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LOWER SNAKE RIVER COMPENSATION PLAN LYONS FERRY HATCHERY EVALUATION PROGRAM

FALL CHINOOK SALMON 1992 ANNUAL REPORT

LOWER SNAKE RIVER
COMPENSATION PLAN
Hatchery Program

Washington Department of
Fish and Wildlife
Hatcheries Division

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1992 ANNUAL REPORT

by

Glen Mendel
Kristine Petersen
Robert Bugert
Deborah Milks
Lance Ross
Jerry Dedloff
Joseph Bumgarner

Washington Department of Fish and Wildlife
Hatcheries Division
600 Capitol Way N.
Olympia, Washington 98501-1091

to

U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan Office
4696 Overland Road, Room 560
Boise, Idaho 83702

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ABSTRACT

This report provides a synopsis of activities from 1 April 1992 to 31 March 1993 by the Washington Department of Fisheries'(WDF) Lower Snake River Hatchery Evaluation Program. This work was completed with Fiscal Year 1992 funds provided by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan (LSRCP). In this report we describe the fall chinook salmon program at Lyons Ferry Fish Hatchery (FH), and related natural production in the Snake River. The LSRCP goal for adult returns of salmon from this hatchery is 18,300 Lyons Ferry origin fall chinook salmon back to the project area (past Ice Harbor Dam).

Fall chinook salmon broodstock at Lyons Ferry FH in 1992 was estimated during collection to consist of 1,332 adults (age 3+) and 273 jacks. Fish were obtained from three sources, voluntary returns to the FH ladder, and fish trapped and transported to Lyons Ferry FH from both Ice Harbor and Lower Granite dams. We obtained 256 adults and 71 jacks from trapping operations at Ice Harbor Dam, 178 adults and 26 jacks from Lower Granite Dam, and 898 adults and 176 jacks through voluntary returns to the hatchery. Additionally, five marked jacks and one minijack were sacrificed at Lower Granite Dam to determine stray rates. Broodstock collection at Lyons Ferry FH and Ice Harbor Dam accounted for 25.3% of the total fall chinook salmon escapement above Ice Harbor Dam. Another 3.7% of escapement was collected at Lower Granite Dam. Only coded-wire tagged (CWT), or blank wire tagged (BWT), salmon were collected at the dams.

Analysis of CWT recoveries from salmon spawned at Lyons Ferry FH indicated a substantial stray rate of fall chinook salmon stocks into the Snake River in 1992 from outside the basin, as in past years. Broodstock collected at Ice Harbor Dam had a 27% estimated incidence of strays from the Umatilla River. Umatilla strays comprised 9% of the fall chinook salmon collected at Lower Granite Dam, and 8% of salmon that voluntarily returned to Lyons Ferry FH. Stray fall chinook salmon from Bonneville Dam comprised approximately 3% of the fish that passed Ice Harbor Dam, 1% at Lower Granite Dam, and less than 1% of the fish that voluntarily returned at Lyons Ferry FH.

Fall chinook salmon were spawned at Lyons Ferry FH from 20 October to 8 December. Peak of spawning was 21 November. We read the CWT of all marked fish prior to spawning. Matings consisted of single female/single male lots (with a backup male). Only salmon verified to be of Lyons Ferry FH origin were used for broodstock. All 1989 brood fish from Lyons Ferry, marked (CWT) strays, or unmarked fish were spawned together as "strays". The

resultant eggtake was 2,994,676 (plus 9,000 eggs to WSU). Progeny from all stray and unmarked salmon were transferred to Klickitat FH (1,917,215 eyed eggs).

We determined fertilization rates for fresh and frozen semen from stray fall chinook salmon at Lyons Ferry FH. We also compared fertilization rates based on the amount of semen used, with or without ovarian fluid, and short (<1 hr) or long term (< 1 yr) cryopreservation. Fresh semen produced fertilization rates of approximately 99%. All tests with frozen semen at Lyons Ferry FH produced mean fertilization rates of 20-34%. We also conducted tests of cryopreserved semen at WSU to determine the quality of semen preservation and fertilization rates we could expect in the laboratory. Mean fertilization rates were approximately 2-9% at the laboratory.

Lyons Ferry FH released 364,022 yearling (1990 brood) fall chinook salmon directly from the hatchery on 15 April. Another 325,579 yearling (1990 brood) fall chinook salmon were barged downstream of Ice Harbor Dam for release on 17 April 1992. All fish were adipose clipped and CWT, except for 10,332 fish that were BWT or VT only. Approximately half the fish were marked with an externally visible red elastomer tag (VT) in the clear skin behind the left eye. Another 224,439 subyearlings (1990 brood) were released in June 1991 (Mendel et al 1992).

We were involved in a cooperative effort to monitor natural spawning in all streams upriver of Lower Granite Dam that are believed to be used by fall chinook salmon adults. Spawning ground counts in the Clearwater, Grande Ronde, Imnaha, Salmon and mainstem Snake rivers in 1992 totaled 26, 5, 3, 1 and 48 redds, respectively. Although 40 redds were observed during index surveys of the Snake River, a total of 46 redds were observed during weekly counts in 1992. An additional two redds were observed by Idaho Power personnel after the last aerial survey. After broodstock collections at Lower Granite Dam, 668 adults passed the dam. This provides an adult/redd ratio of about 8.05. This adult/redd ratio is substantially below the 12.8 adults/redd obtained in 1991 (revised from Mendel et al. 1992). By accounting for fall back at Lower Granite Dam and fish "lost" in the reservoir we estimate the adult/redd ratio was 4.7 (Mendel et al. 1993a).

We also monitored fall chinook salmon spawning below Lower Granite Dam. We observed a minimum of 23 redds in the lower Tucannon River in 1992. We recovered 15 carcasses, two of which were marked. Both marked fish were returns from yearling releases at Lyons Ferry FH. We are unable to account for approximately 2,556 adult salmon of Lyons Ferry origin between Ice Harbor Dam and Lower Granite Dam.

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SECTION 1: INTRODUCTION

1.1: Program Objectives

Congress authorized the Lower Snake River Fish and Wildlife Compensation Plan (LSRCP) in 1976. As a result of that plan, Lyons Ferry Fish Hatchery (FH) was designed, constructed, and is currently operating. A partial objective of this hatchery is to compensate for the loss of 18,300 adult fall chinook salmon, Snake River stock (USACE 1975). An evaluation program was initiated in 1984 to monitor the success of Lyons Ferry FH in meeting the LSRCP compensation goals and to identify any production adjustments required to accomplish those objectives.

The Washington Department of Fisheries (WDF) has identified two broad-based goals in its evaluation program: 1) monitor hatchery practices at Lyons Ferry FH to ensure quality smolt releases, high downstream migrant survival, and sufficient contribution to fisheries with escapement to meet the LSRCP compensation goals, and 2) gather genetic information which will help maintain the integrity of Snake River Basin fall chinook salmon stocks (WDF 1992). A specific list of the evaluation program's objectives is outlined in Appendix A.

This report briefly summarizes activities performed by the Washington Department of Fisheries' LSRCP Fall Chinook Salmon Evaluation Program for the period 1 April 1992 through 31 March 1993. We will continue to evaluate these data and we expect to present additional results of the 1992 data in subsequent annual reports. Separate reports describe the 1992 fall chinook salmon trapping activities at lower Snake River dams (Mendel et al. 1994) and our fall chinook salmon Radio Telemetry Study (Mendel et al. 1993a). Results of activities associated with the WDF Spring Chinook Salmon Evaluation Program for the 1992 contract period were published separately (Mendel et al. 1993b).

1.2: Description of Facilities

Lyons Ferry FH is located at the confluence of the Palouse and Snake Rivers at river kilometer (RK) 90 (Lower Monumental Pool, Figure 1). Design capacity for the fall chinook salmon program is 101,800 pounds (9,162,000 subyearling smolts at 90 fish per pound). Lyons Ferry FH has a single pass well water system through the incubators, two adult holding ponds, and 28 raceways. Salmon[1] are hatched and reared at Lyons Ferry FH and either released on-station or barged downstream of Ice Harbor Dam and released. Broodstock are derived from various sources (Section 2). The first year of adult (≥3 years old) returns to the hatchery was 1986.

[1] *The term salmon as used in this report refers to fall chinook salmon.*

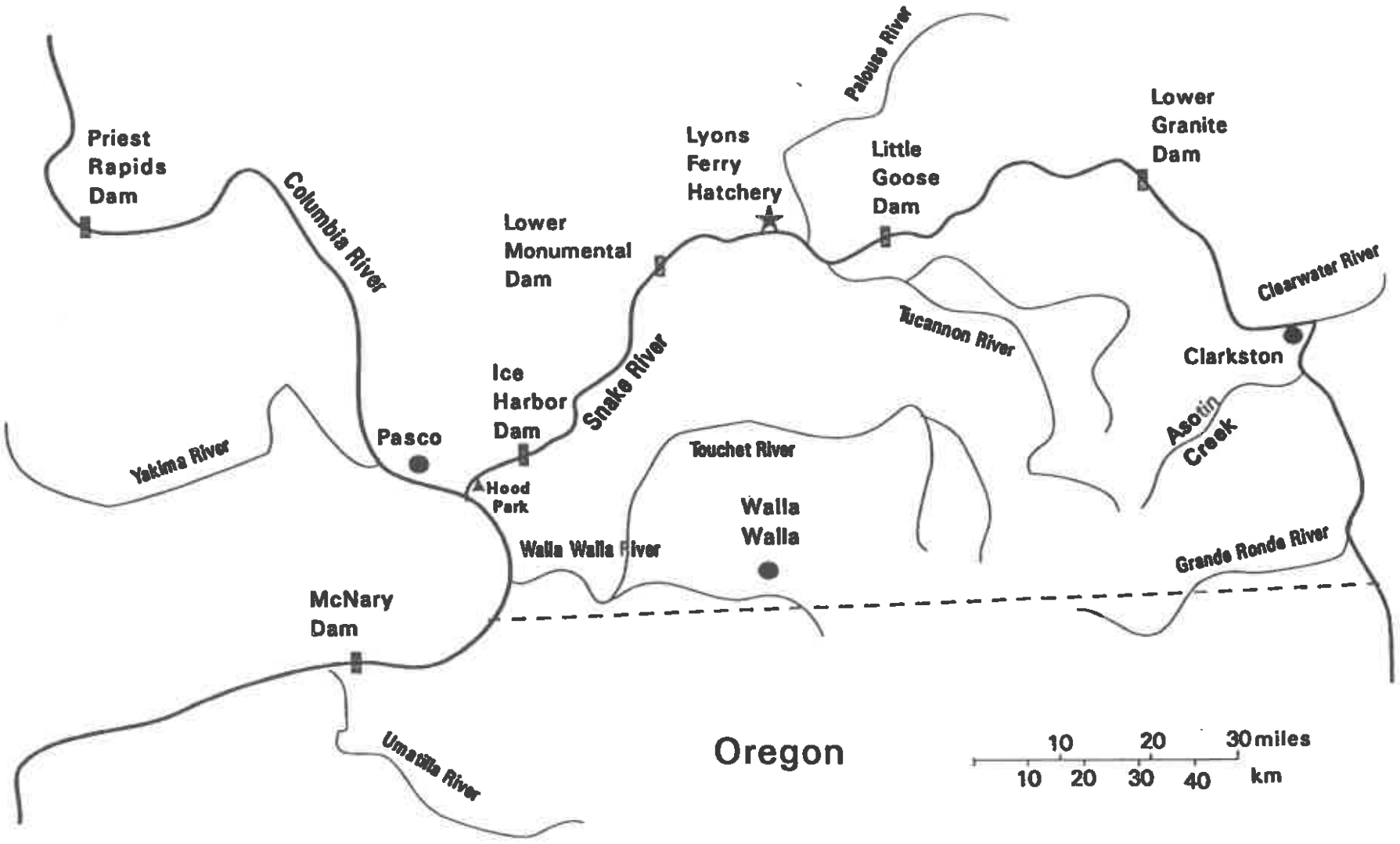

Figure 1. Lower Snake River Basin, showing the location of Lyons Ferry Fish Hatchery and major tributaries in the area.

SECTION 2: BROODSTOCK MANAGEMENT

2.1: Broodstock Collection

Lyons Ferry FH has been building its broodstock since the facility became operational in 1984. Salmon are obtained from two primary sources: 1) returns to the Lyons Ferry FH ladder, and 2) adults trapped at Ice Harbor Dam for transport to Lyons Ferry FH (Bugert and Hopley 1991). From its inception through 1990, Lyons Ferry FH broodstock collection from these two sources has averaged 37% of total escapement to the project area--past Ice Harbor Dam (Bugert et al. 1991). In 1992, broodstock collection from these two sources was 25.3% of total estimated escapement (1,401 of 5,530) past Ice Harbor (Table 1). An ancillary source of broodstock in 1990-1992 was the National Marine Fisheries Service (NMFS) upstream migrant trap at Lower Granite Dam (Section 2.1.3), which collected another 3.7% (204 broodstock) of the total fall chinook escapement to the project area in 1992. Numbers of broodstock collected are based on estimates at the time of collection. Broodstock were collected in 1992 according to our Broodstock Collection Protocol (Appendix B).

During the period 1984-1986, eyed eggs were transported from Kalama Falls FH to Lyons Ferry FH, as part of the Snake River Egg Bank Program. Broodstock collection from 1984-1990 and during the eggbank program (1977-1984) have been summarized previously (Bugert and Hopley 1989, Bugert et al. 1991). During 1992, 19.2% of adult broodstock were obtained from Ice Harbor Dam and 67.4% were collected as voluntary returns to Lyons Ferry FH (based on estimates at the time of collection). The remaining broodstock were obtained from Lower Granite Dam (13.4%).

2.1.1: Voluntary returns to Lyons Ferry Fish Hatchery

In general, numbers of fall chinook salmon returning to the Lyons Ferry FH ladder vary yearly with run size at Ice Harbor Dam (Mendel et al. 1992). A total of 898 adults and 176 jacks[2] voluntarily returned to Lyons Ferry FH in 1992. Duration of returns was 84 days, compared to the 1986-1990 average of 81 days. Duration of returns has changed little since 1986, yet the peak of returns has varied (Table 2). A strong peak of voluntary returns occurred on 19 October 1992 (181 adults and 33 jacks).

