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LYONS FERRY EVALUATION STUDY
1988-89 Annual Report

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ABSTRACT

Total production at Lyons Ferry Hatchery in 1988 was 849,378 summer steelhead weighing 165,104 pounds. Average smolt size was 5.1 fish/pound (SD =0.4). A total of 266,360 rainbow trout weighing 92,225 pounds were planted into 36 waters. An additional 138,146 trout weighing 11,780 pounds were reared for Idaho. Average trout size planted was 2.9 fish/pound. Total trout production was 124% of goal this year.

Nine study groups of coded wire tagged and branded steelhead were released from 3 different locations. Tag loss averaged 1.13% (SD=.89) and brand loss averaged 5.11% (SD=2.04).

Average wild parr, transitional and smolt length on the Tucannon River was 71.4 mm, 115.9 mm and 168.4 mm respectively. Peak emigration of wild smolts occurred in May. The Passage Index (P.I.) for hatchery smolts increased from an average of 26.0% of release at McNary Dam in 1988 to 29.8% of release in 1989. Travel times were similar for both years.

Adults from 1986 and 1987 smolt releases returned to Lower Granite Dam at between 0.31% and 1.07% for one year returns and between 0.29% and 1.55% for combined first and second year returns. One-ocean age fish averaged 58.4 cm in length and 2-ocean age fish averaged 70.5 cm. The adult trap at LFH was operated from 1 Sept. to 13 Dec. 1988, and from 27 March to 12 April 1989 with a total of 1,127 fish and 1,400 fish captured respectively. Males and females comprised 38.8% and 61.2% respectively. Wild fish were only 0.25% of the fish trapped at the hatchery this year. Tagged and branded fish made up 10.8% of the fish trapped. A total of 1,263,237 eggs were spawned from 243 females. One-ocean age fish averaged 4,365 eggs/female and 2-ocean age fish averaged 6,021 eggs/female.

Adults returning from releases of Washington LSRCP smolts contributed to high sea sport and commercial fisheries as well as to 11 different harvest fisheries in the Columbia and Snake Rivers. Contribution to these fisheries for individual tag groups ranged from 0.161% to 1.148% of smolts released. The largest harvestors of these steelhead were the lower Columbia River sport fishery, the mid-Columbia River treaty Indian net fishery and the Snake River and tributary sport fisheries.

Creel Surveys for coded wire tag recovery were conducted on the Snake and Grande Ronde rivers. We sampled 14.3% of the estimated sport harvest on the upper Snake River in the 1988-89 season and collected 189 tags from LV fin clipped fish. In a joint survey of the upper Grande Ronde River with Oregon Department of Fish and Wildlife, we estimated anglers expended 1,842 days of efforts to harvest steelhead. Anglers kept 647 fish and released 443 fish. We recovered 36 tagged fish of washington origin, which represent and estimated 214 total tagged fish caught.

A disk tagging study was conducted to compare returns of dorsal disk tags of different reward denominations to a more traditional metal jaw tag used by National Marine Fisheries Service. Both $5.00 and $20.00 disk tags were voluntarily returned for reward at a significantly greater rate than the $5.00 jaw tag. The $20.00 disk tag was returned at a greater rate than the $5.00 disk tag, however the difference was not statistically significant. Estimated exploitation of Washington origin LSRCP returning adults in the sport fishery above Lower Granite Dam was 33.4%.

We conducted spawning ground surveys on 40.2 miles of the Tucannon River, 43.5 miles of the Touchet River and 18.4 miles of Asotin Creek. Redd densities ranged from 0.6 redds/mile to 5.2 redds/mile.

Juvenile salmonid densities in project area streams averaged lower in 1988 then in 1987, the second year of decline. There were wide variations in population densities from site to site. Residual hatchery steelhead smolts accounted for 7.7% and 5.5% of the density of fish in two sections of the Tucannon River.

ACKNOWLEDGEMENTS

We would like to thank Kent Ball and Tim Cochenaur of Idaho Fish and Game, Charles Morrill and Diane Sheffield of Washington Department of Wildlife, Jerry Harmon and his National Marine Fisheries Service (NMFS) crew at Lower Granite Dam and Carl Ross of NMFS in Pasco, and Larry Basham of the Fish Passage Center for their personal and corporate contribution to the data base on which this report is founded. We would also like to express our thanks to the staff of the PMFC for their timely and accurate reporting of coded wire tag recovery information.

We would like to express a special thanks to Rich Carmichael and his crew with Oregon Department of Fish and Wildlife for their patience and professionalism in working on a joint creel survey on the Grande Ronde River.

We thank Douglas Kuehn and Lance Ross for their untiring work and pleasant attitude in talking with thousands of anglers during creel surveys.

We thank John Hisata, Dan Herrig and Randy Cooper for reviewing and offering comment on the draft report.

We also would like to express special appreciation to the managers and staffs of Lyons Ferry and Tucannon fish hatcheries for their support and hard work at making the LSRCP program in Washington a success, and to the Staff of the LSRCP office in Boise for their firm support.

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INTRODUCTION

This is the sixth report in a series by the Washington Department of Wildlife concerning Lyons Ferry Hatchery. The reporting period for this report is 1 July 1988 through 30 June 1989.

This report contains a complete presentation of data collected and a review of all activities undertaken during the report period.

The 1988 project proposal, as submitted to the U.S. Fish and Wildlife Service (FWS), served as a guideline to determine our progress in the evaluation project for the year. The goals, objectives and tasks of that proposal are provided in Appendix A.

We continue to collect tags from our tag release groups to determine adult steelhead contribution to Compensation Plan and other harvest areas. We expected drought conditions in 1987 and 1988 to have serious effects on adult returns through decreased smolt survival rates for both years. Adult returns this year have provided some insight into how LSRCP releases can successfully maintain steelhead runs under adverse environmental conditions.

This is the first year of tagged adults returning to the Walla Walla River system. Because of limited tagging ability and personnel to census return areas for tag recoveries, other areas have been emphasized. Those river surveys have been successfully completed and now allow us to begin work in the Walla Walla. Early results are both encouraging and discouraging. Survival of tagged smolts to McNary Dam was comparable for the Touchet River fish (a tributary to the Walla Walla) when compared to Lyons Ferry Hatchery and Tucannon River released tag groups. However, returning adults destined for the Touchet River are wandering far up the Snake River. This behavior which has been identified in several other groups of LFH reared fish poses additional questions about our rearing techniques, stocks of fish and release strategies.

See Schuck et al. (1989) for a complete program description. Facilities and production goals did not change in 1988-89.

METHODS

Hatchery Operation Monitoring

Juvenile Growth

There were no changes in our methods of sampling growth rates during the production year or in sampling the smolts prior to release in the spring. A detailed description of the sampling is available in our 1983 Annual Report (Schuck 1985).

Fish Marking Program

Three types of marking programs were accomplished this year: 1) adipose clipping to designate hatchery produced harvestable adults for selective fisheries, 2) coded-wire tagging (cwt) for specific contribution and return rate studies, and 3) all cwt fish received a nitrogen freeze brand to allow easy identification of migrating smolts and returning adults without sacrificing the fish.

We contracted with Washington Department of Fisheries (WDF) to conduct our marking and tagging program. Adipose clipping was completed during August/September 1988, just prior to their transfer into the large rearing ponds. Tagging and branding was accomplished during February 1989. Tag loss was determined as in 1985 (Schuck and Mendel 1987). Tag codes and brands are reported to the Pacific Marine Fishery Commission (PMFC) for publication in their annual report.

Fish at Release

Fish release strategies and release procedures were similar in 1989 as for 1988 however the Walla Walla conditioning pond was not used. This was a private facility operated jointly by the landowner and a local sports club. Complications with their ability to release fish on a timely manner and ensure complete release of fish from the pond forced us to return to direct river releases. See Schuck et al (1989) for a discussion of the other release strategies used in previous years.

Hatchery Smolt Emigration

We assessed smolt survival throughout their migration from samples collected and expanded at the Snake and Columbia River dams by National Marine Fisheries Service (NMFS) and Fish Passage Center (FPC) personnel (Schuck et al. 1989; Fish Passage Center 1989). Personnel from the U.S. Fish and Wildlife Service, Columbia River Field Station, Cook, Washington collected samples of blood and gill tissue and photographed pre-smolts at Lyons Ferry Hatchery and three conditioning ponds this year. This was a follow up on sampling done in 1988 (see Schuck et al, 1989) to determine if measurable differences in smoltification existed among groups of smolts released under different circumstances. Samples were analyzed and summarized by the USFWS at Cook. Final results will be written up as a separate paper but are presented in preliminary form in this report.

Adult Steelhead Returns To Project Area

Passage at Dams and Characteristics of Adults

The National Marine Fishery Service monitors adult passage at Lower Granite Dam annually as part of their migration research (Jerry Harmon, NMFS, personal comm., 1989). Adults coming into the trap were sampled for marks and the information, along with sample rates when available, was provided to us.

Disk Tag Study

Information gathered during a fish tracking study (Mendel and Schuck 1989) suggested a differential return of tags used in the study. Orange colored disk tags attached through the dorsal musculature were returned for a $2.00 reward in greater numbers than silver colored jaw tags attached to the mandible with a $5.00 reward. We have used jaw tag returns to estimate exploitation in recent years and this disparity of return rates caused us to doubt the accuracy of this data.

In 1988 a disk tag/jaw tag comparison study was undertaken to determine if the results obtained in 1987-88 were correct. We also wanted to determine which variable, tag type or reward amount, was contributing to the different observed return rates.

Equal numbers of two denominations of disk tag, $5.00 and $20.00, and $5.00 jaw tags were attached to 1-ocean age and 2-ocean age adult steelhead returning to above Lower Granite Dam and destined for the Grande Ronde River. Tags were attached at the NMFS trap at Lower Granite Dam between 20 September and 14 October 1988.

Tags were imprinted with a label identifying the reward amount, the releasing agency and the tag return address. No other advertising or instructions to anglers were undertaken as this methodology most closely duplicated the return procedure used by NMFS for their jaw tags. During creel survey operations, tag numbers from all types of tags were recorded but tags were not collected. Only voluntary returns for a reward were considered in the study results. Returns of tags were accepted for the study through 30 June 1989. Returns of tags were analyzed for statistical differences using Chi Square. Both differences between tag types and tag value were tested for significant differences.

Returns to Lyons Ferry Hatchery

We examined all steelhead that entered the hatchery ladder and trap for marks. The ladder was open only part of the period when steelhead were migrating past the hatchery and could have entered the trap. All captured fish were retained until the spring of 1989 when they were sorted for spawning purposes. Fish that were identified as destined for upstream hatcheries and injured males were returned to the river. Fish trapped during April 1989 were examined for brands and fin clips and returned to the river. All other fish were retained.

Returns to Other Locations

Spawning Ground Surveys

Sections of the Touchet and Tucannon Rivers and Asotin Creek were walked to count redds, adults and carcasses. The sections have been delineated by road miles or river miles taken from U.S.G.S. aerial photographs. Peak spawning period was not determined in 1989. High murky water conditions in late March and April precluded more than one survey this year. All other methods were as described by Schuck et al. (1989).

Steelhead Creel Surveys

The consumptive steelhead fishery for the Snake River occurred 1 September to 31 December 1988, and 1 January to 31 March 1989. Regulations were wild steelhead release, with daily catch, possession and annual limits of 2, 4 and 30 steelhead, respectively. A run of 86,561 summer steelhead were available for this fishery.

The consumptive fishery for the Grande Ronde River, except for the catch and release section at the mouth, occurred 1 September to 31 December 1988, and 1 January to 15 April 1989. Wild release regulations were in effect and daily catch, possession and annual limits for steelhead were 2, 4 and 30 respectively. A joint survey of the upper Grande Ronde was conducted by ODFW and WDW personnel. All data collected were summarized by ODFW. Angler effort, catch rates, harvest and coded wire tag recoveries and expansions were calculated by ODFW as described in Carmichael et al. (1988).

Fishing regulations for the Touchet, Tucannon, and Walla Walla rivers were unchanged from 1988.

Objectives of creel surveys on the Snake and Grande Ronde rivers during these seasons were:

1. Estimate that portion of the sport catch contributed by returning steelhead of Lyons Ferry Hatchery origin. The following tasks are required to accomplish this objective:

    a) Estimate the percentage of the catch that is marked.

    b) Examine coded wire tags, brands and disk tags and identify the release location, agency, and date for all marked steelhead observed in the catch.

c) Estimate the total contribution of adult steelhead that was produced by Lyons Ferry Hatchery.

2. Obtain information regarding lengths, weights, sex, age, duration of ocean residency, and the percentage of fish of hatchery origin in the harvest.

3. Estimate angler exploitation rates for marked groups of adult Lyons Ferry Hatchery steelhead.

The study area (Fig. 1) was smaller than in 1987-88. We did not survey the Snake river below Lyons Ferry Hatchery (section 166)this year and we combined the upper river areas described by Mendel et al. (1988) into three main areas:

1. Little Goose -- from Little Goose Dam to Lower Granite Dam (37.2-WDW mgmt, zone 167).

2. Lower Granite -- from Lower Granite Dam to Red Wolf Bridge in Clarkston, WA. (approx. 30.5 miles -- part of WDG mgmt zone 168).

3. Mid Snake -- from Red Wolf Bridge in Clarkston (just downstream of the Idaho - Washington border) upstream to the Grande Ronde River (at Lime point) (this portion of the Snake River is managed by the Idaho Fish and Game (IFG) and WDW).

The Grand Ronde River within Washington was divided into 3 major segments as follows:

1. Lower -- mouth to "The Narrows" just upstream of Joseph Creek (approx. 4.5 miles).

   Zone D -- mouth to Asotin County Road Bridge (approx. 2.5 miles) . Catch and release area, bait prohibited.

   Zone E -- Asotin Co. Road Bridge to the "Narrows" (approx. 2 miles). Consumptive fishery area, Wild Steelhead Release.

2. Shumaker -- access limited to Shumaker Grade. Consumptive fishery area, Wild Steelhead Release.

3. Upper -- access area below State Highway 129 Bridge (at Bogans Oasis) to Oregon state line. Consumptive fishery area, Wild Steelhead Release.

Areas of other streams surveyed include:

Tucannon River -- mouth to the little Tucannon R. (No effort counts were conducted on this river.)

Punchcard estimates for Washington rivers were used as total

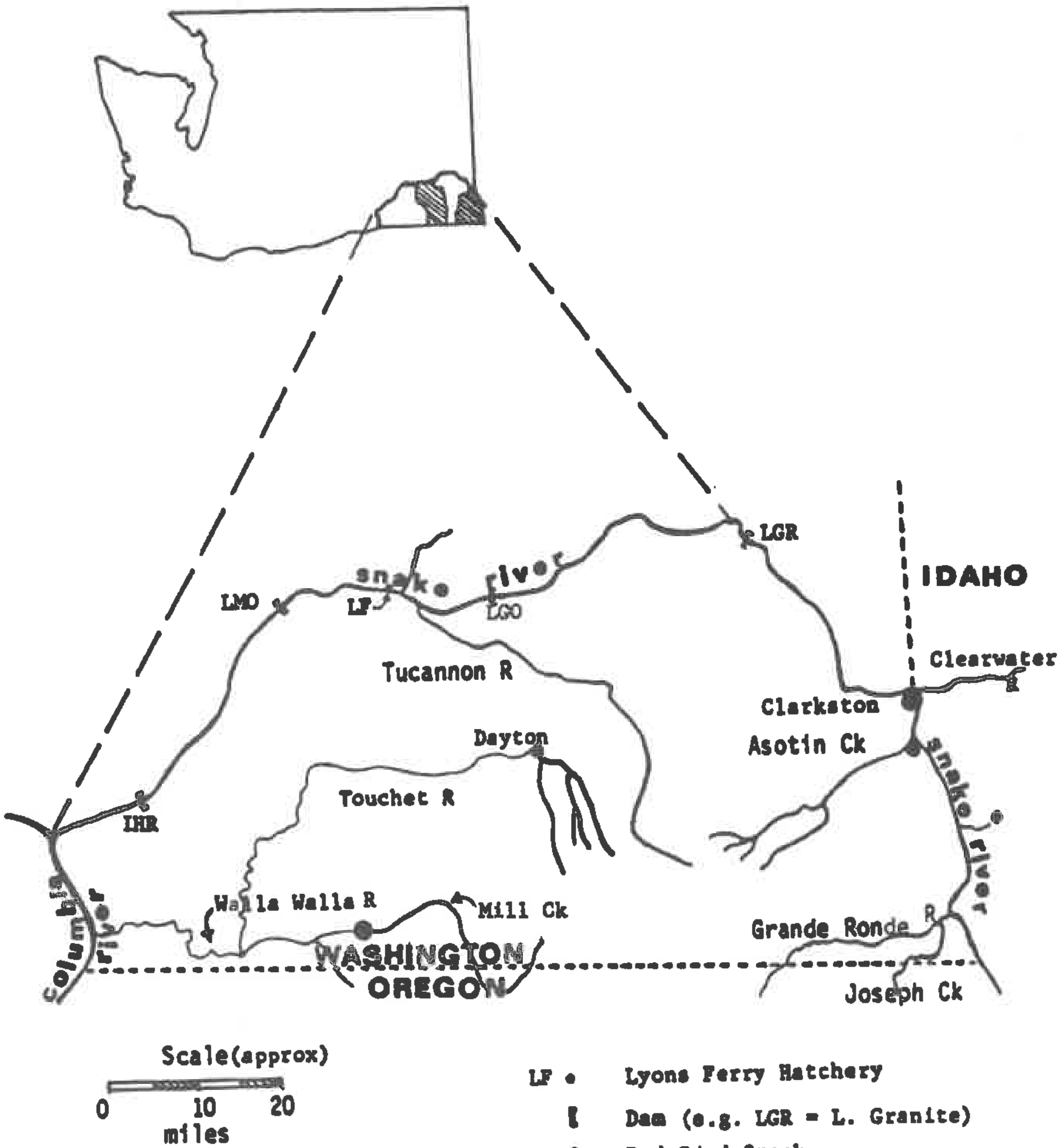


Figure 1. The relative locations of the major streams in southeast Washington and the landmarks used in this study.

harvest. Creel survey methods were generally similar to those described by Mendel et al. (1988) and Schuck et al. (1989). The methodology this year was again an effort to maximize the number of fish sampled for marks and cwt recovery. Expansions of tags harvested by Idaho anglers were done by IDFG personnel and provided to us for inclusion in this report.

We adjusted punchcard harvest in Washington by multiplying estimated harvest by our correction factor (1.1205) for underestimation (Mendel et al. 1988). Total estimated tags harvested was based on the adjusted figures. Sport fishing exploitation rates in the Snake River above Lower Granite Dam were computed using disk tag return rates.

Harvest of adults destined for Compensation Plan areas occurs in sport, commercial and treaty Indian fisheries throughout the Columbia River Basin. Estimates of harvest and tags recovered (interception rates) are available from WDW, Oregon Department of Fish and Wildlife (ODFW), IDFG, WDF and the Indian tribes. Where these data are available, they are used to determine the total contribution of LSRCP fish within the basin.

