chinook smolt releases into the Snake River since initiation of the LSRCP program (number per pound is shown in parentheses as fpp).

Release Year	Age	Rearing Hatchery	
		Hagerman[1] (fpp)	Lyons Ferry[2] (fpp)
1979	Zero	99,000 (85-93)	
1980	↓	225,863 (43-59)	
1981		181,291 (34-80)	
1982		699,152 (30-100)	
1983		78,895 (44)	
1984		427,191 (53-84)	
1985	Zero	128,230 (49)	539,392 (67-85)
	Yearling		650,300 (10)
1986	Zero		1,789,560 (55-87)
	Yearling		481,950 (8)
1987	Zero		674,047 (75-95)
	Yearling		386,919 (7-9.5)
1988	Zero		4,573,447 (74)
	Yearling		407,840 (8)
1989	Zero		1,765,433 (78-92)
	Yearling		413,017 (10)

[1] From Hagerman NFH Annual Reports FY82 through FY85 and Dworshak FAO records.

[2] Zero and yearling releases have been made since 1985. Data from Seidel et al. 1986, 1987, and 1988 and hatchery reports.

Spring Chinook

Three state agencies and the Service manage four hatcheries to produce spring chinook for the LSRCP program. A fifth hatchery, Clearwater FH, is scheduled to begin operations under state management by 1991. When originally proposed, the spring chinook program was to produce about 5.8 million smolts at 15 fpp for a total of about 388,700 pounds. Assuming the estimated smolt-to-adult return rate of 0.87 percent (Table 3), this release was expected to meet the return goal of 50,700 adults. (For a comparison, Figure 2 shows spring chinook returns to the Snake River basin from 1975 through 1989). Some changes in smolt target sizes and numbers have occurred at various hatcheries; these are discussed below.

Table 7. Preliminary estimates (based on coded wire tag expansions) of Lyons Ferry fall chinook returns to various fisheries and to the Lyons Ferry hatchery (rack plus ladder trap) for brood years 1983, 1984, and 1985 (from Bugert et al. 1989).

Brood Year Release Group	Total Release	Release Year	Year Recovered	Fishery Contribution	Hatchery Returns (Percent of release)
1983					
yearling on station	650,300	1985	1985	157	3,677
			1986	2,839	1,289
			1987	10,403	2,808
			1988	4,186	535
		Total		17,585	8,309(1.28)
1984					
subyearling on station	539,392	1985	1986	88	78
			1987	328	248
			1988	1,042	131
		Total		1,458	457(0.08)
yearling on station	481,950	1986	1986	4	90
			1987	142	166
			1988	1,565	183
		Total		1,711	439(0.09)
1985					
subyearling on station	1,542,168	1986	1987	106	113
			1988	231	125
		Total		337	238(0.015)
subyearling transport	247,392	1986	1987	3	6
			1988	47	0
		Total		50	6(<0.01)
yearling on station	230,413	1987	1987	42	195
			1988	287	183
		Total		329	378(0.16)
yearling transport	156,506	1987	1987	17	112
			1988	282	120
		Total		299	232(0.15)

Lookingglass FH. The first LSRCP spring chinook facility to be completed and fully operational was Lookingglass FH on Lookingglass Creek in Oregon in 1982 (Figure 1). According to the Lookingglass design memorandum (DM 5), the facility would produce 1,390,000 spring chinook smolts at 20 fpp for a total of 69,600 pounds. The Corps stated in DM 5 that the 15 fpp guideline for spring chinook size could not be met at Lookingglass FH because of cold water

temperatures in Lookingglass Creek (Corps 1979). At 15 fpp, about 1,042,600 smolts could be produced. Using the original model's estimated smolt-to-adult return of 0.87 percent and the production potential for 15 fpp spring chinook smolts (Table 3), the return goal for the Lookingglass FH program is computed to be about 9,070 adults (Table 2). Recently, Oregon Department of Fish and Wildlife (ODFW) increased their size at release goal to 10 to 12 fpp at Lookingglass FH, which they can achieve with the use of warm well water. The return rate for the larger 12 fpp smolts must be about 1.1 percent to meet the adult return goal and would be 0.65 percent for the smaller 20 fpp smolts.

Lookingglass FH, operated by ODFW, is the only chinook rearing facility for both the Grande Ronde and Imnaha River compensation programs. Other adult trapping, egg-taking, and release facilities include Big Canyon in the Grande Ronde basin and Imnaha in the Imnaha River basin. According to the Corps' DM 5, the production targets are to release about 44,900 pounds of smolts into the Grande Ronde River basin and 24,600 pounds into the Imnaha River basin (Corps 1979). The compensation goals are to return about 5,860 and 3,210 adults to the Grande Ronde and Imnaha basins respectively. At 12 fpp the weight production limitations of the facilities would result in a release of about 538,800 smolts into the Grande Ronde and 295,200 smolts into the Imnaha.

Table 8 summarizes releases into the two basins since 1983. Grande Ronde release numbers have been greater than expected, particularly in 1984 and 1985, when most fish were released as fingerlings. The Imnaha releases have been well below the projected numbers because of low broodstock numbers and poorer than expected egg to smolt survival. Because of egg and production space availability resulting from the small Imnaha program, the total number of pounds of smolts produced at Lookingglass FH for the Grande Ronde River was about 48,000 pounds for 1986 brood fish (1988 releases), exceeding the 44,900 pound goal. The Imnaha River releases totaled about 20,747 pounds for the BY1986, below the 24,600 pound goal.

Return data from Lookingglass FH-reared fish are limited to 1982, 1983, and 1984 brood years. Table 9 shows returns for the 1985 through 1987 run years. Assuming most adults escaping to the Snake River basin are returning to their release sites, the program is over 25 percent of the way toward reaching its

goal of over 9,070 adults back to the Snake River basin. Although the Grande Ronde River program is progressing towards its return goal, the Imnaha program is far behind its goal of 3,210 adults. It is, however, too early to predict a trend.

Table 8. Releases of spring chinook hatchery production from Lookingglass FH from 1983 to spring 1989 (fish size in fish per pound (fpp)).

