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LYONS FERRY EVALUATION STUDY

1989-90 ANNUAL REPORT #AFF 1/LSR-91-08

FISHERIES MANAGEMENT DIVISION

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1989-90 Annual Report

July, 1991

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TABLE OF CONTENTS

ABSTRACT

Total steelhead production at Lyons Ferry Hatchery in 1989 was 818,352 summer steelhead weighing 181,985 pounds, for an average smolt size of 4.5 fish/pound (SD = 0.87). Rainbow trout were planted into 39 waters, a total of 226,690 fish weighing 91,829 pounds. An additional 138,146 trout weighing 11,780 pounds were reared for Idaho. Total trout production was 120% of goal this year. Average trout size planted was 2.5 fish/pound.

Twelve study groups of coded wire tagged and branded steelhead were released from 3 different locations. Tag loss averaged 1.27% (SD=1.06) and brand loss averaged 4.24% (SD=1.23). Smoltification samples taken from smolts 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 decreased from an average of 29.8% of release at McNary Dam in 1989 to 20.8% of release in 1990. Travel times were similar for both years.

Adults from 1987 and 1988 smolt releases returned to Lower Granite Dam at between 0.47% and 1.24% for one year returns and between 0.68% and 2.11% for combined first and second year returns. One-ocean age fish averaged 59.5 cm in length and 2-ocean age fish averaged 72.8 cm. The adult trap at LFH was operated from Aug. 3 to Dec. 12 1989. A total 2,458 fish were captured. Males and females comprised 38.6% and 61.4% respectively. Wild fish represented 0.61% of the fish trapped at the hatchery this year. Tagged and branded fish made up 23.5% of the fish trapped. A total of 2,570,676 eggs were spawned from 437 females. A total of 1,483,485 eggs were retained for hatching and rearing. One- ocean age fish averaged 4,898 eggs/female and 2-ocean age fish averaged 6,561 eggs/female.

Adult returns from LSRCP releases contributed to 10 different fisheries in the Columbia River basin and offshore ocean area. Returning adults generally contributed 50% or greater of their total harvest to the LSRCP area. Contribution to fisheries and escapement into the LSRCP area from the 1986 smolt release ranged from 0.114% to 0.633% smolt to adult survival. Adults from the 1987 smolt release returned into the LSRCP area at from 0.168% to 1.148% survival. 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. These numbers represent 312% and 338% ,respectively, of our annual LSRCP goal.

We conducted creel surveys on the Snake, Grande Ronde, Walla Walla, Touchet and Tucannon rivers. We sampled between 9.8 and 13.4% of the harvest on sections of the Snake River and collected 275 snouts from ventral fin clipped steelhead. Female steelhead made up 61% of the LFH origin fish checked in the creel with males comprising 39%. Anglers expended an estimated 2,212 angler days of effort on the Grande Ronde River in the 1989-90 season. A total estimated 136 Washington origin coded wire tags of 5 different groups were harvested in the Washington portion of the river.

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

Juvenile salmonid densities in project area streams were analyzed for the period 1983-1989. Densities and population size of 0 aged steelhead/rainbow decreased or remained stable in the North and South Forks of Asotin Creek and in the Tucannon River. During the same period, densities and population sizes of older age rainbow/steelhead juveniles (> 0 aged) remained stable or increased in all the streams. Adult spawning escapement decreased in all the streams. 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 for their expert assistance with the Grande Ronde creel survey and especially for providing an excellent statistical analysis of the results.

A special word of thanks to Jerry Harmon and the other NMFS personnel operating the adult 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.

Douglas Kuehn spent unnumbered hours collecting creel survey data and inputting the information into our data-base. His efforts made completion of the report much easier.

We would like to thank John Hisata, Bob Gibbons, Dr. Peter Hahn and Dan Herrig for reviewing the draft manuscript.

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

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

This report by the Washington Department of Wildlife addresses progress toward meeting mitigation goals established under the Lower Snake River Compensation plan (LSRCP) in Washington through operation of the Lyons Ferry Hatchery complex. The reporting period for this report is July 1, 1989 through June 30, 1990 inclusive. 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, already finished in early 1991, dealt with one major objective under the 1989 statement of work. The Instream Habitat Construction and Evaluation Project began in 1983 to assess the success of instream habitat structures placed in streams to increase resident trout production. The results of the study should be applicable in a broad range of geographical areas and thus were supplied in a separate single topic report for wider distribution.

The 1989 project proposal, as submitted to the U.S. Fish and Wildlife Service (FWS), served as a guideline to determine our progress in the evaluation project for the year. The goals, objectives and tasks of that proposal are provided in Appendix A.

Results from our third year of smoltification testing were similar to results from 1989. 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.

We continued to collect tags from our tag release groups to determine adult steelhead contribution to Compensation Plan 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 in both years. Adult returns this year continue to provide some indication of how LSRCP releases can successfully maintain steelhead runs under adverse environmental conditions.

Early results from coded wire tag experiments in the Walla Walla River system continue to be of concern. Survival of tagged smolts to McNary Dam was comparable for the Touchet River fish (a tributary to the Walla Walla) when compared to Lyons Ferry Hatchery and Tucannon River released tag groups. However, returning adults destined for the Touchet River are wandering far up the Snake River. This behavior, which has been identified in several other groups of LFH reared fish, poses additional questions about the ability of our stocks of fish and release strategies to meet the goals as outlined under the LSRCP program.

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 1989 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

Three types of release methods were used in 1990: 1) brood stock smolt releases from Lyons Ferry are allowed to volitionally migrate from the rearing ponds, 2) fish are pumped from the release structure into tank trucks and hauled directly to various streams and rivers in Southeast Washington; and 3) fish are pumped from the release structure into tank trucks, then transferred to conditioning ponds on the Tucannon, Grande Ronde and Touchet rivers. After 5-8 weeks in the conditioning ponds the fish are then allowed to volitionally emigrate over a 2 week period before the remaining fish are forced from the ponds.

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

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, 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, blood thyroxin (T_4), and skin guanine levels were measured as physiologic indicators of smoltification. This information along with mean lengths and weights of fish sampled are reported. This was a follow up on sampling done in 1988 and 1989 (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 1989 except that direct stream releases from raceways at the hatchery and from the rearing pond release structure occurred immediately before release. 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

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., 1990). Adults coming into the trap were sampled for marks and brands. The summarized information, along with sample rates when available, was provided to us.

Returns to Lyons Ferry Hatchery

We examined all steelhead that entered the hatchery ladder and trap for marks. The ladder was open only part of the period when steelhead were migrating past the hatchery and could have entered the trap. All captured fish were retained until the spring of 1990 when they were sorted for spawning purposes. Fish that were identified as destined for upstream hatcheries and injured males were returned to the river.

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. Peak spawning period was not determined in 1990. All other methods were as described by Schuck et al. (1989).

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 consumptive steelhead fishery for the Snake River occurred September 1 to December 31, 1989, and January 1 to March 31, 1990. Regulations required wild steelhead release, with daily catch, possession and annual limits of 2, 4 and 30 steelhead, respectively.

The consumptive fishery for the Grande Ronde River, except for the catch and release section at the mouth, occurred September 1 to December 31, 1989, and January 1 to April 15, 1990. Wild release regulations were in effect and daily catch, possession and annual limits for steelhead were 2, 4 and 30 respectively. A joint survey of the upper Grande Ronde was conducted by ODFW and WDW personnel. All data collected were summarized by ODFW. Angler effort, catch rates, harvest and coded wire tag recoveries and expansions were calculated by ODFW as described in Carmichael et al. (1988).

Fishing regulations for the Touchet, Tucannon, and Walla Walla rivers were unchanged from 1989.

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.

Work done in 1986-88 (Mendel et al 1988) showed that punchcards underestimated harvest when compared to intensive creel survey estimates. An adjustment to the estimnates is therefore required. Punchcard estimates are adjusted by multiplying by our correction factor (1.1205) for underestimation (Mendel et al. 1988), to determine total harvest. Total estimated harvest of tagged fish was based on the adjusted figures. Creel survey and coded wire tag expansion methods were generally similar to those described by Mendel et al. (1988) and Schuck et al. (1989) although we made an effort to maximize the number of fish sampled for marks and cwt recovery. Expansions of tags harvested by Idaho anglers but collected by Washington creel survey personnel were done by IDFG personnel and provided to us for inclusion in this report.

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

Returns of Coded Wire Tag Groups

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

Juvenile Steelhead Populations in Project Rivers

Summer Densities

All of our juvenile population density sampling in 1989 was done to evaluate the effectiveness of man-made instream habitat structures. These structures were placed in Southeast Washington streams in 1983 and 1984 in an attempt to improve rearing

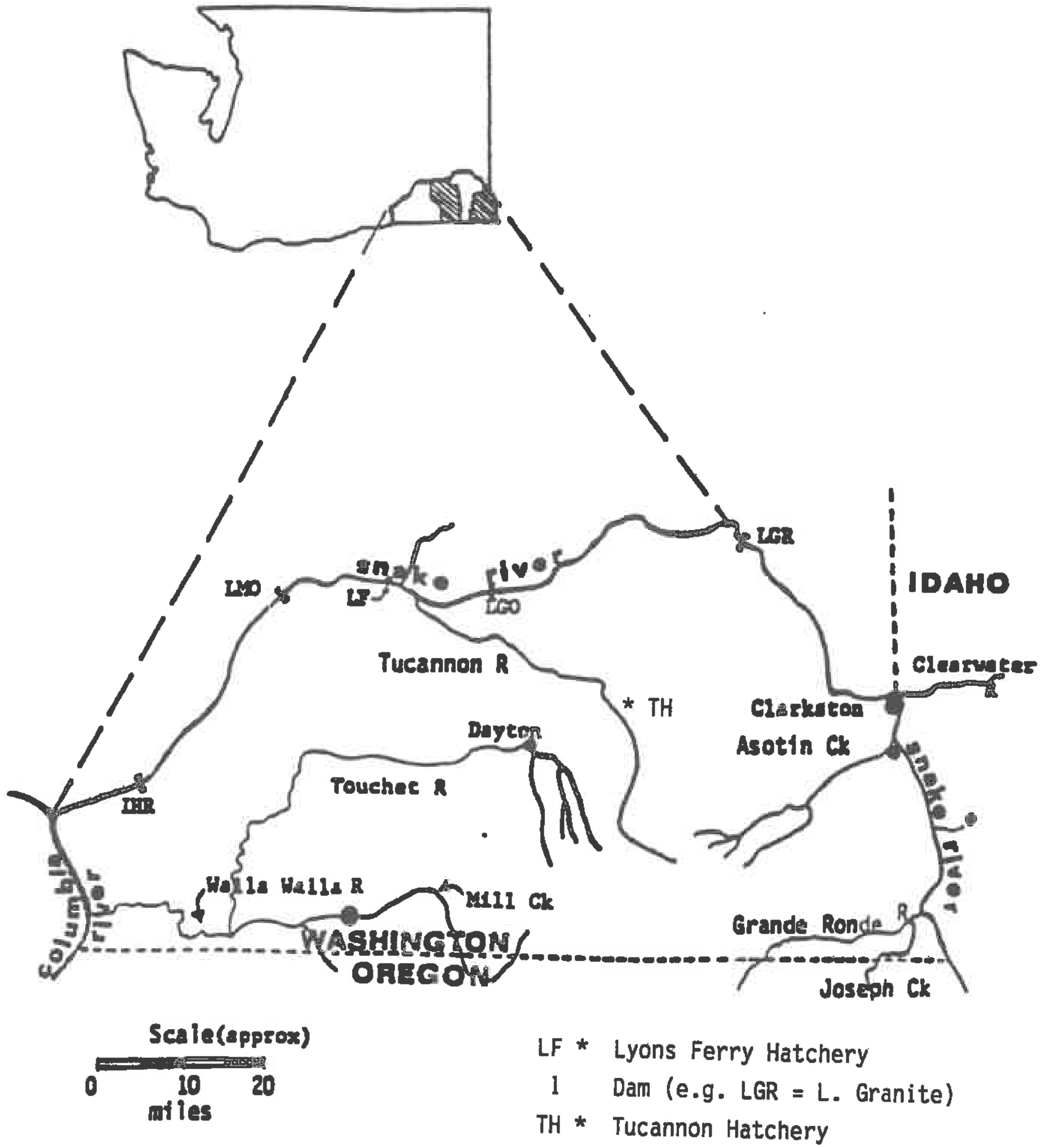


Figure 1. The relative locations of major LSRCP streams and Facilities mentioned in this report.

conditions for and increase production of older age resident trout. The results of that work is presented in Viola et al. (1991) as a completion report on the effectiveness of those structures after 5-6 years. No other juvenile sampling in LSRCP streams was conducted. However, 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 collected by WDF is presented.

Long Term Trends

We reviewed juvenile density information from index areas of Southeast Washington streams collected since 1983. These data are presented with an analysis of probable trends. The purpose of the analysis is to determine if any long term changes in fish densities and total population size may be occurring.

Sections of the North and South Fork of Asotin Creek and the Tucannon River were identified as juvenile steelhead density and population index areas (described below). Samples from these areas provided steelhead juvenile density and population trend information for each sample year.

North Fork of Asotin Creek: Confluence with the South Fork upstream 4.65 miles to the US Forest Service boundary.

South Fork of Asotin Creek: Confluence with the North Fork upstream 3.46 miles to a bridge crossing.

Tucannon River: From camp 1 upstream 11.6 miles to Panjab Creek.

Information on annual juvenile steelhead densities, river surface area and adult steelhead spawning escapement within index areas on each river was obtained from annual and project completion reports (Mendel 1984, Mendel 1985, Schuck and Mendel 1987, Schuck et al. 1988, Viola et al. 1991) and un-published WDF data from 1987. Populations of both 0 aged and greater than 0 age (>0) juvenile steelhead were estimated for areas of artificial habitat structures and unimproved areas within the river index sections. Population estimates were calculated by multiplying densities (#/100m²) obtained from reports by the total 100m² annually available within improved and unimproved areas of index river sections. 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 100m² for each age class. Total density of all age classes from within the entire river section was the sum of both age classes. All information was analyzed to develop annual juvenile steelhead density trends. An effort was made to correlate these trends with variations in spawning escapement, rearing success, and riparian and instream habitat.

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, 1989-90.

Specie[A]	Stock[A]	No. Eggs	No. Fry	Number planted	Percent[B] survival	Food fed(lbs)	Fish(lbs) produced	Feed conv.
LYONS FERRY HATCHERY								
RB	SPOK.	304,500	259,190	207,186[D]	68.0[E]	44,741	34,223	1.12
SSH	LFH	1,483,485	291,116	0	0.0			
SSH	WAL	250,104	226,025	239,140	95.6	29,925	32,900	0.92
SSH	WEL/SKA		186,958	169,017	90.4	62,238	40,882	1.52
SSH	PAH		331,278	300,590[F]	90.7	58,304	53,143	1.10
TUCANNON HATCHERY								
RB	SPOK.	226,200	166,963	160,701	71.0	67,185	57,845	1.18
SSH	PAH.		79,252	79,252	100.0[C]	4,100	15,850	1.10

A- RB = rainbow, SSH = summer steelhead, SPOK = Spokane, LFH = Lyons Ferry Hatchery, WAL = Wallowa, PAH = Pahsimeroi, WEL/SKA = Wells/skamania.
B- Egg to smolt/catchable survival where applicable, otherwise fry to smolt
C- Pre-smolt to smolt survival only.
D- 69,040 @ 9.6 fish/lb planted into the Snake R. @ LFH and 138,146 fish weighing 11,780 pounds transferred to Idaho.
E- 46,051 fish lost to IHN
F- Includes 79,252 pre-smolts weighing 11,323 lbs. transferred to Tucannon Hat.

There were two outbreaks of Infectious Hematopoietic Necrosis (IHN) at Lyons Ferry Hatchery this year. All groups of eggs collected from the Lyons Ferry origin adult steelhead tested positive for the virus. The decision was made to retain the eggs as all groups of eggs were water hardened in iodophore to kill virus that was present. After hatching and while the fry were still in the hatchery troughs, an epizootic of IHN was diagnosed. A total of 291,116 fry were lost in the epizootic. Because of the severity of the outbreak, the decision was made to destroy the remaining fry and eggs. No Lyons Ferry origin fish remained from the 1989 brood at LFH by August 12, 1989 (Table 1). The second outbreak of IHN occurred in the Spokane stock rainbow trout. The virus was detected in moribund fish at 9.6/lb. Fish in three raceways were affected, total loss was 46,051 fish with an additional 69,040 fish were planted in the Snake River at LFH. No other severe disease problems were experienced.

To offset the losses of fish to IHNV, replacement fish from other hatcheries were obtained. Goldendale stock rainbow were brought onto the hatchery and placed in an empty rearing pond to isolate them from the raceway portion of the hatchery which had experienced the IHN epizootic. This was the first time rainbow had been placed in our rearing ponds. Avian predation on this group of fish was excessive. Large numbers (100-400) of seagulls, terns and mergansers were present on the pond except for brief periods of time after hazing. The rainbow were removed approximately one month later and an estimated 12,000 of 81,370 fish had been lost.

Summer steelhead from Idaho and from other hatcheries in Washington contributed to production at Lyons Ferry in 1989-90. Pahsimeroi and Wells stock fish were received at the hatchery at various stages and sizes of development. Feed conversions were in expected ranges for all groups. The very high conversion rate calculated for the Wallowa origin fish is unexpected and likely due to errors in measurements taken at the beginning and end of the rearing period. The fish were of normal size and condition at release.

Egg-to-fry survival for steelhead was acceptable for groups in 1990 (Table 2). Wallowa stock fish were hatched at Tucannon Hatchery in 1989 to keep the fish away from IHN problems at LFH but the program was back at LFH in 1990. The severe IHN epizootic forced us to spawn more fish to ensure a sufficient supply of fish for the year. No IHN was identified in the fish therefore only 1,483,485 eggs of the 2,461,617 eggs taken were retained for hatching. The remaining eggs were either transferred to other hatcheries or destroyed.

Table 2: Juvenile mortality, Lyons Ferry Hatchery 1987-90.

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
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

A- Eyed eggs B- Green eggs

Table 3. Smolt releases from Lyons Ferry Hatchery, 1987-90.

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
1987											
TOUCHET R.@DAYT	53	102,050	19,625	4/20-30	WELLS			AD	5.2		
TOUCHET R.@DAYT	53	34,677	6,669	4/20-30	L.FERRY			AD	5.2		
WALLA WALLA R.	32	50,527	8,500	04/21	WELLS			AD	5.9		
WALLA WALLA R.	32	18,880	3,200	04/22	WELLS			AD	5.9		
WALLA WALLA R.	35	25,018	4,905	04/30	WELLS			AD	5.1		
WALLA WALLA R.	35	7,150	1,300	04/22	L.FERRY			AD	5.5		
WALLA WALLA R.	30	23,400	4,500	04/24	L.FERRY			AD	5.2		
MILL CR.	3	26,100	4,500	04/21	WELLS			AD	5.8		
SNAKE R.@ IHD		11,314	2,057	04/23	WELLS		RD-7P-1	AD	5.5		
SNAKE R.@ IHD		11,468	2,085	04/27	WELLS		LA-7P-3	AD	5.5		
SNAKE R.@ IHD		11,406	2,001	04/30	WELLS		LA-7P-1	AD	5.7		
SNAKE R.@ LFH	58	649	118	04/23	WELLS	P.I.T.		AD	5.5		
SNAKE R.@ LFH	58	650	116	04/23	WELLS	P.I.T.		AD	5.6		
SNAKE R.@ LFH	58	650	114	04/23	WELLS	P.I.T.		AD	5.7		
SNAKE R.@ LFH	58	19,972	3,385	04/23	WELLS		LD-7K-1	AD	5.9		
SNAKE R.@ LFH	58	18,676	3,335	04/27	WELLS		RA-7K-3	AD	5.6		
SNAKE R.@ LFH	58	19,716	3,459	04/30	WELLS		RA-7K-1	AD	5.7		
SNAKE R.@ LFH	58	25,384	5,288	4/24-30	L.FERRY	63/39/15	RA-IF-1	AD-LV	4.8	0.30	2.7
SNAKE R.@ LFH	58	25,459	5,304	4/24-30	L.FERRY	63/39/14	RA-IF-3	AD-LV	4.8	0.70	0.8
SNAKE R.@ LFH	58	25,431	4,462	4/24-30	WALLOWA	63/37/03	LA-IF-1	AD-LV	5.7	0.30	3.9
SNAKE R.@ LFH	58	25,586	4,489	4/24-30	WALLOWA	63/39/13	LA-IF-3	AD-LV	5.7	0.93	2.4
ASOTIN CR.	0.8	22,950	4,500	04/22	L.FERRY			AD	5.1		
TUCANNON R.@CURL	47	101,408	17,791	4/21-30	L.FERRY			AD	5.7		
TUCANNON R.@CURL	47	20,272	3,556	4/22-30	L.FERRY	63/38/45	RA-IY-2	AD-LV	5.7	0.35	4.3
TUCANNON R.@CURL	47	20,357	3,571	4/22-30	L.FERRY	63/39/03	RA-IY-3	AD-LV	5.7	0.12	4.9
TUCANNON R.@CURL	47	20,194	3,543	4/22-30	L.FERRY	63/38/44	RA-IY-1	AD-LV	5.7	0.11	1.3
G.RONDE @ C.WOOD	25	20,099	3,722	4/20-30	WALLOWA	63/38/40	RA-IC-1	AD-LV	5.4	0.56	5.4
G.RONDE @ C.WOOD	25	20,083	3,719	4/20-30	WALLOWA	63/38/41	RA-IC-2	AD-LV	5.4	1.00	5.2
G.RONDE @ C.WOOD	25	20,115	3,725	4/20-30	WALLOWA	63/38/42	RA-IC-3	AD-LV	5.4	0.58	1.0
G.RONDE @ C.WOOD	25	20,164	3,734	4/20-30	WALLOWA	63/38/43	RA-IC-4	AD-LV	5.4	0.23	7.7
G.RONDE @ C.WOOD	25	120,384	22,286	4/20-30	WALLOWA			AD	5.4		
G.RONDE IN ORE.	41	25,340	4,500	04/28	WALLOWA			AD	5.6		
G.RONDE IN ORE.	41	27,160	4,656	04/29	WALLOWA			AD	5.8		
"totals"		922,687	168,715				Mean fish/pound =		5.5	0.5	3.7
								SD =	0.3	0.3	2.0
1988											
SNAKE R.@ LFH	58	25,025	5,324	4/28	L.FERRY	63/50/19	LA-S-1	AD-LV	4.7	0.91	1.40
SNAKE R.@ LFH	58	25,317	5,387	4/28	L.FERRY	63/50/18	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		

Table 3. (con't)