[2] *Throughout this report, jacks collected in trapping operations and returns to the hatchery rack were distinguished by size at the time of collection. The length criterion for jacks collected at Ice Harbor and Lower Granite dams, and Lyons Ferry FH was ≤ 61 cm fork length in 1992. Coded-wire tags or scale analysis has revealed that many of these salmon are adult fish (age 3+) of either sex.*

Table 1. Contribution of 1984-1992 fall chinook salmon returns to Lyons Ferry Fish Hatchery (FH) from Ice Harbor Dam, Kalama Falls FH, Lyons Ferry FH ladder, and from Lower Granite Dam (LGR). Values are compared to total counts at Ice Harbor Dam.

Year	Collection point	Number collected [a] adults	jacks	Ice Harbor Dam count adults	jacks
1984	Lyons Ferry FH	0	0	1,410	642
	Ice Harbor Dam	663	97		
	Kalama Falls FH	220	10		
1985	Lyons Ferry FH	6	4,070 [b]	2,046	7,119
	Ice Harbor Dam	589	90		
	Kalama Falls FH	952	0		
1986	Lyons Ferry FH	245	1,125	3,152	2,665
	Ice Harbor Dam	212	23		
	Kalama Falls FH	576	0 [c]		
1987	Lyons Ferry FH	1,654	543	6,812	1,619
	Ice Harbor Dam	1,613	47		
1988	Lyons Ferry FH	327	1,053	3,847	2,035
	Ice Harbor Dam	1,076	6		
1989	Lyons Ferry FH	704	670	4,638	1,352
	Ice Harbor Dam	1,179	0		
1990	Lyons Ferry FH	521	602	3,447	1,839
	Ice Harbor Dam	1,092	0		
	Lower Granite Dam	49	0		
1991	Lyons Ferry FH	863	675	4,500	1,526
	Ice Harbor Dam	361	71		
	Lower Granite Dam	37	0		
1992 [d]	Lyons Ferry FH	898	176	4,636	894
	Ice Harbor Dam	256	71		
	Lower Granite Dam	178	26		

[a] *Classification of adults and jacks is based on size (adults ≥ 62 cm fork length) at collection. Minijacks not included in this table.*

[b] *The first release from Lyons Ferry FH was in 1985 (1983 brood); first returns of hatchery-reared stock to Lyons Ferry FH were age 2 jacks in 1985.*

[c] *The last year adults returned to Kalama Falls FH was 1986.*

[d] *Broodstock accounted for at Lyons Ferry FH were 823 adults and 150 jacks (voluntary returns); 322 adults and 40 jacks from Ice Harbor, 156 adults and 48 jacks at LGR based on actual measurements with adults ≥ 62 cm (185 adults and 19 jacks with 56 cm minimum for adults) for a total of 1,311 adults and 228 jacks (An additional 5 jacks and one minijack were sacrificed at LGR).*

Table 2. Voluntary returns of fall chinook salmon to Lyons Ferry Fish Hatchery, duration of returns, and peak day of returns from 1986 through 1992 (estimated at time of collection).

Year	Number of returns: adults	Number of returns: jacks	Duration of returns	Peak return day: date	Peak return day: number
1986	245	1,125	5 Sep - 15 Nov	18 Sep	24
1987	1,645	543	13 Sep - 12 Dec	26 Sep	202
1988	327	1,053	9 Sep - 5 Dec	16 Sep	95
1989	704	670	6 Sep - 4 Dec	1 Oct	56
1990	521	602	5 Sep - 14 Nov	7 Nov	57
1991	863	675	13 Sep - 4 Dec	1 Oct	54
1992	898	176	14 Sep - 7 Dec	19 Oct	214

At Lyons Ferry FH 823 adults and 150 jacks were accounted for during spawning. We believe the discrepancy between estimated returns and the number of fish processed occurred primarily because some steelhead are misclassified as salmon, and jacks or adults are misclassified based on size during the automated sorting of voluntary returns. Also, small jacks may have escaped after being counted.

2.1.2: Ice Harbor Dam trapping

Since 1984, all salmon trapped at Ice Harbor Dam have been trucked to Lyons Ferry FH (Table 3). An average of 28.5% of adults counted at Ice Harbor Dam were taken for broodstock from 1984-1990. However, only adipose-clipped salmon were trapped in 1991 and 1992. A total of 256 adults and 71 jacks were trapped and hauled to Lyons Ferry FH, representing 5.9% of the total run of fall chinook salmon adults passing Ice Harbor Dam in 1992 (Table 1). Actual trap efficiency for the period of operation was 50.0% (Mendel et al. 1994). Fish were collected from the south shore fish ladder where 84.7% (4,686 of 5,530) of fall chinook salmon (adults and jacks) passing Ice Harbor Dam were counted in 1992.

2.1.3: Lower Granite Dam trapping

Adult collections NMFS personnel collected marked (coded-wire tagged) salmon adults at the trap in the south shore fish ladder at Lower Granite Dam. They trapped from 8 September to 4 December 1992. The trap was closed prior to 8 September because of high water temperatures. WDF honored a request by NMFS to transport all marked hatchery salmon captured at the adult trap at Lower Granite Dam to Lyons Ferry FH (Appendix C). This was an attempt to limit the number of known hatchery salmon that could spawn upstream of Lower Granite Dam. Collection of marked salmon also enabled us to: 1) monitor adult salmon composition at the

dam (only previously done in 1990 and 1991), 2) collect fish for a spawning program designed to remove marked stray salmon, and 3) supplement Lyons Ferry FH eggtake.

Captured salmon were given a numbered jaw tag and transported in a 1,200 L aerated non-refrigerated tank truck to Lyons Ferry FH. Lyons Ferry Hatchery personnel estimated 178 adults and 26 jacks were brought in from Lower Granite Dam by visual classification of the fish as they entered the hatchery ponds. Based on actual fish measurements at the dam, 156 adults and 48 jacks were hauled to the hatchery (using > 61 cm minimum fork length for adult salmon). However, if we use a 56 cm minimum for adults, we estimate that 185 adults (69 CWT and 116 blank-wire tagged - BWT) and 19 jacks (8 CWT and 11 BWT) were transported from Lower Granite as broodstock. Estimates of the number of adults and jacks hauled to Lyons Ferry are complicated because the fish counters at Lower Granite Dam use 55 cm <u>total</u> length, whereas WDF uses $\leq$ 61 cm fork length, to classify jacks. Five of the salmon brought into the hatchery with adipose clips and CWT were not accounted for from Lower Granite during processing at Lyons Ferry FH. These fish may have been accounted for with salmon from other sources (Ice Harbor or volùntary returns).

Sixty-nine coded-wire tagged (CWT) adults ($\geq$ 56 cm) and eight jacks were accounted for as broodstock in 1992, plus 5 marked jacks were sacrificed at the dam. These fish represent 94.2% of the marked salmon (87 adults and jacks) that are estimated to have passed the counting window during the fall chinook salmon passage period (18 August to 15 December; Mendel et al. 1994). Another 116 blank-wire tagged (BWT) adult and 11 BWT jack salmon were collected at the trap and transported to Lyons Ferry FH. These BWT fish are progeny (1989 brood) from Lyons Ferry Hatchery whose parents consisted of a high proportion of strays from the Umatilla River. One additional marked salmon (minijack <30 cm) was collected and held frozen at Lower Granite to obtain stay rate information (Appendix D, Table 2). Five additional fish with CWTs were not accounted for with salmon from Lower Granite at Lyons Ferry FH. These fish apparently got mixed with fish from other sources.

The 1992 CWT recovery data were used by Larrie LaVoy [3] to estimate run composition at Lower Granite Dam and escapement upstream into the Snake River spawning grounds (Blankenship et al. 1993). LaVoy used a slightly different separation of adults and jacks (187 and 22) than our estimate (185 adults and 24 jacks). He estimated total escapement past Lower Granite Dam to be 668 adults (855 counted - 187 collected) and 80 (102-22 collected) jack fall chinook salmon in 1992 (Blankenship et al. 1993). He also estimated 549 adults and 71 jacks of natural origin, 100 adults and three jacks of Lyons Ferry origin, and 19 adults and six jacks of other hatchery origin escaped past Lower Granite. By subtracting the number of marked (adipose clipped, CWT) adult salmon collected and hauled to Lyons Ferry FH from the number of adipose clipped fish that were observed passing the counting windows we estimate that seven marked adults escaped upstream. No marked jacks were estimated to have escaped upstream of Lower Granite Dam to spawn in 1992.

Table 3. Numbers of fall chinook salmon trapped at Ice Harbor Dam (estimated at time of collection) and hauled to Lyons Ferry Fish Hatchery, duration of trapping, and peak day of trapping from 1984 through 1992.

	Number trapped		Duration of	Peak trapping day	
Year	adults	jacks	trapping	date	number
1984	663	97	1 Sep - 5 Oct	11 Sep	57
1985	589	90	31 Aug - 30 Sep	9 Sep	68
1986	212	23	4 Sep - 3 Oct	18 Sep	24
1987	1,613	47	2 Sep - 11 Oct	26 Sep	97
1988	1,076	6	3 Sep - 11 Oct	15 Sep	67
1989	1,179	0	2 Sep - 11 Oct	26 Sep	78
1990	1,092	0	4 Sep - 6 Oct	12 Sep	100
1991	361	71	4 Sep - 31 Oct	12 Sep[a]	35
1992	256	71	31 Aug - 31 Oct	14 Sep[a]	30

[a] *Only adipose clipped salmon were collected for broodstock.*

[3] *Larrie LaVoy, WDF, Wenatchee, WA*

2.2: Stray Fish

Procedures In 1992, as in 1991, Lyons Ferry broodstock were collected at three locations: 1) Ice Harbor Dam (adipose-clipped salmon only) 2) Lower Granite Dam (wire-tagged salmon only) and 3) Lyons Ferry FH (marked and unmarked fish voluntarily returned). We have information on adult and jack stock composition at Lower Granite Dam from 1990-1992 samples (LaVoy 1994), and composition of jacks alone from 1985 to 1988 (Bugert et al. 1991). In 1992, six additional marked salmon (five jacks and one minijack) were collected and held frozen at Lower Granite Dam to prevent these marked hatchery fish from escaping and spawning naturally, and to obtain additional stray rate information.

Results Marked salmon from Lyons Ferry FH and Umatilla FH comprised the first and second most numerous stocks at all three collection locations (Tables 4, 5, 6). Expansions for each CWT code from Lyons Ferry FH were based on the number of all marked and unmarked fish released on approximately the same dates (Appendix D). This method accounts for fish from Lyons Ferry FH that were branded or were otherwise unmarked that may not be included with the experimental mark groups in the Pacific States Marine Fisheries Commission (PSMFC) database. All other CWT codes were expanded according to data available in the PSMFC database. Recovered fish with BWT (1989 brood Lyons Ferry origin) were added to the number of salmon from Lyons Ferry FH estimated from CWT expansions. Based on these CWT expansions most (70%) of the fall chinook salmon collected at Ice Harbor Dam were of Lyons Ferry origin in 1992. However, in 1990 and 1991 this stock comprised approximately 50% of the fish collected at Ice Harbor Dam (Mendel et al. 1992). Likewise, voluntary returns to Lyons Ferry FH in 1992 were comprised primarily (91.5%) of Lyons Ferry origin salmon. The percentage of returns to Lyons Ferry FH that are known Lyons Ferry origin salmon has increased each of the last three years. The percentage of salmon collected at Lower Granite Dam that are of Lyons Ferry origin increased to 83.1% in 1992 (74% in 1991 and 75% in 1990). That percentage changes to 91.4% when three fish that lost CWTs and five fish that could not be accounted for at Lyons Ferry FH are included (Blankenship et al. 1993). LaVoy (1994) estimates that approximately 87% of the salmon arriving at LGR were of Lyons Ferry origin in 1992. His estimate includes sample rate at the dam.

The CWT expansions for salmon from Lyons Ferry FH are slightly reduced for Ice Harbor and voluntary returns based solely on data reported to PSMFC (Appendix E). The most substantial decrease occurs at Lower Granite where the expanded contribution from Lyons Ferry is reduced from 133 fish (including all unmarked fish) to 98 fish using PSMFC data. Neither of these

methods accounts for sample rates. Sample rates can be applied to fish collected at the dams, but not to voluntary returns to Lyons Ferry FH.

Four of six fish killed at Lower Granite Dam for stray rate information originated from Lyons Ferry FH. The other salmon were either spring or summer chinook salmon from the Imnaha or Wenatchee rivers (Appendix D-Table 3).

All salmon released from Lyons Ferry FH have been marked with wire tags (CWT and adipose clipped, or BWT and unclipped), beginning with the 1989 brood. Marks provide fishery managers the capability to identify and potentially prevent these fish from entering the Snake River above Lower Granite Dam. We estimate that 127 salmon with BWT were recovered at Lower Granite in 1992. Another 61 salmon with BWT from the 1989 brood were collected as voluntary returns to Lyons Ferry FH. Expanded return, or run composition, estimates based on CWT alone for salmon of Lyons Ferry origin collected at the hatchery (voluntary returns), or at Lower Granite Dam, would be underestimated without accounting for salmon with BWTs.

Table 4. Stock composition (from CWT) of fall chinook salmon trapped at Ice Harbor and transported to Lyons Ferry FH, 1992.

Origin	Number of tags recovered	Expanded contribution [a]	Percent of expanded
Lyons Ferry	277	465	69.7
Umatilla	32	181	27.1
Bonneville	19	19	2.9
Other [b]	2	2	0.3
Lost [c]	3	--	--
Totals	333	667	100.0

[a] *Expansion based on mark rate.*

[b] *Two recoveries from Columbia River release, R-2, 7/50/34 and 7/50/36.*

[c] *Includes lost or unreadable CWT. An additional eight with no tags.*

Table 5. Stock composition (from CWT and BWT) of fall chinook salmon collected as voluntary returns to Lyons Ferry FH in 1992.

Origin	Number of tags recovered	Expanded contribution [a]	Percent of expanded
Lyons Ferry	437[b]	605[b]	91.5
Umatilla	10	51	7.7
Bonneville	2	2	0.3
Other [c]	1	3	0.5
Lost [d]	4	--	--
Totals	454	661	100.0

[a] *Expansion based on mark rate, BWTs are added to CWT expansions.*
[b] *This includes an estimate of an additional 61 salmon with BWT.*
[c] *One recovery from Santiam River spring release, 7/55/02 R3.*
[d] *Includes lost or unreadable CWT. An additional 12 with no tags.*

Table 6. Stock composition (from CWT and BWT) of fall chinook salmon trapped at Lower Granite Dam and trucked to Lyons Ferry FH in 1992 (includes five jacks and a minijack killed at the dam).