Release Year	Period[1]	Grande Ronde Basin (fpp)	Imnaha Basin (fpp)	Totals
1983	SP	434,640 (20)		
	W	789,516 (25-31)	0	
Total for 1983		1,224,156	0	1,224,156
1984	SP	29,650 (31)	29,184 (32)	
	SU	977,717 (80-160)		
	FA	582,087 (20-33)	56,217 (24)	
		261,221 (17-28)		
Total for 1984		1,850,675	85,401	1,936,076
1985	SP	920,528 (15-24)	59,595 (17.4)	
	SU	104,800 (32)		
	FA	741,684 (8.5-29.5)		
Total for 1985		1,767,012	59,595	1,826,607
1986	SP	563,025 (10-15.7)	35,553 (10.8)	
	SU	505,753 (24-54)		
	FA	328,161 (23-25)		
Total for 1986		1,396,939	35,553	1,432,492
1987	SP	1,016,804 (9-36)	123,530 (8)	
	FA	82,445 (23)		
Total for 1987		1,099,249	123,530	1,222,779
1988	SP	825,299 (7-29)	199,506 (9-10)	
	FA	168,874 (21-22)		
Totals for 1988		994,173	199,506	1,193,679
1989	SP	716,256 (15-36)	142,320 (16)	

[1] W = Dec, Jan, Feb
SP = Mar, Apr, May
SU = Jun, Jul, Aug
FA = Sep, Oct, Nov

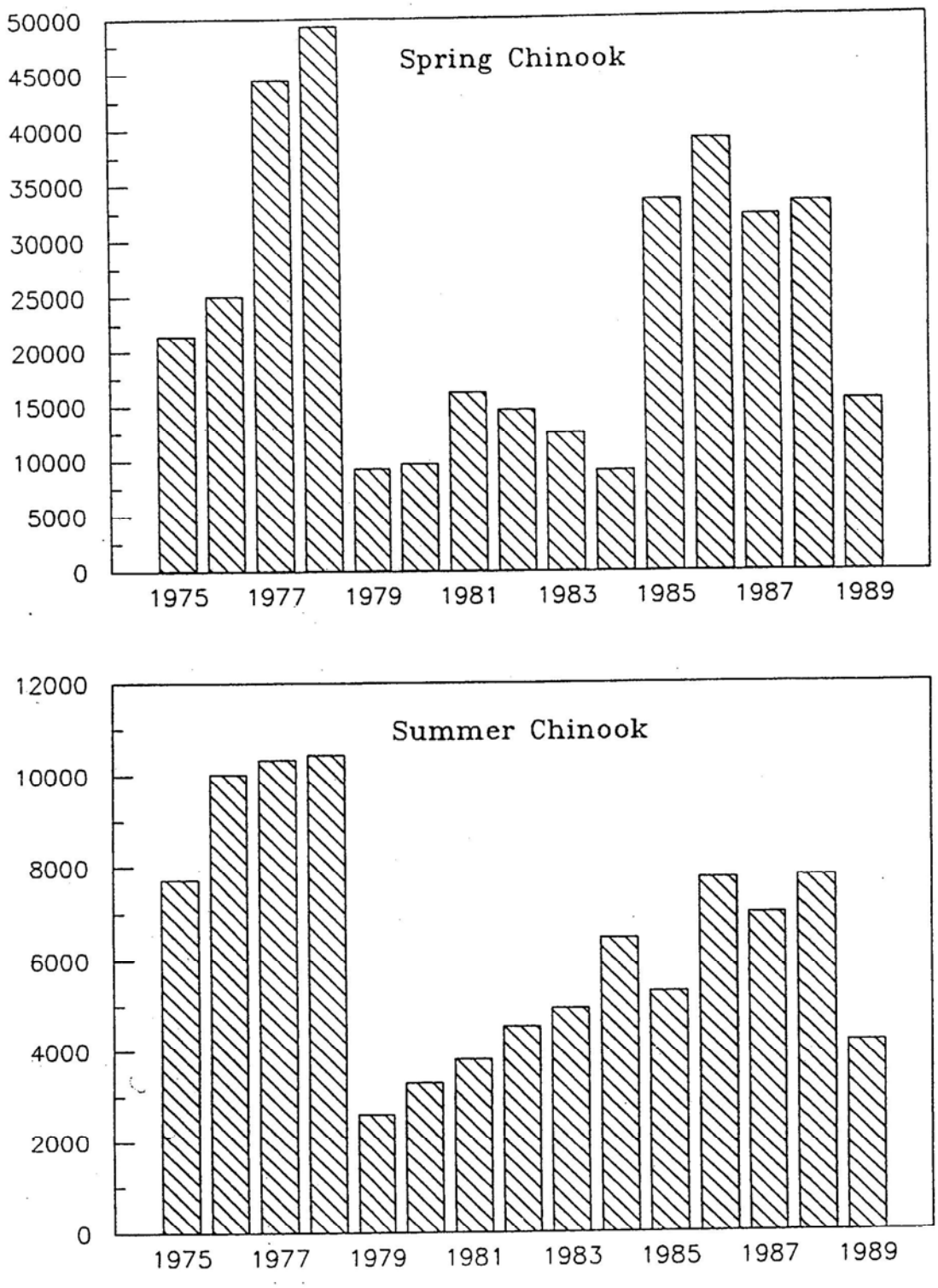

Figure 2. Spring and summer chinook salmon return counts (adults and jacks) at Ice Harbor Dam near the mouth of the Snake River from 1975 through 1989.

Lyons Ferry FH. In addition to the fall chinook program, Lyons Ferry FH Phase II is also responsible for rearing spring chinook for the Tucannon River compensation effort. The FH was designed to produce 132,000 spring chinook at 15 fpp for a total of 8,800 pounds (Table 4). At the estimated return rate of 0.87 percent for the 15 fpp spring chinook smolts (Table 3), the return goal for the program is about 1,148 adults (Table 2).

The Lyons Ferry FH Phase II spring chinook program is a cooperative program between Washington Department of Fisheries (WDF) and Washington Department of Wildlife (WDW). Spring chinook adults are trapped and held at the Tucannon FH, a WDW-operated facility, until late August when spawning occurs. The eggs are transported to Lyons Ferry Salmon FH (Phase II) for fertilization, incubation, and rearing and then returned to the Tucannon FH adult ponds in the fall to acclimate until their April release date.

Table 9. Estimated hatchery-origin spring chinook adult returns to the Lookingglass FH ladder (Grande Ronde River) and Imnaha River weir through the 1987 run (Carmichael and Messmer 1986, Carmichael et al. 1986, 1989).

Location		Return Years 1985	1986	1987
Lookingglass				
	Jacks	10	84	62
	Adults	442	312	2,408
Imnaha				
	Jacks	14	7	16
	Adults	0	14	6
Totals	Jacks	24	91	78
	Adults	442	326	2,414

Table 10 summarizes Tucannon River spring chinook releases for 1987 through 1989. Release goals were exceeded in 1988 and 1989 in number of fish, size, and total pounds of production. Although there have been some disease problems, the future outlook is good for continued success of that program. To date, all adult returns to the weir and trap on the Tucannon River have been wild fish; the run size is about 250 to 300 adults. The first hatchery-reared chinook (jacks) returned to the Tucannon River in 1989.

Table 10. Spring chinook production from Lyons Ferry FH for release from 1987 through 1989 (fpp = fish per pound).

