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LYONS FERRY EVALUATION STUDY
1991–92 ANNUAL REPORT

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FISHERIES MANAGEMENT DIVISION
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ABSTRACT

Total steelhead production at Lyons Ferry Hatchery (LFH) in 1991 was 631,002 summer steelhead weighing 145,796 pounds for an average smolt size of 4.3 fish/lb. A total of 218,917 rainbow trout weighing 97,264 pounds were planted into 40 waters for an average size of 2.25 fish/lb. Additionally, 181,494 fish weighing 5,180 pounds were reared and provided to Idaho as part of the LSRCP mitigation program.

Five study groups of branded, coded wire tagged and fin clipped juvenile steelhead were released into two rivers. Production releases of juvenile steelhead were fully developed at release with 95-98% of fish being smolted or transitioning to smolting. All groups of marked fish traveled downstream more slowly than in past years, likely a result of drought flows in 1992.

The final adult returns of tagged fish released as part of an OMP vs DRY feed comparison study were trapped at LFH. The two groups returned at nearly identical survival rates, however, a difference was observed in the adult age at return between the groups.

A total of 2,035 adult steelhead were trapped at LFH in the summer and fall of 1991. Females comprised 66.2% of fish trapped. One-salt aged fish represented only 38.5% of all fish trapped, a significantly lower percentage than in previous years. Passage of tagged fish at Lower Granite Dam continues to show substantial straying of all groups of fish released into S.E. Washington streams.

Creel surveys were conducted on many streams to recover coded wire tags from study fish. Estimates of angler effort, harvest and tagged fish harvest are summarized. Total returns of adults to the LSRCP area were significantly higher than the 0.5% smolt-to-adult survival goal in the LSRCP for the Snake and Touchet rivers and significantly lower for the Tucannon River. We estimated that LSRCP production returned 7,163 adults to the basin in 1991, 154% of the goal.

Trends in natural populations of steelhead in LSRCP streams between 1983-1992 shows substantial variation in age class abundance between years with a slight general decrease in total populations levels. Adult spawning escapement estimates are highly variable, likely due to river conditions during surveys. Overall escapement appears to have decreased in recent drought years.

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 his crew for their leadership in the joint Grande Ronde River creel census and for providing the statistical analysis and tag expansions.

A perennial thanks to Jerry Harmon and the other NMFS personnel at Lower Granite Dam for their professional and diligent reading of brands on returning adult steelhead. Their data proves invaluable each year in understanding the behavior of our returning steelhead.

John Johnson and Jason Mings spent months tracking down anglers and removing snouts from coded wire tagged steelhead. Their work forms the basis for the most tedious, but very important sport recovery portion of our tag recovery effort. We sincerely appreciate their efforts.

We would like to thank John Hisata, John Kerwin and Daniel Herrig for reviewing the draft manuscript and providing invaluable comment and direction.

Finally we would like to express our special appreciation to the managers and staffs of Lyons Ferry and Tucannon hatcheries for their support and hard work at making Washington's LSRCP program a success and to the Staff of the LSRCP office for their firm support and the funding of these studies.

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INTRODUCTION

This 1991-92 annual report is one of a series describing Washington Department of Wildlife's (WDW) progress toward meeting mitigation goals established for the Lower Snake River Compensation Plan (LSRCP). The study period for this report was 1 July 1991 through 30 June 1992. The LSRCP program began in Washington in 1981 with construction of Lyons Ferry Hatchery (LFH). Refurbishing of the Tucannon State Hatchery in 1984-85 followed and completed the production facilities for trout and steelhead. Three remote acclimation ponds were constructed along the Tucannon, Touchet and Grande Ronde rivers to allow acclimation of smolts prior to release. These facilities form the basis for WDW's mitigation program around which the evaluation program works. The results of evaluation studies presented are an attempt to answer the questions of whether mitigation goals have been met, what problems exist in the program that may eventually cause problems for natural salmonid populations and the mitigation program, and what actions can be taken to improve the hatcheries' productivity. An additional report presenting the results of studies on steelhead residualism and residual steelhead predation on juvenile salmon has been provided under separate cover (Martin et al. 1993).

The final results from our 1988-89 feed study are presented and discussed. This study looked at the effects of feed type on juvenile growth and smolt to adult survival rates to point of release (Lyons Ferry Hatchery).

Collection of coded wire tags from LFH origin steelhead occurred in several sport and commercial fisheries from Canada to Idaho. Lower Columbia River and Snake River sport fisheries and the Zone 6 Indian net fishery were most successful in harvesting LSRCP fish.

Development of a new Tucannon River broodstock began in 1991. Tagged releases of this stock will be carefully monitored to assess behavior upon return. It is hoped that substituting this stock for the existing LFH stock will improve homing performance to the Tucannon River. Evaluation of the development process is expected to continue to the next 5-6 years.

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. Pre-release fork lengths in millimeters and weight in grams are taken from a sample of each group and a visual determination of whether the fish is a smolt, transitional smolt, parr or precocious males is also noted. A detailed description of the sampling is available in our 1983 annual report (Schuck 1985).

Fish Marking Program

Four 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 contributions and return rate studies, 3) nitrogen freeze branding of all tagged fish to allow easy identification of smolts and returning adults without sacrificing the fish, and 4) left ventral only fin clipping of endemic stocks to identify hatchery origin returning adults while restricting sport harvest.

Adipose clipping was completed during August/September 1991 by hatchery and temporary personnel, just prior to their transfer into the large rearing ponds. We contracted with Washington Department of Fisheries (WDW) to conduct our coded wire tagging and branding program. Tagging and branding was accomplished during February 1992. Tag loss was determined by sampling 1,000 fish from each group with a portable cwt detector. Brands were visually examined for their presence and quality (light, burned, location). Tag codes and brands are reported to the Pacific States Marine Fishery Commission (PSMFC) for publication in their annual report.

Fish at Release

Multiple release methods were used in 1992: 1) brood stock smolt releases from Lyons Ferry were allowed to volitionally outmigrate from the rearing ponds, 2) fish were pumped from the

release structure into tank trucks and hauled directly to various streams and rivers in Southeast Washington, 3) fish were pumped from the release structure into tank trucks, then transferred to conditioning ponds on the Tucannon, Grande Ronde and Touchet Rivers. After 5-8 weeks in the conditioning pond fish were allowed to volitionally emigrate over a two week period before the remaining fish were forced from the ponds.

The release of fish from conditioning ponds along with similar direct stream releases occurred again this year for a comparison of smolt response. This was the third 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). Sampling frequencies was similar to that done in 1990. Residualized fish were again sampled from the streams when migrating fish were collected at the first collector dam (McNary). A comparison of the physical attributes of smolts collected at the Dam and residual smolts sampled in the release streams was presented and discussed by Martin et al. (1993).

Lyons Ferry Hatchery Feed Study

In response to the request for a feed change, a diet comparison study was devised to compare juvenile (fry to smolt) and adult (smolt to adult survival) performance of groups of fish fed Moore Clark Dry Salmon Diet and Silver Cup OMP Trout Diet beginning 1 October 1988.

Early rearing and feeding practices of juvenile steelhead remained unchanged for the study. That is, swimup fry were fed a dry crumble starter feed in the hatchery then converted to OMP when moved outside to raceways. The OMP ration was based on a WDW feeding optimization program (Pro-Ped). Fish were programmed to be 5.0 fish per pound at release on May 1, 1989.

All fish were reared in raceways until September 1, 1988 when adipose clipping was completed and fish were transferred into rearing ponds by September 10, 1988.

All fish continued to receive OMP ration until 1 October, when rearing pond #2 was converted to the dry diet. Average lengths, weights and condition factor (K) were computed for each of the study groups on October 1. Monthly samples of 150 fish were collected until release to monitor growth within the two ponds. During February of 1989, 50,000 fish from each rearing pond were removed, coded wire tagged and freeze branded. The tagged fish were held in raceways for another three weeks until final tag loss and brand quality samples were completed and the remaining fish in two rearing ponds were removed to conditioning ponds. The two separate groups were then returned to rearing ponds and to complete their rearing. Smoltification samples of gill ATPase, blood thyroxin (T_4) and physical morphometry (Goede's Organosomatic Index) were collected prior to release as well as length, weight, condition factor and a visual determination of development (parr, transitional, smolt, precocious male).

Both ponds were drained in late April and the groups released into the Snake River at Lyons Ferry Hatchery on 30 April 1989. Adults returning to the ladder and trap at LFH during the 1990 and 1991 run years were used to determine smolt to adult survival rates. Numbers of tagged fish passing Lower Granite Dam would also be documented to determine whether there was a different return or behavior pattern of adults within the river.

The original study design called for three consecutive years of the test. A catastrophic virus outbreak in 1990 and a water supply failure to the hatchery in 1991 prevented the study from being completed. The results from 1989 are presented here with the understanding that conclusions from a single years test may not be representative of fish performance over a wide range of conditions that may be encountered among release years.

Preliminary juvenile growth data, sizes at release, Goede's Organosomatic data and the smoltification information was reported in our 1988-1989 Annual Report (Schuck et al. 1990). The second year of adult returns to the Snake River basin is presented in this report, as well as

adult returns from 1990.

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, personnel., 1992). Adults coming into the trap were sampled for marks and brands.

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 time when steelhead were migrating past the hatchery and could have entered the trap. All captured fish were retained until December of 1992 when they were sorted for spawning purposes. Fish that were identified as destined for upstream hatcheries, injured fish and fish not needed for broodstock were returned to the river to spawn naturally.

Adult steelhead returns to spawning grounds

Results from spawning ground surveys conducted from 1989 through 1991 indicated that we were underestimating the actual number of redds constructed by spawning steelhead that returned to the LSRCP area (Schuck et al. 1991). The method used to estimate the number of redds per mile prior to 1992 consisted of a complete survey of the river at the beginning of spawning season and another complete survey at the end of spawning season. Often high water flows and turbid conditions precluded the second survey at the end of season. Many redds that were constructed during this period of high flows became unrecognizable prior to our second survey. This inability to account for steelhead redds that were constructed but became eradicated during periods of high water flows prior to being surveyed was the reason for our underestimates in previous years. To overcome this problem in the spring of 1992 we used index sites to gather information that would allow us to estimate the number of redds that became unrecognizable. Weekly surveys of these index sites allowed close observation of redd construction and deterioration over time. We were able to determine the beginning, peak and end of spawning

activity as well as redds that were constructed the year before but were still recognizable.

Three, two mile long index sites were established in areas of historically high spawning activity within the upper, middle and lower sections of each river. Index sites were walked weekly and all redds were observed. All new redds were recorded and marked with flagging tape containing the date and survey number. Notes were recorded concerning the condition of all previously constructed redds. An effort was made to have the same person walk the same index site each week so that he became familiar with the site and redd locations. After the majority of all spawning activity had taken place, a survey of 50% of each river (every other mile), plus index sites, was made. Redds per mile were calculated by doubling the number of redds observed during the survey of 50% of the river and then adding a calculated percentage of redds based on information collected during index site surveys to account for redds that were constructed but became unrecognizable. Then dividing the total number of redds by the total miles surveyed from each river.

Tucannon Hatchery Weir/Trap

We trapped both hatchery and wild steelhead in the Tucannon River, December 1991 through May 1992. We were able to document the number of wild and hatchery fish that were returning to spawn above the weir. Also, every fifth wild fish of both females and males was kept for spawning at the hatchery.

Steelhead Creel Surveys

Creel surveys of the steelhead sport fishery within the LSRCP area were conducted during the entire consumptive fishery on the Snake River and its tributaries. Sport fishing for steelhead was allowed from September 1, 1991 through March 31, 1992 on the Snake River and September 1, 1991 through April 15, 1992 on the tributaries to the Snake. Regulations required wild steelhead release, with daily catch, possession and annual limits of 2, 4 and 30 steelhead, respectively.

A joint creel survey of the upper Grande Ronde was conducted by ODFW and WDW personnel. Angler effort, catch rates, harvest and coded wire tag recoveries and expansions were calculated by ODFW as described in Carmichael et al. (1988).

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

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

   a) Sample the sport harvest and collect information on the number of both CWT and non-tagged steelhead harvested. Collect the snouts from all CWT /LV clipped fish for tag removal. Examine coded wire tags and identify the release location, agency, and date for all marked steelhead observed in the catch.

   b) calculate a sample rate by dividing the sum of both tagged and untagged steelhead sampled during the creel surveys by the estimated total sport harvest. The latter is determined from Washington Department of Wildlife punchcard estimates of sport harvest

   c) Expand for each LFH origin tag code sampled in the creel survey by dividing the number of fish sampled per each LFH origin tag code by the sample rate.

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

3. Estimate angler exploitation rates for groups of adult Lyons Ferry Hatchery steelhead. Information is also collected on angler effort and catch rates: hrs/fish caught, hrs/fish kept and total harvest of all steelhead within the LSRCP area.

Trends in Juvenile steelhead density, population size 1983-1992.

The following sections of the North and South Forks of Asotin Creek and the Tucannon River were identified as juvenile steelhead density and population index sections:

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

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

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

Juvenile steelhead densities from six specific sites within index areas were, in recent years, (1991 and 1992) obtained from field sampling specifically for the purpose of monitoring trends in juvenile steelhead abundance. Juvenile steelhead densities from these same sites within index areas from years earlier than 1991 were extracted from reports concerning field work performed for other purposes (Mendel 1984, Mendel 1985, Schuck and Mendel 1987, Schuck et al. 1988, un-published Washington Department of Fisheries 1990 data, Schuck and Viola 1990, Schuck and Viola 1990 and Viola et al. 1991).