Returns of Coded Wire Tag Groups

Coded wire tags are collected throughout the Columbia River basin by several agencies in several different sport, tribal and commercial fisheries. Tag recoveries are either reported directly to the tagging agency along with sample rate information and pertinent fishery information or reported to the PMFC for inclusion in the tag recovery data base. Both of these types of tag recovery are used in assembling data for this report. In addition, recovery of our tags through LSRCP evaluation activities is a primary source of tag recovery for the Snake River drainage.

Juvenile Steelhead Populations in Project Rivers

Summer Densities

We did not collect juvenile salmonid densities in streams this year. Personnel from WDF electrofished extensively throughout the Tucannon River for separate habitat types (pool, riffle, run, and side channel). The steelhead/rainbow trout and other non-chinook species data from that sampling are presented in Appendix B. A summary of chinook salmon densities by habitat type in the Tucannon River for 1988 can be found in Bugert et al.(1989). Habitat data for sites were collected according to WDF procedures (Seidel and Bugert 1987).

RESULTS AND DISCUSSION

Hatchery Operation Monitoring

Juvenile Growth

A summary of production for both hatcheries is presented in Table 1. Numbers in the table represent lot performance over an entire production period.

Table 1: Trout production at Lyons Ferry/Tucannon hatcheries, 1988-89.

Specie[A]	Stock[A]	No. Eggs	No. Fry	Number planted	Percent[B] survival	Food fed(lbs)	Fish(lbs) produced	Feed conv.
TUCANNON HATCHERY								
RB	SPOK.	210,050	163,944	170,279	81.1	67,185	57,845	1.16
LYONS FERRY HATCHERY								
RB	SPOK.	291,450	282,750[C]	96,080[D]	83.7	44,741	34,223	1.12
SSH	LFH	941,765	818,148	597,607	63.5	137,928	103,075	1.34
SSH	WA	502,956	479,387	424,915[E]	84.5	50,605	43,902	1.15

A- RB = rainbow, SSH = summer steelhead, SPOK = Spokane, LFH = Lyons Ferry Hatchery, WA = Wallowa.
B- Egg to smolt/catchable survival.
C- 48,108 fish weighing 4,220 lbs. planted to Sprague Lake and 99,885 fish weighing 1,683 lbs. transfered to IDFG.
D- Planted in Washington.
E- Includes 101,080 pre-smolts planted at 53.2/lb.

Lyons Ferry Hatchery stock fish reared 395-410 days from egg to smolt while Wallowa fish reared one year. One group of Lyons Ferry stock fish were fed OMP while the remaining groups were fed Silver Cup dry salmon diet. All groups converted well (Table 1).

There was no outbreak of Infectious Hematopoietic Necrosis (IHN) at either hatchery this year in the 1988 brood.

All 1989 brood year eggs received from Oregon were examined by a pathologist and certified as disease free at the time of transfer. No further disease incidence or complications were noted.

Egg-to-fry survival for steelhead was acceptable for groups in 1989 (Table 2). Decreased survival rate in 1989 for LFH stock is a result of more intensive egg and fry picking due to IHN infections. We are unsure of the reasons causing decreased survival for Wallowa stock fish. The large egg take of LFH stock steelhead in 1989 was again made to ensure adequate eggs in the event of a heavy IHN infestation. IHN was found in all of the fish spawned, which eventually resulted in the loss of the entire years production.

Table 2: Juvenile mortality, Lyons Ferry Hatchery 1987-89

Stock	Brood year	Eggs in	Fry out	% Survival
Wallowa	1987	432,076[A]	414,176	95.8
	1988	502,956	479,387	95.3
	1989	236,214	186,958	79.1
LFH	1987	1,111,506[B]	983,901	88.5
	1988	941,765	793,240	84.2
	1989	1,263,237	941,163	74.5

A- Eyed eggs B- Green eggs

Fish Marking

We contracted our steelhead marking with WDF. Tag loss increased in 1989 over that experienced in 1988. Brand loss and overall brand quality decreased this year with 5.11% (SD=2.04) unreadable brands. A complete listing of the tag/brand groups is summarized in Table 3.

Fish at Release

Two stocks of steelhead, Wallowa and Lyons Ferry, were used in 1989. Samples were taken from various raceways and conditioning ponds during the release period (Table 4).

Table 4. Smolt characteristics at Lyons Ferry Hatchery, 1989.

Lake/ Raceway	Stock[A]	Number fish sampled	No. of sample days	Mean length mm (SD)	Mean weight gms (SD)	No. fish /lb.	K factor	% Precocious males
Cotton-wood C.P.	WA	520	4	180.2 (34.2)	67.7 (36.6)	6.7	1.05	2.6
Dayton C.P.	LF	443	4	208.5 (16.8)	94.8 (24.7)	4.8	1.03	4.7
Curl Lk.	LF	469	4	208.0 (17.0)	96.8 (23.4)	4.7	1.06	7.2
RW-11,12 OPM feed	LF	200	1	206.3 (15.6)	91.9 (20.3)	4.9	1.01	5.0
RW-13,14 Dry feed	LF	198	1	210.7 (19.0)	99.7 (25.8)	4.6	1.08	5.0

A. WA = Wallowa stock, LF = Lyons Ferry Stock.

Table 3: Lyons Ferry steelhead smolt releases and mark groups.

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
1987											
TOUCHET R.@DAYT	53	102,050	19,625	4/20-30	WELLS			AD	5.2		
TOUCHET R.@DAYT	53	34,677	6,669	4/20-30	L.FERRY			AD	5.2		
WALLA WALLA R.	32	50,527	8,500	04/21	WELLS			AD	5.9		
WALLA WALLA R.	32	18,880	3,200	04/22	WELLS			AD	5.9		
WALLA WALLA R.	35	25,016	4,905	04/30	WELLS			AD	5.1		
WALLA WALLA R.	35	7,150	1,300	04/22	L.FERRY			AD	5.5		
WALLA WALLA R.	38	23,400	4,500	04/24	L.FERRY			AD	5.2		
MILL CR.	3	26,100	4,500	04/21	WELLS			AD	5.8		
SNAKE R.@ IHD		11,314	2,057	04/23	WELLS		RD-7P-1	AD	5.5		
SNAKE R.@ IHD		11,468	2,085	04/27	WELLS		LA-7P-3	AD	5.5		
SNAKE R.@ IHD		11,406	2,001	04/30	WELLS		LA-7P-1	AD	5.7		
SNAKE R.@ LFH	58	649	118	04/23	WELLS	P.I.T.		AD	5.5		
SNAKE R.@ LFH	58	650	116	04/23	WELLS	P.I.T.		AD	5.6		
SNAKE R.@ LFH	58	650	114	04/23	WELLS	P.I.T.		AD	5.7		
SNAKE R.@ LFH	58	19,972	3,385	04/23	WELLS		LD-7K-1	AD	5.9		
SNAKE R.@ LFH	58	18,676	3,335	04/27	WELLS		RA-7K-3	AD	5.6		
SNAKE R.@ LFH	58	19,716	3,459	04/30	WELLS		RA-7K-1	AD	5.7		
SNAKE R.@ LFH	58	25,384	5,288	4/24-30	L.FERRY	63/39/15	RA-IF-1	AD-LV	4.8	0.30	2.7
SNAKE R.@ LFH	58	25,459	5,304	4/24-30	L.FERRY	63/39/14	RA-IF-3	AD-LV	4.8	0.70	0.8
SNAKE R.@ LFH	58	25,431	4,462	4/24-30	WALLOWA	63/37/03	LA-IF-1	AD-LV	5.7	0.30	3.9
SNAKE R.@ LFH	58	25,586	4,489	4/24-30	WALLOWA	63/39/13	LA-IF-3	AD-LV	5.7	0.93	2.4
ASOTIN CR.	0.7	22,950	4,500	04/22	L.FERRY			AD	5.1		
TUCANNON R.@CURL	47	101,408	17,791	4/21-30	L.FERRY			AD	5.7		
TUCANNON R.@CURL	47	20,272	3,556	4/22-30	L.FERRY	63/38/45	RA-IY-2	AD-LV	5.7	0.35	4.3
TUCANNON R.@CURL	47	20,357	3,571	4/22-30	L.FERRY	63/39/03	RA-IY-3	AD-LV	5.7	0.12	4.9
TUCANNON R.@CURL	47	20,194	3,543	4/22-30	L.FERRY	63/38/44	RA-IY-1	AD-LV	5.7	0.11	1.9
G.RONDE @ C.WOOD	25	20,099	3,722	4/20-30	WALLOWA	63/38/40	RA-IC-1	AD-LV	5.4	0.56	5.4
G.RONDE @ C.WOOD	25	20,083	3,719	4/20-30	WALLOWA	63/38/41	RA-IC-2	AD-LV	5.4	1.00	5.2
G.RONDE @ C.WOOD	25	20,115	3,725	4/20-30	WALLOWA	63/38/42	RA-IC-3	AD-LV	5.4	0.58	1.0
G.RONDE @ C.WOOD	25	20,164	3,734	4/20-30	WALLOWA	63/38/43	RA-IC-4	AD-LV	5.4	0.23	7.7
G.RONDE @ C.WOOD	25	120,384	22,286	4/20-30	WALLOWA			AD	5.4		
G.RONDE IN ORE.	41	25,340	4,500	04/28	WALLOWA			AD	5.6		
G.RONDE IN ORE.	41	27,160	4,656	04/29	WALLOWA			AD	5.8		
"totals"		922,687	168,715					Mean fish/pound =	5.5	0.5	3.7
								SD =	0.3	0.3	2.0
1988											
SNAKE R.@ LFH	58	25,025	5,324	4/28	L.FERRY	63/50/19	LA-S-1	AD-LV	4.7	0.91	1.40
SNAKE R.@ LFH	58	25,317	5,387	4/28	L.FERRY	63/50/16	LA-S-2	AD-LV	4.7	0.50	1.30
SNAKE R.@ LFH	58	25,260	5,374	4/30	L.FERRY	63/50/14	RA-S-2	AD-LV	4.7	0.39	0.97
SNAKE R.@ LFH	58	25,123	5,345	4/30	L.FERRY	63/50/13	RA-S-1	AD-LV	4.7	0.70	1.40
SNAKE R.@ LFH	58	4,392	915	4/29	WALLOWA			AD	4.8		
ASOTIN CREEK	0.7	28,975	4,750	4/20	WALLOWA			AD	6.1		
WALLA WALLA R.	22	25,200	4,500	4/21	L.FERRY			AD	5.6		
WALLA WALLA R.	24	25,650	4,500	4/21	L.FERRY			AD	5.7		
WALLA WALLA R.	27	19,000	3,600	4/22	L.FERRY			AD	5.3		
WALLA WALLA R.	25	5,040	900	4/22	L.FERRY			AD	5.6		
WALLA WALLA R.	25	25,200	4,500	4/22	L.FERRY			AD	5.6		
WALLA WALLA R.	22	30,596	5,666	4/22	L.FERRY			AD	5.4		

Table 3 (cont.)

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
WALLA WALLA R.	24	25,200	4,500	4/25	L.FERRY			AD	5.6		
WALLA WALLA R.	27	25,200	4,500	4/26	L.FERRY			AD	5.6		
MILL CREEK	3	25,650	4,500	4/21	L.FERRY			AD	5.7		
MILL CREEK	3	26,100	4,500	4/26	L.FERRY			AD	5.8		
GRANDE RONDE	25	208,262	43,387	4/15	WALLOWA			AD	4.8		
GRANDE RONDE	22	12,414	2,035	4/29	WALLOWA			AD	6.1		
TOUCHET R.@DAYT	53	19,992	4,209	4/15-	L.FERRY	63/50/28	LA-IV-3	AD-LV	4.7	0.20	2.00
TOUCHET R.@DAYT	53	18,871	3,973		L.FERRY	63/50/31	LA-IV-1	AD-LV	4.7	0.61	0.51
TOUCHET R.@DAYT	53	19,681	4,143	TO	L.FERRY	63/49/49	RA-IV-3	AD-LV	4.7	0.57	1.14
TOUCHET R.@DAYT	53	20,001	4,211		L.FERRY	63/49/47	RA-IV-1	AD-LV	4.7	0.09	0.78
TOUCHET R.@DAYT	53	92,179	19,406	-4/30	L.FERRY			AD	4.7		
TUCANNON R.@CURL	48	20,121	3,530	4/25 -	L.FERRY	63/49/44	LA-H-1	AD-LV	5.7	0.60	0.80
TUCANNON R.@CURL	48	20,110	3,528	TO	L.FERRY	63/49/42	RA-H-2	AD-LV	5.7	0.53	2.66
TUCANNON R.@CURL	48	20,115	3,529		L.FERRY	63/49/41	RA-H-1	AD-LV	5.7	0.77	2.79
TUCANNON R.@CURL	48	100,947	17,710	-4/30	L.FERRY			AD	5.7		
G.RONDE IN ORE.	41	50,640	8,440	4/28	WALLOWA			AD	6.0		
"totals"		970,341	186,862				Mean fish/pound =		5.2	0.53	1.43
								SD =	0.5	0.2	0.7
1989											
SNAKE R.@ LFH	58	51,152	10,234	4/30	L.FERRY	63/55/08	RA-IJ-1	AD-LV	5.0	3.60	6.80
SNAKE R.@ LFH	58	47,352	10,315	4/30	L.FERRY	63/01/32	RA-IJ-3	AD-LV	4.6	0.90	9.10
WALLA WALLA R.	24	18,300	3,050	4/21	WALLOWA			AD	6.0		
WALLA WALLA R.	22	21,600	4,500	4/19	L.FERRY			AD	4.8		
WALLA WALLA R.	24	21,600	4,500	4/20	L.FERRY			AD	4.8		
WALLA WALLA R.	27	21,600	4,500	4/20	L.FERRY			AD	4.8		
WALLA WALLA R.	25	21,360	4,450	4/20	L.FERRY			AD	4.8		
WALLA WALLA R.	25	1,680	350	4/21	L.FERRY			AD	4.8		
MILL CREEK	3	21,600	4,500	4/19	L.FERRY			AD	4.8		
ASOTIN CREEK	0.7	29,975	5,450	4/27	WALLOWA			AD	5.5		
GRANDE RONDE	25	222,050	41,896	4/18-27	WALLOWA			AD	5.3		
G.RONDE IN ORE.	41	50,410	9,700	4-25/26	WALLOWA			AD	5.2		
TOUCHET R.@DAYT	53	20,465	2,766	4/18	L.FERRY	63/02/50	LA-IT-3	AD-LV	4.8	0.70	2.30
TOUCHET R.@DAYT	53	20,224	2,889		L.FERRY	63/02/49	RA-IT-3	AD-LV	4.8	0.90	4.70
TOUCHET R.@DAYT	53	20,444	2,921	TO	L.FERRY	63/02/47	LA-IT-1	AD-LV	4.8	0.60	4.60
TOUCHET R.@DAYT	53	20,565	2,896		L.FERRY	63/50/53	RA-IT-1	AD-LV	4.8	0.70	2.00
TOUCHET R.@DAYT	53	78,870	13,850	4/27	L.FERRY			AD	4.8		
TUCANNON R.@CURL	48	20,261	4,604	4/15	L.FERRY	63/50/35	LA-IJ-1	AD-LV	4.4	0.80	5.40
TUCANNON R.@CURL	48	20,502	4,604		L.FERRY	63/50/49	LA-IJ-4	AD-LV	4.4	0.70	5.30
TUCANNON R.@CURL	48	20,178	4,586	TO	L.FERRY	63/50/50	LA-IJ-3	AD-LV	4.4	1.30	5.80
TUCANNON R.@CURL	48	99,190	22,543	5/08	L.FERRY			AD	4.4		
total		849,378	165,104					Mean =	5.1	1.13	5.11
								SD	0.37	0.89	2.04

Fish size at release ranged from 4.6 - 8.0 fish/lb and the average size for the entire release of smolts was 5.8 fish/lb (Std.Dev.=1.5). Total production was 849,378 fish totaling 165,104 pounds. Table 3 summarizes the smolt releases into southeast Washington rivers for 1987-1989.

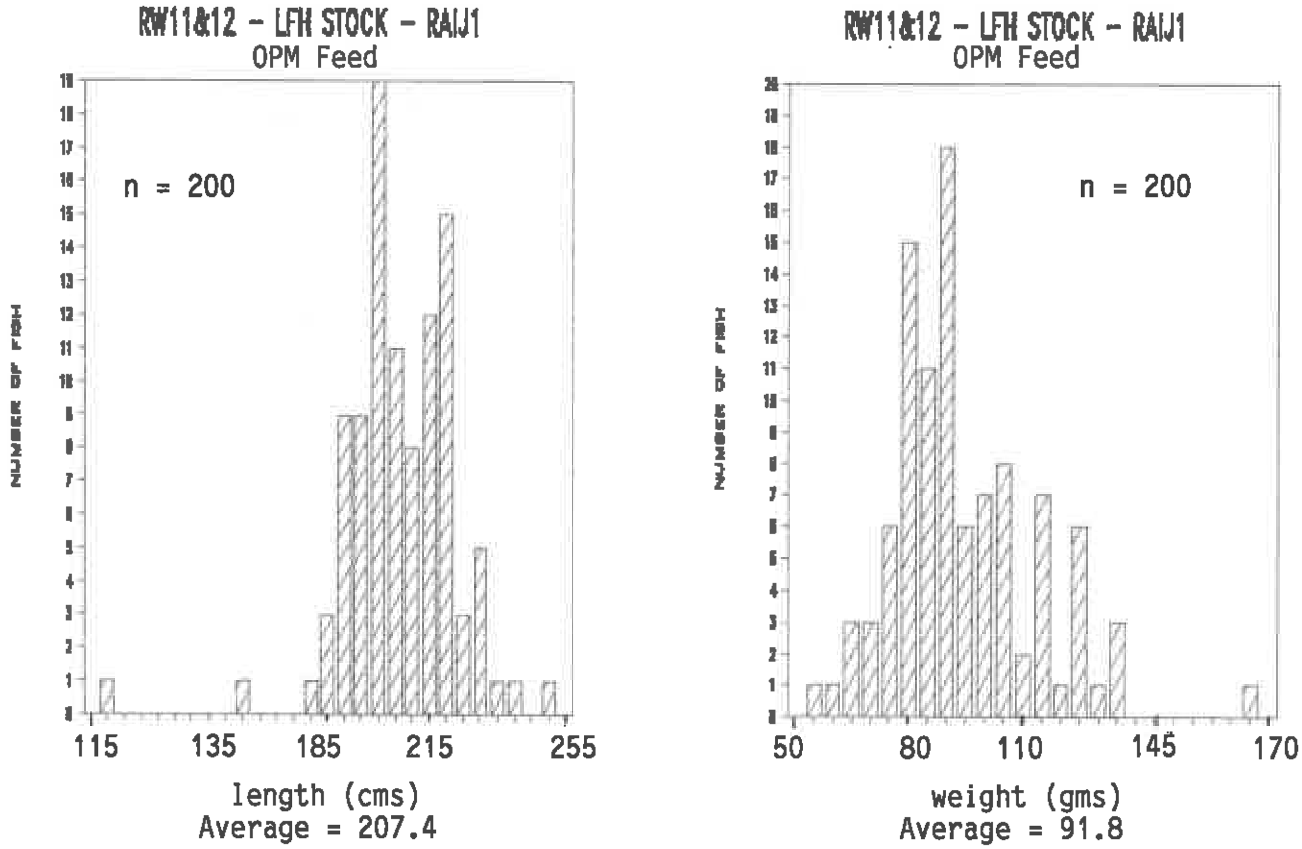
Precocious males usually migrated out toward the end of the release period, with almost no precocious fish captured on the first sample day when fish began migrating volitionally. Transitionally developed fish, those not fully developed as a smolt based on physical appearance, comprised an average 33.5% (SD= 8.6%) of conditioning pond fish sampled at release. Cottonwood C.P. had the highest levels of transitional fish (38.4% SD= 12.6) of any of the C.P.'s. Fish coming directly out of the raceways at LFH had a much higher percentage of transitional fish, 74.7% and 58.0% for dry food fed and moist food fed, respectively, than found in the C.P.'s. A further comparison of OMP versus dry feed fed fish was done using physiological data and portions of the Goedes' Organosomatic index. There was no significant difference between the two groups in any of the factors compared. The actual data used to compare the groups is provided in Appendix C. Figures 2-6 depict the range and variation of samples of fish lengths and weights taken from raceways and conditioning ponds in 1989.