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
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	25	208,262	43,387	4/15	WALLOWA			AD	4.8		
GRANDE RONDE	22	12,414	2,035	4/29	WALLOWA			AD	6.1		
TOUCHET R.@DAYT	53	19,992	4,209	4/15-	L.FERRY	63/50/28	LA-IV-3	AD-LV	4.7	0.20	2.00
TOUCHET R.@DAYT	53	18,871	3,973		L.FERRY	63/50/31	LA-IV-1	AD-LV	4.7	0.61	0.51
TOUCHET R.@DAYT	53	19,681	4,143	TO	L.FERRY	63/49/49	RA-IV-3	AD-LV	4.7	0.57	1.14
TOUCHET R.@DAYT	53	20,001	4,211		L.FERRY	63/49/47	RA-IV-1	AD-LV	4.7	0.09	0.78
TOUCHET R.@DAYT	53	92,179	19,406	-4/30	L.FERRY			AD	4.7		
TUCANNON R.@CURL	48	20,121	3,530	4/25 -	L.FERRY	63/49/44	LA-H-1	AD-LV	5.7	0.60	0.80
TUCANNON R.@CURL	48	20,110	3,528	TO	L.FERRY	63/49/42	RA-H-2	AD-LV	5.7	0.53	2.66
TUCANNON R.@CURL	48	20,115	3,529		L.FERRY	63/49/41	RA-H-1	AD-LV	5.7	0.77	2.79
TUCANNON R.@CURL	48	100,947	17,710	-4/30	L.FERRY			AD	5.7		
G.RONDE IN ORE.	41	50,640	8,440	4/28	WALLOWA			AD	6.0		
'totals'		970,341	186,862				Mean fish/pound =		5.2	0.53	1.43
								SD =	0.5	0.2	0.7
1989											
SNAKE R.@ LFH	58	51,152	10,234	4/30	L.FERRY	63/55/08	RA-IJ-1	AD-LV	5.0	3.60	6.80
SNAKE R.@ LFH	58	47,352	10,315	4/30	L.FERRY	63/01/32	RA-IJ-3	AD-LV	4.6	0.90	9.10
WALLA WALLA R.	24	18,300	3,050	4/21	WALLOWA			AD	6.0		
WALLA WALLA R.	22	21,600	4,500	4/19	L.FERRY			AD	4.8		
WALLA WALLA R.	24	21,600	4,500	4/20	L.FERRY			AD	4.8		
WALLA WALLA R.	27	21,600	4,500	4/20	L.FERRY			AD	4.8		
WALLA WALLA R.	25	21,360	4,450	4/20	L.FERRY			AD	4.8		
WALLA WALLA R.	25	1,680	350	4/21	L.FERRY			AD	4.8		
MILL CREEK	3	21,600	4,500	4/19	L.FERRY			AD	4.8		
ASOTIN CREEK	0.8	29,975	5,450	4/27	WALLOWA			AD	5.5		
GRANDE RONDE	25	222,050	41,896	4/18-27	WALLOWA			AD	5.3		
G.RONDE IN ORE.	41	50,410	9,700	4-25/26	WALLOWA			AD	5.2		
TOUCHET R.@DAYT	53	20,465	2,766	4/18	L.FERRY	63/02/50	LA-IT-3	AD-LV	4.8	0.70	2.30
TOUCHET R.@DAYT	53	20,224	2,889		L.FERRY	63/02/49	RA-IT-3	AD-LV	4.8	0.30	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	20,585	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	48	20,261	4,604	4/15	L.FERRY	63/50/35	LA-IJ-1	AD-LV	4.4	0.80	5.40

Table 3. (con't)

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
TUCANNON R.@CURL	48	20,502	4,604		L.FERRY	63/50/49	LA-IJ-4	AD-LV	4.4	0.70	5.30
TUCANNON R.@CURL	48	20,178	4,586	TO	L.FERRY	63/50/50	LA-IJ-3	AD-LV	4.4	1.30	5.80
TUCANNON R.@CURL	48	99,190	22,543	5/08	L.FERRY			AD	4.4		
"totals"		847,279	167,248					Mean =	4.9	1.13	5.11
								SD	0.38	0.83	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	25	179,250	35,066	4/15-	WALLOWA			AD	5.0		
GRANDE RONDE	25	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	6,600	2,000	23	WEL/SKA			AD	3.3		
TUCANNON R.@CURL	48	20,012	4,002	4/15	PAHSIM	63/39/12	LA-IC-1	AD-LV	5.0	1.7	3.3
TUCANNON R.@CURL	48	20,065	4,013	to	PAHSIM	63-39-11	RA-IC-1	AD-LV	5.0	0.7	2.9
TUCANNON R.@CURL	48	39,175	7,835	4/30	PAHSIM			AD	5.0		
TUCANON @MARENGO	25	19,992	3,570	25	PAHSIM	63/08/38	RA-IC-2	AD-LV	5.6	0.4	5.7
TUCANON @MARENGO	25	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

Fish Marking

Tag loss increased slightly in 1990 over that experienced in 1989 but not significantly. Brand loss declined this year with only 4.24% (SD=1.23) unreadable brands, however overall brand quality was hampered by readable but light brands. 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

Three stocks of steelhead were released in 1990. The loss of all LFH origin fish to IHN necessitated the use of Wells/ Skamania origin fish from the Columbia River and Pahsimeroi River fish obtained from Idaho. We again received Wallowa stock fish from Oregon for use in the Grande Ronde River. Samples were taken from various raceways and conditioning ponds during the release period and are summarized in Table 4.

Table 4. Smolt characteristics at Lyons Ferry Hatchery, 1990.

Lake/ Raceway	Stock[A]	Number fish sampled	No. of sample days	Mean length mm (SD)	Mean weight gms (SD)	No. fish /lb.	K factor	% Precocious males
Cotton-wood C.P.	WA	477	3	213.8 (28.5)	89.0 (33.8)	5.1	1.1	---
Dayton C.P.	WE/SK	481	3	213.3 (40.2)	139.1 (57.1)	3.4	1.3	2.7
Curl Lk.	PAH	660	4	190.2 (23.2)	75.4 (26.6)	6.0	1.1	0.2
RW-13	PAH	207	1	196.6 (17.2)	77.1 (20.0)	6.0	1.0	---
RW-14,15	PAH	210	1	199.2 (19.6)	86.6 (24.5)	5.2	1.1	2.4
RW-16,17	PAH	210	1	201.0 (17.9)	86.2 (23.6)	5.3	1.04	---
Lake 1	PAH	719	4	211.9 (24.1)	93.2 (27.6)	5.0	0.95	---
Lake 2	WE/SK	347	3	240.0 (31.1)	142.6 (46.4)	3.2	0.99	3.5

A. WA = Wallowa stock, WE/SK = Wells/Skamania stock, PAH = Pahsimeroi stock.

Fish size at release ranged from 3.4 - 5.7 fish/lb and the average size for the entire release of smolts was 4.5 fish/lb (Std.Dev.=0.87). Total steelhead production was 818,352 fish totaling 181,985 pounds. Table 3 summarizes the smolt releases into Southeast Washington rivers for 1987-1990.

Precocious males usually made up only a small portion of the fish sampled (Table 4). Transitionally developed fish, those not fully developed as a smolt based on physical appearance, comprised an average 26.7% (SD= 3.9%) of conditioning pond fish sampled at release, a decrease in the number of transitional fish from 1989. Fish coming directly from the raceways at LFH had a much higher percentage of transitionally developed fish, 52.8% (SD= 7.2%), than found in fish acclimated in the conditioning ponds. Fish sampled from the rearing ponds at LFH and to be released directly into streams had a similar percentage of smolts (70.4%), transitionals (25.8%) and parr (2.6%) as fish sampled from conditioning ponds. Figures 2-9 depict the range and coefficient of variation of samples of fish lengths and weights taken from raceways and conditioning ponds in 1990.

The results from smoltification samples in 1990 showed similar physiological responses to those seen in 1989. ATPase in Curl lake fish was higher than fish at LFH just prior to release (Fig. 10). Direct stream release fish had similar levels of ATPase as those released directly from LFH. Fish sampled from raceways had lower levels than in pond reared fish or fish released from the conditioning ponds. Blood Thyroxin (T_4) levels fluctuated in all sampled groups but measured higher in Curl Lake fish and in fish released at Asotin Creek. Guanine values in Fig.11 show similar results as seen in other sample types.

Condition factor declined steadily in most samples just prior to release and continued to decline until recapture at McNary Dam (Fig. 12). Condition factor increased in residual smolts in the Tucannon River and was substantially higher than smolts sampled at McNary dam on the same day. Average length of smolts captured at McNary Dam (Fig. 13) was greater than for residual smolts captured in river. This is consistent with data collected in 1989. Average weight (Fig. 13) is lower for smolts captured at the dams than for residuals which is due to slendering that occurs during migration.

Discussion

Fish growth and performance was excellent considering the variety of stocks and sizes of fish that comprised the production this year. Smoltification at time of release was generally good for most fish. The very large size of fish released from Dayton pond and the high K-factor may have affected their emigration success. Differences that occur in fish sizes between hatchery samples and our sampling is likely due to the prolonged sampling

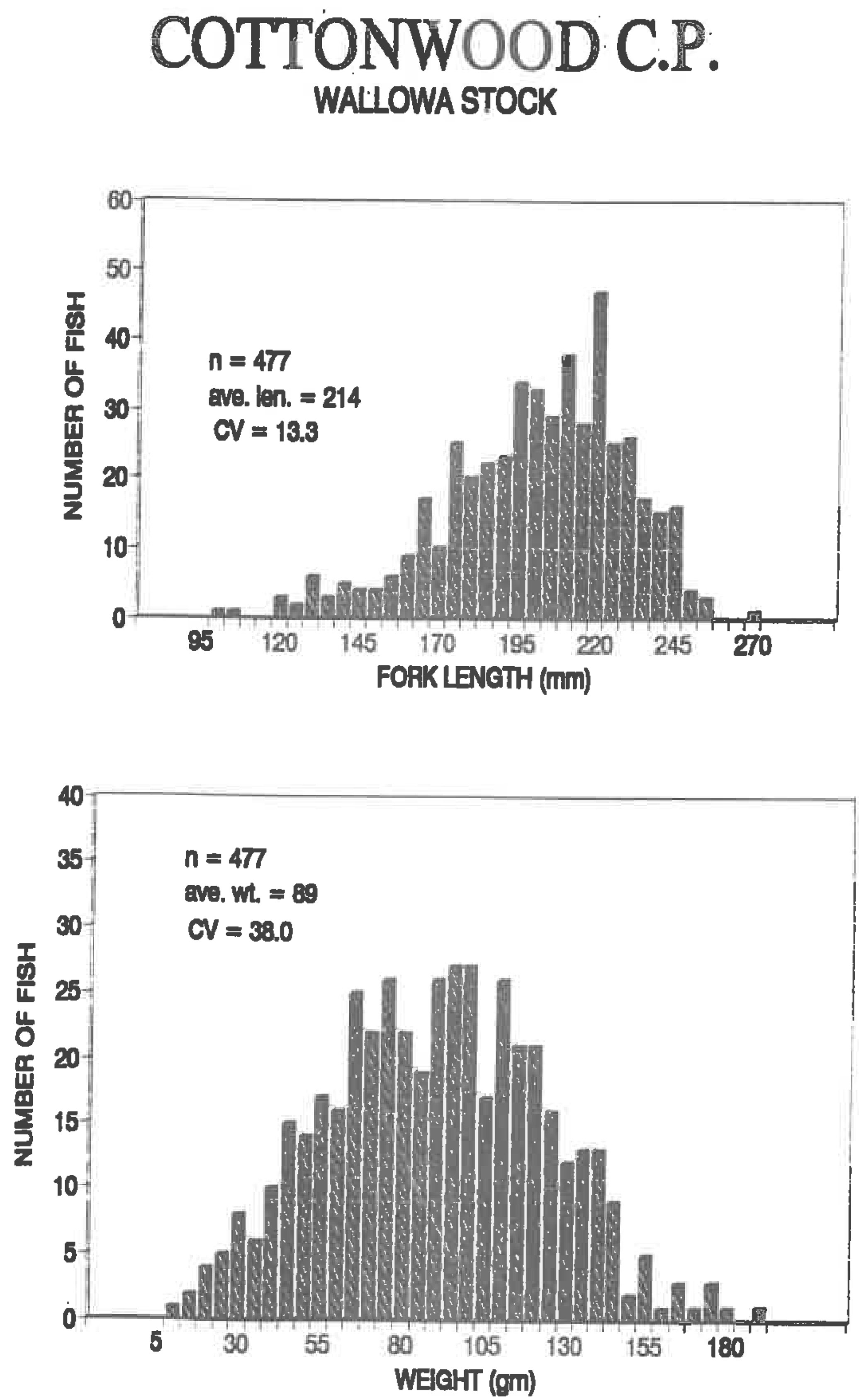


Figure 2. Length (top) and weight (bottom) histograms for steelhead released at Cottonwood Conditioning Pond, 1990.

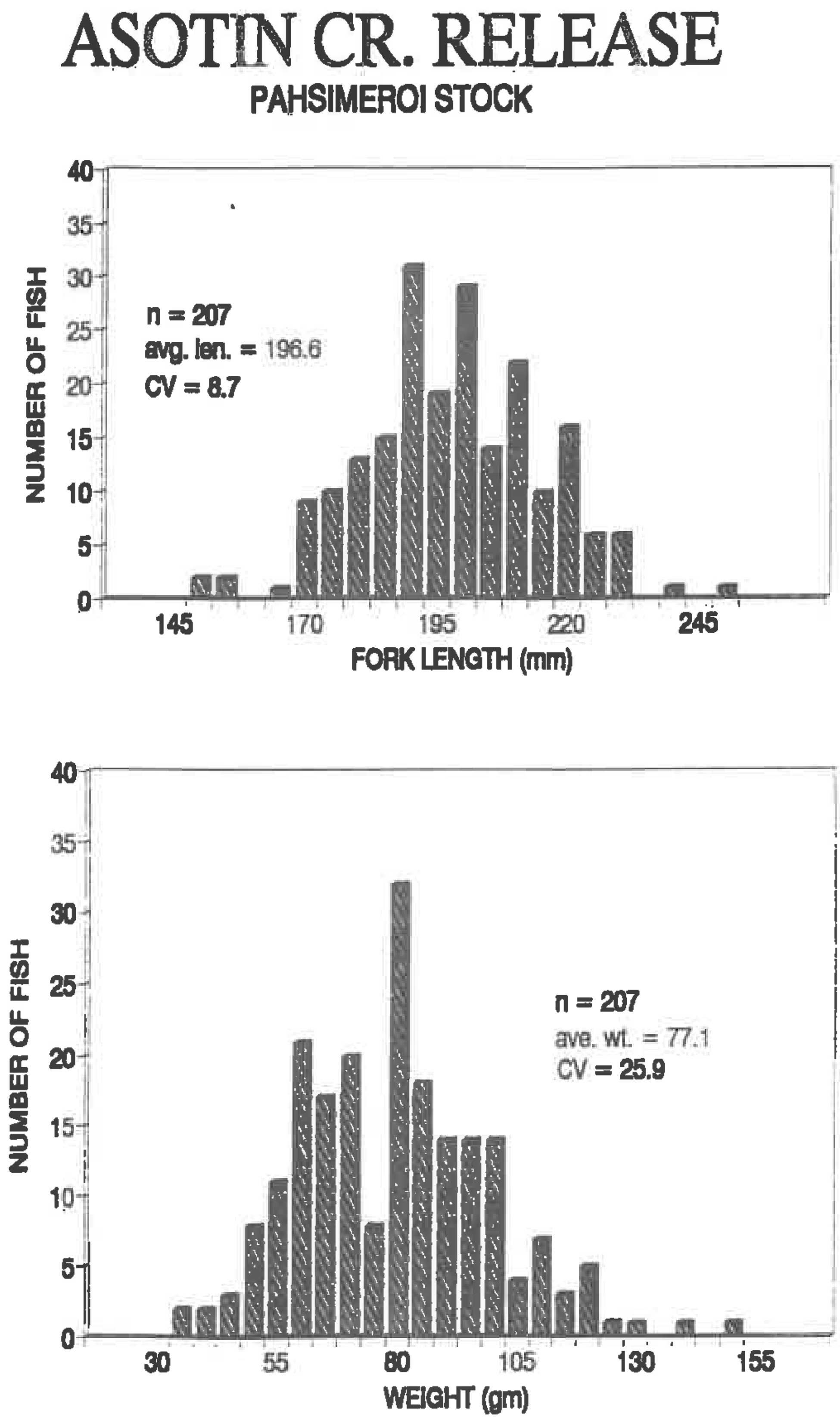
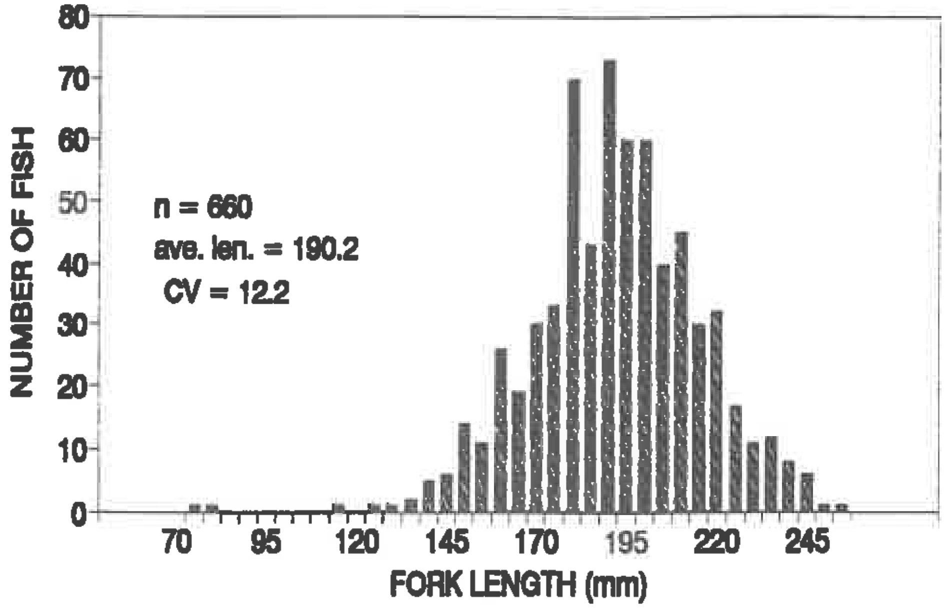


Figure 3. Length (top) and weight (bottom) histograms for steelhead released at the mouth of Asotin Cr., 1990.

CURL LAKE
PAHSIMEROI STOCK



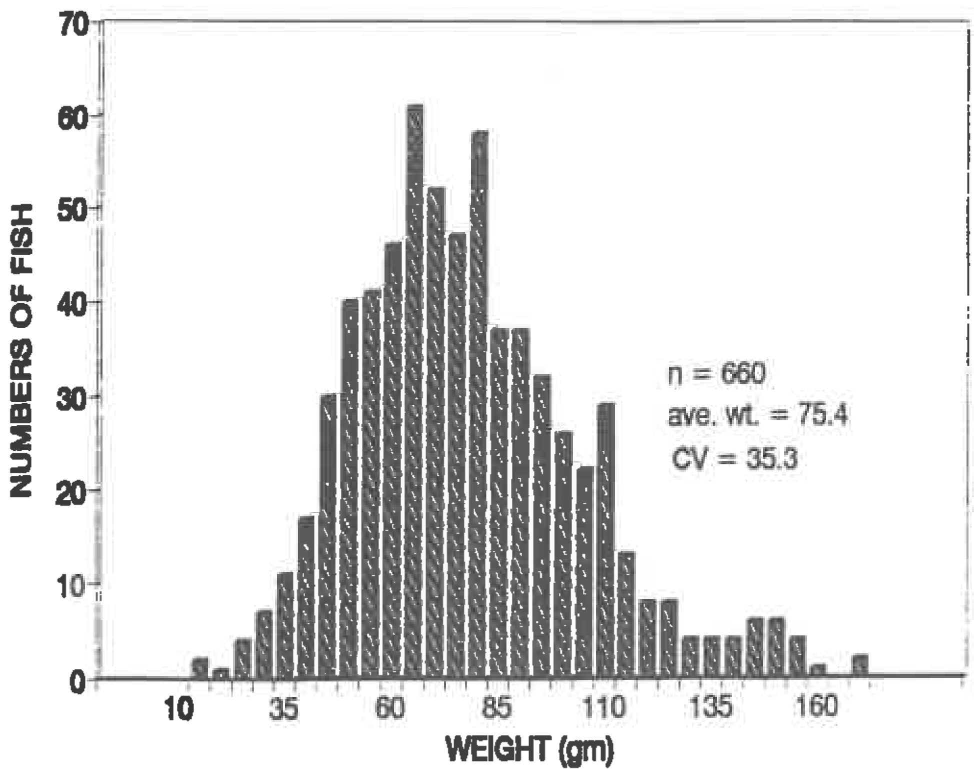


Figure 4. Length (top) and weight (bottom) histograms for steelhead released from Curl Lk. on the Tucannon River, 1990.

TUC. R. REL. AT MARENGO

PAHSIMEROI STOCK

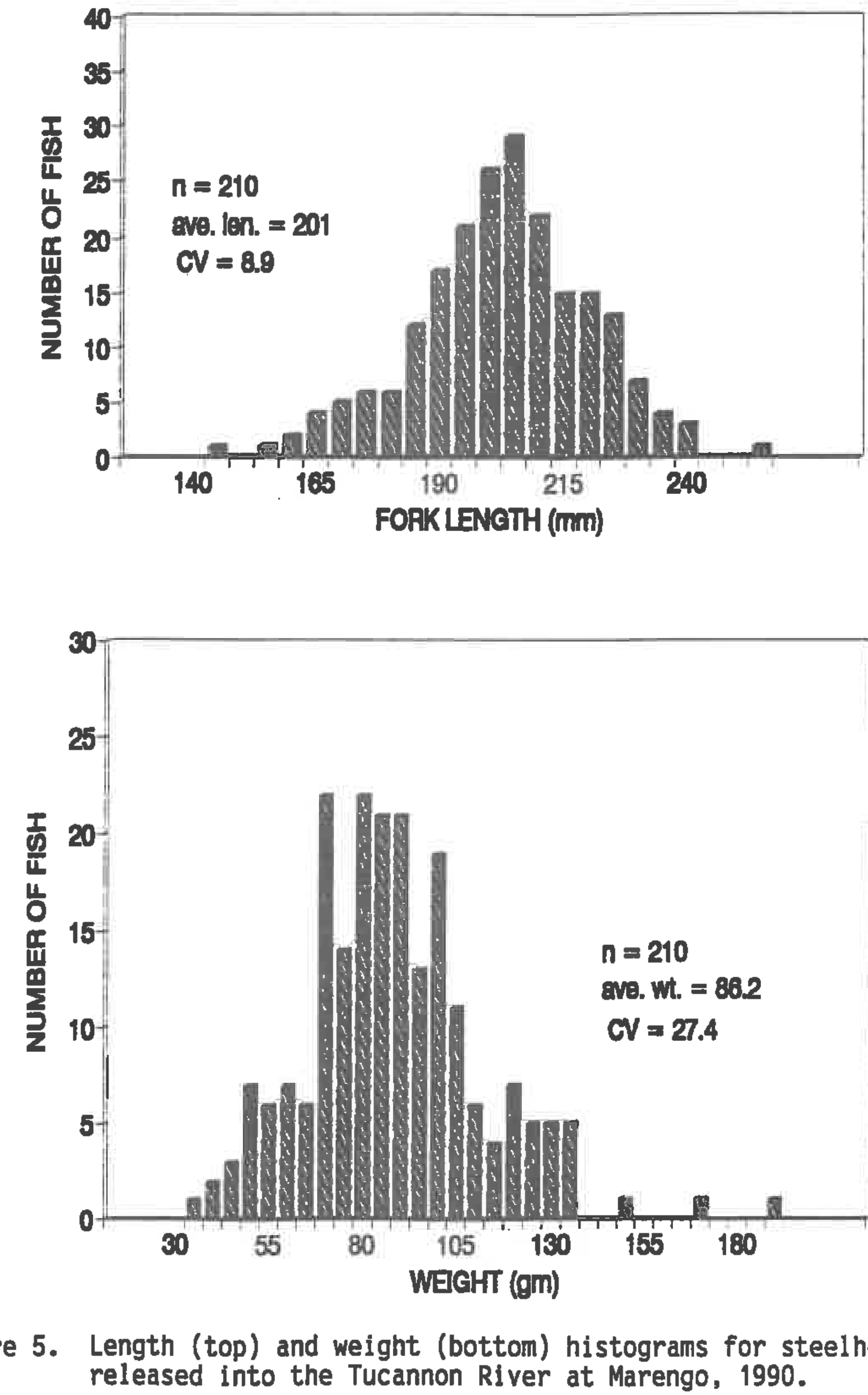


Figure 5. Length (top) and weight (bottom) histograms for steelhead released into the Tucannon River at Marengo, 1990.