During 1990 and 1991 annual electrofishing surveys of six sites within each river index section have provided juvenile steelhead trend information for each sample year. Three of the six sites sampled within each river index section were located in areas of artificial habitat improvement, the other three in areas where the habitat had not been altered. Mean densities (#/100 m2) for both 0 aged and greater than (>0) 0 aged juvenile steelhead were calculated for both improved and unimproved areas. Population estimates for both 0 aged and >0 aged juvenile steelhead were calculated by multiplying mean densities times river surface area in 100 m^2 annually available within improved and unimproved sections. A total population estimate for both 0 aged and >0 aged juvenile steelhead was calculated as the sum of the populations estimates from both the improved and unimproved areas. These estimates were then divided by the total area available within the entire index river section for that year. This provided a density per 100 m^2 for each age class.

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, 1991-92.

Lyons Ferry Hatchery

Species [A]	Stock [A]	No. Eggs	No. Fry	No. Produced	% [B] Survival	Fish lbs. Produced
SSH	WAL	451,317	435,855	269,285 [C]	59.7	44,000
SSH	LFH	1,296,241	1,115,368	449,725 [D]	34.7	88,134
RB	SPOK.	402,000	388,125	321,332 [E]	80.0	44,744

Tucannon Hatchery

RB (91)	SPOK.	105,600	--	98,884 [F]	93.6	2,562
RB (90)	SPOK.	216,000	--	145,226	67.2	56,385
GB (90)	FORD	25,212	--	26,507	100	6,195
SSH	TUC.	14,504	--	9,958	68.7	2,075
SSH	OXBO	293,500	--	296,400 [G]	100	520
RB (92)	SPOK.	101,500	--	91,120 [H]	89.8	440

A - RB = rainbow, SSH = summer steelhead, GB = german brown; SPOK = spokane, LFH = Lyons Ferry Hatchery, WAL = Wallowa, TUC = Tucannon, OXBO = Oxbow (Hells Canyon)

B - egg to smolt survival rate.

C - 132,000 fish lost to avian predators

D - 172,000 fish lost to avian predators: 92,116 fish weighing 3,476 lbs planted as sub-smolts.

E - 181,494 fish weighing 5,180 lbs transferred to IDFG : 55,286 fish weighing 382 lbs planted in Sprague Lake: 21,000 fish weighing 600 lbs planted in Deer Lk, Stevens Co.

F - 12,584 fish weighing 1,210 lbs transferred to LFH for rearing (included in Tucannon Production and % survival): 35,420 fish weighing 115 lbs planted into Rock Lake.

G - 296,400 fish weighing 520 lbs planted in Rock Lake.

H - 91,120 fish weighing 420 lbs planted in Rock Lake.

Egg-to-fry survival for steelhead was highly variable for groups in 1992 (Table 2). Wallowa/ Cottonwood stock fish were utilized heavily this year for the first time, however poor egg quality resulted in a 64% green egg loss. Over-ripe eggs, sperm quality and excessively warm weather during spawning are suspected to have been the causes of the loss. Severe IHN epizootics in two takes of LFH stock shortly after hatching forced us to destroy all of those fish and reduced survival to 33.6%.

Table 2. Egg to fry survival, Lyons Ferry Hatchery 1988-92

Stock	Brood Year	Eggs In	Fry Out	% Survival
Wallowa	1988	502,956	479,387	95.3
	1989	236,214	186,958	79.1
	1990	428,000	409,477	95.7
	1991	421,025	416,470	98.9
	1992	225,012	212,160	94.3
Wal/Cottonwood	1992	558,437	186,656	33.4
Lyons Ferry	1988	941,765	793,240	84.2
	1989	1,263,237	793,240	84.2
	1990	1,483,485	1,002,320	67.6
	1991	1,296,249	1,115,368	86.0
	1992	1,239,055	416,265	33.6

Fish Marking

Tag loss increased slightly in 1992 over that experienced in 1991 but not significantly. Brand loss declined this year with only 2.1% (SD=1.6) unreadable brands. Light brands continue to cause problems in accurate brand readings at the dams during the spring emigration (see migration through dams, below). Light brands are frequently acceptable for juvenile passage estimates at the dams but become unreadable on returning adults. An alternative to branding would be desirable to improve our ability to non-lethally sample adults at various locations. A complete listing of the tag/brand groups is summarized in Table 3 .

Fish at Release

Two stocks of steelhead were released in 1992. The loss of fish at the hatchery because of the

TABLE 3. LYONS FERRY/TUCANNON HATCHERIES' SMOLT RELEASES, 1989-92.

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
1989											
SNAKE R.@ LFH	58	51,152	10,234	4/30	L.FERRY	63/55/08	RA-IJ-3	AD-LV	5.0	3.6	6.8
SNAKE R.@ LFH	58	47,352	10,315	30	L.FERRY	63/01/32		AD-LV	4.6	0.9	9.1
WALLA WALLA R.	24	18,300	3,050	21	WALLOWA			AD	6.0		
WALLA WALLA R.	22	21,600	4,500	19	L.FERRY			AD	4.8		
WALLA WALLA R.	24	21,600	4,500	20	L.FERRY			AD	4.8		
WALLA WALLA R.	27	21,600	4,500	20	L.FERRY			AD	4.8		
WALLA WALLA R.	25	21,360	4,500	20	L.FERRY			AD	4.8		
WALLA WALLA R.	25	1,680	350	21	L.FERRY			AD	4.8		
MILL CREEK	3	21,600	4,500	19	L.FERRY			AD	4.8		
ASOTIN CREEK	0.8	29,975	5,450	27	WALLOWA			AD	5.5		
GRANDE RONDE	29	222,050	41,896	4/18-27	WALLOWA			AD	5.3		
G.RONDE IN ORE.	41	50,410	9,700	4/25&26	WALLOWA			AD	5.2		
TOUCHET R.@DAYT	53	20,465	2,766	4/18	L.FERRY	63/02/50	LA-IT-1	AD-LV	4.8	0.7	2.3
TOUCHET R.@DAYT	53	20,224	2,889	to	L.FERRY	63/02/49	RA-IT-3	AD-LV	4.8	0.9	4.7
TOUCHET R.@DAYT	53	20,444	2,921		L.FERRY	63/02/47	LA-IT-1	AD-LV	4.8	0.6	4.6
TOUCHET R.@DAYT	53	20,565	2,896		L.FERRY	63/50/53	RA-IT-1	AD-LV	4.8	0.7	2.0
TOUCHET R.@DAYT	53	76,771	15,994	4/27	L.FERRY			AD	4.8		
TUCANNON R.@CURL	41	20,261	4,604	4/15	L.FERRY	63/50/35	LA-IJ-1	AD-LV	4.4	0.8	5.4
TUCANNON R.@CURL	41	20,502	4,604	to	L.FERRY	63/50/49	LA-IJ-4	AD-LV	4.4	0.7	5.3
TUCANNON R.@CURL	41	20,178	4,586		L.FERRY	63/50/50	LA-IJ-3	AD-LV	4.4	1.3	5.8
TUCANNON R.@CURL	41	99,190	22,543	5/8	L.FERRY			AD	4.4		
"totals"		847,279	167,248					MEAN=	4.9	1.1	5.1
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	AD-LV	3.7	1.5	3.2
WALLA WALLA R.	27	14,000	4,000	20	WEL/SKA			AD	3.5		
WALLA WALLA R.	24	14,800	4,000	19	WEL/SKA			AD	3.7		
WALLA WALLA R.	22	13,200	4,000	19	WEL/SKA			AD	3.3		
WALLA WALLA R.	25	14,400	4,000	19	WEL/SKA			AD	3.6		
WALLA WALLA R.	25	18,400	4,000	18	WEL/SKA			AD	4.6		
WALLA WALLA R.	27	15,600	4,000	19	WEL/SKA			AD	3.9		
MILL CREEK	3	15,200	4,000	18	WEL/SKA			AD	3.8		
MILL CREEK	3	17,000	5,000	20	WEL/SKA			AD	3.4		
ASOTIN CREEK	0.8	20,142	3,730	17	PAHSIM	63/07/25	LA-IC-4	AD-LV	5.4	0.4	3.4
ASOTIN CREEK	0.8	19,950	3,500	18	PAHSIM	63/14/22	RA-IC-4	AD-LV	5.7	1.0	5.8
ASOTIN CREEK	0.8	23,000	5,000	24	PAHSIM			AD	4.6		
ASOTIN CREEK	0.8	23,275	4,750	24	PAHSIM			AD	4.9		
ASOTIN CREEK	0.8	28,600	5,500	26	PAHSIM			AD	5.2		
ASOTIN CREEK	0.8	22,880	4,400	30	PAHSIM			AD	5.2		
GRANDE RONDE	29	179,250	36,066	4/15-	WALLOWA			AD	5.0		
GRANDE RONDE	29	59,750	11,274	4/30	WALLOWA			AD	5.3		
TOUCHET R.@DAYT	53	20,190	5,769	4/15	WEL/SKA	63/39/08	LA-S-1	AD-LV	3.5	4.4	5.7
TOUCHET R.@DAYT	53	19,780	5,651	to	WEL/SKA	63/39/07	RA-S-1	AD-LV	3.5	0.9	4.6
TOUCHET R.@DAYT	53	69,775	19,936	4/30	WEL/SKA			AD	3.5		
TOUCHET @WAITSBG	37	6,600	2,000	23	WEL/SKA			AD	3.3		
TUCANNON R.@CURL	41	20,012	4,002	4/15	PAHSIM	63/39/12	LA-IC-1	AD-LV	5.0	1.7	3.3
TUCANNON R.@CURL	41	20,065	4,013	to	PAHSIM	63/39/11	RA-IC-1	AD-LV	5.0	0.7	2.9
TUCANNON R.@CURL	41	39,175	7,835	4/30	PAHSIM			AD	5.0		
TUCNON @MARENGO	26	19,992	3,570	25	PAHSIM	63/08/38	RA-IC-2	AD-LV	5.6	0.4	5.7
TUCNON @MARENGO	26	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

TABLE 3. LYONS FERRY/TUCANNON HATCHERIES' SMOLT RELEASES, 1989-92.

LOCATION	R.M.	NUMBER	POUNDS RELEASED	DATE (MM/DD)	STOCK	TAG CODE	BRAND	FIN CLIPS	SIZE #/LB.	TAG LOSS(%)	BRAND LOSS(%)
1991											
ASOTIN CREEK											
GRANDE RONDE	29	252,799	47,698	4/16&30	WALLOWA			AD	5.3		
G.RONDE IN ORE.	41	52,500	10,000	4/30	WALLOWA			AD	5.2		
MILL CREEK	3	17,000	5,000	17	L.FERRY			AD	3.4		
MILL CREEK	3	12,950	3,500	23	L.FERRY			AD	3.7		
SNAKE R.@ LFH	58	19,550	5,750	18	L.FERRY			AD	3.4		
SNAKE R.@ LFH	58	16,830	5,100	18	L.FERRY			AD	3.3		
SNAKE R.@ LFH	58	21,275	5,750	18	L.FERRY			AD	3.7		
TOUCHET R.@DAYT	53	20,044	5,011	15	L.FERRY	63/40/61	RA-IT-1	AD-LV	5.3	0.1	6.2
TOUCHET R.@DAYT	53	20,108	5,027	16	L.FERRY	63/40/60	LA-IT-1	AD-LV	5.3	0.0	8.5
TOUCHET R.@DAYT	53	20,128	5,032	17	L.FERRY	63/40/62	RA-IT-3	AD-LV	5.3	0.1	9.4
TOUCHET R.@DAYT	53	20,044	5,011	18	L.FERRY	63/40/59	LA-IJ-3	AD-LV	3.8	0.1	1.6
TOUCHET R.@DAYT	53	20,132	5,033	19	L.FERRY	63/40/58	LA-IJ-1	AD-LV	3.8	0.6	1.6
TOUCHET R.@DAYT	53	20,104	5,026	22	L.FERRY	63/14/56	RA-IJ-1	AD-LV	3.8	0.9	3.7
TOUCHET R.@DAYT	53	27,960	6,990	30	L.FERRY			AD	3.7		
TUCANNON R.@CURL	48	20,032	5,414	24	L.FERRY	63/14/49	RA-H-2	AD-LV	3.7	1.4	8.1
TUCANNON R.@CURL	48	20,184	5,455	24	L.FERRY	62/14/50	LA-H-2	AD-LV	3.7	1.0	3.3
TUCANNON R.@CURL	48	20,390	4,855	4/16	L.FERRY	63/14/55	RA-7-1	AD-LV	4.2	1.2	5.6
TUCANNON R.@CURL	48	20,170	4,803	to	L.FERRY	63/14/52	RA-7-3	AD-LV	4.2	1.9	4.9
TUCANNON R.@CURL	48	80,000	19,048	4/30	L.FERRY			AD	4.2		
TUCANON @MARENGO	25	19,987	5,552	23	L.FERRY	63/14/44	RA-H-1	AD-LV	3.6	1.1	3.4
TUCANON @MARENGO	25	19,998	5,555	24	L.FERRY	63/14/47	LA-H-1	AD-LV	3.6	0.7	4.0
WALLA WALLA R.	29	34,000	10,000	16	L.FERRY			AD	3.4		
WALLA WALLA R.	26	16,500	5,000	17	L.FERRY			AD	3.3		
WALLA WALLA R.	27	33,000	10,000	18	L.FERRY			AD	3.3		
WALLA WALLA R.	25	74,000	20,000	4/22&25	L.FERRY			AD	3.7		
WALLA WALLA R.	26	17,500	5,000	26	L.FERRY			AD	3.5		
WALLA WALLA R.	23	16,269	4,930	29	L.FERRY			AD	3.3		
WALLA WALLA R.	25	7,480	2,200	17	L.FERRY			AD	3.4		
"totals"		940,934	227,740					MEAN=	4.1	0.7	5.0
								SD=	0.7	0.6	2.5
1992											
GRANDE RONDE	29	213,622	39,559	4-3/19	WALLOWA			AD	5.4		
G.RONDE IN ORE.	41	25,425	5,650	20	WALLOWA			AD	4.5		
G.RONDE IN ORE.	41	24,500	4,900	21	WALLOWA			AD	5.0		
SNAKE R.@ LFH	58	18,000	5,000	14	L.FERRY			AD	3.6		
SNAKE R.@ LFH	58	21,000	5,000	14	L.FERRY			AD	4.2		
SNAKE R.@ LFH	58	18,000	5,000	15	L.FERRY			AD	3.6		
SNAKE R.@ LFH	58	9,688	3,460	17	L.FERRY			AD	2.8		
TOUCHET R.@DAYT	53	45,628	13,036	13	L.FERRY	63/59/47	RA-IY-1	AD-LV	3.5	0.6	3.3
TOUCHET R.@DAYT	53	49,889	14,254	13	L.FERRY			AD	3.5		
TUCANNON R.@CURL	48	30,096	8,134	16	L.FERRY	63/42/63	RA-S-2	AD-LV	3.7	3.8	3.7
TUCAN from CURL	48	30,098	6,270	4/15-30	L.FERRY	63/42/60	RA-S-1	AD-LV	4.8	2.8	2.6
TUCAN from CURL	48	30,000	6,250	4/15-30	L.FERRY			AD	4.8		
TUCAN from CURL	48	9,958	2,075	4/15-30	TUCANON	63/44/12		LV	4.8	0.7	
TUCANON @MARENGO	25	29,888	8,308	4/16-17	L.FERRY	63/43/01	LA-S-1	AD-LV	3.6	1.6	3.2
WALLA WALLA R.	25	21,000	5,000	14	L.FERRY			AD	4.2		
WALLA WALLA R.	24	20,000	5,000	14	L.FERRY			AD	4.0		
WALLA WALLA R.	23	15,210	3,900	15	L.FERRY			AD	4.0		
WALLA WALLA R.	25	19,000	5,000	15	L.FERRY			AD	3.8		
"totals"		631,002	145,796					MEAN=	4.3	1.6	2.1
								SD=	0.6	1.3	1.6

