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LYONS FERRY EVALUATION STUDY
1990-91 Annual Report

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ABSTRACT

Total steelhead production at Lyons Ferry Hatchery (LFH) in 1990 was 940,934 summer steelhead weighing 227,740 pounds, for an average smolt size of 4.1 fish/pound. A total of 264,974 rainbow trout weighing 98,088 pounds were planted into 39 waters An additional 272,164 trout weighing 7,589 pounds were reared for Idaho Fish and Game as a portion of WDW responsibility under the Lower Snake River Compensation Plan (LSRCP). Total trout production was 122% of goal this year. Average trout size planted was 2.7 fish/pound.

Twelve study groups of coded wire tagged and branded steelhead were released from 3 different locations. Tag loss averaged 0.75% (SD=0.60) and brand loss averaged 5.02% (SD=2.60). Samples for physiological analysis were taken from fish released from raceways, rearing ponds and conditioning ponds indicated that fish released from conditioning ponds were more fully smolted than those released directly from hatchery holding areas.

The Passage Index (P.I.) for hatchery smolts increased from an average of 20.8% of release at McNary Dam in 1990 to 25.0% of release in 1991. This average is misleading because travel rates were slower in 1991 as compared to 1990 (5.5-6.4 and 3-4.5 miles per day) for 1990 and 1991, respectively. Also median (50%) passage at McNary Dam took longer in 1991 as compared to 1990 (7-23 and 30-43 days for 1990 and 1991 respectively). Low river flows and cooler than normal river temperatures are believed to have caused the slower emigration of smolts.

Adults return rates to Lower Granite Dam during 1988-1990 from 1987 smolt releases ranged from 0.47% to 1.24% for one year returns; from 0.68% to 2.11% for combined first and second year returns; and from 0.66% to 1.90% for combined one, two and three year returns. The 1987 smolt release returned adults as 51.9% one-ocean age, 48% as 2-ocean age and 0.1% as three-ocean age. One-ocean age fish averaged 59.5 cm in length and 2-ocean age fish averaged 72.8 cm. The 1990-91 run to above Lower Granite Dam was one of the lowest in years; only 43.3% of the 1989-90 run.

The adult steelhead trap at LFH was operated from July 30 to November 16, 1990. A total 2,434 fish were captured. Males and females comprised 59% and 41%, respectively. Wild fish represented 0.86% of the fish trapped at the hatchery this year. Tagged and branded fish made up 26.9% of the fish trapped. Average length for one ocean fish and two ocean fish was 57.6 and 72.4 cm, respectively. A total of 2,570,676 eggs were spawned from 437 females. A total of 1,296,249 eggs were retained for hatching and rearing. One ocean age fish averaged 4,224 eggs/female and 2-ocean age fish averaged 6,283 eggs/female.

Adult returns from LSRCP releases contributed to 10 different fisheries in the Columbia River basin and offshore ocean area. More than 50% oOf the total harvest of returning adults occurred in the LSRCP area. Contribution to sport fisheries and escapement into the LSRCP area from the 1987 smolt release ranged from 0.55% to 1.15%. Adult survival from the 1988 smolt release that were harvested in sport fisheries and or escaped into the LSRCP area ranged from

0.38% to 1.33%. Based on these survival rates, we estimated that Washingtons' LSRCP steelhead program contributed 14,511 fish to the Columbia River basin in the 1988 run year and 15,736 fish in 1989 and 6,740 fish in 1990. These numbers represent 312%, 338% and 145% of our annual LSRCP goal for 1988, 1989 and 1990, respectively.

We conducted creel surveys on the Snake River, Mill Creek, McNary pool on the Columbia River, Grande Ronde, Walla Walla, Touchet and Tucannon rivers. We sampled 15.7% of the sport harvest from the Snake River and 24.4% of the harvest from the remaining areas. We collected 138 and 102 snouts from ventral fin clipped steelhead from the Snake River and Snake River tributaries and McNary pool, respectively. Female steelhead made up 52.4% of the LFH origin fish checked in the creel with males comprising 44.8% with 2.8% unknown sex on the Snake River. Female steelhead made up 59.3% of the LFH origin fish checked in the creel with males comprising 38.2% with 2.4% unknown sex on the Snake River tributaries and McNary pool. Anglers expended an estimated 1,456 angler days of effort on the Grande Ronde River in the 1990-91 season. Only one Washington origin coded wire tag was sampled from the harvest.

We conducted spawning ground surveys on 44.2 miles of the Tucannon River and its tributaries, 43.1 miles of the Touchet River and its tributaries and 18.4 miles of Asotin Creek and Charlie Creek . Redd densities ranged from 0/mile to 14.6/mile.

Juvenile salmonid densities in the Tucannon River were analyzed for the period 1983-1990. Densities and population size of 0 aged steelhead/rainbow correlated with spawning escapement. During the same period, densities and population sizes of older age rainbow/steelhead juveniles (age 1 and older) remained stable or increased. Improved instream habitat alterations are providing improved rearing areas and supporting stable or increasing populations of older aged fish. We believe that instream habitat structures placed in 1983-84 may have offset the impacts of 4 drought years by providing pool habitat for older age fish.

ACKNOWLEDGEMENTS

We would like to thank Kent Ball and the coded wire tag recovery staff of Idaho Fish and Game for their assistance in the joint Snake River creel survey and in removing our coded wire tags. Thanks also to Rich Carmichael and crew of Oregon Department of Fish and Wildlife for their expert assistance with the Grande Ronde creel survey and especially for providing a statistical analysis of the results.

A special word of thanks to Jerry Harmon and the other National Marine Fisheries Service personnel operating the adult steelhead trap at Lower Granite Dam. Their professional manner and thoroughness helped to provide a substantial data base of adult return and passage through brand recovery.

We would like to thank John Hisata, John Kerwin, Einar Wold and Dan Herrig for reviewing the draft manuscript.

We also 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 report by the Washington Department of Wildlife (WDW) addresses progress toward meeting mitigation goals established under the Lower Snake River Compensation Plan (LSRCP) in Washington through operation of the Lyons Ferry Hatchery (LFH) complex. The reporting period for this report is July 1, 1990 through June 30, 1991 inclusive. The relative locations of major streams within the project area are presented in Figure 1. This report contains a partial presentation of data collected and a review of all activities undertaken during the report period.

An additional project completion report (Viola and Schuck 1991), already finished in early 1992, dealt with one objective under the 1990 statement of work. That report short report discussed estimates of the levels of residual steelhead smolts in three streams of Southeast Washington. These data were of interest in relation to possible effects of residual steelhead on recently listed populations of threatened spring chinook salmon.

Results from our fourth year of smoltification testing are discussed. This testing was initiated to look at the possibility of conditioning ponds interfering with smoltification and imprinting, one possible explanation for poor adult returns to their release site. The data did not clearly identify a problem within our release program.

We continued to collect tags from our tag release groups to determine adult steelhead contribution to LSRCP area and other harvest areas. We expected the drought conditions of 1987 through 1989 to have serious effects on adult returns because of decreased smolt survival rates. Adult returns this year continue to provide some indication of how LSRCP releases can successfully maintain steelhead runs under adverse environmental conditions.

The second year of results from coded wire tag experiments in the Walla Walla River system duplicated 1989 results. Survival of tagged smolts to McNary Dam was comparable for the Touchet and Walla Walla rivers when compared to Lyons Ferry Hatchery and Tucannon River released tag groups. However, returning adults destined for both rivers 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 the ability of our stocks of fish and release strategies to meet the goals as outlined under the LSRCP program. Severe drought and low flow in the basin, especially the Walla Walla, cannot be overlooked as a possible overriding factor that may be driving the behavior of these fish. additional studies are warranted will continue.

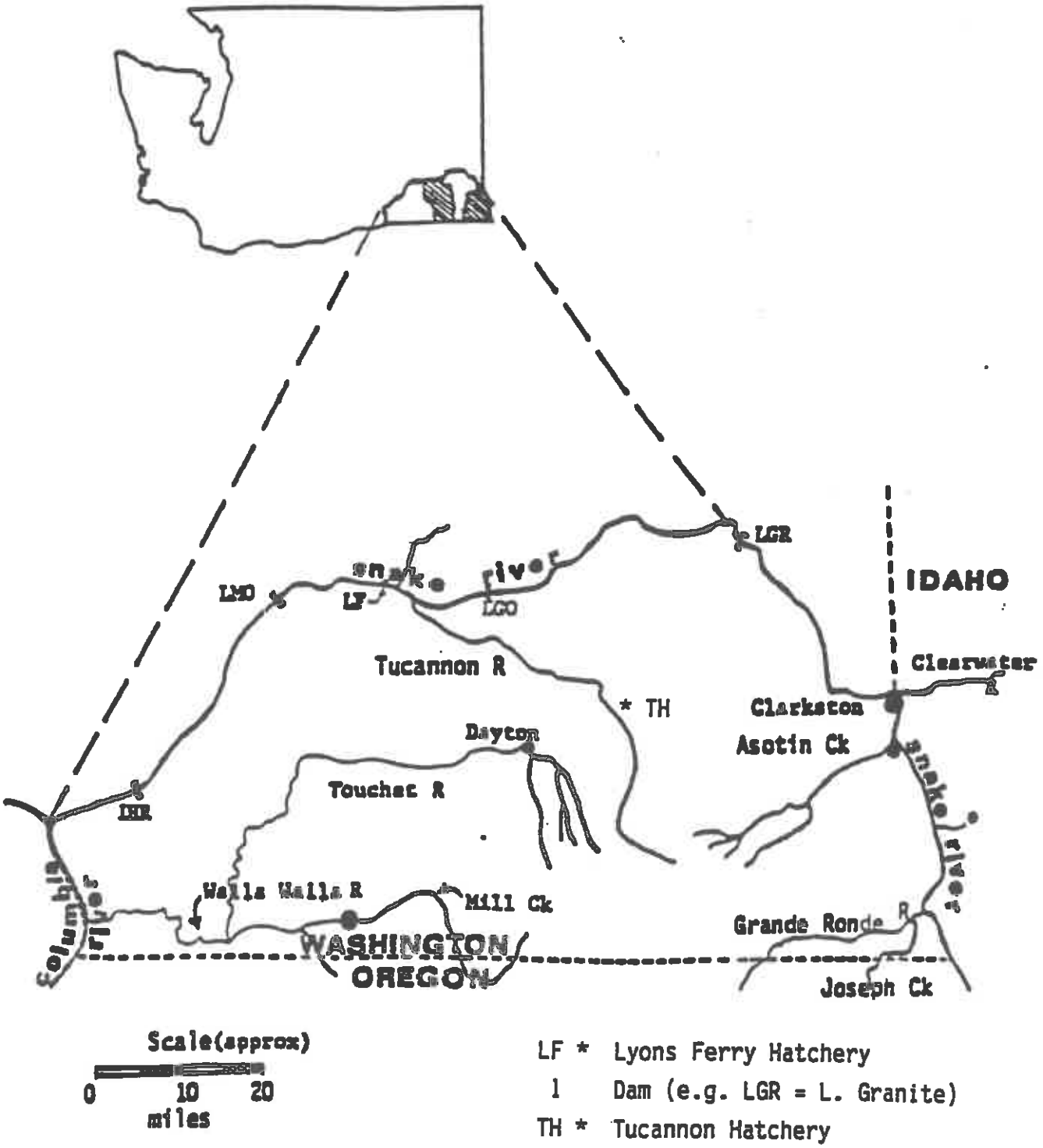


Figure 1. The relative locations of major LSRCP streams and Facilities mentioned in this report.

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) and left ventral fin clipping 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.

Adipose clipping was completed during August/September 1990 by hatchery and temporary personnel, just prior to their transfer into the large rearing ponds. We contracted with Washington Department of Fisheries (WDF) to conduct our coded wire tagging and branding program. Tagging and branding was accomplished during February 1990. Tag loss was determined as in 1985 (Schuck and Mendel 1987). Tag codes and brands are reported to the Pacific States Marine Fishery Commission (PSMFC) for publication in their annual report.

Fish at Release

Multiple release methods were used in 1991: 1) brood stock smolt releases from Lyons Ferry were allowed to volitionally outmigrate from the rearing ponds, 2) fish were pumped from the release structure into tank trucks and hauled directly to various streams and rivers in Southeast Washington; and 3) fish were 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 were then allowed to volitionally emigrate over a 2 week period before the remaining fish are forced from the ponds.

The release of fish from conditioning ponds along with similar direct stream releases occurred again this year for a comparison of smolt response. This was the second year of a three year study to evaluate release strategies.

Lyons Ferry Hatchery Feed Study

Between 1982 when Lyons Ferry began operation and 1988, Oregon Moist Pellet (OMP) diet was used exclusively for the

rearing of juvenile steelhead from swim-up through release as smolts. Beginning in 1988 a dry salmon diet was utilized at the hatchery on some groups of fish and it was proposed by the new Hatchery Manager to convert all steelhead production from OMP to dry diet. The three primary reasons for the change were ease of storage of the dry diet (freezing not required), equal growth rates and health performance between groups of fish fed either diet and cost.

Although there were many studies done by feed manufacturers that supported claims of equal growth performance of Dry Diet when compared to OMP, no studies had been conducted that followed early rearing with comparisons of adult returns on steelhead. It was decided to initiate a study in 1988 to compare the performance of groups of steelhead at LFH fed OMP and Dry Diet. Fish were started on OMP mash as had been done in the past but one group was fed Dry Diet from the time they left the hatchery building until released as smolts in 1990. The second group was fed OMP through time of release. The groups were sampled monthly for growth and health status and then sampled just prior to release for average length, weight and condition factor and the percentage of fish that were considered smolted, in a transitional stage or parr. In addition to these standard samples, a Goede's Organosomatic Index sample was collected from each of the two groups as well as blood and tissue samples that would characterize their degree of smoltification from ATPase levels and blood thyroxin activity. A sample of 50,000 fish from the two groups were coded wire tagged and branded which allowed the collection of passage data at McNary Dam during their out migration. Returning tagged adults would also allow the comparison of adult survival rates for the two feed types. The study was planned to run for three years. Unfortunately, disease problems plagued LFH in 1989-90. No LFH stock fish were available to continue the study. Disaster again prevented the study from being continued in 1990-91 because of the loss of the hatchery's water supply line. One year's release of fish from the feed study is therefore the only data that will be available.

Preliminary juvenile growth data, sizes at release, Goede's Organosomatic data and the smoltification information were reported in our 1988-89 Annual Report (Schuck et al. 1990). The first year of adult returns to the Snake River basin is presented in this report. A final presentation of adult returns and comparison of the performance of the groups will be provided in the 1991-92 Annual report.

Hatchery Smolt Emigration

We assessed smolt survival throughout their migration in the Snake and Columbia rivers from samples collected and expanded at the Snake and Columbia River dams by personnel from the National Marine Fisheries Service (NMFS) and Fish Passage Center (FPC).

Personnel from the U.S. Fish and Wildlife Service (USFWS), Columbia River Field Station, Cook, Washington collected samples of blood and gill tissue and photographed smolts at Lyons Ferry Hatchery, Curl Lake conditioning pond and from direct stream releases at Marengo on the Tucannon River and Asotin Creek. Gill ATPase and blood thyroxin (T_4) were measured as physiologic indicators of smoltification. This information along with mean lengths and weights of fish sampled are reported. This was a continuation of sampling done in 1988- 1990 (Schuck et al, 1989) to determine if measurable differences in smoltification existed among groups of smolts released under different circumstances. Sampling frequency was similar to that done in 1990. Residualized fish were again sampled from the streams when migrating fish were collected at the first collector dam (McNary or Lower Granite). Samples were analyzed and summarized by the USFWS at Cook.

Adult Steelhead Returns To Project Area

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 December of 1990 when they were sorted for spawning purposes. Fish that were identified as destined for upstream hatcheries, injured fish and fish not needed for broodstock were returned to the river.

Passage at Dams and Characteristics of Adults

The National Marine Fishery Service monitored adult passage at Lower Granite Dam as part of their migration research (Jerry Harmon, NMFS, personal comm., 1991). Adults coming into the trap were sampled for marks and brands.

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 were delineated by road miles or river miles taken from U.S.G.S. aerial photographs. Because of high runoff conditions during the spring, peak spawning period was not determined in 1991. All other methods were as described by Schuck et al (1989) except for the following modifications.

A systematic sampling method was employed to speed data collection during the second or third walks of survey areas. A 50% sample of selected stream sections was walked in a normal fashion to look for redd construction. During the walk, new redds were counted as well as redds from the first walk (old

redds). Average new and old redds per mile for the sample sections were then multiplied by the total length of the section to obtain an estimated total new and old redds. Estimated old redd numbers were then compared to actual numbers from the first walk to determine the accuracy of our procedure. The actual number of redds counted from the first walk was added to the estimated number of redds from subsequent counts to obtain an estimated total redd count.

A random sample of test sites were walked completely to obtain an actual number of redds for comparison with estimated numbers for the same section.

Tucannon Hatchery Weir/Trap

We trapped both hatchery and wild steelhead on the Tucannon River from December through May. This served a dual purpose. We were able to document the numbers of wild and hatchery fish that were returning to spawn above the weir. Also, every fifth wild fish of both males and females were kept for spawning.

Steelhead Creel Surveys

The primary emphasis of creel surveys is to recover the maximum number of coded wire tagged/ freeze branded adult steelhead. We utilize Washington Department of Wildlife punchcard estimates of sport harvest to determine our sample rates for all individual rivers. These sample rates are then used to expand coded wire tag recoveries by river and river section.

The recreational steelhead fishery for the Snake River occurred September 1, 1990, through March 31, 1991. Regulations required wild steelhead release, with daily catch, possession and annual limits of 2, 4 and 30 steelhead, respectively.

The recreational fishery for the Grande Ronde River, exclusive of the catch and release section at the mouth, occurred September 1 until November 19, 1990 when a catch and release only regulation went into effect. Poor steelhead escapement into the Snake River above Lower Granite Dam aroused concern in Oregon that insufficient adult hatchery steelhead would be available for their hatchery broodstock without sport harvest restrictions in the Washington portion of the river. A catch and release only regulation was in effect until March 1, 1991 when the general season reopened. Wild release regulations were in effect during periods open for harvest. A joint survey of the upper Grande Ronde was conducted by Oregon Department of Fish and Wildlife (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 past years.

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 and brands 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 were produced by Lyons Ferry Hatchery.

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

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

Areas of other streams surveyed include:

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

Touchet River -- mouth to the Wolf Fork bridge. (No effort counts were conducted on this river.)

McNary Pool -- McNary Dam upstream for 0.75 miles.

Harvest estimates and coded wire tag expansions for LSRCP program areas and for other areas within the Columbia River basin were completed as in 1989 (see Schuck et al, 1991).

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 PSMFC for inclusion in the tag recovery data base. Both sources of tag recovery are used in assembling data for this report. Data obtained through LSRCP evaluation activities are crucial for the Snake River drainage.