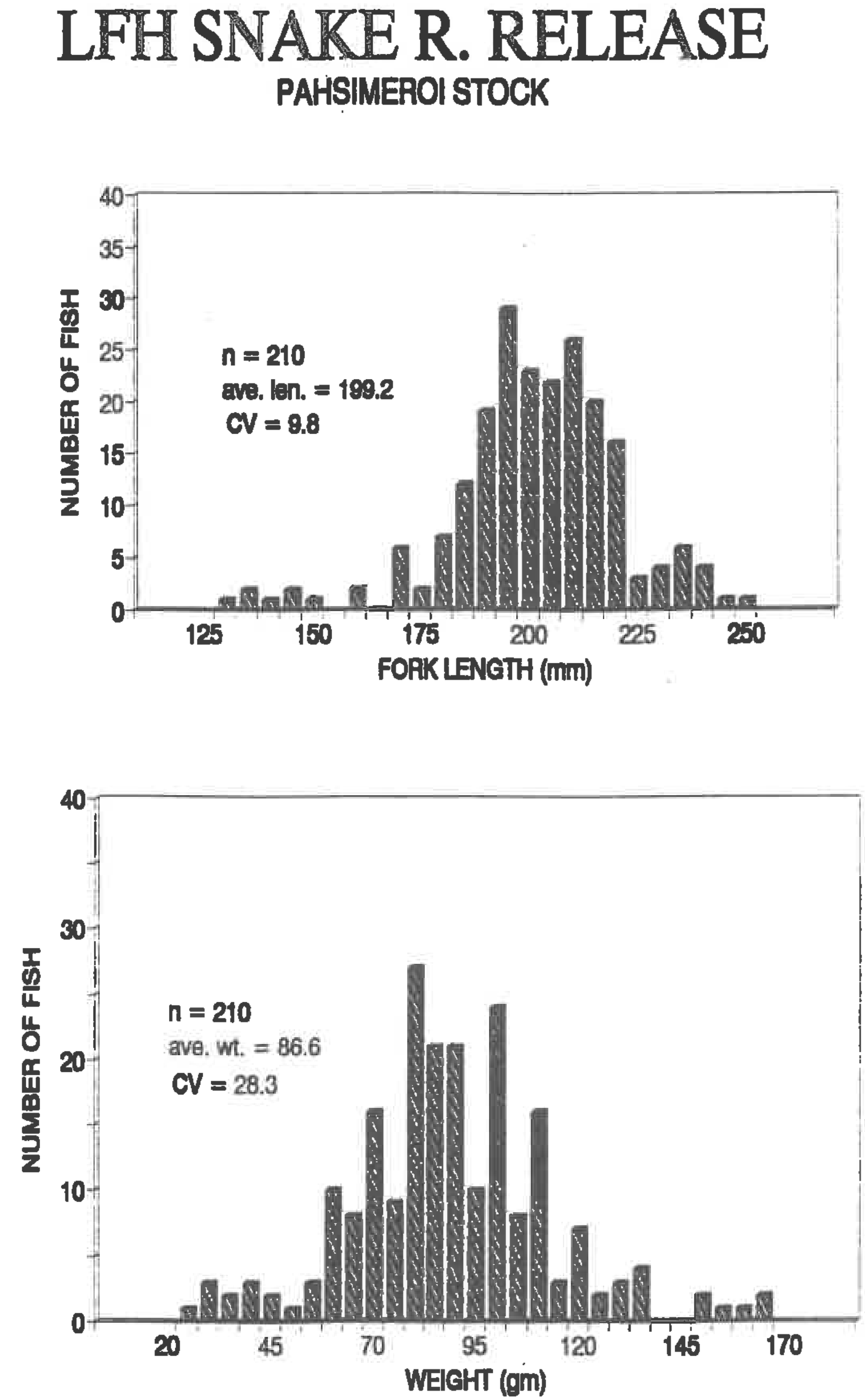
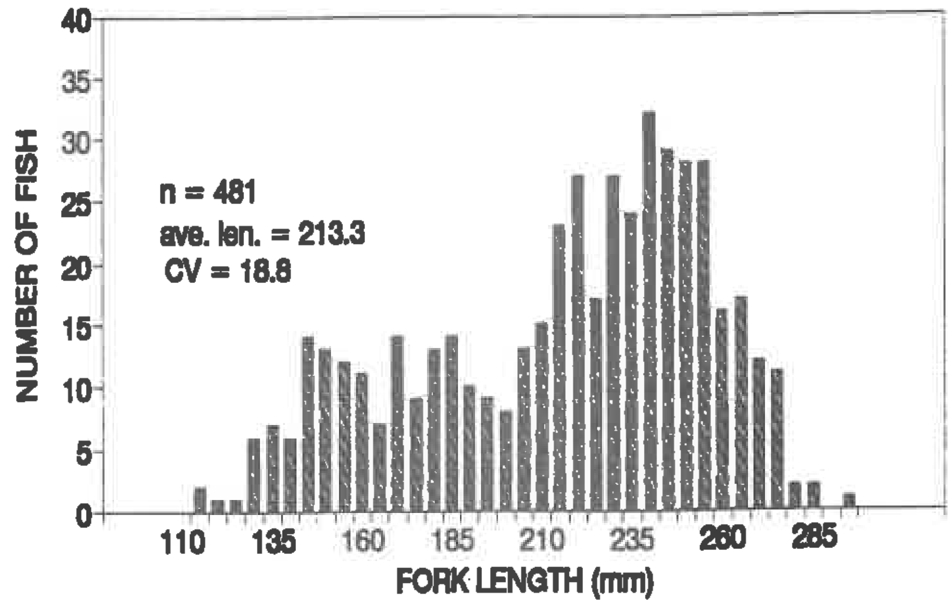


Figure 6. Length (top) and weight (bottom) histograms for steelhead released into the Snake River at LFH, 1990.

DAYTON C.P.
WELLS/SKAMANIA STOCK



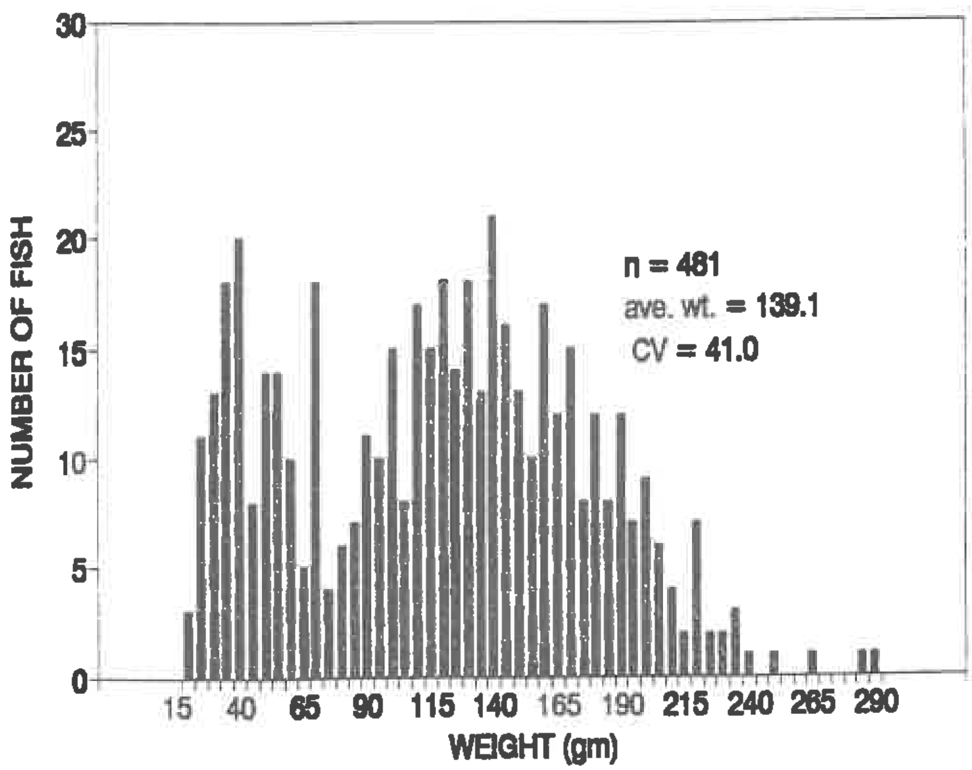
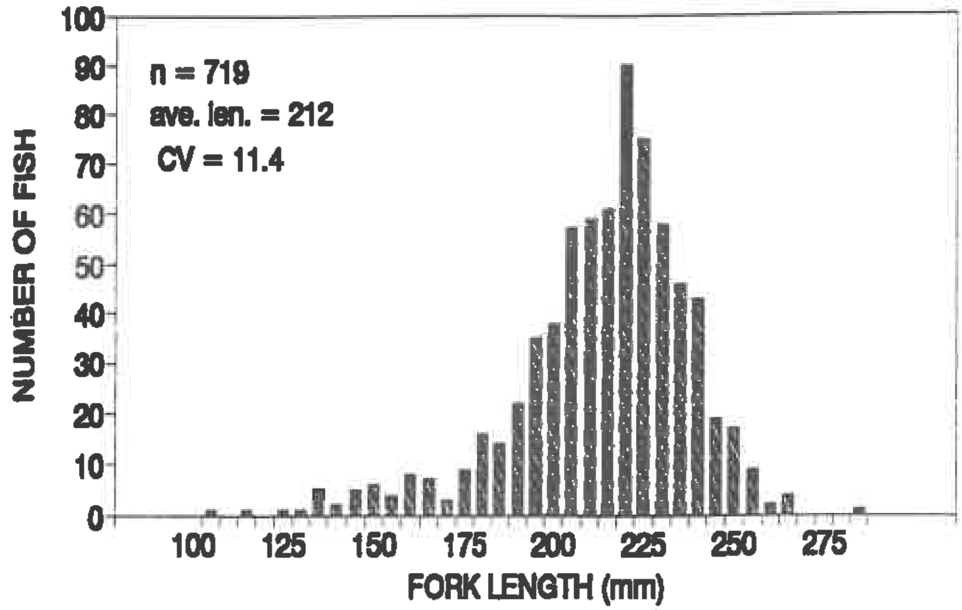


Figure 7. Length (top) and weight (bottom) histograms for steelhead released from Dayton C.P. into the Touchet River, 1990.

LAKE 1

PAHSIMEROI STOCK



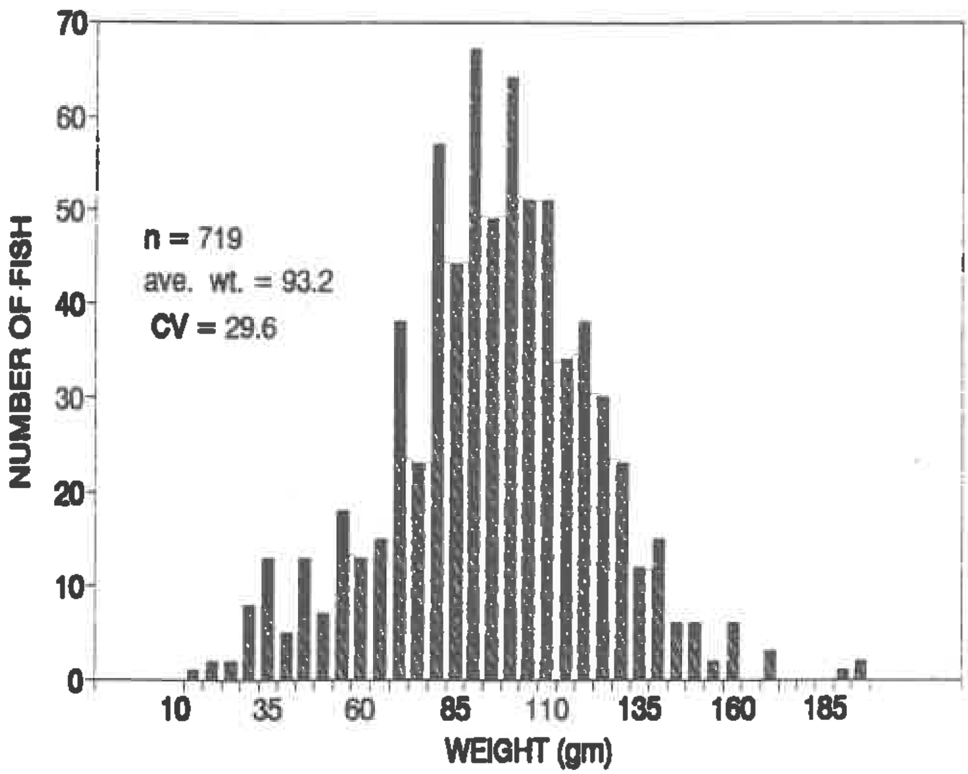
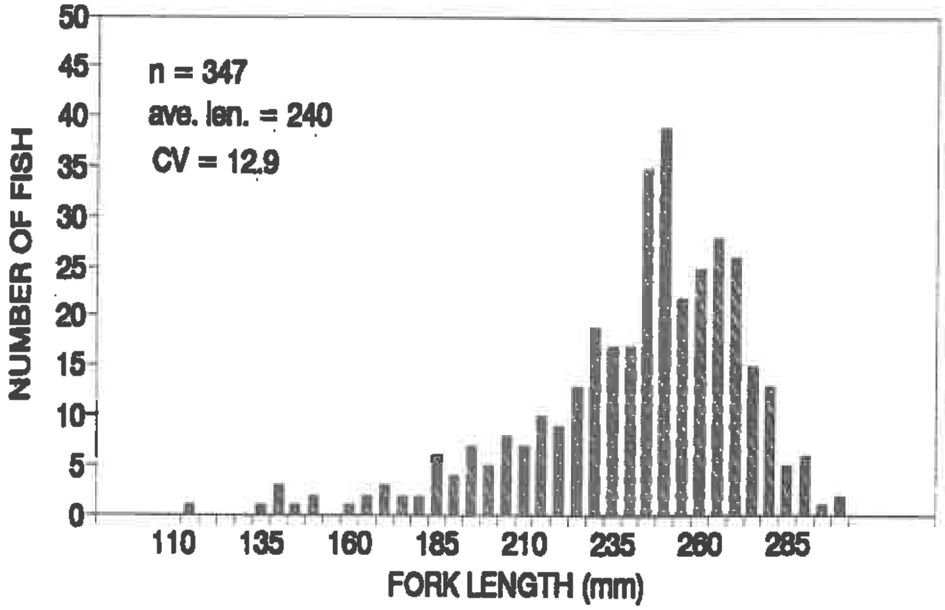


Figure 8. Length (top) and weight (bottom) histograms for steelhead released at various locations in SE Washington, 1990

LAKE 2

WELLS/SKAMANIA STOCK



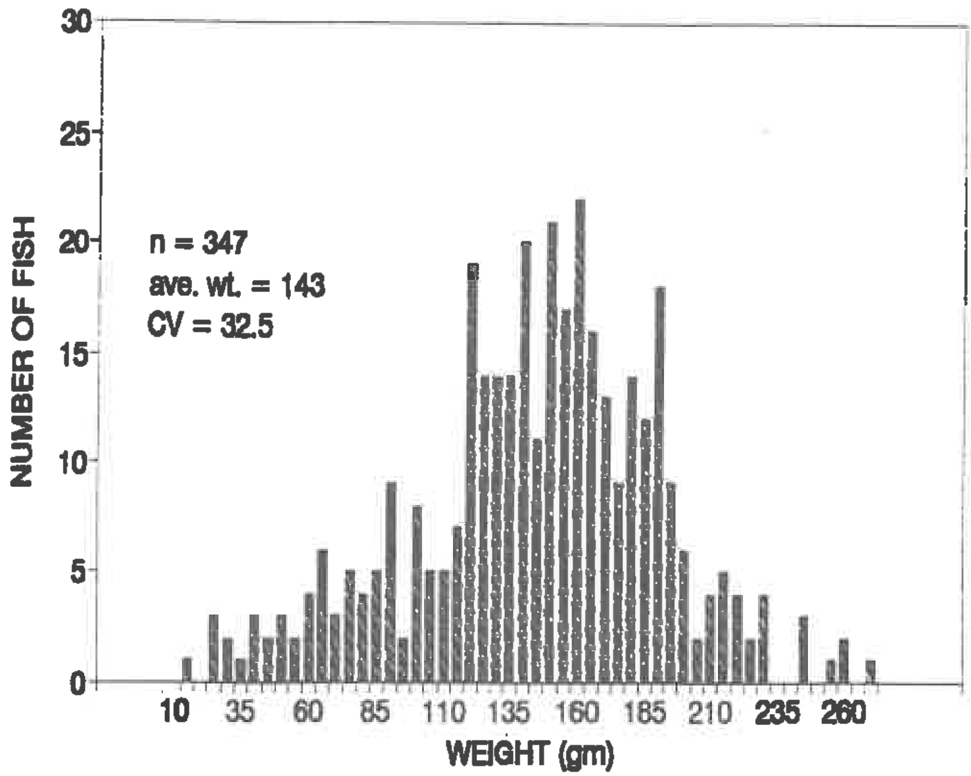


Figure 9. Length (top) and weight (bottom) histograms for steelhead released at various locations in SE Washington, 1990.

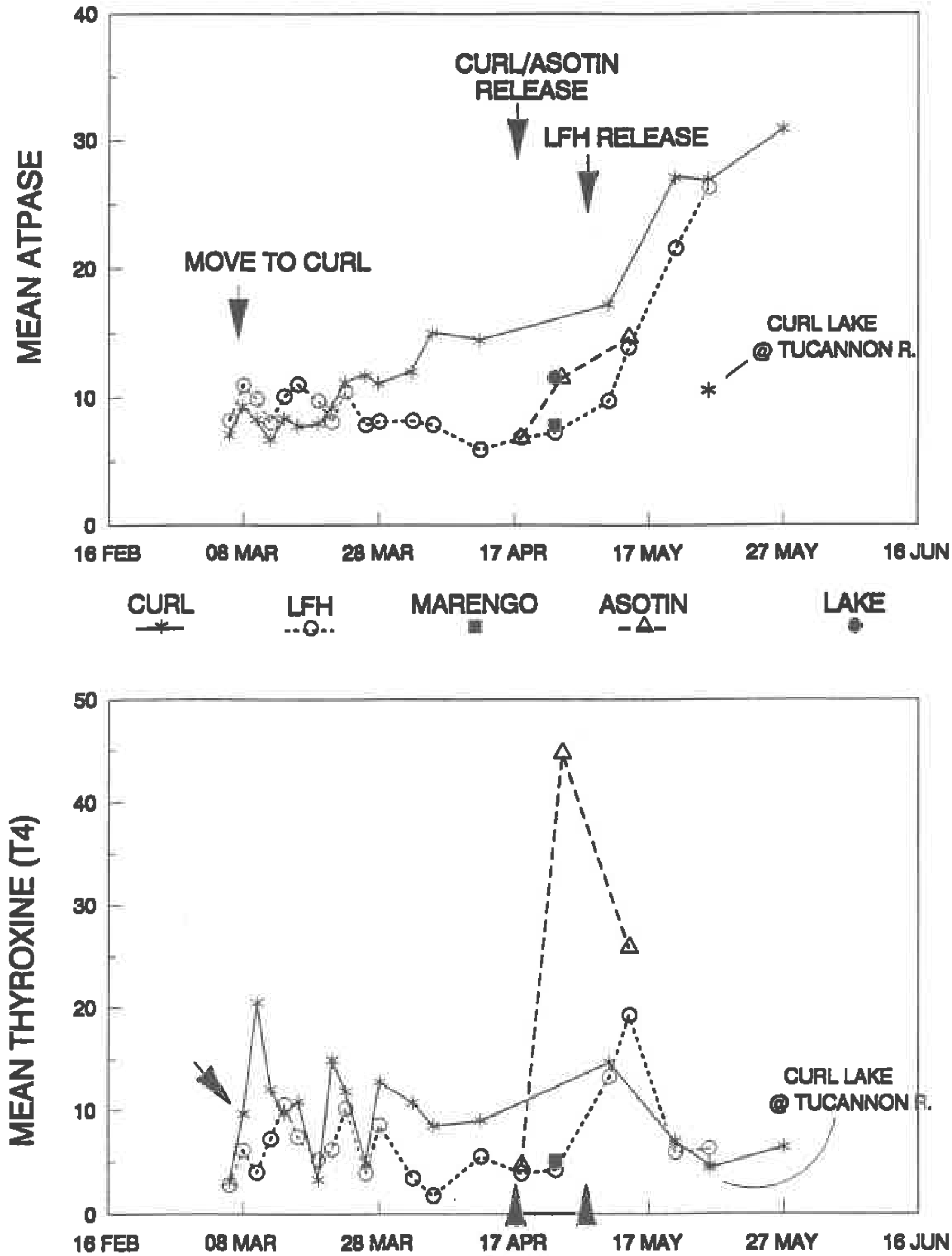


Figure 10. Mean ATPase (top) and mean thyroxin (bottom) levels from sampled juvenile steelhead.

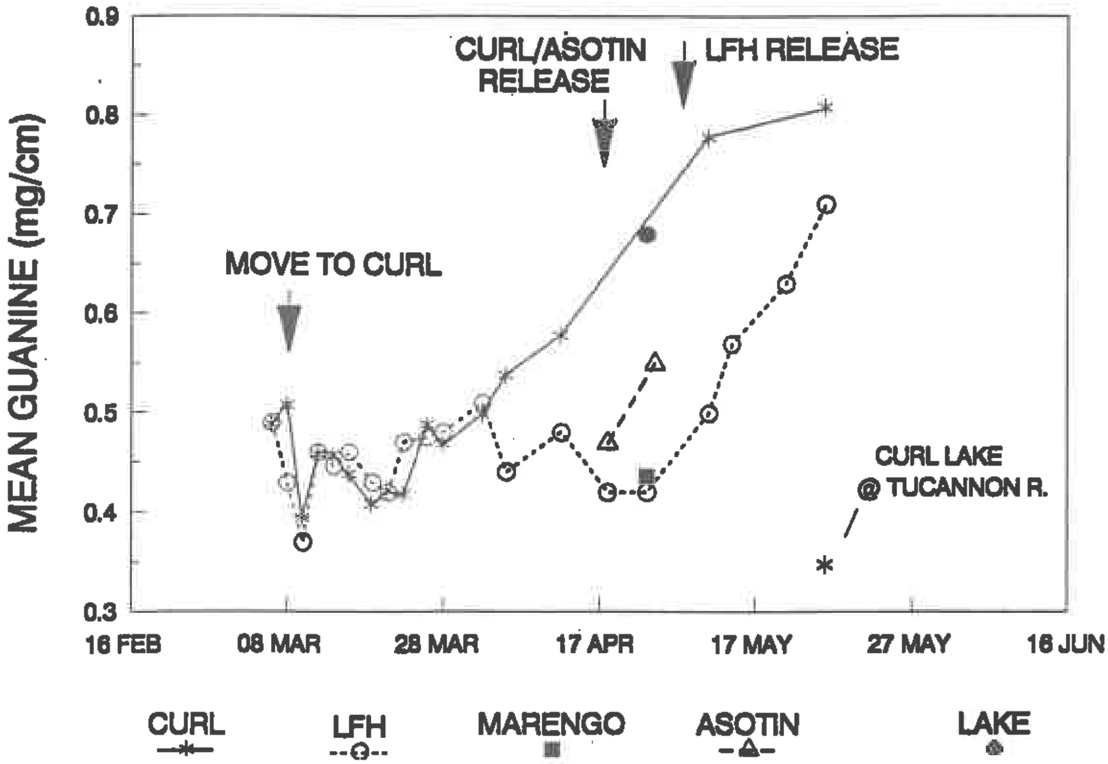


Figure 11. Mean Guanine levels found in sampled juvenile steelhead.