Origin	Number of tags recovered	Expanded contribution [a]	Percent of expanded
Lyons Ferry	186[b]	260[b]	83.1
Umatilla	11	27	8.6
Bonneville	2	2	0.6
Other [c]	3	24	7.7
Lost [d]	3	--	--
Totals	205	313	100.0

[a] *Expansion based on mark rate, BWTs added to CWT expansions.*
[b] *This includes 127 BWT salmon hauled from Lower Granite Dam.*
[c] *One recovery of Rogue R. spring chinook (7/37/58 - minijack), one Imnaha R. spring chinook (7/58/46), and one Wenatchee R. summer chinook (63/11/19).*
[d] *Includes lost or unreadable CWT.*

SECTION 3: ADULT RETURNS

We estimate that 3,228 fall chinook salmon of Lyons Ferry origin returned to the Snake River at Ice Harbor Dam by slightly modifying an estimate by LaVoy (WDF, unpublished data). Two hundred ninety-four of these fish were accounted for at Lower Granite Dam (LaVoy 1994). Another 544 salmon of Lyons Ferry origin are estimated to have arrived at Lyons Ferry FH (expanded values - Appendix D). We estimate that approximately 18 Lyons Ferry origin salmon spawned in the Tucannon River. Approximately 73.5% of the estimated 3,228 fish of Lyons Ferry origin are not accounted for at various points upstream of Ice Harbor Dam.

SECTION 4: HATCHERY OPERATIONS

4.1: Spawning and Eggtake

4.1.1: Spawning operations

All fish transported to the hatchery were commingled in a common pond at Lyons Ferry FH. Salmon voluntarily returning to the hatchery were held in a separate pond at Lyons Ferry FH. Fish collected at Lower Granite Dam were given a numbered jaw tag when trapped, enabling us to identify their origin and date of collection.

In 1992 we did not mark salmon voluntarily returning to Lyons Ferry FH with uniquely colored tags (electrical wire ties) around the caudal peduncle to designate the week of arrival at the hatchery, as we had in previous years. We have not found that stray rate differed substantially between weeks of collection (Bugert et al. 1991).

Ripe fish were killed and set aside during spawning operations. Marked fish had the CWT removed and read to determine the fish's origin prior to fertilization of the eggs. Fish were spawned together in three distinct groups: Lyons Ferry origin (CWT) fish, strays (CWT or BWT), and unmarked fish. Only known Lyons Ferry origin fish (excluding 1989 brood fish) were mated together, by single male/single female matings. Tagged (CWT) fish found to be strays were spawned with other strays, 1989 brood salmon from Lyons Ferry origin, or with fish of unknown origin. WDF had decided in 1990 not to use any 1989 brood fall chinook salmon as broodstock when they returned as adults because of the high proportion of strays comprising the parents. Fertilized eggs from known Lyons Ferry fish were incubated separately from those known to be progeny of stray or unmarked fish. Only progeny of Lyons Ferry origin (CWT) adults were retained for program use. Progeny of stray or unmarked broodstock were transported out of the Snake River Basin as "eyed" eggs.

Duration of 1992 fall chinook salmon spawning was from 20 October through 8 December (Table 7). Peak of spawning was on 21 November, when 601,348 eggs were taken. This peak date is consistent with previous years, and apparent peaks on the spawning grounds. The total egg take at Lyons Ferry FH (after "picking") was 2,265,557 (plus an estimated 9,000 eggs sent to Washington State University - WSU), with an initial mortality rate of about 6% (Table 8).

Table 7. Collection and spawning summary for 1992 fall chinook salmon broodstock at Lyons Ferry Salmon Hatchery.

Week ending	Arrivals [a] adult	jack	Mortality M	F	J	Spawned M [b]	F [c]	J [d]	Eggtake [e]
5 Sep	26	1							
12 Sep	36	1							
19 Sep	138	23							
26 Sep	168	19	1	2					
3 Oct	134	28							
10 Oct	124	26		1					
17 Oct	128	14		2	1				
24 Oct	227	63	3	7		1	7	36	29,539
31 Oct	77	30	1	7		28	67	51	257,909
7 Nov	96	27	4	8		34	120	22	469,316
14 Nov	78	20	4	2		71	160	26	561,985
21 Nov	52	18	7	2	2	136	180	24	601,348
28 Nov [f]	29	0	29	4	8	107	54	21	176,262
5 Dec	16	2	16		3	104	42	14	139,381
12 Dec	3	1	3	2		78	17	5	38,817
Totals [g]	1,332	273	68	37	14	559	647	199	2,274,557

[a] *Escapement is estimated during collection. Numbers include one trap mortality at Lyons Ferry FH and three salmon that died in transport from Lower Granite Dam to the hatchery.*

[b] *Includes at least fourteen males killed without being spawned ("surplused") during the spawning season, two on 9 November and 12 on 8 December (hatchery records do not show the 12 on 8 December). Most males were live spawned.*

[c] *Includes six females that were not ripe when killed; two females were not ripe on 17 November, two females were spawned out and two were not ripe on 8 December.*

[d] *Includes seven jacks spawned during the season; one on 20 October, one on 3 November, one on 17 November and four on 1 December. All other jacks were surplused.*

[e] *Corrected total eggtake after shocking was 2,274,557 eggs. This includes 9,000 eggs from stray salmon that were sent to Washington State University, as well as eggs from stray females used for cryogenics experiment at Lyons Ferry FH.*

[f] *Plus three unmarked jacks and one unmarked female that volunteered into the hatchery. These fish are not included in this table because they were inadvertently omitted from hatchery records.*

[g] *Actual number of salmon that were accounted for at Lyons Ferry FH was 1,311 adults and 213 jacks (according to hatchery records).*

Table 8. Duration and peak of spawning, eggtake, and percent egg mortality at Lyons Ferry Fish Hatchery since it began operation.

Year	Spawning duration	Peak of spawning	Eggtake	Percent egg loss
1984	8 Nov - 5 Dec	21 Nov	1,567,823	21.58
1985	2 nov - 14 Dec	7 Nov	1,414,342	3.99
1986	22 Oct - 17 Dec	19 Nov	592,061	3.98
1987	20 Oct - 14 Dec	17 Nov	5,957,976	3.82
1988	18 Oct - 6 Dec	12 Nov	2,926,748	3.41
1989	21 Oct - 16 Dec	11 Nov	3,518,107	5.75
1990	20 Oct - 8 Dec	6 Nov	3,512,571	8.28
1991	15 Oct - 10 Dec	12 Nov	2,994,676 [a]	8.30 [b]
1992	20 Oct - 8 Dec	21 Nov	2,265,557 [a]	5.96 [b]

[a] *Plus 9,000 eggs from stray females given to WSU.*

[b] *Combined loss from both known Lyons Ferry and other fish; known Lyons Ferry was 5.06%, and stray or unknown fish was 9.29%.*

4.1.2: Sperm cryopreservation evaluation

We conducted two sets of cryogenic experiments in 1992. One set of experiments was conducted at Lyons Ferry FH, while the other experiment was conducted at a laboratory at WSU.

Experiment One

We conducted cryopreservation experiments at Lyons Ferry FH in 1992 using gametes from stray fall chinook salmon as well as semen cryopreserved for one year from three Lyons Ferry FH origin salmon. Poor results from using cryopreserved semen in 1991 (Mendel et al. 1992) caused us to question the use of this technique for federally listed chinook salmon stocks. Our goals for the experiments in 1992 were to refine the techniques, confirm results obtained from WSU about short term freezing, and to determine if cryopreservation could be successfully used under routine hatchery operations (at acceptable fertilization rates for a production level hatchery operation).

On 17 November 1992 we conducted fertilization experiments using stray fall chinook salmon collected at Lyons Ferry FH and previously frozen semen from known Lyons Ferry origin fish. We wanted to compare fertilization rates using fresh (unfrozen) semen (control), with short term cryopreservation (semen frozen in liquid nitrogen less than one hour), and semen cryopreserved for long term (one year). This test would enable us to evaluate the effects of cryopreservation (short and long term) on

fertilization rates of fall chinook salmon. Another test was to evaluate effects on fertilization rates of two different quantities of semen per unit of eggs (1 ml vs 2 ml of semen). Additionally, we learned that personnel at WSU drain the ovarian fluid from the eggs before adding semen. Therefore, we wished to determine if fertilization rates obtained without ovarian fluid would be comparable with fertilization rates obtained under normal hatchery practices at Lyons Ferry FH (with ovarian fluid and incubated in large stacks of trays, etc.).

We attempted to keep the egg handling and incubation processes as similar as possible after fertilization as those used in routine hatchery operations at Lyons Ferry FH. Eggs from three stray females were pooled and divided into 15 lots (separate incubation tray per lot). Semen from four unmarked, unknown origin males were collected for the experiments from voluntary returns to the hatchery. Fertilization procedures included the use of semen from a primary male, with the addition of semen from a backup male 30 seconds later. This method of fertilizing eggs is a standard practice at Lyons Ferry FH.

Our experiment had six different study groups, and three replicates per group.

Test A: <u>With and without ovarian fluid</u>

Group 1. (Control) Fresh semen (1 ml per male) combined with eggs and ovarian fluid (standard practice at Lyons Ferry FH).

Group 2. Fresh semen, 1 ml per male, ovarian fluid drained from the eggs prior to fertilization.

Test B: <u>Comparison of cryopreserved vs fresh semen)</u>

Group 1. (Control) Fresh semen (1 ml per male) combined with eggs and ovarian fluid (standard practice at Lyons Ferry FH).

Group 3. Semen (1 ml semen per male) that had been cryopreserved for less than one hour, and partially thawed prior to combination with eggs and ovarian fluid. Same males used in each group.

Test C: Quantity of the semen used

Group 3. Semen (1 ml per male) cryopreserved for less than one hour and partially thawed prior to combination with eggs.

Group 4. Error; was to be similar to Group 3, except 2 ml of semen per male was to be used. Unfortunately, there was an error that left us short on straws of frozen semen to perform this test. Instead, we used 1 ml of semen for each male, and added the activator after semen from the first male was combined with the eggs (instead of after the semen from second male was added, as was the situation for the other cryopreserved groups). Note: no replicates in this group.

Group 5. Was similar to Group 3, except 2 ml of semen per male were used instead of 1 ml (same males as in Group 3 & 4).

Test D: Long term vs short term cryopreservation

Group 3. Semen (1 ml per male) that had been cryopreserved for less than one hour, and partially thawed prior to combination with eggs and ovarian fluid.

Group 6. Semen (1 ml per male) cryopreserved and stored for 1 year (from known Lyons Ferry origin salmon), and thawed prior to combination with eggs and ovarian fluid. Note: different males used in this group than all other groups.

Procedures: Eggs from three females were mixed together and then separated into 15 lots of approximately 600 eggs each. Ovarian fluid was drained from three lots.

General cryopreservation procedures were as described in Mendel et al. 1992 (Appendix C). Motility was tested with fresh semen from each male. The fresh semen was kept cool while the cryogenically preserved semen was freezing (less than one hr).

We kept the semen, cryogenic extender, and activator cool. We put 3 ml of extender into each of the first six test tubes, then added 1 ml of semen to each. We froze six straws of semen from the first male on dry ice, then placed them in liquid nitrogen. This process was repeated for each successive male. Each straw was frozen for 15-50 minutes.

Semen from the primary male was added to the eggs; then 30 seconds later we added semen from the secondary male. The eggs and semen were stirred by hand after each semen addition. We added 50 ml of activator (enough to cover the eggs) immediately after semen from the second male was added to the eggs. The rest

of the egg handling procedures were the same as used by the hatchery (i.e. drained the egg lots, placed eggs in iodophor solution of 1:100 concentration for water hardening for one hr), and then placed in 15 tray incubator stacks).

We encountered a few problems with our experiments that did not enable us to follow our initial study design. About two minutes after the activator was added to lot number 7 (Group 5), one straw of frozen semen from male number two was added in error. Only semen from male numbers 1 and 4 were to be used with this egg lot in Group 3. The semen that was added in error probably did not contribute to fertilization of eggs because of the amount of elapsed time after the initial semen was added to the eggs (Gary Thorgaard, WSU, personal communication). Because semen from male number 2 was used in error, there were not enough straws of frozen semen from this male to perform three replicates for Group 5. Instead, only two replicates were completed for Group 5. The experiment was modified to use the one remaining straw from male number 2. We decided to add activator after semen from the primary male was combined with the eggs in Group 4 instead of adding activator after semen from the second male was combined with eggs (as in other study groups with cryopreserved semen). This enabled us to make a cursory comparison of the fertilization rates for lots 8 and 10 regarding the effects of timing of the addition of activator.

Results: Eggs and mortalities associated with all tests were enumerated at the "eyed" stage on 16 December. No difference was observed in fertilization rates using fresh semen for eggs with or without ovarian fluid (Table 9.). Mean fertilization rate for the control group with ovarian fluid was 98.6% (sd 1.16, n=3), while the rate without ovarian fluid was 98.9% (sd 0.06, n=3).

All semen that was cryopreserved produced low fertilization rates. The semen frozen for less than one hour had an average fertilization rate of 20.3% (Group 3) when using 1 ml per male, compared to the 98.6% mean rate for the controls (Group 1), and the 33.9% fertilization rate when using 2 ml of semen per male (Group 5). The addition of activator after the primary male (unlike the other groups of cryopreserved semen) produced a 27.7% fertilization rate (Group 4). However, as there were no replicates associated with this treatment, results regarding timing of the addition of activator should be used with caution.

Table 9. Results of fertilization tests performed at Lyons Ferry FH, 17 November 1992. [Note: Eggs from three stray female fall chinook were pooled, then divided into 15 lots. Semen from four stray males collected in 1992, and semen cryopreserved in 1991 from three known Lyons Ferry males were used. All egg lots were fertilized with ovarian fluid with the eggs, except Group 2.]