main pipeline breakage was high, however fish were not lost because of lack of water, but during transfer to other hatcheries. Bird predation at LFH was the highest recorded in the hatchery's history. 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, 1992.

COTTONWOOD SMOLT PRE-RELEASE

GROUP	DATE	SAMPLE SIZE	MEAN LENGTH (S.D.)	MEAN WEIGHT (S.D.)	MEAN Kfl (S.D.)
AD-ONLY	4/6/92	208	193.0 (27.2)	78.1 (33.0)	1.02 (0.10)
AD-ONLY	4/12/92	191	201.1 (28.5)	84.6 (34.0)	0.98 (0.10)

LAKE SMOLT PRE-RELEASE

GROUP	DATE	SAMP. SIZE	MEAN LENGTH (S.D)	MEAN WEIGHT (S.D.)	MEAN Kfl (S.D.)	MALE/ FEMALE	%MALE	#PRECOC. MALES (%)
AD-ONLY	4/8/92	77	209.8 (33.6)	108.0 (51.0)	1.08 (0.09)	8/11	47.0	0 (0.0%)
AD-ONLY	4/14/92	139	214.0 (36.5)	115.6 (49.0)	1.12 (0.44)	71/68	51.1	1 (1.4%)
AD-ONLY	4/20/92	94	210.3 (30.0)	105.2 (47.5)	1.06 (0.13)	17/7	71.0	0 (0.0%)
AD-ONLY	4/27/92	75	206.8 (39.4)	102.8 (56.9)	1.04 (0.07)	13/2	87.0	0 (0.0%)
AD-LV	4/8/92	98	206.3 (19.6)	96.0 (28.5)	1.07 (0.07)	17/11	61.0	2 (11.8%)
AD-LV	4/14/92	117	216.9 (18.0)	108.0 (34.5)	1.04 (0.17)	54/62	46.2	4 (7.4%)
AD-LV	4/20/92	97	205.0 (19.5)	90.8 (26.4)	1.03 (0.08)	19/9	68.0	2 (10.5%)
AD-LV	4/27/92	95	209.7 (37.0)	92.1 (30.6)	1.0 (0.10)	16/13	55.0	1 (6.3%)
LV-ONLY	4/8/92	13	191.9 (39.5)	85.5 (41.9)	1.07 (0.05)	--	--	--
LV-ONLY	4/14/92	8	125.5 (19.8)	20.8 (11.5)	0.96 (0.02)	--	--	--
LV-ONLY	4/20/92	11	191.7 (24.7)	69.2 (22.8)	0.94 (0.05)	--	--	--
LV-ONLY	4/27/92	38	183.4 (22.2)	64.3 (33.1)	0.98 (0.16)	2/4	33.0	0 (0.0%)

Table 4 . (con't.) Pre-release smolt samples

DAYTON POND SMOLT PRE-RELEASE

GROUP	DATE	SAMP. SIZE	MEAN LENGTH (S.D.)	MEAN WEIGHT (S.D.)	MEAN Kfl (S.D.)	MALE/ FEMALE	% MALE	#PRECO MALES (%)
AD-ONLY	4/8/92	98	215.9 (29.6)	127.6 (55.1)	1.21 (0.21)	16/7	70.0	1 (6.3)
AD-ONLY	4/14/92	70	198.5 (33.9)	--	--	16/9	74.0	1 (6.3)
AD-ONLY	4/20/92	96	214.0 (38.5)	117.7 (54.0)	1.11 (0.13)	20/6	77.0	1 (5.0)
AD-LV	4/8/92	107	224.4 (17.2)	132.5 (35.5)	1.15 (0.12)	9/11	45.0	2 (10)
AD-LV	4/14/92	70	220.7(16.4)	--	--	16/9	74.0	2 (12.5)
AD-LV	4/20/92	107	229.1 (19.2)	133.9 (36.2)	1.10 (0.07)	31/4	89.0	6 (19.4)

DIRECT STREAM @ MARENGO (M) AND CURL LAKE (C) SMOLT PRE-RELEASE

AD-LV (M)	4/15/92	56	229.3 (17.9)	128.2 (36.4)	1.04 (0.11)	32/24	57.0%	2 (6.3%)
AD-LV (C)	4/15/92	74	222.2 (20.7)	114.0 (31.8)	1.02 (0.09)	25/39	34.0%	0 (0.0%)

A. Kfl = Condition factor
B. Precoc. = Precocious
C. % of precocious males is taken from male / female sample

Fish size at release ranged from 2.5 - 5.4 fish/lb and the average size of the entire release of smolts was 4.3 fish/lb (Std. Dev.= 0.6). Total steelhead production was 631,002 fish totaling 145,796 pounds. Table 3 summarizes the smolt releases into Southeast Washington rivers for 1989-1992.

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 with smolts and transitionals making up between 95-98%of fish in our pre-release samples. Precocious males were present as 1-5% of fish sampled. A more complete discussion of smolt performance and the level of residualism experienced from several of our 1992 releases

has already been presented under separate cover (Martin et al. 1993). The study showed that fish acclimated in conditioning ponds and fish that were not coded wire tagged residualized at a measurably lower rate than for tagged and direct stream released fish. Residual steelhead and planted catchable size rainbow trout can, and do, consume juvenile wild steelhead and salmon, although not in great numbers. Residual steelhead sampled were larger than the average pre-release size for all groups, however we are uncertain if sampling methods and fish growth may account for the difference.

The tagging program went very smoothly this year. Brand quality is still a problem. Quality of brands, not quantity, was again stressed daily in the marking, however the consistent presence of light brands in our samples is frustrating. Constant observation and correction of improper technique is essential for consistent brand quality, even when using experienced branding personnel. Most branders tend to under time their branding, resulting in "light" brands. We will continue to pursue means to eliminate this problem.

Hatchery Smolt Emigration

Releases

Fish were transferred to conditioning ponds in early March. The screens were removed from the outlet structures of all the ponds on 6 April in response to smolts actively schooling and circling the ponds and concern over extremely low drought flows in all rivers. Large numbers of fish were noted exiting the ponds for the next 3-5 days. Fish fed actively during this period but feeding was stopped as the pond levels were lowered. All ponds were empty by 30 April. All smolt plants for 1989-1992 are summarized by release day in Table 3.

Migration Through Dams

Table 5 summarizes passage estimates for brand groups released in 1990-92. Median (50%) passage of the fish from 1992 groups passed the first collected dam between 7-23 days after release, although individuals from various groups continued to pass the dams through June. Average daily travel rates for various brand groups ranged between (3.6-4.5) miles per day to McNary Dam (FPC 1992).

Table 5. Estimated passage of branded/tagged Lyons Ferry Hatchery steelhead at McNary Dam, 1990-92. (FPC 1991-1993)

Brand	Release site	Passage index	Number released	% of release	Size (#/lb)	Stock
McNary						
1990						
LA,RA-IC-1	Curl Lk.	12,431	38,835	31.9	5.0	Pahsimeroi
LA,RA-IC-2	Tuc. @ Marengo	7,274	38,072	19.1	5.5	Pahsimeroi
LA,RA-IC-3	LFH	10,169	38,955	26.1	5.6	Pahsimeroi
LA,RA-IC-4	Asotin	476	40,092	1.2	5.5	Pahsimeroi
LA,RA-S-1	Touchet	7,571	39,970	19.0	3.5	Wells/Skamania
LA,RA-S-2	Walla Walla	5,352	39,817	13.4	3.8	Wells/Skamania
1991						
LA,RA-IJ-1,3	Touchet-large	18,752	58,901	31.8	3.8	LFH
LA,RA-IT-1,3	Touchet-small	13,318	55,440	24.0	5.3	LFH
RA-7-1,3	Curl Lake	8,464	38,430	22.0	4.2	LFH
LA,RA-H-2	Tucan. @ Curl	7,384	37,759	19.6	3.7	LFH
LA,RA-H-1	Tuc. @ Marengo	9,198	38,502	23.9	3.6	LFH
1992						
RA-S-1	Curl Lake	8,420	29,324	28.7	4.8	LFH
RA-S-2	Tucan. @ Curl	5,908	28,973	20.4	3.7	LFH
LA-S-1	Tuc. @ Marengo	6,824	28,926	23.6	3.6	LFH
RA-IY-1	Touchet R.	11,560	44,026	26.3	3.5	LFH

Discussion

Average fish size for the entire hatchery production decreased slightly in 1992 from 1991. Size variability also decreased slightly over 1991 due to a decrease in number of stocks of fish used in the program.

All of the Tucannon River fish groups migrated downstream at similar rates of between 3.6 and 3.8 miles per day to McNary Dam (FPC, 1993). The Touchet River fish migrated slightly faster at 4.5 miles/day. The smaller fish acclimated in Curl Lake appear to have performed marginally better in surviving to McNary Dam than did fish released directly into the Tucannon at Curl and Marengo. The differences in the Passage Indices for acclimated and direct release were not as

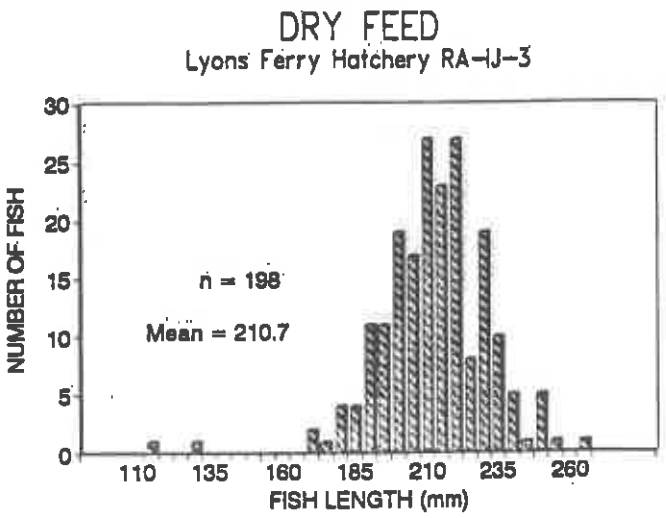
great as noted in 1991. How effectively each group was captured at the dam can be variable depending upon degree of smoltification and other factors. All the groups released in 1992 traveled at similar rates and were collected at about the same levels as groups in the previous two years. Fish released from the Touchet River consistently travel downstream at a faster rate than do Tucannon River fish. This may be a result of greater in-river travel distance for the Touchet River fish. Tucannon River fish must migrate through 90 miles of reservoirs and pass two dams before reaching McNary Dam.