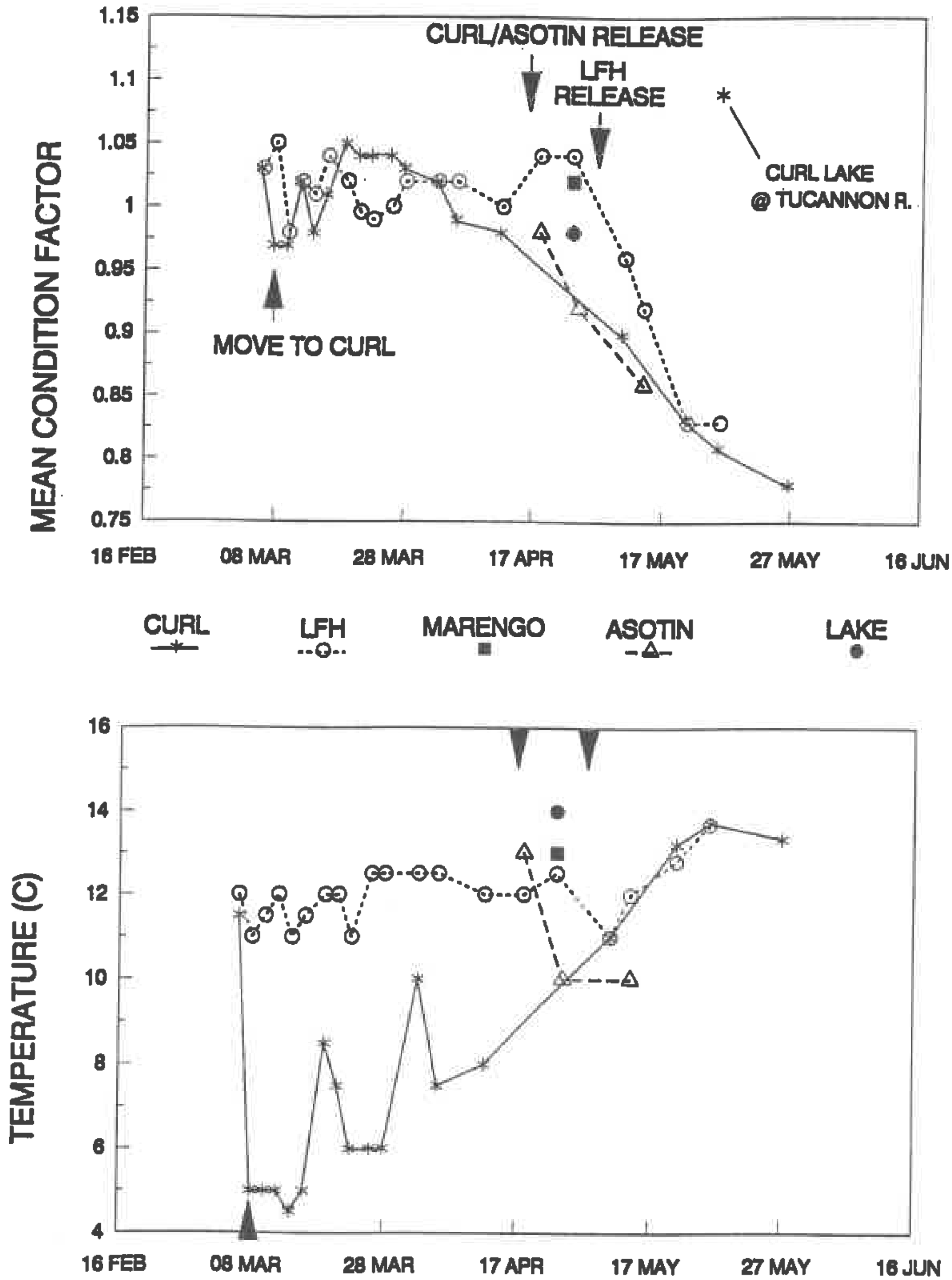


Figure 12. Mean condition factor of juvenile steelhead sampled (top) and water temperature (bottom).

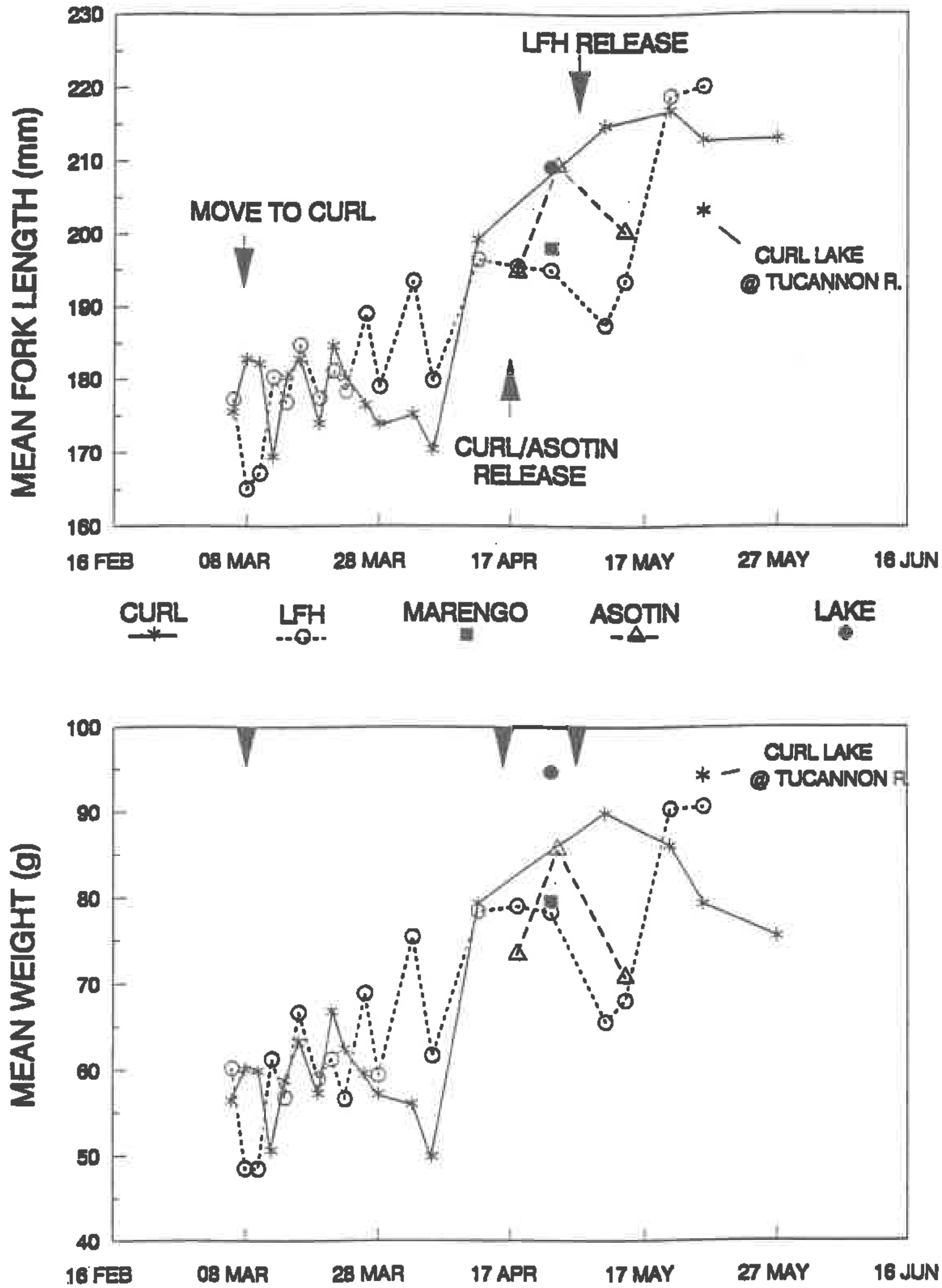


Figure 13. Mean fork length (top) and weight (bottom) from sampled juvenile steelhead.

period. Our first pre-release samples may be taken fully 3 weeks prior to final emigration. This amount of time is sufficient for growth to occur and differences in release sizes to be measurable. We will attempt to shorten our sample time in the future to help control this variability in sample results.

The tagging program went smoothly this year. Brand quality is still a problem. A lack of consistency in quality is probably 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 1990. Constant observation and correction of improper technique is essential for consistent brand quality, even when using experienced branding personnel.

Results from this years' physiology samples indicate that juvenile steelhead moved from LFH and held in conditioning ponds prior to release were more smolted 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 slightly 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 only 2.2% of the fish released. However we are unsure if the small sample size for smoltification tests is unable to identify a portion of the population which is contrary to the norm or average. Variation in the samples can be high with a coefficient of vairation (CV) ranging from 25-40% (John Beeman, pers. comm.)

We believe smoltification tests to be valuable in answering questions about our release strategies. However, results from the physiology samples leave several questions unanswered; 1) If our smolts are experiencing the desired physical changes that are normally associated with imprinting, why are so many of these fish migrating past their rivers of release as returning adults to the upper Snake River? 2) Does the larger size of fish collected at McNary Dam indicate that we should be releasing larger smolts from our facilities to improve emigration? 3) are sample sizes used in 1988 and 1989 sufficient to characterize the releases and could potential residual fish be identified prior to release with larger sample sizes?

Unfortunately, we do not yet fully understand the importance each factor plays in determining smolt behavior. Neither do we understand whether environmental factors, such as drought and summer water temperatures in the Snake and Columbia rivers, may also be having an impact on fish behavior. We will continue to investigate all these questions in an attempt to fully describe and understand the problem and provide a solution.

Hatchery Smolt Emigration

Releases

All smolt plants for 1987-90 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. Large numbers of fish were noted exiting Dayton and Cottonwood ponds for the next 3-5 days. Emigration then decreased over the next 7 days. Fish fed actively during this period but feeding was stopped as the pond levels were lowered. All ponds were empty on April 30. Cold weather and resulting cold water temperatures in the Tucannon River again inhibited emigration from Curl Lake.

Migration Through Dams

Table 5 summarizes passage estimates for brand groups released in 1988-1990. Median (50%) passage of the fish from 1990 groups passed the first collector dam between 7-23 days after release (Figs. 14-19), although individuals from various groups continued to pass the dams through June. Average daily travel rates for various brand groups ranged between (6.1-7.0) miles per day to McNary dam and (5.5-6.4) miles per day to Lower Granite Dam (FPC,1991). These travel rates are consistent with groups released in previous years (Schuck et al, 1989).

Discussion

Average fish size for the entire hatchery production increased again in 1990 although individual releases in some cases were of smaller size than in 1989. Size variability increased in 1990 over 1989 due to the variety of stocks and ages of fish used in the program after losses to IHNV (Table 4).

The Tucannon River fish (Figs. 19-20) were again the slowest to leave their river system. Migration appeared to occur only after several days residence within the river itself. The fish acclimated in Curl Lake Pond appear to have performed substantially different than did fish released directly into the Tucannon at Marengo. The differences in Passage Index, 31.9% vs 19.1% for acclimated and direct release respectively, may not be truly representative of actual performance as the direct release suffered from a greater percentage of "light" brands that would bias recovery results. Other 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 the first of May and then again near the first of June correspond to increased flows in the rivers at those times.

Figure 14.

1990 Lower Granite Passage Distribution

Lyons Ferry Steelhead (Asotin)

LA-IC-4, RA-IC-4

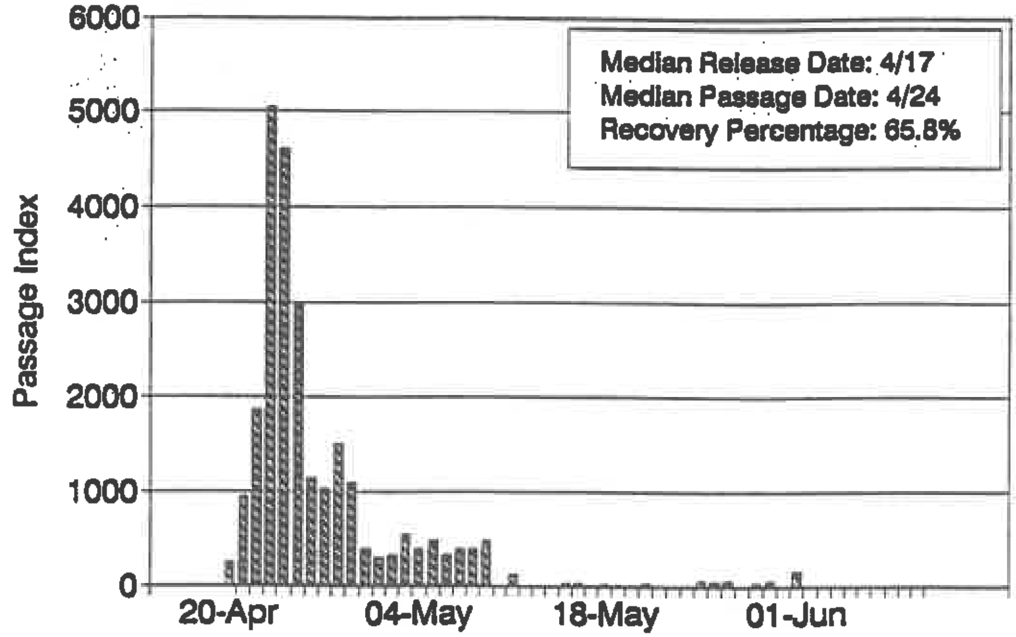


Figure 15.

1990 McNary Passage Distribution

Lyons Ferry Steelhead (on-site)

LA-IC-3, RA-IC-3

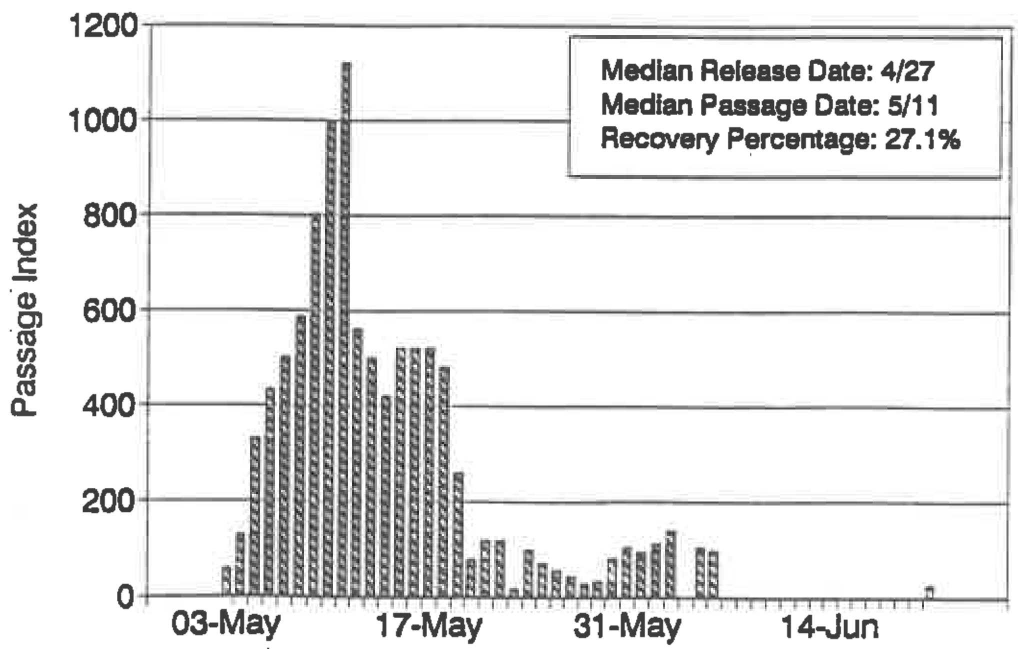


Figure 16.

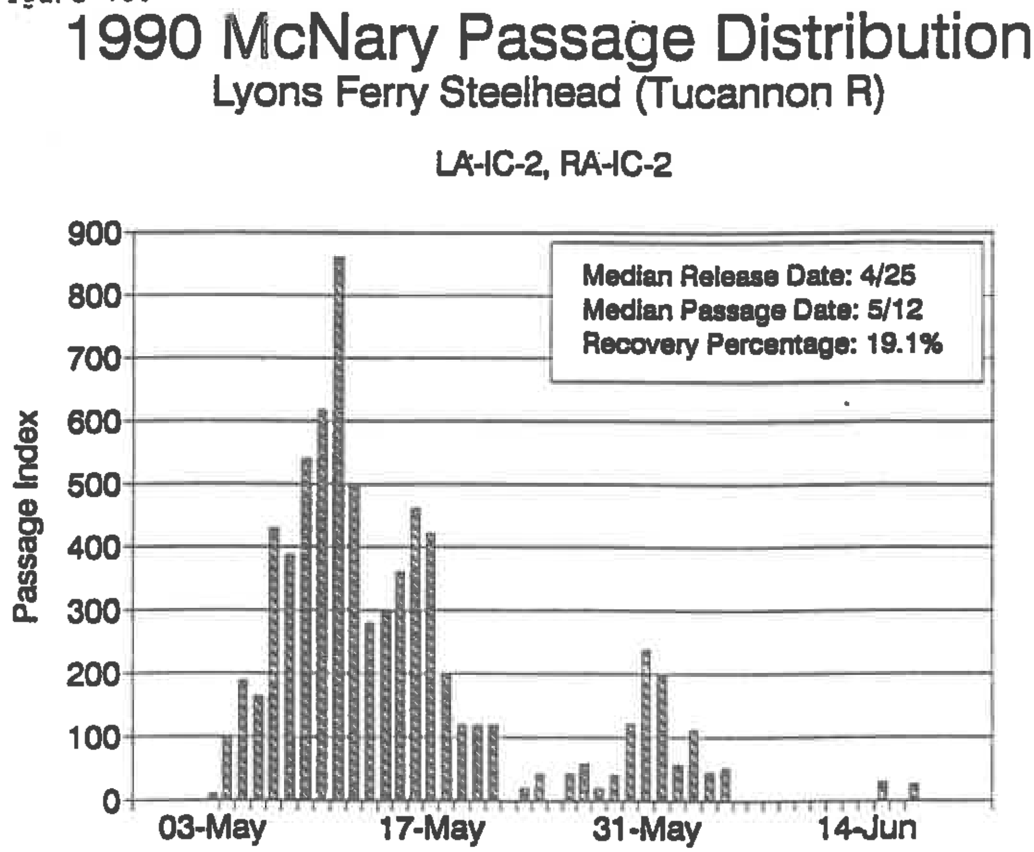


Figure 17.

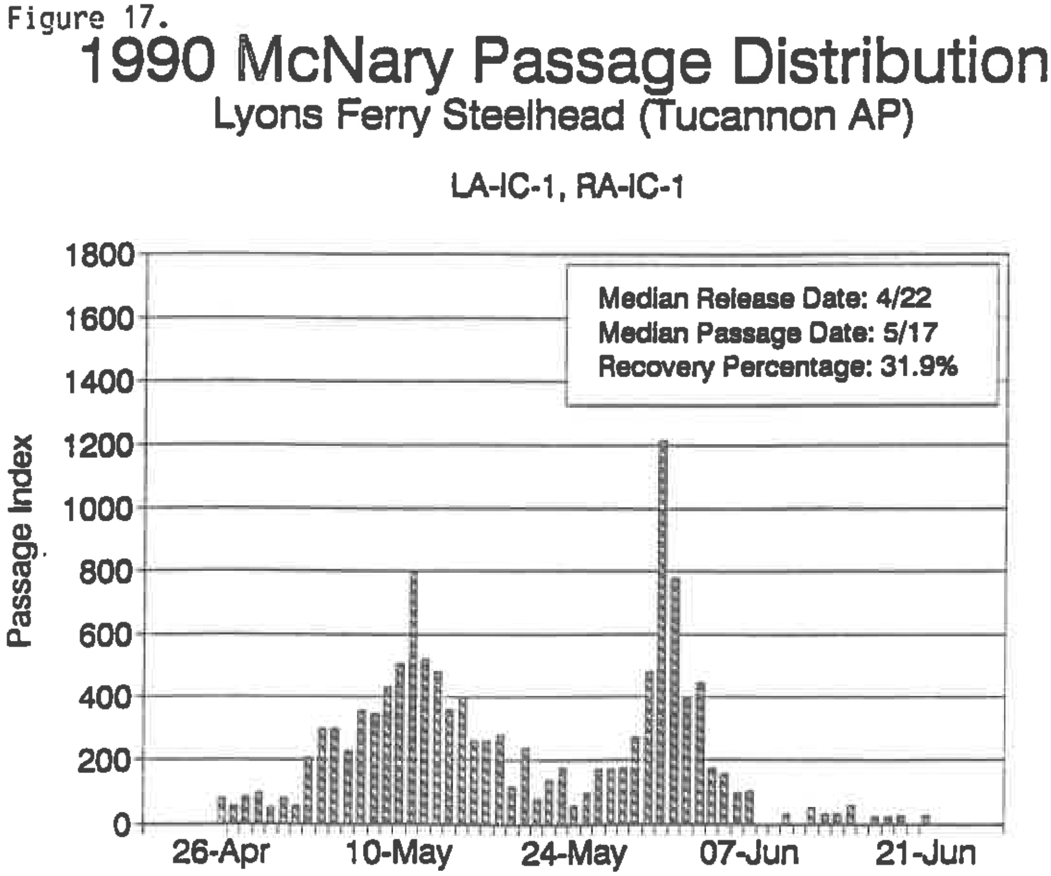


Figure 18.

1990 McNary Passage Distribution

Lyons Ferry Steelhead (Touchet AP)

LA-S-1, RA-S-1

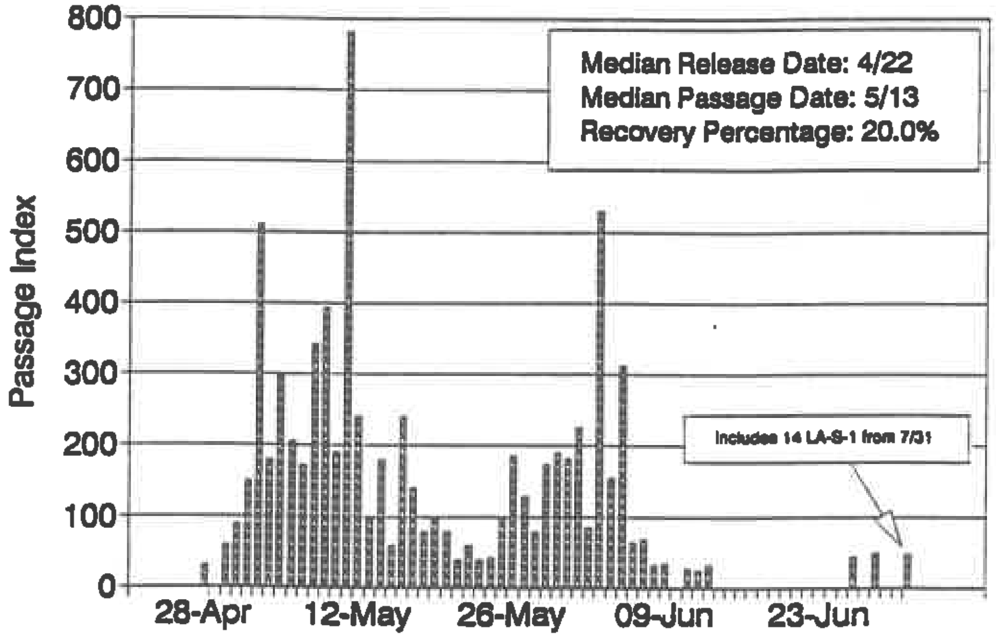


Figure 19.

1990 McNary Passage Distribution

Lyons Ferry Steelhead (Walla Walla)

LA-S-2, RA-S-2

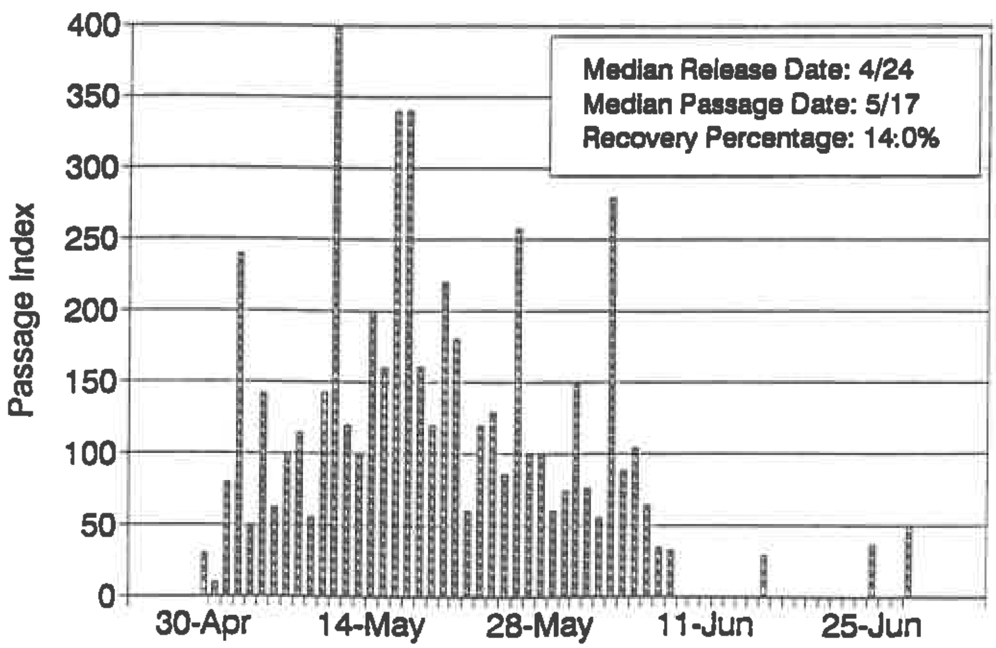


Table 5. Estimated passage of branded Lyons Ferry, Wallowa, Wells/ Skamania and Pahsimeroi stock steelhead at Lower Granite and McNary Dam, 1987-89. (FPC 1988-89-90).