Group	Lot number	Primary male number	Secondary male Number	Live eggs	Total eggs	Percent fertilization	Relative fert. (%) [a]
Control							
Group 1	1	1	4	859	862	99.7	--
(fresh semen,	2	2	1	748	768	97.4	--
1 ml/male)	3	3	2	761	770	98.8	--
					mean	98.6	
					sd	1.16	
Treatments							
Group 2	4	1	4	737	745	98.9	--
(fresh semen,	5	2	1	799	809	98.8	--
1 ml/male,	6	3	2	837	846	98.9	--
eggs without					mean	98.9	
ovarian fluid)					sd	0.06	
Group 3	7 [b]	1	4	126	812	15.5	15.5
(frozen	8	2	1	89	855	10.4	10.7
<1 hr,	9	3	2	278	791	35.1	35.5
1 ml/male)					mean	20.3	20.6
					sd	13.04	13.15
Group 4 [b]	10	2	1	213	770	27.7	28.4
(see Group 3)							
Group 5	11	1	4	159	816	19.5	19.6
(frozen	12	3	2	419	868	48.3	48.0
< 1 hr,					mean	33.9	34.3
2 ml/male)					sd	20.36	20.72
Group 6	13	203	627	188	778	24.2	--
(frozen 1 yr,	14	836	203	166	724	22.9	--
1 ml/male	15	627	836	329	832	39.5	--
					mean	28.9	
					sd	9.23	

[a] *Fertilization rate relative to the results using fresh semen for the same males with egg lots in Group 1.*

[b] *An additional straw of semen from male 2 was added in error about two minutes after initial addition of semen (from both males) and activator.*

[c] *We used only one straw of semen (1 ml) per male. We were short of straws of cryopreserved semen because of the error in [b].*

Semen that had been stored for one year (from different males than used in the above tests) produced a mean fertilization rate of 28.9% (Group 6). This mean fertilization rate is not substantially different from that obtained from short term freezing (Group 3). However, it is well below mean fertilization rates obtained with fresh semen from different males (Group 1).

Currently, cryopreservation of semen does not produce adequate fertilization rates to incorporate this procedure into standard hatchery practices at Lyons Ferry FH. We are concerned using this technique to improve genetic mixing or gene banking will reduce production of threatened chinook salmon, unless fertilization rates are substantially improved. We have not determined if the low fertilization rates we observed for cryopreserved semen are associated with our semen freezing and thawing procedures, or whether a difference occurs based on personnel applying the technique. We will continue to experiment with this procedure in 1993 in an effort to improve our techniques and fertilization rates.

Experiment Two

On 9 December 1992, a fertilization experiment was performed at WSU by our staff to determine the quality of stored semen that we froze in liquid nitrogen last year. This test was to determine if fertilization rates varied between lots of frozen semen because of possible differences in techniques or personnel, and to evaluate the quality of semen from several males in our cryopreservation inventory.

Eggs from two stray female fall chinook salmon were collected at Lyons Ferry FH on 8 December and used in this experiment. Eggs from each female were kept separate in sealed, oxygenated plastic bags. Eggs were transported to our office and stored overnight in a refrigerator. One group of eggs contained a substantial amount of blood in the ovarian fluid that pooled in the bottom of the bag overnight; we used these eggs in the experiment. The eggs were transported to WSU in coolers the next day. Eggs were mixed together and distributed evenly over 18 containers. We attempted to maintain similar ovarian fluid quantities in each container.

Cryopreserved semen from two Tucannon River spring chinook and seven Lyons Ferry fall chinook salmon were evaluated. Semen from each male was tested with two lots (containers) of eggs. One straw of semen was used for each egg lot. No semen from back-up males were used.

After six lots of eggs were individually fertilized, each was drained of ovarian fluid and placed in a separate incubation tray. Three incubation trays totaling 18 egg lots were used in this experiment. Eggs were water hardened in a 1:100 iodophor

solution for 1 hr, as is standard practice at Lyons Ferry FH. The incubation trays were submerged in the iodine solution for this experiment, but the iodine was not circulated over the eggs as it is at Lyons Ferry. Eggs were fixed (as per instructions from Paul Wheeler and Gary Thorgaard, WSU) with "Stockard's solution" after 14 days so fertilized and unfertilized eggs could be enumerated.

Problems: The cryogenic activator added to semen and two egg lots of the test group was mixed 10 times too strong. The recipe yielding 1 liter of activator was used, although only enough distilled water was added to yield 100 ml. The activator turned viscous when added to the eggs. Therefore, the initial two lots with semen from Tucannon River spring chinook male # 10 were discarded along with approximately 1,000 eggs. Eighteen egg lots remained for use in the tests.

Results: Fertilization rates were low for all stored cryopreserved semen tested from spring and fall chinook salmon (Table 10). Mean fertilization rates of cryopreserved semen were 1.9%, 1.8%, 4.2%, 14.0% and 13.2 for 18 September, 6 November, 20 November, 27 November, and 3 December, respectively. Of those fish evaluated, fertilization rates averaged 1.9% for spring chinook salmon (n=4, sd=2.16) and 8.9% for known Lyons Ferry fall chinook (n=14, sd=6.3). It is interesting to note that semen from males 203, 627 and 836 were used in both Experiment One (at Lyons Ferry FH) and Two (at WSU). The experiment at WSU tested fertilization rates from individual males (Table 10) whereas the Lyons Ferry experiment included backup males for fertilization according to hatchery protocol (Table 9). No conclusions can be made concerning the benefit of backup males for increased fertilization rates because egg sources differed and the experiments were conducted at different times and locations.

After the experiments were completed we met with WSU staff to discuss our results and expectations for cryopreserved semen. We were hoping to attain average fertilization rates of about 75% for use in hatchery operations. Gary Thorgaard and Paul Wheeler (WSU) suggested the results from our experiments at Lyons Ferry FH were encouraging. They felt that consistent results of 50% fertilization should be attainable, but 75% is probably not realistic. They see cryopreservation as being useful in gene banking, where 20% fertilization may retain genetic variability of an endangered species. However, we are concerned about reducing the number of viable fertilized eggs and subsequent loss of adult salmon production from a threatened species.

Table 10. Results of a fertilization experiment performed at WSU, 9 December 1992. [Note: Eggs from two stray female fall chinook salmon from Lyons Ferry FH were pooled, then divided into 18 lots. We used semen preserved in 1991 from two Tucannon River wild spring chinook and 7 known Lyons Ferry origin fall chinook salmon. One straw from each male was used in each lot (1 ml semen per straw) for single pair matings. Egg lots contained ovarian fluid when fertilization occurred. Activator was added immediately after semen was added to the eggs. Eggs were fixed on 23 December 1992 to determine fertilization rates.]

Date frozen (1991)	Egg lot number	Male number	Live eggs	Total eggs	Percent fertilization
Spring Chinook					
18 Sept.	1	9	9	332	2.7
	2	9	14	307	4.6
	3	5	1	367	0.3
	4	5	0	370	0.0
				mean	1.9
				sd	2.16
Fall Chinook					
6 Nov.	5	203	8	326	2.5
	6	203	15	408	3.7
	7	153	1	317	0.3
	8	153	2	364	0.5
				mean	1.8
				sd	1.64
20 Nov.	9	461	17	355	4.8
	10	461	13	367	3.5
				mean	4.2
				sd	0.92
27 Nov.	11	627	47	376	12.5
	12	627	64	373	17.2
	13	619	50	363	13.8
	14	619	43	340	12.6
				mean	14.0
				sd	2.20
3 Dec.	15	836	32	312	10.3
	16	836	30	362	8.3
	17	823	68	366	18.6
	18	823	52	335	15.5
				mean	13.2
				sd	4.72

A preliminary review of the literature and contact with other researchers has provided little information concerning the use of cryopreserved semen from chinook salmon. Dr. Joseph Cloud at the University of Idaho has done research primarily with sockeye salmon and trout and he has obtained higher (about 50%) fertilization rates using cryopreserved semen in smaller (1 ml) straws (personal communication).

4.1.3: Egg transfer

Under authority of an interagency and tribal agreement, Lyons Ferry FH staff transported progeny of stray and unmarked adults to Klickitat FH (1,236,653 eyed eggs) for release there. Another 9,000 eggs were sent to WSU for a cryogenics experiment (Section 4.1.2).

4.2: Incubation and Rearing

1992 brood

The total corrected 1992 brood eggtake was 2,274,557 eggs, of which 1,373,326 were from stray or unknown origin fall chinook parents and 901,232 eggs were known Lyons Ferry FH origin broodstock. Egg loss was 127,672 from the stray and unknown origin fish and 45,655 eggs from known Lyons Ferry FH origin. A substantial portion (54.8%) of the eggtake was shipped off station to either WSU or Klickitat Hatchery because they were from parents of stray or unknown origin. Lyons Ferry FH retained all eyed eggs (855,577) of known Lyons Ferry origin broodstock (verified through CWT). Fry loss prior to ponding was 20,406. Total fry ponded equalled 835,171 (738 lbs). At the end of March 1993 the 1992 brood consisted of 827,206 fry weighing 6,191 lbs.

1991 brood

Cumulative loss after ponding the 1991 brood was 46,717 fish at Lyons Ferry FH. On 31 March 1993, the 1991 brood consisted of 760,968 fish weighing 57,401 lbs. Average food conversion rate was 1.3. All fish were adipose clipped and marked with CWT. Approximately half this brood was marked with externally visible red elastomer (VT) in the clear skin behind the left eye in September and October 1992 (Appendix F). Approximately one half were released on-station and the other half were barged below Ice Harbor Dam and released in April 1993.

4.3: Disease Incidence and Prophylaxis

The 1992 broodstock were given flush treatments of Formalin 1:7,000) as prophylaxis for fungus (Saprolegnia sp.). Females were injected once with Erythromycin 200 (20 mg/kg of fish) to reduce infection levels of Renibacterium salmoninarum (causative agent of Bacterial Kidney Disease, BKD). Eggs (1992 brood) were segregated based on the incidence of BKD in the parents (using ELISA techniques), but ELISA values were rated as low (3.6%) or none (96.4%). Generally this brood has had no fish health problems during the report period.

The 1991 brood salmon were given 21 day Gallimycin feedings at 2% of body weight/day during March-April and October-November 1992 to control BKD. A gut parasite, Hexamita sp., was detected in smaller fish in May. Several ponds required treatment with 3% Epsom salts in the feed for 4-7 days. Treatment was not effective so feeding rate was increased in June from 1.1-1.4% body weight per day to 3% body weight per day for one week, then 2% per day for the second week. Loss was slightly elevated through August due to "pinhead/dropout syndrome". No other disease treatments were administered.

4.4: Smolt Releases

The fall chinook salmon production goal for Lyons Ferry FH is to rear 800,000 yearlings for a mid-April release at 10 fish/pound (80,000 lbs), with roughly half the fish to be transported downstream of Ice Harbor Dam, and half to be released directly from the hatchery. If more eggs are available, they are to be released as subyearlings in early June, either on-station or transported by barge. The subyearlings are transported if Snake River flows and available spill are low. This strategy places the fish in the highest survival potential (Bugert et al. 1991). However, this strategy may be modified in the future to accommodate outplanting fall chinook smolts upstream of Lower Granite Dam.

We marked (adipose clip and CWT, plus red external tag) nearly half the 1991 brood prior to release to identify salmon known to originate from Lyons Ferry FH upon their return as adults, (see Appendix F). These marks will enable us to externally identify some of these fish upon return. In recent years, the practice of externally marking fish prior to release from Lyons Ferry FH has advanced from the use of BWT to colored elastomer placed in clear tissue behind the left eye. We plan to continue with this type of mark in 1993 for a 1994 release, but we hope to use different color elastomers to indicate the location of release. The rationale for use of this external mark

is to enable us to determine migration timing and relative survivals of juveniles at mainstem dams, as well as identify the origin of returning adults quickly and accurately in the future.

The 1990 brood yearlings were released in April 1992. On 15 April 243,692 fish were released directly from Lyons Ferry FH into the Snake River. Another 325,579 fish were barged below Ice Harbor Dam on 17 April and released. Approximately half of these fish contained a red filament VT behind the left eye, and the remaining fish contained a BWT in the left cheek. Hatchery records indicate the average size of these fish as 8-9 fish per pound (fish/lb) and 164.1 mm fork length (sd=20.26, CV= 9.14) based on measurements from one pond. Mean condition factor was 1.12. However, we also collected size information from both ponds of direct releases from Lyons Ferry FH and from three ponds of salmon to be barged in 1992. Mean fork lengths of direct released fish were not significantly different between ponds ($t=1.7$, $p>0.05$, $n=261$ fish). Additionally, mean lengths did not differ significantly between the three sampled ponds for barge release ($t<1.2$, $p>0.05$, $n=211$). Therefore, lengths were pooled by release type. Mean fork length for direct release fish ($x=171$mm, sd=17.5, $n=263$, CV=11.0) was significantly larger than fish transported and released by barge (Figure 2 and 3; $x=163.4$mm, sd=19.1, $n=313$, CV=11.7; $t=3.6$, $n=574$, $p<0.001$). Results of comparisons of mean weights were similar to those of mean lengths. We detected no significant difference between mean weights of fish from different ponds, by release type. Pooled mean weights were 58.6g (sd=16.1, $n=150$, CV=27.5) for direct release fish, which was significantly heavier than the 49.7g for barged fish (sd=17.5, $n=133$, CV=35.2; $t=4.55$, $n=282$, $p<0.001$). Condition factors were similar (1.115 and 1.123), but fish per pound estimates were higher for barged fish (9.3) compared to direct released fish (7.9).

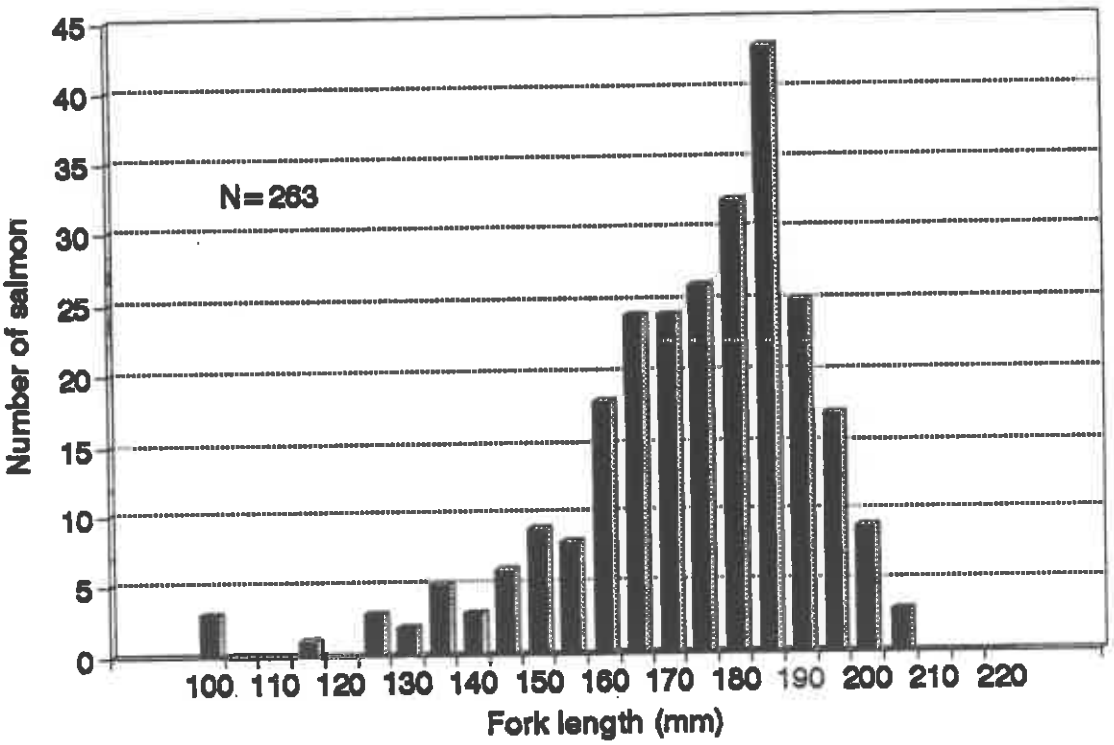

Figure 2. Length frequency distribution of yearling fall chinook salmon (1990 brood year) released at Lyons Ferry FH on 15 April 1992.