Brood Year	Release Year	Number	Size (fpp)
1985	1987	12,922	6
1986	1988	153,725	10
1987	1989	152,165	9

Sawtooth FH. Sawtooth FH is the uppermost spring chinook hatchery facility in the Columbia River Basin; it is about 900 miles from the ocean. Sawtooth FH became operational in 1985 and was designed to produce 2.98 million spring chinook smolts at 20 fpp for a total of 149,000 pounds (Corps 1982a). As noted above with other facilities, the 15 fpp guideline was not considered possible at Sawtooth FH due to the cold water. At 15 fpp and 149,000 pounds of capacity, about 2,235,000 smolts would have been produced. Using the original model's adult return rate of 0.87 percent for the 15 fpp spring chinook smolts (Table 3), the return goal for the Sawtooth FH program is about 19,445 adults. For the smaller 20 fpp smolts, the return rate must only be 0.65 percent to meet the adult return goal.

The East Fork satellite facility was designed to be operated with the Sawtooth FH. It is being used to trap adults, take eggs, and release fish (directly into the East Fork of the Salmon River). The design memoranda (DM 14 and 15) for the Sawtooth (Corps 1982a) and East Fork (Corps 1981b) facilities did not specify the smolt release goal for the East Fork, but IDFG's Anadromous Fisheries Management Plan 1985-1990 (IDFG 1985) indicated a release goal for the East Fork of 700,000 smolts (based on the 15 fpp size). Therefore, about 6,090 chinook adults of the 19,445 goal for the Upper Salmon River are expected to return to the East Fork.

Table 11 summarizes Sawtooth FH releases since 1982. Releases have been building slowly in each basin as adult returns have increased and rearing problems have been corrected. The size of release has often been slightly smaller than the target of 20 fpp. The 1989 smolt total production, including Rapid River stock, was about 73,900 pounds of smolts.

Table 11. Spring chinook production for Sawtooth FH from 1982 to spring 1989. Fish size in fish per pound (fpp) is in parentheses.

Release		Location of Release	
Year	Period[1]	Sawtooth FH (fpp)	East Fork (fpp)
1982	SP	18,480[2,3]	0
1983	SP	167,895 (28.7)[3]	0
1984	SP	230,550 (15.9)[3]	0
1985	SP	420,060 (22.6)[3]	0
1986	SP	347,481 (26.3)	108,690 (28)
	FA	103,660 (25)	0
1987	SP	1,081,400 (23)[4]	195,100 (25)
	FA	100,600 (23)	
1988	SP	2,330,200 (20.5)[5]	249,200 (19.5)
	SU	48,000 (80)[6]	
	FA	990,400 (19.6)	
1989	SP	1,299,800 (22)[5]	305,300 (19.7)

1 SP = Mar, Apr, May
SU = June, July, August
FA = Sep, Oct, Nov

2 Fish were part of an eye fluke study

3 Reared at McCall FH

4 An additional 1,367,320 Rapid River stock were reared at Sawtooth FH and released in the Clearwater River basin.

5 Includes Yankee Fork releases

6 Offsite release

Table 12 lists returns to the two upper Salmon River traps since temporary and permanent facilities began operation in 1981. The returns include wild, natural, and hatchery-origin fish.

Table 12. Spring chinook returns to the Sawtooth FH and East Fork weirs, includes wild, natural, and hatchery-origin returns. (Adults are passed above the weir annually to spawn naturally.)

	Sawtooth		East Fork	
Year	Jacks	Adults	Jacks	Adults
1981	23	806	-	-
1982	16	246	-	-
1983	17	349	-	-
1984	76	330	22	117
1985	295	1,344	31	272
1986	51	1,718	5	189
1987	17	1,327	1	271
1988	80	1,405	6	542
1989	412	476	22	106

Completed coded-wire tag (CWT) return data are limited to McCall FH-reared fish released at Sawtooth FH in 1983 and 1984 (Table 13). Although the number of returning adults is low, the return rate for brood year 1982 fish (a release of larger fish) is very good compared to many upriver spring chinook facilities. Partial returns from releases after 1984 are not nearly as promising, however; CWT data in the next few years will give a much better indication of rearing success at Sawtooth FH.

Table 13. Estimated Sawtooth FH rack returns based on CWT expansions for brood years 1981, 1982, (CWT data from Cochnauer and Elam 1989).

Brood Year	Total Release	Release Year	Year Recovered	Hatchery Returns	Percent of release
1981	167,895	1983	1984	89	
			1985	229	
			1986	46	
			Total	283	0.168
1982	230,550	1984	1985	349	
			1986	911	
			1987	346	
			Total	1606	0.70

Dworshak NFH. In June 1982 Dworshak NFH was expanded from its function as a steelhead mitigation facility to include spring chinook trapping, spawning, and rearing. The new facilities were designed to rear 70,000 pounds of spring chinook to 20 fpp for a total of 1.4 million smolts (Corps 1981a). The adult return goal for Dworshak NFH is 9,135 spring chinook (calculated using the 15 fpp size, total rearing capacity, and 0.87 percent return rate guideline from Table 3). At 20 fpp the smolt-to-adult return rate must be 0.65 percent to reach the adult return goal.

Starting in 1986 twelve raceways formerly used to rear resident trout were also used to rear spring chinook. This increased Dworshak's chinook rearing potential by about 20,000 pounds, for a total of 90,000 pounds. This additional rearing effort is expected to continue when eggs are available and until Clearwater FH is built and in full production.

Table 14 summarizes Dworshak NFH chinook releases since 1982. Smolts were reared to four to seven fpp during the first three years of operation and were plagued with poor health. When sizes were maintained at 18 to 20 per pound starting with the 1985 release, health improved considerably. The smolt release in 1987 exceeded the target release when the trout raceways were converted to salmon rearing. Many fry (125+ fpp) and fingerling releases have been in tributaries of the Clearwater River above the hatchery. Smolt releases of about 200,000 were made in 1988 at Powell and in 1989 at Powell and Crooked River, two satellites of the yet-to-be-constructed Clearwater FH; otherwise, all smolt releases have been from Dworshak NFH.

Table 14. Spring chinook production for Dworshak NFH from 1982 to 1988. Fish size in fish per pound (fpp) is in parentheses.