Brand[A]	Release site	Passage index	Number released	% of release	Size (#/lb)	Stock[B]
McNary						
1988						
LA,RA-H	Tucannon	12,134	59,290	20.5	5.7	LFH
LA,RA-S	LFH	29,807	99,449	29.9	4.7	LFH
LA,RA-IV-1,3	Touchet	21,547	77,669	27.7	4.7	LFH
1989						
RA-IJ-I	LFH	15,529	51,152	30.4	5.0	LFH
RA-IJ-3	LFH	15,072	47,352	31.8	4.6	LFH
LA-IJ-1,3,4	Tucannon	13,961	60,941	22.9	4.4	LFH
LA-IT-1,3	Touchet	13,503	40,909	33.0	4.8	LFH
RA-IT-1,3	Touchet	12,572	40,789	30.8	4.8	LFH
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
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 the poorest performance of LFH released fish of the three years. Tucannon River fish again increased their passage index which seems to follow the small but consistent increases seen in the last two years even though the stock of fish was different this year. Passage index for the Touchet and Walla Walla rivers fish was less than in 1989. We believe the reason for this decrease to be residualism in the very large smolts released from the Dayton C.P. and poor brand recovery at McNary Dam causing an underestimate of actual performance. Our efforts to estimate residualism in the Touchet through a creel survey on the river were unsuccessful.

Adult Steelhead Returns

Passage at Dams

Table 6 lists estimated escapement of Lyons Ferry fish to above Lower Granite Dam (LGD), by release year, for each mark group and the percentage of release that these fish represent. A list of release locations for brand groups is provided in Table 4.

Run timing for the Wallowa stock fish generally follows passage norms at LGD (Figure 9). The first returns of LFH fish to LGD in 1989 occurred in April, a full year before their spawning time.

Characteristics of Returning Adult Steelhead

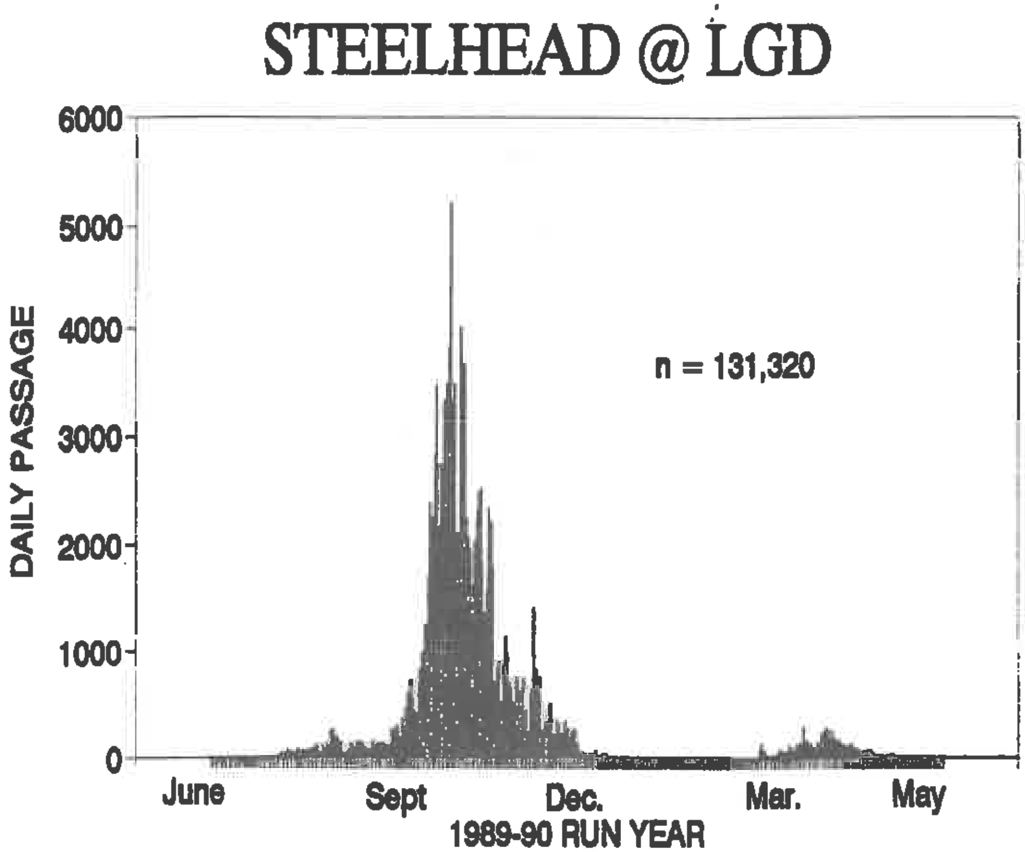
The information from returning adult steelhead was collected at LGD from coded wire tagged/branded adults as they passed through the fish ladder. Smolts released in 1986 returned as 44.6% 1-ocean age, 55.0% 2-ocean age and 0.4% 3-ocean age (Table 6). This release year showed a substantial increase of 2 ocean age fish compared to previous years returning adults. Average size of returning adults by age class for several release years is summarized in Table 7.

Returns to Lyons Ferry Hatchery

A total of 2,458 adult steelhead were trapped at Lyons Ferry Hatchery during the 1989 run. The ladder at the hatchery was operational from August 3 - December 12, 1989. Mortality during the trapping and holding/spawning period was 16.4% (402 fish) and 548 fish were returned to the river to spawn naturally. All fish trapped were inspected for fin clips, sex, whether of wild or hatchery origin and for readable brands. Snouts were also collected from fish that had a ventral fin clip and unreadable brand.

Fish sorted from the trap were comprised of 61.4% females and 38.6% males. Wild fish represented 0.61% (15 fish) of the sample and tagged/branded fish represented 23.5% (578 fish) of the total. We trapped no fish during the sping of 1990.

Branded 2-ocean age Wallowa stock fish returning to Lyons Ferry Hatchery as brood stock were trapped at only a 0.01 % return rate (6 fish) which represents a substantial decrease over the 0.15% return rate (137 Wallowa fish) measured in 1988. Branded 2-ocean age Lyons Ferry stock fish returned to the hatchery at a 0.24% return rate (120 fish). Return of 1-ocean age Lyons Ferry Hatchery stock during the 1989 run year was 0.26% (265 fish), down from the 0.38% return rate (194 fish) seen in 1988. A complete listing of brand and tag recoveries to the hatchery is summarized in Appendix D.



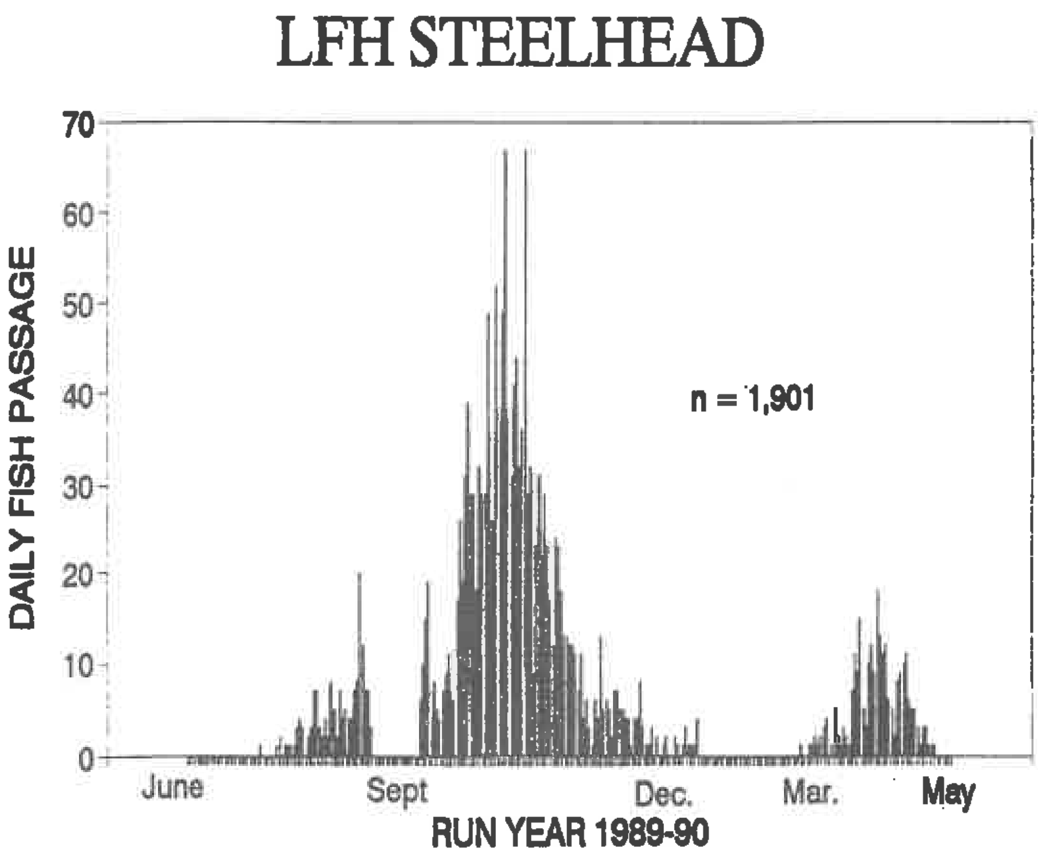


Figure 20. Passage of all Summer Steelhead (top) and LFH origin Summer Steelhead (bottom) at Lower Granite Dam.

Table 6: Adult returns of Lyons Ferry steelhead to above Lower Granite Dam, 1986-89. (Harmon, 1990)[1]

Release year Brand*	Number of adults Return year 1987	 1988	 1989	Total adults captured	No. smolts rel.	% survival[2]
1986						
LA-IJ-1	135	133	0	268	20,136	1.33
LA-IJ-3	131	129	0	260	20,506	1.27
LA-IJ-4	123	116	0	239	20,639	1.16
LA-IK-1	83	128	0	211	20,246	1.04
LA-IK-3	84	86	0	170	20,234	0.84
RA-IK-1	70	87	0	157	20,244	0.78
RA-IK-3	88	95	5	188	20,250	0.93
LA-IT-1	14	45	2	61	20,172	0.30
LA-IT-3	21	41		62	20,177	0.31
RA-IJ-1	121	154	1	276	20,205	1.37
RA-IJ-4	99	143		242	20,038	1.21
RA-IJ-3	122	191	1	314	20,234	1.55
1987						
RA-IF-1		270	198	468	25,308	1.85
RA-IF-3		292	188	480	25,281	1.90
LA-IF-1		193	125	318	25,355	1.25
LA-IF-3		185	150	335	25,348	1.32
RA-IY-1		63	99	162	20,201	0.80
RA-IY-2		63	72	135	20,335	0.66
RA-IY-3		82	84	166	20,172	0.82
RA-IC-1		129	154	283	19,986	1.42
RA-IC-2		141	165	306	19,882	1.54
RA-IC-3		140	151	291	19,998	1.46
RA-IC-4		127	171	298	20,118	1.48
1988						
LA-H-1			99	99	20,000	0.50
RA-H-1			108	108	19,960	0.54
RA-H-2			96	96	20,003	0.48
LA-IV-1			89	89	18,756	0.47
LA-IV-3			98	98	19,952	0.49
RA-IV-1			123	123	19,983	0.62
RA-IV-3			124	124	19,569	0.63
LA-S-1			289	289	24,797	1.17
LA-S-2			285	285	25,190	1.13
RA-S-1			283	283	24,947	1.13
RA-S-2			313	313	25,161	1.24

* 1986: LA-IJ & IK = LFH; RA-IK & LA-IT = Tucannon; RA-IJ = G.Ronde.
1987: RA-IF and LA-IF = LFH; RA-IY = Tucannon R.; RA-IC = G. Ronde.
1988: LA-H, RA-H, LA-IV, RA-IV, LA-S and RA-S = LFH.

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)

Table 7: Average lengths for Lyons Ferry hatchery adult Wallowa and LFH stock steelhead returning to LGD trap, 1989-90.

Release year	Release site	Brand	one ocean n^A	one ocean L (std)	two ocean n	two ocean L (std)
1987	Tucannon R.	RA-IY-1,2,3			255	68.9 (4.6)
	G. Ronde R.	RA-IC-1,2,3,4			637	71.5 (3.7)
	L. Ferry H.	RA-IF-1,3			394	71.1 (4.0)
	L. Ferry H.	LA-IF-1,3			278	71.6 (3.8)
1988	L. Ferry H.	R&LA-S-1,2	1165	59.1 (3.0)		
	Tucannon R.	RA-H-1,2; LA-H-1	302	58.2 (2.9)		
	Touchet R.	R&LA-IV-1,3	435	59.7 (2.9)		
	Weighted Mean			59.5		72.8

A Sample size, does not necessarily indicate total return.

Four hundred and thirty seven (437) females and 955 males of hatchery origin were spawned during February and March 1990 yielding 2,570,676 fertilized eggs (mean =4,984 eggs/female for 1-ocean age fish and mean =6,561 eggs/female for 2-ocean age fish). Two ocean age fish produced an average of 24% more eggs per female. Two ocean age females contributed 55% of the usable eggs, after IHN loss, to the program this year. Females were selected weekly for spawning based on physical examination for ripeness. Males and females from the fall trapping that were retained for spawning were held in separate ponds.

Nearly all lots of eggs sampled tested IHN positive based on ovarian fluid samples. There was also unusually high adult mortality this year. Many of the mortalities occurred in two raceways that had been part of an experimental IHNV vaccine test conducted at the hatchery. It was discovered that all adults in this test had apparently contracted the disease. The eggs taken from these fish were discarded and no further spawning of those fish was conducted. All samples collected to test for IPN virus tested negative.

Returns to Other Locations

Spawning Surveys

Heavy rains and high stream flows during late April and early May interfered with spawning ground surveys in 1990. We were unable to walk some sections of stream twice and because of high flows, many early redds were washed out and therefore uncounted. Table 8 presents a summary of spawning ground redd and adult observations for each stream surveyed in 1990. We were unable to determine peak spawning time in any of the streams.

Discussion

This is the fifth year of spawning data on project streams. Spring runoff conditions determine the success of walking streams. In 1990, a late and heavy run off precluded any attempt an at early (March and April) spawning ground survey. Heavy rains also washed out redds, thus reducing total redd counts. Average redds per mile decreased in all streams from 1989.

Table 8. Redd survey results for streams in southeastern WA., spring 1990.

Stream	Section	Reach length (miles)	Dates surveyed	Redds	Adults	Total redds/mile	CFS	Avg. width (ft.)
Tucannon R.	Main Tucannon[A]	16.2[A]	5-21,22	23	1	1.4		
	Panjab Creek	2.3	4-4,5-17	3	0	1.3		
	Cummings Creek	6.5	5-17	8	1	1.2		
Touchet R.	Main Touchet[C]	1.5	5-23	9	0	6.0		
	South Fork	15.7	3-22,4-9, 5-10,23	54	7	3.4		
	North Fork	7.5	5-18,23	36	0	4.8		27.3
	Wolf Fork	10.3	4-18,5-11	81	12	7.8		
	Robinson	5.0	5-11	18	0	3.6		19.5
Asotin Creek[B]	South Fork	6.6	4-2,5-14,16	17	0	2.6		
	North Fork	4.8	5-17,18	17	6	3.5		28.6
	Charlie Creek	7.0	5-16,17	0	1	2.1		12.6

A From Panjab Bridge to Marengo. Skipped several miles in an attempt to see if redds further down.
B From the mouth of the South Fork to the highway bridge.
C All of Asotin is in road miles, all other measurements are river miles.

Steelhead Creel Surveys

Lower Snake River

We relied on harvest estimates derived from adjusted statewide punchcard returns in 1990 (Table 9). Our creel sampling was primarily to obtain catch composition data and recover coded wire tags. All 1989 run year recoveries of steelhead having 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. A summary of data collected only from fish reared at LFH that were observed on the Snake River is presented in Table 11. All fish kept this year were adipose clipped. In addition some were left ventral (LV) or right ventral (RV) clipped indicating the presence of a coded wire tag.

Table 9. Adjusted[A] punchcard-derived steelhead harvest estimates for WDW management sections[B] on the lower Snake River, fall 1989 and spring 1990 (WDW 1990).

Month	Below Ice H.Dam	Below L. Mon. Dam	Below L. Goose D.	Below L. Granite D.	Above L. Granite D.
Sep.	56.0	34.7	205.1	135.6	374.2
Oct.	42.6	109.8	582.7	257.7	1,964.2
Nov.	16.8	226.3	389.9	150.1	2,747.5
Dec.	72.8	327.2	266.7	135.6	1,827.5
Jan.	16.8	109.8	156.9	163.6	400.0
Feb.	9.0	65.0	112.1	100.8	257.7
Mar.	2.2	23.5	90.8	142.3	367.5
	216.2	896.3	1,804.2	1,085.7	7,938.6

A by multipling by 1.1205 for underestimation (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 all steelhead observed in Washington angler creels along the Snake River, fall 1989 and spring 1990.

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 clipped (n)	% Sampling rate[C]
166	76.0 (51.5-101.0) (179)	4.4 (1.7-9.0) (110)	49.0 (95)	46.4 (90)	4.6 (9)	19.5 (47)	11.9 (23)	10.8
167	72.9 (55.0-112.5) (100)	3.8 (1.7-10.0) (89)	50.5 (52)	49.5 (51)	0 (0)	16.9 (21)	19.4 (20)	9.8
168L	77.2 (53.0-98.3) (368)	4.8 (1.8-9.8) (298)	56.1 (211)	43.4 (163)	0.5 (2)	9.0 (37)	11.7 (44)	
168M	72.0 (51.0-99.5) (544)	3.8 (1.4-5.8) (391)	50.9 (538)	48.9 (517)	0.3 (3)	25.5 (362)	17.8 (188)	13.4[D]
TOTALS			51.8 (896)	47.4 (821)	0.8 (14)	21.2 (467)	12.5 (275)	

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

Table 11. Data from only LFH reared steelhead observed in Washington angler creels along the Snake River, fall 1989 and spring 1990.

Section	Mean fork length (cm) (range) (n) [A]	Mean wt. (kg) (range) (n)	Sex % Female (n)	% Males (n)	% Unknown (n)
166	64.1 (54.5-80.0) (8)	2.7 (1.7-4.5) (6)	50.0 (4)	50.0 (4)	0 (0)
167	65.3 (59.0-76.0) (11)	2.5 (1.8-4.3) (10)	45.5 (5)	54.5 (6)	0 (0)
168L	66.7 (53.0-83.0) (23)	3.2 (2.2-5.1) (18)	60.9 (14)	39.1 (9)	0 (0)
168M	68.2 (58.0-76.0) (30)	3.4 (2.3-4.6) (21)	70.0 (21)	30.0 (9)	0 (0)
TOTALS			61.1 (44)	38.9 (28)	0 (0)

A n = Number of kept fish sampled in the harvest

Grande Ronde River

Approximately 2,212 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 (11.7 river miles of the 37.7 miles in Washington). That represents a 20% increase in angling effort over 1988-89. The average completed fishing trip was (4.28) hours. Tables 12 and 13 are summaries of ODFW data collected from steelhead examined in angler creels along the Grande Ronde River, fall 1989 and spring 1990. The greatest harvest occurred in late March and early April near the Cottonwood Conditioning Pond. A total estimated 136 coded wire tags of 5 different tag groups released by Washington were harvested in the Grande Ronde River (Table 18). All of the tags were harvested in the Washington portion of the river.

Table 12. Estimated angler effort, catch rates, and harvest for steelhead anglers on the Grande Ronde River, 1989 and 1990 (ODFW 1990).

Month	Effort (95% CI)	Catch rate (95% CI)	Total catch (95% CI)	Fish kept (95% CI)	Marked fish rel. (95% CI)	Unmarked fish rel (95% CI)
1989						
Sep.	598.8 (192.7)	0.02 (0.02)	10.1 (12.0)	10 (7.2)	0 ---	5.8 (10.4)
Oct.	1,229.2 (299.3)	0.14 (0.06)	172.3 (68.3)	39.8 (29.0)	21.9 (22.3)	110.6 (51.1)
Nov.	385.1 (133.7)	0.09 (0.05)	35.6 (22.8)	28.1 (16.2)	0 ---	7.4 (9.4)
Dec.	570.1 (202.0)	0.04 (0.03)	25.0 (17.1)	22.2 (16.6)	0 ---	2.7 (5.2)
1990						
Jan.	(No Sample)					
Feb.	1,375.4 (696.4)	0.28 (0.24)	384.7 (341.5)	234.5 (236.1)	59.7 (60.2)	90.6 (89.9)
Mar.	3,874.5 (721.9)	0.28 (0.11)	1,106.4 (439.9)	468.5 (198.1)	591.4 (245.7)	46.5 (32.8)
Apr.	1,434.6 (613.4)	0.31 (0.16)	442.4 (230.7)	216.2 (137.5)	223.1 (108.1)	3.1 (6.2)
Total	9,467.6 (1252.1)	0.230 (0.064)	2,176.5 (607.2)	1,013.6 (332.7)	896.1 (276.0)	266.8 (109.7)

Table 13. 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	Males (SD)[C]	Females n	Females length	Females (SD)
1:1	50(22.3)	26(11.6)	22	625.7	(33.1)	13	601.8	(22.9)
2:1	4 (1.8)	1(.45)	4	660.0	(44.2)	1	600.0	
1:2	50(22.3)	92(41.1)	27	728.6	(54.4)	39	705.4	(40.2)
2:2	0	1(.45)	0	--		1	690.0	
Total	n=104	n=120						

A Age is expressed as a ratio of years spent in freshwater prior to ocean migration:years spent in the ocean prior to spawning migration
B n = the number of fish sampled.
C (SD) = the standard deviation.

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 14). Catch rate and catch composition were calculated for these rivers from information collected during weekday and weekend creel surveys. A summary of data from all fish observed during creel surveys is presented in Table 15. A summary of data from only LFH reared fish that were observed during creel surveys is presented in Table 16.

Table 14. Harvest estimates from punchcard returns for the Tucannon, Touchet, Walla Walla and Grande Ronde Rivers and McNary Pool on the Columbia River, fall 1989 and spring 1990 (WDW 1990).

River	Tucannon	Touchet	Walla W.	Grande Ronde	McNary P.
Month					
May	0	0	0	0	0
June	0	0	0	0	23
July	0	0	0	0	8
Aug.	0	0	0	0	21
Sep.	31	0	15	16	33
Oct.	48	0	180	123	132
Nov.	56	2	580	92	312
Dec.	25	0	171	56	282
Jan.	38	4	330	61	79
Feb.	46	21	209	81	67
Mar.	56	349	192	252	29
Apr.	10	127	10	142	0
Total	310	503	1,687	823	986

Table 15. Data for all steelhead observed in angler creels along the Tucannon, Touchet, Walla Walla and Grande Ronde Rivers and McNary Pool on the Columbia River, fall 1989 and spring 1990.