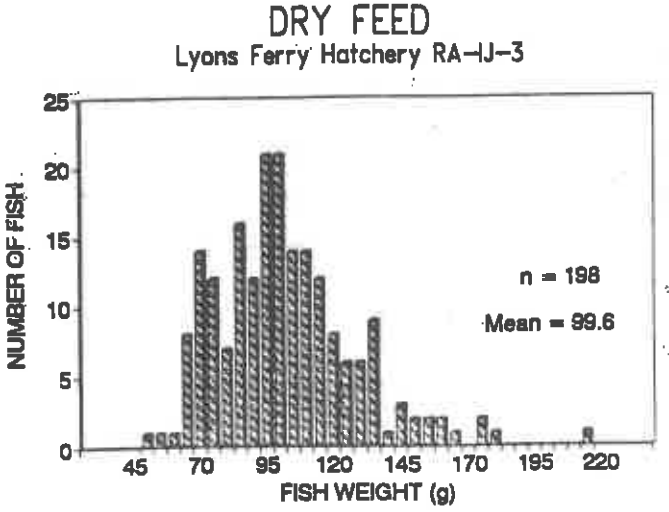
1988-89 Feed Study

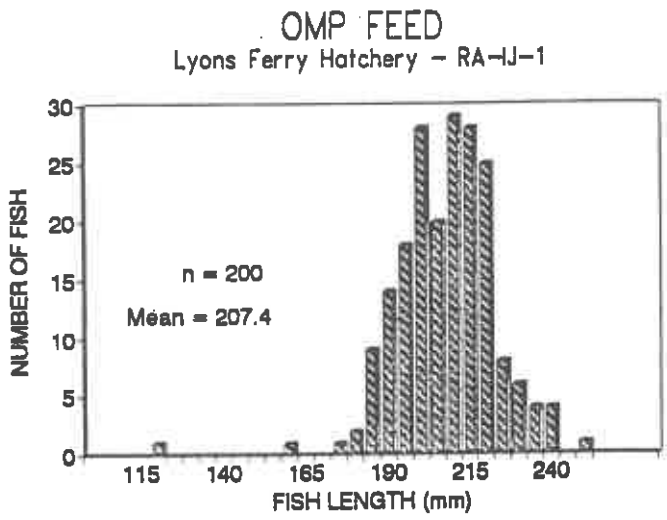
Steelhead at Lyons Ferry Hatchery were raised utilizing a standard trout formula Oregon Moist Pellet (OMP) between 1983 and 1988. The quality of smolts produced and adult return rates from releases were good (Schuck and Mendel 1985, Schuck et al. 1988). A change in managers in 1988 brought about a review of hatchery practices. The use of OMP was questioned as an un-necessarily expensive feed and a change to a less expensive dry diet was recommended. Expected benefits of the feed change were ease of handling and storage, cost savings and equal smolt quality. Smolt to adult survival rates were expected to be equal to OMP.

Juvenile Growth and Performance

The results of juvenile growth and samples collected prior to release were reported by Schuck et al. (1990) but are summarized here. Length and weight histograms for the two groups at release are shown in Figure 1. The two groups were essentially identical in length while the Dry Feed group was 8% heavier than fish fed OMP. Growth was faster and feed conversion was better for dry feed (1.63 : 1) than for OMP feed (1.95 : 1). Table 6 summarizes feed conversions, total weight gain and feed cost comparisons for the study period.







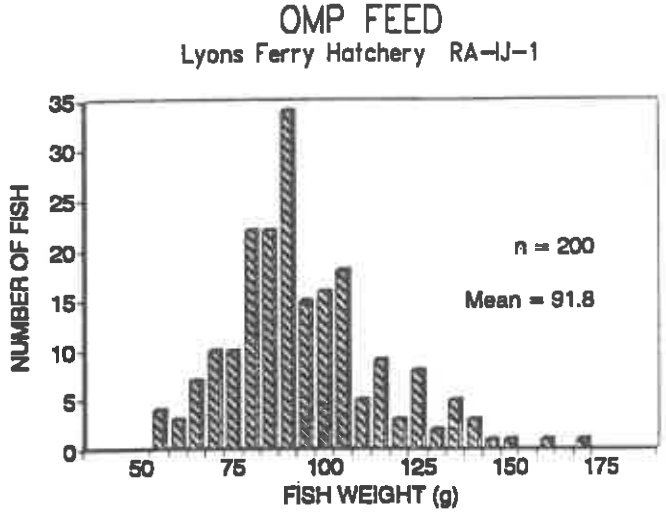


Figure 1. Length and weight histograms for feed study fish released from LFH in 1989.

Table 6. Feed conversions, weight gain and feed costs for 1988-89 LFH feed study.

	OMP Feed	DRY Feed
Total pounds fed	50,964	51,036
Price per pound	$0.39	$0.30
Feed cost	$19,875.96	$15,310.80
Weight gain (pounds)	26,124	31,265
conversion	1.95 : 1	1.63 : 1
Size at release (#/lb.)	4.9	4.6

Table 7 gives a comparison of the visual degree of smoltification prior to release and condition factor for the two study groups. Results from Goede's Organosomatic Index showed no difference in 10 of the 13 items reported between the two feeds. There were differences in appearance of the liver, bile and spleen, however, it is unknown whether these differences would significantly affect smolt to adult performance.

Table 7. Degree of smoltification of feed study groups, LFH 1989.

Development stage	Smolt	Transitional	Parr	Precocious male	K factor
Number of fish					
OMP feed	51^	106	33	10	1.01
(% of total)	(25.5)	(53.0)	(16.5)	(5.0)	
DRY feed	42	138	10	10	1.08
(% of total)	(21.2)	(69.7)	(5.0)	(5.0)	

A - sample size for both groups was 200 fish.

Adult Returns

Adult steelhead returned to LFH in run years 1990 and 1991. Total returns by study group for each year, total returns for the study and percentage smolt to adult survival that those numbers represent are summarized in Table 8.

Table 8. Summary of adult returns to LFH of study groups in the 1990-91 run years.

Feed Type	1990	1991	Total	# Released	% Survival
Moore Clark OMP- Trout Diet	127	98	225	51,152	0.44%
Silver Cup Dry Salmon Diet	127	78	205	47,352	0.43%

Discussion

We could observe or measure no significant difference in juvenile test fish fed the Silver Cup Dry Diet over the OMP which has been used at LFH since 1983. Fish fed actively and converted the dry diet very well. Condition factor was the only area of concern with dry diet fish. The K factor measured for these fish was higher than is considered desirable for pre-release smolts, however it was not out of the range of K factors observed in study groups at LFH in other years.

Adult returns to LFH over the two run years 1990-91 were good. There was no significant difference in return rates between the two groups although more 2-ocean age adults returned from the OMP group than for the DRY feed group. The overall performance of both groups to the hatchery was encouraging as total returns approached the LSRCP goal of 0.5% smolt to adult survival. Unfortunately both groups of returning adults exhibited a strong tendancy to wander upstream. For the two return years 1990-91, adults from each group passed Lower Granite Dam in numbers that represent an estimated 0.39% smolt to adult survival rate. While this identical behavior and return response seems to indicate no altered behavior that is dependent upon food type, the tendancy to by-pass the hatchery remains undesirable from an

overall fishery management view. The "in-place" aspect of mitigation is desirable to minimize wild/hatchery interactions and to maximize sport harvest.

It was unfortunate that conditions in 1990 and 1991 did not allow a continuation of the study. Results from one year of the test appear to show little or no advantage to using the more expensive OMP. Also, a good conversion factor for food fed, ease of handling and a significant cost savings make the use of dry feed at the hatchery desirable to the manager.

We cannot conclude, based on one years data, that there is no difference in the performance of fish fed the two diets under all hatchery and environmental conditions. Results do however support continued testing and do not strongly indicate a problem with using the less expensive dry form of feed to rear high quality steelhead smolts.

Adult Steelhead Returns

Tucannon Hatchery Weir/Trap

We trapped both hatchery and wild steelhead on the Tucannon River January through April 1992. Every fifth wild fish both males and females were kept for spawning. Three females and four males were held for spawning.

Returns to Lyons Ferry Hatchery

A total of 2,035 adult steelhead were trapped at Lyons Ferry Hatchery from August 12 through December 15, 1991. Mortality during the trapping and holding period was 1.7% (35 fish) and 961 fish were returned to the river. All fish trapped were inspected for finclips, sex, whether of wild or hatchery origin and for readable brands. Snouts were collected from a sample of fish that had a ventral fin clip and unreadable brand. Fish sorted from the trap were comprised of 66.2% (1,348) females and 33.8% (687) males. Wild fish represented 0.54% (11 fish) of the sample and tagged/branded fish represented 27.8% (566) of the total. One-ocean age fish returning to LFH represented only 38.5% of fish trapped in 1991. Two-ocean age and three-ocean age fish made up 56.8% and 4.7% respectively. There was a considerable difference in

age classes between males and females. Table 9 summarizes age composition and average fish lengths by age for a sample of fish trapped at LFH.

Table 9. Age composition and mean lengths for males and females spawned at LFH, 1991-92.

	1-ocean	2-ocean	3-ocean
Males (n=100)	59.0% (61.0 cm)	36.0% (71.3 cm)	5.0%(81.6cm)
Females (n=240)	30.0% (61.7 cm)	65.0% (71.5 cm)	5.0% (79.9 cm)
Combined	38.5% (61.4 cm)	56.8% (71.4 cm)	4.7% (80.4 cm)

A complete listing of the returns of branded fish by release year to the hatchery in 1991 is provided in Appendix A.

Passage at Dams

Table 10 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 given in Table 3. The widly varying return rates for various groups does not necessarily represent comparative performance of the releases. Many of the groups passing LGD were released into tributary streams far below the dam (ie: Walla Walla River). The return of adults to above LGD may be an indicator of straying due to many causes such as stock suitability and environmental conditions within the run year.

Adult steelhead returns to spawning grounds

Results from our new methods that incorporated the use of index sites were encouraging. Table 11 presents a summary of our results from the 1992 spawning ground surveys. Average redds per mile increased on the Tucannon River and the South fork of Asotin creek in 1992 as compared to the previous year. Average redds per mile decreased slightly on the North fork of Asotin creek in 1992 as compared to 1991. A detailed discussion of spawning activity is included in the section: **Trends in naturally produced juvenile steelhead density, population size and spawning activity, 1983-1992.**

Table 10. Adult returns of LFH steelhead to above Lower Granite Dam, run years 1989-91.

Release year / Brand*	Number of adults Return year 1989	1990	1991	Total adults captured	No. smolts rel.	% Survival[2]
1988						
LA-H-1	99	30	1	130	20,000	0.65
RA-H-1	108	55	0	163	19,960	0.82
RA-H-2	96	40	0	136	20,003	0.68
LA-IV-1	89	10	1	100	18,756	0.53
LA-IV-3	98	11	0	109	19,952	0.55
RA-IV-1	123	8	0	131	19,983	0.66
RA-IV-3	124	13	0	137	19,569	0.70
LA-S-1	289	58	0	347	24,797	1.40
LA-S-2	285	60	0	345	25,190	1.37
RA-S-1	283	55	0	338	24,947	1.35
RA-S-2	313	71	0	384	25,161	1.53
1989						
RA-IJ-1		57	127	184	47,674	0.39
RA-IJ-3		69	97	166	43,043	0.39
LA-IJ-1		46	46	92	19,166	0.48
LA-IJ-3		43	52	95	19,008	0.50
LA-IJ-4		25	37	62	19,415	0.32
RA-IT-1		22	31	53	20,154	0.26
RA-IT-3		16	27	42	19,273	0.22
LA-IT-1		15	33	48	19,504	0.25
LA-IT-3		11	34	45	19,994	0.23
1990						
LA-S-1			23	23	19,039	0.12
RA-S-1			25	25	18,870	0.13
LA-S-2			7	7	19,168	0.04
RA-S-2			7	7	19,094	0.04
LA-IC-1			111	111	19,352	0.57
LA-IC-2			97	97	19,219	0.50
RA-IC-1			127	127	19,483	0.65
RA-IC-2			108	108	18,852	0.57
LA-IC-3			55	55	17,170	0.32
RA-IC-3			100	100	20,326	0.49
LA-IC-4			144	144	19,457	0.74
RA-IC-4			129	129	18,793	0.69

*1988: LA-H, RA-H, LA-IV, RA-IV, LA-S and RA-S = LFH. 1989: RA-IJ =LFH; LA-IJ = Tucannon; RA-IT, LA-IT = Touchet. 1990: LA-S-1 & RA-S-1 = Touchet; LA-S-2 & RA-S-2 = Walla[2] ; LA-IC-1, LA-IC-2, RA-IC-1 & RA-IC-2 = Tucannon; LA-IC-3 & RA-IC-3 = LFH; LA-IC-4 & RA-IC-4 = Asotin.

Table 11. Spawning ground surveys in S.E. Washington, 1992.

River	Date	Location	Miles	Total Redds	Redds/ Mile	Percent Increase
NF Asotin	4/29	From the mouth upstream 6 miles	6	27	4.5	0%
SF Asotin	4/29	From the mouth upstream 7 miles	7	23	3.3	0%
Main Asotin	4/29	From the confluence bridge downstream 1.25 miles to Charlie Cr.	1.25	3	2.4	0%
Charlie Cr.	4/29	From the mouth upstream 7.7 miles	7.7	19	2.5	0%
South Touchet	5/1	From the mouth upstream 15.7 miles	15.7	165	10.5*	52.4%
North Touchet	5/7	From the confluence upstream 11.1 miles	11.1	80.5	7.25*	15%
Wolf Fork	5/7	From the mouth upstream 10.3 miles	10.3	68	6.6 *	0%
Main Touchet	5/7	From the confluence downstream 1.5 miles	1.5	2	1.3	0%
Robinson Fork	5/8	From the mouth upstream 5.0 miles	5.0	1	0.2	0%
Cummings Creek	5/12	From the mouth upstream 7.0 miles	7.0	63	9.0*	0%
Mill Creek	5/14	From Rooks Park dam upstream 15.5 miles	15.7	61	3.9	0%
Upper Tucannon	5/11	From Sheep creek to PanJab bridge	4.0	48	12*	50%
Middle Tucannon	5/11	From PanJab bridge downstream to Blind Grade	11.75	142.6	12.1*	46.9%
Lower Tucannon	5/11	From Blind Grade downstream to Highway 12	15.5	239	15.4*	48.1%
PanJab Creek	5/15	From the mouth upstream 3.4 miles	3.4	10	2.9	0%

***Percent increase used to adjust for redds eliminated by run off.**

Steelhead Creel Surveys

Lower Snake River

We relied on harvest estimates derived from adjusted state-wide catch-record card returns in 1991-92 (Table 12). Our creel sampling was primarily to obtain catch composition data and recover coded wire tags. All 1991 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 only from fish reared at LFH that were observed in angler creels on the Snake River is presented in Table 13. 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 12. Adjusted[A] catch record card-derived steelhead harvest estimates for WDW management sections[B] on the lower Snake River, fall 1991 and spring 1992 (WDW 1990).