Juvenile Steelhead Populations in Project Rivers

Long Term Trends

Long term juvenile density trend sites were established in the Tucannon River and Asotin Creek in the early 1980's. Sites and methods used were as discussed in our 1989 report (Schuck et al 1991). Efforts in 1990 were to sample these sites and establish formal sites on the Touchet River from sample sites used in the past. An analysis of the data collected and their relation to spawning ground densities within the rivers is also discussed.

A section of the Tucannon River (Campground 1 upstream 11.6 miles to Panjab Creek) was identified as an juvenile steelhead density and population index area. Samples from this area provided steelhead juvenile density and population trend information for each year.

Information on annual juvenile steelhead densities, river surface area and adult steelhead spawning escapement within the index area was obtained from: annual reports; Mendel 1984, Mendel 1985, Schuck and Mendel 1987, Schuck et al. 1988, Viola et al. 1991 and un-published Washington Department of Fisheries data from 1987 and 1990. Population estimates were calculated for both 0 aged and >0 aged juvenile steelhead in areas of artificial habitat improvements and unimproved areas within the river index sections. Individual population estimates were calculated by multiplying densities (#/100m^2) by the total area in 100m^2 annually available within improved and unimproved areas of the index river section. A total population estimate for both 0 aged and >0 aged juvenile steelhead was calculated as the sum of the population estimates from improved and unimproved areas. These estimates were then divided by the total area available within the index river section for that year. This provided a density per 100m^2 for each age class. Total density of all age classes from within the entire river section was the sum of both age classes.

Summer Densities

Personnel from WDF electrofished extensively throughout the Tucannon River for salmonid densities by separate habitat types (pool, riffle, run, and side channel). A summary of the rainbow/steelhead data they collected is presented.

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, 1990-91

Species[A]	Stock[A]	No. Eggs	No. Fry	Number planted	Percent[B] survival	Pounds planted
LYONS FERRY HATCHERY						
RB	SPOK.	435,000	399,493	111,899[C]	90.1	42,591
SSH	LFH	1,483,485	1,002,320	863,267[D]	86.1	168,236
SSH	WAL	428,000	409,477	305,299[E]	74.5	57,698
TUCANNON HATCHERY						
RB	SPOK.	226,800	189,310	182,358[F]	80.4	56,957
RB	SPOK.	96,290	63,732	63,732	66.2	1,740[G]

A- RB = rainbow, SSH = summer steelhead, SPOK = Spokane, LFH = Lyons Ferry Hatchery, WAL = Wallowa.
B- Egg to smolt/catchable survival where applicable, otherwise fry to smolt.
C- 185,430 fish weighing 3,234 pounds, and 62,734 fish weighing 3,605 pounds transferred to Idaho.
D- Includes 148,752 fish (26,665 lbs) to Dayton A.P., 120,560 fish (23,410 lbs) to Curl Lake A.P., and 227,632 fish weighing 3,490 lbs planted into Rock Lake.
E- Includes 52,500 planted in Oregon for ODFW
F- Includes 24,000 fish weighing 750 lbs transferred to Idaho.
G- Late brood rainbow raised for IDFG.

No severe disease problems were experienced at either hatchery in the 1990-91 production year. The failure of the main water supply line to Lyons Ferry Hatchery on May 30, 1991 required that all fish on station be shipped to other facilities. The mortality rate on very small fry, such as the Wallowa stock at 19%, affected the steelhead program. The pipeline was repaired and the hatchery was functional again by August 6, 1991.

Large numbers (100-400) of seagulls and occasional small groups of terns were present on the lakes during much of the winter except for brief periods of time after hazing. The number of birds grow each year. Each of the lakes receives differing

amounts of bird feeding pressure depending on lake location, amount of hazing and the size and behavior of fish within the lake.

Egg-to-fry survival for steelhead was excellent for groups in 1991 (Table 2).

Table 2: Egg to Fry Survival, Lyons Ferry Hatchery 1987-91.

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
	1990	428,000	409,477	95.7
	1990	421,025	416,470	98.9
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
	1990	1,483,485	1,002,320	67.6
	1991	1,296,249	1,115,368	86.0

A- Eyed eggs B- Green eggs

Fish Marking

A tag loss in 1991 of 0.75% is a decrease over that experienced in 1990, but not substantially. Brand loss was similar this year with 5.02% unreadable brands with a coefficient of Variation (CV) equal to 49.6. However, overall brand quality was hampered by readable but light brands and a high degree of variability between groups. The light brands caused problems in accurate brand reading at the dams during the spring emigration (see Migration through Dams, below). A complete listing of the tag/brand groups is summarized in Table 3.

Fish at Release

The 1990-91 production year allowed a return to the use of two stocks of steelhead rather than the three that were released in 1990. We received Wallowa stock fish from Oregon for use in the Grande Ronde River and the remaining rivers were stocked using Lyons Ferry stock. Samples were taken from various raceways and conditioning ponds during the release period and are summarized in Table 4.

Table 3. Smolt releases from Lyons Ferry Hatchery, 1988-91.

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
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	0.8	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	19,080	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		
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	29	208,262	43,387	4/15	WALLOWA			AD	4.8		
GRANDE RONDE	26	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	0.81	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	41	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	41	20,110	3,528	TO	L.FERRY	63/49/42	RA-H-2	AD-LV	5.7	0.53	2.66
TUCANNON R.@CURL	41	20,115	3,529		L.FERRY	63/49/41	RA-H-1	AD-LV	5.7	0.77	2.79
TUCANNON R.@CURL	41	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	3.80	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	21,380	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	0.8	29,975	5,450	4/27	WALLOWA			AD	5.5		
GRANDE RONDE	29	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

Table 3. Continued

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
TOUCHET R.@DAYT	53	20,224	2,689		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	76,771	15,994	4/27	L.FERRY			AD	4.8		
TUCANNON R.@CURL	41	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	41	20,502	4,604		L.FERRY	63/50/49	LA-IJ-4	AD-LV	4.4	0.70	5.30
TUCANNON R.@CURL	41	20,178	4,586	TO	L.FERRY	63/50/50	LA-IJ-3	AD-LV	4.4	1.30	5.80
TUCANNON R.@CURL	41	99,190	22,543	5/08	L.FERRY			AD	4.4		
"totals"		847,279	167,248					Mean =	4.9	1.13	5.11
								SD	0.38	0.89	2.04
1990											
SNAKE R.@ LFH	58	18,150	3,300	4/27	PAHSIM	63/14/21	LA-IC-3	AD-LV	5.5	1.3	5.4
SNAKE R.@ LFH	58	20,805	3,650	27	PAHSIM	63/08/42	RA-IC-3	AD-LV	5.7	1.0	2.3
SNAKE R.@ LFH	58	4,524	780	30	PAHSIM			AD	5.8		
WALLA WALLA R.	24	20,015	5,267	25	WEL/SKA	63/39/09	RA- S-2	AD-LV	3.8	0.9	4.6
WALLA WALLA R.	25	19,802	5,352	24	WEL/SKA	63/39/10	LA -S-2	ADLV	3.7	1.5	3.2
WALLA WALLA R.	27	14,000	4,000	20	WEL/SKA			AD	3.5		
WALLA WALLA R.	24	14,800	4,000	19	WEL/SKA			AD	3.7		
WALLA WALLA R.	22	13,200	4,000	19	WEL/SKA			AD	3.3		
WALLA WALLA R.	25	14,400	4,000	19	WEL/SKA			AD	3.6		
WALLA WALLA R.	25	18,400	4,000	18	WEL/SKA			AD	4.6		
WALLA WALLA R.	27	15,600	4,000	19	WEL/SKA			AD	3.9		
MILL CREEK	3	15,200	4,000	18	WEL/SKA			AD	3.8		
MILL CREEK	3	17,000	5,000	20	WEL/SKA			AD	3.4		
ASOTIN CREEK	0.8	20,142	3,730	17	PAHSIM	63/07/25	LA-IC-4	AD-LV	5.4	0.4	3.4
ASOTIN CREEK	0.8	19,950	3,500	18	PAHSIM	63/14/22	RA-IC-4	AD-LV	5.7	1.0	5.8
ASOTIN CREEK	0.8	23,000	5,000	24	PAHSIM			AD	4.6		
ASOTIN CREEK	0.8	23,275	4,750	24	PAHSIM			AD	4.9		
ASOTIN CREEK	0.8	28,600	5,500	26	PAHSIM			AD	5.2		
ASOTIN CREEK	0.8	22,880	4,400	30	PAHSIM			AD	5.2		
GRANDE RONDE	29	179,250	36,066	4/15-	WALLOWA			AD	5.0		
GRANDE RONDE	29	59,750	11,274	4/30	WALLOWA			AD	5.3		
TOUCHET R.@DAYT	53	20,190	5,769	4/15	WEL/SKA	63/39/08	LA-S-1	AD-LV	3.5	4.4	5.7
TOUCHET R.@DAYT	53	19,780	5,651	to	WEL/SKA	63/39/07	RA-S-1	AD-LV	3.5	0.9	4.6
TOUCHET R.@DAYT	53	69,775	19,936	4/30	WEL/SKA			AD	3.5		
TOUCHET @WAITSBG	37	6,800	2,000	23	WEL/SKA			AD	3.3		
TUCANNON R.@CURL	41	20,012	4,002	4/15	PAHSIM	63/39/12	LA-IC-1	AD-LV	5.0	1.7	3.3
TUCANNON R.@CURL	41	20,065	4,013	to	PAHSIM	63-39-11	RA-IC-1	AD-LV	5.0	0.7	2.9
TUCANNON R.@CURL	41	39,175	7,835	4/30	PAHSIM			AD	5.0		
TUCANON @HARENGO	28	19,992	3,570	25	PAHSIM	63/08/38	RA-IC-2	AD-LV	5.6	0.4	5.7
TUCANON @HARENGO	28	20,020	3,640	25	PAHSIM	63/08/41	LA-IC-2	AD-LV	5.5	1.0	4.0
"totals"		818,352	181,985					MEAN=	4.5	1.3	4.2
								SD =	0.87	1.0	1.2

Table 3. Continued

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
1991											
ASOTIN CREEK											
GRANDE RONDE	29	252,799	47,898	4-16/30	WALLOWA			AD	5.3		
G.RONDE IN ORE.	41	52,500	10,000	4-30	WALLOWA			AD	5.2		
MILL CREEK	3	17,000	5,000	4-17	L.FERRY			AD	3.4		
MILL CREEK	3	12,950	3,500	4-23	L.FERRY			AD	3.7		
SNAKE R.@ LFH	58	19,550	5,750	4-18	L.FERRY			AD	3.4		
SNAKE R.@ LFH	58	16,830	5,100	4-18	L.FERRY			AD	3.3		
SNAKE R.@ LFH	58	21,275	5,750	4-18	L.FERRY			AD	3.7		
TOUCHET R.@DAYT	53	20,044	5,011	4-15	L.FERRY	63/40/61	RA-IT-1	AD-LV	5.3	0.10	6.18
TOUCHET R.@DAYT	53	20,108	5,027	4-16	L.FERRY	63/40/60	LA-IT-1	AD-LV	5.3	0.00	8.50
TOUCHET R.@DAYT	53	20,128	5,032	4-17	L.FERRY	63/40/62	RA-IT-3	AD-LV	5.3	0.10	9.40
TOUCHET R.@DAYT	53	20,044	5,011	4-18	L.FERRY	63/40/59	LA-IJ-3	AD-LV	3.8	0.10	1.60
TOUCHET R.@DAYT	53	20,132	5,033	4-19	L.FERRY	63/40/58	LA-IJ-1	AD-LV	3.8	0.00	1.59
TOUCHET R.@DAYT	53	20,104	5,026	4-22	L.FERRY	63/14/56	RA-IJ-1	AD-LV	3.8	0.89	3.87
TOUCHET R.@DAYT	53	27,960	6,990	4-30	L.FERRY			AD	3.7		
TUCANNON R.@CURL	41	20,032	5,414	4-24	L.FERRY	63/14/49	RA-H-2	AD-LV	3.7	1.38	8.08
TUCANNON R.@CURL	41	20,184	5,455	4-24	L.FERRY	63/14/50	LA-H-2	AD-LV	3.7	0.99	3.28
TUCAN from CURL	41	20,390	4,855	4-16	L.FERRY	63/14/55	RA-7-1	AD-LV	4.2	1.15	5.56
TUCAN from CURL	41	20,170	4,803	to	L.FERRY	63/14/52	RA-7-3	AD-LV	4.2	1.88	4.94
TUCAN from CURL	41	80,000	19,048	4-30	L.FERRY			AD	4.2		
TUCANON @WARENGO	26	19,987	5,552	4-23	L.FERRY	63/14/44	RA-H-1	AD-LV	3.6	1.08	3.44
TUCANON @WARENGO	26	19,998	5,555	4-24	L.FERRY	63/14/47	LA-H-1	AD-LV	3.6	0.89	3.96
WALLA WALLA R.	29	34,000	10,000	4-16	L.FERRY			AD	3.4		
WALLA WALLA R.	26	16,500	5,000	4-17	L.FERRY			AD	3.3		
WALLA WALLA R.	27	33,000	10,000	4-18	L.FERRY			AD	3.3		
WALLA WALLA R.	25	74,000	20,000	4-22/25	L.FERRY			AD	3.7		
WALLA WALLA R.	26	17,500	5,000	4-26	L.FERRY			AD	3.5		
WALLA WALLA R.	23	16,269	4,930	4-29	L.FERRY			AD	3.3		
WALLA WALLA R.	25	7,480	2,200	4-17	L.FERRY			AD	3.4		
		940,934	227,740					MEAN	4.13	0.75	5.02
								SD =	0.68	0.57	2.49

Table 4. Smolt characteristics at Lyons Ferry Hatchery, 1991.

Lake/ Raceway	Stock[A]	Number fish sampled	No. of sample days	Mean length mm (CV)	Mean weight gms (CV)	No. fish /lb.	K factor	% Precocious males
Cotton-wood C.P.	WA	460	3	194.7 (15.0)	75.6 (42.7)	6.0	1.05	0.0
Dayton C.P.	LFH	482	3	207.9 (10.4)	102.8 (29.6)	4.4	1.22	0.0
IT brand		229		196.0	85.8	5.3	1.12	2.2
IJ brand		170		220.1	118.5	3.8	1.10	1.7
no brand		66		218.0	122.2	3.7	1.10	3.0
Curl Lk.	LFH							
7 brand		314	4	191.9 (11.5)	76.6 (33.8)	5.9	1.05	3.8
no brand		448	4	210.5 (14.7)	102.6 (38.5)	4.4	1.04	6.9
RW-18,19 (Tuc. R. @ Marengo)	LFH	220	1	218.7 (13.5)	123.1 (32.2)	3.7	1.27	2.7
RW-16,17 (Tuc. R. @ Curl Lk.)	LFH	206	1	218.6 (11.0)	120.7 (32.4)	3.8	1.17	0.0
RW-14,15 (G. Ronde R. in Oregon)	WAL	208	1	194.8 (17.9)	86.0 (23.6)	5.3	1.11	0.0
Lake 2	LFH	568	4	230.2 (13.7)	134.7 (36.2)	3.4	1.05	1.8

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

Fish size at release ranged from 3.3 - 5.3 fish/lb and the average size for the entire release of smolts was 4.13 fish/lb (C.V. = 16.5). Total steelhead smolt production was 940,934 fish totaling 227,740 pounds. Table 3 summarizes the smolt releases into Southeast Washington rivers for 1988-1991.

Precocious males usually made up only a small portion of the fish sampled (Table 4). There was a large difference between different release groups in the number of transitionally developed fish, those not readily identifiable as a smolt based on physical appearance. These fish comprised an average 28.4% (CV=32.0) of untagged conditioning pond fish sampled at release, 42.3% (CV = 29.1) of tagged conditioning pond fish and 58.2% (CV = 11.6) of tagged fish released directly into streams from

raceways. Figures 2-7 depict the range and coefficient of variation of samples of fish lengths and weights taken from raceways and conditioning ponds in 1991.

The results from samples for physiological analysis in 1991 showed similar responses to those seen in 1989 and 1990. ATPase in conditioning pond fish was higher than in fish at LFH just prior to release (Fig.8). Four weeks after release, LFH direct stream released fish collected at McNary Dam peaked at the highest levels of ATPase of any release group. Fish sampled from raceways had lower levels than pond reared fish or fish released from the conditioning ponds.

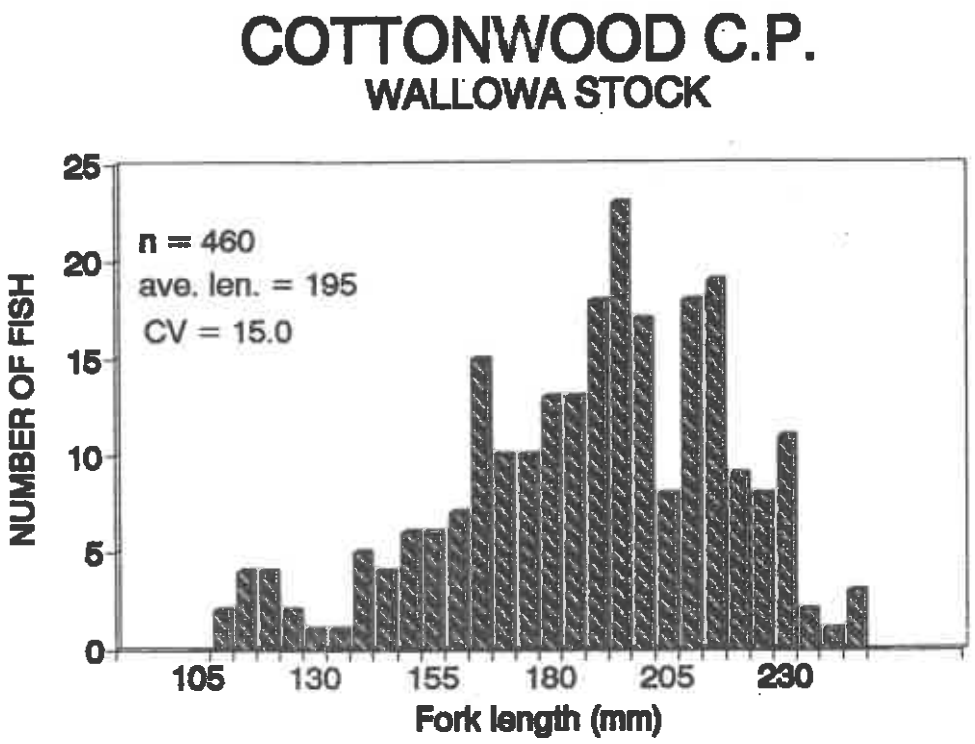
Condition factor declined measurably in all samples between release until recapture at McNary Dam (Fig.10). This should be expected as fish are no longer fed and are actively migrating downriver. Condition factor did not change in residual smolts in the Tucannon and Touchet rivers and was substantially higher than for smolts sampled at McNary dam on the same day. Average length of smolts captured at McNary Dam (Fig.9) was greater for all release groups than for residual smolts captured in river. This is consistent with data collected in 1989 and 1990.