River	Mean fork length (cm) (range) (n) A	Mean wt. (kg) (range) (n)	Fish Kept % Female (n)	Fish Kept % Males (n)	Fish Kept % Unknown (n)	% Fish releas B (n)	% Ventral clip (n)	Sample rate C
Tucannon	61.2 (56.5-69.0) (18)	2.0 (1.5-2.8) (16)	59.1 (13)	27.3 (6)	13.6 (3)	45.0 (18)	22.7 (5)	7.1
Touchet	66.1 (56.0-82.0) (95)	2.5 (1.3-4.3) (84)	55.6 (70)	19.1 (24)	25.4 (32)	19.4 (39)	35.7 (45)	25.0
Walla W.	64.9 (52.0-78.5) (69)	2.6 (1.1-4.5) (68)	54.8 (40)	41.1 (30)	4.1 (3)	31.8 (34)	5.5 (4)	4.3
Grande Ronde D	69.6 (55.0-82.5) (26)	3.4 (1.8-5.9) (20)	46.2 (12)	53.9 (14)	0	72.9 (70)	65.4 (17)	3.1 D
McNary Pool	77.9 (53.0-95.0) (110)	4.7 (1.5-7.5) (105)	50.9 (56)	49.1 (54)	0	30.8 (49)	10.0 (11)	11.2
Totals			53.5 (191)	35.9 (128)	10.6 (38)	37.0 (210)	23.0 (82)	

A n = Number of kept fish sampled in the harvest.
B Percent released is equal to (fish released/fish kept + fish released).
C (# of fish checked/estimated punch card derived harvest).
D Refers only to fish sampled in addition to the co-op. creel survey with ODFW

Table 16. Data for only LFH reared steelhead that were observed in angler creels along the Tucannon, Touchet and Walla Walla Rivers and McNary Pool on the Columbia River, fall 1989 and spring 1990.

River	Mean fork length (cm) (range) (n) [A]	Mean wt. (kg) (range) (n)	Sex % Female (n)	% Males (n)	% Unknown (n)
Tucannon	62.0 (58.5-65.5) (3)	1.8 (1.5-2.4) (3)	50.0 (2)	25.0 (1)	25.0 (1)
Touchet	61.4 (56.0-67.5) (19)	1.9 (1.4-2.3) (17)	63.2 (12)	36.8 (7)	0 (0)
Walla W.	61.8 (59.0-64.0) (4)	2.4 (2.0-2.8) (3)	25.0 (1)	75.0 (3)	0 (0)
McNary Pool	66.0 (61.0-71.0) (2)	2.8 (2.1-3.5) (2)	100.0 (2)	0 (0)	0 (0)
Totals			55.6 (15)	40.7 (11)	1.7 (1)

A n = Number of kept fish sampled in the harvest.
B Only one LFH reared steelhead was caught in the Grande Ronde River outside of those sampled during the cooperative creel survey with ODFW.

Coded-Wire Tag Recovery

Snouts were collected by WDW personnel from 254 sport caught steelhead that had left ventral fin clips. All snouts were examined by Idaho Fish and Game personnel for coded-wire tags (cwts). All cwts recovered by WDW personnel and estimates of the expanded harvests by individual tag code are presented in Table 17 for the Snake River (by zone) and in Table 18 for the Grande Ronde River and other rivers within Southeast Washington.

Table 17. Coded-wire tag expansions for the Snake R., fall 1989 and spring 1990.

	Month									
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar	CWT code	Tot. Tags Recovered	Expanded Harvest[a]
Zone 168										
Sample Rate[a]	(.016)	(.095)	(.118)	(.151)	(.280)	(.062)				
Tags Recovered			3	1	1			63/50/13	4	35
		3	2					63/50/14	5	46
			2	1	2			63/50/16	5	31
			1	4				63/50/19	5	36
		1						63/39/13	1	10
		2	1	1				63/39/14	4	35
		1		2	1			63/39/15	4	21
			1					63/37/03	1	8
			1	1				63/49/41	2	15
			1	3				63/49/42	4	32
		1	1	1				63/49/44	3	25
		1	2	1	1			63/38/40	5	37
			1	3	1			63/38/41	5	33
		1	2					63/38/42	3	26
		1		1				63/38/43	2	17
		2						63/49/47	2	20
			1					63/50/28	1	8
			1					63/50/31	1	8
			1					63/38/44	1	8
		1	1					07/41/25	2	18
		2	1	1				07/41/26	4	40
		2			1			07/41/28	3	24
		1						07/38/59	1	10
		1						07/40/32	1	10
		1						07/40/29	1	10
			2	1				07/40/30	3	23
	1		1		1			07/40/28	2	74
				1				07/40/25	4	7
		1			1			05/18/35	2	14
		1						05/18/50	1	10
				3				05/18/34	3	21
				1				05/18/36	1	7
		1						05/18/53	1	10
		1	2	1				10/29/40	4	33
		1	2	2		1		10/29/32	6	56
			2					10/29/31	1	16
		1						10/29/52	1	10
				1				10/29/39	1	7
		1				1		10/29/33	2	26
		21	16	2	6			No Tag	45	376

Table 17, (con't)

	Month									
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb	Mar	CWT code	Tot. Tags Recovered	Expanded Harvest[A]
Zone 167										
Sample Rate[B]	(.059)	(.058)	(.167)	(.140)	(.177)	(.069)	(.000)			
Tags Recovered	2			1				63/39/14	3	41
				1	1			63/39/15	2	13
		1	2	2	1			63/50/13	6	61
					1			63/50/14	1	6
			2					63/50/16	2	12
			1					63/50/28	1	6
		1						63/50/31	1	17
				1				63/39/03	1	7
					1			63/39/13	1	6
					1			10/29/32	1	6
Zone 166										
Sample Rate[B]	(.156)	(.096)	(.128)	(.071)	(.140)	(.116)	(.011)			
Tags Recovered		1						63/39/14	1	10
		1						63/39/15	1	10
		2		1	1	1		63/50/14	5	50
				1				63/50/16	1	14
				1				63/49/47	1	14
				1				63/49/49	1	14
					1			63/38/41	1	7
		1						07/41/28	1	10
					1			05/18/34	1	7
	1							10/29/33	1	6
		3	2	1			1	No Tag	7	152

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

Table 18. Coded wire tag expansions for other rivers within Southeast Washington, fall 1989 and spring 1990.

River (Zone)	1989 Sept	1989 Oct	1989 Nov	1989 Dec	1990 Jan	1990 Feb	1990 Mar	1990 Apr	CWT code	Total Tags Recovered	Expanded Harvest
Grande Ronde	(.063)	(.057)	(.022)	(.018)	(See footnote A)						
(75)							4	4	633840	8	27
							8	2	633841	10	46
							6	4	633842	10	37
		1	1			1	3	2	633843	8	40
							1		633845	1	3
		1							074029	1	18
							2		no tag	2	8
Tucannon River (189)			(.089)	---		(.087)	(.232)				
							1		633842	1	4
				1			1		634949	2	5
							1		635028	1	4
							1		No Tag	1	4
Walla Walla R. (194)			(.050)	(.047)	(.049)	(.010)	(.115)				
				1					634947	1	21
				3					635028	3	63
Touchet River (185)						(.095)	(.289)	(.181)			
							1		633843	1	3
							8	1	634947	9	30
							6		634949	9	30
							10	2	635028	12	42
							8	4	635031	12	48
							1		No Tag	1	3
McNary Pool (45)		(.227)	(.119)	(.028)	(.038)						
		1							633840	1	4
		1							635019	1	4
					1				051729	1	26
				1					051835	1	36
			1						102932	1	8
		1							102949	1	4
		1							102952	1	4
		2							No Tag	2	8

A CWT expandions based on ODFW creel survey during spring 1990. Sample rates and expansions available in Carmichael et al.(1990).

Table 19: 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 1989-1990. These numbers and percentages also represent a portion of the smolt to adult survival.

Release Year	1988			1987			
Release site CWT Code (Brand)	Snake R. @ LFH 63/50/13,14,16,19 (LA-S-1,2) (RA-S-1,2)	Touchet R. 63/49/47,49 63/50/28,31 (LA-IV-1,3) (RA-IV-1,3)	Tucannon R. 63/49/41,42,44 (LA-H-1) (RA-H-1,2)	Tucannon R. 63/38/44,45 63/39/03 (RA-IY-1,2,3)	Snake R. 63/39/13 63/37/03 (LA-IF-1,3)	Snake R. 63/39/14,15 (RA-IF-1,3)	Grande Ronde R. 63/38/40,41,42,43 (RA-IC-1,2,3)
<u>Location</u>							
L.Col. Sport	11(.011)	9(.012)		1(.002)	1(.002)	2(.004)	1(.001)
Mid.Col Sport	4(.004)						4(.005)
Zone 6 Net Summer Fall Winter	304(.304)	275(.352)	75(.125)	40(.066)	180(.355)	78(.154)	321(.401)
L.Ferry Ladder	261(.261)	147(.188)	12(.020)	33(.081)	6(.012)	118(.233)	1(.001)
Snake R. Sport	284(.284)	107(.137)	65(.108)	15(.037)	24(.047)	130(.257)	113(.141)
Tucannon Sport		9(.012)					4(.005)
Weir			3(.005)	1(.002)			
Walla Walla R.		84(.107)					
Touchet R.		150(.192)					3(.004)
Dworshak NFH	4(.004)	3(.004)	4(.007)	4(.010)	2(.004)	1(.002)	8(.010)
Idaho Sport[A]	94(.094)	16(.020)	10(.017)		34(.067)	38(.075)	82(.103)
Grande Ronde R.[C]				3(.007)			133(.116)
Ocean Harvest[B]	14(.014)	6(.008)	2(.003)			1(.002)	
LSRCP Area Total	634(.642)	516(.660)	94(.157)	56(.092)	64(.126)	286(.565)	336(.420)
Grand Totals	976(.975)	806(1.030)	171(.285)	97(.160)	247(.487)	368(.727)	670(.838)

A Expanded estimates for all rivers based on Idaho punch cards, data from Kent Ball, IDFG, pers. comm.
B Unexpanded estimates for Ocean Harvest.
C Based on a cooperative creel survey with Oregon DFW.

Returns of Coded Wire Tag Groups

We have complete return cycles for LFH released steelhead (1986-87) passing the facility that indicate we are meeting our steelhead goals for the hatchery (Table 6). Many of the fish passing the dam are wandering considerable distances upstream from their point of release. This behavior is also exhibited by fish released from the Tucannon and Touchet rivers. Wandering can jeopardize our ability to meet escapement or harvest goals for our individual mitigation streams. Lower Granite Dam continues to be our most effective tag recovery sample site.

Table 19 presents expanded estimates of harvest of adult Lyons Ferry steelhead within the Columbia River Basin. Percent smolt to adult survival is also presented. This information is based on sampling programs conducted by several Federal, State and Tribal agencies. Many of our fish were intercepted in consumptive fisheries or wandered into other stream systems outside of the LSRCP area.

The Lower Columbia River fisheries harvest a substantial percentage of our total steelhead returns outside of the LSRCP area. If the Lower Columbia River fisheries expanded to their maximum potential, they could jeopardize the ultimate achievement of Snake River goals. These fisheries are subject to wide fluctuations in season length and gear restrictions from year to year. Close monitiouring of these fisheries through the collection of reliable data concerning LSRCP fish contributions to these fisheries is important to protect long term programs.

LFH fish are contributing to fisheries throughout the lower Columbia River basin upon their return. Presently, these fisheries are harvesting numbers of fish in excess of 50% of total adult harvest in the basin for several groups. This level of harvest is a concern. It is likely that if adult return behavior, juvenile survival and emigration behavior can be improved through stock development and proper release size, downriver harvest will be less of a concern to our overall LSRCP area goal.

An uncharacteristically high number of "no tags" were found in section 168 (table 19). This resulted from the fact that during our creel surveys we encountered many sport caught steelhead in section 168 of the Snake River with both left and right ventral fins missing. We were unsure if these fish carried CWT's, therefore snouts were removed and searched for tags. Most of these fish were not tagged. The missing fins were most likely caused during rearing at a hatchery.

We have complete 1 and 2 ocean age returns for the 1986 and 1987 coded wire tag releases. A summary of these returns to various fisheries is presented in Tables 20 and 21. 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 20. Returns of 1986 release LFH steelhead to locations in the Columbia River basin, for run years 1987, 88 and 89 (% smolt to adult survival).

Release location	LFH	LFH	Tucannon	Tucannon	Grande Ronde
Stock	*Wells*	*Wallowa*	*Wallowa*	*Wells*	*Wallowa*
Tag codes	63/38/36 63/38/38	63/33/03 63/33/04	63/33/50 63/33/51	63/32/02 63/33/02	63/33/05-06 63/33/49
Recovery Location		Estimated Harvest or Return			
L. Columbia Sport	87(.143)	25(.062)	26(.064)	6(.015)	52(.087)
Mid-Columbia Sport	12(.020)	25(.062)	25(.062)	---	75(.126)
Deschutes R.	5(.008)	---	---	2(.005)	48(.081)
Zone 6 Treaty Net	571(.935)	254(.632)	118(.294)	47(.117)	514(.860)
Priest Rapids Dam	---	---	---	---	---
LFH ladder	121(.198)	40(.099)	15(.037)	4(.010)	73(.122)
Up. Snake R. Sport	98(.160)	17(.042)	9(.022)	13(.033)	20(.033)
Dworshak NFH	1(.002)	1(.002)	---	1(.002)	---
Idaho Sport	66(.110)	8(.020)	22(.055)	---	53(.088)
Grande Ronde Spt.	---		---	---	230(.385)
Ocean Harvest	13(.021)	1(.002)	---	---	---
Deschutes River	5(.008)	---	---	2(.005)	48(.091)
Tucannon R. Spt.	2(.005)	---	---	1(.003)	2(.005)
LSRCP Total	288(.475)	66(.163)	46(.114)	19(.048)	378(0.633)
Grand Totals	981(1.61)	371(.921)	215(.732)	76(.190)	1109(1.857)

The contribution 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 as measured by harvest and escapement of various brand groups to above Lower Granite Dam. 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 6,20,21).

A broader look at the information provided in Tables 20 and 21 points to some interesting differences in contribution of different stocks of fish to various locations. Wells stock fish released from LFH in 1986 returned at a measurably higher rate than Wallowa stock fish also released from LFH. The Wells stock of fish also contributed a greater percentage of their number to upriver fisheries, and to the rack at LFH than did the Wallowa stock fish. The Zone 6 net fishery was the biggest harvestor of

Table 21. Returns of 1987 release LFH steelhead to locations in the Columbia River basin, for run years 1988-1990 (% smolt to adult survival).

Release location	LFH	LFH	Tucannon	Grande Ronde
Stock	*Wallowa*	*L. Ferry*	*L.Ferry*	*Wallowa*
Tag codes	63/39/13 63/37/03	63/39/14,15	63/38/44,45 63/39/03	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	---	12(.024)	---	16(.020)
Deschutes R.	2(.004)	2(.004)	---	6(.008)
Zone 6 Treaty Net	344(.679)	289(.589)	92(.152)	633(.791)
Priest Rapids Dam	---	---	---	2(.003)
LFH ladder	136(.269)	341(.674)	41(.068)	8(.010)
Up. 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.	---	---	3(.005)	185(.231)
Ocean Harvest	---	2(.004)	---	---
Touchet R.	---	---	---	3(.004)
Tucannon R. Weir	---	---	1(.002)	---
Tucannon R. Spt.	---	---	---	4(.005)
LSRCP Totals	220(0.434)	581(1.148)	102(.168)	440(0.550)
Grand Totals	606(1.195)	949(1.876)	195(.321)	1,183(1.479)

both releases taking 58% of all returns of Wells stock and 68% of the Wallowa stock fish. It appears that the Wells stock of fish was more successful in returning fish to the Snake River area and at evading lower river nets or fishing times than the Wallowa fish. Both groups of fish strayed heavily to above Lower Granite Dam (LGD). A similar release of Wallowa Stock fish and the new Lyons Ferry stock of fish in 1987 showed like results. The Lyons Ferry stock returned at a greater percentage from release and contributed more heavily to LSRCP area fisheries and escapement than the Wallowa stock. Unfortunately all of the groups strayed to above LGD in large numbers.

Results for the Tucannon River released fish are contrary to those released at LFH. Wallowa stock fish released in 1986 greatly out performed releases of Wells stock fish. Most of the fish contributed to fisheries outside of the LSRCP area and large numbers of both groups of fish migrated to above Lower Granite dam on the Snake river (Table 6) in both 1987 and 1988. Only one stock of fish, the new Lyons Ferry stock, was released from the Tucannon in 1987. The performance of this group was disappointing with low recovery of fish in the Tucannon, a relatively large proportion of harvest in the Zone 6 net fishery and the remainder of the fish evidently straying to above LGD and failing to return.

These mixed returns from two different release areas with the same stocks of fish further our belief that the success of releases, especially from tributary rivers, is strongly dependent upon stock. We cannot, however, conclude that returns are totally dependent upon stock, as the 1985 release of Wallowa fish from the Tucannon River returned poorly over the period of 1986-87 even though the fish were nearly identical in size to the 1986 release which did measurably better (Schuck et al. 1989). The fish were of similar size to the 1986 release but were released 2-3 weeks later in the spring. Time of release in this case may have had a dramatic affect on overall returns. Size at release should not have affected return rates for either the LFH or Tucannon groups in 1986 or 1987 as all the releases were between 5.3 and 5.8 fish per pound.

Wallowa stock fish released from Cottonwood C.P. contributed to fisheries at a similar rate as the LFH released Wells stock fish. The consistent performance of our Grande Ronde River releases by returning large numbers of fish to multiple fisheries and to the terminal areas in the upper Snake and Grande Ronde is very encouraging. We believe these returns to be the result of an acceptable stock, proper size and time of release and an easily identifiable tributary stream to "home" to upon return. The minor problems of run timing and contribution to terminal fisheries described by Mendel and Schuck (1989) and Schuck et al.(1990) are generally acceptable when compared with the straying and low survival rates seen in other portions of our LSRCP program.

We estimate that for release year 1988, the 1989 return of adults to the Snake River was 0.88% of smolts released and the average adult return of 1987 released fish for the two run years of 1988 and 1989 was 1.68% of smolts released. Three year returns from the 1986 release averaged 1.51% adults from smolts. Based on these numbers, we estimate that adult returns from Lyons Ferry Hatchery smolt releases into Washington LSRCP waters in 1988 were 14,511 fish to the project area (above Lower Granite Dam or into an appropriate tributary). These numbers represent 312% of the LSRCP goal. Returns of adults in 1989 from smolt releases in 1987 and 1988 to the project area are an estimated 15,736 fish (338% of LSRCP goal).

Juvenile Salmonid Populations in Project Rivers

Summer Densities

Summer electrofishing samples for density estimates of juvenile salmonids were collected by WDF in 1989. We used length-frequencies to determine ages of gamefish for age-specific population and density estimates. Table 22 is a summary of steelhead juvenile densities by habitat type on the Tucannon River. Sampling data collected by WDF during summer and fall 1989 from the Tucannon River and Asotin Creek is presented in Appendix B.

Table 22. Mean steelhead densities per 100^2 meters by habitat type for fall 1989 (WDF electrofishing data).

Site	Pool	Run	Riffle	Boulder Groups	Side Chan.
HMA [A]					
	31.8	32.7	37.5	18.9	38.2
SD=	12.6	7.6	17.8	10.0	19.8
n =	6	5	7	6	6
WILDERNESS [B]					
	10.4	23.5	4.7		
SD=	7.3				
n =	3	1	1		
HARTSOCK [C]					
		17.8	20.8		
SD=		5.4	7.2		
n =		2	2		

A- Tucannon R. within the Wooten W.A.
B- Tucannon R. above Panjab Cr.
C- Tucannon R. below Tumalum Cr.

Trends in Juvenile Steelhead Density and Population Size 1983-1989

. Between 1983-1985 eighty-four instream habitat structures were constructed in the Tucannon River and the North and South Forks of Asotin Creek in an attempt to restore degraded stream habitat and increase salmonid populations (Viola et al. 1991). Construction was completed in 1984 on the North fork of Asotin Creek and the Tucannon River and in 1985 on the South Fork of Asotin Creek. Juvenile steelhead densities and population estimates from 1983-1989, within index areas of the North and South Forks of Asotin Creek and the Tucannon River, are presented in Figures 21-23.

Juvenile steelhead densities and population size of 0-aged steelhead on the North Fork of Asotin Creek decreased in 1984 as compared to 1983. Density and population size of >0 aged steelhead in 1984 remained equal to levels found in 1983. Juvenile density and population size of all ages of steelhead increased in 1986 as compared to previous years. In 1989 population size remained nearly equal to that found in 1986 however juvenile steelhead densities decreased as compared to 1986 (Fig 21).

Juvenile steelhead density and population size of all ages of fish on the South Fork of Asotin Creek remained equal in 1983 as compared to 1984. In 1989 densities and population size of >0 aged fish remained equal to levels found in 1983 and 1984. However, both density and population size of 0 aged steelhead were substantially reduced in 1989 (Fig 22).

Juvenile steelhead 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 and 1989. Density and population size of 0 aged steelhead remained stable in all four sample years (Fig 23).

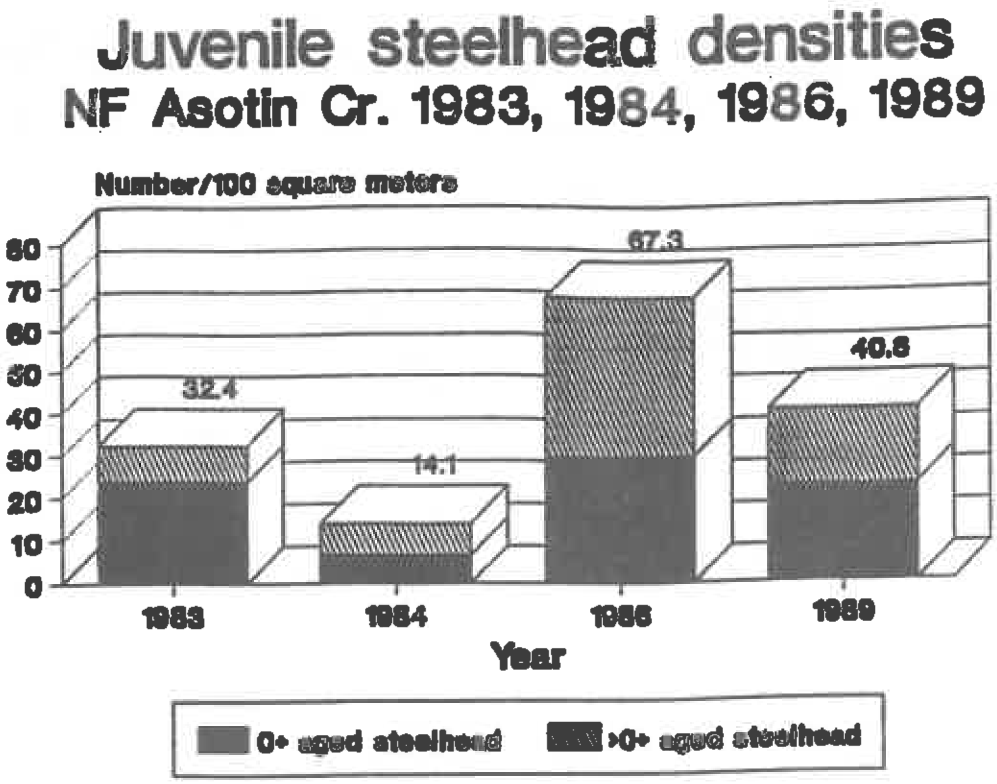
Adult steelhead spawning escapement decreased steadily from 1986-1989 on both the North and South Forks of Asotin Creek (Figures 24 and 25). Adult steelhead spawning escapement in the Tucannon increased steadily in 1987 and 1988 as compared to 1986, but decreased substantially in 1989 (Fig 26).

Discussion

Variations in juvenile steelhead densities and population sizes are dependent upon the level of adult escapement and on spawning and rearing success. Each of these factors is in turn affected annually by variations in available river flow, water temperature and changes in habitat quality.

North Fork Asotin Cr.