Month	Below Ice H. Dam	Below L.Mon.Dam	Below L.Goose D.	Below L.Granite D.	Above L.Granite D.
Sept.	47	49	168	43	248
Oct.	59	350	594	193	1,729
Nov.	96	606	538	180	2,370
Dec.	215	493	352	198	1,015
Jan.	262	139	215	149	468
Feb.	124	146	141	215	208
Mar.	2	64	99	228	33
Totals	805	1,847	2,107	1,206	6,071

A. WDW estimate multiplied by 1.1205 for underestimation (Mendel et al. 1988)
B. WDW management sections are: 164= Below Ice Harbor, 165= Below Lower Monumental, 166= Below Little Goose, 167= Below Lower Granite, 168= Above Lower Granite.

Table 13 . Data from only LFH reared steelhead observed in Washington angler creels along the Snake River, fall 1991 and spring 1992.

	Mean Fork Length(cm) (range) (n)^	Mean Weight(kg) (range) (n)	Fish Kept % Females	% Males	% Unknown	Sample rate
166 Below Little Goose Dam	67.5 58-80 (31)	2.9 1.6-4.7 (26)	75.0 (24)	25.0 (8)	0.0 (0)	22.6%
167 Below Lower Granite Dam	69.7 61-84 (16)	3.4 1.7-5.9 (15)	58.8 (10)	41.2 (7)	0.0 (0)	16.5%
168L Above Low. Granite to Red Wolf Bridge	65.2 56.5-88 (21)	3.0 2.1-7.1 (9)	36.4 (8)	59.0 (13)	4.6 (1)	19.6%
168M Red Wolf Bridge to OR. State Line	63.5 57-74 (17)	2.4 2.1-3.1 (7)	33.3 (6)	61.1 (11)	6.0 (1)	9.5%
TOTALS			53.9 (48)	43.8 (39)	2.2 (2)	

A n= Number of fish sampled in the harvest.

Grande Ronde River

During the 1991-92 steelhead season 3,919 angler days of fishing effort were expended by anglers on that portion of the Grande Ronde River from Bogan's Oasis (RM 26) upstream to the Oregon State line (RM 38.7). This effort represents a 269% increase in angling effort from the 1990-91 season. This increase is most likely due to two factors: 1) the catch and release restrictions that were enacted to protect brood fish for LSRCP hatchery needs in Oregon during the 1990-91 season made fishing less attractive, thus reducing angler effort, and, 2) the 1991-92 run of steelhead was large relative to the previous year. The average completed fishing trip was 5.43 hours. Tables 14 and 15 are summaries of ODFW data collected from steelhead examined in angler creel along the Grande Ronde River during Fall 1991 and Spring 1992. The greatest harvest occurred in late March and early April near the Cottonwood Creek acclimation pond.

Table 14. Estimated angler effort, catch rates, and harvest for steelhead anglers on the Grande Ronde River, 1991 and 1992 (Flesher 1992).

Month	Effort (Hours) (95% CI)	Catch Rate (95% CI)	Total Catch (95% CI)	Fish Kept (95% CI)	Marked Fish Rel. (95% CI)	Unmarked Fish Rel. (95% CI)
1991						
Sep.	241.5 (130.5)	0.0 --	0.0 --	0.0 --	0.0 --	0.0 --
Oct.	2,086.9 (450.3)	.1007 (.0492)	210.1 (102.6)	75.6 (45.1)	84.6 (51.5)	49.9 (33.7)
Nov.	1,157.4 (269.8)	.0843 (.0540)	97.6 (63.2)	62.9 (39.9)	7.2 (79.8)	27.5 (27.0)
1992						
Jan.	2,887.2 (933.0)	.0915 (.0390)	264.2 (112.7)	165.7 (79.9)	51.4 (38.6)	47.1 (36.4)
Feb.	4,721.7 (794.4)	.1736 (.0535)	819,5 (252.5)	386.3 (137.2)	293.3 (108.7)	139.8 (64.5)
Mar.	8,434.4 (1437.0)	.2058 (.0588)	1,736.1 (495.7)	575.4 (188.2)	1,058.6 (313.9)	102.1 (52.1)
Apr.	1,080.2 (376.1)	.2133 (.1468)	230.4 (158.5)	93.9 (68.9)	117.9 (87.2)	18.6 (19.1)
Total	21,278.5		3,520.8	1,413.0	1,696.1	411.6

Table 15. Age composition (%) and fork length (mm) of steelhead sampled from creels on the Grande Ronde River in Washington, fall 1991 and spring 1992 (Flesher et al. 1992).

Age[A] (SD)[C]	n[B]	% Male	% Female	n	Males Length (SD)	n	Females Length (SD)
1:1	187	33.4	36.1	90	605 (32)	97	593 (30)
1:2	82	13.8	16.7	37	712 (59)	45	714 (41)

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

Other Rivers

Harvest estimates for the Tucannon, Touchet, Walla Walla, and the Grande Ronde Rivers and McNary Pool on the Columbia River were obtained from WDW punchcard estimates (Table 16). Catch rate and catch composition were calculated for these rivers from information collected during weekday and weekend creel surveys. A summary of data from only LFH reared fish that were observed during creel surveysalong the Tucannon , Touchet, and Walla Walla rivers is presented in Table 17.

Table 16. Harvest estimates from catch record card returns for the Tucannon, Touchet, Walla Walla and Grande Ronde Rivers and McNary Pool on the Columbia River, fall 1991 and spring 1992 (WDW 1992).

River	Tucannon	Touchet	Walla Walla	Grande Ronde	McNary Pool
Month					
June				2	2
July			2		11
Aug.					7
Sep.	22		15	7	139
Oct.	27		115	263	541
Nov.	27	2	91	108	1,125
Dec.	24	73	115	239	581
Jan.	46	60	64	265	250
Feb.	64	99	49	290	77
Mar.	77	135	29	789	22
Apr.	33	11	9	97	2
Total	320	380	489	2,060	2,757

Table 17 . Data for only LFH reared steelhead that were observed in angler creels along the Tucannon, Touchet and Walla Walla Rivers, fall 1991 and spring 1992.

River	Mean Length(cm) (range) n^	Mean Weight(Kg) (range) n	% Female n	% Male n	% Unknown n	Sample rate
Tucannon	64.7 (55.0-77.0) 14	2.4 (1.7-3.7) 9	64.3 9	35.7 5	0.0 0	12.5%
Touchet	74.7 (68.5-81.3) 8	3.4 (2.7-4.3) 3	75.0 6	25.0 2	0.0 0	5.2%
Walla Walla	66.0 -- --	-- -- --	-- --	100 1	0 --	4.0%
Totals			55.5 15	40.7 11		1.7%

A n = Number of kept fish sampled in the harvest.

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 (cwt). All cwt's recovered by WDW personnel and estimates of the expanded harvest by individual tag code are presented in Table 18 for the Snake River (by zone) and in Table 19 for other rivers within Southeast Washington.

Returns of Coded Wire Tag Groups

We have complete 1 and 2 ocean age returns for the 1989 coded wire tag releases. A summary of these returns to various fisheries is presented in Table 21. Data collected within the basin indicates we are meeting our steelhead goal for the hatchery (Tables 10 & 18). Many of the LFH released fish passing Lower Granite 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 and is a serious issue being investigated.

Expanded estimates of harvest of adult Lyons Ferry steelhead within the Columbia River basin for the 1991 run year, and the percent smolt to adult survival that these numbers represent are presented in Table 20. 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 and mid-Columbia River fisheries harvest a substantial percentage of our total steelhead returns outside of the LSRCP area.

An uncharacteristically high number of "no tags" were found in section 168 (Table 18). 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 eroded during rearing at a hatchery.

Table 18. Coded wire tag expansions, Snake River, fall 1991 and spring 1992.

Zone	Sept	Oct	Nov	Dec	Jan	Feb	Mar	CWT	Tags Rec.	Expanded[A] Harv.
			Sample Rate[B]							
168	(.008)	(.126)	(.105)	(.083)	(.132)	(-)	(-)			
Above Lower Granite Dam				1				63/01/32	1	12
			1					63/02/47	1	10
				1	2			63/07/25	3	27
			1					63/08/38	1	10
		1						63/08/41	1	8
		1						63/08/42	1	8
		1						63/14/21	1	8
			1		3			63/14/22	4	33
			1	1				63/39/12	2	22
		2						63/50/35	2	16
				1	1			63/50/49	2	20
	1	1						63/55/08	2	133
		1	2	1				05/19/45	4	39
				1				05/19/46	1	12
		1			1			05/19/47	2	16
				1				05/20/41	1	10
		1						05/20/42	1	8
			1					05/20/43	1	10
					1			07/45/42	1	8
			1					07/46/50	1	10
				1				07/46/52	1	12
		1	2					07/51/18	3	28
	1							07/51/19	1	10
		3		2	2			07/51/20	7	39
		3						07/51/21	3	24
		2						07/51/22	2	16
		2	2	1	1			07/51/23	6	55
				1				07/51/25	1	8
				1				07/52/17	1	12
			1					10/41/34	1	10
			1					10/41/35	1	10
		1						10/41/53	1	8
			1					23/20/24	1	10
				1				23/20/26	1	12
	21	17	6	2				no tag	47	541

Table 18. (Cont.) CWT expansions, Snake River, fall 1991 and spring 1992.

Zone	Sept	Oct	Nov	Dec	Jan	Feb	Mar	CWT	Tags Rec.	Expanded Harv.
				Sample Rate[B]						
167	(.047)	(.057)	(.261)	(.152)	(.228)	(.233)	(.105)			
Below Lower			1				3	63/01/32	4	32
Granite Dam					1	1		63/02/49	2	8
					1			63/08/42	1	4
					1	1		63/14/21	2	8
						1		63/14/22	1	4
					1			63/39/07	1	4
							1	63/39/12	1	10
						1		63/50/35	1	4
				2	1			63/55/08	3	17
						1		63/55/08	1	4
						1		05/19/47	1	4
							1	05/20/42	1	10
						2		07/51/20	2	9
						2		07/51/21	2	9
					1			07/51/24	1	4
						1		23/20/21	1	4
			1	1	1		2	no tag	5	34
166	(.054)	(.106)	(.314)	(.332)	(.409)	(.170)	(.051)			
Below Little										
Goose Dam			1	3				63/01/32	4	12
				2	1			63/02/49	3	8
			1		1			63/02/50	2	5
		1	1	1				63/07/25	3	15
					2			63/08/42	2	5
				1	1			63/14/21	2	5
			1	1	1			63/39/07	3	9
		1	1					63/39/08	2	13
				2				63/39/09	2	6
					1			63/39/10	1	2
					2			63/50/52	2	4
			1	1	3			63/55/08	5	14
					1			05/18/37	1	2
			1					05/18/38	1	3
				1				05/18/49	1	3
			2	1				05/19/45	3	9
			2					05/19/46	2	6
		1	1					05/20/42	2	13
				1				07/46/57	1	3

Table18. (Cont.) C WT expansions, Snake River, fall 1991 and spring 1992.

Zone	Sept	Oct	Nov	Dec	Jan	Feb	Mar	CWT	Tags Rec.	Expanded[A] Harv.
			Sample Rate[B]							
166 (cont.)	(.054)	(.106)	(.314)	(.332)	(.409)	(.170)	(.051)			
Below Little Goose Dam		1	1					07/51/18	2	13
			1	1				07/51/21	2	6
			1					10/41/42	1	3
			1					10/41/43	1	3
			1					10/41/46	1	3
				1				10/41/53	1	3
		1						10/42/24	1	9
		1						23/20/20	1	9
		3	1	1		2	1	no tag	8	67
165	(.163)	(.023)	(.083)	(.120)	(.101)	(.000)	(.016)			
Below Lower Monumental Dam			1					63/01/32	1	12
			1					63/02/49	1	12
			1					63/02/50	1	12
			1					63/14/21	1	12
				1				63/39/07	1	8
			1					63/39/10	1	12
					1			63/39/12	1	10
			1		1			63/50/52	2	22
			1					05/19/46	1	12
				1				07/51/18	1	8
				1				07/51/20	1	8
				1				07/51/23	1	8
			1					10/40/58	1	12

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

Table 19. Coded wire tag expansions for other rivers in Southeast Washington, fall 1990 and spring 1991.

Zone	Sept	Oct	Nov	Dec	Jan	Feb	Mar	CWT	Tags Rec.	Expanded[A] Harv.
				Sample Rate[B]						
185	(-)	(-)	(-)	(.027)	(.000)	(.020)	(.119)			
Touchet R.										
						1	1	63/02/47	2	58
							2	63/02/49	2	16
				1			1	63/02/50	2	45
						1	1	63/02/52	2	58
189	(.000)	(.000)	(.148)	(.167)	(.457)	(.094)	(.065)			
Tucannon R.										
					1			63/02/50	1	2
					1			63/08/38	1	2
					1			63/39/07	1	2
		1						63/39/10	1	7
						1		63/39/11	1	15
		2	2					63/39/12	4	26
			1	1				63/50/35	2	8
				3				63/50/49	3	6
			1		1			no tag	2	17
194	(-)	(.026)	(.033)	(.070)	(.016)	(.061)	(.069)			
Walla Walla R.										
							1	63/39/10	1	14
45	(.000)	(.006)	(.012)	(.031)	(.056)	(-)	(-)			
McNary Pool[C]										
					1			07/51/25	1	18
			3	3				no tag	6	347

A Est. harvest of tags based on monthly sample rates from the fishery.
B Sample rates used to expand individual CWT recoveries.
C McNary Pool is that section of the Columbia River from McNary Dam to Hwy. 395 in Pasco.