Release Year	Period[1]	Number of Fish (fpp)
1982	W	28,100 (12)
1983	SP	520,903 (5-6)
	FA	75,179 (6.4)
1984	SP	563,889 (125-380)
	SP	267,406 (161-181)
	SP	259,589 (6.9)
	SU	56,683 (42)
	SU	419,747 (22-41)
1985	SP	1,137,139 (22)
1986	SP	506,320 (20)
1987	SP	252,248 (260)
	SP	1,710,710 (18.5)
	FA	192,330 (40)
1988	SP	200,105 (22.4)
	SP	1,132,152 (20.6)
	SP	209,989 (160)
	SP	222,737 (86)
	FA	192,090 (32)
1989	SP	1,653,252 (16-20)
	SP	206,459 (77)
	SU	665,637 (133)
	FA	199,883 (37)

[1] W = Dec, Jan, Feb
SP = Mar, Apr, May
SU = Jun, Jul, Aug
FA = Sep, Oct, Nov

Table 15 summarizes adult returns to the Dworshak NFH ladder since the LSRCP began. Returns have increased to the 2,000 fish level since release sizes

were reduced and fish health improved. The adult return is now about 20 percent of the 9,000 fish goal. The 1989 returns were lower than 1987 or 1988 but not nearly as low as many chinook facilities in the basin. Although complete CWT data are not yet available, estimates of returns suggest that the rate of return is about 0.25 percent. Rack return data from the 1986 release indicates a 0.16 percent return rate (Miller 1989). This rate does not represent a total return to the basin since the tribal fishery and straying fish are not accounted for. Except for the last few years, fish reared at Dworshak have had relatively high incidences of BKD. Although the incidence has been lower in recent years, the disease persists. Until this problem is solved, it may be difficult to achieve the desired adult return goals.

Table 15. Dworshak NFH adult returns to the ladder from 1984 to 1989.

Year	Jacks	Adults	Unknown	Total
1984	14	68	0	82
1985	13	316	5	334
1986	78	437	0	515
1987	25	1980	12	2017
1988	163	1809	0	1972
1989	156	1543	1	1700

Clearwater FH. Clearwater FH is under construction and is scheduled to be operational in September 1991. According to the Corps' DM 17 it will have facilities to rear 91,300 pounds of spring chinook salmon smolts for release off station (Corps 1984). All adults for the program will be trapped at Dworshak NFH or at three satellite sites in Clearwater River basin. The target release size is 15 fpp with a total release of 1,369,500 smolts (Corps 1984). The adult return goal for the program is 11,915 salmon.

The three satellites associated with the Clearwater FH are the 1) Crooked River on a tributary to the South Fork of the Clearwater, 2) Red River another South Fork tributary, and 3) Powell on the Lochsa River in the upper Clearwater River basin. Each satellite includes trapping/holding facilities for adult salmon and a rearing/acclimation pond for spring chinook presmolts. All satellites are scheduled for completion before the Clearwater FH is ready for operation (Table 4). The Sawtooth FH spring chinook program and, more recently, the Dworshak NFH program have provided smolts for direct stream releases and presmolts to the completed facilities for rearing/acclimation to

get the hatchery runs established. The Dworshak program will continue to provide fish for release at these satellite sites as fingerlings are available.

In October 1988, 291,200 salmon presmolts at 25.5 fpp emigrated from the Red River satellite after rearing there since early June. In October 1989 about 240,510 (35 fpp) emigrated from Red River and 314,480 (10 fpp) left the newly completed Powell satellite. Dworshak provided the original pond stocks at 88 to 136 fpp.

Summer Chinook

Only one hatchery, McCall FH in Idaho, was constructed to produce summer chinook under the LSRCP Program. When proposed in the SPECIAL REPORT (Corps 1975), the summer chinook program was to produce almost 1.0 million smolts at 15 fpp for a total of about 61,300 pounds of smolts. Assuming the estimated smolt-to-adult return rate of 0.87 percent from the original model (Table 3), this release was expected to meet the adult return goal of 8,000 adults to the Snake River basin. Figure 2 shows summer chinook returns to the Snake River basin from 1975 through 1989.

McCall FH. McCall FH, completed in 1981 and operated by IDFG, has facilities and water supply to rear about 1 million smolts at 17 fpp. Although the maximum rearing capacity is about 74,000 pounds, the typical production is about 50,000 pounds of smolts at about 20 fpp. The adult trapping and spawning facility for McCall was completed in 1980 and is located on the South Fork of the Salmon River. All smolts are to be released into the South Fork, and the entire adult return goal of 8,000 adults is for the South Fork Salmon River.

Due to concern for the summer chinook run in the mid-1970's, an egg bank program was initiated in 1978 to ensure that the South Fork population would be sustained while McCall FH was being built. Fish were trapped at Little Goose (1978) and Lower Granite (1979 and 1980) and reared at State hatcheries for release in the South Fork. Table 16 summarizes releases for the LSRCP summer chinook program since 1980. The targeted smolt release goals have essentially been met since 1986.

Table 16. Summer chinook production for the South Fork Salmon River since 1980. All rearing except for the 1980 release has been at McCall FH. Fish size in fish per pound (fpp) is in parentheses.

Release Year	Number of Fish (fpp)
1980	124,800 (13)
1981	248,926 (17.5)
1982	122,247 (17.8)
1983	183,896 (20.3)
1984	69,880 (15.6)
1985	564,405 (19.1)
1986	970,348 (20.1)
1987	958,240 (20.2)
1988	1,060,400 (18.7)
1989	975,000 (20.8)

Table 17 shows summer chinook adult returns to the South Fork weir and trap since this satellite facility began operation in 1980. The first hatchery-reared fish began returning in 1981 with the influence of larger releases (500,000 smolts or more) occurring in 1986 and later. Table 18 is an estimate of returns from hatchery-reared releases in 1983, 1984, and 1985. The completed return CWT data from these release years indicate a very good return rate compared to many upper river facilities. The partial return rates from more recent releases indicate lower return rates. CWT studies are continuing at McCall FH and will provide excellent data in the future.

Table 17. Summer chinook returns to the South Fork Salmon River weir, includes wild, natural, and hatchery-reared returns. (Adults are passed above the weir annually to spawn naturally.)

Year	Jacks	Adults	Total
1980	186	194	380
1981	124	400	524
1982	48	502	550
1983	505	433	938
1984	595	934	1,529
1985	828	1,410	2,238
1986	1,222	1,468	2,690
1987	384	2,321	2,705
1988	50	2,343	2,393
1989	495	443	938