An additional smoltification parameter was measured this year. During the 1990 sampling it was noted that most (>80%) of the residual fish sampled in the rivers were male. The male/female ratio of fish collected at McNary Dam however showed a greater percentage of females in the sample. Table 5 summarizes data collected from fish sampled pre- and post release in-river and at McNary Dam. The presence of high percentages of males and precocious males in the residual population, and the higher incidence of precocious males in raceway reared fish is of particular interest.

Discussion

Fish growth and performance was excellent considering the additional stress imposed during the production year by shipping fish around the region while the water supply system was being repaired. Smoltification at time of release was generally good for most fish. The size at release of the two study groups of fish released from Dayton pond (a small group at 6 fish/lb, and a large group at 4 fish/lb) was very close to the goal set for the study. We shortened our sampling time at the conditioning ponds where possible to eliminate some of the differences between hatchery sample sizes used in production reports and our numbers. This was successful for Dayton and Curl Lake ponds but there was still a substantial difference between the two numbers at the Cottonwood facility. We shall continue to examine this discrepancy and attempt to resolve it in 1992.

The tagging program went smoothly this year. Brand quality is still a problem. A lack of consistency in quality is probably



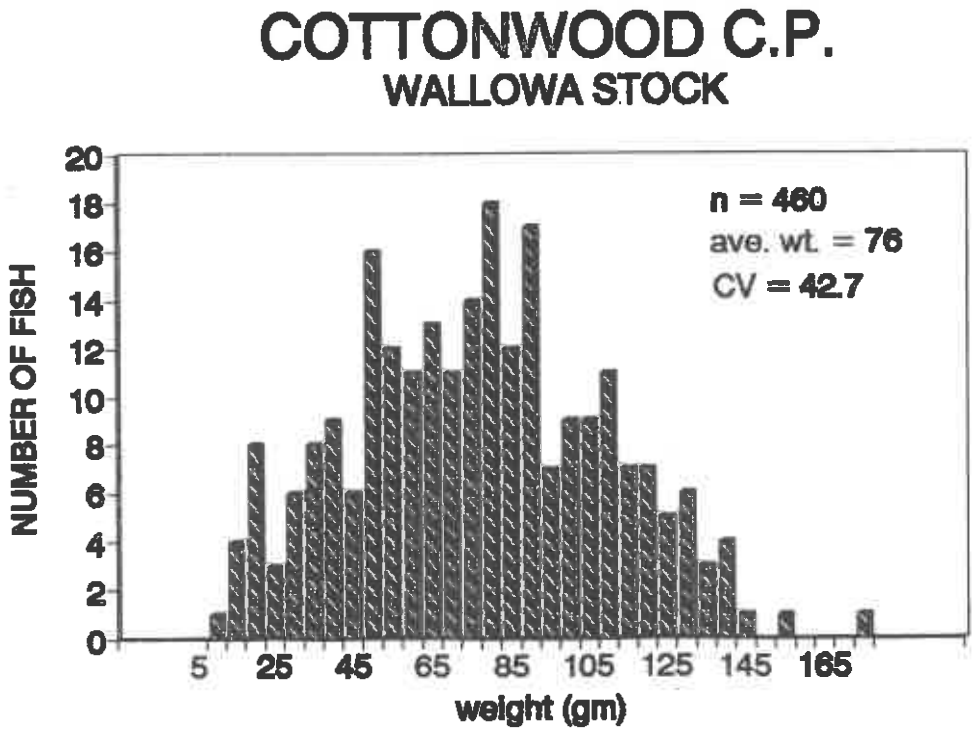
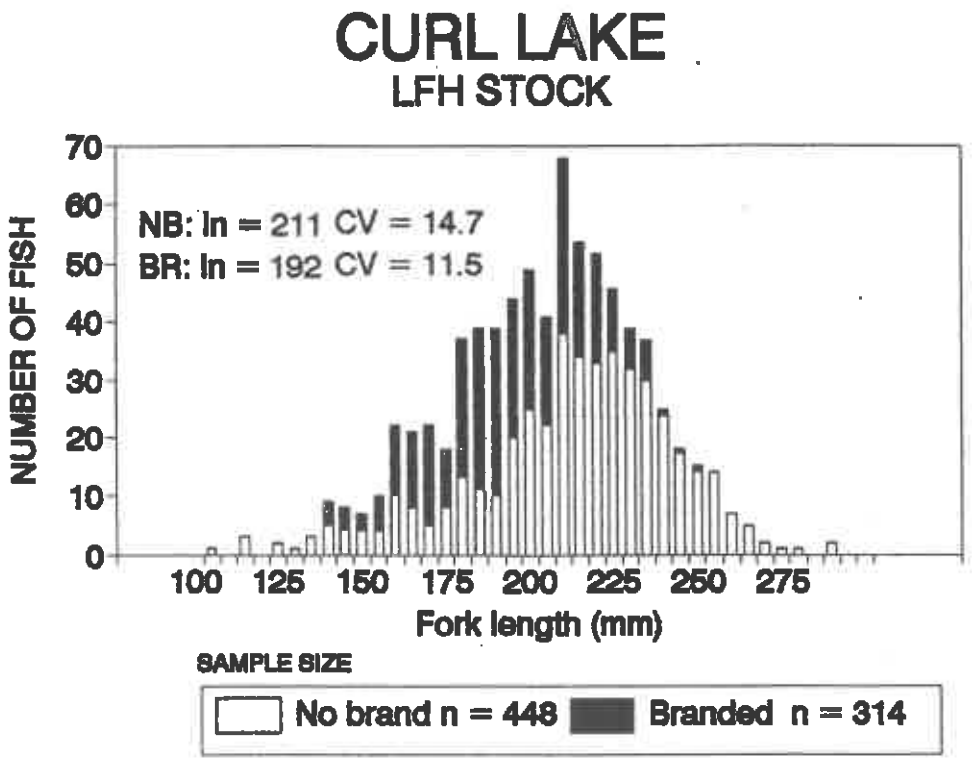


Figure 2. Length (top) and weight (bottom) histograms for steelhead released at Cottonwood C.P., Grande Ronde R., 1991.



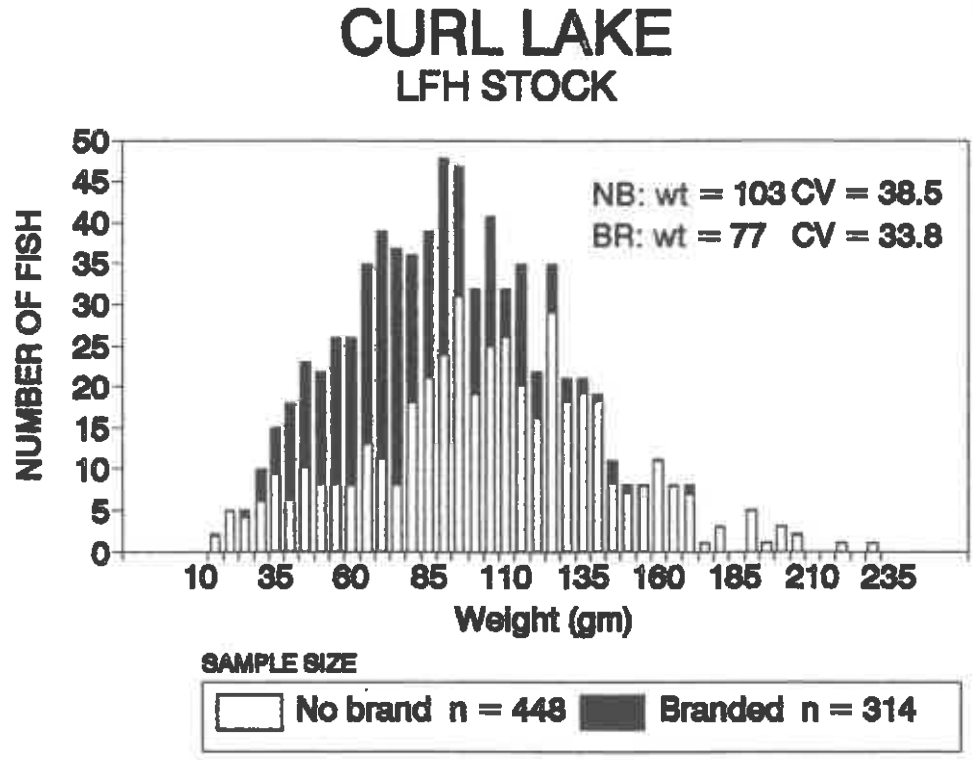
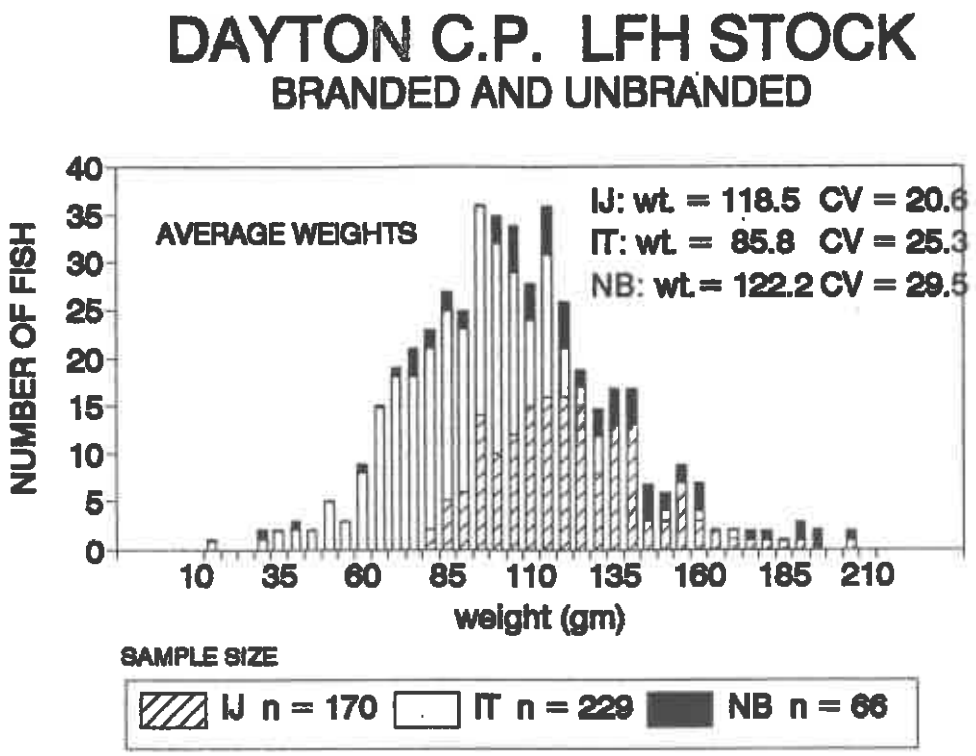


Figure 3. Length (top) and weight (bottom) histograms for steelhead released from Curl Lake C.P., Tucannon River, 1991.



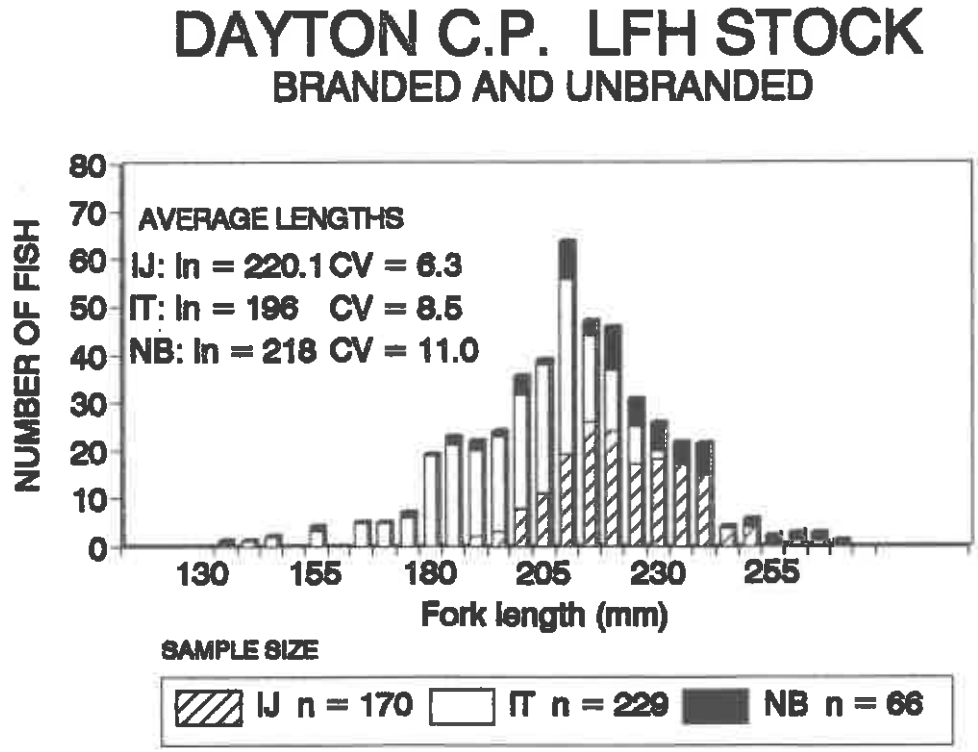


Figure 4. Weight (top) and length (bottom) histograms for steelhead released from Dayton C.P., Touchet River, 1991.

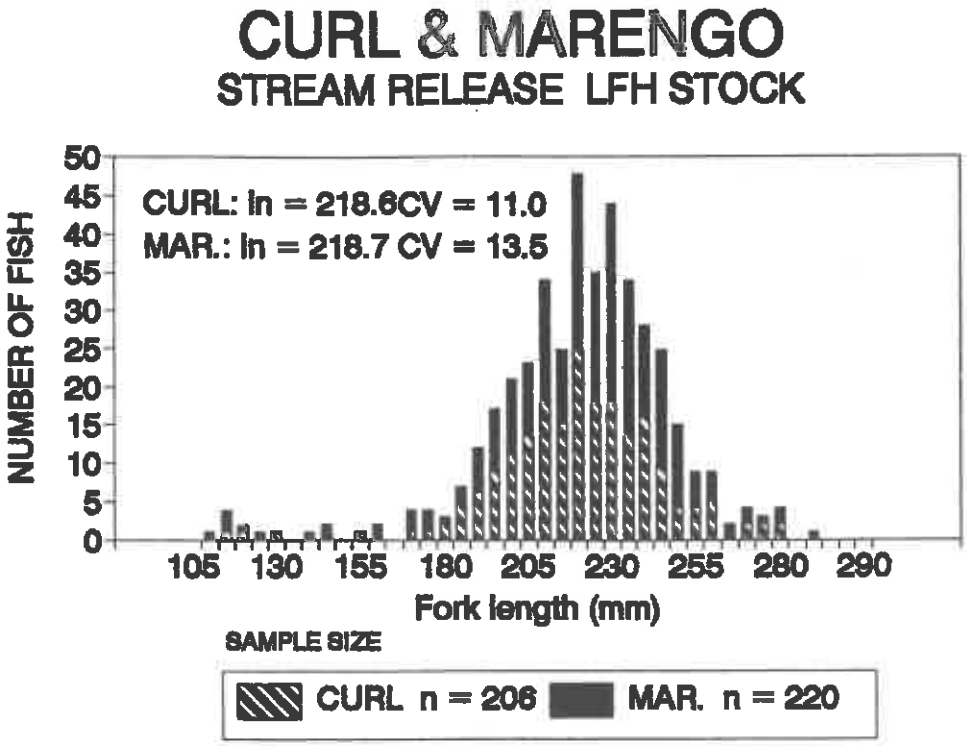
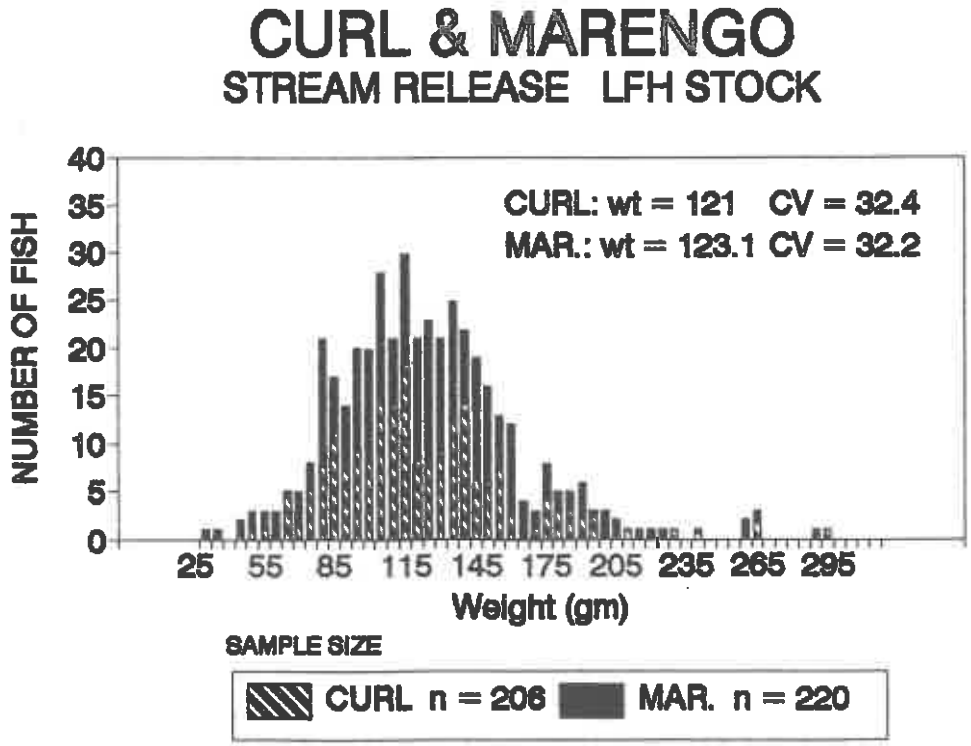
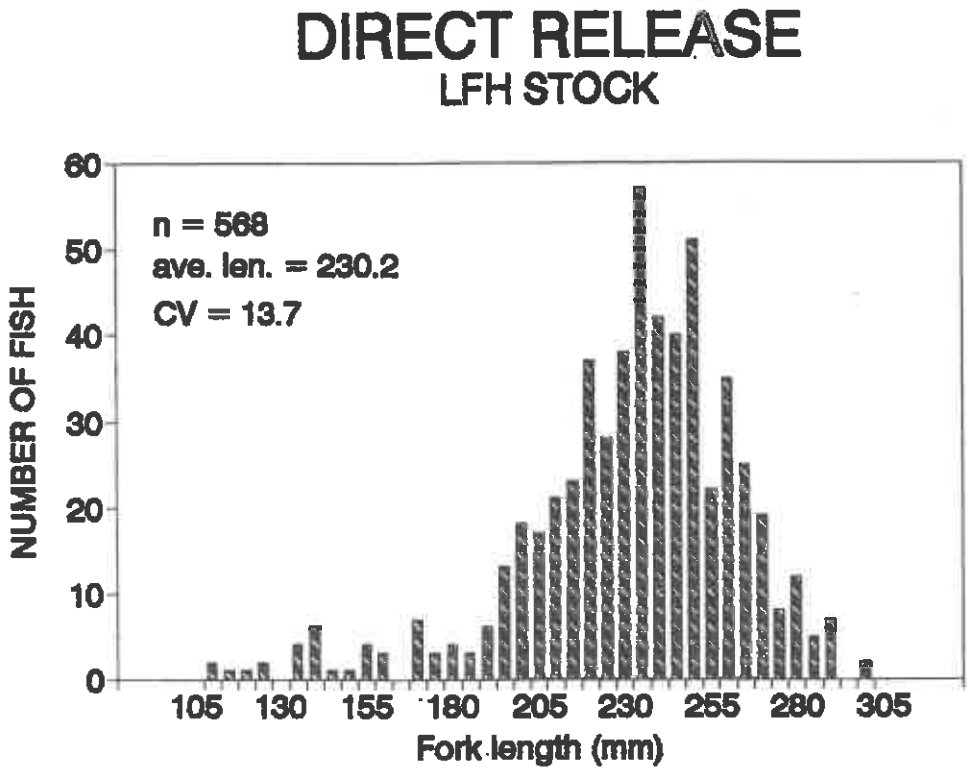