Both juvenile density and population size of 0 aged steelhead decreased in the North Fork of Asotin Creek in 1984 as compared to 1983 (Fig 21). Surface area within the index section was only 5.5% greater in 1984 than in 1983. However extremely high water conditions existed earlier in the season. Poor spawning escapement from the previous year may have resulted in lower 0 age densities, although no escapement information is available for 1983. Density and population size of >0 aged fish in 1984 remained equal to those in 1983. This suggests that the high flows earlier in the year could have negatively affected only 0 aged fish. The habitat structures that were completed in



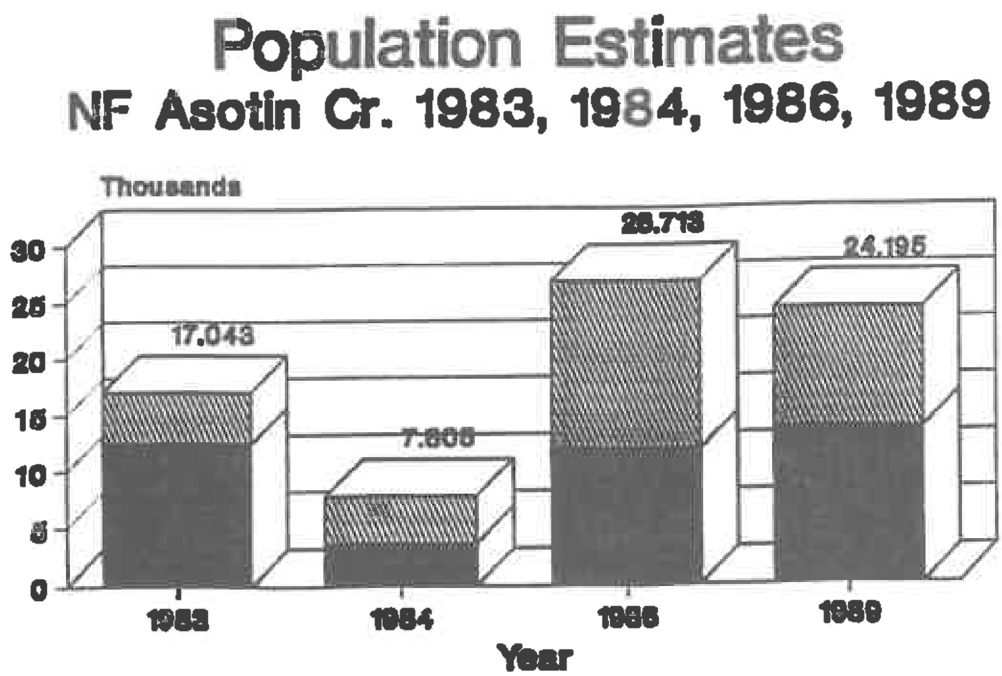


Figure 21. Juvenile steelhead densities (top) and population size (bottom) on the North Fork of Asotin Creek 1983,84,86,89.

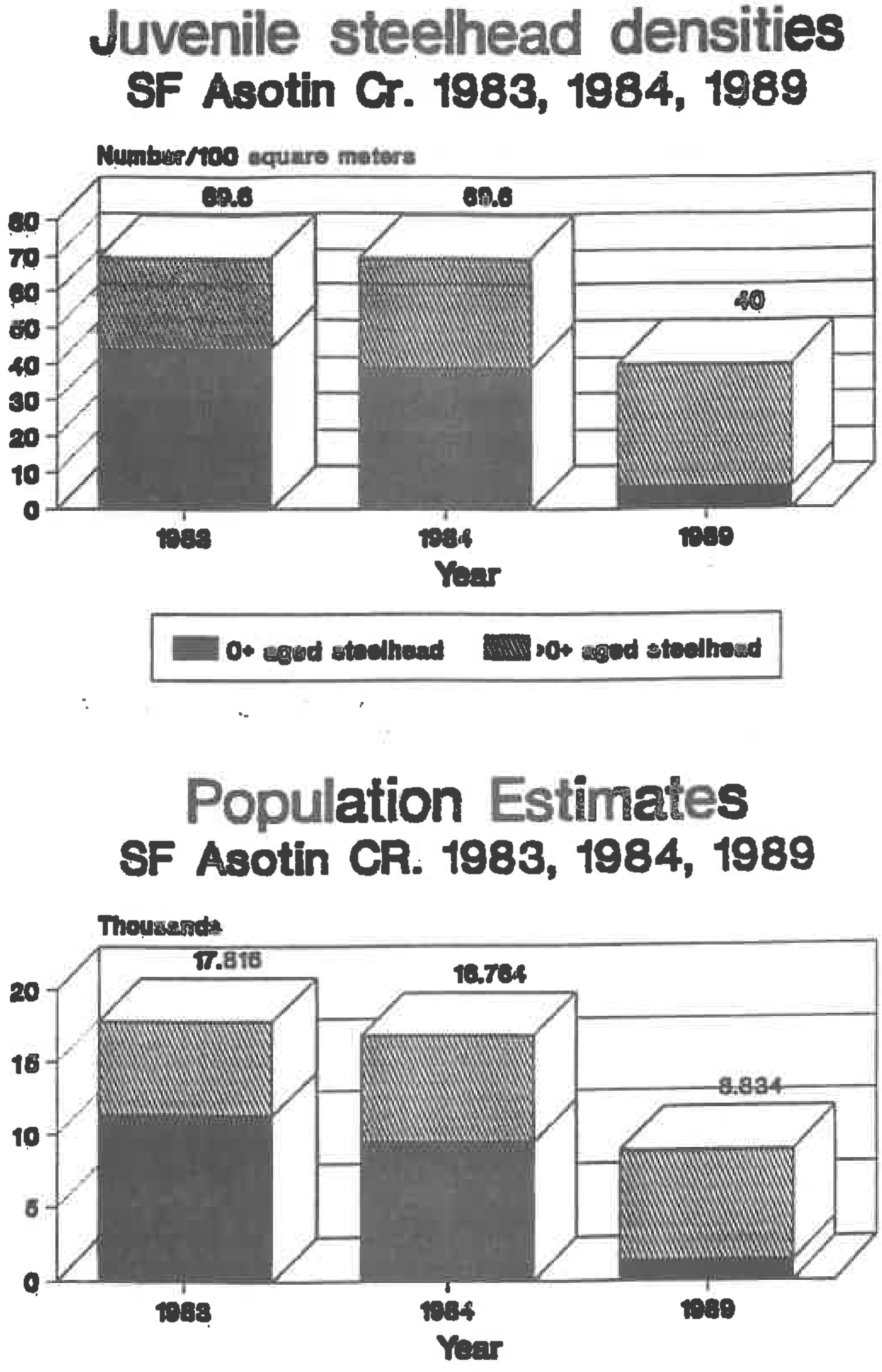
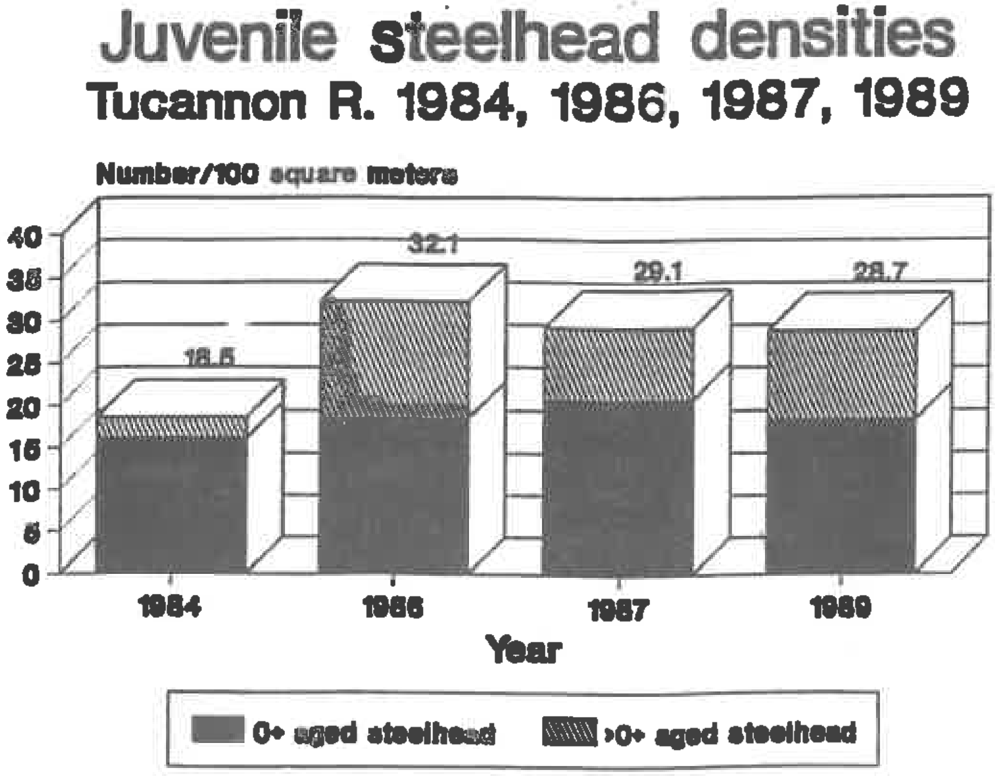


Figure 22. Juvenile steelhead densities (top) and population size (bottom) on the South Fork of Asotin Cr. 1983,84,86,89.



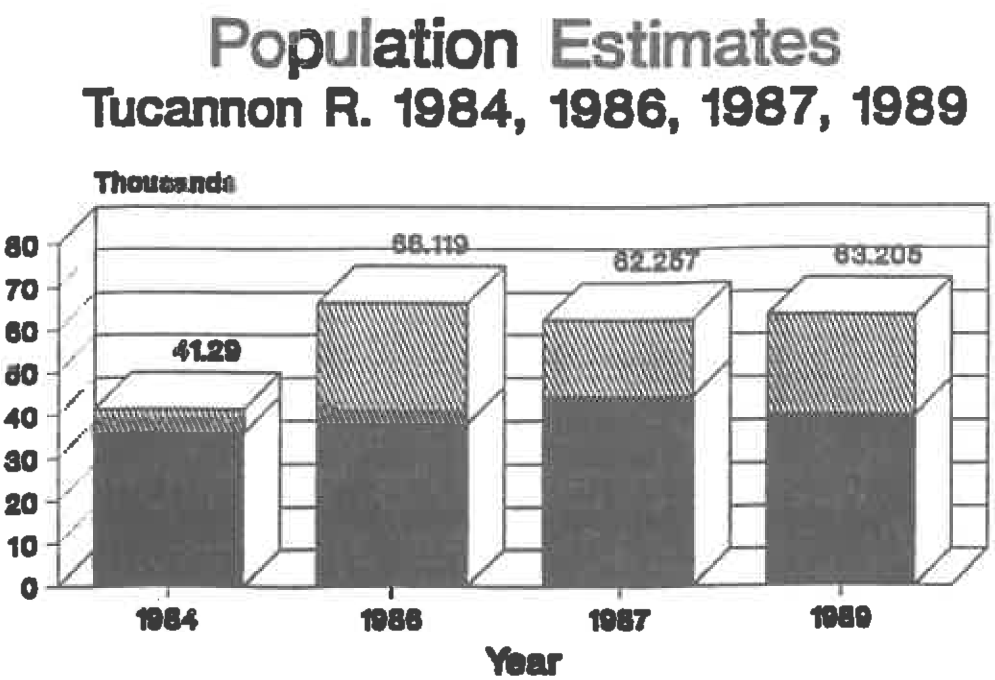


Figure 23. Juvenile steelhead densities (top) and population size (bottom) on the Tucannon River 1984,86,87 and 89.

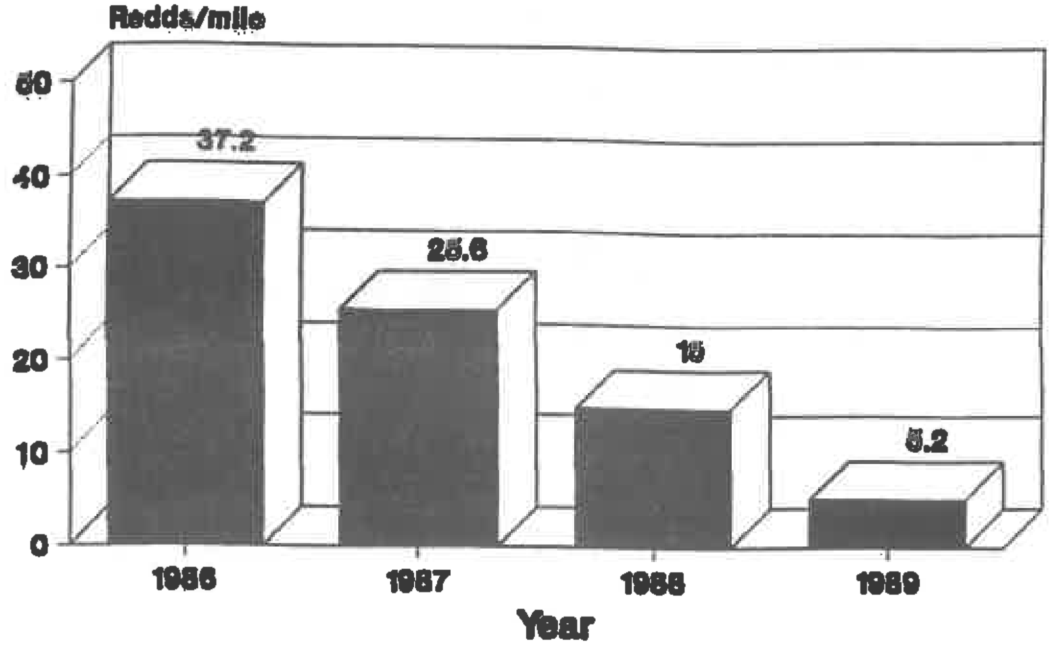


Figure 24. Spawning escapement on the North Fork of Asotin Creek 1986 - 1989.

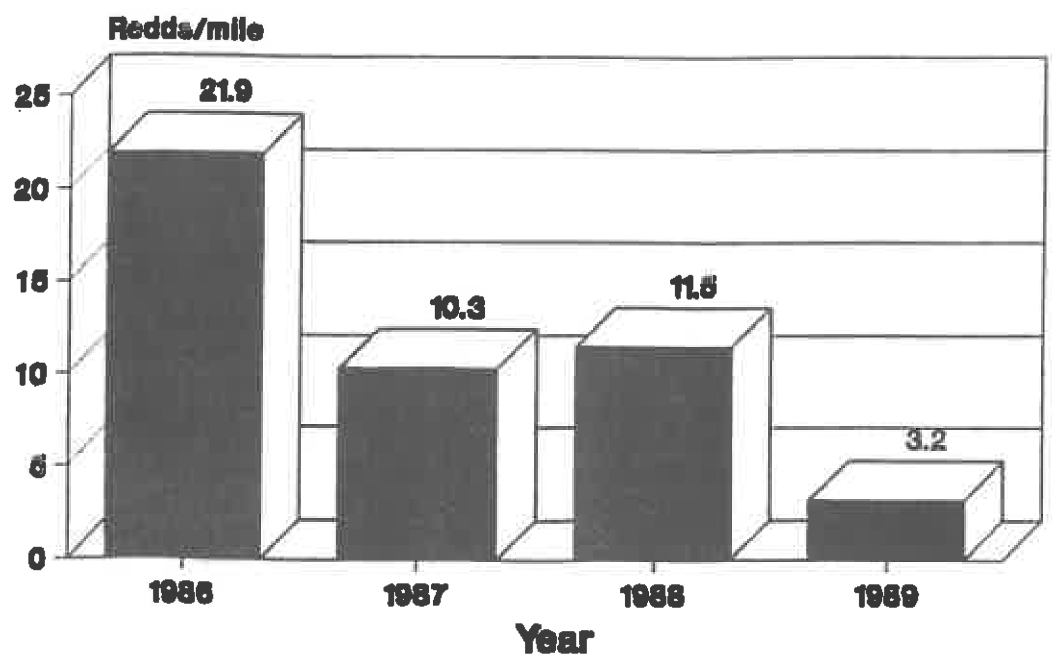


Figure 25. Spawning escapement on the South Fork of Asotin Creek 1986 - 1989.

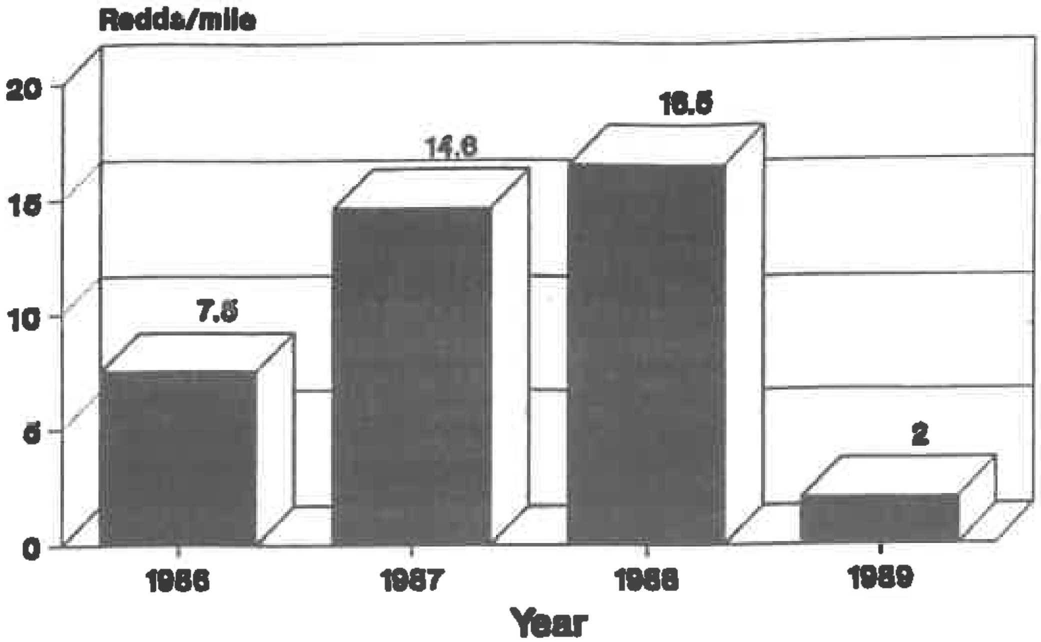


Figure 26. Spawning escapement on the Tucannon River, 1986 - 1989.

1984 on the North Fork were constructed to insure enhanced survival of >0 aged fish (Viola et al. 1991). These structures may have provided areas for only older aged steelhead to escape the impact of high water flows.

Density and population numbers of both 0 aged and >0 aged juvenile steelhead on the North fork of Asotin creek increased in 1986 as compared to 1984. However, 1989 population sizes of both 0 aged and >0 aged steelhead remained nearly equal to the population numbers found in 1986 (Fig 21). In 1989, density of both 0 aged and >0 steelhead was reduced as compared to 1986. Surface area within the index section was 49% higher in 1989 as compared to 1986. This dilution of the population into a greater surface area explains the reduced densities in 1989.

The timing of this sustained population increase from 1986 through 1989, just two years after the completion of the habitat structures, suggests that the structures had a positive effect, resulted in improved rearing conditions, and thus increased juvenile densities and population size. Adult spawning escapement steadily declined from 1986 through 1989 (Fig 24), while juvenile population size remained stable. Therefore increases in population size after 1986 are not due to increased spawning activity.

South Fork Asotin Cr.

Density and population size of both 0 aged and >0 aged steelhead on the South Fork of Asotin Creek remained nearly equal from 1983 to 1984. In 1989 density and population size of >0 aged steelhead remained nearly equal to that found in 1983 and 1984. However density and population size of 0 aged fish declined to only 14% of levels found in 1983 and 1984 (Fig 22). This decline in young of the year steelhead is most likely due to the effects of drought conditions that prevailed in 1989. One of the limiting factors of the South fork of Asotin creek is its small size and shallow nature. Juvenile steelhead in the South Fork are particularly vulnerable when drought conditions prevail. When water levels decrease, edge habitat for young-of-the-year steelhead is quickly lost. Low summer flows in the stream also quickly raise to or above the normal thermal tolerance limits of steelhead. In 1983, a year of adequate water flows, Mendel (1984) recorded stream temperatures up to 73° F. The fact that density and population size of >0 aged steelhead remained equal to those found in 1983 and 1984 suggests that the deeper habitat used by older aged fish remained adequate during drought conditions. The habitat structures that were completed in 1985 on the South Fork were constructed to insure enhanced survival of >0 aged fish (Viola et al. 1991). These structures acted to provide adequate habitat during a critical low water period. Spawning escapement also declined from 1986- 1989 (Fig 25). A combination of marginal aquatic conditions for young of the year steelhead and reduced spawning activity in the South Fork are most likely the reasons for the the reduced numbers of 0 aged steelhead in 1989.

Tucannon River

Juvenile density and population size of >0 aged steelhead increased substantially in the Tucannon River in 1986 as compared to 1984. This increase remained stable in 1987 and 1989 (Fig 23). Density and population size of 0 aged steelhead did not increase but remained at 1984 levels in 1986, 1987 and 1989. The habitat structures that were completed in 1984 on the Tucannon were constructed to enhance 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 in 1987 and 1989. This again suggests that the structures had a positive effect, resulted in improved rearing conditions and thus increased juvenile steelhead population size. An increase in spawning escapement occurred in 1987 and 1988. (Fig 26). Increased spawning activity may have contributed to the numbers of juvenile steelhead in 1988 and 1989.

Our juvenile information suggests some general trends: 1) densities and population size of >0 aged fish increased on the North Fork of Asotin Creek and the Tucannon River and remained stable on the South Fork of Asotin creek after construction of habitat structures. This occurred during a time period containing three drought years. The habitat structures appear to have offered >0 aged steelhead areas to seek seasonal refuge from adverse aquatic conditions. 2) Spawning escapement declined from 1986-1989 in both the North and South Forks of Asotin Creek (Figures 24 and 25). These declines are likely the result of discontinued steelhead smolt plants in Asotin Creek. Increased spawning activity in the lower Tucannon may also explain the decrease in spawning activity in our normal upper survey areas found in 1989. Our spawning ground surveys areas may need to be extended to cover more lower river sections. 3) Zero aged juvenile steelhead on the North Fork of Asotin Creek and the Tucannon River were not as severely affected by drought conditions during 1987-1989 as on the South Fork of Asotin Creek. The greater magnitude of water and depth present in the North Fork Aotin Cr. and Tucannon as compared to the South Fork would reduce the affects of drought and high water temperatures. 4) Smolts planted from LFH may affect spawning escapement and ultimately the densities of juvenile fish found in rearing areas, however, rearing habitat quality and quantity appear to play a more important role. Another possibility may be that returning adults are not effectively spawning in SE Washington streams and therefore are having little effect on instream juvenile populations. We currently do not know.

Catchable Trout Program

Production of legal or catchable size rainbow trout at the Lyons Ferry/Tucannon complex totaled 226,690 fish weighing 91,829 pounds in 1989-90. The cumulative average weight for catchable trout was 2.5 fish per pound for fish released in spring 1990. Appendix D gives a listing of streams and lakes in Southeastern Washington which received compensation plan fish, the number and pounds of fish they received and the number of different stockings into each water. In addition, 138,146 Rainbow trout fry and fingerling weighing 11,780 pounds were reared for Idaho in 1989. This production level represented 120% of the program goal.

CONCLUSIONS

A helpful way to summarize is to list the overall evaluation objectives for this year and discuss the data collected to fulfill those objectives.

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

Rearing of steelhead at LFH went reasonably well, even with the wide variety of fish stocks and sizes to be reared due to IHNV losses. The large size of fish appeared to be a particular problem at the Dayton pond this year and may be due to the feeding rate, but also to the size of the Wells stock fish that were obtained from Ringold rearing station. Condition factors (K) at release was 1.3 for those fish, greater than was desired. Emigration from the Touchet River was negatively affected and will undoubtedly detract from adult returns.

Considerable effort was expended on sampling the level of smoltification of fish prior to release from the hatchery and conditioning ponds. There is a significantly greater number of transitional (incompletely smolted) fish in groups held in raceways at LFH. Also, samples collected from fish at several locations immediately prior to release indicate that fish held in conditioning ponds are more smolted than fish from ponds and raceways at LFH. Despite these results the performance of fish from Curl Lake Conditioning Pond (apparent poor passage at McNary Dam) continues to be unacceptable.

Because of the serious IHNV problems at LFH this year, we were unable to continue our feed comparison study with any hope of duplicating the 1989 release in either stock or size. We also delayed our size and time of release study for one year.

Objective 2: Document smolt and catchable trout releases, and evaluate smolt out-migration behavior and provide management recommendations.