The USFWS research groups from Cook, WA sampled smolts from Curl Lake and Dayton conditioning ponds and from one hatchery rearing pond to compare the physiological response of smolts to the conditioning pond environment. Sampling was done at the hatchery just prior to transfer of smolts to the C.P.'s, every 2 days for the month of March, every four days in April, just before release and finally when fish were collected at McNary Dam after release. Residualized fish were also sampled from the streams when fish were collected at the dam, precocious males were not sampled. The results are presented in Figures 7-9. There was a response in both plasma thyroxin and gill ATPase for fish moved to the C.P.'s. No such response was noted in the hatchery fish until after release. There was also a significant difference in the size of fish collected at the dam from size at release and from size of fish remaining in the streams.

Discussion

The availability of conditioning ponds allowed us to move fish out of the hatchery in early March. This greatly reduced the amount of time spent hauling fish in the critical spring smolt release period.

Fish growth and performance was excellent. Feed conversions were within expected parameters. Smoltification at time of release appeared to be very good for most fish. There continues to be a difference in the size of fish we sample at release and that reported on hatchery planting sheets over the release period. In some cases we attributed differences to small sample size or a biased sample from conditioning ponds. We increased sample size in 1987 and 1988 to address this problem. The two sets of numbers



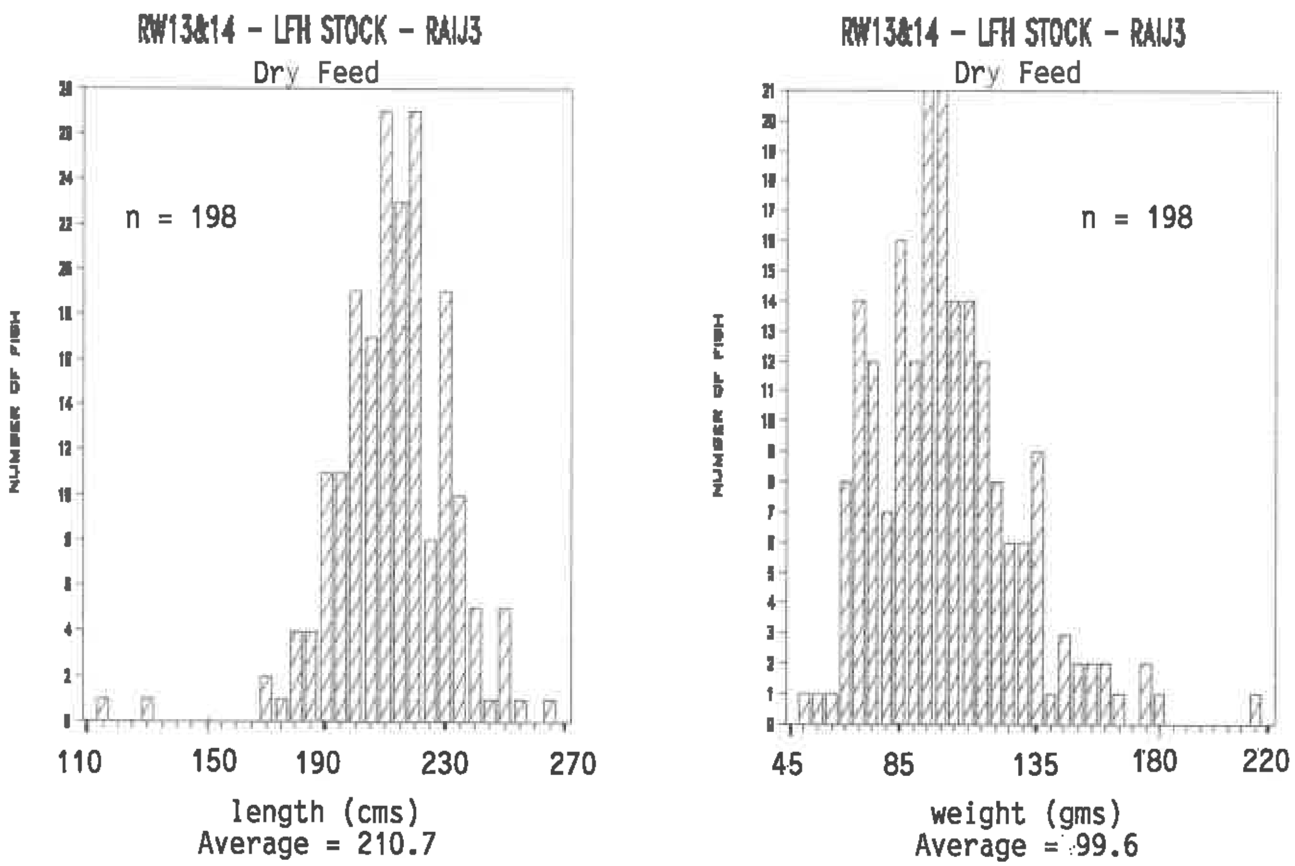
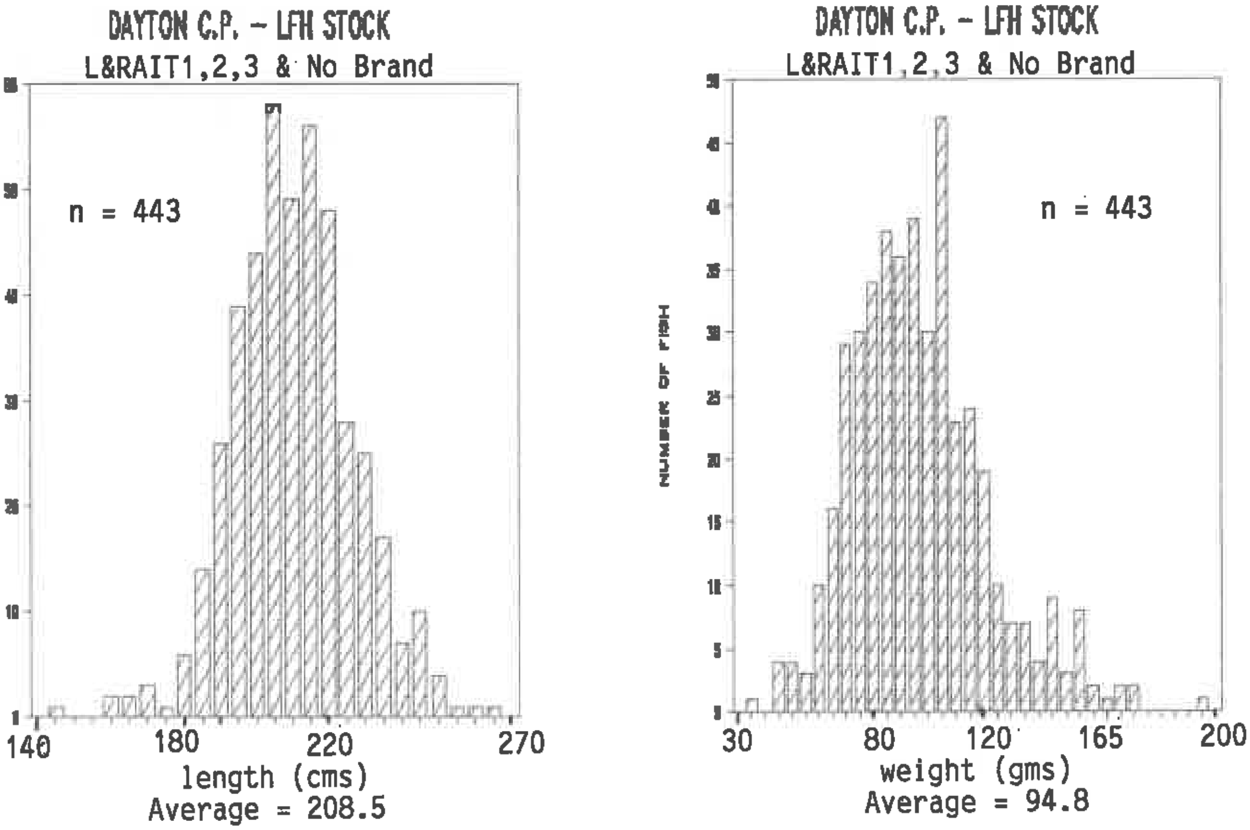


Figure 2: top; Figure 3: bottom



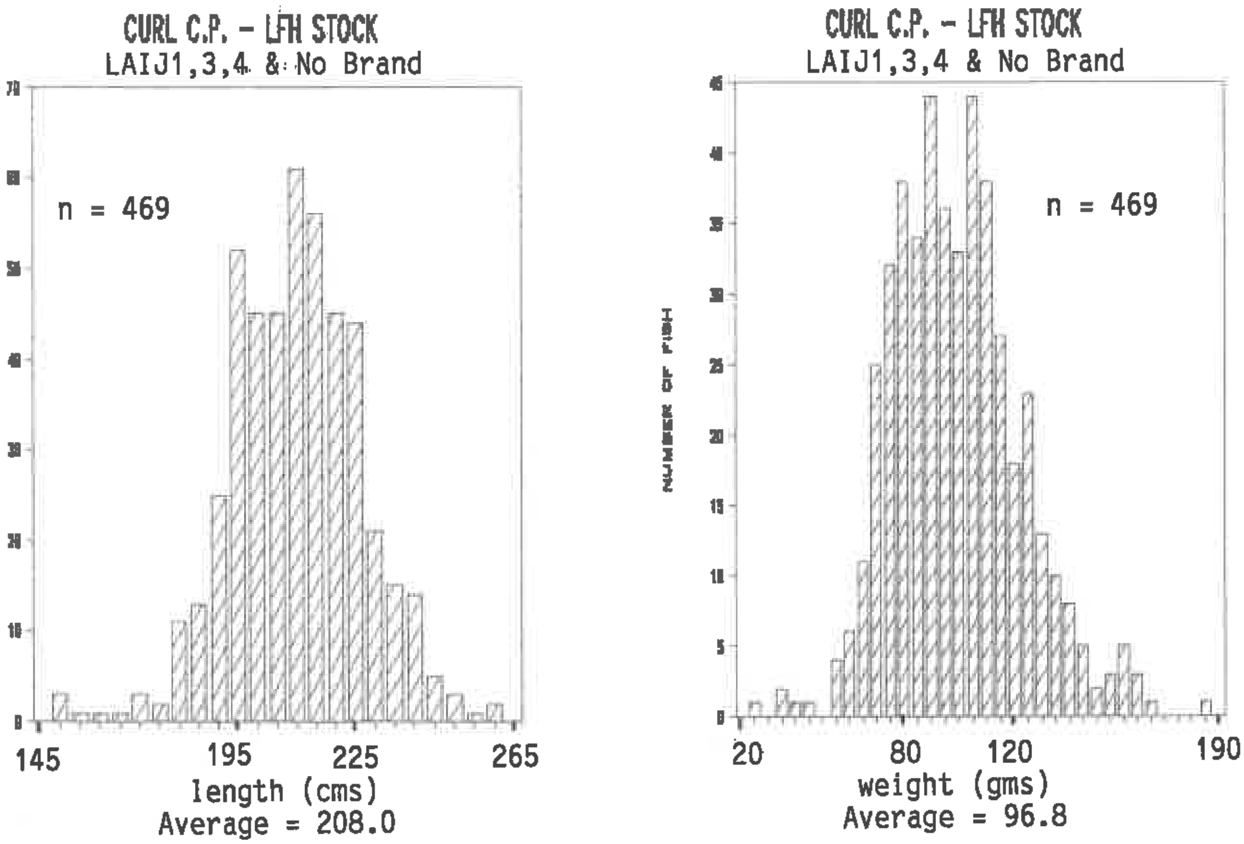
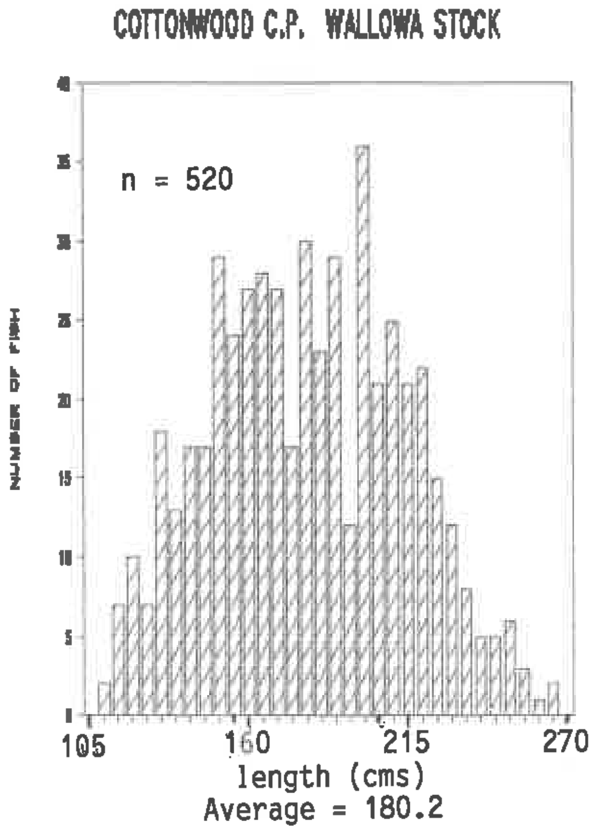


Figure 4: top; Figure 5: bottom


COTTONWOOD C.P. WALLOWA STOCK
n = 520
NUMBER OF FISH
105
160
215
270
length (cms)
Average = 180.2

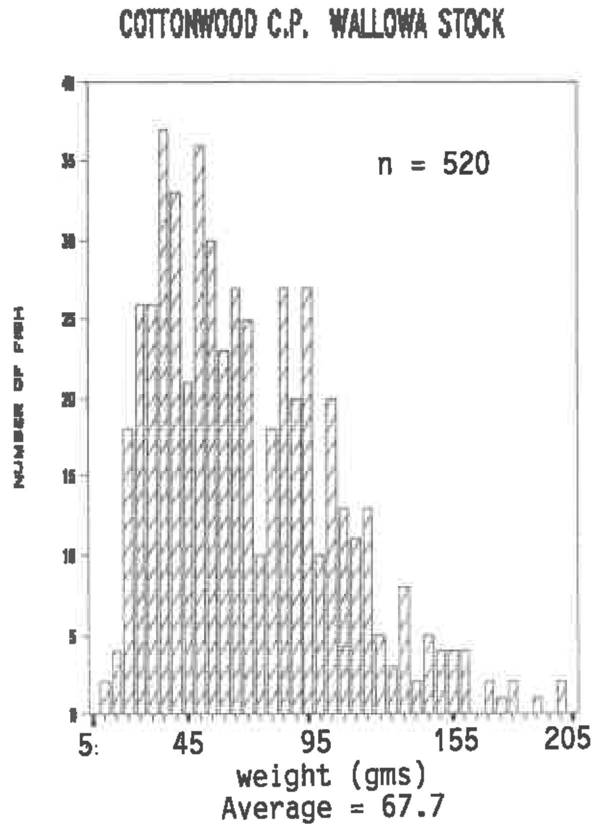

COTTONWOOD C.P. WALLOWA STOCK
n = 520
NUMBER OF FISH
5
45
95
155
205
weight (gms)
Average = 67.7

Figure 6.

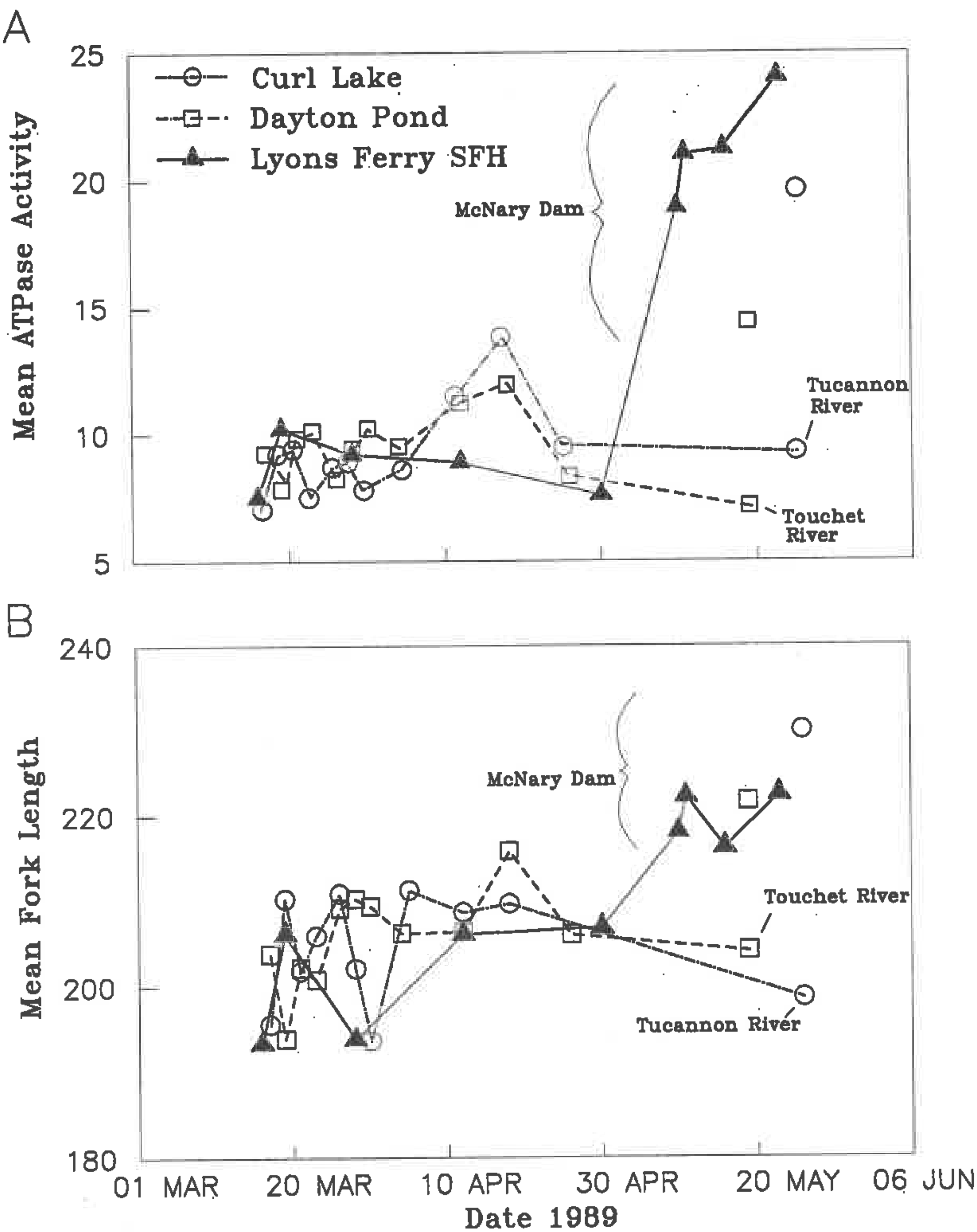


Figure 7: Mean ATPase (umoles P · mg $Prot^{-1}$ · hr^{-1}) (A) and mean fork length (mm) (B) of juvenile steelhead trout held at Curl Lake and Dayton Pond acclimation ponds and those reared at the Lyons Ferry State Fish Hatchery, 1989.