Figure 5. Length (above) and weight (below) histograms for steelhead released directly into the Tucannon River at Curl Lake and Marengo, 1991





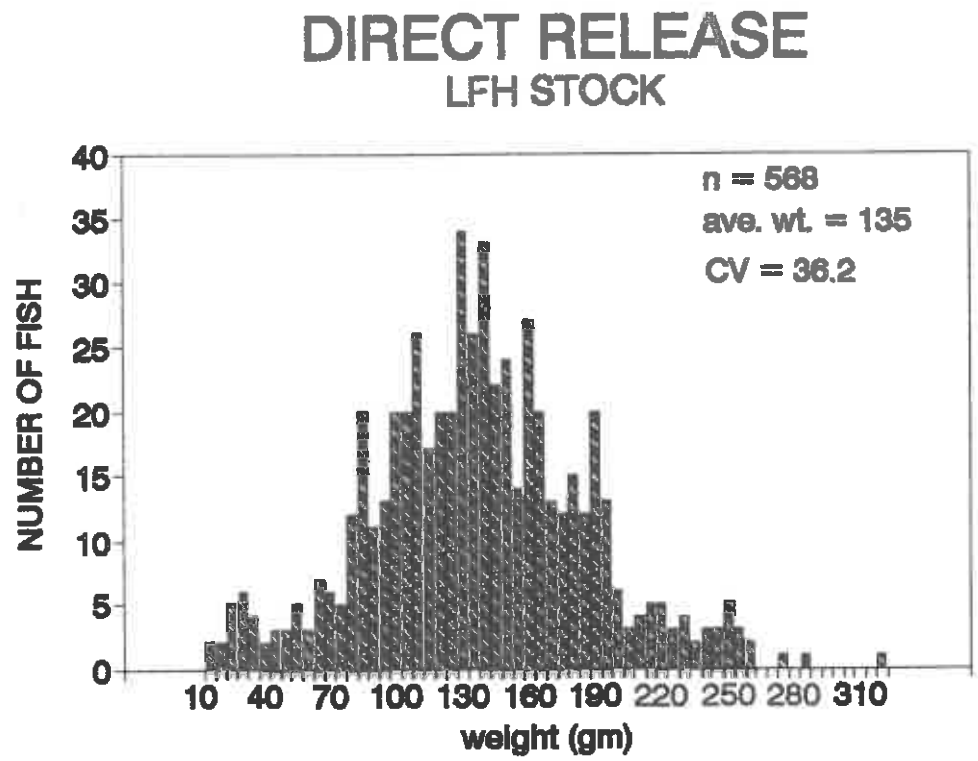
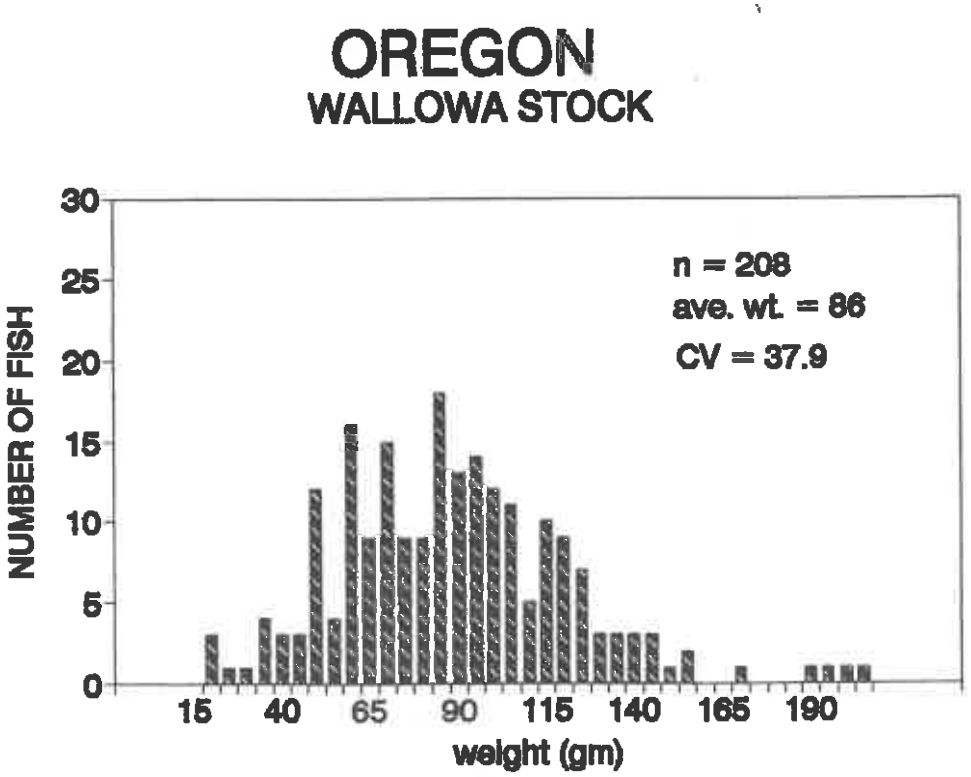


Figure 6. Length (top) and weight (bottom) histograms for steelhead released at various locations in SE Washington, 1991.



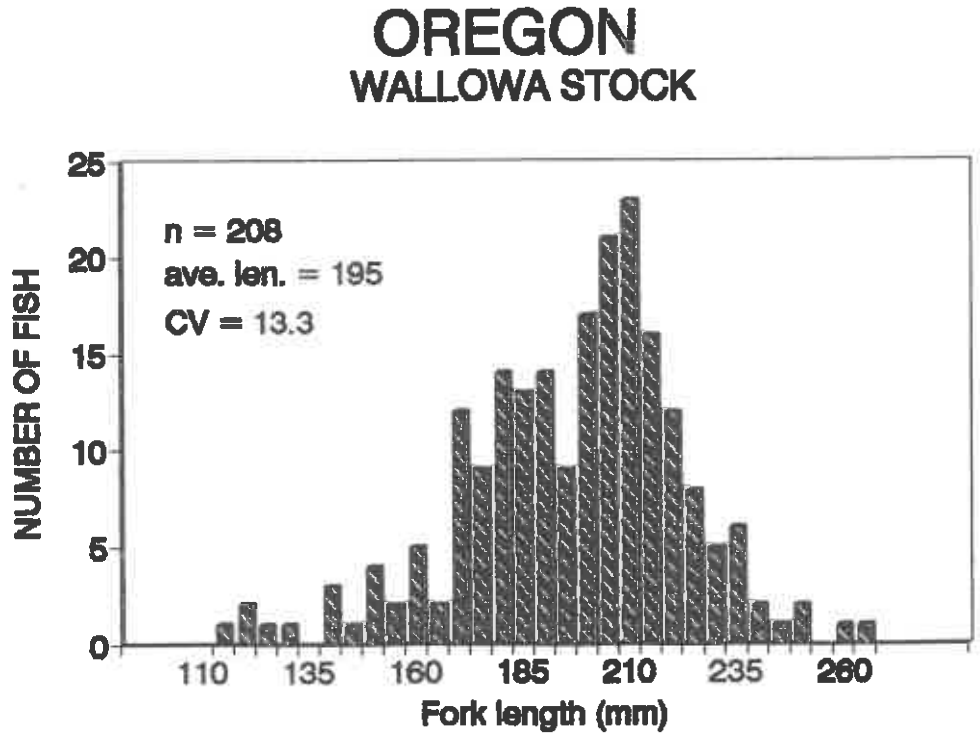


Figure 7. Length (top) and weight (bottom) histograms for steelhead released into Wildcat Cr. on the Grande Ronde River, 1991.

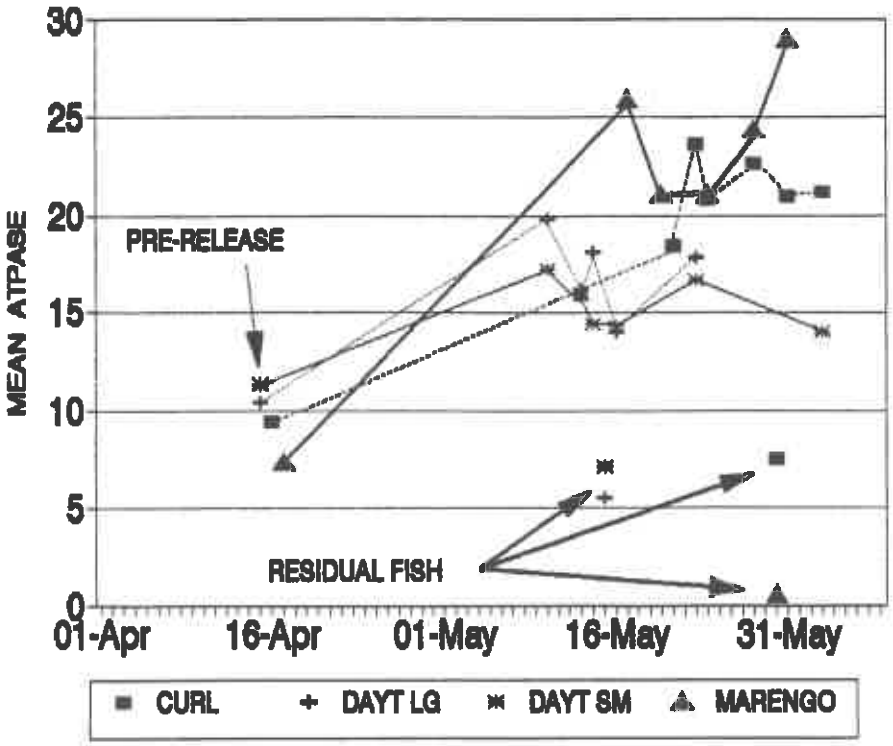


Figure 8. Mean ATPase levels from sampled juvenile steelhead.

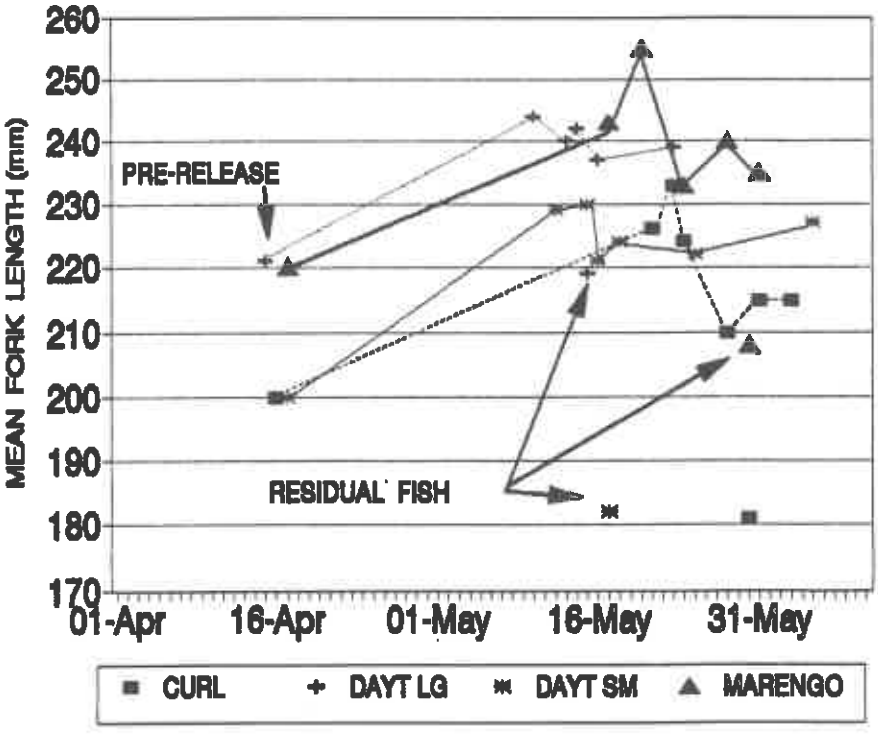


Figure 9. Mean weight from sampled juvenile steelhead.

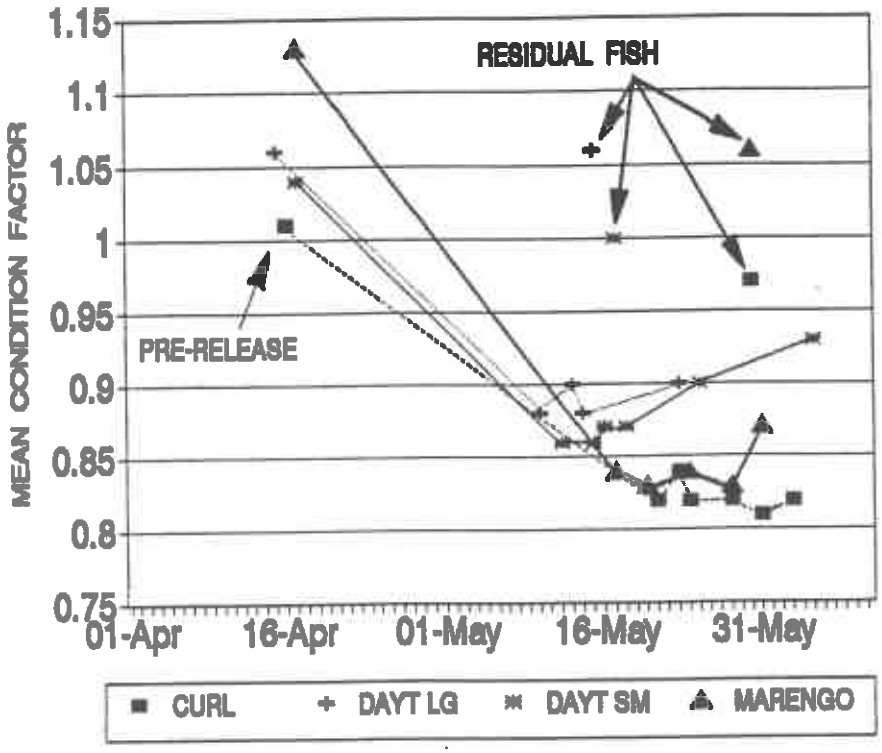


Figure 10. Mean condition factor of juvenile steelhead sampled.

due to the tedious nature of branding and the fact that greater care and attention is required to brand certain brands and brand positions. Quality of brands, not quantity, was again stressed daily during the marking in 1991. Constant observation and correction of improper technique is essential for consistent brand quality, even when using experienced personnel. We may be approaching the best possible brand quality with our current program.

Results from this years' physiology samples indicate that juvenile steelhead moved from LFH and held in conditioning ponds prior to release were more advanced in smoltification at release than fish held at LFH until release. It also seems evident that fish remaining in the stream 5-6 weeks after release were smaller and much less smolted than fish sampled the same day at McNary Dam. This seems consistent with our estimate of the number of residual steelhead in the Tucannon which was 4.3% of the fish released. Residual fish sampled were a consistently high proportion males (>75%) which may indicate a direct relationship between residualization and sex. Raceway rearing may also contribute to the presence of precocious males and residualism. Further tests will be done in 1992. Viola and Schuck (1991) describe efforts at estimating residualization rates in the Tucannon and Touchet rivers in 1991 and the reader should refer to that document for details.

Many of the questions posed in our last annual report concerning the affects of residualization on adult returns and why acclimation of fish in conditioning ponds is not having the desired effect on returning adults remain unanswered. However, we now have more information to describe the physiological status of our smolts from different releases and estimates of how those fish respond after release (emigrate or residualize). This data will help us to better understand the importance each factor plays in determining smolt behavior. We do not understand whether environmental factors, such as drought and summer water temperatures in the Snake and Columbia rivers, have an over riding 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 1988-91 are summarized by release day in Table 3. Fish were transferred to conditioning ponds in early March. The screens were removed from the outlet structures of all the ponds on April 15 in response to smolts actively schooling and circling the ponds. Fish fed actively during this period but feeding was stopped as the pond levels were lowered. All ponds were empty by April 30.

Migration Through Dams

Table 5 summarizes passage estimates for brand groups released in 1989-1991. Median (50%) passage of the fish from 1991 groups passed the first collector dam between 30-43 days after release (Figs. 11-15). Individuals from various groups continued to pass the dams into July. Daily travel rates for various brand groups were only 3-4.5 miles per day. These travel rates are much slower than for groups released in previous years (Schuck et al, 1991). Very low river flows and cooler than normal water temperatures are likely causes for the slow emigration (FPC, 1992.).

Discussion

Average fish size for the entire hatchery production increased again in 1991. Size variability decreased in 1991 over 1990, most likely due to the stable nature of our stocks this year over the mixed stocks and ages of fish used in the program after losses to IHNV in previous years (Table 4).

The Tucannon River fish (Figs.13 -15) were again the slowest to leave their river system. Migration appeared to occur only after many days residence within the river itself. The fish

acclimated in Curl Lake AP were not collected at a significantly higher rate at the Dam than either group released directly into the Tucannon. The Touchet River groups of fish appeared to migrate from their release site over a 6-8 week period in a bi-modal fashion. The distinct passage peaks near mid-May and then again near the first of June correspond to increased flows in the rivers at those times.

Table 5. Estimated passage of branded Lyons Ferry, Wallowa, Wells/ Skamania and Pahsimeroi stock steelhead at Lower Granite and McNary Dam, 1989-91. (FPC 1990-91-92).