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 or another terminal area for which fish are destined. We exceeded the production escapement goal of 0.5% survival back to the Snake River for all tag codes during their combined 1-salt and 2-salt return years except those released from the Tucannon 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. Tucannon River released fish consistently return at a lower rate than any of the other releases. 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 1990 and 1991. 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. This performance is unvarying from year to year and appears to be a strong indication of poor stock suitability for use in the Tucannon River. Touchet River fish perform strongly despite a concern that we have had over the high rate of residualism by smolts into the stream (Viola and Schuck, 1992, Martin et al. 1993). In general the returns of 1990 released fish were lower than 1989 releases which could have resulted from drought spring conditions in 1990.

We estimate that releases of LSRCP steelhead smolts into S.E. Washington streams during the years 1988-1990 returned 7,163 adult steelhead to the LSRCP area of the Snake River Basin during the 1991 run year. This return represents 154% of the goal established for steelhead. We believe this to be a conservative estimate that doesn't fully account for spawning escapement into all tributaries, but is within reasonable limits of actual escapement. The esitmate is derived from applying smolt-to-adult return rates of coded wire tag groups to untagged releases where applicable and combining these estimates with sport harvest for rivers unrepresented by tag group and estimates of escapement to spawning areas for the rivers.

Table 20. 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 1991-1992. These numbers and percentages also represent a portion of the smolt to adult survival.

Release Year	1988			1989		
Release Site	Snake R.	Touchet	Tucannon	Snake R.	Touchet	Tucannon
CWT Code	63/50/13,14 63/50/16,19	63/49/47,49 63/50/28,31	63/49/41,42 63/49/44	63/01/32 63/55/08	63/02/47,49,50 63/50/52	63/50/35,49 63/50/50
Brand	LA-S-1,2 RA-S-1,2	LA-IV-1,3	LA-H-1 RA-H-1,2	RA-IJ-1,3	LA-IT-1,3 RA-IT-1,3	LA-IJ-1,3,4
# Released	100,095	78,147	59,963	96,237	81,126	60,373
Location						
L. Col. Sport				33 (.034)	40 (.049)	18 (.030)
Mid. Col. Sport				2 (.002)	4 (.005)	4 (.007)
Zone 6 Net Fall				90 (.094)	89 (.110)	40 (.066)
L. Ferry Ladder		1 (.001)		182 (.2)	189 (.23)	41 (.07)
Snake R. Sport				89 (.092)	81 (.0003)	40 (.066)
Tucannon Sport					2 (.002)	14 (.023)
W. Walla R.						
Touchet R.					74 (.091)	
Dworshak NFH	1 (.001)	1 (.001)			1 (.001)	
Idaho Sport				86 (.09)	38 (.05)	20 (.003)
Ocean Harvest						
LSRCP Area Total				**357** **(.371)**	**385** **(.474)**	**115** **(.190)**
Grand Totals				**482** **(.501)**	**518** **(.638)**	**177** **(.293)**

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

Table 20. (cont.) Adult returns of LFH steelhead to the Columbia River Basin 1991-92.

Release Year	1990				
Release Site	Snake R.	Touchet	Tucannon	Asotin	Walla Walla
CWT Code	63/14/21 63/08/42	63/39/08 63/39/07	63/39/11,12 63/08/38,41	63/07/25 63/14/22	63/39/09 63/39/10
Brand	LA-IC-3 RA-IC-3	LA-5-1 RA-5-1	LA-IC-1,2 RA-IC-1,2	LA-IC-4 RA-IC-4	RA-S-2 LA-S-2
# Released	38,955	39,970	80,089	40,097	39,817
Location					
L. Col. Sport	1 (.003)	22 (.055)		36 (.090)	
Mid. Col. Sport	7 (.02)	4 (.01)	3 (.004)	8 (.02)	
Zone 6 Net	48	47	47	52	43
Fall	(.123)	(.118)	(.095)	(.130)	(.108)
Winter				19 (.047)	
L. Ferry Ladder	53 (.14)	39 (.1)	11 (.014)	33 (.082)	15 (.04)
Snake R. Sport	50 (.128)	34 (.085)	60 (.075)	79 (.197)	
Tucannon Sport		2 (.005)	43 (.054)		
W. Walla R.					14 (.04)
Touchet R.					
Dworshak NFH					
Idaho Sport	32 (.082)		21 (.026)	48 (.12)	
Ocean Harvest	3 (.008)		15 (.02)	8 (.02)	
LSRCP	135	75	135	160	29
Area Total	(.347)	(.188)	(.169)	(.399)	(.073)
Grand Totals	194 (.498)	148 (.370)	200 (.250)	283 (.706)	72 (.181)

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

Table 21. Returns of 1989 release LFH steelhead to locations in the Columbia River basin, for run years 1990 and 91 (%smolt to adult survival).

Release Year	1989		
Release Site	Snake R. @ LFH	Touchet R. @ Dayton	Tucannon R. @ Curl
CWT	63/55/08 63/01/32	63/50/53 63/02/47,49,50	63/50/35,49,50
(Brand)	(RA-IJ-1,3)	(LA-IT-1,3) (RA-IT-1,3)	(LA-IJ-1,3,4)
Stock	LFH	LFH	LFH
Number Released[A]	96,236	81,106	60,373
Recovery Location		Estimated Harvest or Return	
L. Columbia Sport	80(.083)	56(.069)	29(.048)
Mid-Columbia Sport	2(.002)	21(.026)	4(.007)
Zone 6 Treaty Net	161(.168)	186(.230)	59(.097)
LFH Ladder	406(.432)	346(.427)	84(.141)
Snake River Sport	281(.292)	184(.227)	47(.078)
Dworshak NFH	4(.004)	4(.005)	4(.007)
Idaho Sport	106(.110)	38(.050)	20(.033)
Tucannon R. Sport	15(.016)	47(.057)	24(.040)
Walla Walla R. Sport	0	28(.035)	0
Touchet R. Sport	0	120(.148)	0
Ocean		3(.004)	
LSRCP Area Total	**812(.844)**	**767(.945)**	**179(.296)**
Total	1,036(1.076)	1,033(1.273)	271(.449)

A Release numbers have been adjusted for tag loss.

Trends in naturally produced juvenile steelhead density, population size and spawning activity, 1983-1992.

Density and population size

Naturally produced juvenile steelhead densities and population size estimates from 1983-1992 within the index section on the North Fork of Asotin Creek are presented in Figure 2. Juvenile steelhead densities and population size of 0 aged steelhead on the North Fork of Asotin Creek decreased in 1984 as compared to 1983 while density and population size of >0 aged steelhead in 1984 remained equal to those levels found in 1983. Juvenile density and population size of all ages of steelhead increased in 1986 as compared to all previous years. In 1989 population size remained nearly equal to that found in 1986, although juvenile steelhead densities decreased as compared to 1986. In 1991 juvenile steelhead density and population size of both 0 aged and >0 aged fish were equal to levels found in 1989. In 1992 juvenile steelhead density and total population of 0 aged fish increased dramatically. Density and population size of > 0 aged fish however, increased only slightly as compared to 1991.

Juvenile steelhead densities and population size estimates for the period 1983-1992 within the index section of the South Fork of Asotin Creek are presented in Figure 3. Steelhead densities and population size of all ages of juvenile steelhead on the South Fork of Asotin Creek remained equal in 1983 and 1984. In 1989 steelhead density 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. In 1991 both density and population size of all ages of young steelhead were substantially reduced as compared to 1989. In 1992 juvenile density and population size of 0 aged steelhead increased dramatically as compared to 1991, although densities and population size of >0 aged fish were slightly reduced from levels found in 1991.

Juvenile steelhead densities and population size estimates from 1984-1992 within the index section on the Tucannon River are presented in Figure 4. Densities and population size of 0 aged fish remained slightly above 1984 levels until a decline occurred in 1991. Densities and

population size returned to pre-1991 levels in 1992. Densities and population size of >0 aged fish on the Tucannon River increased in 1986 as compared to 1984 and remained higher than 1984 levels through 1992. Although reduced densities and population numbers occurred in 1991 and 1992 as compared to previous years.

Discussion

Annual variations in juvenile steelhead densities and population sizes are the direct result of the extent of adult spawning and young steelhead rearing success. Each of these factors are in turn affected by annual changes in river flows, water temperatures and habitat quality. Extremes of water flows, water temperatures or changes in habitat quality, even if short lived, can generally result in substantial obstructions to spawning and rearing success and thus affect substantial changes in densities and population sizes.

North Fork Asotin Creek

Both juvenile density and population size of 0 aged steelhead decreased in the North Fork of Asotin Creek in 1984 as compared to 1983 (Figure 2). Extremely high water conditions existed early in the season. It is possible that reduced spawning escapement or destruction of redds resulted in reduced numbers of 0 aged steelhead, however we have no spawning survey information for 1984 supports this theory. Density and population size of >0 aged steelhead remained equal to those levels found in 1983. Density and population size of all fish increased substantially in 1986 and remained high through 1992. We have no information about spawning activity prior to 1986 , however 1986 spawning surveys (Figure 5) showed a high level of redd construction. This is believed to be the result of returning adult steelhead from hatchery reared smolts planted in Asotin Creek, 1983-1985. All planting of hatchery reared juvenile steelhead into the upper area of Asotin Creek was discontinued after 1986. Subsequent spawning surveys show a steadily decreasing amount of spawning activity from 1987 through 1989 which we believe to be the result of discontinuing our plants of steelhead in 1987 (Figure 5). After 1989 our surveys show that the reduced level of spawning activity continued through 1992. Juvenile densities and population sizes of steelhead surveyed from 1986 through 1992 do not correlate with decreased spawning. Levels of spawning activity decreased as compared to 1986 during

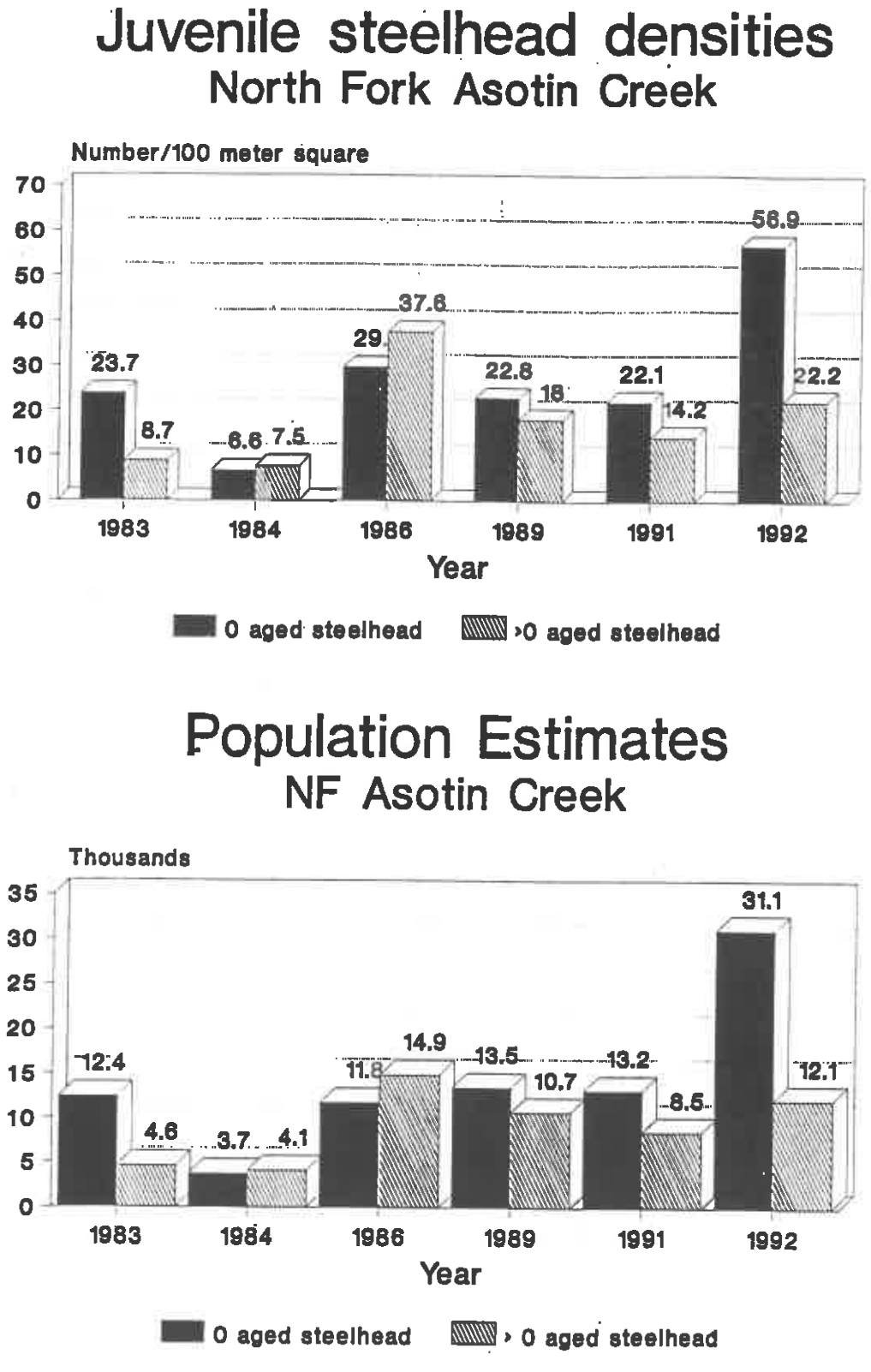


Figure 2. Juvenile steelhead densities and population estimates, North Fork Asotin Creek 1983-92.