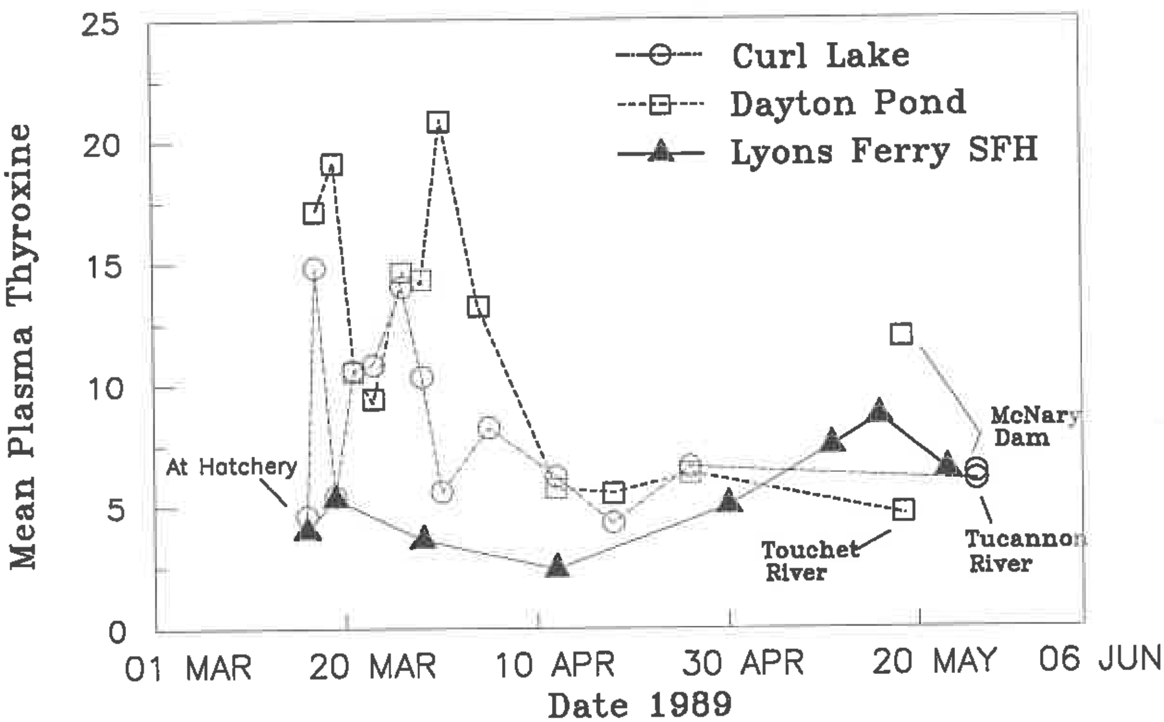


Figure 8: Mean plasma thyroxin levels of juvenile steelhead held at Curl Lake and Dayton acclimation ponds and those reared at LFH, 1989.

compared much more closely in 1987 whereas marked differences appeared in 1988. The sampling procedure for hatchery records must be scrutinized to determine a method that is more consistent and accurate from year to year.

The tagging program went smoothly this year. Brand quality was stressed daily during the marking in 1988. We suspected that poor brand quality experienced in 1987 was due primarily to improper branding procedure and failure to consistently correct the problem, especially with new branding personnel. Constant observation and correction of improper technique is essential for consistent brand quality, even when using experienced branding personnel.

Results from the physiology samples raise several questions; 1) If our smolts are experiencing the desired physical changes that are normally associated with imprinting, why are so many of these fish migrating past their rivers of release as returning adults to the upper Snake River? 2) Does the larger size of fish collected at McNary Dam indicate that we should be releasing larger smolts from our facilities to improve emigration? 3) Does the gill ATPase decrease prior to 1 May in the conditioning pond fish indicate that we should be releasing our fish earlier in the year? Unfortunately, we do not yet fully understand the interaction or importance each of these factors has on smolt survival and homing. Neither do we understand whether environmental factors, such as drought and summer water temperatures in the Snake and Columbia rivers, may also be having an impact on fish behavior. We will continue to investigate all these questions in an attempt to fully describe and understand the problem and provide a solution.

Hatchery Smolt Emigration

Releases

All smolt plants for 1986-89 are summarized by release day in Table 3. Three types of release are now used: 1) brood stock smolt releases from Lyons Ferry are allowed to volitionally migrate from the rearing ponds, 2) fish are pumped from the release structure into tank trucks and hauled directly to various streams and rivers in Southeast Washington; and 3) fish are pumped from the release structure into tank trucks, then transferred to conditioning ponds on the Tucannon, Grande Ronde and Touchet rivers. After 5-8 weeks in the conditioning ponds the fish are then allowed to volitionally emigrate over a 2 week period before the remaining fish are forced from the ponds.

The conditioning ponds were watched closely to ensure that any problems that might occur would not jeopardize the fish. Fish were transferred to conditioning ponds in early March. The screens were removed from the outlet structures of Cottonwood and Dayton ponds on 18 April in response to smolts actively schooling and circling the ponds. Screens were removed from Curl Lake on 15 April. To encourage emigration, pond levels were lowered 8". Large numbers of fish were noted exiting Dayton and Cottonwood ponds for the next

3-4 days. Emigration then slowed for the next 7 days. We continued to feed the fish during this period but stopped feeding on 22 April. The fish then began to actively leave the ponds as the level was lowered. Cottonwood and Dayton ponds were empty on 27 April. Very cold weather and resulting cold water temperatures in the Tucannon River again inhibited emigration from Curl Lake. Pond levels were drawn down steadily for 5 days until Curl Lake pond was empty, on 8 May.

Migration Through Dams

Table 5 summarizes passage estimates for brand groups released in 1987 - 1989. Median (50%) passage of the fish from all 1989 groups passed McNary Dam around 20 days after release, although individuals from various groups continued to pass the dams through the end of July. Average daily travel rates for various brand groups ranged between 5.2-5.8 miles per day to McNary dam (FPC,1989). These travel rates are consistent with groups released in previous years (Schuck et al, 1989). Travel rates appeared to increase for the groups below McNary Dam. Sample size and trapping efficiency is poor at John Day Dam which may invalidate these data.

Table 5. Estimated passage of branded Lyons Ferry and Wallowa stock steelhead at McNary Dam, 1987-89. (FPC 1987-88-89).

Brand[A]	Release site	Passage index	Number released	% of release	Size (#/lb)	Stock[B]
McNary						
1987						
RA-IF-1,3	LFH	18,906	50,843	37.2	4.8	LFH
LA-IF-1,3	LFH	18,005	51,017	35.3	5.7	WA
RA-IY-1,2,3	Tucannon	16,930	60,823	27.8	5.7	LFH
1988						
LA,RA-H	Tucannon	12,134	59,290	20.5	5.7	LFH
LA,RA-S	LFH	29,807	99,449	29.9	4.7	LFH
LA,RA-IV-1,3	Touchet	21,547	77,669	27.7	4.7	LFH
1989						
RA-IJ-I	LFH	15,529	51,152	30.4	5.0	LFH
RA-IJ-3	LFH	15,072	47,352	31.8	4.6	LFH
LA-IJ-1,3,4	Tucannon	13,961	60,941	22.9	4.4	LFH
LA-IT-1,3	Touchet	13,503	40,909	33.0	4.8	LFH
RA-IT-1,3	Touchet	12,572	40,789	30.8	4.8	LFH

A Refer to table 3 for additional information.
B LFH = Lyons Ferry Hatchery, WA = Wallowa

Discussion

Average fish size increased again for 1988 releases while size variability remained similar to previous years (Table 4).

Hatchery steelhead emigration appeared to closely follow that of wild fish, which peaked in late April (see Juvenile Populations). The Tucannon River fish were again the slowest to leave their river system. Migration appeared to occur only after several days residence within the river itself.

Other groups of fish appeared to migrate quickly from their release site and continue downstream without delay.

The passage index (P.I.) shows consistent passage performance to McNary Dam for groups released at LFH and the Tucannon River. Passage at McNary for fish released on the Tucannon River increased dramatically in 1987 over 1986 passage (Schuck et al 1989) and we concluded that the change to the new Lyons Ferry stock of fish might be having a strong benefit on the Tucannon. The P.I. for Tucannon released fish was lower this year however and only about 70% of the P.I. for both LFH and Dayton C.P. releases. Migration speed was similar for all groups.

The difference in the P.I. may indicate reduced smoltification of the Tucannon releases, however this seems to be inconsistent with the physiological samples collected by the USFWS. We believe that additional intensive sampling of several factors such as stock behavior, fish physiology, C.P. climate and release size is necessary to provide an answer. Early indications are that all these factors may be affecting emigration performance and smolt survival.

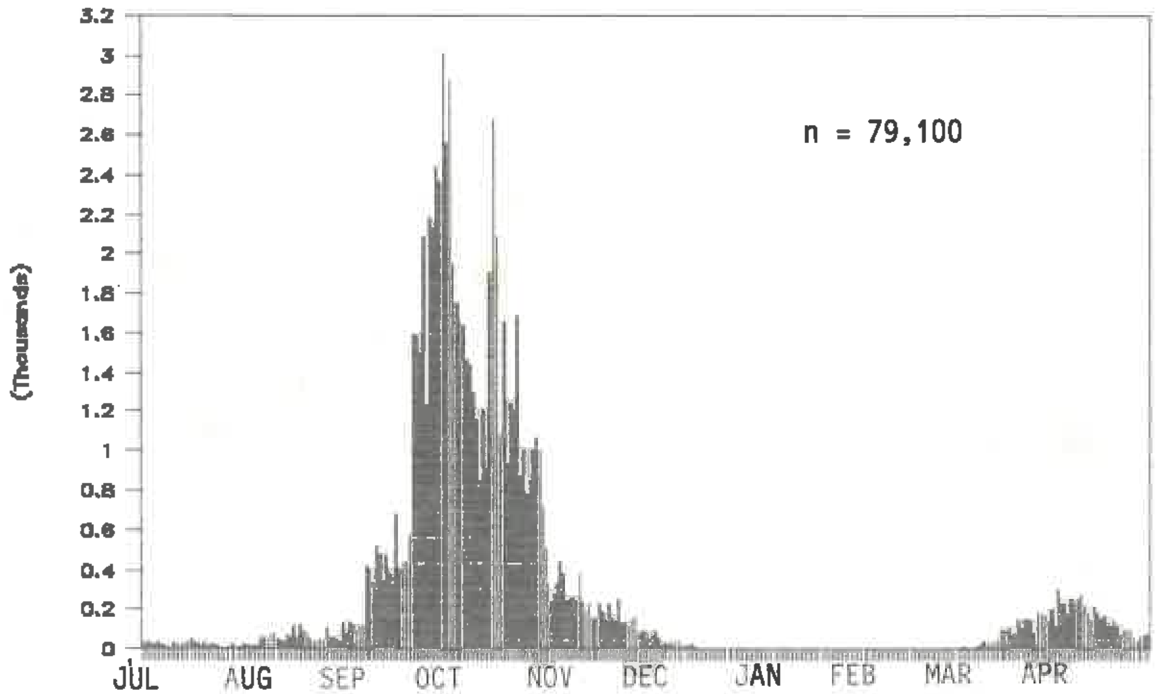
Tagged and branded smolts were released from the Dayton C.P. for the second time in 1989. Performance based on their P.I. and travel rates was very similar to fish released from LFH, and an improvement over the 1988 performance.

Adult Steelhead Returns

Passage at Dams

Table 6 lists estimated escapement of Lyons Ferry fish to above Lower Granite Dam (LGD), by release year, for each mark group and the percentage of release that these fish represent.

Run timing for the Wallowa stock fish generally follows passage norms at LGD (Figure 9). The first returns of LFH fish to LGD in 1988 occurred in April, a full year before their spawning time.



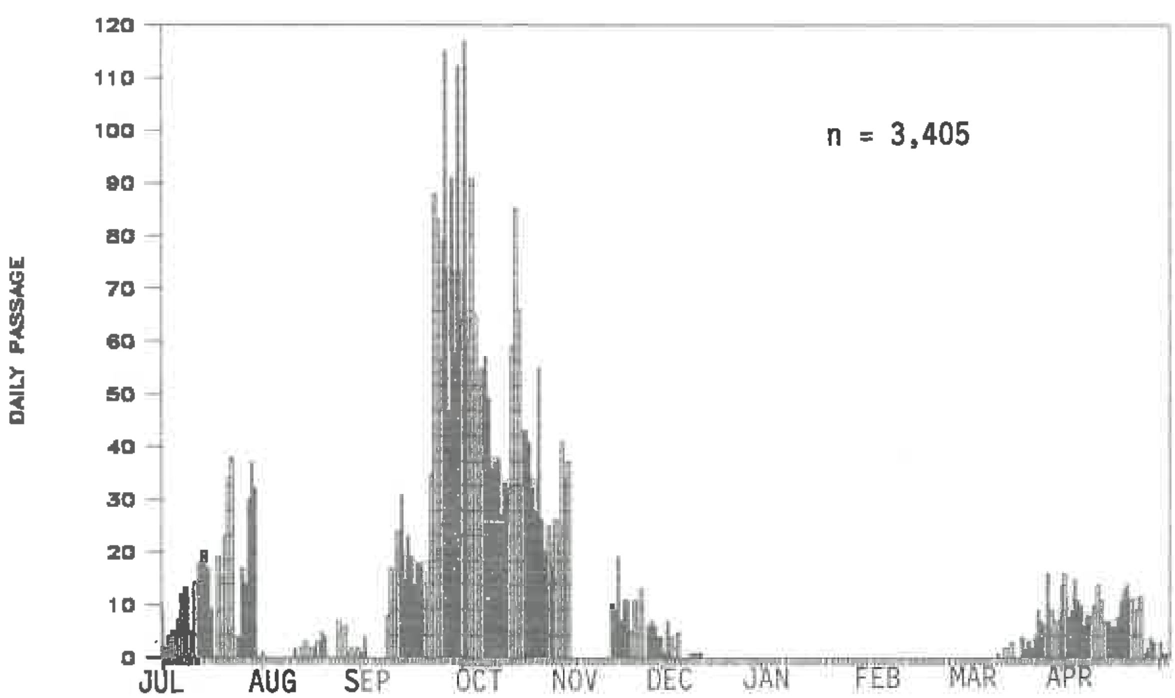


Figure 9: Lower Granite Dam steelhead passage (top), and Wallowa stock passage at Lower Granite Dam (bottom), 1988-89.

Table 6: Adult returns of Lyons Ferry steelhead to above Lower Granite Dam, 1985-87. (Harmon, 1988)[1]

Release year Brand*	Number of adults Return year 1986	1987	1988	Total adults captured	No. smolts rel.	% survival[2]
1985						
RA-H-1	429	147	0	576	28,191	2.04
RA-H-2	83	64	0	147	28,373	0.51
RA-17-1	553	259	4	816	41,028	2.04
RA-17-3	468	203	2	673	40,201	1.74
LA-S-1	101	71	0	172	39,094	0.45
LA-S-2	85	88	0	173	39,094	0.46
1986						
LA-IJ-1		135	133	268	20,136	1.33
LA-IJ-3		131	129	260	20,506	1.27
LA-IJ-4		123	116	239	20,639	1.16
LA-IK-1		83	128	211	20,246	1.04
LA-IK-3		84	86	170	20,234	0.84
RA-IK-1		70	87	157	20,244	0.78
RA-IK-3		88	95	183	20,250	0.90
LA-IT-1		14	45	59	20,172	0.29
LA-IT-3		21	41	62	20,177	0.31
RA-IJ-1		121	154	275	20,205	1.36
RA-IJ-4		99	143	242	20,038	1.21
RA-IJ-3		122	191	313	20,234	1.55
1987						
RA-IF-1			270	270	25,308	1.07
RA-IF-3			292	292	25,281	1.16
LA-IF-1			193	193	25,355	0.76
LA-IF-3			185	185	25,348	0.73
RA-IY-2			63	63	20,201	0.31
RA-IY-3			82	82	20,335	0.40
RA-IY-1			63	63	20,172	0.31
RA-IC-1			129	129	19,986	0.64
RA-IC-2			141	141	19,882	0.71
RA-IC-3			140	140	19,998	0.70
RA-IC-4			127	127	20,118	0.63

* 1985: RA-H LFH; RA-17 = G.Ronde LA-S = Tucannon R. 1986: LA-IJ & IK = LFH; RA-IK & LA-IT = Tucannon; RA-IJ = G.Ronde. 1987: RA-IF and LA-IF = LFH; RA-IY = Tucannon R.; RA-IC = G. Ronde.

1 No current estimate of trap efficiency exists for the L. Gran. bypass. Past studies indicate 85-90% (Harmon, Pers. Comm). These numbers are not expanded.

2 Smolt to adult survival is based on numbers of tagged juveniles released with a corresponding brand. (Adjusted for tag and brand loss)

Characteristics of Returning Adult Steelhead

The information from returning adult steelhead was collected at LGD from coded wire tagged/branded adults as they passed through the fish ladder. Releases through 1985 returned as 67.2% 1-ocean age, 32.5% 2-ocean age and 0.23% 3-ocean age. The size of fish for each year class for several brand groups is consistent over the 4 years represented (Table 7).

Table 7: Average lengths for Lyons Ferry hatchery adult Wallowa and Wells stock steelhead returning to LGD trap.