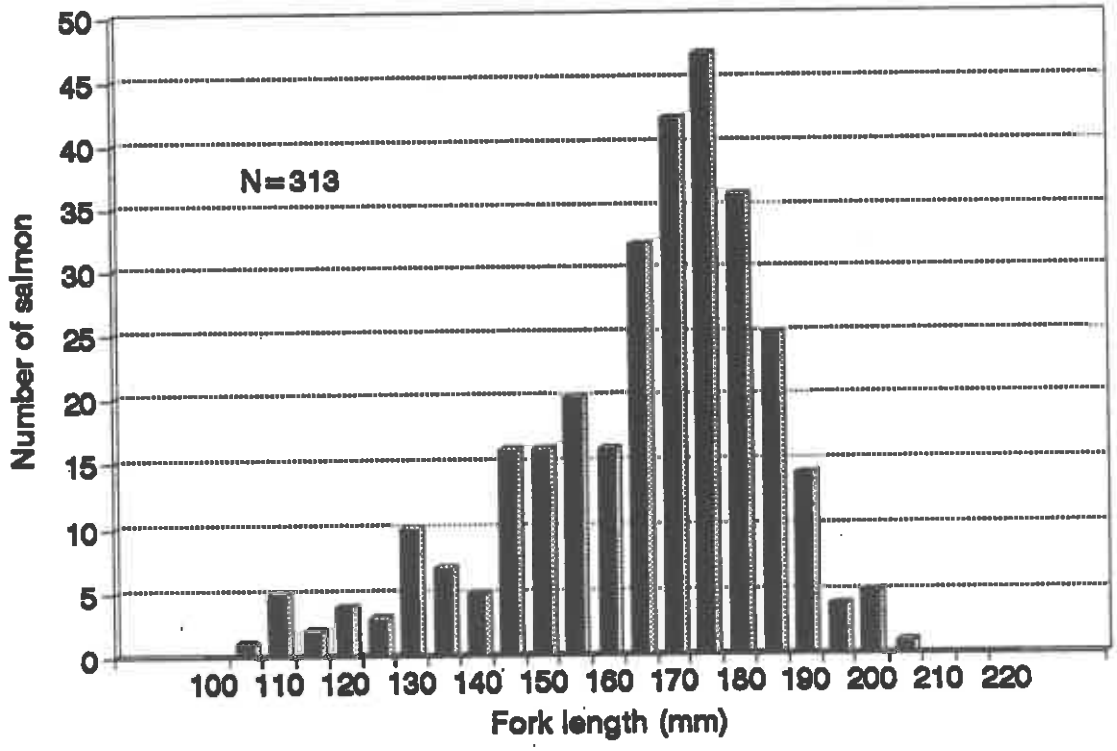

Figure 3. Length frequency distribution of yearling fall chinook salmon (1990 brood year) transported by barge and released downstream of Ice Harbor Dam on 17 April 1992.

The 1991 brood eggtake was 3,003,879, of which 828,514 eyed-eggs were determined to be Snake River stock, and therefore retained. Of these retained fish, 760,018 fish were released as yearlings in 1993; 414,997 fish were released at the hatchery on 12 April, and 345,021 were released below Ice Harbor Dam on 19 April 1993. All released fish were marked (adipose clipped and CWT). Approximately 31.6% of the barged fish, and 45.7% of the on-station released fish were VT tagged with red elastomer behind the left eye (see Appendix F for a list of releases from Lyons Ferry FH).

SECTION 5: NATURAL PRODUCTION

5.1: Streams Above Lower Granite Dam

In October, November and December 1992, WDF, U.S. Fish and Wildlife Service (USFWS), Idaho Power Company (IPC), Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), and the U.S. Forest Service (Wallowa Whitman) jointly conducted fall chinook salmon spawning surveys on the Snake River and its tributaries above Lower Granite Dam. Streams were surveyed with a Hiller 12E helicopter.

5.1.1: Spawning surveys

In 1992 the mainstem Snake River was surveyed for salmon redds on 13 and 23 November, and again on 12 December. These index flights were conducted on approximately the same dates as survey flights in 1990 and 1991. Spawning index flights of the Snake River were scheduled to include that segment of the Snake River between Asotin (RK 235) and Hells Canyon Dam (RK 397.4). A total of 39 redds were observed in the Snake River during these index flights and verified from the "ground" (Table 11). One other redd, with a fish present, was counted from the air, but not located during ground truthing. Results of index counts are similar to those in 1990 and 1991, but less than during other years (Table 12).

Conditions were fair to good during spawning survey flights in 1992. Discharge below Hells Canyon Dam was relatively stable at about 9,130 cfs (Table 13). IPC took turbidity measurements (in ntu) at several locations along the river during flight dates (Groves 1993), but during index flights visibilities ranged from 7-13 ft (secchi disk measurement).

Table 11. Date, river kilometer (RK), and number of new fall chinook salmon redds (adults) observed during spawning index survey flights of the Snake River in 1992.

RK	Proximal landmark	13 November	23 November	12 December
245.2	Big Bench Point	1 (1)	6	-
257.1	Lower Buffalo Range	2 (3)	1	-
258.9	Below upper Buffalo	1[a] (1)		
259.0	Upper Buffalo Rapids	6	1	-
261.3	Captain John Creek	5 (4)	4	-
266.6	Upper Billy Creek	-	1	-
284.4	WA/OR State line			
307.3	Eureka Bar	-	-	1
311.7	Above Divide Creek	5	1	-
319.9	Above Robinson Gulch	-	3	-
332.1	Below High Range	1 (1)	1	-
	Totals	21	18	1

[a] *This redd would have been counted from the air, but it was not verified from the ground.*

Table 12. Numbers of fall chinook salmon redds and adults seen during index surveys in the mainstem Snake River from 1986 to 1992, with a comparison of visibility and discharge during the surveys.

Year	Number of surveys	Number of redds	Number of adults	Visibility (feet)	Discharge (kcfs)
1986	1	7[a]	0	- -	- -
1987	2	66	13	9-10[b]	13.8-15.8
1988	2	57	19	9-10	11.6-15.6
1989	2	58	27	- -	9.1-11.7
1990	3	37	17	8-11	9.0-10.8
1991	3	32	9	- -	9.6- 9.6
1992	3	40	10	7-13	9.1- 9.2

[a] *Flows from Hells Canyon Dam were not lowered for the 1986 survey, which hindered visibility.*

[b] *Visibility readings (measured with a Secchi disk) are taken downstream of the Grande Ronde River; data were not collected in 1986, 1989, 1991. The 1992 data are from Groves (1993).*

Table 13. Snake River discharge during the period of fall chinook salmon spawning ground surveys, 1992 (Phil Groves, Idaho Power Company, personal communication).

Survey date	Discharge (cfs) mean	maximum	minimum
16 Oct	10,111	10,460	10,010
23 Oct	9,882	10,120	9,026
30 Oct	9,230	9,347	9,132
5 Nov	9,132	9,132	9,132
13 Nov	9,132	9,132	9,132
23 Nov	9,132	9,132	9,132
4 Dec	9,132	9,132	9,132
12 Dec	9,186	9,239	9,132

Additionally, aerial spawning surveys were conducted on the Snake River weekly from 16 October to 12 December. No redds or fish were observed during the 16, 23, or 30 October flights. Flights on 16 and 30 October covered the Snake River from Asotin to Pittsburg Landing (RK 347), and Asotin to Cochran Islands (RK 288), respectively. All other flights included the entire river from Asotin to Hells Canyon Dam (Appendix G). Five redds and five live fish were observed during the 5 November flight; but these redds were also observed during the 13 November index flight. A total of 46 individual redds and 16 fish were observed during all weekly flights. Spawning was initiated by 5 November, but not before 30 October. The last new redd was located on 12 December. The peak of spawning apparently occurred between 13-23 November.

Some disparity between aerial redd counts and "ground" verification occurred. One redd that would have been counted from the air on 5 November, and again on 13 November (RK 258.9), was not verified from the ground. On 4 December six possible new redds and one live salmon were counted during the flight (two redds at RK 266.6, two at RK 344.0, one at RK 349.6, and one redd at RK 352.9). All these redds were later confirmed from water surface checks from a boat. However, none of these redds (RK 344.4) would have been counted during the helicopter survey without ground verification. A total of 46 redds were counted from the air. Another two redds were observed near Captain John Creek by IPC personnel in a boat after the last flight (Phil Groves, IPC). Many other redds or test digs that had been listed as questionable from the air were believed to be caused by boats (jet or propeller wash and boat groundings) when inspected from a boat. These potential redds were not counted if they were questionable from the air and not confirmed from the ground.

Thirty-five redds were observed in tributaries of the Snake River in 1992 (Table 14). These redds were distributed among the Clearwater, Grande Ronde, Salmon and Imnaha rivers.

The Clearwater River was surveyed by the Nez Perce Tribe from its mouth to Greer (RK 85) on 20 November and again on 3 December. Water was low and visibility was relatively good. Twenty-four redds were seen during the 20 November aerial survey and another two redds during the 12 December 1992 survey[4]. Six different carcasses and no live salmon were seen during each flight. Four redds were observed each year during spawning surveys in 1990 and 1991.

The Salmon River and Clearwater rivers were surveyed by the Nez Perce Tribe on the same dates. Surveys were conducted from Riggins to the mouth of the Salmon River. One redd was observed a short distance upstream of Cottonwood Creek (RK 17) on 3 December. No live or dead salmon were observed, but a radio tagged fall chinook salmon was detected below a rapids in the lower Salmon River (RK 4.8).

The Grande Ronde River was surveyed with a helicopter several times in 1992. The NPT requested that we extend our flight on 16 October to include the area from the town of Wallowa downstream to the mouth of the Grande Ronde in an attempt to confirm the presence of a group of early spawning salmon. We surveyed the Wallowa River downstream of the town of Wallowa, the Minam River downstream of the confluence with the Wallowa River, and the Grande Ronde River downstream to Cottonwood Creek (RK 46.2). Shortage of fuel and time prevented us from surveying the Grande Ronde River to its mouth. Visibility was excellent for aerial survey. However, no salmon or redds were observed. A total of five redds and six live salmon were observed during all flights in 1992 (Table 14). Few fall chinook salmon redds have been observed in the Grande Ronde River in recent years. No redds or salmon were observed in the Grande Ronde River in 1991. One redd was observed in 1990, none in 1989, one in 1988, seven in 1987, and none in 1986.

The Imnaha River was surveyed six times in 1992 (Appendix G). Flights extended upriver in 1992 to Fence, Horse or Cow creeks. Three redds, and one possible redd, were observed in the lower 0.5 km on 5 November. A radio tagged salmon was detected there as well. Ground checks by USFWS and WDF personnel verified three redds and a possible redd. Four redds were observed in the Imnaha River in 1991.

[4] *Bill Arnsberg, Nez Perce Tribe, Lapwai, ID.*

Asotin Creek and Alpowa creeks were not surveyed in 1992. We have not documented use of these streams in the past (Mendel et al. 1992).

Table 14. Numbers of new redds observed, and their approximate location (RK), from fall chinook salmon spawning survey flights of the Imnaha, Grande Ronde, Salmon and Clearwater Rivers, 1992.[a]

River (RK)	Landmark	Observation Dates[b] 23 Oct.	30 Oct.	5 Nov.	20 Nov.	3 Dec.
Imnaha						
(<1)	none	0	-	3	-	-
Grande Ronde						
(5)	Horse Ranch	0	1	0	-	-
(7)	Joseph Creek	1	0	1	-	-
(50)	McNeil Island	1	0	0	-	-
(30)	Upper Shumaker	0	0	1	-	-
Salmon						
(17)	Above Cottonwood Creek	-	-	-	0	1
Clearwater						
(15)	Hog Island	-	-	-	0	1
(30)	Below Deadmans Eddy	-	-	-	1	0
(31)	Above Deadmans Eddy	-	-	-	1	0
(36)	Fir Island	-	-	-	21	0
(65)	Dworshak Hatchery	-	-	-	1	0
(85)	Greer	-	-	-	0	1

[a] *Appendix G provides the dates and flight paths of aerial surveys.*

[b] *The Salmon and Clearwater Rivers were surveyed on 3 December while the Snake, Grande Ronde, and Imnaha rivers were surveyed on 4 December.*

Discussion The 1992 count of fall chinook salmon at Lower Granite Dam (18 August to 15 December) was 855 adults, 102 jacks, and 41 mini-jacks (< 30 cm; USACE, 1993). The adult count is higher than in 1991, and higher than the 1987 to 1991 average of 661 adults (951 in 1987, 627 in 1988, 706 in 1989, 391 in 1990, and 630 in 1991). Mark rate (adipose clipped) was 8.9% of the adults counted (Mendel et al. 1994). NMFS personnel trapped 185 marked (CWT or BWT) adults and 24 jacks (19 live and five jacks

and one minijack sacrificed) at Lower Granite Dam for WDF broodstock and stray rate monitoring needs. LaVoy, WDF, modified this estimate to 187 adults and 22 jacks because of slight difference in classification of adults and jacks. Therefore, LaVoy's adjusted total spawning escapement above Lower Granite Dam was 668 adult and 80 jack fall chinook salmon (855-187 adults, and 102-22 jacks - Blankenship et al. 1993). Composition of the salmon escapement upstream of Lower Granite Dam is estimated to be 549 natural origin and 119 hatchery origin adults, and 71 natural origin jacks and nine hatchery jacks (LaVoy 1994).