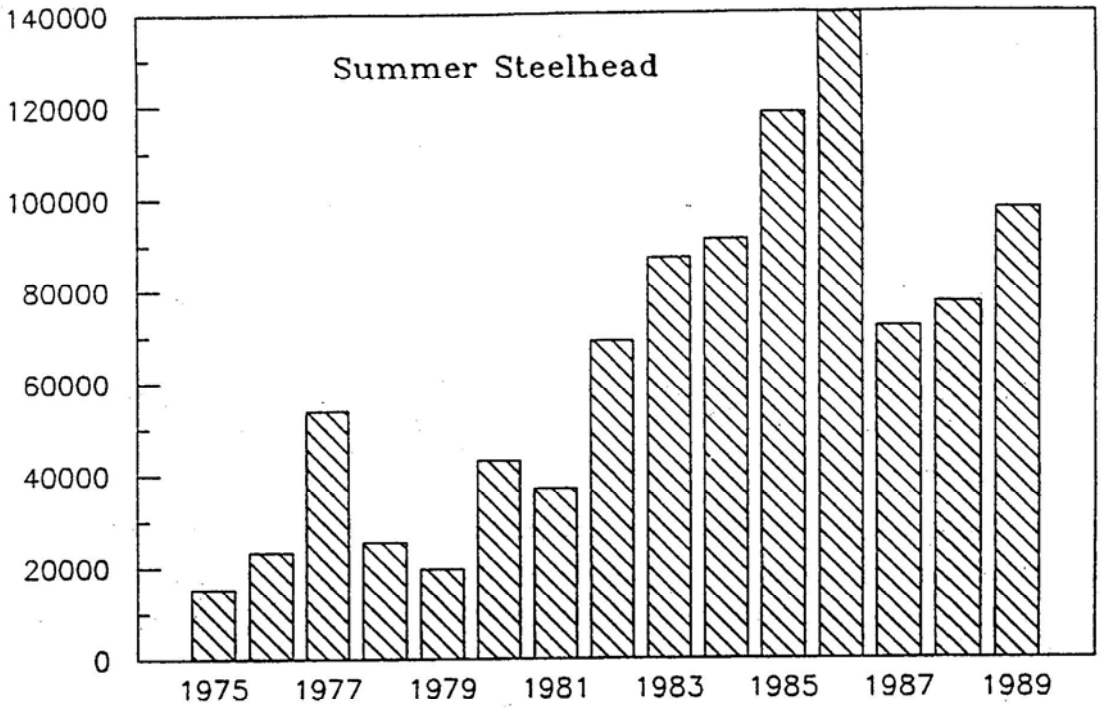

Figure 3. Summer steelhead adult return counts at Ice Harbor Dam near the mouth of the Snake River from run years 1974-1975.

Steelhead Trout

Three state agencies and the Service manage four hatcheries to produce steelhead trout for the LSRCP program. A fifth hatchery, Clearwater FH, will begin operation under IDFG management by 1991. When originally proposed, the steelhead program was to produce about 11 million smolts at 8 per pound for a total of about 1.38 million pounds (Corps 1975). Assuming the estimated smolt-to-adult return rate of 0.50 percent (Table 3), this smolt release was expected to meet the return goal of 55,100 adults to the Snake River basin. (Figure 3 shows summer steelhead returns to the Snake River basin from 1975 through 1989.) Some changes have occurred with the size and numbers of smolts released from various facilities; these are discussed below.

Table 18. Estimated · uth Fork Salmon River returns of McCall FH-reared summer chinook based on CWT data from brood year 1981, 1982, and 1983 releases (data from Cochnauer and Elam 1989).

Brood Year	Total Release	Release Year	Estimated Rate of Return	Estimated Returns
1981	183,896	1983	0.80	1,471
1982	69,880	1984	0.44	307
1983	564,405	1985	0.465	2,624

Irrigon FH. Irrigon FH is operated by ODFW and is the sole steelhead rearing LSRCP facility in Oregon. The hatchery was completed in 1985 and is located adjacent to the Columbia River outside the Snake River basin (Figure 1 and Table 4). According to the Irrigon FH design memorandum (DM 11), the facility was constructed to produce about 1.6 million steelhead smolts at 6 fpp for a total of 280,000 pounds (Corps 1983a). Because of the ideal rearing temperature of the Irrigon FH well water and the desire to produce a larger smolt, exceeding the 8 fpp guideline originally proposed for steelhead was anticipated during the design phase. At 8 fpp, about 2.24 million smolts would have been produced. Assuming the estimated smolt-to-adult return of 0.50 percent for the 8 fpp smolts (Table 3), the return goal for the Irrigon FH program is calculated to be 11,200 adults (Table 2). At 6 fpp and a production of 1.6 million smolts, however, the smolt-to-adult return must be about 0.7 percent to meet the adult goal.

Irrigon FH rears steelhead for both the Grande Ronde River and Imnaha River hatchery production programs. Three other facilities that operate in concert with Irrigon FH are Wallowa FH and the Big Canyon and Little Sheep Creek satellites. Wallowa FH is designed to trap and spawn adults and incubate about 2.7 million eggs to the eye-up stage (Corps 1983b). Big Canyon in the Grande Ronde basin and Little Sheep Creek in the Imnaha basin are designed to trap and spawn adults; and all three have acclimation and release facilities for steelhead smolts. According to DM 11, the production targets in Oregon call for the release of about 225,000 pounds of smolts into the Grande Ronde basin and 55,000 pounds in the Imnaha River basin (Corps 1983a). The compensation goals are to return about 9,000 and 2,200 adults to the Grande Ronde and Imnaha basins respectively. At 6 fpp the weight production

limitations of the facilities result in a target release of about 1.35 million smolts into the Grande Ronde and 330,000 smolts into the Imnaha.

Table 19 summarizes smolt releases into the two basins since 1985 when Irrigon FH was completed. Releases into the Grande Ronde basin have been near or above the targeted level since 1987, and the size has been at the desired level or larger. The targeted Imnaha release numbers and sizes were at the projected level by 1988. The total number of pounds of smolts produced at Irrigon for the Grande Ronde was about 265,000 pounds by the 1987, exceeding the 225,000 pound goal. The Imnaha releases totaled about 62,540 pounds for the 1988 and 64,365 for 1989, both years were well above the 55,000 pound goal.

Table 19. Releases of Irrigon FH-reared steelhead smolts from 1985 through spring 1989 (size in fish per pound - fpp).

Release Year	Grande Ronde Basin (size)	Imnaha Basin (size)
1985	742,085 (5.9-8.8)	79,225 (4.9-10.0)
1986	192,553 (4.2)	115,735 (4.4-11.2)
1987	1,573,379 (4.4-7.0)	93,716 (4.6-8.0)
1988	1,388,418 (4.3-6.0)	331,447 (4.3-5.9)
1989	1,342,144 (5-5.2)	321,823 (5)

Analysis of initial return data to LSRCP-funded steelhead facilities in Oregon began in 1986. Table 20 shows returns for 1986 through 1988 for the Wallowa FH and Little Sheep traps. Although data are preliminary, we estimate that about 1,500 hatchery steelhead were harvested by anglers in both 1987 and 1988. We have no accurate estimate of total hatchery origin steelhead returning to the Snake River basin that are not caught and do not return to the hatcheries or other traps; therefore, an accurate estimation of the total returns to the basin as a result of the Oregon steelhead program is not possible at this time. However, if the ODFW program has adult return rates similar to Washington Department of Wildlife's (WDW) 0.75 to 1.2 percent return rates (discussed below and in Schuck et al. 1989), adult return goals in Oregon have been achieved or will be in the near future.