Release year	Release site	Brand	Mean length(cm) one ocean n[A]	one ocean L	two ocean n	two ocean L
1985	L.Ferry H.	RA-H-1[B]	429	58.5	147	70.0
	L.Ferry H.	RA-H-2	83	57.4	64	67.9
	G.Ronde R.	RA-17-1,3	1021	57.6	462	69.6
	Tucannon R.	LA-S-1,2	186	57.8	159	68.3
1986	L.Ferry H.	LA-IJ-1,3,4	389	59.2	389	71.7
	L.Ferry H.	LA-IK-1,3	167	59.6	167	71.2
	Tucannon R.	RA-IK-1,3	158	59.2	158	71.2
	Tucannon R.	LA-IT-1,3	35	59.4	35	69.7
	G.Ronde R.	RA-IJ-1,2,3	342	59.7	342	71.4
1987	L.Ferry H.	RA-IF-1,3	562	58.5		
	L.Ferfy H.	LA-IF-1,3	378	58.2		
	Tucannon R.	RA-IY-1,2,3	208	57.4		
	G.Ronde R.	RA-IC-1,2,3,4	537	58.2		
		Weighted Mean		**58.4**		**70.5**

A Sample size, does not necessarily indicate total return.
B Wells stock released at LFH.

Disk Tag Study

We compared voluntary returns of three different tag groups for statistical differences using Chi-Square, as described in Zar (1984). The comparisons were based upon tag recoveries as presented in Table 8. Results showed no significant difference between returns of fish tagged with $5 and $20 disk tags (P>.05). However there were significantly greater returns of fish tagged with $5 and $20 disk tags than returns of jaw tagged fish (P>.05).

Table 8. Numbers released, returned and percentages of returns from 3 different tag types used during the disk tag study, 1988-89.

Tag type	Number released	Number returned	Percent returned
$5 Disk	198	60	30.3
$20 Disk	198	72	36.4
$5 Jaw	203	41	20.2

Discussion

The results show that tag type, not reward amount, is responsible for the increased return rates. Also, it is not economically beneficial to increase rewards for returned disk tags to $20. A statistically similar rate of tag return can be accomplished with a $5 reward.

Significantly greater returns of disk tags may be the result of three factors: tag loss, tag color, and anglers collecting tags. Jaw tags may be lost from fish at a greater rate than disk tags. For example Slatick (1976) found that 20% of jaw tags were lost from steelhead in the upper Columbia and Lower Snake rivers. Our disk tags were red and may have been more visable to anglers than the silver colored jaw tags. It may be more of a novelty among anglers to keep a jaw tag as opposed to keeping a disk tag. We have data to test any of these theories.

The results of our tagging study have convinced us that the use of jaw tags as a measure of harvest will provide erroneous results. Specifically, voluntary jaw tag returns will underestimate the harvest of tagged fish in the sport fishery.

We did recover one disk tag from a tributary of the Grande Ronde River in April and one disk tag from the juvenile separator at Little Goose Dam in May, which had fallen out of the fish. Two additional tags were recovered from fish by personnel at the Little Goose Dam facility in May that were still securely attached. Based on our examination of disk tagged fish in the sport fishery, we do not believe there was a significant loss of tags prior to the end of the season.

We believe the results obtained with disk tags more closely represent a true level of harvest for our fish in the area above LGD. Exploitation of tagged groups of LFH reared steelhead by the Snake river sport fishery has been estimated using various methods in past years. Mendel and Schuck (1989) and Schuck et al (1989) concluded that the use of jaw tags consistently under estimated exploitation in the sport fishery. The return of dorsal disk tags was used as the basis for this conclusion and convinced us to follow up the study with an additional year of disk tagging. The results of our study this year strongly points to the error of using jaw tags as a tool in estimating exploitation and possible reasons for the error. What is important here is recognizing the level of sport exploitation of tagged groups of steelhead that has likely been occurring for the past several years. The lack of accurate information from jaw tags lead us to believe that a significant percentage of our fish passing Lower Granite Dam were neither contributing to the sport fishery nor returning to their point of release to spawn. The improved estimate of sport exploitation helps answer the question about the fate of seemingly unaccounted for fish. An exploitation rate of between 30-36% is much more acceptable than the previously reported 7-11%.

Returns to Lyons Ferry Hatchery

A total of 2,527 adult steelhead were trapped at Lyons Ferry Hatchery during the 1988 run. The ladder at the hatchery was operational from 1 Sept - 13 Dec 1988. A total of 1,127 adult steelhead were trapped for spawning during this time period. Mortality was 6.7% (76 fish) and 303 fish were returned to the river to spawn naturally. The ladder was open a second time from 27 March - 12 April, solely to sample returning adults for coded wire tags. Fourteen hundred adults were trapped for that purpose. All fish trapped during both time periods were inspected for fin clips, sex, origin and readable brands. Snouts were also collected from fish that had a ventral fin clip and unreadable brand. Natural mortality was 61.1% (855 fish) during the second trapping period and all other fish were returned to the river.

Fish sorted from fall trapping were comprised of 52.0% females and 47.9% males. Wild fish represented 0.53% of the sample and tagged/branded fish represented 10.7% of the total fall trapping. Fish sorted from spring trapping were comprised of 62.0% females, 27.1% males and 11.0% unknown sex. No wild fish were identified from second trapping period and tagged/branded fish represented 10.9% of the total spring trapping.

Branded Wallowa stock fish returning to Lyons Ferry Hatchery as brood stock were trapped at a 0.15 % return rate (137 fish) which represents a significant increase over the 0.004% return rate (7 Wallowa fish) measured in 1987. Branded 2-ocean Wells stock fish returned to the hatchery at a 0.14% return rate (84 fish). The number of returning 2-ocean age Wells stock fish were similar to the 1987 return of 0.11% (64 fish). Returns of 1-ocean age Lyons Ferry Hatchery stock during the 1988 run year was 0.38% (194 fish). A complete listing of brand and tag recoveries to the hatchery is summarized in Appendix D.

Two hundred and forty three (243) females and 576 males of hatchery origin were spawned yielding 1,263,237 fertilized eggs (mean =4,365 eggs/female for 1-ocean age and mean =6,021 eggs/female for 2-ocean age). Two ocean age fish produced an average of 38% more eggs per female. Females were selected weekly for spawning based on physical examination for ripeness. Males and females from the fall trapping that were retained for spawning were held in separate ponds.

Scale samples were collected from all spawned females and from 102 of the spawned males (Appendix E). Analysis of scale information from female fish showed that 48.5% were 1 ocean age, 42.4% 2 ocean age and 9.1% were regenerated scales which precluded age determination. Analysis of scale information collected from male fish showed that 72.5% were 1 ocean age, 14.7% 2 ocean age, 1.0% 3 ocean age fish while 11.8% were regenerated scales.

Nearly all lots of eggs sampled tested IHN positive based on ovarian fluid samples. These eggs were retained for production. Samples were also collected to test for IPN virus. All samples were negative.

Returns to Other Locations

Spawning Surveys

Table 9 presents a summary of spawning ground redd and adult observations for each stream surveyed in 1989. We have consistent data that shows that a slight fluctuation in the peak spawning period can be expected from year to year, dependent upon spring weather. Based on our previous years information, peak spawning occurred between mid April and mid May for the Tucannon river and its tributaries. The peak of Touchet River spawning also occurred between mid April and mid May except for the South Fork Touchet, where peak spawning occurred within the second week of April. Peak spawning for Asotin Creek and tributaries occurred prior to the second week of May. Peak spawning on Charlie Creek occurred prior to the third week in April (Schuck et al. 1989).

Discussion

This is the fourth year of spawning data on project streams. Spring runoff conditions determine the success of walking streams. In 1988 water and weather conditions were good for our surveys. This year a late and heavy run off precluded any attempt at an early (late March, early April) spawning ground survey. We were not able to walk any of the rivers until early May which left only enough time for one survey of each stream. Two surveys were accomplished on most streams in 1988.

Table 9. Redd survey results for streams in southeastern WA., spring 1989.

Stream	Section	Reach length (miles)	Dates surveyed	Redds	Adults	Total redds/mile	CFS	Avg. width (ft.)
Tucannon R.	Upper Tucannon[A]	7.8	5-16	9	1	2.2		32.8
	Main Tucannon[B]	22.4	5-16,17,31	45	3	2.0	154.4	44.1
	Panjab Creek	2.3	5-16	5	0	2.2		22.5
	Cummings Creek	6.5	5-17	28	2	4.3		13.3
	Meadow Creek	1.2	5-16	0	0	0		14.2
Touchet R.	Main Touchet[C]	1.5	6-8	1	0	0.6		49.5[D]
	South Fork	15.7	5-9,15	39	0	2.5	67.6	31.3
	North Fork	11.2	5-15/6-8	43	0	3.8	65.2	34.1
	Wolf Fork	10.3	5-9	34	7	3.3	60.9	28.5
	Robinson	5.0	5-12	16	1	3.2	17.7	19.7
Asotin Creek[E]								
	South Fork	6.6	5-3	21	4	3.2		13.1
	North Fork	4.8	5-4	25	6	5.2		31.6
	Charlie Creek	7.0	5-2	13	1	1.8	16.7	15.8

[A] From the mouth of Bear Creek to Panjab Bridge.
[B] From Panjab Bridge to Marengo.
[C] From the mouth of the South Fork to the highway bridge.
[D] Based on only one measurement of width.
[E] All of Asotin is in road miles, all other measurements are river miles.

The number of steelhead redds per mile were greatly reduced in all rivers in 1989 as compared to 1988. The mean number of redds per mile on the Tucannon River, Touchet River, Asotin Creek and their tributaries were only 25.1, 18.0 and 19.2 percent of those found in 1988.

Possible explanations for this reduction include: (1) Poor returns due to reduced survival and possible wandering behavior brought about by drought conditions of the previous two years. (2) A combination of a late survey conducted after the peak spawning period and high stream flows may have greatly reduced redd visibility.

Steelhead Creel Surveys

Lower Snake River

We relied on harvest estimates derived from statewide punchcard returns in 1989 (Table 10). Our creel sampling was primarily to obtain catch composition data and recover coded wire tags. A summary of data collected from fish observed on the Snake River is presented in Table 11. All fish kept this year were adipose clipped. In addition some were left ventral (LV) or right ventral (RV) clipped indicating the presence of a coded wire tag.

Table 10. Punchcard-derived steelhead harvest estimates for WDW manage-sections on the lower Snake River, fall 1988 and spring 1989 * (WDW 1988).

Month	Below Ice H.Dam	Below L. Mon. Dam	Below L. Goose D.	Below L. Granite D.	Above L. Granite D.
Sep.	39	4	143	28	194
Oct.	37	137	411	274	1019
Nov.	6	126	139	80	960
Dec.	28	233	111	85	1045
Jan.	7	152	67	94	546
Feb.	4	30	37	76	98
Mar.	0	4	9	102	198
	---	---	---	---	---
	121	686	917	739	4060

* WDG mgmt. sections are 164 = below Ice Harbor, 165 = below Lower Monumental Dam, 166 = below Little Goose Dam, 167 = below Lower Granite Dam, 168 = Above Lower Granite Dam.

Grande Ronde River

Approximately 1,842 angler days fishing effort were expended by anglers on that portion of the Grande Ronde River from Bogans Oasis to the Oregon State line (11.7 river miles of the 37.7 miles in Washington). The average completed fishing trip was 4.04 hours. Tables 12 and 13 are summaries of ODFW data collected from steelhead examined in angler creels along the Grande Ronde River, fall 1988 and spring 1989. The greatest harvest occurred in late March and early April near the Cottonwood Conditioning Pond. A total estimated 214 coded wire tags of 7 different tag groups released by Washington were harvested in the Grande Ronde River in 1988-89 (Table 17). All but three of the tags were harvested in the Washington portion of the river.

Table 11. Data from steelhead observed in angler creels along the Snake River, fall 1988 and spring 1989.

Section	Mean fork length (cm) (range) (n) [A]	Mean wt. (kg) (range) (n)	% Female (n)	% Males (n)	% Unknown (n)	% Fish released[B] (n)	% Ventral clipped (n)	Sampling rate[C]
166	75.9 (57.5-95.0) (99)	4.6 (1.9-14.5) (63)	60.7 (68)	27.7 (31)	11.6 (13)	15.8 (21)	11.6 (13)	10.8
167	68.5 (56.0-95.0) (47)	3.6 (1.8-6.8) (35)	43.1 (22)	43.1 (22)	13.7 (7)	19.0 (12)	13.7 (7)	5.8
168L	76.5 (52.1-102.0) (289)	5.1 (1.9-9.5) (184)	49.0 (171)	32.7 (114)	18.3 (64)	9.6 (37)	14.0 (49)	
168M	73.4 (50.3-106.0) (573)	3.8 (1.3-10.1) (149)	40.0 (280)	40.9 (286)	19.1 (134)	23.3 (220)	17.1 (120)	25.4[D]
TOTALS			44.6 (541)	37.4 (453)	18.0 (218)	25.8 (290)	12.2[E] (189)	

A n = Number of kept fish sampled in the harvest; fish not seen or where no data was recorded are not included.
B Percent released is equal to (fish released/fish kept + fish released).
C (# of fish checked/estimated harvest).
D Includes 168L.
E Includes fish checked by IDFG in 168M. Total checked by WDW = 71.

Table 12. Estimated angler effort, catch rates, and harvest for steelhead anglers on the Grande Ronde River, 1988 and 1989 (ODFW 1988).

Month	Effort (95% CI)	Catch rate (95% CI)	Total catch (95% CI)	Fish kept (95% CI)	Marked fish rel. (95% CI)	Unmarked fish rel. (95% CI)
1988						
Sep.	404.8 (274.9)	0.04 (0.06)	17 (23.8)	10 (19.8)	0 ---	7 (13.2)
Oct.	1554.3 (246.0)	0.12 (0.10)	193 (138.1)	54 (46.4)	29 (35.0)	110 (79.0)
Nov.	742.3 (278.3)	0.14 (0.16)	104 (121.0)	28 (35.0)	0 ---	76 (84.5)
Dec.	274.0 (112.9)	0.15 (0.20)	42 (54.5)	29 (36.4)	13 (22.2)	0 ---

Table 12 (cont.)

Month	Effort (95% CI)	Catch rate (95% CI)	Total catch (95% CI)	Fish kept (95% CI)	Marked fish rel. (95% CI)	Unmarked fish rel. (95% CI)
1989						
Jan.	(No Sample)					
Feb.	662.7 (440.0)	0.0	0	0	---	---
Mar.	2386.2 (1337.9)	0.20 (0.10)	374 (248.0)	271 (194.0)	4 (7.0)	100 (71.0)
Apr.	1455.8 (215.7)	0.25 (0.10)	360 (136.0)	255 (104.0)	4 (9.0)	101 (54.5)
Total	7440.10 (1502.1)	.146 (.046)	1090 (342.1)	647 (231.5)	50 (42.8)	393 (147)

Table 13. Age composition (%) and fork length (cm) of steelhead sampled from creels on the Grande Ronde River, fall 1988 and spring 1989. Carmichael et al. (1990).

State, river, age	Age composition		Males			Females		
	male	female	n[A]	length	(SD)[B]	n	length	(SD)
Oregon								
Wallowa + Grande Ronde								
1 Ocean	58.5	27.6	72	60.0	(29.8)	34	58.3	(30.1)
2 Ocean	2.4	11.4	3	75.5	(35.0)	14	70.4	(28.6)
Washington								
Grande Ronde								
1 Ocean	31.0	17.7	35	60.6	(26.5)	20	60.4	(26.9)
2 Ocean	11.5	39.8	13	74.6	(68.3)	45	73.2	(36.7)

A n = the number of fish sampled.
B (SD) = the standard deviation.

Other Streams

Harvest estimates for Mill Creek and the Touchet, Tucannon and Walla Walla rivers were obtained from WDW punchcard estimates (Table 14). Catch rate and catch composition data were collected on the Tucannon River by sampling weekend days 2-3 times per month. A summary of data from fish observed during creel survey of the Tucannon river is presented in Table 15.

All 1988 run year recoveries of marked Lyons Ferry Hatchery (LFH) origin steelhead containing length or sex information are located in project or district files. These data were used for sex ratios, mean length and mark rate.

Table 14. Harvest estimates from punchcard returns for the Walla Walla, Touchet, Tucannon rivers and Mill Creek, fall 1988 and spring 1989 (WDW 1989).

Month	Tucannon R.	Touchet R.	Walla W. R.	Mill Ck.
Sep.	2	0	26	2
Oct.	28	2	104	0
Nov.	37	6	364	0
Dec.	30	48	333	0
Jan.	67	17	155	15
Feb.	15	2	41	9
Mar.	33	37	59	15
Apr.	43	117	15	33
	---	---	---	---
Total	255	231	1097	74

Table 15. Data for steelhead observed in angler creels along the Tucannon River, fall 1988 and spring 1989.

x Length in cm (n)[A]	x Weight kg (n)	% female (n)	% wild (n)	% Ventral clipped (n)	Total no. of fish checked	Sample rate %
66.3 (9)	2.2 (9)	40.0 (4)	40.0 (4)	0 0	10	3.9

A number fish sampled.

Coded-Wire Tag Recovery

Snouts were collected, or brands and jaw tags were read, by WDW personnel from 174 sport caught steelhead that had left ventral fin clips. Four snouts were lost, but all others were examined by NMFS personnel for coded-wire tags (cwts). All cwts recovered by WDW personnel and estimates of the expanded harvests by individual tag code are presented for the Snake River by zone (Table 16), and for the Grande Ronde River (Table 17).

Table 16. Coded-wire tag expansions for the Snake R., fall 1988 and spring 1989.

	Month					CWT code	Tot. Tags Recovered	Expanded Harvest[B]
	Sept.	Oct.	Nov.	Dec.	Jan.			
Zone 168								
Sample Rate[A]	(.046)	(.150)	(.262)	(.333)	(.219)			
Tags Recovered		1	1	2		63/33/49	4	17
		1		1		63/33/04	2	10
		1				63/38/38	1	7
			1	2		63/37/03	3	10
			1	2		63/38/41	3	10
			1		1	63/39/13	2	9
			2		2	63/39/15	4	17
					3	63/39/14	3	14
					1	63/38/45	1	4
				2	1	63/38/36	3	11
				1		63/38/37	1	3
				1		63/38/40	1	3
				1		63/38/44	1	3
				1		63/33/50	1	3
				1		63/33/51	1	3
				1		63/33/02	1	3
				1		63/33/03	1	3
		1				7/40/25	1	7
			1			7/40/26	1	4
		1				7/37/62	1	7
			1	1		7/41/26	2	7
			1			7/37/61	1	4
			2	1		7/37/63	3	11
			3			7/41/28	3	12
				1		7/41/25	1	3
					1	7/41/22	1	5
		1				5/17/53	1	7
				2	1	5/17/29	3	11
			1			10/29/36	1	4
			1			10/29/31	1	4
				1	1	10/28/56	2	8
						lost	4	15
Zone 167								
Sample Rate	(.000)	(.088)	(.011)	(.021)	(.057)			
Tags Recovered		2				63/38/37	2	23
					1	63/39/15	1	18
		1				23/19/47	1	11
Zone 166								
Sample Rate	(.156)	(.106)	(.045)	(.040)	(.107)			
Tags Recovered			1			63/38/37	1	22
			1			5/17/29	1	22
	1					10/29/50	1	6

A- Sample rates used to expand individual CWT recoveries.
B- Est. harvest of tags based on monthly sample rates and tags recovered from the fishery.