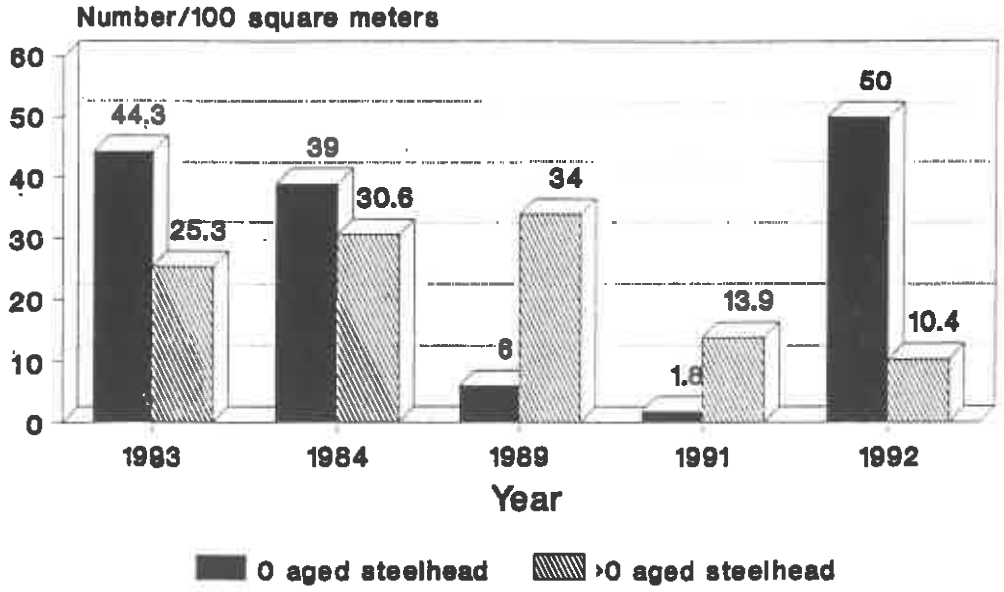
this time period while density and population size of 0 aged steelhead remained at 1986 levels and densities and population size of 0 aged steelhead increases substantially in 1992. We believe that our spawning surveys during those years underestimated the actual spawning activity that was occurring at that time (see spawning survey section). In reality, spawning activity may have remained at 1986 levels or higher through 1992. This sustained level of spawning escapement could have been the result of increased adult returns that were the progeny naturally produced from returning hatchery adults.

South Fork Asotin Creek

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 (Figure 3). In 1989 density and population size of >0 aged remained nearly equal to that found in 1983 and 1984. Density and population size of 0 aged fish, however, declined to very low levels in 1989 and 1991 as compared to 1984. We originally thought that drought conditions alone were the reason for this decline (Schuck et al. 1991). We now believe that a combination of low water conditions and extensive beaver dams at the mouth of the South Fork blocked upstream migration of adult spawning steelhead in 1989 and 1991 (Figure 5). This obstruction to upstream migration of spawners and resulting low numbers of 0 aged fish in 1989 would also result in reduced recruitment of fish to the >0 aged group in 1991. The beaver dams at the mouth of the South fork were gone in the spring of 1992 and spawning escapement increased considerably when compared to 1991 (Figure 5). Density and population size of 0 aged steelhead increased dramatically in 1992 (Figure 3). We expect an increase in the density and population size of >0 aged fish in 1993 as 0 aged fish present in 1992 mature. These events support our theory that the beaver dams did block upstream migration of spawning steelhead in the past. Removal of these dams during the spring spawning season may be needed to ensure access by adult spawning steelhead in low water years.

Tucannon River

Density and population size of 0 aged steelhead remained relatively stable from 1984 through 1990, showed a decline in 1991 and increased again to pre 1990 levels in 1992. Densities and



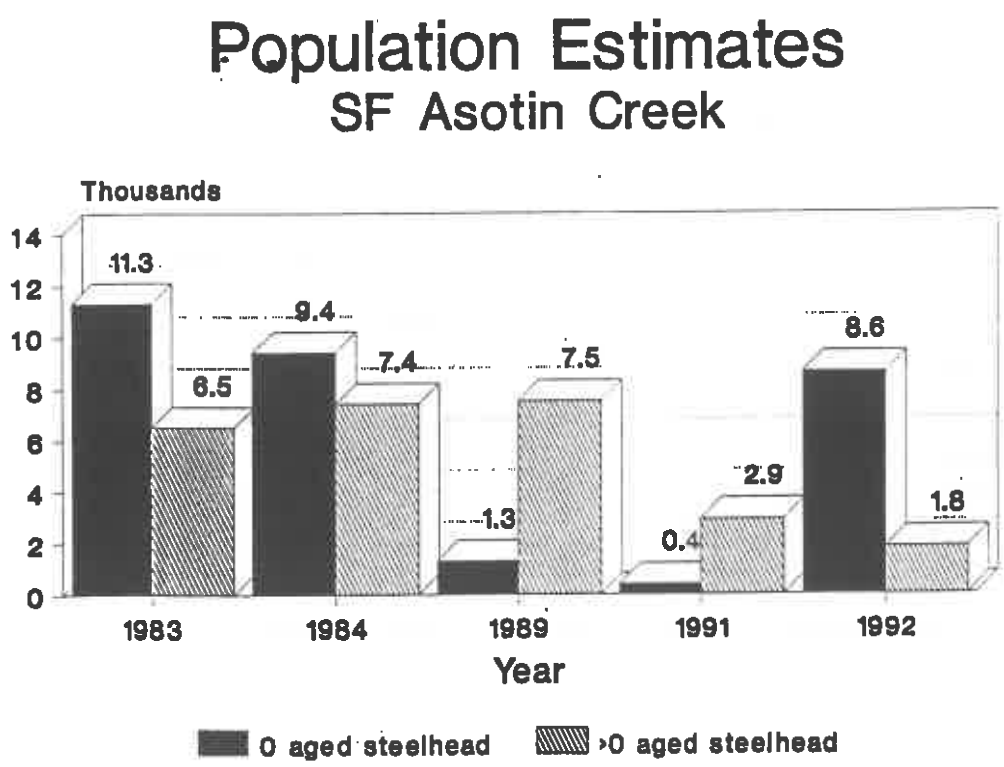


Figure 3. Juvenile steelhead densities and population estimates, South Fork Asotin Creek 1983-92.

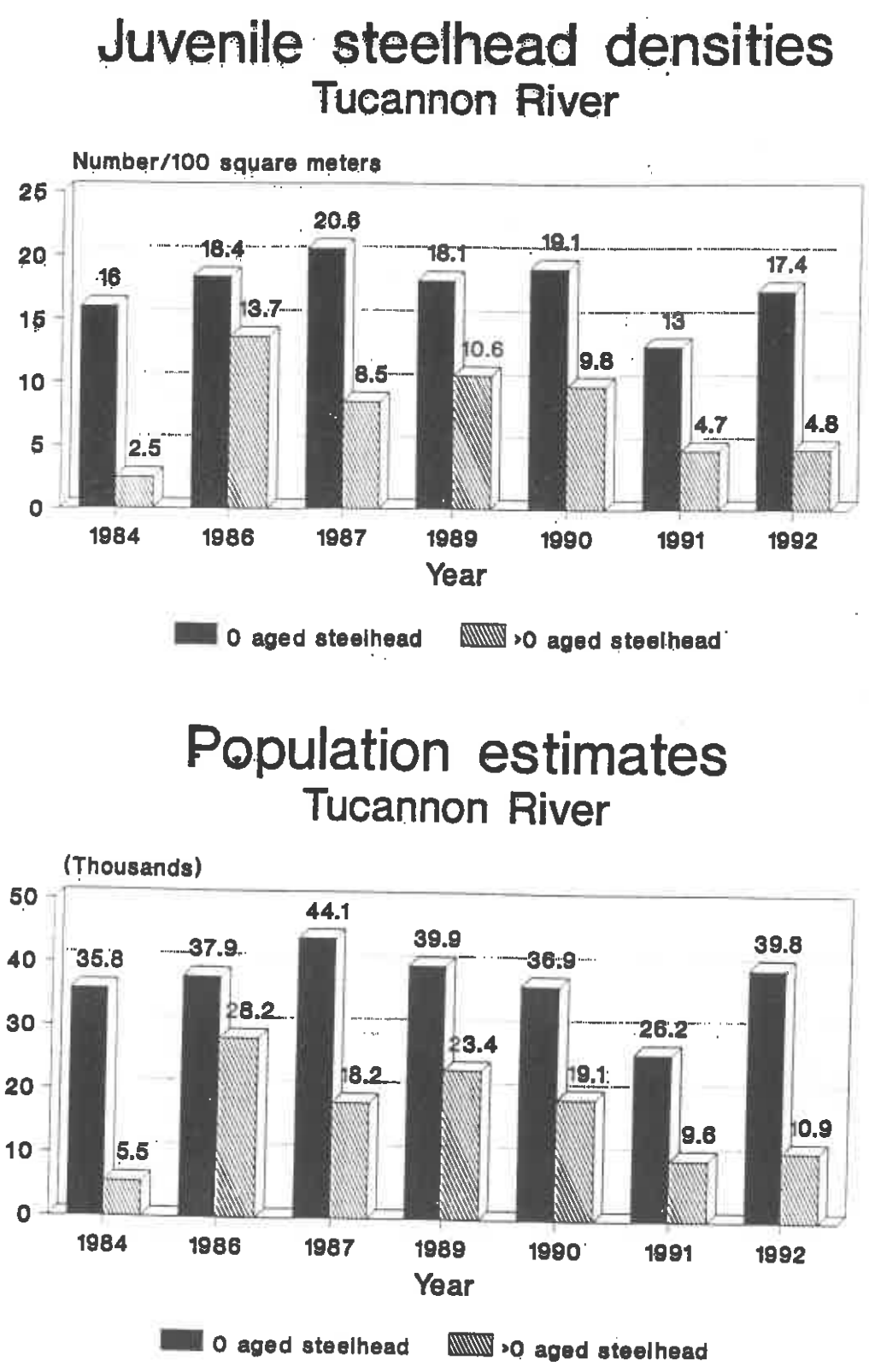


Figure 4. Juvenile steelhead densities and population estimates, Tucannon River 1984-92.

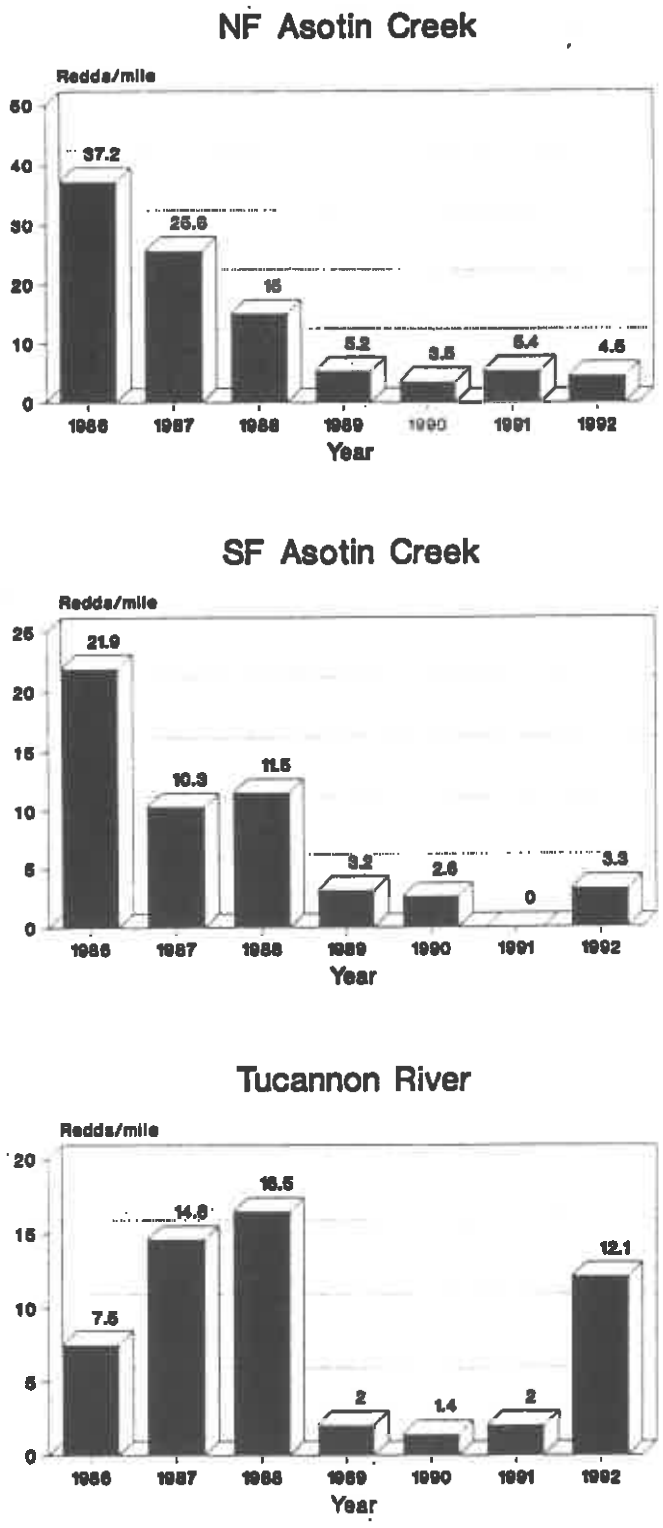


Figure 5. Spawning escapement for streams in Southeast Washington 1986-92.

population size of 0 aged steelhead from 1984 through 1992 do not correlate well with estimated spawning escapement from our surveys of those same years. Our spawning ground surveys show substantially reduced activity in 1989, 1990 and 1991, while density and population size of 0 aged fish did not decline to a similar extent. Again we believe our spawning survey methods substantially under estimated during those years.