Brand[A]	Release site	Passage index	Number released	% of release	Size (#/lb)	Stock[B]
McNary						
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
1990						
LA,RA-IC-1	Curl Lk.	12,431	38,835	31.9	5.0	PAHSIM
LA,RA-IC-2	Tuc.@ Mar.	7,274	38,072	19.1	5.5	PAHSIM
LA,RA-IC-3	LFH	10,169	38,955	26.1	5.6	PAHSIM
LA,RA-IC-4	Asotin	476	40,092	1.2	5.5	PAHSIM
LA,RA-S-1	Touchet	7,571	39,970	19.0	3.5	WEL/SKA
LA,RA-S-2	Walla Walla	5,352	39,817	13.4	3.8	WEL/SKA
1991						
LA,RA-IJ-1,3	Touchet-Large	18,752	58,901	31.8	3.8	LFH
LA,RA-IT-1,3	Touchet-Small	13,318	55,440	24.0	5.3	LFH
RA-7-1,3	Curl Lake	8,464	38,430	22.0	4.2	LFH
LA,RA-H-2	Tuc. R @ Curl	7,384	37,759	19.6	3.7	LFH
LA,RA-H-1	Tuc.R @ Marengo	9,198	38,502	23.9	3.6	LFH
Lower Granite						
1990						
LA,RA-IC-4	Asotin	25,186	40,092	63.0	5.5	PAHSIM

A Refer to table 3 for additional information.
B LFH = Lyons Ferry Hatchery, WA = Wallowa, PAHSIM = Pahsimeroi, WEL/SKA = Wells/ Skamania from Ringold Springs.

The passage index (P.I.) shows a varied performance of LFH released fish for the last three years. (Note: P.I. is an

1991 McNARY PASSAGE DISTRIBUTION
Lyons Ferry Steelhead (Touchet-Large)

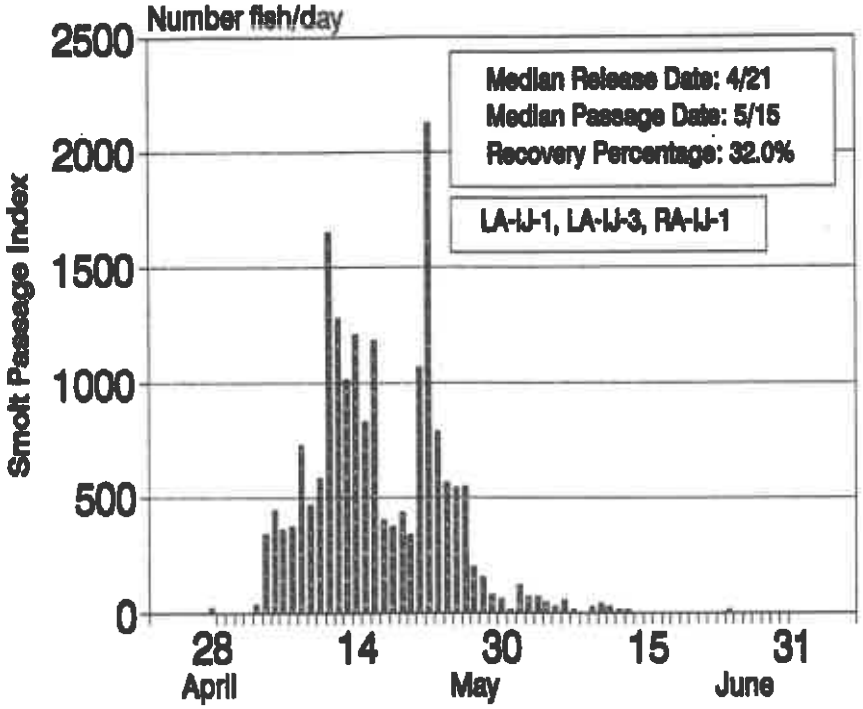
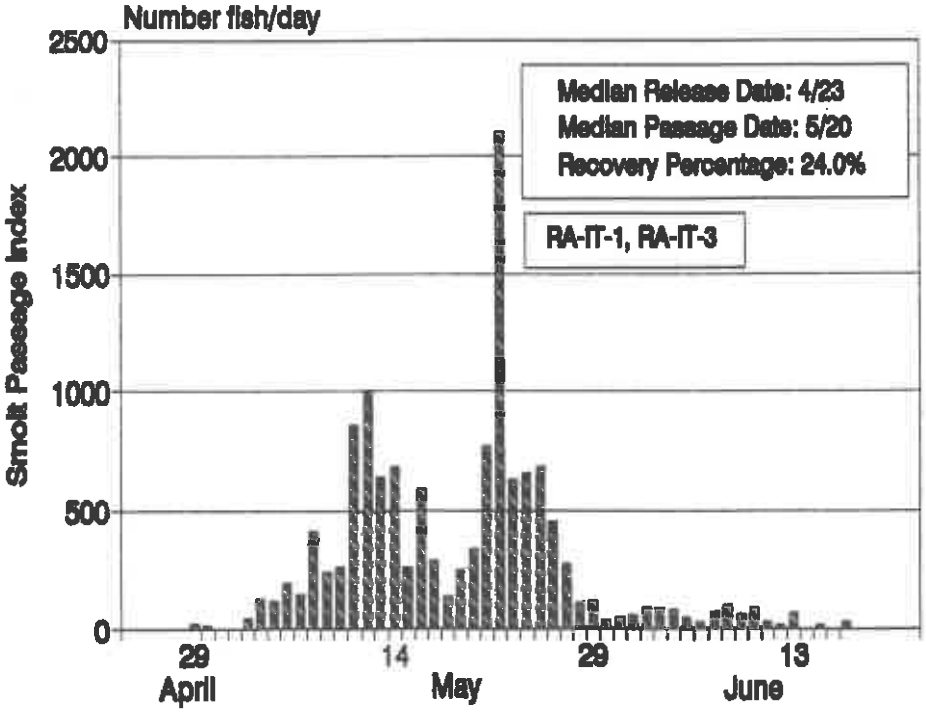


Figure 11.

Figure 12.

1991 McNARY PASSAGE DISTRIBUTION
Lyons Ferry Steelhead (Touchet-Small)



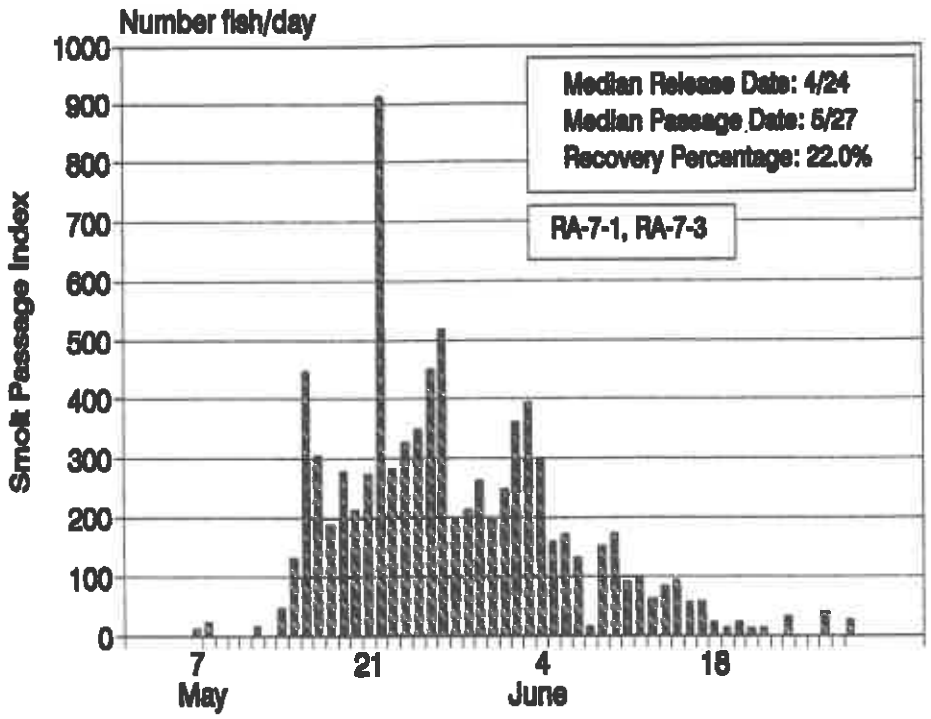
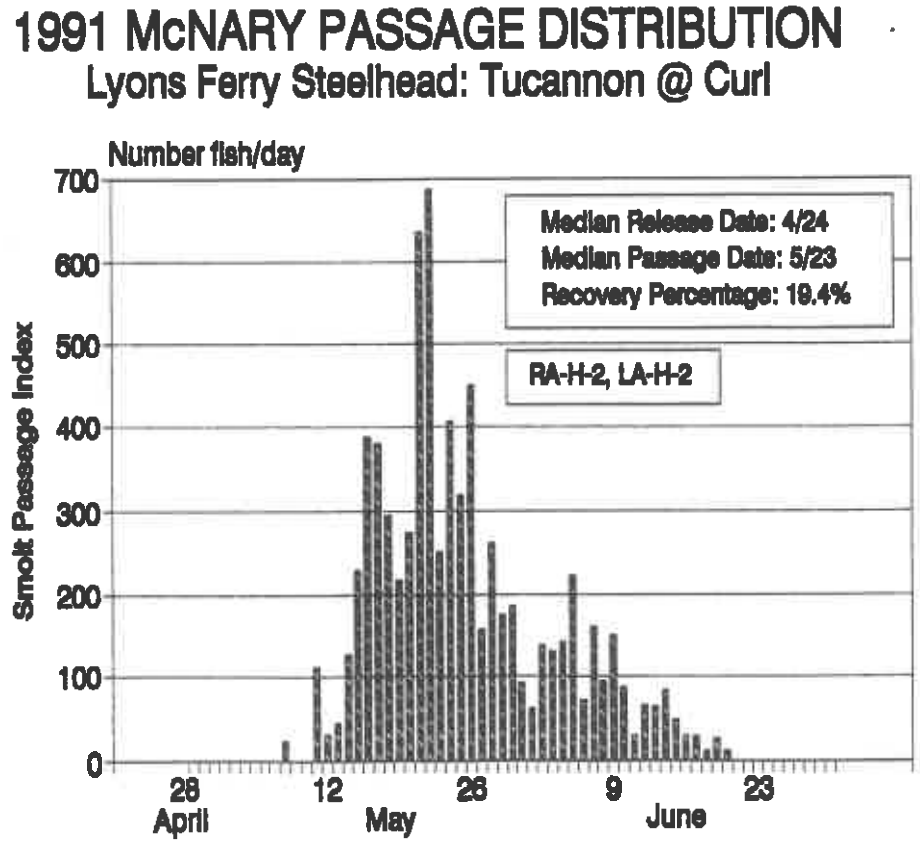


Figure 13.

Figure 14.



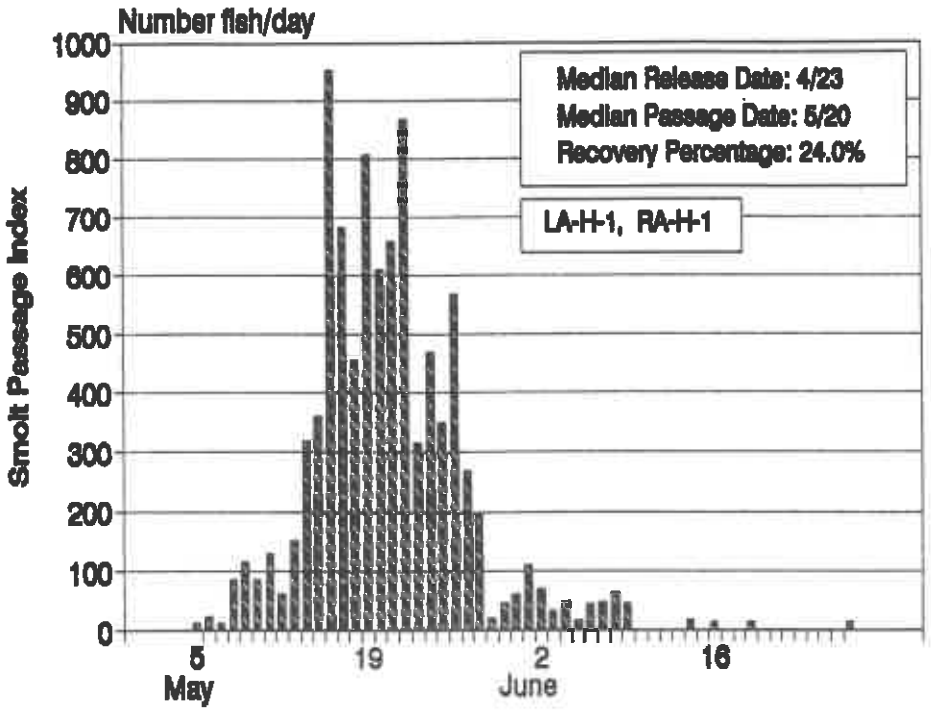


Figure 15.

indicator of the number of fish collected for transport at the juvenile collector dams on the Snake and Columbia rivers, not an estimate of total survival to that point. We use the number here as an indicator of relative performance among groups and between years.) Tucannon River fish decreased their passage index in 1991. Part of the decrease may be a result of the many study groups released this year. A return to our Lyons Ferry stock does not appear to have had an improving effect on emigration behavior. Passage index for the Touchet and Walla Walla rivers fish improved this year with a more consistent size fish within the study groups. The large group emigrated at a higher rate or at least were collected at a higher rate at McNary Dam. This trend is supported by our residualism estimates where small fish were present in angler creels at a higher rate in June of 1991 (Viola & Schuck, 1991). Flows were also higher in 1991 on the Touchet River than in 1990.

There was no presence of IHN in samples collected in 1991. All samples collected to test for IPN virus tested negative as well.

Hatchery Feed Study

A total of 233 adult steelhead returned to LFH during the fall of 1990 that had visible brands from the feed study. These numbers were expanded to account for brand loss and a total estimated return to the hatchery was computed. The numbers of males and females and the estimated total is presented in Table 6.

Table 6. Returns of tagged/branded feed study fish to LFH during the 1990 run year.

Brand / Feed type		RA-IJ-1 OMP		RA-IJ-3 Dry Diet	
		Males	Females	Males	Females
		59	59	62	53
	Total	118		115	
Expanded	Total[A]	127		127	

A Expansions are based on brand loss from Table 3.

Through the first year of returns the performance of the two groups appears identical. There were slightly more fish that passed Lower Granite Dam (Table 7) from the dry feed study group, however general contribution to other fisheries throughout the basin were very similar. The second year of adult returns will be necessary before any conclusions can be made.

Passage at Dams

Table 7. 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. A list of release locations for brand groups is provided in Table 3. Lyons Ferry origin fish generally passed the dam with the majority of the steelhead run.

Adult Steelhead Returns

Returns to Lyons Ferry Hatchery

A total of 2,434 adult steelhead were trapped at Lyons Ferry Hatchery during the 1990 run. The ladder at the hatchery was operational from July 30 - November 16, 1990. Mortality during the trapping and holding/spawning period was 3.9% (96 fish) and 1407 fish were returned to the river. All fish trapped were inspected for fin clips, sex, whether of wild or hatchery origin and for readable brands. Snouts were collected from a sample of fish that had a ventral fin clip and unreadable brand. Fish sorted from the trap were comprised of 59% (1,436) females and 41% (998) males. Wild fish represented 0.86% (21 fish) of the sample and tagged/branded fish represented 26.9% (656 fish) of the total. We trapped no fish during the spring of 1991.

The adult escapement to LFH this year was exceptional considering the very depressed run of steelhead into the Snake River as a whole. We captured nearly an identical number of adults, including tagged fish, as in 1989 which was one of the best steelhead runs in the last 10 years. This level of return of LFH origin fish on a coast-wide depressed return year (Cooper and Johnson, 1992) is somewhat unexplainable. This type of performance may indicate some differential ocean survival pattern for our fish, but what may have caused this is unknown.

Branded 2-ocean age Lyons Ferry stock fish returned to the hatchery at a 0.14% return rate (140 fish), down from the 0.24% rate in 1989 but not unusual in relation to the low overall return of steelhead to the Snake River this year. Return of 1-ocean age Lyons Ferry Hatchery stock during the 1989 run year was 0.25% (224 fish), very similar to the 1989, 0.26% return rate. A complete listing of brand and tag recoveries to the hatchery is summarized in Appendix D.

One-ocean age steelhead returning to Lyons Ferry in 1990 averaged 57.6cm (CV = 8.5) in length and 2-ocean age fish averaged 72.4cm (CV = 4.5).

Two hundred and sixty one (261) females and 532 males of hatchery origin were spawned during February and March 1991 yielding 1,296,249 fertilized eggs. One ocean age fish contributed 699,680 (54%) eggs (mean = 4,224 eggs/female) and 2-ocean age fish contributed 547,534 (42.2%) eggs (mean = 6,283 eggs/female) to the brood. Fish of unknown age contributed 49,035 (3.8%) eggs. Ages were determined from known age tagged fish and from length frequency histograms derived from known age fish. Females were selected weekly for spawning based on physical examination for ripeness. Males and females that were retained for spawning were held in separate ponds.

Table 7: Adult returns of Lyons Ferry steelhead to above Lower Granite Dam for Run years 1988-90. (Harmon, 1991)[1]

Release year		Number of adults Return year			Total adults	No. smolts	% survival[2]
Brand	Site	1988	1989	1990	captured	rel.	
1987							
RA-IF-1	LFH	270	198	1	469	25,308	1.85
RA-IF-3	LFH	292	188	0	480	25,281	1.90
LA-IF-1	LFH	193	125	0	318	25,355	1.25
LA-IF-3	LFH	185	150	0	335	25,348	1.32
RA-IY-1	Tucannon	63	99	1	163	20,201	0.81
RA-IY-2	Tucannon	63	72	0	135	20,335	0.66
RA-IY-3	Tucannon	82	84	1	167	20,172	0.83
RA-IC-1	G.Ronde	129	154	0	283	19,986	1.42
RA-IC-2	G.Ronde	141	165	0	306	19,882	1.54
RA-IC-3	G.Ronde	140	151	0	291	19,998	1.46
RA-IC-4	G.Ronde	127	171	0	298	20,118	1.48
1988							
LA-H-1	Tucannon		99	30	129	20,000	0.64
RA-H-1	Tucannon		108	55	163	19,960	0.82
RA-H-2	Tucannon		96	40	136	20,003	0.68
LA-IV-1	Touchet		89	10	99	18,756	0.53
LA-IV-3	Touchet		98	11	109	19,952	0.55
RA-IV-1	Touchet		123	8	131	19,983	0.66
RA-IV-3	Touchet		124	13	137	19,569	0.70
LA-S-1	LFH		289	58	347	24,797	1.40
LA-S-2	LFH		285	60	345	25,190	1.37
RA-S-1	LFH		283	55	338	24,947	1.35
RA-S-2	LFH		313	71	384	25,161	1.53
1989							
RA-IJ-1	LFH			57	57	47,674	0.12
RA-IJ-3	LFH			69	69	43,043	0.16
LA-IJ-1	Tucannon			46	46	19,166	0.24
LA-IJ-3	Tucannon			43	43	19,008	0.23
LA-IJ-4	Tucannon			25	25	19,415	0.12
RA-IT-1	Touchet			22	22	20,154	0.11
RA-IT-3	Touchet			16	16	19,273	0.08
LA-IT-1	Touchet			15	15	19,504	0.08
LA-IT-3	Touchet			11	11	19,994	0.08

1 No current estimate of trap efficiency exists for the L. Gran. bypass. Past studies indicate 85-90% (Harmon, Pers. Comm).