Table 17. Coded-wire tag expansions for the Grande Ronde River, fall 1988 and spring 1989 (Carmichael et al 1990).

	Month				CWT code	Tot. Tags Recovered	Expanded Harvest[A]
	Nov.	Dec.	Mar.	Apr.			
Tags			5	4	63/33/05	9	65
Recovered			1	3	63/33/06	4	26
	1	2	5	5	63/33/49	13	71
			2	1	63/38/40	3	15
			1		63/38/41	1	3
				2	63/38/42	2	12
			2	2	63/38/43	4	22

A- Est. harvest of tags based on monthly sample rates and tags recovered from the fishery.

Returns of Coded Wire Tag Groups

Many other fish bound for the Snake river were intercepted in consumptive fisheries or wandered into other stream systems where they were sampled (Table 18). These numbers represent expanded estimates of harvest that occurred based on sampling programs conducted by several Federal, State and Tribal agencies.

We have complete 1 and 2 ocean age returns now for the 1985 coded wire tag releases. A summary of returns to various fisheries is presented in Table 19. A total contribution of the releases to the Columbia River basin fisheries and escapement is an important estimate of contribution to the LSRCP area. These numbers are an indication of our progress toward meeting our compensation goal of 0.5% smolt-to-adult survival and our adult return goal of 4,656 fish back to the Snake River basin.

Table 18: Adult returns of Lyons Ferry steelhead to locations and fisheries within the Columbia River basin 1988-89 (% smolt to adult survival those numbers represent).

Location	63/38/36-7-8 (LA-IJ-1,3,4)	63/33/03-04 (LA-IK-1,3)	63/33/50-51 (RA-IK-1,3)	63/32/02-33/02 (LA-IT-1,3)	63/33/05-6-49 (RA-IJ-1,2,3)	63/39/14-15 (RA-IF-1,3)	63/37/03-39/13 (LA-IF-1,3)	63/38-40-41-42-43 (RA-IC-1,2,3,4)	63\38-44-45,39/03 (RA-IY-1,2,3)
	Tag Code (Brand)								
L.Col. Sport	59(.097)	25(.062)	19(.047)	6(.015)	45(.075)	52(.103)	39(.077)	85(.106)	
Mid.Col Sport	12(.020)	25(.062)	25(.062)		75(.126)	12(.024)		12(.015)	
Zone 6 Net									
Summer	61(.100)	6(.015)	4(.010)	6(.015)	22(.037)	6(.012)	14(.028)		2(.003)
Fall	225(.368)	123(.306)	57(.142)	28(.070)	267(.447)	185(.366)	145(.286)	256(.320)	41(.068)
Winter	58(.095)	24(.060)		5(.012)	42(.070)	29(.057)	5(.010)	56(.070)	9(.015)
L.Ferry Ladder	99(.162)	30(.074)	14(.035)	4(.010)	8(.013)	223(.441)	130(.256)	7(.009)	8(.013)
Snake R. Sport	66(.108)	13(.032)	6(.015)	3(.008)	17(.028)	49(.097)	19(.037)	13(.016)	7(.012)
Dworshak NFH	1(.002)	1(.002)		1(.002)					3(.005)
Idaho Sport[A]	6(.010)	8(.020)			33(.055)	22(.043)	5(.010)	24(.030)[A]	28(.046)
Grande Ronde R.					162(.271)			52(.087)	
Ocean Harvest	12(.019)					1(.002)[B]			
Priest Rapids Dam	3(.005)							2(.002)	
Deschutes R.				2(.005)	7(.012)	2(.004)	2(.004)	6(.008)	
Snake R. Total	172(.282)	52(.129)	20(.050)	8(.020)	212(.355)	294(.581)	154(.304)	96(.120)	46(.076)
Grand Totals	602(.985)	255(.634)	125(.312)	55(.138)	678(1.135)	581(1.148)	359(.708)	513(.641)	98(.161)

A Expanded estimates for all rivers based on Idaho punch cards, data from Kent Ball, IDFG, pers. comm.
B Unexpanded estimates for Ocean Harvest.

Table 19. Returns of 1985 release LFH steelhead to locations in the Columbia River basin, for run years 1986-87 (% smolt to adult survival those figures represent).

Tag Code	62-16-44	62-16-45	62-16-27/28	62-16-29/30
Recovery Location		Estimated Harvest or Return		
L. Columbia Sport	49(.181)	16(.059)	119(.154)	15(.020)
Mid-Columbia Sport	---	---	---	---
Deschutes R.	---	---	27(.034)	2(.003)
Zone 6 Treaty Net	141(.562)	86(.321)	476(.607)	106(.141)
Priest Rapids Dam	4(.016)	---	---	---
LFH ladder	89(.355)	48(.179)	13(.017)	1(.001)
Up. Snake R. Sport	156(.622)	16(.060)	224(.286)	67(.089)
Dworshak NFH	---	---	---	---
Idaho Sport	19(.076)	---	34(.043)	23(.031)
	458(1.82)	166(.620)	866(1.12)	212(.281)

The actual performance of the various mark groups of LFH steelhead is encouraging and it appears that we are close to meeting our mitigation/compensation goals. For all the tag codes listed, we met or exceeded the production escapement goal of 0.5% survival back to the Columbia River system and met the goal for escapement to the Snake River (Table 6). Sampling Lower Columbia River harvest is crucial to tracking the performance and contribution of our releases. These fisheries harvest a substantial percentage of total returns into the system and are subject to wide fluctuations in season length and gear restrictions from year to year. They could jeopardize ultimate achievement of Snake River goals if they expand to their maximum potential. Reliable data concerning LSRCP fish contributions to these fisheries will be the only means to protect long term programs if downstream management of mixed stock fisheries threatens the success of mitigation.

Fish passage data collected at Lower Granite Dam continues to be our single most effective tag recovery sample site. We have complete return cycles for LFH released steelhead (1982-84) passing the facility that indicate we are meeting our steelhead goals for the hatchery (Table 6). Many of the fish passing the dam had been released from the hatchery as smolts and are wandering considerable distances upstream from their point of release. This behavior is also exhibited by fish released in 1984-85 from the Tucannon Hatchery. We discussed migrational behavior in another publication this year (Mendel and Schuck 1989) in greater detail. This behavior can jeopardize our ability to meet escapement or harvest goals for our individual mitigation streams.

A broader look at the information provided in Table 18 points to some interesting differences in contribution of different stocks of fish to various locations. Tag code 62-16-44 was used in Wells stock fish released from LFH in 1985 and tag code 62-16-45 was used in Wallowa stock fish also released from LFH. Returns of the Wells stock fish as adults greatly exceeded the number of Wallowa stock fish returning. It is also interesting to note that although these fish were released at LFH, substantial numbers of both migrated to above Lower Granite dam on the Snake river (Table 6) in both 1987 and 1988. Again however, there were many more of the Wells stock fish than of the Wallowa fish.

This difference in returning adults may have resulted from multiple causes such as size at release, general stock performance, release time, release strategy or different fish cultural practices used with the two groups. It is our opinion that size at release and general stock performance are the most likely answers to the difference. The other factors listed were identical or very nearly the same for the two groups listed.

Size at release could have had an affect on return rates as the Wells fish were released at 2.6 fish/lb. compared with the Wallowa fish released at 5.5 fish/lb. We don't believe, however that size was solely responsible for such a large difference in return. Also, tag codes 62-16-27/28 listed in Table 18 were Wallowa stock fish released from Cottonwood C.P. at an identical size as the LFH released fish. These fish contributed to fisheries at a similar rate as the LFH released Wells fish. We strongly suspect that the use of Wallowa stock fish downriver is affecting their overall performance. This possible "out of place" use of an upriver stock in concert with a greater size at release of the Wells fish may explain the greater return of the latter. This data does require serious consideration about the advisability of using upriver stocks for downriver releases. The poor returns from Wallowa stock fish in the Tucannon River (tag codes 62-16-29/30) also serves to support this concern.

LFH fish are contributing to fisheries throughout the lower Columbia River basin upon their return. Presently, these fisheries are not harvestinf sufficient numbers to place LSRCP goals for returning adults in jeopardy. We estimate that for release year 1985, the 1987 return of adults to the Snake River was 0.39% of smolts released and the average adult return for the two run years of 1986 and 1987 was 1.22% of smolts released. One year returns from the 1986 release averaged 0.452% adults from smolts. This represents a decrease over the previous years survival although still well within our goal of 0.5% over their life cycle. Based on these numbers, we estimate that adult returns from Lyons Ferry Hatchery smolt releases into Washington LSRCP waters in 1987 were 6,758 fish to the project area (above Lower Granite Dam or into an appropriate tributary). These figures are based on return rate information in Table 6 and do not represent adult returns from smolts reared for ODFW.

Juvenile Salmonid Populations in Project Rivers

Spring Emigration

Emigrating steelhead were trapped on the Tucannon River during each month the WDF scoop trap was operational. Table 20 summarizes results of the trapping. Although mark/recapture tests were conducted to estimate trapping efficiency for each month, insufficient recaptures occurred to allow calculation of a trapping efficiency this year. Therefore, we made no estimate of total smolt emigration. Trapping data is provided solely for smolt size and timing information.

Table 20. Tucannon River smolt trapping data for steelhead, 1988-89.

	Fish Captured			No.	x Len.	No.	x Len.[A]	x Wt.(n)
Month	Hat.	Wild		Hat.	(SD)	Wild	(SD)	(SD)
Oct. 88	0	1	**Smolts**	85	207.1	95	168.4	47.3 (8)
Nov.	0	11			(20.9)		(20.7)	(10.5)
Dec.	0	41						
Jan. 89	0	29	**Trans.**	7	201.7	162	115.9	15.9 (37)
Feb.	0	3			(6.6)		(28.6)	(14.9)
Mar.	1	55						
Apr.	16	60	Parr	--	--	85	71.4	6.5 (16)
May	94	117					(49.4)	(4.4)
June	6	33						
			Unknowns	11	--	8	--	--
Total	117	350		103		350		

A Weights and lengths were not taken on all fish.

Discussion

Tucannon River trapping data was disappointing. Very low numbers of wild fish were collected during this trapping season. Mark/recapture tests to measure trap efficiency with upstream releases of wild emigrants were totally unsuccessful. Too few individuals were ever collected on one day to compute a recapture rate. We must conclude from this years data that the trap as currently operated by WDF is not capable of providing accurate smolt emigration data. A different location and/or a different style of smolt trap will be required to provide this data.

Summer Densities

Summer electrofishing samples for density estimates of juvenile salmonids were collected by WDF in 1988. We used length-frequencies to determine ages of gamefish for age-specific population and density estimates. Table 21 is a summary of steelhead juvenile densities by habitat type on the Tucannon River. Sampling data collected by WDF during summer and fall 1988 from the Tucannon River and Asotin Creek is presented in Appendix B.

Table 21. Steelhead densities per 100^2 meters by habitat type for fall 1988 (WDF electrofishing data).

site	Pool	Run	Riffle	Boulder groups	Side chan.	Tributaries
HMA						
	38.8	37.4	42.0	34.5	41.6	--
SD=	(24.1)	(7.9)	(8.9)	(11.0)	(17.3)	
n =	6	5	7	6	6	--
WILDERNESS						
	33.3	41.3	28.4	--	--	--
SD=	(10.9)	(16.0)				
n =	3	2	1	--	--	--
HARTSOCK						
	49.1	25.1	30.3	--	--	--
SD=		(19.2)	(8.3)			
n =	1	3	2	--	--	--
NF ASOTIN Cr.						
	71.2	76.7	82.1			
SD=	(21.1)	(20.1)				
N=	2	2	1			
SHEEP Cr.	--	--	--	--	--	11.4
n =						1
PANJAB Cr.	--	--	--	--	--	19.1
n =						1
CUMMINGS Cr.	-	--	--	--	--	49.9
SD=						(4.0)
n =						2

Three of 6 sites electrofished in the Wilderness section of the Tucannon River and 13 of 30 sites within the HMA contained adipose clipped (includes branded and LV clipped) steelhead smolts that had residualized after release from Curl Lake. Residual hatchery fish accounted for 7.7% and 5.5% of the density of fish in the Wilderness and HMA sections respectively that had hatchery fish present.

Catchable Trout Program

Production of legal or catchable size rainbow trout at the Lyons Ferry/Tucannon complex totaled 266,360 fish weighing 92,225 pounds in 1988-89. The cumulative average weight for catchable trout was 2.8 fish per pound for fish released in spring 1988. Appendix F gives a listing of streams and lakes in Southeastern Washington which received compensation plan fish, the number and pounds of fish they received and the number of different stockings into each water. In addition, 75,141 Rainbow trout fry weighing 2,530 pounds and 63,005 Rainbow trout fingerlings weighing 9,250 pounds were reared for Idaho in 1989. This production level represented 124% of the program goal.

CONCLUSIONS

Much of the preliminary data collection that has been undertaken by the Lyons Ferry Evaluation since 1982 has been documentation of production practices, release of fish, juvenile survival through the Snake and Columbia River systems and the adult returns to terminal fisheries and escapement, (where we could monitor it) from those releases. Much of that has gone well and substantial progress has been made toward answering the basic question about whether LFH would be capable of meeting compensation goals.

The conclusions below are arranged similar to previous reports. The complete objectives with approaches and tasks are included in Appendix A for reference. Recommendations are listed together following the conclusions.

Objective 1: Document juvenile growth and development and fish cultural procedures.

Growth of steelhead and rainbow trout are excellent at both LFH and Tucannon Hatchery. Nearly constant water temperature and abundant space for steelhead production in our three rearing ponds have assurred a high quality product. Disease outbreaks other than a severe case of IHN in the 1989 brood steelhead have been non-existant. Avian predators in 1989 became a serious problem. A change in hazing techniques has been ineffective in deterring a growing population of seagulls and mergansers. Other techniques such as netting, scare away explosives and lethal removal are being reviewed with WDW staff.

Differences in the mean size of fish at release, based on hatchery samples and evaluation staff samples, continue to occur. To date we are unable to determine the cause of these differences as they are not consistent for all release sites or days. We will be closely examining sampling techniques in 1990.

Samples of fish taken at release have become an integral part of the effort to understand the wandering behavior experienced for several years. Organosomatic and physiology samples have been very informative and will, if possible, be continued. A test between dry and OMP feeds in 1989 showed no apparent physical or physiological differences between smolts. The use of dry feed in place of the OMP would represent a substantial cost savings. Cost however is not the overriding factor. The test was done to determine whether fish of equal quality could be produced and that will return at equal rates as adults. Both groups were tagged and branded and we will follow the adult returns closely.

Objective 2: Document smolt and resident trout releases and evaluate smolt out-migration behavior. Provide management recommendations.

Sub-obj. 2.1

Coded wire tagging and branding continues to be a very important tool. Smolt physiology and emigration performance as measured by brand recaptures at the Snake and Columbia rivers collector dams are providing good early data on their performance.

Residualism occurrs at various rates for different years and release locations. We are unsure to what extent it is contributing to smolt loss from hatchery releases as there is no way to sample in large rivers. One year in the last four has seen an abundant population of resident smolts in the Snake River pools as evidenced by sport harvest. Smolts contribute heavily to the opening day sport harvest in tributary rivers but do not continue to do so for more than 10-14 days. We are meeting adult survival rates for our rivers so do not consider residualism a serious problem.

WDF smolt trapping data has been unacceptable for estimating emigration numbers but has provided data on wild escapement timing which is its only useful assistance at this time.

Sub-obj. 2.2

Wandering is an annoying problem that does not threaten "in-kind" returns but is interferring with our goal to replace our steelhead "in-place". No adult performance tests were begun but many discussions with USFWS personnel concerning possible causes have been completed. Sampling of juvenile fish to determine if imprinting to a river system is occurring has been our major emphasis. Also, close examination of adult returns of tag groups has helped define the possible causes of the wandering. We will continue to sample smolts under different release strategies, size and stocks to develop a solution to the wandering.

Objective 3: Estimate adult returns to down-river and terminal areas as a measure of compensation success.

Considerable time was spent in documenting, sampling and estimating adult returns and harvest. The use of adipose clipping to identify hatchery from wild fish has been very helpful in analyzing hatchery return rates.

Tag recoveries at LFH showed some of the best return rates to the hatchery since releases started. There were also excellent returns of tag groups to the upper Snake River. Returns of tagged fish destined for LFH, Tucannon River and Touchet River to the trap at Lower Granite Dam reinforces our perception of the wandering problem.

Length, sex ratio and return age ratios have all stayed reasonably constant. A comparison of Wells versus Wallowa stock fish released at LFH showed a dramatically greater return for Wells stock fish. These results require a strong examination of the use of Wallowa stock fish in down river areas. Wells fish consistantly outperformed the Wallowa fish in every fishery and location we sampled.

Down river sport and commercial and treaty Indian net fisheries harvest nearly one half of all adult returns from tagged LFH origin releases. If these fisheries expand beyond their current size and efficiency, this could jeopardize the returns of our LSRCP fish.

We were unable to obtain any new or accurate estimates of adult passage mortality for the lower Columbia River dams. The Corps of Engineers will be funding adult passage research in the Snake and Columbia Rivers in 1990-91.

Sampling sport fisheries is our biggest single consumer of time and effort. The large geographical area involved and length of time that seasons run makes sampling costly. These are important fisheries though and we believe the effort and cost expended is worthwhile. We will continue to limit the number of fisheries we sample to conserve budgets and provide a high quality of sample on fewer rivers.

Escapement of adult steelhead into tributaries of the Snake River to spawn is a recognized benefit of the LSRCP program. Our tagging studies have shown that between 30-40% of fish escaping above Lower Granite Dam and destined for the Grande Ronde River, were harvested in sport fisheries. This leaves 60-70% of the fish to spawn, or attempt to spawn, in streams. Recent years data have shown that fish released from the Touchet and Tucannon rivers are wandering far upstream and not returning to their point of juvenile release. We believe this is negatively affecting sport harvest and escapement. Redd density in all streams surveyed in 1989 as down substantially from 1988 although returns of tagged fish destined for those rivers were abundant at Lower Granite Dam. We will continue these surveys to track changes in our management of hatchery releases.

Objective 4: Evaluate the effectiveness of instream habitat improvement structures placed in Asotin Cr. and the Tucannon River during 1983-86 to increase habitat and trout production.

We did not conduct this portion of the study in 1988-89. We placed more emphasis on the analysis of data already collected in other portions of the project and completion of pending reports. By delaying the evaluation until 1989-90, all the structures used in the original pre-construction and one-year post-construction study will have been in place for 5 years. This will more closely meet our original goal of measuring 1 and 5 year post construction structure status and population densities.