The total redds counted on the Snake River above Lower Granite Dam during index counts in 1992 was 40, resulting in a ratio of about 16.7 adults per observed redd in the Snake River above Lower Granite Dam (668 adults/40 redds). However, a total of 83 redds were accounted for upstream of Lower Granite Dam in the Snake River and tributaries, therefore, the adult-per-redd ratio would be 8.05 (668/83). By accounting for fall back and fish "lost" in the reservoir the adult-per-redd ratio is reduced to 4.7 (Mendel et al. 1993a). The adult-per-redd ratio in 1991 (revision of Mendel et al. 1992) was 12.8 (590 adults/46 redds). Prior ratios were 7.4 in 1990, 10.2 in 1989, and 7.8 in 1988. However, surveys conducted in 1989 and 1988 consisted of only one flight each year.

5.1.2: Carcass recovery

Personnel from WDF, assisted by the USFWS, IPC and NPT, recovered 44 fall chinook salmon carcasses from the upper Snake River Basin (upstream of Lower Granite Dam) in 1992 (Blankenship et al. 1993). Eleven of these carcasses were recovered from the Clearwater River, with an additional nine carcasses recovered at Dworshak Hatchery, on the Clearwater River. A total of 19 carcasses were recovered from the Snake River. Eleven carcasses were recovered from the Big Bench Point (RK 245.2) portion of the Snake River. The most upstream carcass was recovered from below High Range (RK 331.7). Three carcasses were recovered from the Grande Ronde River, and two other carcasses were recovered from the lower Imnaha River.

Five of the carcasses were yearling migrants based on scale patterns. Electrophoresis was used to determine the genetic origin of 42 of these fish. Twelve salmon have a high probability of Columbia River origin (Blankenship et al. 1993).

5.2: Below Lower Granite Dam

The Tucannon River was surveyed on foot about once a week from 29 October to 9 December 1992. Surveys were from the mouth of the river upstream to Highway 12 (RK 22.2), or Enrich Bridge (RK 28.0), during most weeks. Several surveys included the river from Marengo (RK 39.9) downstream to Highway 12. Survey conditions were fair to good during all survey dates.

Twenty-three redds and 35 live salmon were observed in the Tucannon River in 1992 (Table 15). Two redds, one live salmon and one carcass were located upstream of Fletcher's Dam (RK 9.2), upstream of Starbuck, in 1992. These are the first fall chinook salmon observed upstream of the dam, which has been documented as a passage impediment for the past five years (Mendel et al. 1992). The dam was modified in 1992 with the addition of two downstream weirs, a notch to concentrate flows, and an improved fish ladder, by WDF and Bonneville Power Administration (BPA), to improve salmon passage. Spawning ground density was 3.8 redds/mile (2.4 redds/km) downstream of Fletcher's Dam in 1992, compared with 8.8 redds/mile (5.5 redds/km) in 1991, 6.6 in 1990, 5.2 in 1989, 2.8 in 1988, 1.7 in 1987 (Mendel et al. 1992, Bugert et al. 1991).

We found 15 carcasses (6 female, 5 male, 1 jack, and 3 unknown) in the lower Tucannon River. Two marked (CWT) carcasses were found and both were from Lyons Ferry FH (63-02-32, 63-02-37, yearling releases). Several radio tagged salmon were located in the Tucannon River, but none were recovered in the river.

We surveyed the Palouse River from slackwater to Palouse Falls on 16 November. One redd and two salmon were observed. Survey conditions were poor (visibility of 0.5 m) because of turbid water, but better than past years. No redds or adults were observed here in 1991. One redd and three adults were seen here in 1990, and two redds and four adults in 1989.

Table 15. Date, location surveyed, and numbers of redds and carcasses seen during Tucannon River fall chinook salmon spawning surveys in 1992.

Survey date	River kilometer[a]	New redds	Carcasses recovered[c] Females	Males	Jacks
29 Oct	22.2 - 9.6	0			
	9.6 - 0.0	1			
4 Nov	22.2 - 9.6	0		1w	
	9.6 - 0.0	1	1h		
10 Nov	39.9 - 22.2	1			
	22.2 - 9.6	1		1w	
	9.6 - 0.0	3			
18 Nov	39.9 - 22.2[b]	0			
	22.2 - 9.6	0			
	9.6 - 0.0	8	2w	1w	
23 Nov	9.6 - 0.0	5	1w	1w	1w
30 Nov	39.9 - 22.2[b]	0			
	22.2 - 9.6	0			
4 Dec	9.6 - 0.0[b]	1	1w	1w	
7 Dec	22.2 - 9.6[b]	0	1h		
	9.6 - 0.0	2			
Totals		23	6	5	1

[a] *River segments were as follows: Marengo (RK 39.9) to Highway 12 Bridge (RK 22.2), Bridge to Fletcher's Dam (9.6), Dam to mouth (RK 0.0).*

[b] *River segments may have been surveyed as much as two days apart.*

[c] *Origin of fish (h=hatchery, w=wild) as determined by adipose clip or unclipped is indicated, plus 3 fish of unknown origin.*

The final 1992 fall chinook salmon count at Ice Harbor Dam (12 August to 31 October) was 4,636 adults and 894 jacks (30 to 56 cm fork length; USACE, 1993). The adult count was similar to the 1987 to 1990 average of 4,654. In 1992 we collected approximately 256 adults and 71 jacks from Ice Harbor for broodstock at Lyons Ferry FH. Another 898 adults and 176 jacks voluntarily returned to the hatchery. At Lower Granite Dam 855 adults and 102 jacks were counted (of which we collected 185 adults and 24 jacks). Approximately 69 fish could be accounted for spawning in the Tucannon River (23 redds counted at 3 adults/ redd) and two in the Palouse River. Therefore, approximately 2,556 adults and 545 jacks (56% of fall chinook) upstream of Ice Harbor Dam are not accounted for; similar to the results in 1991. These values are the difference between the Ice Harbor Dam counts and the sum of the following: 1) Lower Granite Dam counts, 2) Lyons Ferry FH voluntary returns, and 3) estimated escapement to the Tucannon and Palouse rivers. Possible disposition of these missing fish include fall back at Ice Harbor Dam, mortality, or spawning in tailraces of the lower Snake River dams. Most of the loss of salmon (3,037 fish) apparently occurred between Ice Harbor and Lower Monumental dams in 1992. As much as 62% of the loss of fish upstream of Ice Harbor Dam may be attributable to fall back at Ice Harbor (Mendel et al. 1993a). For a more detailed discussion of fish loss between Snake River dams in 1992 see Mendel et al. 1993a.

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APPENDIX A

Washington Department of Fisheries' objectives for the LSRCP Hatchery Evaluation Program. These objectives are interrelated in scope, and are not set in priority.

1) Document juvenile fish output for Lyons Ferry and Tucannon FH. Records will be compiled and summarized by numbers of fish produced at each facility and categorized by stock, size, weight, and planting location. Fish condition and survival rates to planting will be noted.

2) Maintain records of adult returns to the Snake River Basin for each rearing program, categorized by stock and brood year. Data are collected at hatchery racks and spawning grounds by program staff, and compared with escapement to other hatcheries and streams throughout the Columbia River Basin.

3) Document contributions of each rearing program to the various fisheries through coded-wire tag returns. Pacific Coast states, Federal, and Canadian agencies cooperate in returning tags and catch data to the agency of origin. We will attempt to tag sufficient fish to represent each rearing program, and to avoid duplication with contribution studies from other hatcheries.

4) Document downstream movement to Fish Passage Center and National Marine Fisheries Service sampling points on the Snake River and/or lower Columbia River for each rearing program. Program staff will retrieve and summarize data for the Lyons Ferry/Tucannon facilities. Survival rate comparisons for each rearing program will be made. We will use these data to modify hatchery releases to improve downstream migrant survival.

5) Quantify genetic variables that might be subject to alteration under hatchery production strategies. We plan to identify and quantify as many genetic variables as possible in all available Snake River chinook salmon populations. Similar data for other populations which may overlap with Snake River chinook salmon in the lower Columbia River are being developed. These data include qualitative loci analysis through electrophoresis, and quantitative analysis of such factors as meristics, adult and juvenile body morphometry, adult size, run timing, and disease susceptibility.

6) Maintain genetic integrity of indigenous Snake River salmon stocks. Utilization and maintenance of native stocks is an important goal of the LSRCP. We plan to protect these stocks through two strategies: a) identify stray adults at Lyons Ferry and Tucannon FH for removal from the broodstock, and b) mark sufficient smolts prior to release for their proper identification upon return.

7) Determine the success of any off-station enhancement projects, and determine the impact of hatchery fish on wild stock. Our emphasis will be to evaluate changes in natural production in response to hatchery enhancement, and to develop escapement goals based upon optimum natural and hatchery production. We will study interactions at both the juvenile and adult life stages. We may use information obtained from Objective 5 to develop genetic marks (qualitative or quantitative) which could provide techniques for evaluating interactions of wild and hatchery fish in the Tucannon River system.

8) Evaluate and provide management recommendations for major hatchery operational practices, including:

A. Optimum size and time-of-release strategies will be determined for both spring and fall chinook salmon. Existing size, time and return data for other Columbia River Basin programs will be reviewed to determine the release strategies which would have the most likelihood of success. Continual refinement may be necessary in some cases.

B. Selection and maintenance of broodstock will be done in conformance with LSRCP goals. Criteria will be developed to program genetic management as determined by Objectives 5 and 6, and in accordance with tribal agreements.

C. Loading densities, feeding regimes, disease investigations, or other special treatments on experimental hatchery practices often require mark-release-return groups to facilitate evaluation. Program staff will develop the experimental designs, direct the marking, and analyze the results.

9) Evaluate and provide management recommendations for Snake River salmon distribution programs basin-wide. As Lyons Ferry FH and Tucannon FH goals are reached, eggtake needs to supplement natural production in other streams will be specified. We will set priorities for off-site distribution, based upon current escapement levels, habitat quality, and agreements with co-managing agencies and tribes. Evaluation and improvement of the distribution plan will be an on-going process.

10) Coordinate research and management programs with hatchery capabilities. Advance notice to the hatcheries for specific study groups of marking programs will allow a more efficient use of hatchery facilities and reduce handling and stress on the fish. Research and management programs will be reviewed to determine if the hatcheries will have the capabilities to meet program goals.

APPENDIX B

BROODSTOCK COLLECTION PROTOCOL
SNAKE RIVER FALL CHINOOK SALMON, 1992

Background

Washington Department of Fisheries (WDF) personnel trap fall chinook salmon at Ice Harbor and Lower Granite Dams for broodstock at Lyons Ferry Fish Hatchery (FH). National Marine Fisheries Service (NMFS) assists WDF in collection at the latter project. Fall chinook salmon broodstock are also obtained through voluntary returns to the hatchery. A detailed description of broodstock management at Lyons Ferry FH is provided in the WDF Lower Snake River Compensation Plan hatchery evaluation program's annual reports.

Since inception of Lyons Ferry FH in 1984, average fall chinook salmon returns to the Snake River (measured by Ice Harbor Dam counts) is 4,054 adults. The production goal for fall chinook salmon at Lyons Ferry FH is 9,162,000 subyearling smolts released at 90 fish per pound (fpp). Production capabilities at Lyons Ferry FH are limited, however, because of low escapement of fall chinook salmon to the Snake River and the need to cull stray salmon from hatchery broodstock. The current production plan for Lyons Ferry FH is to release up to 800,000 yearlings at 10 fpp, to provide higher survival potential, with all remaining Snake River stock released as subyearlings at 80-120 fpp.

Fall chinook salmon are also collected by WDF at these two projects for radio telemetry research. Trap procedures are essentially the same as for broodstock collection, and are described in detail in the study plan. Steelhead are trapped at the Ice Harbor ladder by the Idaho Cooperative Fish and Wildlife Research Unit (ICFWRU).

Ice Harbor Trap Operations

The ICFWRU operated the Ice Harbor trap in previous years, primarily under directive of the Snake River Fall Chinook Eggbank Program. The primary objective of the trapping program from 1984 to present is collection of adults for direct contribution to Lyons Ferry broodstock. Beginning in 1990, a related objective of the trap is to cull marked (adipose clipped) stray salmon from Snake River escapement.

The trap will be installed at the top of the south shore fish ladder at Ice Harbor Dam for the duration of fall chinook salmon passage at Ice Harbor Dam (12 August to 31 October). Broodstock collections will not begin until early September however, because high water temperatures usually preclude significant movement of salmon until September, and stress to

handled fish is unwarranted. About 15% of fall chinook salmon counted at Ice Harbor Dam pass the north shore ladder. No attempt is made to collect salmon from this ladder.

Action plan To the extent feasible, all adipose-clipped chinook salmon will be trapped and transported immediately to Lyons Ferry FH. Salmon will be transported in an aerated, insulated, 5,700 L tank truck. Water in the tank truck will be medicated with 1 gm Oxytetracycline HCI per 300 L of water. The trap will be operated only during daylight hours, approximately 6:30 am to 7:00 pm, and fish will be allowed to migrate through the trap when it is not operated. To prevent crowding in the holding tanks, salmon will be loaded from the holding tanks into the tank truck a minimum of two times a day, unless few fish are captured, or timing of their entry into the trap make this unnecessary. After loading, fish will be held in the tank truck until sundown and then transported to Lyons Ferry.

Three actions will be taken to mitigate stress on salmon: 1) trap operations will not begin until average daily water temperatures do not exceed 72° F, 2) steelhead will not be counted and classified by size during trap operations, 3) if required, the sides of the holding pens will be modified to reduce abrasion of fish.

The criterion to classify the minimum adult size for chinook salmon in the trap will be 57 cm total length, or larger. To the extent feasible, all marked jacks (30 to 56 cm) will be collected during trap operations for transport to Lyons Ferry FH. No effort will be made to trap salmonid minijacks (less than 30 cm total length).