Resident trout plants into 39 waters in SE Washington and fingerling production for Idaho were above goal for 1990. A shift in the program for Idaho from catchable size trout to fingerling and advanced fingerling production is going well.

We attempted to estimate smolt residualism in the Touchet and Tucannon rivers by using a modified Petersen mark/recapture method in the opening weeks of the sport trout season. Problems with angler selectivity for larger fish and differential catchability of marked and unmarked fish seriously hampered the results. We were unable to estimate residualism on the Touchet River but estimated only 2.2 % on the Tucannon. Our methodology needs refinement but the results on the Tucannon indicate a much lower level of residualism than we expected. We will repeat the work in 1991 with improved methods.

High water during the smolt emigration period in 1990 precluded any electrofishing to determine wild run timing. The smolt trap operated by WDF continues to be inefficient at trapping hatchery or wild steelhead. No useful smolt timing data was obtained. Any work in the future that may require accurate smolt enumeration and trapping for run timing will require improved methods and equipment.

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

This objective consumes a great majority of our time. The widely scattered fisheries require a large time investment to obtain a meaningful sample. We again concentrated on tag recovery during our creel efforts and utilized WDW sport catch estimates for steelhead harvest. Sample rates were much higher using this method and we believe it is a more appropriate type of sample.

Adults returning from our smolt releases contribute heavily to sport and commercial seasons throughout the Columbia River basin. The Zone 6 Indian Net fishery and Snake River and tributary sport fisheries harvest the greatest numbers of returning fish. Recovery of brands from Lower Granite Dam is very informative and provides one of our biggest sources of coded wire tag information in the Snake River.

Return rates of marked fish to Lyons Ferry Hatchery increased measurably in 1989. The performance of the Lyons Ferry stock of fish is good to the mid Snake area, however there continues to be considerable numbers of steelhead destined for LFH that move into the upper Snake drainage to winter, and don't ever return to the hatchery. These fish do contribute to sport fisheries in the wintering areas.

Based on recoveries of tags from fish released in 1986 and 1987, we have successfully met our mitigation goals as described under the LSRCP for total adults to return and for smolt to adult survival. The Tucannon River releases continue to return at a minimum level to meet its goal and there remains a significant straying problem of fish from all release areas to far up the Snake River and its tributaries.

Spawning surveys were marginally successful because of heavy rains in late April and early May. All tributaries were surveyed except Meadow Creek in the Tucannon drainage and Mill Creek in the Walla Walla drainage.

Objective 4: Estimate juvenile age class densities on selected streams as an indicator of any increased spawning escapement and success.

We conducted electrofishing surveys for juveniles on Asotin Creek and the Tucannon River. Long term trends in juvenile populations in these rivers from 1983-1989 show widely fluctuating populations and densities of 0 age fish but stable or increasing populations of >0 age fish. There does appear to be a relationship between spawning escapement and 0 age densities. We have concluded that improved habitat in all the streams, that is provided by instream structures built in 1983-85, is supporting stable or significantly greater populations of older age (>0 age) rainbow/steelhead trout. These structures appear to be providing rearing area to support 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.

A full presentation of the data and discussion of our results based on a statistical analysis of the effectiveness of instream habitat structures is presented in Viola et al. (1991).

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Appendix A.

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

<u>Approach</u>: Lyons Ferry Hatchery (LFH) was designed to produce 116,400 pounds of smolts annually at 8 fish/pound. The original goal of 8 fish/lb smolt releases does not appear to be the best size for smolt survival through the river system or for adult returns. WDW management goals have also changed with improved fish cultural practices that allow rearing a much larger smolt. Determining if a more cost efficient means of rearing the smolts without affecting smolt quality or adult returns will now be an integral part of the objective. A 3-year feed comparison study was begun in 1988. Two groups will be reared throughout the year; Group 1 will be fed the OMP diet that has been used in past years and Group 2 will be fed a dry feed at a similar feeding rate. Monthly samples will be taken of both groups to monitor growth rates and fish health under current hatchery programs. This monitoring will continue. Smolt size and condition will be checked at release to determine if any major physical differences are evident. Both groups will receive coded wire tags and freeze brands to allow measurement of return rates to the hatchery. Blood physiology and gill ATPase samples will also be taken at release to measure if there is any difference in degree of smoltification that can be attributed to feed type.

Multiple stocks of steelhead will continue to be cultured at the hatchery; one long-term hatchery stock and at least one wild/natural-origin stock to be used in upper Snake River tributaries. Relative performance of juvenile fish in the hatchery may be an indicator of long-term adult performance. All aspects of hatchery operation will be monitored. Recommendations for changes in hatchery procedure will be made, if necessary, to improve returns. Work on this aspect of the program will be ongoing.

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

Task 1.11. Sample 150 fish monthly of each separately reared group for mean fork length and weight, in millimeters and grams respectively.

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

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

a. disease
b. avian predators
c. stocking estimate errors

1. Compare hatchery estimates (weight/count and volume) with more precise individual weight and known number of fish samples.

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

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

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

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

Subobjective 1.2. Determine condition of hatchery smolts at time of release.

Task 1.21. See task 1.14.

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

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

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

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

Subobjective 1.3. Compare juvenile growth and development of fish fed dry feed to fish fed the standard OMP diet, and determine if differences negatively affect adult returns.

Task 1.31. See tasks 1.11, 1.14, 1.24, 1.25, 2.11, 2.12

Task 1.32. Compare costs of rearing smolts using dry feed with costs for using OMP.

Task 1.33. Monitor adult returns of the two separate feed study groups to LFH and determine if there are any statistical differences in returns attributable to feed type.

Task 1.34. Provide an annual update on smolt performance from the two groups and determine the preferred feed for LFH based on smolt and adult performance.

B. **Objective 2. Document smolt and resident trout releases, and evaluate smolt out-migration behavior, and provide management recommendations.**

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

Subobjective 2.1. Document numbers, size, time of release, methods, and location of steelhead smolt and resident trout plants, and evaluate steelhead out-migration performance.

Task 2.11. Tag and brand representative groups from each major release area within the restrictions of hatchery holding space. Minimum group size of 20,000 fish will be used to ensure adequate tag return; a total of approximately 240,000 will be branded/tagged.

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

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

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

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

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

Subobjective 2.2. Attempt to determine reasons for Lyons Ferry brood stock releases bypassing the hatchery outlet.

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

Task 2.22. Release test groups of smolts from conditioning ponds and from the hatchery. Conduct physiological samples of smolts at release (Task 1.25) to measure any differences in smoltification that might explain apparent straying behavior.

Subobjective 2.3. Attempt to determine outmigration timing and condition of wild or naturally produced steelhead smolts.

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

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

C. **Objective 3. Estimate adult returns to down-river and terminal areas (streams, ocean harvest, sport, commercial and treaty indian harvest, hatcheries, escapement) as a measure of compensation success.**

Approach: Adult returns are the goal of the LSRCP program. Measuring adult returns to the point of release and to other intermediate or terminal areas is necessary to determine program progress. Adult harvest will be sampled in appropriate main river and terminal area commercial, treaty Indian and sport seasons through existing state and federal programs and analyzed using CWT data.

Continuance of downriver sampling programs is essential for a complete, accurate evaluation of compensation goals achievement. Terminal harvest within the LSRCP area will be estimated using existing WDW punch card estimates corrected for bias. Percent of LFH's contribution to harvest and escapement will be computed. Two methods to assess spawning escapement will be compared. Redd counts in established stream areas will continue as will adult trapping and enumeration in some areas. Comparison of the two will allow WDW to properly manage existing native stocks in concert with expected hatchery returns.

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

Task 3.11. (Same as Task 2.11)

Task 3.12. Compile and analyze sample data from Columbia River and Snake River adult sampling stations to determine regional return rates for marked groups. (see Subobjective 3.3).

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

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

Task 3.22. Compare adult returns to LFH from Wells and Wallowa broodstock releases made in 1983 through 1986.

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

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

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

Subobjective 3.3. Estimate sport and commercial harvest of returning adults.

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

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

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

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

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

Subobjective 3.4. Estimate spawning escapement.

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

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

Asotin Creek	Tucannon River
Charlie Creek	Cummings Creek
S.F. Asotin	Panjab Creek
N.F. Asotin	Meadow Creek
George Creek	Bear Creek
Touchet River	Walla Walla River
S.F. Touchet	Miller Creek
N.F. Touchet	
Wolf Fork	
Robinson Fork	

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

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

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

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

Because of rapidly expanding interest in habitat improvement in the Northwest to improve salmonid populations, a separate report detailing the results of these improvements on resident trout populations may be helpful. Data collected in 1989 would be combined with 1983-84 data, analyzed and provided under a separate cover from the annual report.

Subobjective 4.1. Estimate populations of salmonids in streams for both treatment and control sites. Compare trout densities for these areas with pre-treatment densities. Assess the durability and current status of the structures.

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

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

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

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

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

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

Subobjective 4.2. Conduct creel survey of Asotin Creek and the Tucannon River to determine the number and composition of catchable hatchery and native trout in the creel and any differential use of areas.

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

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

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

Task 4.24. Tucannon River (same as tasks 4.21-4.23)

Subobjective 4.3. Compare the data collected with pretreatment and control site data to determine if measurable increases in trout populations and habitat quality due to habitat improvement have occurred. Write a separate report providing these results.

E. **Objective 5. Write annual report of all activities listed in objectives 1-4 and evaluate effectiveness of approach and tasks for satisfying all objectives.**

Approach: Timely analysis of data is critical to the continuity and efficacy of the evaluation program. Completion of an annual report should precede the budgeting process for subsequent years. Results should guide changes that may be necessary in programs and their budgets. The current contract reporting period has been adjusted to more appropriately represent a production/return year for the hatchery. This also allows data analysis and report writing to be done between, not during, important field data collection periods.

Task 5.1. Provide a summary progress report of activities for the agreement period by July 1, 1990.

Task 5.2. Assemble results from all tasks, analyze all data collected, and draft detailed report for FWS review by October 1, 1990.

Task 5.3. Provide 10 copies of the final report to FWS by January 1, 1991.

Appendix B

Table 1. Gamefish population and density information from sites electrofished by WDF personnel, summer and fall 1989.

SITE TYPE (Date)	AGE[A]	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
WILDERNESS (Above Panjab Cr.)								
3 Pool	0+	2	0		2	---[B]	43.2	4.6
(7-27)	1+	2	1		3	3.2		6.9
	2+	2	1		3	3.2		6.9
	TOT	6	2		8	2.0		18.5
7 Pool	0+	8	0		8	---[B]	127.2	6.3
(7-27)	1+	2	0		2	---[B]		1.5
	2+	0	1		1	---[B]		0.7
	TOT	10	1		11	0.7		8.6
	BT	0	1		1	---[B]		0.7
	WF	2	0		2	---[B]		1.5
10 Run	0+	9	5		14	10.3	106.1	13.2
(7-25)	1+	7	0		7	---[B]		6.5
	2+	2	0		2	---[B]		1.8
	TOT	20	5		25	2.4		23.5
	AD	2	0		2	---[B]		1.8
	BT	2	0		2	---[B]		1.8
11 Pool	0+	1	1		2	12.7	144.0	1.4
(7-19)	1+	3	1		4	1.9		2.7
	TOT	4	2		6	2.7		4.2
	WF	1	0		1	---[B]		0.7
12 Riffle	0+	1	1		2	12.7	84.8	2.3
(7-20)	1+	0	0		0			---
	2+	2	0		2	---[B]		2.3
	TOT	3	1		4	1.9		4.7
HMA(Habitat Mgmt. Area H.Q. to Panjab Cr.)								
1 Riffle	0+	33	7		40	4.5	167.3	23.9
(8-01)	1+	8	2		10	1.7		5.9
	TOT	41	9		50	4.7		29.8
2 Boulder	0+	15	1		16	0.6	249.1	6.4
(8-01)	1+	7	0		7	---[B]		2.8
	TOT	22	1		23	0.5		9.2
	BT	1	0		1	---[B]		0.4
3 Run	0+	14	3		17	1.8	115.2	14.7
(8-02)	1+	8	3		11	2.5		9.5
	2+	1	0		1	---[B]		0.8
	TOT	23	6		29	4.8		25.2

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
4 Pool (8-03)	0+	8	4	0	12	1.2	133.5	8.9
	1+	6	0	1	7	0.8		5.2
	2+	1	0	1	2	13.2		1.5
	TOT	15	4	2	21	1.7		15.7
5 Riffle (8-02)	0+	68	4		72	---B	203.1	35.4
	1+	17	3		20	1.6		9.8
	2+	5	0		5	---B		2.5
	TOT	90	9		99	1.9		48.7
6 Riffle (8-02)	0+	38	7		45	4.2	103.0	43.6
	1+	12	5		17	5.9		16.5
	2+	3	0		3	---B		2.9
	TOT	53	12		65	6.9		63.1
7 Boulder (9-21)	0+	2	1		3	3.2	187.5	1.6
	1+	11	2		13	1.4		6.9
	2+	1	0		1	---B		0.5
	TOT	15	3		18	1.7		9.6
	AD	1	0		1	---B		0.5
8 Pool (8-03)	0+	16	11		27	50.8	127.0	21.2
	1+	4	4		8	26.9		6.3
	2+	4	4		8	26.9		6.3
	TOT	24	19		43	166.1		33.8
9 Riffle (8-07)	0+	24	9		33	10.6	227.0	14.5
	1+	16	3		19	1.6		8.4
	TOT	40	12		52	7.6		22.9
10 Run (8-07)	0+	24	7		31	5.2	140.0	22.1
	1+	7	8		15	---C		10.7
	2+	0	1		1	---B		0.7
	TOT	31	16		47	16.6		33.5
11 Boulder (8-29)	0+	23	5		28	2.3	200.0	14.0
	1+	10	4		14	5.8		7.0
	2+	0	1		1	---B		0.5
	TOT	33	10		43	6.7		21.5
12 Pool (8-29)	0+	20	5		25	2.4	168.1	14.8
	1+	22	3		25	1.4		14.8
	2+	3	2		5	3.3		2.9
	TOT	45	10		55	4.7		32.7
	AD	2	2		4	4.5		2.3
	BT	0	3		3	---B		1.7

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m^2)	DENSITY (FISH/100m^2)
13 Riffle	0+	27	5	0	32	0.6	184.3	8.6
(8-07)	1+	4	2	1	7	2.1		1.8
	2+	1	0	0	1	---[B]		0.3
	TOT	32	7	1	40	1.0		10.8
14 Run	0+	15	0		15	---[B]	93.4	16.1
(8-08)	1+	5	2		7	2.3		7.5
	TOT	21	2		23	0.9		24.6
	AD	1	0		1	---[B]		1.1
	BT	1	0		1	---[B]		1.1
15 Boulder	0+	15	3		18	1.7	162.0	7.0
(9-14)	1+	17	2		19	1.1		7.4
	2+	2	0		2	---[B]		0.7
	TOT	34	6		40	1.0		15.6
	AD	0	1		1	---[B]		0.4
	BT	2	0		2	---[B]		0.7
16 Pool	0+	26	0	1	27	0.2	177.6	15.2
(8-09)	1+	4	1	1	6	1.7		3.4
	2+	1	3	0	4	3.1		2.3
	TOT	31	4	2	37	1.0		20.8
	BT	1	1	0	2	---[B]		1.1
17 Boulder	0+	35	4		39	1.4	180.0	21.6
(8-28)	1+	18	5		23	4.9		12.7
	2+	3	0		3	---[B]		1.6
	TOT	56	9		65	4.2		36.1
18 Riffle	0+	41	1		42	0.3	26.4	33.2
(8-10)	1+	4	1		5	1.5		3.9
	2+	1	0		1	---[B]		0.7
	TOT	46	2		48	0.6		37.9
Run	0+	59	8		67	2.2	191.0	35.1
(8-15)	1+	7	1		8	0.9		4.2
	2+	1	0		1	---[B]		0.5
	TOT	67	9		76	3.8		39.7
	WF	2	0		2	---[B]		1.0
20 Riffle	0+	69	3		72	0.7	151.0	37.6
(8-21)	1+	11	5		16	6.2		8.4
	2+	1	4		5	---[C]		2.6
	TOT	82	12		94	4.3		49.2
	AD	1	0		1	---[B]		0.5

Appendix B Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	2	3	POPULATION (N)	95% CI	AREA (m²)	DENSITY (FISH/100m²)
21 Pool	0+	24	8		32	7.8	116.7	27.4
(8-21)	1+	12	3		15	1.9		12.8
	2+	13	0		13	---B		11.1
	TOT	49	11		60	4.8		51.4
	AD	1	1		2	12.7		1.7
	BT	2	1		3	3.2		2.5
22 Pool	0+	24	7	0	31	1.0	119.0	26.1
(8-17)	1+	5	1	0	6	0.4		5.0
	2+	6	1	0	7	0.3		5.8
	TOT	35	9	0	44	1.0		36.9
	WF	1	0	0	1	---B		0.8
23 Boulder	0+	14	4		18	2.4	175.2	10.3
(9-19)	1+	14	3		17	1.8		9.7
	2+	2	1		3	3.2		1.7
	TOT	30	8		38	5.2		21.6
	AD	1	0		1	---B		0.5
24 Run	0+	26	3		29	1.3	108.0	26.8
(8-17)	1+	12	1		13	0.6		12.0
	2+	1	1		2	12.7		1.8
	TOT	39	5		44	1.6		40.7
	BT	1	0		1	---B		0.9
HMAS (side channels within the HMA)								
1-S	0+	13	8		21	23.3	50.1	41.9
(8-29)	1+	5	2		7	2.3		13.9
	TOT	18	10		28	19.1		55.8
	AD	1	0		1	---B		1.9
2-S	0+	5	2		7	2.3	86.0	8.1
(8-10)	1+	10	3		13	2.2		15.1
	2+	2	1		3	3.2		3.4
	TOT	17	6		23	5.5		26.7
	BT	1	0		1	---B		1.2
	WF	2	0		2	---B		2.3
3-S	0+	13	1		14	0.6	36.5	38.3
(8-15)	1+	5	0		5	---B		13.6
	2+	4	0		4	---B		10.9
	TOT	22	1		23	0.5		63.0
4-S	0+	8	2		10	1.7	132.1	5.9
(8-28)	1+	3	2		5	3.3		2.9
	2+	4	1		5	1.5		2.9
	TOT	15	5		20	4.4		11.8
	AD	4	1		5	1.5		2.9

Appendix B, Table 1. (cont.)

SITE TYPE (Date)	AGE	PASS 1	PASS 2	PASS 3	POPULATION (N)	95% CI	AREA (m²)	DENSITY (FISH/100m²)
5-S (8-30)	0+	8	3	0	11	2.5	41.1	26.7
	1+	2	0	1	3	3.1		7.3
	2+	3	2	0	5	3.3		12.2
	TOT	13	5	1	19	1.6		46.2
	WF	0	1	0	1	---B		2.4
6-S (8-10)	0+	12	3		15	1.9	96.4	15.5
	1+	6	1		7	1.0		7.3
	2+	2	1		3	3.2		3.1
	TOT	20	5		25	2.4		25.9
	AD	1	1		2	12.7		2.1
HARTSOCK (HMA H.Q. to Hartsock grade)								
2 Run (7-25)	0+	8	0	1	9	0.6	128.4	7.0
	1+	4	2	2	8	7.0		6.2
	2+	0	0	1	1	---B		0.7
	TOT	12	2	4	18	5.2		14.0
5 Riffle (7-18)	0+	17	11	4	32	10.3	209.6	15.3
	1+	1	0	0	1	---B		0.5
	TOT	18	11	4	33	10.0		15.7
6 Run (7-18)	0+	24	8		32	7.8	161.6	19.8
	1+	3	0		3	---B		1.8
	TOT	27	8		35	7.5		21.6
8 Riffle (7-19)	0+	35	15		50	22.1	246.2	20.3
	1+	10	3		13	2.2		5.3
	2+	1	0		1	---B		0.4
	TOT	46	18		64	14.0		25.9
	AD	1	0		1	---B		0.4

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 B, Table 2. Other Game Fish Species Data.

SITE	Species[A]	Lengths (wt)in g.) (mm)
WILD 7	BT	184
10	BT	165,149(40)
11	BT	139(26.8)
HMA		
2	BT	174(62.0)
12	BT	148,231,268
14	BT	325
15	BT	305,260
16	BT	247,230
19	WF	53(0.5),62(2.1)
21	BT	220
22	WF	65
24	BT	169
HMA-Side channels		
2	BT	147
	WF	49(1.0),66
5	WF	66(2.6)
HART		
7	WF	390,400

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

Appendix C: Brand and tag recoveries from the trap at LFH during the 1989 run year.

Brand	Stock	Release Year	Actual Tag Return
RA-IF-1	LFH*	1987	58
RA-IF-3	LFH		60
LA-IF-1	WALLOWA		2
LA-IF-3	WALLOWA		4
RA-IY-1	LFH		19
RA-IY-2	LFH		3
RA-IY-3	LFH		11
RA-IC-1	WALLOWA		0
RA-IC-2	WALLOWA		0
RA-IC-3	WALLOWA		1
RA-IC-4	WALLOWA		0
Total			158
LA-S-1	LFH	1988	57
LA-S-2	LFH		73
RA-S-1	LFH		59
RA-S-2	LFH		76
LA-IV-1	LFH		38
LA-IV-3	LFH		35
RA-IV-1	LFH		31
RA-IV-3	LFH		44
LA-H-1	LFH		2
RA-H-1	LFH		5
RA-H-2	LFH		5
Total			425

* Lyons Ferry Hatchery Stock.

Appendix D:

Rainbow and G.Brown Trout Plants, Lyons Ferry/Tucannon, 1990.

COUNTY	LOCATION	No.of Plants	Pounds of Fish	No. Fish Planted
ASOTIN	Alpowa Ck.	1	360	1,044
	Asotin Ck.	1	1,470	3,969
	Golf Course Pd.	4	4,710	11,104
	Headgate Pd.	2	1,060	2,984
	Silcott Pd.	3	1,830	4,387
	W.Evans Pd.	3	2,030	4,807
	TOTAL		11,460	28,295
COLUMBIA	Big Four	1	1,800	3,960
	Blue Lk.	5	6,310	15,551
	Blue Lk.(GB)	1	840	2,688
	Curl Lk.	2	4,760	12,376
	Dam Pd.	2	1,087	2,042
	Dayton Jv.Pd.	2	680	1,972
	Deer Lk.	5	7,650	17,801
	Orchard Pd.	2	477	1,001
	Rainbow Lk.	5	9,250	22,562
	Spring Lk.	4	6,340	15,288
	Spring Lk.(GB)	1	645	1,742
	Touchet R.(GB)	1	5,280	10,829
	Tucannon R.	1	6,870	18,549
	Watson Lk.	3	4,335	10,075
	TOTAL		49,559	121,177
FRANKLIN	Big Flat	1	2,000	5,000
	Marmes Pd.	1	208	499
	TOTAL		2,208	5,499
GARFIELD	Bakers Pd.	1	320	864
	Casey Pd.	1	380	1,102
	Coles Pd.	1	380	1,102
	Pataha Ck.	2	1,480	4,148
	TOTAL		2,560	7,216
WALLA WALLA	Blue Creek	1	210	609
	College Pl. Pd.	2	960	2,652
	Coppei Ck.	1	510	1,479
	Dry Ck.	1	510	1,479
	Fishhook Pk. Pd.	2	2,740	7,914
	Jefferson Pk. Pd.	2	960	2,652
	Mill Ck.	1	1,920	5,184
	Quarry Pd.	3	9,580	24,071
	TOTAL		17,390	46,040
WHITMAN	Alkali Ck.	1	200	540
	Garfield Pd.	1	510	1,530
	Gilcrest Pd.	2	1,085	3,025
	Klemgard Pd.	1	770	2,002
	Pampa Pd.	2	4,355	8,870
	Riparia Pd.(RB)	1	417	1,001
	Riparia Pd.(GB)	1	760	1,368
	Union Flat Ck.	1	575	1,495
	TOTAL		8,652	13,899
	Total Rainbow		91,829	226,690
	Total German Brown		7,525	16,627
	GRAND TOTAL		99,354	243,317