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Appendix A: 1988 Project Proposal

OBJECTIVE 1: DOCUMENT JUVENILE GROWTH AND DEVELOPMENT AND FISH CULTURAL PROCEDURES.

Approach: Lyons Ferry hatchery was designed to produce 116,400 pounds of smolts annually at 8 fish /pound. These numbers were based upon experience and were the best estimate at the time. No large well water hatchery existed on the Snake R. at that time so actual assessment of performance is important to accurately predict long-term production capacity and optimum size at release. The original goal of 8 fish/pound smolt releases does not appear to be the best size for smolt survival through the river system or for adult returns. Multiple stocks of steelhead will also be cultured at the hatchery; one long term hatchery stock and at least one wild/natural-origin stock to be used in upper Snake R. tributaries. Relative performance of juvenile fish in the hatchery may be an indicator of long-term adult performance. All aspects of hatchery operation will be monitored. Recommendations for changes in hatchery procedure will be made, if necessary, to improve returns. Work on this aspect of the program will be ongoing.

SUB-OBJ. 1.1 Determine mean rearing time from egg to release for resident trout and for comparison of Wallowa and Wells steelhead stocks. Document hatchery performance through monitoring growth rates, conversion factors and susceptibility to predation or die-off.

Task 1.11 Sample 0.005 to 0.01 percent of separately reared groups for mean fork length and weight, in millimeters and grams respectively.

Task 1.12 Document disease history to determine effects on growth. (Available from hatchery records but will include viral disease certification from parent samples taken at time of spawning).

Task 1.13 Estimate raceway, or pond mortality, based on estimates of numbers of fish stocked versus number of fish removed. Attempt to identify sources of mortality. Some possibilities are:

a. disease
b. avian predators
c. stocking estimate errors
    1. Compare (weight-count)x(volume) hatchery estimates with more precise individual weight and known number of fish samples.

2. Compute 95% confidence intervals around estimates of fish planted using both methods to compare.

Task 1.14 Calculate condition factors for all groups based on data from task 1.11.

Task 1.15 Compare smolt and resident trout production (pounds and numbers) with hatchery compensation goals.

Task 1.16 Document special fish cultural requirements (if any) of each release group and/or stock.

SUB-OBJ. 1.2 ***Determine condition of hatchery smolts at time of release.***

Task 1.21 See task 1.14

Task 1.22 Sample for descaling and fin condition utilizing standard descaling report forms (if available) used by transporting agencies.

Task 1.23 Sample all CWT/brand groups for tag/brand loss prior to release. (see Objective 2)

Task 1.24 Utilize portions of Goede's organosomatic index procedure to assess the quality of smolts released. This will also allow for comparison to other state hatchery smolts.

Task 1.25 Assist the USFWS research staff in sampling smolts released from LFH and the remote conditioning ponds. Assess any differences in smoltification between hatchery and conditioning pond releases based on levels of blood thyroxin (T_4) and gill ATP-ase levels.

OBJECTIVE 2: DOCUMENT SMOLT AND RESIDENT TROUT RELEASES AND EVALUATE SMOLT OUT-MIGRATION BEHAVIOR. PROVIDE MANAGEMENT RECOMMENDATIONS.

Approach: Marking of juveniles with coded-wire tags, brands, fin clips and combinations of the three are an essential part of the juvenile/adult performance program. Improvements in tagging technology have aided the rapid collection and interpretation of migration data. Representative groups from each stock and release group will be marked, tagged and branded for positive identification. Established monitoring systems at hydroelectric dams on the Snake and Columbia Rivers supply the needed juvenile migration data to assess initial migration performance and smolt survival to, or past, multiple sampling points.

SUB-OBJ 2.1 ***Document numbers, size, time of release, methods, and location of steelhead smolt and resident trout plants. Evaluate out-migration performance.***

Task 2.11 Tag and brand representative groups from each major release area within the restrictions of hatchery holding space. Minimum group size of 20,000 fish will be used to ensure adequate tag return.

Task 2.12 Observe and record smolt migration behavior from rearing ponds, and conditioning ponds. Observe numbers of fish migrating over period of time and estimate total numbers left in rearing ponds.

Task 2.13 Observe and document smolt behavior from river release sites, according to river conditions and willingness to migrate.

Task 2.14 Determine migration time and performance down river by using information gathered at established smolt transport and sampling locations on the Snake and Columbia Rivers. Brands allow immediate assessment of group performance.

Task 2.15 Assess smolt residualism by surveying release sites and reasonably adjacent areas of streams through electrofishing and/or angler creel checks.

Task 2.16 Obtain smolt trapping information from the WDF trap on the Tucannon River. Attempt to correlate juvenile population estimates from up river areas to estimated smolt emigration.

SUB-OBJ 2.2 ***Attempt to determine reasons for Lyons Ferry brood stock releases to bypass the hatchery outlet; and discover other methods to properly imprint smolts and improve returns to the hatchery.***

Task 2.21 Mark all brood stock releases from the hatchery with CWT/brand to allow ease of trapping and tracking at dams as returning adults. (See table 1).

Task 2.22 Release four test groups at two different times (late April;early May) from the hatchery. Conduct physiological samples of smolts at release (Task 1.25) to measure any differences in smoltification that might explain apparent straying behavior.

Task 2.23 Conduct a literature search to determine all possible reasons for anadromous steelhead to migrate past their point of origin/release. Some reasons may be:

1. Warm summer water temperatures near hatchery.
2. Chemical interference from Palouse River effluent.
3. Failure of fish to imprint to hatchery water supply.
4. Inability of fish to distinguish hatchery water from Snake River water (assumes a common aquifer).
5. Genetically transmitted migratory and wintering behavior.
6. Genetic or stock deficiency causing aberrant migratory behavior.

Task 2.24 Design and conduct, if possible, a test to determine if steelhead reared at the hatchery are capable of selecting for hatchery well water versus Snake River water collected immediately above the hatchery. Pre-smolt juveniles would be used in side by side raceway experiments. Test could be conducted with the assistance of National Marine Fisheries Service personnel who have expressed an interest in providing technical expertise.

SUB-OBJ 2.3 ***Attempt to determine out-migration timing and condition of wild or naturally produced steelhead smolts.***

Task 2.31 Electrofish sections of streams on several occasions during the spring to determine relative abundance, condition and out-migration timing.

Task 2.32 Evaluate WDF smolt trapping data for the Tucannon River and determine, if possible, an estimated parr to smolt survival rate for steelhead.

OBJECTIVE 3: ESTIMATE ADULT RETURNS TO DOWN-RIVER AND TERMINAL AREAS (STREAMS, OCEAN HARVEST, SPORT, COMMERCIAL AND TREATY INDIAN HARVEST, HATCHERIES, ESCAPEMENT) AS A MEASURE OF COMPENSATION SUCCESS.

Approach: Adult returns are the purpose of L.S.R.C.P. hatcheries. Measuring adult returns to the point of release and other intermediate or terminal areas is necessary. Adult harvest will be sampled in appropriate main river and terminal area commercial, treaty Indian and sport seasons through existing state and federal programs. Continuance of down-river programs is essential for complete, accurate evaluation of compensation goals. Terminal harvest within the L.S.R.C.P. area will be estimated using existing WDW punchcard estimates corrected for bias. Percent of Lyons Ferry fish contribution to harvest and escapement will be computed. Two methods to assess spawning escapement will be compared. 1) Redd counts in established stream areas will continue; 2) Adult trapping and enumeration in some areas, and spawning ground surveys will allow WDW to properly manage existing native stocks in concert with expected hatchery returns.

SUB-OBJ. 3.1 ***Identify returning hatchery adults using coded-wire tags, freeze brands or fin clips to estimate return rates.***

Task 3.11 (Same as Task 2.11)

Task 3.12 Adipose clip remaining steelhead production to comply with state management criteria and allow positive identification for wild/hatchery ratios. (see Task 3.33).

Task 3.13 Compile sample data from Columbia River and Snake River adult sampling stations to determine regional return rates for marked groups.(See Sub-obj. 3.3).

SUB-OBJ. 3.2 ***Document hatchery rack returns of marked production and broodstock hatchery releases. Marked returns will be used as part of totals for quantifying percent return from release.***

Task 3.21 Use rack returns from hatchery records for Lyons Ferry, Tucannon, and Wallowa Hatcheries to compute adult return rates to hatcheries.

Task 3.22 Compare adult returns, to Lyons Ferry, from Wells and Wallowa broodstock releases made in 1983 through 1985.

Task 3.23 Determine timing of returns from Lyons Ferry releases by examining returns of branded, CWT adults to adult collection facilities at McNary and Lower Granite Dams, and to Lyons Ferry and Wallowa hatcheries.

Task 3.24 Document length and sex of returning adults. Collect scales as in Task 3.35.

Task 3.25 Assist with spawning of adults and collection of samples to ensure control of infectious viral diseases. Samples will be analyzed by WDF disease laboratories in Washington.

SUB-OBJ. 3.3 ***Estimate sport and commercial harvest of returning adults.***

Task 3.31 Design and conduct creel surveys for the Snake, Grande Ronde and Tucannon rivers to collect coded wire tagged adults that were sport caught. Estimate contribution of LFH released steelhead to these sport fisheries. Estimate smolt to adult survival to the creel.

Task 3.32 Obtain sport harvest of adult steelhead on the Tucannon, Snake and Grande Ronde Rivers using steelhead punch card estimates. Regular creel checks will be required to determine wild/hatchery ratios in the catch and for cwt expansions.

Task 3.33 Obtain estimates of down-river (Columbia and other incidental tributary) sport and commercial harvest through existing sampling conducted under other programs.

Task 3.34 Obtain estimates of adult mortality rates through lower river hydroelectric projects.

Task 3.35 Collect and read scale samples to determine length/age relationships and duration of fresh water and ocean residence for LFH released fish. Determine the percentage of smolts emigrating from the Snake River that have reared an additional year after release from the hatchery.

SUB-OBJ. 3.4 ***Estimate spawning escapement.***

Task 3.41 Use coded-wire tag return rates at Lower Granite Dam to estimate mean adult escapement for sample groups. Subtract harvest estimates for the mid-Snake and Grande Ronde Rivers (Task 3.31) to obtain net adult escapement to point of release. (Note: estimates of escapement to Wallowa Hatchery through ODFW marking programs may be available as a check for this estimate.)

Task 3.42 Walk study sections established on tributary streams beginning March 1, to identify: (a) initial date of spawning; (b) density of spawners, expressed as redds/mile; (c) differences in spawning areas; (d) completion of spawning. Number of times walked and dates will be dependent upon climatic and water clarity conditions. Streams include:

ASOTIN CR.
- Charlie Cr.
- S.Fk. Asotin
- N.Fk. Asotin
- George Cr.

TUCANNON R.
- Cummings Cr.
- Panjab. Cr.
- Meadow Cr
- Bear Cr.

TOUCHET R.
- S.Fk. Touchet
- N.Fk. Touchet
- Wolf Fk.
- Robinson Fk.

WALLA WALLA R.
- Mill Cr.

Task 4.11 Locate treatment and control sites on both streams and determine which sites will be used for evaluation study and comparison.

Task 4.12 Conduct population estimates for juvenile salmonids within each site using methods as in the previous evaluation.

Task 4.13 Collect all necessary biological data from fish to allow direct comparison with existing pre-treatment and control data.

Task 4.14 Collect snorkling estimates of populations from both treatment and control sites for use in future assessments.

Task 4.15 Collect measurements of instream habitat (pool area, amount of cover stream shading, etc.) to allow comparison of current habitat quality with pre-treatment and controls.

Task 4.16 Compare current population parameters with pre-treatment and control parameters to determine if actual increases in trout densities within the streams have occurred. Summarize the changes that have occurred over time.

SUB-OBJ. 4.2 CONDUCT A CREEL SURVEY OF ASOTIN CREEK AND THE TUCANNON RIVER TO DETERMINE THE NUMBER AND COMPOSITION OF CATCHABLE HATCHERY AND NATIVE TROUT IN THE CREEL AND ANY DIFFERENTIAL USE OF AREAS.

Task 4.21 Organize a creel survey of Asotin Cr. during the summer trout season that repeats the survey conducted during 1984.

Task 4.22 Conduct the creel survey between June 1 and July 15 Collect length, weight, sex/maturity and scale samples from all native trout retained in the creel. Read scales to determine if any change in age composition of resident fish has occurred. Compare angler use of improved and unimproved portions of the streams.

Task 4.23 Summarize survey results, giving estimated harvest, % exploitation of hatchery catchable plants, % wild contribution to the catch and any preferential use by anglers.

Task 4.24 Tucannon River (Same as tasks 4.21-4.23)

OBJECTIVE 4: EVALUATE THE EFFECTIVENESS OF INSTREAM HABITAT IMPROVEMENT STRUCTURES PLACED IN ASOTIN CREEK AND THE TUCANNON RIVER DURING 1983-86 TO INCREASE HABITAT AND TROUT PRODUCTION.

Approach: Mendel (1984) and Hallock and Mendel (1985) described the installation and preliminary evaluation of instream habitat structures placed in the Tucannon River and Asotin Creek of Southeastern Washington. Control and treatment sites were identified and physical and biological data collected from these sites. Structures were then constructed in the streams to increase pools as rearing habitat. Population estimates for treatment sites were conducted one year after construction to measure any increases in trout densities around structures. The literature indicates (Hunt, 1976) maximum increases in populations may not occur for 4-5 years after improvement. Collection of population density estimates for both treatment and control sites need to be accomplished during the summer of 1988 to complete the primary evaluation of the effectiveness of the structures. Electrofishing for juvenile densities will be conducted in 1988 following the methods described by Mendel (1984), to ensure comparable results. Also, an effort will be made to utilize snorkling in over-lapping sample areas to compare methodologies and results with electrofishing. If snorkling is to be used more extensively in the future as our primary juvenile sampling tool, we must be able to relate electrofishing data collected in past years.

Physical measurements of treatment and control sites will also be collected as done in 1983-84. These measurements will allow us to assess the durability of structures and the % of increased pool habitat provided to the stream after 4-5 years.

A creel survey of Asotin Creek will be conducted following the methods used in 1984. Angler effort and harvest will be estimated and compared between treatment and control sites. Catch composition will be documented to determine any increased resident trout production or change in age composition. A similar survey will be conducted on the Tucannon River.

Because of rapidly expanding interest in habitat improvement in the Northwest to improve salmonid populations, a separate report detailing the results of these improvements on resident trout populations may be helpful. Data collected in 1988 would be combined with 1983-1984 data, analyzed and provided under a separate cover.

SUB-OBJ. 4.1 Estimate Populations of Salmonids in Streams for Both Treatment and Control Sites. Compare Trout Densities for These Areas with Pre-treatment Densities. Assess the Durability and Current Status of the Structures.

SUB-OBJ. 4.3 COMPARE THE DATA COLLECTED WITH PRETREATMENT AND CONTROL SITE DATA TO DETERMINE IF MEASURABLE INCREASES IN TROUT POPULATIONS AND HABITAT QUALITY DUE TO HABITAT IMPROVEMENT HAVE OCCURRED. WRITE A SEPARATE REPORT PROVIDING THESE RESULTS.

Appendix B

Table 1. Gamefish population and density information from sites electrofished by WDF personnel, summer and fall 1988.

SITE TYPE (Date)	AGE[A]	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
WILDERNESS (Above Panjab Cr.)								
1 RIFFLE	0+	13	2		15	1.3	70.3	21.3
(7-27)	1+	4	1		5	1.5		7.1
	TOT	17	3		20	1.6		28.4
3 POOL	0+	5	0		5	---	50.7	9.8
(7-27)	1+	3	2		5	3.3		9.8
	2+	1	0		1	---		1.9
	TOT	9	2		11	1.6		21.6
5 POOL	0+	6	0		6	---	42.7	14.1
(10-11)	1+	3	2		5	3.3		11.7
	2+	3	0		3	---		7.0
	3+	1	0		1	---		2.3
	TOT	13	2		15	1.3		35.2
	AD[A]	2	0		2	---		4.7
	DV	1	0		1	---		2.3
10 RUN	0+	15	3		18	1.7	113.4	15.8
(10-11)	1+	5	3		8	3.3		7.1
	2+	3	0		3	---		2.6
	3+	1	2		3	7.6		2.6
	TOT	24	8		34	5.9		29.9
	AD	1	1		2	12.7		1.8
11 POOL	0+	41	5		46	1.6	148.5	30.9
(8-30)	1+	8	2		10	1.7		6.7
	2+	3	2		5	3.3		3.4
	3+	1	1		2	12.7		1.3
	TOT	53	10		64	3.6		43.1
	DV	1	1		2	12.7		1.3
	WF	1	0		1	---		0.7
15 RUN	0+	17	0		17	---	55.0	30.8
(7-27)	1+	4	1		5	1.5		9.1
	2+	4	0		4	---		7.3
	3+	1	2		3	7.6		5.5
	TOT	26	3		29	1.3		52.6
	AD	1	1		2	12.7		3.6

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m²)	DENSITY (FISH/100m²)
HMA(Habitat Mgmt. Area H.Q. to Panjab Cr.)								
1 RIFFLE	0+	57	3		60	0.8	142.7	42.0
(8-02)	1+	4	1		5	1.5		3.5
	TOT	61	4		65	1.1		45.6
2 BOULDER	0+	28	12		46	12.1	283.5	16.2
(8-03)	1+	12	0		12	---		4.2
	2+	2	2		4	4.5		1.4
	TOT	42	14		61	9.1		21.5
3 RUN	0+	22	2		24	0.9	111.0	21.6
(8-02)	1+	6	5		16	22.4		14.4
	2+	2	3		8	25.8		7.2
	3+	1	1		2	12.7		1.8
	TOT	31	11		46	8.5		41.4
4 POOL	0+	6	2		8	2.1	188.9	4.2
(8-03)	1+	0	1		1[B]	---		0.5
	2+	2	1		3	3.2		1.6
	TOT	8	4		13	5.6		6.8
5 RIFFLE	0+	42	11		56	6.2	172.6	32.4
(8-04)	1+	11	4		15	2.7		8.6
	2+	3	0		3	---		1.7
	3+	1	0		1	---		0.6
	TOT	57	15		76	7.1		44.0
6 RIFFLE	0+	33	9		44	5.3	129.9	33.8
(8-04)	1+	7	2		9	1.8		6.9
	2+	2	2		4	4.5		3.1
	TOT	42	13		59	7.8		45.4
7 BOULDER	0+	15	5		21	4.4	199.0	10.5
(8-17)	1+	8	4		13	5.5		6.5
	2+	2	1		3	3.2		1.5
	TOT	25	10		39	9.2		19.6
8 POOL	0+	17	8		29	10.6	141.8	20.5
(8-24)	1+	6	2		8	2.1		5.6
	2+	4	0		4	---		2.8
	3+	1	0		1	---		0.7
	TOT	28	10		42	8.6		26.6
	AD	1	0		1	---		0.7