Lower Granite Trap Operations

The fall chinook salmon passage period at Lower Granite Dam is 18 August to 15 December. To the extent possible, all wire-tagged chinook salmon (adults, jacks, and minijacks) entering the Lower Granite Dam trap from 1 September to 20 November will be collected for transport to Lyons Ferry FH. Trapping will continue after 20 November if marked salmon continue to arrive at the dam. The salmon will be collected by NMFS, and transported and subsequently processed by WDF. Salmon will be trapped, anesthetized, given numbered jaw tags, and transported in a 1,200 L aerated non-refrigerated tank truck, with water obtained from Lyons Ferry FH wells. These fish will be differentiated at Lyons Ferry FH from those trapped at Ice Harbor Dam by the presence of jaw tags. Minijacks will be killed when trapped and frozen for processing at Lyons Ferry FH.

Lyons Ferry FH Volunteers

All salmon that volunteer to Lyons Ferry FH from 18 August to 11 December will be retained for broodstock. Salmon in the trap will be transferred to the holding pond at least three times a week, to reduce stress to fish. Volunteers will be held separately from salmon trapped at the dams.

APPENDIX C

Request from NMFS to collect fall chinook salmon at Lower Granite Dam and WDF's response.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way NE
Bin C15700, Bldg. 1
Seattle, Washington 98115-0070

APR 27 1992

F/NW

Mr. Joe Blum, Director
Washington Department of Fisheries
115 General Administration Bld, AX-11
Olympia, Washington 98504

Dear Joe,

We are seeking your assistance in continuing protective measures for Snake River fall chinook salmon recently listed by the National Marine Fisheries Service as threatened under the Endangered Species Act (ESA). Consistent with Section 4(b)(1) of the ESA, NMFS relied solely on the best scientific data available in making this determination after taking into account those efforts, including those of your agency, being made to protect Snake River fall chinook. Efforts by the Washington Department of Fisheries in the operation of Lyons Ferry Hatchery in 1991 were important and should continue.

Until a final recovery plan is developed for fall chinook salmon, we would appreciate receiving a written statement from you indicating actions implemented for 1991 operation of Lyons Ferry Hatchery will continue in 1992 and subsequent years. Examples of such protections are not using natural (non-hatchery) fall chinook for hatchery broodstock purposes, and efforts to minimize the escapement of hatchery origin fall chinook above Lower Granite Dam. We would also appreciate your help in seeing that no marked hatchery origin fall chinook salmon escape or are released upstream from Lower Granite Dam.

In the near future, we expect these and other matters relating to the operation of Lyons Ferry Hatchery to be reviewed as part of the consultation process under Section 7 of the ESA.

I appreciate your commitment to the conservation of Snake River salmon listed under the ESA, and look forward to your continued assistance and cooperation. Questions regarding this or related matters can be directed to Rob Jones, of my staff, at (503) 230-5429.

Sincerely,

Rolland A. Schmitten
Regional Director

cc: USFWS - Plenert/Shake

JOSEPH R. BLUM
Director

STATE OF WASHINGTON
DEPARTMENT OF FISHERIES
115 General Administration Building, M.S. AX-11 • Olympia, Washington 98504 • (206) 753-6600 • (SCAN) 234-6600

May 12, 1992

Mr. Rolland A. Schmitten
Regional Director
National Marine Fisheries Service
7600 Sand Point Way Northeast
Bin C15700, Building 1
Seattle, Washington 98115-0070

Dear Rollie:

This is in response to your recent inquiry regarding the efforts of the Washington Department of Fisheries, through the Lyons Ferry Salmon Hatchery, to protect the Snake River fall chinook salmon.

Until a final recovery plan is developed for Snake River fall chinook, we plan to continue operation of the Lyons Ferry Hatchery in the manner which we have operated since 1990. Hatchery origin fish (both strays and Snake River stock) will be removed at traps located at Ice Harbor and Lower Granite dams. Additional fish will "volunteer" into a trap located at the hatchery. Eggs that are kept for the Lyons Ferry program will be only from coded-wire-tagged (Lyons Ferry) Snake River adults.

All progeny from Lyons Ferry Hatchery releases in 1990 and 1992 (no releases in 1991) have a wire tag implanted in them which will trigger the trap at Lower Granite dam. The trap operates at a minimum efficiency of 80 percent. We will extend operation of this trap in 1992 to twenty-four hours a day in an effort to eliminate stray hatchery fish escaping above Lower Granite dam.

The trap is operated by National Marine Fisheries Service personnel. Fish are transported by Washington Department of Fisheries personnel. We will request funds for our part of the trapping operation from the United States Fish and Wildlife Lower Snake River Compensation Plan office for the increased costs associated with the extended hours of operation.

I look forward to continued cooperation with you in the conservation effort of the Snake River fall chinook salmon. If you have any additional questions regarding the operation of the Lyons Ferry Hatchery, please let me know.

Sincerely,

Joseph R. Blum
Director

JRB:KH:fw

APPENDIX D

Coded-wire tags recovered (and expansions) at Lyons Ferry FH in 1992. Expansions are based on mark rates. Apparent addition errors are due to rounding to the nearest whole number following expansion (VOL = volunteers to the hatchery, IH = Ice Harbor Dam, LGR = Lower Granite Dam, BY = brood year, UM = Umatilla, BON = Bonneville).

Table 1. Stray coded-wire tags recovered at Lyons Ferry FH, 1992.

							EXPANDED RECOVERY			
VOL	IH	LGR	TOTAL	TAGCODE	SOURCE	BY	RATE	VOL	IH	LGR	TOTAL
		1	1	7/00/16	UM-IRRIGON	90	2.05			2	2
		1	1	7/37/58	ROGUE R SPR	88	17.60			18	18
		1	1	7/40/36	UM-MEACHUM	86	1.28			1	1
	1		1	7/40/37	UM-MEACHUM	86	1.28		1		1
1		1	2	7/45/37	UMATILLA	87	1.09	1		1	2
		1	1	7/45/39	UMATILLA	87	1.09			1	1
	1		1	7/45/40	UMATILLA	87	1.09		1		1
	1	1	2	7/46/46	UM-IRRIGON	88	15.28		15	15	31
	2		2	7/46/47	UM-IRRIGON	88	16.03		32		32
2	3		5	7/46/48	UM-IRRIGON	88	15.27	31	46		76
		2	2	7/47/53	UM-IRRIGON	88	1.02			2	2
	1		1	7/47/54	UM-IRRIGON	88	1.06		1		1
1	2		3	7/47/57	UM-IRRIGON	88	1.00	1	2		3
1	2		3	7/47/58	UM-IRRIGON	88	1.01	1	2		3
1		1	2	7/47/60	UM-IRRIGON	88	1.05	1		1	2
	1		1	7/47/63	UM-IRRIGON	88	1.01		1		1
1	3		4	7/50/07R5	UM-IRRIGON	87	9.52	10	29		38
	1		1	7/50/34	COLUMBIA R	88	1.01		1		1
	1		1	7/50/36	COLUMBIA R	88	1.01		1		1
	1		1	7/52/25	UMATILLA	90	25.71		26		26
	1	1	2	7/53/22	UMATILLA	89	1.09		1	1	2
		1	1	7/53/23	UMATILLA	89	1.09			1	1
1	2		3	7/54/03	UMATILLA	89	2.49	2	5		7
1	3		4	7/54/04	UMATILLA	89	2.47	2	7		10
	3		3	7/54/05	UMATILLA	89	2.46		7		5
1		1	2	7/54/49	UMATILLA	90	2.06	2		2	4
	3		3	7/54/51	UMATILLA	90	1.00		3		3
1			1	7/55/02R3	SANTIAM [a]	89	3.10	3			3
	1		1	7/56/01	UMATILLA	90	1.07		1		1
	1		1	7/56/02	UMATILLA	90	1.04		1		1
	1		1	23/21/39	NMFS-BON	86	1.12		1		1
	1		1	23/21/40	NMFS-BON	86	1.08		1		1
	1		1	23/21/62	NMFS-BON	86	1.12		1		1
	1		1	23/22/03	NMFS-BON	86	1.09		1		1
	1		1	23/24/55	NMFS-BON	89	1.08		1		1
	1		1	23/25/08R3	NMFS-BON	87	1.01		1		1
	1		1	23/25/21R3	NMFS-BON	87	1.01		1		1
		1	1	23/26/18	NMFS-BON	89	1.09			1	1

Appendix D, Table 1, continued.

							EXPANDED RECOVERY			
VOL	IH	LGR	TOTAL	TAGCODE	SOURCE	BY	RATE	VOL	IH	LGR	TOTAL
	1		1	23/26/31R3	NMFS-BON	87	1.02		1		1
	1		1	23/26/38R3	NMFS-BON	87	1.03		1		1
	1		1	23/26/47R3	NMFS-BON	87	1.01		1		1
1	1		2	23/26/49R3	NMFS-BON	87	1.03	1	1		2
	2		2	23/26/55R3	NMFS-BON	87	1.01		2		2
	1		1	23/28/04R3	NMFS-BON	88	1.03		1		1
	1		1	23/28/19R3	NMFS-BON	88	1.02		1		1
	1		1	23/28/49R3	NMFS-BON	88	1.03		1		1
	1		1	23/31/01R3	NMFS-BON	88	1.02		1		1
	1		1	23/31/04R3	NMFS-BON	88	1.02		1		1
		1	1	23/31/32R3	NMFS-BON	88	1.01			1	1
	1		1	23/31/52R3	NMFS-BON	88	1.02		1		1
1			1	23/32/02R3	NMFS-BON	88	1.01	1			1
4	3	3	10	LOST TAG				4	3	3	10
12	8		20	NO TAG				12	8		20
29	64	17	110		= TOTALS =			72	213	50	333

[a] Santiam River spring chinook.

Table 2. Coded-wire tags recovered from chinook salmon trapped and sacrificed at the trap at Lower Granite Dam, 1992.

				EXPANDED RECOVERY	
Number	Tag code	Source	Brood	Rate	Total
1	7/58/46	IMNAHA RIVER-SPRING	90	1.00[a]	1
1	63/11/19	WENATCHEE R.-SUMMER	89	4.97	5
2	63/41/18	LYONS FERRY	90	1.00	2
2	63/42/09	LYONS FERRY	90	1.01	2
6					10

[a] *This fish was a 28 cm minijack salmon (male, 1990 brood) from Lookinglass Hatchery. All other fish listed here were jacks.*

Appendix D, continued.

Table 3. Lyons Ferry origin coded-wire tags recovered at Lyons Ferry FH in 1992.

							EXPANDED RECOVERY				
VOL	IH	LGR	TOTAL	TAGCODE	SOURCE [a]	BY	RATE	VOL	IH	LGR	TOTAL
	3	3	6	63/02/26R6	LF-OS	88	5.19		16	16	31
	1	4	5	63/02/28R6	LF-OS	88	5.19		5	21	26
63	49	6	118	63/02/31R6	LF-TY	88	1.33	84	65	8	157
46	51	3	100	63/02/32R6	LF-TY	88	1.33	61	68	4	133
41	39	10	90	63/02/35R6	LF-OY	88	2.49	102	97	25	224
40	41	13	94	63/02/37R6	LF-OY	88	2.49	100	102	32	234
1			1	63/36/34	LF-TS	85	1.01	1			1
8	1		9	63/40/12	LF-OY	90	1.00	8	1		9
3			3	63/40/13	LF-TY	90	1.01	3			3
40	6	2	48	63/41/18	LF-TY	90	1.01	40	6	2	48
23	2	1	26	63/41/20	LF-TY	90	1.01	23	2	1	26
8	8	1	17	63/41/43	LF-TS	90	1.01	8	8	1	17
6	1		7	63/41/60	LF-TS	90	1.01	6	1		7
24	2	1	27	63/42/09	LF-OY	90	1.01	24	2	1	27
8	4		12	63/42/10	LF-TY	90	1.01	8	4		12
	1		1	63/42/59R6	LF-TS	86	1.34		1		1
	1		1	63/44/01R6	LF-TS	86	1.34		1		1
	1		1	63/44/11R6	LF-OY	86	2.44		2		2
12	6		18	63/47/50R6	LF-TY	87	1.00	12	6		18
3	3	1	7	63/47/52R6	LF-OY	87	2.54	8	8	3	18
13	10	1	24	63/47/55R6	LF-TY	87	1.00	13	10	1	24
2	2	3	7	63/47/56R6	LF-OY	87	2.54	5	5	8	18
1	2		3	63/52/04R6	LF-TS	88	2.86	3	6		9
	3		3	63/52/07R6	LF-TS	88	2.86		9		9
5	10	1	16	63/55/44R6	LF-OS	89	1.03	5	10	1	16
4	9	4	17	63/55/47R6	LF-OS	89	1.03	4	9	4	18
7	9	1	17	63/55/49R6	LF-TS	89	1.04	7	9	1	18
18	12		30	63/55/50R6	LF-TS	89	1.04	19	12		31
376	277	55	708		= TOTALS =			544	465	129	1138

[a] *LF = Lyons Ferry, OS = onstation subyearling release, TS = transport subyearling release, OY = onstation yearling release, OT = transport (barge) yearling release.*

APPENDIX E

Coded-wire tag recoveries (and expansions according to data reported to Pacific States Marine Fisheries Commission) at Lyons Ferry FH in 1992 and 1991. Vol = voluntary return to Lyons Ferry FH. IH = hauled from Ice Harbor Dam, LG = hauled from Lower Granite Dam.

Table 1. Recoveries of Lyons Ferry origin CWTs at Lyons Ferry Hatchery in 1992.