Lyons Ferry FH. WDW is responsible for steelhead programs in Washington and thus operates Lyons Ferry FH Phase I. Lyons Ferry was completed in November 1983 and is located on the north side of the Snake River in the reach impounded by Lower Monumental Dam (Figure 1 and Table 4). The Lyons Ferry design memorandum (DM 4, Revision 1) indicated it would produce 116,400 pounds of steelhead at 7 fpp, i.e. 814,800 smolts (Corps 1980a). As with Irrigon FH, the well water at constant temperature allows rearing larger fish. At 8 fpp (from the original model - Table 3) about 931,200 smolts could be produced; and, assuming the 0.5 percent smolt-to-adult, the smolts would return 4,656 adults to the project area. The return rate for the larger 7 fpp smolt must be about 0.57 percent to meet the adult return goal.

Table 20. Estimated hatchery-origin steelhead returns to Wallowa FH and Little Sheep traps in 1986, 1987, and 1988 (data from Carmichael and Messmer 1986 and Carmichael et al. 1986, 1989).

Location	1985-1986	1986-1987	1987-1988
Wallowa FH	1,960	3,855	2,073
Little Sheep	23	620	808
TOTALS	1,983	4,475	2,881

Lyons Ferry FH rears fish for release from three satellite acclimation/final rearing ponds and for direct releases into several southeast Washington streams. The three ponds are Cottonwood Pond on the lower Grande Ronde River, Curl Lake on the Tucannon River, and Dayton Pond on the Touchet River. Dayton Pond, as well as several other nearby stream release sites, are in the Walla Walla River basin which is outside the Snake River basin. WDW selected streams for releases outside the Snake River because of the paucity of suitable anadromous fish streams in southeast Washington. All adult trapping for the brood fish was to occur at Lyons Ferry FH. However, a new floating weir at Tucannon FH capable of operation during the entire steelhead run will also allow broodstock to be taken there.

Table 21 summarizes releases of Lyons Ferry FH-reared steelhead since its completion in 1983. The hatchery has met or exceeded its targeted smolt

release goals since 1984. In 1988, for example, 970,340 smolts were released weighing 186,862 pounds and averaging about 5.2 fpp.

Table 21. Releases of Lyons Ferry FH-reared steelhead smolts from 1983 to 1988 by location and satellite (size in fish per pound-fpp)

Release Year	Lyons Ferry	Grande Ronde (Cottonwood Pd.)	Touchet (Dayton Pd.)	Tucannon (Curl Lk)	Other WA Streams	Wallowa FH
1983	138,530 (4.3-7.0)	0	76,250 (7.1)	148,275 (6.5)	156,234 (5.3-15.5)	183,782 (6.8-7.1)
1984	138,378 (3.3-5.3)	0	144,665 (4.7-5.7)	195,315 (4.9-9.0)	196,750 (4.7-8.2)	501,452 (6.5-8.5)
1985	104,498 (2.6-5.5)	149,400 (5.5-10.1)	149,665 (5.2-8.4)	151,609 (5.7)	236,908 (7.7)	379,353 (5.0-8.4)
1986	101,761 (5.3-5.9)	124,200 (4.6)	155,605 (5.3-6.9)	141,068 (5.6)	304,914 (5.3-6.9)	0
1987	162,173 (4.8-5.9)	200,845 (5.4)	136,727 (5.2)	162,231 (5.7)	208,211 (5.1-5.9)	52,500 (5.6-5.8)
1988	105,117 (4.7-4.8)	220,676 (4.8-6.1)	170,724 (4.7)	161,293 (5.7)	261,891 (5.4-6.1)	50,640 (6.0)
1989	98,504 (4.8)	222,050 (5.3)	158,468 (4.8)	160,061 (5.8)	221,950 (5.2)	

Return data resulting from Lyons Ferry FH releases are difficult to estimate because of the variety of release sites and lack of trapping facilities. Even the ladder at Lyons Ferry FH is not open during the entire spectrum of the run because of the large number of stray fish which enter. A reasonable estimate of returns from releases above Lower Granite Dam can be obtained from fish that are CWTed and branded as smolts. Smolt-to-adult return rates of 1985 Grande Ronde releases for 1986 and 1987 returns have shown Snake River return rates of 2.04 and 1.74 percent for two tag/brand groups (Schuck et al. 1989). Even Lyons Ferry FH and Tucannon River (Curl Lake site) releases in 1985 returned adults above Lower Granite Dam at rates from 0.45 to 2.1 percent. Schuck et al. (1989) estimated that Lyons Ferry FH releases resulted in 6,758 adult steelhead returning to the Snake River basin in 1987. This return is above the 4,656 goal for the Lyons Ferry FH program.

Magic Valley FH. IDFG operates Magic Valley FH which is located south of the Snake River in south central Idaho (Figure 1). Completed in 1987, the hatchery (originally called Crystal Springs) was designed (see DM 16) to produce 349,800 pounds of steelhead smolts at 5 fpp for a total of 1,749,000 smolts (Corps 1982b). (Originally, the facility was to produce 291,500 pounds of smolts to meet LSRCP goals (Table 4). Because of concerns for disease losses, the production design was increased by 20 percent.)

As is the case with other hatcheries that have constant temperature water sources, Magic Valley FH's spring water allows smolts to be reared to 5 fpp, somewhat larger than the 8 fpp proposed for steelhead in the original model (Table 3). At 8 fpp about 2,332,000 smolts would have been produced with a production capacity of 291,500 pounds. Assuming a smolt-to-adult return rate of 0.5 percent for the 8 fpp smolts (Table 3), the return goal for Magic Valley FH is established as 11,660 adults (Table 2). At 5 fpp and production of 1,749,000 smolts, the smolt-to-adult return rate must be 0.67 percent to meet this adult goal.

Magic Valley FH rears fish for release into the Salmon River basin. Originally, only the so-called "A" strain steelhead was to be reared but "B" strain has also been and will continue to be reared there. Two upper Salmon River LSRCP facilities operate in concert with Magic Valley FH: Sawtooth FH and the East Fork satellite. Steelhead adults are trapped at both facilities, the eggs are fertilized and incubated at Sawtooth FH, and eyed-eggs are shipped to Magic Valley (and Hagerman NFH--discussed below) for rearing.

Table 22 summarizes releases of Magic Valley FH-reared smolts from 1983 through 1989. Because the hatchery is located outside the compensation area, all smolts must be transported by tankers to remote locations. All releases were direct stream releases into upper Salmon River tributaries, the East Fork, and several lower Salmon River tributaries. Release numbers and pounds in both years were well above the design levels due to the excellent water quality and quantity from their spring water source.

Because Magic Valley FH has only been operating a couple years, return data are not available to determine return rates or adult returns from releases.

However, return rates are expected to be similar to those of Hagerman NFH, discussed below.

Table 22. Release information for Magic Valley FH-reared steelhead smolts from 1983 to 1989 (size in fish per pound-fpp).