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	2	3	POPULATION (N)	95% CI	AREA (m²)	DENSITY (FISH/100m²)
9 RIFFLE	0+	41	8		50	3.4	239.4	20.8
(8-17)	1+	11	3		14	2.1		5.8
	2+	1	0		1	---		0.4
	TOT	53	11		66	4.6		27.6
10 RUN	0+	25	6		32	3.7	145.6	21.9
(8-16)	1+	1	0		1	---		0.7
	2+	1	1		2	12.7		1.4
	3+	0	1		1[B]	---		1.4
	TOT	27	8		37	5.5		25.4
	AD	0	1		1[B]	---		1.4
11 BOULDER	0+	12	15		27[B]	---	207.2	8.0
(8-16)	1+	8	3		11	2.5		5.3
	2+	2	0		2	---		0.9
	3+	2	1		3	3.2		1.4
	TOT	24	19		89	120.1		42.9
12 POOL	0+	25	17	1	44	3.8	329.7	13.3
(8-15)	1+	16	5	4	26	4.1		7.8
	2+	7	3	1	11	1.8		3.3
	TOT	48	25	7	85	7.6		25.7
	AD	5	2	2	9	2.8		2.7
13 RIFFLE	0+	50	6		56	1.8	203.0	27.6
(8-11)	1+	12	1		13	0.7		6.4
	2+	1	1		2	12.7		1.0
	TOT	64	9		74	2.9		36.5
	AD	1	1		2	12.7		1.0
14 RUN	0+	17	3		20	1.6	89.5	22.3
(8-11)	1+	14	1		15	0.6		16.8
	2+	1	0		1	---		1.1
	TOT	32	4		6	1.5		40.2
	AD	1	0		1	---		1.1
15 BOULDER	0+	42	5		7	1.6	162.7	28.9
(8-10)	1+	13	1		14	0.6		8.6
	2+	3	1		4	1.9		2.4
	3+	2	0		2	---		1.2
	TOT	60	7		67	1.9		41.2
16 POOL	0+	40	7		48	3.1	167.5	28.6
(8-10)	1+	10	3		13	2.2		7.8
	2+	5	4		11	11.0		6.6
	3+	1	0		1	---		0.6
	TOT	56	14		73	6.1		43.6
	AD	1	0		1	---		0.6

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
17 BOULDER	0+	58	9		68	3.1	233.0	29.2
(8-09)	1+	20	4		24	2.0		10.3
	2+	4	2		6	2.7		2.6
	3+	2	0		2	---		0.8
	TOT	84	15		101	4.5		43.3
18 RIFFLE	0+	60	8		68	2.2	138.6	49.1
(8-09)	1+	4	4		12	22.9		8.6
	TOT	64	12		78	4.4		56.3
19 RUN	0+	34	8		43	3.8	143.6	29.9
(7-26)	1+	12	3		15	2.0		10.4
	2+	4	0		4	---		2.8
	3+	2	1		3	3.2		2.1
	TOT	52	12		66	5.0		46.0
20 RIFFLE	0+	54	2		56	0.6	206.9	27.1
(8-23)	1+	12	6		21	9.7		10.1
	2+	3	1		4	1.9		1.9
	3+	0	1		1[A]	0.5		0.5
	TOT	69	10		80	3.1		38.7
21 POOL	0+	30	6		36	2.3	86.7	41.5
(8-08)	1+	5	1		6	1.2		6.9
	2+	2	0		2	---		2.3
	3+	1	0		1	---		1.2
	TOT	37	7		48	4.9		55.4
	AD	5	2		7	2.3		8.1
22 POOL	0+	71	9		80	2.2	129.0	62.0
(8-18)	1+	7	2		9	1.8		7.0
	2+	3	1		4	1.9		3.1
	3+	1	0		1	---		0.8
	TOT	83	12		96	3.3		74.4
	AD	1	0		1	---		0.8
23 BOULDER	0+	30	6		36	2.3	137.0	26.3
(8-22)	1+	6	2		8	2.0		5.8
	2+	3	2		5	3.3		3.6
	3+	2	0		2	---		1.4
	TOT	41	10		53	5.0		38.7
	AD	1	2		3[B]	7.6		2.2
24 RUN	0+	20	1		21	0.5	87.8	23.9
(8-02)	1+	6	1		7	1.0		8.0
	2+	1	1		2	12.7		2.3
	TOT	27	3		30	1.2		34.2
	AD	1	1		2	12.7		2.3

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m²)	DENSITY (FISH/100m²)
HMAS (Side channels within the HMA)								
1-S	0+	17	2		19	1.1	59.6	31.9
(8-23)	1+	8	1		9	0.8		15.1
	2+	2	0		2			3.4
	TOT	27	3		30	1.2		50.3
	AD	4	0		4	---		6.7
2-S	0+	13	0		13		80.6	16.2
(7-26)	1+	23	3		26	1.4		32.4
	2+	5	0		5			6.2
	3+	1	0		1			1.2
	TOT	42	3		45	1.0		56.0
	AD	1	0		1	---		1.2
	WF	3	1		4	1.9		5.0
3-S	0+	3	1	0	4	0.6	52.5	7.6
(8-02)	1+	5	0	1	6	1.0		11.4
	2+	1	0	0	1	---		1.9
	3+	1	0	0	1			1.9
	TOT	10	1	1	12	0.8		22.8
4-S	0+	8	6	4	23	14.7	84.9	27.1
(8-01)	1+	0	0	2	2 B			2.4
	3+	1	0	0	1			1.2
	TOT	9	6	6	33	34.4		38.8
	AD	2	1	0	3	1.1		3.5
	WF	0	1	0	1			1.2
5-S	0+	3	2		5	3.3	39.8	12.6
(8-01)	1+	2	0		2			5.0
	2+	1	0		1			2.5
	TOT	6	2		8	2.1		20.1
6-S	0+	34	4		38	1.4	94.5	40.2
(8-08)	1+	12	1		13	0.7		13.8
	2+	5	0		5	---		5.3
	3+	2	0		2	---		2.1
	TOT	53	5		58	1.4		61.4
	DV	1	0		1	---		1.1
HARTSOCK (HMA H.Q. to Hartsock grade)								
1 RUN	0+	5	0		6	1.2	103.9	5.7
(10-11)	1+	5	1		4	2.0		3.8
	2+	3	1		4	2.0		3.8
	TOT	13	2		15	1.3		14.4
5 RUN	0+	39	18		69	19.2	158.8	43.5
(9-15)	1+	6	1		7	1.1		4.4
	TOT	45	19		75	16.7		47.2

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
6 RUN	0+	16	8		28	11.1	263.0	10.6
(9-15)	1+	2	1		3	3.2		1.4
	2+	1	1		2	12.7		0.8
	TOT	19	10		36	16.4		13.6
7 POOL	0+	19	9		33	12.2	92.4	35.7
(9-29)	1+	4	2		6	2.7		6.5
	2+	5	1		6	1.2		6.5
	TOT	28	12		46	12.2		49.7
	WF	1	1		2	12.7		2.2
8 RIFFLE	0+	53	10		64	3.6	226.5	28.3
(9-13)	1+	8	5		16	11.8		7.1
	2+	1	1		2	12.7		0.8
	TOT	62	16		82	7.1		36.2
9 RIFFLE	0+	26	6		33	3.6	168.0	19.6
(9-13)	1+	6	1		7	1.1		4.2
	2+	1	0		1	---		0.6
	TOT	33	7		41	3.5		24.4
SHEEP CREEK								
1 RIFFLE	0+	0	0		0	---	87.9	---
(7-13)	1+	1	0		1	---		1.1
	2+	8	0		8	---		9.1
	3+	1	0		1	---		1.1
	TOT	10	0		10	---		11.4
CUMMINGS CR.								
1 RUN	0+	11	0		11	---	28.4	38.7
(7-14)	1+	1	1		2	12.7		7.0
	2+	2	0		2	---		7.0
	TOT	14	1		15	0.6		52.7
2 RIFFLE	0+	9	1		10	0.8	29.7	33.6
(7-14)	1+	1	0		1	---		3.4
	2+	2	0		2	---		6.7
	3+	1	0		1	---		3.4
	TOT	13	1		14	0.6		47.1
PANJAB CR.								
2 POOL	0+	4	1		5	1.5	57.7	8.6
(7-13)	1+	0	0		0	---		---
	2+	4	0		4	---		6.9
	3+	1	1		2	12.7		3.5
	TOT	9	2		11	1.6		19.1
	AD	3	0		3	---		5.2

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	2	3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
NF ASOTIN CR.								
2 RUN	0+	16	1		17	0.5	40.0	9.2
(8-25)	1+	4	1		5	1.5		2.6
	2+	3	0		3	---		7.5
	TOT	23	2		25	0.8		13.5
3 POOL	0+	22	4		26	1.8	62.1	41.8
(8-25)	1+	4	2		6	2.7		9.6
	2+	2	0		2	---		3.2
	3+	1	0		1	---		1.6
	TOT	29	6		35	2.4		56.3
4 RIFFLE	0+	28	4		32	1.6	54.8	58.4
(8-25)	1+	9	1		10	0.8		18.2
	2+	3	0		3	---		5.5
	TOT	40	5		45	1.6		82.1
5 RUN	0+	32	2		34	0.7	42.9	79.3
(8-25)	1+	4	0		4	---		9.3
	2+	1	0		1	---		2.3
	TOT	37	2		39	0.7		90.9
6 POOL	0+	14	2		16	1.2	39.5	40.5
(8-25)	1+	7	1		8	0.9		20.3
	2+	5	1		6	1.2		15.2
	3+	3	1		4	1.9		10.1
	TOT	29	5		34	1.9		86.1

A Age based on length-frequency histograms. AD = adipose or ventral fin clips or brands.

B Pass 1 and 2 added for a minimum estimate. Reduction between passes insufficient.

Appendix B, Table 2. Other Game Fish Species Data.
Tucannon River and Tribs., 1988.

SITE	Species[A]	Lengths (mm)
WILD 1	DV	220
3	DV	210
5	DV	151
11	DV	164,162
SHEEP		
1	DV	145,119
HMA		
3	DV	167,215,165
5	DV	182
8	WF	280
12	DV	260,230,220
14	DV	220,250,146
15	DV	157,296
17	DV	192
18	DV	240
21	DV	200
22	WF	45
23	DV	184
24	DV	202
	WF	(2-NO LENGTHS)
HMA-Side channels		
2	WF	52,57,58
4	WF	43
6	DV	140
HART		
7	WF	390,400

[A] DV = bull trout, WF = white fish.

Appendix C.

Table 1. Summary of data collected from Lyons Ferry State Trout Hatchery. Mean, sample size, minimum and maximum values, standard deviation (St Dev), and coefficient of variation (CV) are listed.

	Oregon Moist Pellets	Silver Cup Dry
ATPase		
mean	7.61	7.08
sample size	20	20
minimum	4.86	4.85
maximum	12.53	12.15
St Dev	2.21	1.97
Cv (%)	29.04	27.82
Fork Length		
mean	206.84	209.75
sample size	19	20
minimum	167.0	172.0
maximum	233.0	255.0
St Dev	17.93	23.06
Cv (%)	8.67	10.99
Weight		
mean	94.10	92.37
sample size	19	20
minimum	42.20	43.20
maximum	176.30	158.20
St Dev	31.75	29.93
Cv (%)	33.74	32.40
Glucose		
mean	104.07	102.70
sample size	10	10
minimum	73.20	65.30
maximum	149.30	163.30
St Dev	29.63	36.77
Cv (%)	28.47	35.80
Chloride		
mean	141.80	136.70
sample size	10	10
minimum	134.0	130.0
maximum	161.0	145.0
St Dev	8.53	4.76
Cv (%)	6.01	3.48
Plasma Protein		
mean	5.91	6.15
sample size	20	18
minimum	4.0	4.5
maximum	8.5	7.8
St Dev	1.28	1.03
Cv (%)	21.66	16.75

Appendix C. (cont.)

Table 1 (continued).

	Oregon Moist Pellets	Silver Cup Dry
Hematocrits		
mean	48.45	51.32
sample size	20	19
minimum	31.00	46.00
maximum	58.00	60.00
St Dev	6.39	4.00
Cv (%)	13.19	7.91

Appendix C. (cont.)

Table 2. Summary of Goede method of health assessment of steelhead trout from Lyons Ferry State Fish Hatchery conducted for the Food Challenge 1989. Unlisted categories were rated as normal.

	Oregon Moist Pellets	Silver Cup Dry
Sample size	20	20
Descale (%)	L6/R6 - 5	0
	R6P - 10	0
	0	L6 - 5
	OK - 85	OK - 95
Thymus (%)		
0	100	95
1	0	5
Mesenteric Fat (%)		
0	0	5
1	5	5
2	5	10
3	75	80
4	15	0
Mean value	3.00	2.65
Spleen (%)		
B	55	0
R	10	25
E	0	5
G	35	70
Liver (%)		
A	60	95
B	25	0
E	10	5
F	5	0
Bile (%)		
0	0	5
1	15	5
2	10	45
3	75	45

Appendix C. (cont.)

Table 3. Catagories used in the Goede method of health assessment.

Descale:	As per Fish Transport and Oversite Team (FTOT) April, 1988
Eyes:	Normal (N), Expothalmia (E1, E2), Hemorrhagic (H1, H2), Blind (B1, B2), Missing (M1, M2), Other (OT)
Gills:	Normal (N), Frayed (F), Clubbed (C), Marginate (M), Pale (P), Other (OT)
Pseudobranchs:	Normal (N), Swollen (S), Swollen & Lithic (S&L), Inflamed (I), Other (OT)
Thymus:	No Hemorrhage (0), Mild Hemorrhage (1), Severe Hemorrhage (2)
Mesenteric fat:	Internal body fat expressed with regard to amount present 0 - None 1 - Little, where less than 50% of each cecum is covered 2 - 50% of each cecum is covered 3 - More than 50% of each cecum is covered 4 - Cecae are completely covered by fat
Spleen:	Black (B), Red (R), Granular (G), Nodular (NO), Enlarged (E), Other (OT)
Hind Gut:	No inflammation (0), Mild inflammation (1), Severe inflammation (2)
Kidney:	Normal (N), Swollen (S), Mottled (M), Granular (G), Urolithiasis (U), Other (OT)
Liver:	A - Red B - Light red C - "Fatty" Liver; "coffee cream" color D - Nodules in Liver E - Focal Discoloration F - General Discoloration OT - Other
Bile:	0 - Yellow or straw color; bladder empty or partially full 1 - Yellow or straw color; bladder full, distended 2 - Light green to "grass" green 3 - Dark green to blue/green
Blood:	Hematocrit - Volume of red blood cells (erythrocytes) expressed as percent of total blood volume. Centrifuged 5 min at 10,000 rpm. Leucocrit - Volume of white blood cells (leucocytes) expresssed as percent total blood volume. Plasma Protein - Amount of protein in plasma, expressed as gram percent (grams/100ml). Determined with hand-held protometer.

Appendix D: Brand and tag recoveries from the trap at LFH during the 1988 run year.

Brand	Stock	Release Year	Actual Tag Return	Expanded[A] Tag Recoveries
LA-IJ-1	WELLS	1986	24	30
LA-IJ-4	WELLS		33	38
LA-IJ-3	WELLS		25	31
LA-Ik-1	WALLOWA		9	12
LA-IK-3	WALLOWA		13	18
RA-IK-1	WALLOWA		7	8
RA-IK-3	WALLOWA		6	6
LA-IT-1	WELLS		1	2
LA-IT-3	WELLS		1	2
RA-IJ-1	WALLOWA		1	2
RA-IJ-3	WALLOWA		2	3
RA-IJ-4	WALLOWA		2	3
Total			124	155
RA-IF-1	LFH	1987	96	113
RA-IF-3	LFH		91	110
LA-IF-1	WALLOWA		51	70
LA-IF-3	WALLOWA		42	60
RA-IY-1	LFH		2	2
RA-IY-2	LFH		3	4
RA-IY-3	LFH		2	2
RA-IC-1	WALLOWA		1	2
RA-IC-2	WALLOWA		1	2
RA-IC-3	WALLOWA		1	1
RA-IC-4	WALLOWA		1	2
Total			291	368

[A] Expanded tag recoveries include estimated tags from mortalities not sampled.

Appendix E.

Table 1: Scale age summary for female and male steelhead spawned at LFH, 1989.

Scale Age	n	% of Sample	Mean Length (cm)	Std. Dev.
Females				
1.1	118[A]	48.5	59.4	4.3
1.2	103	42.4	71.4	2.8
Males				
1.1	74	72.5	59.6	3.6
1.2	15	14.7	75.4	4.4
1.3	1	1.0	87.0	---
TOTAL	311			

A Includes one wild fish at 59.5 cm.

Appendix F:

Rainbow and G.Brown Trout Plants, Lyons Ferry/Tucannon, 1989.

COUNTY	LOCATION	No.of Plants	Pounds of Fish	No. Fish Planted
ADAMS	Sprague Lk.	1	4,220	48,108
	TOTAL		4,220	48,108
ASOTIN	Alpowa Ck.	1	450	1,485
	Asotin Ck.	1	1,300	4,290
	Golf Course Pd.	4	2,964	9,067
	Headgate Pd.	2	1,570	4,174
	Silcott Pd.	4	1,594	4,381
	W.Evans Pd.	4	1,844	5,651
	TOTAL		9,722	29,048
COLUMBIA	Big Four	1	1,600	4,160
	Blue Lk.	5	7,570	22,232
	Curl Lk.	3	5,356	16,688
	Dam Pd.	2	835	2,000
	Dayton Jv.Pd.	2	925	2,680
	Orchard Pd.	2	678	1,500
	Rainbow Lk.	6	13,263	38,720
	Spring Lk.	6	8,545	24,685
	Touchet R.(GB)	1	5,930	13,119
	Tucannon R.	3	7,780	23,346
	Watson Lk.	1	1,040	3,224
	TOTAL		53,522	152,354
FRANKLIN	Big Flat	1	2,400	7,440
	Marmes Pd.	1	400	1,000
	TOTAL		2,800	8,440
GARFIELD	Bakers Pd.	1	470	1,504
	Casey Pd.	1	370	999
	Coles Pd.	1	370	999
	Pataha Ck.	2	2,090	6,298
	TOTAL		3,300	9,800
WALLA WALLA	Blue Creek	1	250	800
	College Pl. Pd.	2	1,220	3,274
	Coppei Ck.	1	700	1,820
	Dry Ck.	2	900	2,460
	Fishhook Pk. Pd.	2	2,860	7,784
	Jefferson Pk. Pd.	2	1,220	3,274
	Mill Ck.	2	4,860	15,720
	Quarry Pd.	2	8,832	24,979
	TOTAL		20,822	59,918
WHITMAN	Alkali Ck.	1	330	1,056
	Garfield Pd.	1	600	1,620
	Gilcrest Pd.	2	1,415	4,065
	Pampa Pd.	3	4,630	9,997
	Riparia Pd.(RB)	1	334	1,069
	Riparia Pd.(GB)	1	430	860
	Union Flat Ck.	1	660	2,112
	TOTAL		10,995	45,900
	Total Rainbow		92,225	266,360
	Total German Brown		6,360	13,979
	GRAND TOTAL		98,585	280,339