CWT CODES FOUND												EXPANDED RECOVERY			
VOL	IH	LG	TOTAL	AGENCY	DATA 1	DATA 2	RELEASE SOURCE	BROOD YEAR	NUMBER TAGGED	NUMBER AD-ONLY	UNMARKED	EXPANSION RATE	VOL	IH	LG	TOTAL
	3	3	6	63	2	26	Lyons Ferry	88	113,193	2,075	18,244	1.18	0	4	4	7
	1	4	5	63	2	28	Lyons Ferry	88	113,285	2,076	18,244	1.18	0	1	5	6
63	49	6	118	63	2	31	Lyons Ferry	88	58,988	458	18,708	1.32	83	65	8	156
46	51	3	100	63	2	32	Lyons Ferry	88	58,989	458	18,708	1.32	61	68	4	132
41	39	10	90	63	2	35	Lyons Ferry	88	55,922	496	83,264	2.50	102	97	25	225
40	41	13	94	63	2	37	Lyons Ferry	88	56,597	502	83,264	2.48	99	102	32	233
1			1	63	36	34	Lyons Ferry	85	49,112	366	0	1.01	1	0	0	1
8	1		9	63	40	12	Lyons Ferry	90	23,954	113	0	1.00	8	1	0	9
3			3	63	40	13	Lyons Ferry	90	21,137	268	0	1.01	3	0	0	3
40	6	2	48	63	41	18	Lyons Ferry	90	218,110	1,515	0	1.01	40	6	2	48
23	2	1	26	63	41	20	Lyons Ferry	90	202,674	2,566	0	1.01	23	2	1	26
8	8	1	17	63	41	43	Lyons Ferry	90	111,784	562	0	1.01	8	8	1	17
6	1		7	63	41	60	Lyons Ferry	90	110,748	1,345	0	1.01	6	1	0	7
24	2	1	27	63	42	9	Lyons Ferry	90	104,820	792	0	1.01	24	2	1	27
8	4		12	63	42	10	Lyons Ferry	90	98,374	560	0	1.01	8	4	0	12
	1		1	63	42	59	Lyons Ferry	86	126,076	2,836	0	1.02	0	1	0	1
	1		1	63	44	1	Lyons Ferry	86	128,283	1,034	0	1.01	0	1	0	1
	1		1	63	44	11	Lyons Ferry	86	58,735	236	64,443	2.10	0	2	0	2
12	6		18	63	47	50	Lyons Ferry	87	59,608	299	0	1.01	12	6	0	18
3	3	1	7	63	47	52	Lyons Ferry	87	57,756	58	69,443	2.20	7	7	2	15
13	10	1	24	63	47	55	Lyons Ferry	87	59,609	299	0	1.01	13	10	1	24
2	2	3	7	63	47	56	Lyons Ferry	87	57,594	58	69,249	2.20	4	4	7	15
1	2		3	63	52	4	Lyons Ferry	88	116,935	3,121	21,288	1.21	1	2	0	4
	3		3	63	52	7	Lyons Ferry	88	117,168	3,128	21,208	1.21	0	4	0	4
5	10	1	16	63	55	44	Lyons Ferry	89	123,640	3,662	0	1.03	5	10	1	16
4	9	4	17	63	55	47	Lyons Ferry	89	123,233	3,601	0	1.03	4	9	4	17
7	9	1	17	63	55	49	Lyons Ferry	89	118,104	4,716	0	1.04	7	9	1	18
18	12		30	63	55	50	Lyons Ferry	89	119,941	4,787	0	1.04	19	12	0	31
376	277	55	708										541	439	98	1,078

Appendix E: Table 2. Recoveries of Lyons Ferry origin CWTs at Lyons Ferry Hatchery in 1991.

CWT CODES FOUND												EXPANDED RECOVERY			
VOL	IH	LG	TOTAL	AGENCY	DATA 1	DATA 2	RELEASE SOURCE	BROOD YEAR	NUMBER TAGGED	NUMBER AD-ONLY	UNMARKED	EXPANSION RATE	VOL	IH	LG	TOTAL
2	1	1	4	63	2	26	Lyons Ferry	88	113,193	2,075	18,244	1.18	2	1	1	5
1	1	1	3	63	2	28	Lyons Ferry	88	113,285	2,076	18,244	1.18	1	1	1	4
42	6		48	63	2	31	Lyons Ferry	88	58,988	458	18,708	1.32	56	8	0	64
36	5		41	63	2	32	Lyons Ferry	88	58,989	458	18,708	1.32	48	7	0	54
41	5		46	63	2	35	Lyons Ferry	88	55,922	496	83,264	2.50	102	12	0	115
52	6		58	63	2	37	Lyons Ferry	88	56,597	502	83,264	2.48	129	15	0	144
1			1	63	36	38	Lyons Ferry	85	49,325	468	0	1.01	1	0	0	1
	1		1	63	36	42	Lyons Ferry	85	49,325	468	0	1.01	0	1	0	1
3	7		10	63	41	56	Lyons Ferry	85	152,479	1075	0	1.01	3	7	0	10
3	4		7	63	41	59	Lyons Ferry	85	156,036	470	0	1.00	3	4	0	7
2	3	2	7	63	42	59	Lyons Ferry	86	126,076	2,836	0	1.02	2	3	2	7
3	7		10	63	42	61	Lyons Ferry	86	125,570	2,824	0	1.02	3	7	0	10
6	10	1	17	63	42	62	Lyons Ferry	86	127,715	1,030	0	1.01	6	10	1	17
5	12		17	63	44	1	Lyons Ferry	86	128,283	1,034	0	1.01	5	12	0	17
12	16		28	63	44	7	Lyons Ferry	86	60,523	213	0	1.00	12	16	0	28
12	16		28	63	44	8	Lyons Ferry	86	60,281	212	0	1.00	12	16	0	28
13	22	2	37	63	44	11	Lyons Ferry	86	58,735	236	64,112	2.10	27	46	4	78
21	14	6	41	63	44	13	Lyons Ferry	86	58,970	237	64,369	2.10	44	29	13	86
37	40	1	78	63	47	50	Lyons Ferry	87	59,608	299	0	1.01	37	40	1	78
13	7	2	22	63	47	52	Lyons Ferry	87	57,756	58	69,443	2.20	29	15	4	48
39	37		76	63	47	55	Lyons Ferry	87	59,609	299	0	1.01	39	37	0	76
11	3	3	17	63	47	56	Lyons Ferry	87	57,594	58	69,249	2.20	24	7	7	37
4			4	63	52	4	Lyons Ferry	88	116,935	3,121	21,288	1.21	5	0	0	5
2			2	63	52	7	Lyons Ferry	88	117,168	3,128	21,208	1.21	2	0	0	2
3			3	63	52	11	Lyons Ferry	87	122,850	2,125	21,246	1.19	4	0	0	4
2			2	63	52	13	Lyons Ferry	87	122,899	2,125	21,254	1.19	2	0	0	2
1	1	2	4	63	52	14	Lyons Ferry	87	124,345	374	839,682	7.76	8	8	16	31
2	2	2	6	63	52	16	Lyons Ferry	87	124,394	374	840,018	7.76	16	16	16	47
5	3		8	63	55	44	Lyons Ferry	89	123,640	3,662	0	1.03	5	3	0	8
6	1		7	63	55	47	Lyons Ferry	89	123,233	3,601	0	1.03	6	1	0	7
9	1		10	63	55	49	Lyons Ferry	89	118,104	4,716	0	1.04	9	1	0	10
10	1		11	63	55	50	Lyons Ferry	89	119,941	4,787	0	1.04	10	1	0	11
399	232	23	654										654	325	65	1,044

APPENDIX F

Fall chinook salmon releases, and numbers of fish marked (coded-wire tagged) and unmarked, by release year and type since inception (1985) of Lyons Ferry Hatchery.

Release year Age (brood yr)	Release type[a]	Date[b]	Number CWT	CWT code[c]	Adipose only marked	Number unmarked	lbs	fish/ lb
1985								
yearling (83)	direct	4/17	250,831	21/52	1,769	235,125	48,773	10
			83,611	32/18	589	78,375	16,468	10
subyearling (84)	direct	6/6	78,064	32/27	235	100,900	2,354	76[d]
			78,504	32/28	236	101,400	2,369	76[d]
			78,417	32/26	236	101,400	2,367	76[d]
1986								
yearling (84)	direct	4/2&3	258,355	28/41	1,821	181,500	55,210	8
		4/4&8				40,274[e]	5,035	8
						181,500	22,688	8
subyearling (85)	direct	6/10	49,325	36/38	468		859	58
			49,325	36/39	468		859	58
			49,325	36/40	468		859	58
			49,325	36/41	468		859	58
			49,325	36/42	468		859	58
						81,003[e]	1,157	70
						1,212,200	13,933	87
subyearling (85)	barge	6/13	49,112	36/33	366		900	55
			49,112	36/34	366		900	55
			49,112	36/35	366		900	55
			49,112	36/36	367		900	55
			49,112	36/37	366		900	55
1987								
yearling (85)	direct	4/14	152,479	41/56	1,075		25,592	6
						39,906[f]	4,425	9
						36,300	3,862	9
						653[g]	69	9
yearling (85)	barge	4/16	156,036	41/59	470		22,682	7
subyearling (86)	direct	6/1	126,076	42/59	2,836		2,686	48
			125,570	42/61	2,824		2,675	48
						80,484[h]	1,059	76
subyearling (86)	barge	6/2	128,283	44/01	1,034		1,821	71
			127,715	42/62	1,030		1,836	71
						78,200	745	105
1988								
yearling (86)	direct	4/14	58,970	44/13	237	64,369	15,447	8
			58,735	44/11	236	64,112	15,385	8
						39,952[i]	4,994	8
yearling (86)	barge	4/19	60,523	44/07	213		7,592	8
			60,281	44/08	212		7,562	8

Appendix F continued.

Release year Age (brood yr)	Release type[a]	Date[b]	Number CWT	CWT code[c]	Adipose only marked	Number unmarked	lbs	fish/ lb
1989								
subyearling (87)	direct	6/1	124,345	52/14	374	839,682	18,196	53
			124,394	52/16	374	840,018	18,202	53
						79,961[i]	1,509	53
subyearling (87)	barge	6/8	122,850	52/11	2,125	21,246	2,759	53
			122,899	52/13	2,125	21,254	2,760	53
						271,500	3,879	70
						886,300	8,953	99
						1,114,000	8,984	124
yearling (87)	direct	4/14	57,594	47/56	58	69,249	12,690	10
			57,756	47/52	58	69,443	12,725	10
						39,044[j]	3,904	10
yearing (87)	barge	4/20	59,609	47/55	299		5,991	10
			59,608	47/50	299		5,991	10
subyearling (88)	direct	6/8	113,285	02/28	2,076	18,244	1,485	90
			113,193	02/26	2,075	18,244	1,483	90
						828,485	8,663	96[k]
						39,991[l]	580	69
						40,025[l]	580	69
subyearling (88)	barge	6/14	117,168	52/07	3,128	21,208	1,887	75
			116,935	52/04	3,121	21,208	1,884	75
						173,595	2,755	63
						125,091	1,061	118
						88,378	982	90
1990								
yearling (88)	direct	4/16	56,597	02/37	502	83,264	15,596	9
			55,922	02/35	496	83,264	15,520	9
yearling (88)	barge	4/17	58,988	02/31	458	18,708	7,105	11
			58,989	02/32	458	18,708	7,105	11
subyearling (89)	direct	6/6	123,233	55/47	3,601		2,306	55
			123,640	55/44	3,662		2,315	55
		6/6				79,676[m]	1,035	77
		6/6				303,255[n]	4,332	70
		6/18				793,349[n]	10,868	73
		6/25				604,205[n]	8,757	69
		7/2				534,174[n]	7,524	71
		7/2				768,312[n]	10,821	71
		7/12				227,413[n]	2,707	84
subyearling (89)	barge	6/8	118,104	55/49	4,716		1,981	62
			119,941	55/50	4,787		2,012	62

Appendix F continued.

Release year Age (brood yr)	Release type[a]	Date[b]	Number CWT	CWT code[c]	Adipose only marked	Number unmarked	lbs	fish/ lb
1991								
subyearling (90)	barge	6/2	111,784	41/43	562		2,293	49
			110,748	41/60	1,345		2,288	49
1992								
yearling (90)	direct	4/15	104,820[e]	42/09	792[e]		13,201	8
						5,125[p]	641	8
						5,207[o1]	651	8
			4,386[q]	43/20			548	8
			218,110[f]	41/18	1,515[f]		27,453	8
			23,954[s]	40/12	113[s]		3,008	8
yearling (90)	barge	4/17	98,374[t]	42/10	560[t]		10,993	9
			202,674[u]	41/20	2,566[u]		22,804	9
			21,137[u]	40/13	268[u]		2,378	9

[a] Barged fish were released immediately downstream of Ice Harbor Dam.
[b] Release date (month/day).
[c] All tag codes start with agency code 63.
[d] Mean length of marked (67 fpp) and unmarked fish (85 fpp) differed.
[e] Freeze branded (RA-7k-1 in April 1986) and branded RA-T-3 in June.
[f] Freeze branded LA 7N-1.
[g] PIT tagged (Passive Integrated Transponder) by NMFS for migration timing.
[h] Freeze branded LA S-1.
[i] Freeze branded RA 7S-1 for April release and RD R-1 for June.
[j] Freeze branded LD 7U-1 (13,033), LA 7U-1 (13,017) and LA 7U-3 (12,994).
[k] The average of six groups of different sized fish.
[l] Freeze branded LAU-1 (39,991) and branded LAU-3 (40,025).
[m] Freeze branded RA U-1 (39,813) and RA U-3 (39,863) and all BWT in the snout.
[n] All with blank wire tags (BWT) in the snout.
[o] 50.4% have red filament tags behind left eye and 49.6% have BWT in left cheek.
[o1] BWT in left cheek.
[p] All with red filament tags behind left eye (VT).
[q] 49.4% have VT behind left eye and 50.6% have BWT in left cheek.
[r] 49.7% have VT behind left eye and 50.3% have BWT in left cheek.
[s] 49.6% have VT behind left eye and 50.4% have BWT in left cheek.
[t] 51.7% have VT behind left eye and 48.3% have BWT in left cheek.
[u] 49.8% have VT behind left eye and 50.2% have bwt in left cheek.

Appendix G

Aerial redd survey dates and flight paths, 1992.

River	Date	Flight Path
Snake	10/16	Pittsburg Landing to Asotin
	10/23	Asotin to Imnaha (upstream), Hells Canyon to Imnaha
	10/30	Asotin to Grande Ronde (upstream), Cochrane Is. to Asotin
	11/05	Asotin to Imnaha (upstream), Hells Canyon to Imnaha
	11/13	Asotin to Hells Canyon Dam
	11/23	Asotin to Hells Canyon Dam
	12/04	Asotin to Hells Canyon Dam
	12/12	Asotin to Hells Canyon Dam
Imnaha	10/23	Mouth to Fence Creek
	11/05	Mouth to Horse Creek
	11/13	Mouth to Fence Creek
	11/23	Mouth to Cow Creek
	12/04	Mouth to Cow Creek
	12/12	Mouth to Cow Creek
Grande Ronde		
	10/16	Wallowa (town) down Wallowa and Minam to Cottonwood Creek
	10/23	Mouth to Troy
	10/30	Troy to Mouth
	11/05	Mouth to 4-0 Ranch
	11/13	Mouth to the "Narrows"
	11/23	Troy to Mouth
	12/12	Mouth to Troy
Salmon	11/20	Riggins to Mouth
	12/03	Riggins to Mouth
Clearwater		
	11/20	Mouth to S.F. (upstream to Cottonwood Cr.)
	12/03	Mouth to S.F. (upstream to Cottonwood Cr.)