Release Year	Numbers (size)	Pounds
1983	133,361 (3.7-4.6)	31,615
1984	264,574 (2.6-4.1)	94,015
1985-87	Hatchery Under Construction	
1988	2,063,000 (4.6)	454,200
1989	2,202,800 (4.3)	509,100

Hagerman NFH. Hagerman NFH is operated by the FWS and, like Magic Valley FH, it is located adjacent to the Snake River in south central Idaho (Figure 1). Hagerman became a LSRCP facility in 1984 when the trout producing facility was expanded and modified to accommodate rearing 340,000 pounds of steelhead smolts for the LSRCP program (Corps 1980b). About 100,000 pounds of space was retained to rear trout. As noted above for Magic Valley FH, the target size for Hagerman is 5 fpp (DM 7), resulting in a production of 1,700,000 smolts. At the modeled size (Table 3) of 8 fpp, about 2,720,000 smolts would be produced. Using the modeled 0.5 percent smolt-to-adult return rate (for the 8 fpp size-Table 3), the return goal for Hagerman NFH is 13,600 adults to the Snake River basin. At 5 fpp and a production of 1,700,000 smolts, the smolt-to- adult return rate must be 0.8 percent to meet the adult return goal.

Table 23 summarizes releases of Hagerman NFH-reared smolts since 1983. All releases are hauled by tanker to streams that are an average distance of about 200 miles from the hatchery. Although release sites vary from year to year, the bulk of the fish are released at Sawtooth FH, the East Fork satellite, in the Little Salmon River drainage, and in Slate Creek (Lower Salmon River). Both "A" and "B" steelhead have been reared and released in most years. Some surplus fingerlings are also released each fall when pond splits are completed, but they are not a major part of the program. Due water quantity limitations, smolt release numbers and pounds have been slightly below design amounts, whereas the fish sizes have generally been larger than expected.

Return data for Hagerman NFH-reared steelhead consists of trapping data from Sawtooth FH and the East Fork trap, CWT data (primarily from test groups), and harvest estimates. Table 24 summarizes trapping data from fall 1984 through spring 1989; the returns include adults of both hatchery (as identified by adipose fin clips) and natural origin (adults are annually passed over the weir to allow natural spawning).

Table 23. Release information for Hagerman NFH-reared steelhead smolts.

Release Year	Numbers (size)	Pounds
1983	424,400 (3.2)	131,380
1984	1,120,000 (3.2)	346,000
1985	1,346,497 (4.4)	310,090
1986	1,527,334 (4.45)	343,267
1987	1,535,351 (4.46)	336,604
1988	1,550,031 (4.7)	332,325
1989	1,478,830 (4.9)	299,425

Table 24. Hatchery and natural origin steelhead returns to the Sawtooth FH and East Fork satellite traps from 1985 through 1989 (R. Alsager, Sawtooth FH, personal comm.).

Run Years	Sawtooth FH		East Fork		Totals
	Hatchery	Wild	Hatchery	Wild	Hatchery
1984-1985[a]	485	41	71	6	556
1985-1986[a]	2,182	30	443[b]		2,625[b]
1986-1987[a]	2,114	73	210	14	2,424
1987-1988	864	126	170	40	1,034
1988-1989	719	75	362	17	1,081

[a] All hatchery fish smolts had their adipose fins removed starting in 1984; hatchery adults returning from releases earlier then 1984 could be classified as wild.

[b] Wild count not available from East Fork.

CWT returns from Hagerman NFH are available both from releases prior to the LSRCP expansion of the hatchery and from releases after the LSRCP program was initiated in 1983. Unexpanded return rates have varied widely from 0.01 percent to 0.63 percent (Cochnauer and Elam 1989). Studies comparing various sizes at release have shown that larger smolts return at higher rates than smaller smolts of the same release year. Most CWT return data have been expanded and used to help determine the contribution of Hagerman releases to steelhead fisheries in Idaho; these data are discussed below.

Harvest surveys have been conducted in the Salmon River under LSRCP funding since 1984. During the 1984-1985 season, surveys showed that about 2,485 LSRCP-produced fish were harvested or returned to hatchery facilities (Ball 1986a, 1986b). During the 1985-1986 and 1986-1987 seasons respectively, an estimated 17,316 and 16,966 LSRCP-produced adults were accounted for in the harvest and at hatchery racks (Ball 1988 and Ball 1989). Ball (1990) estimated that "A" strain steelhead reared at Hagerman and Magic Valley hatcheries returned to Idaho streams at rates up to 2.54 percent and that exploitation rates by anglers may have reached 85 percent for upper Salmon River releases. If return rates continue to be high as the hatcheries reach full production, adult return goals of the Hagerman NFH and Magic Valley FH programs should be met or exceeded in most future years.

Clearwater FH. As noted above in the spring chinook section, Clearwater FH is under construction and is scheduled to be operational in September 1991. It will have facilities to rear 350,000 pounds of steelhead smolts for release at associated satellites and in Clearwater River basin tributaries. All adults for the program will be trapped at Dworshak NFH or at three satellite facilities. The target release size is 5 fpp with a total release of 1,750,000 smolts (Corps 1984). At the modeled size of 8 fpp (Table 3) and return rate of 0.5 percent, the adult goal for Clearwater FH is 14,000 steelhead.

Resident Trout

WDW manages two hatcheries to produce resident trout (trout) for the LSRCP program. When originally proposed, the trout program was to produce 233,000 trout at 2.5 fpp for a total of about 93,000 pounds (Corps 1975). These "catchable-sized" trout were to compensate for the loss of 67,500 angler-days of fishing. During the hatchery siting phase of the program, the WDW and Corps agreed that at least 29 stream segments (100-200 feet in length) would be improved with one or more instream structures in lieu of producing 7,000 pounds of hatchery trout (equivalent to two raceways at Lyons Ferry FH). From 1983 to 1986, 91 structures were built in the Tucannon River (36), South Fork Asotin Ck (31), North Fork Asotin Ck (18), and Asotin Ck (6) (Fuller 1986). The structural integrity of the instream structures has been good to date, and

they will be further evaluated to determine their success in producing trout and improving trout angling. The remaining 86,000 pounds of trout production was incorporated into rearing facilities at Lyons Ferry and Tucannon FH's.

Lyons Ferry Phase I was designed to rear 45,000 pounds of trout for release into Washington and Idaho waters. At the time of the hatchery design, WDW and IDFG estimated that about 6,200 pounds of the total production would be reared for release in Idaho to offset their trout angler losses, with the remainder to go into Washington streams and lakes.

Tucannon FH, located on the Tucannon River, was designed (DM 19) to rear the remaining 41,000 pounds for the compensation program (Corps 1983c). Tucannon FH was an existing resident trout hatchery operated by WDW that was rebuilt for the LSRCP program and completed in 1984.