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 Lower Granite Dam from coded wire tagged/branded adults as they passed through the fish ladder. Smolts released in 1987 returned as 51.9% 1-ocean age, 48.0% 2-ocean age and 0.1% 3-ocean age (Table 7). This release year showed a similar return of 2 ocean age fish as the 1986 release year and an increased contribution of 2-ocean aged fish in the return compared to previous years returning adults. The 1990-91 return of steelhead to above Lower Granite Dam was one of the lowest in many years. A total of 56,865 fish passed above the dam in the fall and spring, only 43.3% of the 1989-90 run (USACE, 1990, 1991)

Returns to Other Locations

Tucannon Hatchery Weir/trap

Forty-two hatchery steelhead and twenty wild steelhead were passed above the trap. Six additional wild steelhead, three males and three females, were retained for spawning. An unknown number of steelhead were witnessed jumping over the weir. A list of steelhead handled in the trap and retained for spawning can be found in appendix B.

Spawning Surveys

Table 8 presents a summary of spawning ground redd and adult observations for each stream surveyed in 1991. Spawning in all streams in 1991 was comparable to 1989 and 1990 results and much lower than in 1988. Similar results are likely due to similar sampling efforts and river flow conditions. Heavy rainfall during the period spawning ground counts were made either precluded any further counts, made visibility difficult or erased existing redds. Such conditions for the last three years likely have caused an under estimation of the actual spawning activity.

Discussion

This is the sixth year of spawning data on project streams. New counting procedures (see methods) were tested and proved accurate. The systematic sampling requires less physical exertion and time to cover each stream. These factors limit the number of streams sampled each year. By the addition of index areas in each stream to monitor redd life, better estimates of actual spawning escapement on more stream miles can be made with a similar amount of time and effort. These new methods will be combined on all streams in 1992 to estimate total spawning density regardless of flow conditions. Trapping on the Tucannon in 1992 may also allow estimates of hatchery and wild spawners to be made.

Table 8. Redd survey results for streams in southeastern WA., spring 1991.

Stream	Section	Reach length (miles)	Dates surveyed	Redds	Total redds/mile	CFS
Tucannon R.	Main Tucannon[A]	35.4	4-12,5-6	100	2.8	94.0
	Panjab Creek	2.3	4-12,5-6	0	0	
	Cummings Creek	6.5	4-19	11	1.7	
Touchet R.	Main Touchet[B]	1.5	4-22,5-10	22	14.6	
	South Fork	15.7	4-01,5-10	43	2.7	62.7
	North Fork	10.6	4-22,5-10	40	3.8	53.4
	Wolf Fork	10.3	4-7,22,5-7	54	5.2	53.4
	Robinson	5.0	5-11	11	2.2	
Asotin Creek	South Fork	6.6	4-16	0	0	
	North Fork	4.8	4-17	26	5.4	
	Charlie Creek	7.0	4-17	10	1.4	

A End of road above Sheep Cr. downstream to Robertson's bridge.
B Mouth of South Fork downstream to Highway 12 bridge.

Steelhead Creel Surveys

Lower Snake River

We relied on harvest estimates derived from adjusted statewide punchcard returns in 1991 (Table 9). Our creel sampling was primarily to obtain catch composition data and recover coded wire tags. All 1990 run year recoveries of 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. A summary of data collected from fish observed on the Snake River is presented in Table 10. All legal to keep fish this year were adipose clipped. In addition some were left ventral (LV) indicating the presence of a coded wire tag.

Table 9. Adjusted[A] punchcard-derived steelhead harvest estimates for WDW management sections[B] on the lower Snake River, fall 1990 and spring 1991 (WDW 1991).

Month	Below Ice H.Dam	Below L. Mon. Dam	Below L. Goose D.	Below L. Granite D.	Above L. Granite D.
Sep.	17	7	104	39	110
Oct.	25	269	266	211	944
Nov.	58	334	242	213	1,571
Dec.	19	235	533	223	386
Jan.	2	17	92	116	156
Feb.	0	19	92	211	133
Mar.	2	29	196	184	48
	123	910	1,525	1,197	3,348

A by multiplying by 1.1205 for under estimation (Mendel et. al. 1988)
B 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.

Table 10. Data from steelhead observed in Washington angler creels along the Snake River, fall 1990 and spring 1991.

Section	Mean fork length (cm) (range) (n) [A]	Mean wt. (kg) (range) (n)	Fish Kept % Female (n)	% Males (n)	% Unknown (n)	% Fish released[B] (n)	% Ventral[E] clipped (n)	Sample rate[C]
164 [F]	73.0 (55.0-96.0) (9)	5.0 (3.0-7.7) (3)	11.1 (1)	88.9 (8)	0 (0)	25.0 (3)	22.2 (2)	.073
165	73.8 (53.5-99.5) (101)	4.0 (1.4-8.5) (76)	48.0 (49)	52.0 (53)	0.0 (0)	15.7 (19)	13.7 (14)	.112
166	71.4 (51.0-103.0) (300)	3.6 (1.2-9.0) (225)	48.7 (150)	47.7 (147)	3.6 (11)	21.8 (86)	20.5 (63)	.202
167	70.4 (53.0-95.0) (139)	3.4 (1.2-7.5) (116)	57.9 (81)	35.7 (50)	6.4 (9)	21.4 (38)	26.4 (37)	.117
168L	81.6 (56.0-107.5) (25)	5.4 (1.8-10.2) (19)	56.0 (14)	44.0 (11)	0 (0)	16.7 (5)	8.0 (2)	
168M	76.5 (52.0-100.0) (178)	4.7 (1.5-9.1) (147)	58.6 (106)	40.9 (74)	0.6 (1)	24.3 (58)	11.1 (20)	.114 [D]
TOTALS			**52.4** (401)	**44.8** (343)	**2.8** (21)	**21.5** (209)	**18.0** (138)	

A n = Number of kept fish sampled in the harvest; fish not seen or where no data were recorded are not included.
B Percent released is equal to (fish released/fish kept + fish released).
C (# of fish checked/estimated punch card derived harvest).
D Includes 168L.
E Number ventral clipped/ total kept.
F WDG mgmt. sections are 164 = below Ice Harbor, 165 = below Lower Monumental Dam, 166 = below Little Goose Dam, 167 = below Lower Granite Dam, 168L = Above Lower Granite Dam to Red Wolf Bridge, 168M = Red Wolf Bridge to Oregon State Line.

Grande Ronde River

Approximately 1,456 angler days of fishing effort were expended by anglers on that portion of the Grande Ronde River from Bogans' Oasis to the Oregon State line. This effort represents a 34% decrease in angling effort from 1989-90. This decrease is most likely due to catch and releases restrictions that were in affect until March of 1991. The average completed fishing trip was 5.8 hours. Tables 11 and 12 are summaries of ODFW data collected from steelhead examined in angler creels along the Grande Ronde River, fall 1990 and spring 1991. The greatest harvest occurred in late March and early April near the Cottonwood Conditioning Pond. A total of only one coded wire tag from tag groups released by Washington was harvested (Table 17).

Table 11. Estimated angler effort, catch rates, and harvest for steelhead anglers Grande Ronde River within Washington, 1990 and 1991 (ODFW 1991).

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)
1990						
Sep.	670.5 (176.9)	0.01 (0.009)	7.4 (7.3)	0 (---)	0 (---)	7.4 (7.3)
Oct.	992.5 (360.1)	0.06 (0.064)	58.6 (56.1)	32.2 (33.1)	0 (---)	26.4 (29.1)
Nov.	458.4 (203.5)	0.16 (0.177)	74.8 (90.5)	13.4 (26.7)	26.7 (45.7)	37.0 (47.4)
Dec.	68.6 (38.9)	2.20 (0.041)	150.7 (2.8)	0 (---)	2.0 (3.0)	148.7 (3.0)
1991						
Mar.	3,401.6 (608.8)	0.22 (0.069)	750.8 (235.5)	404.9 (138.9)	313.5 (113.9)	32.4 (24.3)
Apr.	2,853.9 (430.7)	0.16 (0.056)	466.8 (158.8)	306.4 (111.4)	143.3 (63.4)	17.2 (19.4)
Total	8,445.5 (871.8)	0.179 (0.036)	2,177.5 (607.2)	754.5 (181.6)	485.5 (138.2)	269.1 (64.2)

Table 12. Age composition (%) and fork length (mm) of steelhead sampled from creels on the Grande Ronde River in Washington, fall 1989 and spring 1991 (Carmichael et al. 1991).

Age[A]	Age composition n(%) male	Age composition n(%) female	Males n[B]	Males length (SD)[C]	Females n	Females length (SD)
1:1	34[a](9.9)	8(4.7)	33	600.0 (36.0)	8	599.0 (25.0)
2:1	32(18.7)	97(56.7)	30	756.0 (50.0)	94	722.0 (34.0)

A Includes one fish that was assumed to be male.

Other Rivers

Harvest estimates for the Tucannon, Touchet, Walla Walla and Grande Ronde Rivers and McNary Pool on the Columbia River were obtained from WDW punchcard estimates (Table 13). Catch rate and catch composition were calculated for these rivers from information collected during weekday and weekend day creel surveys. A summary of data from all fish observed during creel surveys is presented in Table 14.

Table 13. Harvest estimates from punchcard returns for the Tucannon, Touchet, Walla Walla and Grande Ronde Rivers and McNary Pool on the Columbia River, fall 1990 and spring 1991 (WDW 1991).

Month	Tucannon	Touchet	Walla Walla	Mill Creek	McNary Pool	Grande Ronde
May	0	0	2	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	13	0
Aug.	0	0	0	0	6	0
Sep.	7	0	4	0	58	2
Oct.	72	4	400	0	906	30
Nov.	26	15	469	2	435	19
Dec.	61	17	82	0	30	2
Jan.	19	4	97	11	37	2
Feb.	48	50	255	17	28	2
Mar.	82	164	143	2	15	285
Apr.	22	80	22	2	0	311
Total	337	334	1,468	34	1,528	653

Table 14. Data for steelhead observed in angler creels along the Tucannon, Touchet and Walla Walla Rivers, Mill Creek and McNary Pool on the Columbia River, fall 1990 and spring 1991.

River	Mean fork length (cm) (range) (n) [A]	Mean wt. (kg) (range) (n)	Fish Kept % Female (n)	% Males (n)	% Unknown (n)	% Fish released[B] (n)	% Ventral[D] clipped (n)	Sample rate[C]
Tucannon	62.5 (51.0-86.5) (51)	2.4 (1.3-5.9) (36)	50.9 (29)	40.3 (23)	8.7 (5)	54.8 (69)	47.4 (27)	.169
Touchet	65.0 (51.5-77.5) (40)	2.4 (1.2-3.7) (31)	69.8 (30)	25.6 (11)	4.7 (2)	43.4 (33)	34.9 (15)	.129
Walla W.	65.8 (50.8-81.0) (226)	2.8 (1.2-8.7) (203)	61.2 (143)	35.3 (82)	3.0 (7)	18.6 (53)	9.1 (21)	.158
Mill Creek	63.1 (54.5-77.0) (5)	2.3 (1.0-4.0) (5)	20.0 (1)	80.0 (4)	0 (0)	37.5 (3)	0 (0)	.147
McNary Pool	79.2 (52.0-103.5) (386)	4.8 (1.4-10.3) (365)	58.6 (236)	40.4 (163)	1.0 (4)	20.7 (105)	9.7 (39)	.264
Totals			59.3 (439)	38.2 (283)	2.4 (18)	26.2 (263)	13.8 (102)	

A n = Number of kept fish sampled in the harvest; fish not seen or where no data were recorded are not included.
B Percent released is equal to (fish released/fish kept + fish released).
C (# of fish checked/estimated punch card derived harvest).
D Number ventral clipped/ total kept.

Coded-Wire Tag Recovery

Snouts were collected by WDW personnel from sport caught steelhead that had left ventral fin clips. All snouts were examined by Idaho Fish and Game personnel for coded-wire tags (CWT). All CWTs recovered by WDW personnel and estimates of the expanded harvests by individual tag code are presented in Table 15 for the Snake River (by zone) and in Tables 16 and 17 for the other rivers within southeast Washington.

Table 15. Coded-wire tag expansions for the Snake R., fall 1990 and spring 1991.

	Month									
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar	CWT code[C]	Tot. Tags Recovered	Expanded Harvest[A]
Zone 168										
Sample Rate[B]	(.288)	(.063)	(.163)	(.087)	(.012)					
Tags Recovered		1						63/01/32	1	16
	1	1						63/55/08	2	19
		1						63/49/41	1	16
			1					5/17/12	1	6
			1					5/18/50	1	6
		1	1					5/18/51	2	22
			1					5/18/52	1	6
			1					7/38/59	1	6
		1						10/29/29	1	16
Zone 167										
Sample Rate[B]	(.153)	(.066)	(.089)	(.211)	(.094)	(.109)	(.136)			
Tags Recovered										
		1	1	2		1	3	63/01/32	8	67
				2	2		1	63/55/08	5	38
					1			63/02/49	1	11
			1					63/50/52	1	11
							1	63/49/41	1	7
			1					63/49/42	1	11
		2		1		1		63/50/13	4	44
				1				63/50/14	1	5
		1		1		1		63/50/16	3	29
						1		63/50/28	1	9
							1	63/50/50	1	7
			1					5/20/41	1	11
				1				7/46/57	1	5
						1		10/29/29		9
				1				10/29/38	1	5
							1	Lost	1	7

Table 15. (continued)

	Month								Tot. Tags	Expanded
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar	CWT code[C]	Recovered	Harvest[A]
Zone 166										
Sample Rate[B]	(.038)	(.124)	(.054)	(.319)	(.250)	(.196)	(.240)			
Tags Recovered										
				11		1		63/01/32	12	43
				3				63/55/08	3	9
				2				63/02/47	2	6
		1		1				63/02/49	2	11
				1				63/02/50	1	3
					1			63/50/52	1	4
				3			1	63/50/13	4	14
			1	2				63/50/14	3	25
				2				63/50/16	2	6
				3	1			63/50/19	4	10
		1		1				63/50/28	2	11
				1				63/49/49	1	3
				1				63/50/35	1	3
		1						5/17/12	1	8
							1	5/17/14	1	4
				1				5/18/49	1	3
							1	5/18/50	1	4
						1		5/18/52	1	5
				1				5/19/47	1	3
			1					5/20/43	1	19
		1						10/29/28	1	8
		1						10/29/55	1	8
Zone 165										
Sample Rate[B]		(.022)	(.111)	(.208)	(.535)					
Tags Recovered			1					63/02/47	1	9
			1					63/02/49	1	9
			1					63/02/50	1	9
			2					63/50/52	2	18
				1				63/50/28	1	5
			1					63/49/49	1	9
		1						5/18/46	1	45
			1		1			5/18/53	2	11
			1					7/38/58	1	9
			1					10/28/19	1	9
Zone 164										
Sample Rate[B]		(.081)	(.086)	(.105)						
Tags Recovered			1					63/50/52	1	12

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

Table 16. Coded wire tag expansions for other rivers within Southeast Washington, fall 1990 and spring 1991.

River (Zone)	1990 Sept	1990 Oct	1990 Nov	1990 Dec	1991 Jan	1991 Feb	1991 Mar	1991 Apr	CWT code	Total Tags Recovered	Expanded Harvest
Tucannon River (189)	(.056)		(.154)	(.230)	(.053)	(.104)	(.378)	(.227)			
						1	2		63/01/32	3	15
				1			1		63/02/47	2	3
		2							63/02/49	2	36
			1				1		63/50/52	2	9
								1	63/38/45	1	4
		1							63/49/41	1	18
		1							63/49/42	1	18
				2				3	63/49/44	5	22
		1							63/50/31	1	18
				1			2		63/50/35	3	10
Walla Walla R. (194)	(.158)		(.186)	(.146)	(.309)	(.137)	(.042)				
		2							63/02/47	2	13
			1						63/02/49	1	5
			1						63/02/50	1	5
			1						63/50/52	1	5
			1						63/49/41	1	5
		1	1						63/49/47	2	12
			3						63/49/49	3	16
		1	2						63/50/28	3	11
		2							63/50/31	2	13
Touchet River (185)			(.333)		(.309)	(.160)	(.140)	(.088)			
			1				2		63/02/49	3	17
						1		1	63/02/50	2	18
								1	63/50/52	1	11
						1	2		63/49/47	3	21
							2		63/50/28	2	14
						1	2		63/50/31	3	21

Table 16. (continued)

River (Zone)	1990 Sept	1990 Oct	1990 Nov	1990 Dec	1991 Jan	1991 Feb	1991 Mar	1991 Apr	CWT code	Total Tags Recovered	Expanded Harvest
McNary Pool (45)	(.362)	(.298)	(.257)								
	1	1							63/02/47	2	6
			1						63/02/50	1	4
		2							63/50/52	2	7
			2						63/49/47	2	8
			1						63/49/49	1	4
		1							5/18/49	1	3
		1	2						5/18/50	3	11
		2	1						5/18/51	3	11
		2							5/18/52	2	7
		1							5/18/53	1	3
		1							7/40/28	1	3
		1							7/40/29	1	3
		1							7/40/31	1	3
		1							7/46/57	1	3
		3							10/29/31	3	10
			1						10/29/33	1	4
		1							10/41/39	1	3
			1						10/40/50	1	4

Table 17. Coded-wire tag expansions for the Grande Ronde River, fall 1990 and spring 1991 cooperative creel survey with ODFW (Flescher 1991).

	CWT code	Number Recovered	Number Expanded
Oregon	63/49/44	1	5
Washington	7/46/51	1	3

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.

Table 18: Adult returns of Lyons Ferry steelhead and (percent of the total fish released at each release site that were harvested or trapped) at certain locations within the Columbia River Basin 1990-1991. These numbers and percentages also represent a portion of the smolt to adult survival.

Release Year	1987	1988			1989		
Release site	Tucannon R.	Snake R. @ LFH	Touchet R.	Tucannon R.	Snake R. @ LFH	Touchet R.	Tucannon R.
CWT Code	63/38/44,45 63/39/03	63/50/13,14,16,19 (LA-S-1,2)	63/49/47,49 63/50/28,31	63/49/41,42,44 (LA-H-1)	63/01/32 63/55/08	63/02/47,49,50 63/50/52	63/50/35,49,50, (LA-IJ-1,3,4)
(Brand)	(RA-IV-1,2,3) (RA-IV-1,3)	(RA-S-1,2)	(LA-IV-1,3)	(RA-H-1,2)	(RA-IJ-1,3)	(LA-IT-1,3) (RA-IT-1,3)	
Num. Rel.[D]	40,505	100,095	78,147	59,963	96,237	81,126	60,373
Location							
L.Col. Sport		59(.059)	48(.061)		48(.050)	16(.020)	11(.018)
Mid.Col Sport			12(.015)			17(.021)	
Zone 6 Net							
Summer							
Fall		71(.071)	88(.113)	30(.050)	71(.074)	97(.120)	19(.002)
Winter							
L.Ferry Ladder	40(.099)	140(.140)	27(.035)	22(.037)	224(.232)	157(.194)	43(.071)
Snake R. Sport		133(.130)	37(.047)	34(.057)	192(.200)	103(.127)	7(.012)
Tucannon Sport	4(.010)		18(.023)	58(.097)	15(.016)	45(.055)	10(.017)
Weir							
Walla Walla R.			52(.067)	5(.008)		28(.035)	
Touchet R.			56(.072)			46(.057)	
Dworshak NFH					4(.004)	3(.004)	4(.007)
Idaho Sport[A]		41(.004)	10(.013)	9(.015)	20(.020)		
Grande Ronde R.[C]				1(.00002)			
Ocean Harvest [B]		4(.004)				3(.004)	
LSRCP Area Total	44(.109)	314(.314)	200(.256)	130(.215)	455(.473)	382(.471)	64(.106)
Grand Totals	44(.109)	448(.448)	348(.445)	159(.265)	554(.576)	515(.635)	94(.146)

A Expanded estimates for all rivers based on Idaho punch cards, data from Marsha White, IDFG, pers. comm.
B Unexpanded estimates for Ocean Harvest.
C Based on a cooperative creel survey with Oregon DFW.
D Release numbers have been adjusted for tag loss.

We have complete 1, 2 and 3 ocean age returns for the 1987 releases, and 1 and 2-ocean age returns for 1988 coded wire tag releases. A summary of these returns to various fisheries is presented in Table 19 and 20. The total contribution from releases to the Columbia River basin fisheries 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 19. Returns of 1987 release LFH steelhead to locations in the Columbia River basin, for run years 1988, 89 and 90 plus (% adult survival those figures represent).

Release location Stock Tag codes	LFH Wallowa 63/39/13 63/37/03	LFH LFH 63/39/14-15	Tucannon LFH 63/38/44-45 63/39/03	Grande Ronde Wallowa 63/38/40,41, 42,43
Recovery Location		Estimated Harvest or Return		
L. Columbia Sport	40(.079)	54(.107)	1(.002)	86(.108)
Mid-Columbia Sport	0	12(.024)	0	16(.020)
Deschutes R.	2(.004)	2(.004)	0	6(.008)
Zone 6 Treaty Net	344(.679)	289(.589)	92(.152)	633(.791)
Priest Rapids Dam	0	0	0	2(.003)
LFH ladder	136(.269)	341(.674)	81(.134)	8(.010)
Snake R. Sport	43(.085)	179(.354)	22(.036)	126(.158)
Dworshak NFH	2(.004)	1(.002)	7(.012)	8(.010)
Idaho Sport	39(.077)	60(.119)	28(.046)	106(.133)
Grande Ronde Spt.	0	0	3(.005)	185(.231)
Ocean Harvest	0	2(.004)	0	0
Touchet River	0	0	0	3(.004)
Tucannon Weir	0	0	5(.008)	0
Tucannon R. Spt.	0	0	0	4(.005)
LSRCP Totals	220(.434)	581(1.148)	146(.241)	440(.550)
Grande Total	606(1.195)	949(1.876)	239(.394)	1,183(1.479)

Table 20. Returns of 1988 release LFH steelhead to locations in the Columbia River basin, for run years 1989, 90, 91 and the percent smolt to adult survival that those figures represent.

Release Year	1988		
Release site	Snake R. @ LFH	Touchet R.	Tucannon R.
CWT Code	63/50/13,14,16,19 (LA-S-1,2)	63/49/47,49 63/50/28,31	63/49/41,42,44 (LA-H-1)
(Brand)	(RA-S-1,2)	(LA-IV-1,3)	(RA-H-1,2)
Stock	LFH	LFH	LFH
Number Released [A]	100,095	78,147	59,963
Recovery Location	Estimated Harvest or Return		
L. Columbia Sport	70(.070)	57(.073)	0
Mid-Columbia Sport	4(.004)	12(.015)	0
Zone 6 Treaty Net	375(.375)	363(.465)	105(.175)
LFH ladder	401(.401)	174(.223)	34(.057)
Snake R. Sport	417(.417)	144(.184)	99(.165)
Dworshak NFH	4(.004)	3(.004)	4(.007)
Idaho Sport	135(.135)	26(.033)	19(.032)
Grande Ronde Spt.	0	0	5(.008)
Ocean Harvest	18(.018)	6(.008)	2(.003)
Tucannon R. Spt.	0	27(.035)	58(.097)
Tucannon R. Weir	0	0	3(.005)
Walla Walla R. Spt	0	136(.174)	5(.008)
Touchet R. Spt	0	206(.264)	0
LSRCP Area Total	1,332(1.331)	716(.916)	227(.379)
TOTAL	1,424(1.423)	1,154(1.476)	329(.549)

A Release numbers have been adjusted for tag loss.

The actual performance of the various mark groups of LFH steelhead is encouraging and it appears that we are currently meeting our mitigation/compensation goals for most release areas. We estimate that 6,740 adult steelhead returned to the LSRCP area this year. These numbers represent 145% of the LSRCP goal. This estimate can be considered a minimum since we did not include any spawning fish due to the problems we experienced in obtaining a correct estimate of spawning escapement. Considerably fewer adult steelhead returned to the LSRCP area than in previous years. We believe this to be a result of the reduced run size in 1990-91, which was only 43.3% of the 1989-90 run. 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, except for the Tucannon River, met the goal for escapement to the Snake River (Tables 19 and 20).

Juvenile Salmonid Populations in Project Rivers

Trends in Juvenile Steelhead Density and Population Size 1983-1990

Information on annual juvenile steelhead densities, river surface area and adult steelhead spawning escapement within the Tucannon River index area was obtained from: annual reports Mendel 1984, Mendel 1985, Schuck and Mendel 1987, Schuck et al. 1988, Viola et al. 1991 and un-published Washington Department of Fisheries data from 1987 and 1990. Population estimates were calculated for both 0 aged and >0 aged juvenile steelhead in areas of artificial habitat improvements and unimproved areas within the river index sections. Individual population estimates were calculated by multiplying densities (#/100m^2) by the total area in 100m^2 annually available within improved and unimproved areas of the index river section. A total population estimate for both 0 aged and >0 aged juvenile steelhead was calculated as the sum of the population estimates from improved and unimproved areas. These estimates were then divided by the total area available within the index river section for that year. This provided a density per 100m^2 for each age class. Total density of all age classes from within the entire river section was the sum of both age classes.

Results

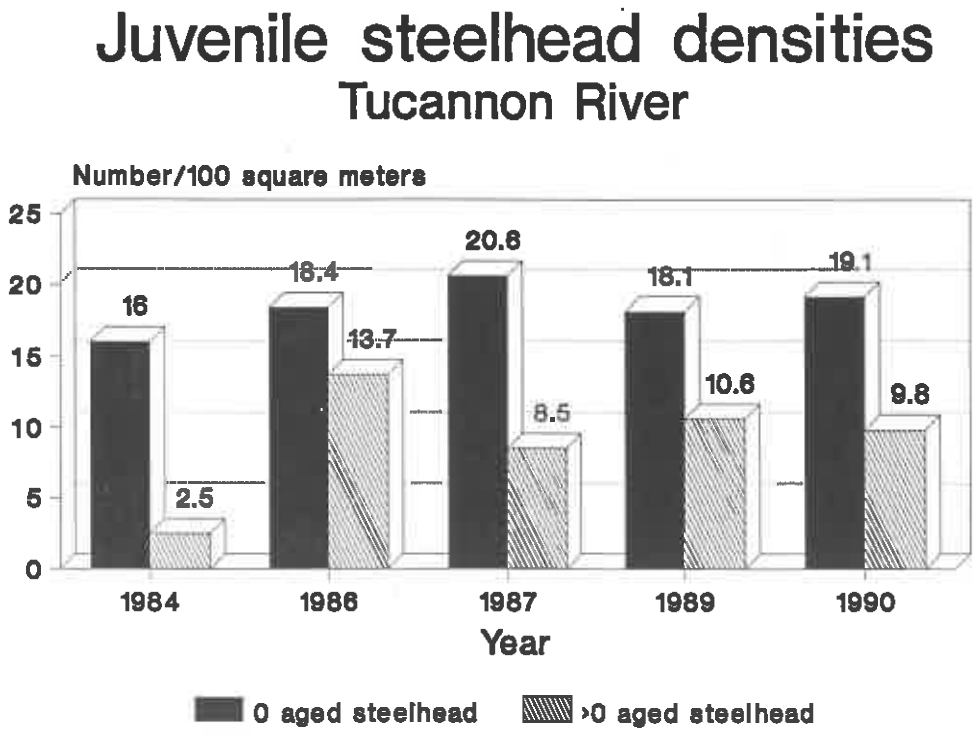
Juvenile steelhead densities and population estimates from 1983-1990 within the index area of the Tucannon River are presented in Figure 16. Densities and population size of fish >0 age on the Tucannon River increased in 1986 as compared to 1984 and remained only slightly below the 1986 levels in 1987, 1989 and 1990. Density and population size of 0 aged steelhead were similar in all five sample years.

Adult steelhead spawning escapement increased steadily in 1987 and 1988 as compared to 1986 on the Tucannon River. However spawning escapement decreased substantially in 1989 and remained very low in 1990 (Fig 17).

Discussion

Variations in juvenile steelhead densities and population sizes can be considered an indicator of adult escapement and of spawning and rearing success. Each of these factors is in turn affected annually by variations in available river flow, water temperature and in habitat quality.

Juvenile density and population size of >0 aged steelhead increased substantially on the Tucannon River in 1986 as compared to 1984. This increase remained stable in 1987, 1989 and 1990 (Figure 16). Density and population size of 0 aged steelhead did not increase substantially but remained near 1984 levels in 1986,



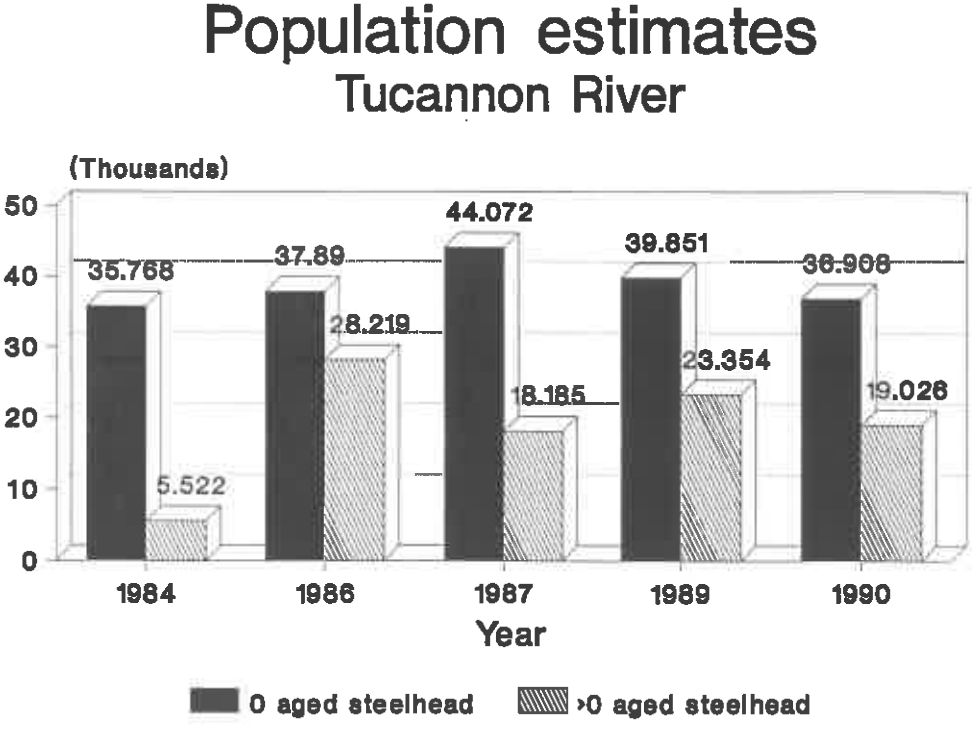


Figure 16. Juvenile steelhead densities (top) and population size (bottom) on the Tucannon River 1984-90.

Spawning escapement
Tucannon River 1986-1990

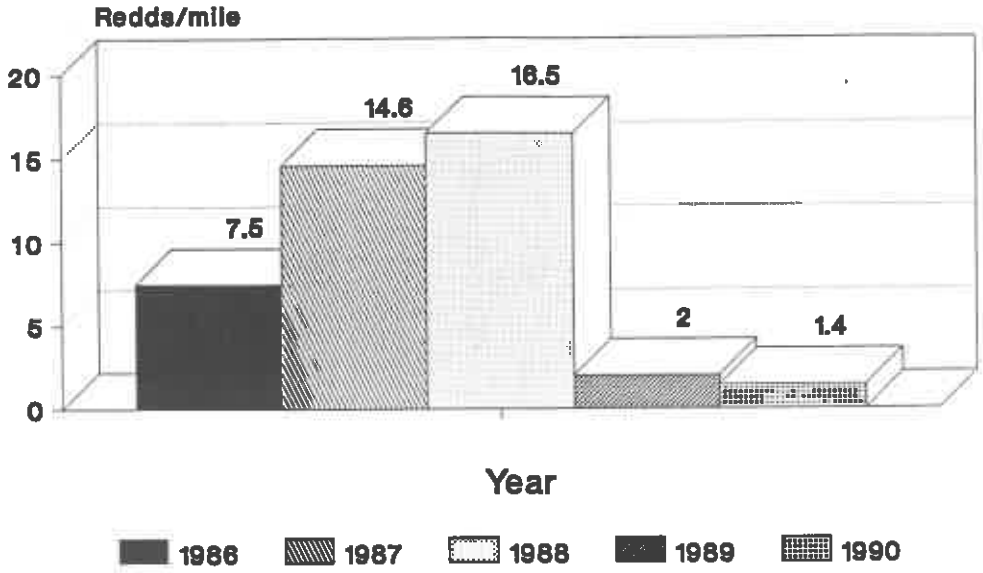


Figure 17.

1987, 1989 and 1990. During 1983 and 1984, 36 instream habitat alteration structures were constructed in the Tucannon River in an attempt to restore degraded stream habitat and increase salmonid populations. The structures were specifically designed to insure enhanced survival of >0 aged fish (Viola et al. 1991). Numbers and density of >0 aged juvenile steelhead increased two years after the completion of the habitat structures in 1986 and remained stable from 1987 through 1990. This suggests that the structures had a positive effect and resulted in improved rearing conditions and thus increased juvenile steelhead population size. Substantial spawning activity occurred in 1988 and may have maintained the numbers of >0 aged juvenile steelhead in 1989. However spawning escapement was very low in 1989 and both 0 aged and >0 aged densities and population size remained at a level similar to the levels of 1986, 1987 and 1989.

Densities and population size of fish >0 age increased on the Tucannon River and remained stable after construction of habitat structures even in years when estimated spawning escapement was very low. This occurred during a period containing three drought years. The habitat structures have offered steelhead of ages >0, areas to seek seasonal refuge from adverse aquatic conditions. Spawning escapement declined from 1988 to 1990 suggesting that low river flows may have precluded

the upstream movement of spawning adult steelhead. Increased spawning activity in the lower Tucannon may also explain the decrease in spawning activity found upriver in 1989. Although our spawning ground surveys areas were extended to cover lower river sections, an increase in spawning activity was not seen. Unfortunately a complete survey of the river was not possible because of adverse river conditions.

Summer Densities

Samples for density estimates of juvenile salmonids were also collected by WDF by electrofishing during the summer of 1990. We used length-frequencies to determine ages of game fish 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 for each site collected by WDF during summer and fall 1990 from the Tucannon River and Asotin Creek are presented in Appendix C.

Table 21. Mean steelhead densities per 100^2 meters by habitat type for fall, 1990. (WDF electrofishing data).

Site	Pool	Run	Riffle	Boulder Groups	Side Chan.
HMA [A]					
	29.9	28.9	31.1	30.2	29.6
SD=	12.3	4.5	7.4	8.7	15.8
n =	6	6	6	6	6

A- Tucannon R. within the Wooten W.A.

Catchable Trout Program

Production of legal or catchable size rainbow trout at the Lyons Ferry/Tucannon complex totaled 264,974 fish weighing 98,088 pounds in 1990-91. The average weight for catchable trout was 2.7 fish per pound for fish released in spring 1991. Appendix D gives a listing of streams and lakes in Southeastern Washington which received LSRCP fish, the number and pounds of fish they received and the number of different stockings into each water. In addition, 272,164 rainbow trout fry and fingerling weighing 7,589 pounds were reared for Idaho in 1990. This production level represented 123% of the program goal.

CONCLUSIONS

Despite problems at LFH with ruptured water lines and constantly increasing bird predation, we were still able to release a total of 940,934 juvenile steelhead from two stocks; Wallowa and LFH stock at an average of 4.13 fish per pound weighing a total of 227,740 pounds.

The degree that fish exhibited the morphology and physiology associated with smoltification at release varied widely among release groups from various locations. Considerable effort was expended on sampling the level of ATPase of fish prior to release from the hatchery and conditioning ponds. Pre-release levels of ATPase were higher in fish acclimated in conditioning ponds as compared to fish destined for direct stream release. We believe therefore that acclimation is affecting the physiological development of our smolts. However both the lower percent of transitionally developed smolts and the higher levels of ATPase in un-tagged fish suggests that either the process of tagging or the tag itself may be negatively affecting smoltification.

We estimated that as of June 1 all out migration had ceased and that 4.3% (between 9.9 - 32.8 %) of our juvenile steelhead stocked in the Tucannon and the Touchet rivers had failed to emigrate. The only significant difference in residualism was fish from the smaller length mode residualized at a higher percentage than fish from the larger length mode on the Touchet River. A consistent characteristic noted among residual fish from both rivers was that at least 80% were males. We also estimated that approximately 1000 yearling rainbow trout, 4.7% of all rainbow trout planted remained in the Tucannon River August through October. Our methods need refinement but the results indicate a much lower level of residualism than we expected. We will repeat the work in 1992 with improved methods.

We conducted electrofishing surveys for naturally produced juvenile steelhead on the Tucannon River. The long term trend in juvenile populations in this river from 1983-1990 showed widely fluctuating populations and densities of 0 age fish but stable or increasing populations of older age fish. There does appear to be a relationship between spawning escapement and 0 age densities. We have concluded, however, that habitat improvements placed in the river in 1983-84 are providing rearing area to support these increasing or stable populations of older age fish, even during drought years. We are presently unsure whether spawning hatchery origin fish are having any impact, good or bad, on juvenile populations in study streams.

Adults returning from our smolt releases contribute heavily to sport and commercial seasons throughout the Columbia River

basin. The Zone 6 Indian Net fishery, the main stem Snake River and Snake River tributary sport fisheries harvest the greatest numbers of returning fish.