Table 25 summarizes releases of resident trout under the LSRCP program since 1984. Since 1986 releases of catchable-sized trout have been either slightly below or above the targeted goals. Disease problems have resulted in losses in a few years, but generally the resident trout program has been successful with no major problems in meeting release goals. As noted above, the efficacy of the instream program will continue to be monitored.

SUMMARY

Production in Pounds

Table 26 compares the pounds of smolts released by LSRCP FH's from 1987 to 1989 with the target production in pounds estimated in each hatchery's design memorandum. For various reasons salmon production in pounds is somewhat lower than the targets originally outlined during hatchery design. Regarding fall chinook, broodstock have never been available to completely meet the original program's egg needs. In FY1988, the release of over 4.5 million zero-age fish and over 400,000 yearlings resulted in the poundage goal being met, primarily because of the large (8 fpp) yearlings.

Table 25. Resident trout releases from Lyons Ferry and Tucannon FH's from 1984 through 1989.

Year	Release State	Numbers (size)	Weight
1984	Washington	198,528 (3.3)	59,437
	Idaho	0	
1985	Washington	198,453 (2.5-3.1)	63,895
	Idaho	0	
1986	Washington	253,951 (2.9)	86,548
	Idaho	1,000 (3.1)	3,100
	Idaho	100,000	[1]
1987	Washington	203,772 (2.85)	71,614
	Idaho	1,000 (3.0)	3,000
	Idaho	100,000 (60)	1,667
1988	Washington	213,937 (3.1)	68,180
	Idaho	1,000 (3.1)	3,100
	Idaho	100,289 (103)	973
1989	Washington	265,360 (2.8-3.0)	92,225
	Idaho	117,148 (10-11)	11,400
	Idaho	13,344 (24)	556
	Idaho	63,005 (6.8)	9,250
	Idaho	75,141 (29.7)	2,530

[1] Unknown

Although spring chinook broodstock were lacking at Lookingglass and Sawtooth to completely fill those programs in several brood years, the production in pounds has been near or above capacity for the last three years at all completed facilities. The addition 20,000 pounds being reared at Dworshak helps make up for shortages at Lookingglass and Sawtooth FH's. When Clearwater FH reaches full production, the weight production will be near the target figure.

Summer chinook production in pounds is less than projected because the smolts have generally been smaller than expected with no increase in numbers released. Broodstock returns in 1989 did not provide sufficient eggs to fill the facility, so FY1991 releases will be less than the goal.

Table 26. Production of LSRCP FH's in pounds in FY1987, 1988, and 1989 expressed as a percent of the designed production goals.

Species/FH	Smolt Production Goal in Pounds	Percent of Production Goals Achieved		
		FY1987	FY1988	FY1989
FALL CHINOOK:				
Lyons Ferry	101,800	66	114	48
SPRING CHINOOK:				
Lookingglass[1]	69,600	140	104	92
Lyons Ferry	8,800	25	175	192
Sawtooth[1,2]	149,000	75	88	82
Dworshak[2]	70,000	132	91	126
Clearwater[1]	91,300	0	13	27
Total/Average Percent	388,700	78	76	81
SUMMER CHINOOK:				
McCall	74,000	64	77	63
STEELHEAD:				
Irrigon	280,000	104	119	117
Lyons Ferry	116,400	145	161	142
Magic Valley	249,800	0	182	204
Hagerman	340,000	99	98	88
Clearwater	350,000	0	0	0
Total/Average Percent	1,336,200	60	98	97
RESIDENT FISH:				
Lyons Ferry/Tucannon	86,000	87	83	107

[1] Releases include fall presmolt releases.
[2] Includes pounds reared for Clearwater FH releases.

In general, steelhead production has exceeded the amounts estimated during design. Broodstock has not been lacking to provide hatcheries with their egg needs and fish sizes have exceeded design estimates. In the case of Magic Valley FH, more water is available than expected, fish have been larger than expected, and disease losses have not been as great as anticipated.

Production in Numbers

Table 27 compares numbers of smolts produced with target production numbers estimated during the hatchery design phase. Salmon smolt releases are below targeted goals for various reasons. For fall chinook, the broodstock has not

been available to supply sufficient eggs. In the mean time, WDF is experimenting with yearling releases to improve return rates. Spring chinook smolt production at Lookingglass and Sawtooth FH's has also been restricted due to a shortage of eggs from suitable stocks. Lyons Ferry and Dworshak are exceeding target release numbers due to availability of eggs (at both facilities) and increased rearing space (at Dworshak). Clearwater FH is yet to come fully on line so rearing space is restricting that program. Summer chinook smolt releases are on target at McCall FH.

Table 27. Production of LSRCP FH's in numbers in FY1987, 1988, 1989 expressed as a percent of the designed releases.

Species/FH	Smolt Production Goal in Numbers	Percent of Production Goals Achieved		
		FY1987	FY1988	FY1989
FALL CHINOOK:				
Lyons Ferry	9,162,000	12	54	23
SPRING CHINOOK:				
Lookingglass[1]	1,390,000	106	80	74
Lyons Ferry	132,000	10	117	115
Sawtooth[1,2]	2,980,000	92	90	87
Dworshak[2]	1,400,000	122	95	118
Clearwater[1]	1,369,500	0	21	41
Totals	7,271,500	82	77	82
SUMMER CHINOOK:				
McCall	1,000,000	96	106	98
STEELHEAD:				
Irrigon	1,600,000	104	108	104
Lyons Ferry	814,800	113	119	106
Magic Valley	1,749,000	0	118	126
Hagerman	1,700,000	90	91	87
Clearwater	1,750,000	0	0	0
Totals	7,613,800	54	83	82
RESIDENT FISH:				
Lyons Ferry/Tucannon	233,000	88	92	114

[1] Releases include fall presmolt releases.
[2] Includes pounds reared for Clearwater FH releases.

Steelhead smolt releases are generally greater than expected because of the availability of broodstock. Steelhead smolts being produced at all facilities

have also been larger than estimated. Resident trout goals measured by weight or numbers been above those expected in design memoranda.

Adult Returns

Little complete CWT return rate data are available for LSRCP facilities. Most tagging done early in the program was to test size, time or location of releases or some rearing option (e.g. comparing diets); more recently, CWTing has been done to determine contribution or total returns to the basin. Salmon CWT return rates are generally lower than needed for success. Studies have shown adult return rates from less than 0.1 percent to 0.8 percent with many facilities having returns of about 0.2 percent.

Recent steelhead returns meet or exceed expectations at rates of 0.6 to over 2.0 percent. Although some adult return estimates are now available (see hatchery-by-hatchery adult return tables above), ongoing CWT studies and other marking will provide more accurate estimates of total adult returns to the basin in the next three or four years. Bi-annual updates of this report will provide adult return estimates as they become available.

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