Spawning surveys were again marginally successful because of heavy rains during the survey time period. Adverse conditions resulted in an under estimate of spawning activity. We have recognized the need for improved methods. Early testing of the use of index areas has been encouraging. We will utilize and test this new method again in 1992.

Return rates of marked fish to Lyons Ferry Hatchery were almost identical to the 1989 run year despite the reduce run size that was experienced with most stocks of steelhead in Washington in 1990.

We have successfully met our mitigation goals as described under the LSRCP. This statement is based on recoveries of tags from fish released in 1987 and 1988 that were sampled in 1990-91 during: 1) creel surveys; 2) as the adult steelhead passed Lower Granite Dam and 3) from within the trap at LFH. We estimate that 6,740 adult steelhead returned to the LSRCP area. This number represents 145% of the LSRCP goal. We believe this estimate can be considered a minimum since we did not include any spawning fish due to the problems we have experienced in obtaining a correct estimate of spawning escapement. Considerably less LFH reared adult steelhead returned to the LSRCP area than in previous years. We believe this is due to the overall reduction of run size of all stocks of steelhead in 1990; the 1990 run was only 43.3% of the 1989-90 run size. We met or exceeded the smolt to adult survival goal for all rivers within the LSRCP area except for the Tucannon. However, we suspect that more fish return to the Tucannon than our present methods indicate. New methods designed to provide a more intensive survey of returning adults to the Tucannon will be implemented in 1992. There also remains a substantial straying problem of fish from all release areas to far up the Snake River and its tributaries.

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Appendix A.

The number of juvenile steelhead sampled at acclimation ponds and river sites and the number of males (NM), number of precocious males (NPM), percent of males (%M) and percent of precocious males (%PM).

Pre-release sampling

Sam site	N	NM	NPM	% M	% PM
Curl Pond	120	61	3	50.8	2.5%
91413-M	60		2		
91413-U	60		1		
Dayton Pond	176	89	1	50.6	0.6%
91416-L	60		0		
91416-S	61		0		
91416-V	55		1		
Lyons Ferry Raceway	120	61	9	50.8	7.5%
91413-1	29		2		
91413-2	27		1		
91413-5	30		4		
91413-6	30		2		
91413-U	4		0		
Lyons Ferry Lake	60	34	1	56.7	1.7%

Post - Release Sampling

Sam site	N	NM	NPM	% M	% PM
Tucannon River	91	72	19	79.1	20.9%
91413-1	19		1		
91413-2	11		1		
91413-M	30		8		
91413-U	31		9		
Touchet River	73	56	15	76.7	20.5%
91416-L	28		10		
91416-S	31		4		
91416-U	14		1		
McNary Dam	114	45	0	39.5	0.0%
91413-1	13		0		
91413-2	12		0		
91413-5	1		0		
91413-6	0		0		
91413-M	29		0		
91416-L	30		0		
91416-S	29		0		

Appendix B. Steelhead trapped at Tucannon Hatchery weir, Spring 1991.

Date	Wild or Hatchery	Sex	Length	Comments
12/31/91	H	F	66.0	Passed
02/25/91	W	F	61.0	Passed
02/25/91	H	F	55.9	Passed
03/04/91	H	F	71.1	Passed
03/04/91	H	M	64.8	Passed
03/04/91	H	M	55.9	Passed
03/04/91	H	M	61.0	Passed
03/04/91	H	F	73.7	Passed
03/05/91	H	M	66.0	Passed
03/05/91	H	F	74.9	Passed
03/05/91	W	F	78.7	Passed
03/06/91	H	M	55.9	Passed
03/06/91	W	F	77.5	Passed
03/09/91	H	F	68.5	Passed
03/11/91	H	F	58.4	Passed
03/11/91	H	F	72.4	Passed
03/11/91	H	M	71.1	Passed
03/12/91	H	M	62.2	Passed
03/14/91	H	M	63.5	Passed
03/14/91	W	F	71.1	Spawned
03/14/91	H	F	73.7	Passed
03/14/91	W	F	72.4	Passed
03/14/91	W	M	----	Passed
03/18/91	W	F	----	Passed
03/18/91	H	F	76.2	Passed
03/18/91	W	F	76.2	Passed
03/19/91	H	M	55.9	Passed
03/19/91	H	M	76.2	Passed
03/19/91	W	F	71.1	Passed
03/20/91	H	F	58.4	Passed
03/20/91	H	M	61.0	Passed
03/21/91	H	M	78.7	Passed
03/21/91	H	F	55.9	Passed
03/21/91	H	F	62.2	Passed
03/23/91	H	F	78.7	Passed
03/23/91	H	F	66.0	Passed
03/23/91	W	M	53.3	Passed
03/25/91	W	M	50.8	Passed
03/25/91	H	M	64.8	Passed
03/25/91	H	F	58.4	Passed
03/26/91	H	F	74.9	Passed
03/26/91	H	F	72.4	Passed
03/27/91	W	M	83.8	Spawned
03/31/91	W	M	76.2	Passed
03/31/91	W	M	81.3	Passed
03/31/91	H	F	71.1	Passed
04/01/91	H	M	76.2	Passed
04/01/91	W	M	76.2	Passed
04/01/91	H	F	73.7	Passed

Appendix B. Steelhead trapped at Tucannon Hatchery weir, Spring 1991 (continued)

Date	Wild or Hatchery	Sex	Length	Comments
04/01/91	H	M	55.9	Passed
04/05/91	W	M	81.3	Passed
04/07/91	H	M	73.7	Passed
04/09/91	H	M	66.0	Passed
04/10/91	W	M	78.7	Spawned
04/15/91	H	F	58.4	Passed
04/17/91	W	F	73.7	Spawned
04/17/91	W	M	71.0	Passed
04/17/91	H	F	58.4	Passed
04/18/91	H	F	78.7	Passed
04/18/91	W	F	66.0	Passed
04/18/91	W	F	68.5	Passed
04/23/91	W	M	55.8	Spawned
04/23/91	W	F	68.5	Passed
04/30/91	W	F	68.5	Passed
05/07/91	H	M	63.5	Passed
05/15/91	W	F	58.4	Spawned

TOTALS	Male	Avg. Length	Female	Avg. Length
Hatchery	18	65.1	24	67.4
Wild	12	69.7	14	70.1

Appendix C

Table 1. Gamefish population and density information from sites electrofished by WDF personnel, summer and fall 1990.

SITE TYPE (Date)	AGE[A]	PASS 1	2	3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
HMA(Habitat Mgmt. Area H.Q. to Panjab Cr.)								
1 Riffle	0+	23	6		29	3.8	136.2	22.0
(9-25)	1+	6	0		6	---[B]		4.4
	2+	2	0		2	---[B]		1.5
	TOT	32	6		38	2.2		27.9
	AD	1	0		1	---[B]		0.7
2 Boulder	0+	29	5		34	2.0	222.0	15.3
(8-27)	1+	14	5		19	4.5		9.0
	2+	0	2		2	---[B]		0.9
	TOT	44	12		56	6.3		26.6
	AD	1	0		1	---[B]		0.5
3 Run	0+	16	2		18	1.1	111.2	16.2
(9-13)	1+	8	2		10	1.7		9.0
	2+	0	1		1	---[B]		0.9
	TOT	24	5		29	2.2		26.1
	WF	1	0		1	---[B]		0.9
4 Pool	0+	8	2		10	1.7	107.6	9.3
(9-25)	1+	5	3		8	3.3		7.4
	2+	0	1		1	---[B]		0.9
	TOT	13	6		21	7.2		19.5
5 Riffle	0+	51	8		60	3.0	205.4	29.2
(8-22)	1+	15	3		18	1.7		8.8
	2+	2	1		3	3.2		1.5
	TOT	68	12		82	4.3		39.9
	BT	1	0		1	---[B]		0.5
6 Run	0+	14	3		17	1.8	110.9	15.3
(8-27)	1+	11	3		14	2.0		12.6
	2+	1	0		1	---[B]		0.9
	TOT	26	6		32	3.6		29.8
	WF	1	0		1	---[B]		0.9
7 Boulder	0+	16	1		17	0.5	196.0	8.7
(8-22)	1+	10	2		12	1.5		6.1
	2+	0	1		1	---[B]		0.5
	TOT	26	4		30	1.7		15.3
	BT	1	0		1	---[B]		0.5

Appendix C, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	2	3	4	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
8 Pool	0+	16	5	3	2	26	2.1	161.7	16.1
(8-23)	1+	9	5	2	4	23	8.6		14.2
	2+	6	1	2	0	9	1.1		5.6
	TOT	31	11	7	6	58	6.0		49.9
	BT	0	0	0	1	1	---B		0.6
9 Riffle	0+	30	2			32	0.8	241.6	13.2
(8-07)	1+	10	3			13	2.2		5.4
	2+	1	0			1	---B		0.4
	TOT	42	4			47	1.6		19.5
10 Run	0+	37	8			46	3.6	153.4	30.0
(8-20)	1+	5	2			7	2.3		4.6
	2+	2	0			2	---B		1.3
	TOT	44	10			54	4.8		36.5
	BT	0	1			1	---B		0.7
11 Boulder	0+	42	8	8		60	4.4	208.3	28.8
(8-15)	1+	10	0	1		11	1.5		5.3
	2+	2	0	0		2	---B		1.0
	TOT	55	8	9		73	3.4		35.0
	AD	1	0	0		1	---B		0.5
12 Pool	0+	20	4			24	2.0	155.0	15.5
(8-16)	1+	6	1			7	1.0		4.5
	2+	4	2			6	2.7		3.9
	TOT	30	7			37	3.7		24.5
	BT	0	1			1	---B		0.6
	WF	1	2			3	---B		1.9
13 Riffle	0+	36	5			41	1.8	183.0	22.4
(8-15)	1+	6	4			12	9.9		6.6
	2+	3	0			3	---B		1.6
	TOT	45	9			54	3.6		30.1
14 Run	0+	13	1			14	0.6	100.0	14.0
(8-20)	1+	9	3			12			12.0
	TOT	22	4			26	1.8		26.0
	BT	1	0			1	---B		1.0
15 Boulder	0+	25	4	1		30	0.8	100.0	30.0
(8-13)	1+	4	6	0		10	2.5		10.0
	2+	0	1	0		1	---B		1.0
	TOT	29	11	1		41	1.8		41.0

Appendix C, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	2	3	4	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
16 Pool	0+	7	3			10	5.3	187.7	5.3
(8-14)	1+	5	2			7	2.3		3.7
	2+	3	4			15	61.5		8.0
	TOT	15	9			24	18.6		18.6
	BT	3	0			3	---[B]		1.6
17 Boulder	0+	28	9			40	7.0	181.8	22.0
(8-09)	1+	6	4			12	9.9		6.6
	2+	3	2			5	3.3		2.8
	TOT	37	15			52	13.7		33.0
18 Riffle	0+	25	5			30	2.2	134.6	22.3
(8-09)	1+	7	2			9	1.8		6.7
	2+	2	0			2	---[B]		1.5
	TOT	34	7			42	3.4		31.2
	BT	0	1			1	---[B]		0.7
19 Run	0+	18	2			20	1.0	150.0	13.3
(8-13)	1+	6	4			12	9.9		8.0
	2+	2	2			4	4.5		2.7
	TOT	26	8			34	5.6		24.0
	WF	1	0			1	---[B]		0.7
20 Riffle	0+	43	5			48	1.6	183.7	26.1
(8-08)	1+	7	7			31	87.2		16.9
	2+	4	1			5	1.5		2.7
	TOT	54	13			70	5.9		38.1
21 Pool	0+	13	1			14	0.6	80.0	17.5
(8-08)	1+	4	2			6	2.7		7.5
	2+	6	2			8	2.0		10.0
	TOT	23	5			28	2.3		35.0
	BT	1	1			2	---[B]		2.5
22 Pool	0+	25	6	3	2	36	1.6	129.6	27.8
(8-01)	1+	3	0	2	0	5	1.7		3.9
	2+	0	0	1	1	2	---[B]		1.6
	TOT	28	6	6	3	44	3.1		34.0
	BT	0	1	0	0	0	---[B]		0.8
	WF	2	0	0	0	2	---[B]		1.6
23 Boulder	0+	23	4	5		33	3.5	169.9	19.4
(8-01)	1+	5	5	0		10	1.9		5.9
	2+	5	1	1		7	1.4		4.1
	TOT	33	10	6		51	4.7		30.0
	BT	0	0	1		1	---[B]		0.6

Appendix C; Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	2	3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
24 Run	0+	15	6	0	21	1.2	110.3	19.0
(8-01)	1+	7	1	1	9	1.0		8.2
	2+	2	1	1	4	3.0		3.6
	TOT	24	8	2	34	2.0		30.8
	BT	1	0	0	1	---[B]		0.9
	WF	1	0	1	2	---[B]		1.8
HMAS (side channels within the HMA)								
1-S	0+	10	1		11	0.7	34.6	31.8
(8-22)	1+	4	0		4	---[B]		11.6
	2+	1	0		1	---[B]		2.9
	TOT	15	1		16	0.6		46.2
2-S	0+	9	1		10	0.8	58.0	17.2
(8-06)	1+	11	1		12	0.7		20.7
	2+	7	0		7	---[B]		12.1
	TOT	27	2		29	0.8		50.0
	WF	1	0		1	---[B]		17.2
3-S	0+	7	0		7	---[B]		17.5
(8-08)	1+	1	1		2	12.7		5.0
	2+	2	1		3	3.2		7.5
	TOT	11	2		13	1.4		32.6
	AD	1	0		1	---[B]		2.5
4-S	0+	10	1		11	0.7	79.2	13.2
(8-22)	TOT	10	1		11	0.7		13.2
5-S	0+	6	1		7	1.0	56.7	12.3
(8-14)	1+	1	0		1	---[B]		1.8
	2+	1	0		1	---[B]		1.8
	TOT	8	1		9	0.8		15.9
	BT	1	0		1	---[B]		1.8
	WF	1	0		1	---[B]		1.8
6-S	0+	12	1		13	0.6	117.8	11.0
(8-14)	1+	4	2		6	2.7		5.1
	2+	3	0		3	---[B]		2.5
	TOT	19	3		22	1.5		18.7

A Age based on length-frequency histograms. AD = adipose or ventral fin clips or brands. BT = Bull Trout; WF = White Fish.

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

Appendix C, Table 2. Other Game Fish Species Data.

SITE	Species[A]	Lengths in mm. (weight in gm.)
HMA		
2	BT	169(42.4)
3	WF	280
5	BT	162(50.2)
6	WF	190
7	BT	178(53.8)
8	BT	215
10	BT	168(43.8)
12	BT	225
	WF	372,341
14	BT	208(89.6)
16	BT	167(44.7),360,458
17	BT	170(58.0)
18	BT	154(36.5)
19	WF	48(1.0)
21	BT	169, 170(55.3)
22	WF	49(1.1), 300
	BT	169
23	BT	240
24	BT	145
	WF	261,283
HMA-Side channels		
2	WF	70
3	BT	200(82.9)
5	WF	56(1.7)
	BT	200(72.5)

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

Appendix D: Brand and tag recoveries from the trap at LFH during the 1990 run year.

Brand	Stock	Release Year	Actual Tag Return
LA-IF-3	WALLOWA		2
RA-IY-1	LFH		7
RA-IY-3	LFH		4
RA-IC-1	WALLOWA		1
Total			14
LA-S-1	LFH	1988	25
LA-S-2	LFH		33
RA-S-1	LFH		36
RA-S-2	LFH		46
LA-IV-1	LFH		11
LA-IV-3	LFH		16
RA-IV-1	LFH		14
RA-IV-3	LFH		15
LA-H-1	LFH		9
RA-H-1	LFH		7
RA-H-2	LFH		6
Total			218
LA-IJ-1	LFH	1989	21
LA-IJ-3	LFH		12
LA-IJ-4	LFH		10
RA-IJ-1	LFH		118
RA-IJ-3	LFH		115
LA-IT-1	LFH		47
LA-IT-3	LFH		22
RA-IT-1	LFH		48
RA-IT-3	LFH		40
Total			424

* Lyons Ferry Hatchery Stock.

Appendix E.

Rainbow and G.Brown Trout Plants, Lyons Ferry/Tucannon, 1991.

COUNTY	LOCATION	No.of Plants	Pounds of Fish	No. Fish Planted
ASOTIN	Alpowa Ck.	0	0	0
	Asotin Ck.	1	1,710	4,104
	Golf Course Pd.	2	2,600	7,420
	Headgate Pd.	2	750	2,400
	Silcott Pd.	2	1,114	3,372
	W.Evans Pd.	2	1,464	4,317
	TOTAL		7,648	21,613
COLUMBIA	Big Four	1	1,540	4,004
	Blue Lk.	5	5,270	14,992
	Curl Lk.	4	4,770	12,831
	Dam Pd.	2	1,013	2,001
	Dayton Jv.Pd.	2	774	2,163
	Deer Lk.	6	7,200	20,193
	Orchard Pd.	1	385	1,001
	Rainbow Lk.	7	8,554	23,183
	Spring Lk.	6	5,348	14,939
	Touchet R.(RB)	1	1,970	4,531
	Touchet R.(GB)	3	4,400	11,306
	Tucannon R.	3	9,030	21,113
	Watson Lk.	2	2,505	6,841
	TOTAL (RB)		48,359	127,792
	TOTAL (GB)		4,400	11,306
FRANKLIN	Big Flat	2	1,896	4,999
	Marmes Pd.	2	811	1,001
	TOTAL		2,707	6,000
GARFIELD	Bakers Pd.	1	340	1,020
	Casey Pd.	1	275	990
	Coles Pd.	1	275	990
	Pataha Ck.	2	915	3,030
	TOTAL		1,805	6,030
WALLA WALLA	Blue Creek	1	160	576
	College Pl. Pd.	2	760	2,532
	Coppei Ck.	1	412	1,442
	Dry Ck.	1	412	1,442
	Fishhook Pk. Pd.	2	2,220	7,548
	Jefferson Pk. Pd.	2	760	2,532
	Quarry Pd.	2	9,100	25,020
	Mill Ck.	1	1,520	3,648
	Mill Ck. Res.	5	14,820	39,098
	TOTAL		30,164	83,838
WHITMAN	Alkali Ck.	1	145	522
	Garfield Pd.	1	491	1,375
	Gilcrest Pd.	2	985	3,178
	Klemgard Pd.	2	664	2,099
	Pampa Pd.	3	4,320	10,012
	Riparia Pd.(RB)	1	365	949
	Riparia Pd.(GB)	1	358	1,002
	Rock Lake (GB)	1	1,465	8,204
	Union Flat Ck.	1	435	1,566
	TOTAL (RB)		7,405	19,701
	TOTAL (GB)		1,823	9,206
	TOTAL RAINBOW		**98,088**	**264,974**
	TOTAL BROWNS		**6,223**	**20,512**
	GRAND TOTAL		**104,311**	**285,486**