Densities and population size of fish >0 age increased on the Tucannon River and remained at higher than 1984 levels after construction of instream habitat improvement structures in 1984 (Figure 4). We believe that these instream habitat structures were successful in providing improved rearing conditions and resulted in increased survival of older aged juvenile steelhead (Viola et al. 1991). Our surveys showed a reduced density and population size of fish >0 aged in 1991 and 1992. The reason for this decline is unclear at this time.

Catchable trout program

Production of legal or catchable size rainbow trout at the Lyons Ferry/Tucannon complex totaled 218,917 fish weighing 97,264 pounds in 1990-91. The average weight for catchable trout was 2.25 fish per pound for fish released in spring 1992. Appendix B gives a listing of streams and lakes in Southeastern Washington which received LSRCP fish, the number and pounds of fish they received and the number of different stockings into each water. In addition, 181,494 rainbow trout fry and fingerlings weighing 5,180 pounds were reared for Idaho in 1991. This production level represented 122% of the program goal.

CONCLUSIONS

The 1991 production year was plagued with problems. Outbreaks of IHN at the hatchery severely reduced the number of LFH brood steelhead to rear. While these occurrences are not an annual event, managing the production around such unexpected losses is difficult. It was decided that fish from other hatcheries in Washington, Oregon and Idaho would not be used to refill all available production space at LFH and further complicate the management of broodstocks for LFH and concern about returning fish breeding with wild populations. In addition, bird predation from the rearing ponds reached near catastrophic proportions this year (Harty 1993).

Our work to assess and characterize steelhead smolt residualism has been very informative. Results collected from this effort will have a strong effect on management in the future. See Martin et al. (1993) for a full discussion.

Adult returns continue to contribute strongly to fisheries throughout the Columbia and Snake rivers basins. Sport and treaty Indian harvest and escapement to LFH and to above Lower Granite Dam were the largest components of the 1991 run of CWT marked LFH study fish. Behaviors persist in these returning fish, however, that are not desirable. The Tucannon River releases of fish generally perform poorly when compared to releases from other rivers. Overall returns are consistently lower than for any other group and they pass Lower Granite Dam at a higher relative rate than for other groups. We believe this long term behavior is an indication of poor stock suitability. Efforts to develop a broodstock from wild Tucannon steelhead continue. If these efforts are successful, we propose converting entirely to that stock for the mitigation production. Many studies will need to be conducted in the next 5 years to assess the performance of the new broodstock.

Although similar wandering problems occur with both the Walla Walla and Touchet Rivers releases, the problem is not so clearly understood. A near absence of flowing water at the

mouth of the Walla Walla during the late summer and fall may prevent adult steelhead from finding their home river. Under these circumstances, assessing stock behavior is complicated and inconsistent from year to year. The concern over wild stock management in all streams calls for a review of our stock selection for the Walla Walla/ Touchet system and traps in Oregon and on the Touchet River at Dayton in 1992-93 will help assess whether sufficient wild fish are present from which to develop another locally adapted broodstock that could be used for production at LFH.

We exceeded our goal for returning adult steelhead. We estimate that 7,163 adult steelhead returned to the LSRCP area during the 1991 run year that were the result of production at LFH. Considerably more fish actually returned to the Columbia River Basin that were harvested in fisheries. This level of success is measurably lower than the numbers of adults returned in past years. It is, however, a substantial achievement under less than optimum drought conditions.

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Appendix A: Brand and tag recoveries from the trap at LFH during the 1991 run year.

Brand	Stock	Release Year	Actual Tag Return
RA-IV-3	LFH	1988	1
Total			1
LA-IJ-1	LFH	1989	19
LA-IJ-3	LFH		14
LA-IJ-4	LFH		3
RA-IJ-1	LFH		91 OMP
RA-IJ-3	LFH		71 DRY
LA-IT-1	LFH		43
LA-IT-3	LFH		31
RA-IT-1	LFH		52
RA-IT-3	LFH		42
Total			366
LA-IC-3	LFH	1990	29
RA-IC-3	LFH		18
RA-S-2	LFH		7
LA-S-2	LFH		6
LA-IC-4	LFH		14
RA-IC-4	LFH		17
LA-S-1	LFH		14
RA-S-1	LFH		21
LA-IC-1	LFH		2
RA-IC-1	LFH		8
Total			**136**
Unreadable brands		63	
Wild			11

Appendix B.

Rainbow and Brown trout Plants, Lyons Ferry/Tucannon, 1992.

COUNTY	LOCATION	No. of Plants	Pounds of Fish	No. Fish Planted
ASOTIN	Alpowa Cr.	1	360	1,008
	Asotin Cr.	1	1,595	3,828
	Golf Course Pd.	3	2,125	5,506
	Headgate Pond	2	740	2,008
	Silcoft Pond	2	837	2,180
	West Evans Pd.	2	1,895	4,823
	TOTAL		7,552	19,353
COLUMBIA	Beaver Lake	2	836	1,701
	Big Four Lk.	1	1,795	3,052
	Blue Lake	4	5,830	13,828
	Curl Lake	3	4,210	10,525
	Dam Pond	2	1,365	1,502
	Dayton Jv. Pd.	2	998	2,022
	Deer Lake	6	6,341	14,214
	Orchard Pond	1	1,093	1,202
	Rainbow Lake	6	9,766	22,431
	Spring Lake	5	6,661	15,188
	Touchet R.(Rb)	1	1,820	4,550
	Touchet R.(GB)	2	3,795	12,524
	Tucannon R.	1	4,255	10,212
	Watson Lake	2	1,729	3,462
	TOTAL Rainbow		46,699	103,889
	Browns		3,795	12,524
FRANKLIN	Dalton Lake	2	2,493	4,986
	Marmes Pond	1	304	517
	TOTAL		2,797	5,503
GARFIELD	Baker's Pond	1	370	1,036
	Casey Pond	1	560	1,568
	Pataha Creek	2	1,610	4,116
	Deadman Creek	1	400	1,000
	TOTAL		2,940	7,720
WALLA WALLA	College Pl. Pd.	2	900	2,445
	Coppei Creek	1	510	1,428
	Dry Creek	1	510	1,428
	Fishhook Pk. Pd.	2	2,895	7,613
	Jefferson Pk. Pd.	2	900	2,445
	Quarry	4	14,220	25,753
	Mill Creek	1	1,870	4,488
	Mill Creek Res.	5	9,610	22,368
	TOTAL		31,415	67,968
WHITMAN	Alkalai Creek	1	180	504
	Garfield Pond	1	680	1,904
	Gilcrest	2	1,180	3,154
	Klemgaard Pond	1	540	1,512
	Pampa Pond	1	1,800	4,680
	Riparia Pond	2	941	1,218
	Rock Lake (GB)	1	505	1,667
	Union Flat Cr.	1	540	1,512
	TOTAL Rainbow		5,861	14,484
	Browns		505	1,667
	TOTAL RAINBOW		**97,264**	**218,917**
	TOTAL BROWNS		**4,300**	**14,191**
	TOTAL FISH PLANTED		**101,564**	**233,108**

Appendix C: Juvenile density sample sites on Southeast Washington streams.

Site Name	Site Type	Site Length	Road Mile	Description and Reference Point
North Fork Asotin Ck.				
NA-C4	Control	95	1.25	By smalll clearing past rusted road closure gate.Ref:0+90RB,alder
NA2c-83	3 Log Weirs	100	1.35	Across a large meadow.Ref:0-13LB,alder.
NA-C2	Control	87	1.80	Above split in creek 300ft. above NA4a.Ref:0+04RB,D.fir.
NA4-84	18 Boulders	100	1.90	In first campgrd. above NA4a-83. Ref:0+00RB,alder.
NA-C1	Control	83	2.60	Across the road from a rock face. Ref:1+16RB,alder.
NA8-84	12 Boulders	75	3.00	Ref:0-18LB,alder.
South Fork Asotin Ck.				
SA1-83	2 Log Weirs	119	0.40	300ft. above Campbell Grade Road. Ref:0+00RB,alder.
SA-C3	Control	100	0.80	0.1 mile above Hodson's cattleguard Ref:1+29RB,alder.
SA-C2	Control	99	1.95	By 20ft. high eroding bank. Ref:0+25RB,boulder.
SA6B-83	1 Log Weir 8 Boulders	77	2.35	.15 mile below road closure gate. Ref:0+00LB,cottonwood.
SA-C5	Control	104	3.55	Above and continuous with SA6-84. Ref:0+03LB,cottonwood.
SA7-84	8 Boulders	70	3.60	Creek runs next to road here. Ref:0-50LB,ponderosa pine.

Appendix C. (cont.)

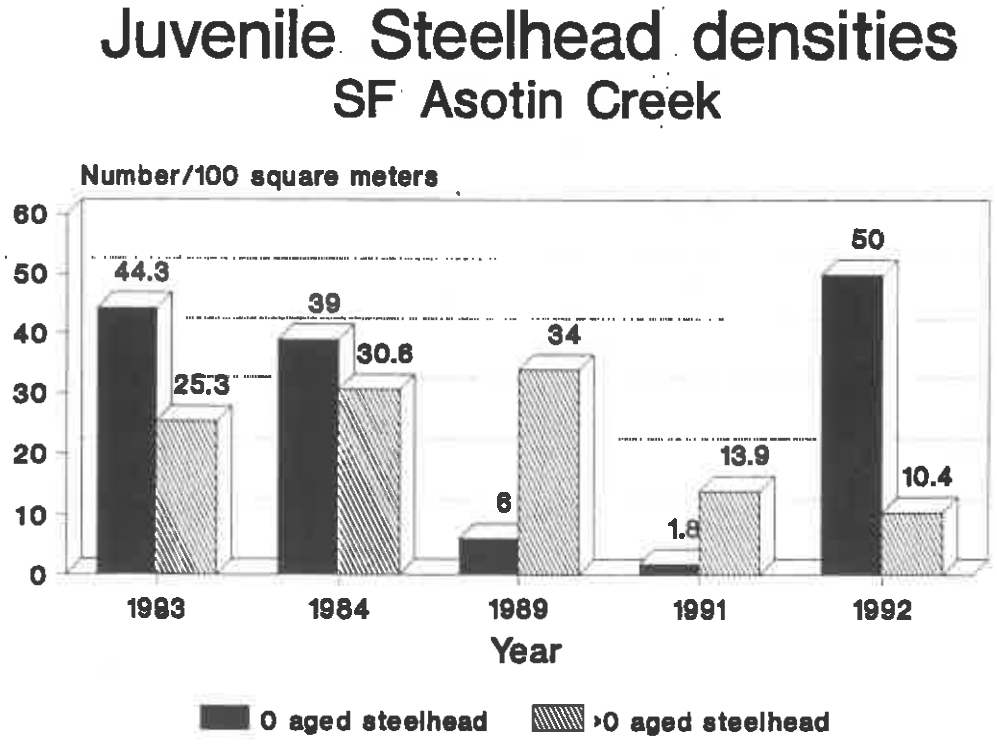
Site Name	Site Type	Length	Site Road Mile	Description and Reference Point
Tucannon River				
TN-C1	Control	100	0.10	Near lower outhouse at camp 2. Ref:0+02LB,ponderosa pine.
TN3-84	12 Boulders	166	0.35	Day use above camp 3. Ref:2+66LB,cottonwood.
TNC4-84	Control	100	6.80	159ft below TN24-84. Ref:0+02RB,douglas fir.
TN24-84	31 Boulders	163	6.85	600ft. above campgrd. above Guard Station.Ref:0+65LB,alder.
TNC5-84	Control	100	8.40	Day use area just above large B.P..Ref:0+30LB,douglas fir
TN31-84	13 Boulders 1 Log Weir	153	11.10	Just below Panjab bridge. Ref:0-62LB,bridge piling.

Appendix D. Steelhead trapped at Tucannon Hatchery weir, Spring 1992.

Date	Wild/Hatchery	Sex	Length	Comments
01/04/92	H	-	-	Passed
01/15/92	H	F	-	Passed
01/15/92	H	M	-	Passed
01/29/92	H	-	-	Passed
01/29/92	H	-	-	Passed
01/29/92	H	-	-	Passed
02/20/92	H	-	-	Passed
02/20/92	H	-	-	Passed
02/21/92	H	-	-	Passed
02/28/92	H	-	-	Passed
02/28/92	H	-	-	Passed
02/28/92	H	-	-	Passed
03/02/92	H	-	-	Passed
03/02/92	H	-	-	Passed
03/04/92	H	-	-	Passed
03/04/92	H	-	-	Passed
03/04/92	H	-	-	Passed
03/09/92	H	-	-	Passed
03/09/92	H	-	-	Passed
03/09/92	W	M	66	Held
03/10/92	W	F	53	Held
03/11/92	W	M	56	Held
03/11/92	H	-	-	Passed
03/14/92	H	F	-	Passed
03/18/92	W	M	53	Passed
03/18/92	W	M	-	Passed
03/18/92	W	M	-	Passed
03/18/92	W	M	-	Passed
03/20/92	H	M	-	Passed
03/26/92	W	M	61	Passed
03/26/92	H	M	-	Passed
03/26/92	H	M	-	Passed
03/26/92	H	M	-	Passed
03/26/92	H	F	-	Passed
03/26/92	H	F	-	Passed
03/26/92	H	F	-	Passed
03/30/92	W	F	56	Passed
04/03/92	W	M	58	Passed
04/03/92	H	M	-	Passed
04/03/92	H	F	-	Passed

Appendix D. (con't) Steelhead trapped at Tucannon Hatchery weir, Spring 1992.

Date	Wild/Hatchery	Sex	Length	Comments
04/03/92	H	F	-	Passed
04/07/92	W	M	56	Held
04/07/92	W	F	58	Passed
04/07/92	H	M	-	Passed
04/13/92	W	M	53	Passed
04/13/92	W	F	58	Passed
04/13/92	H	F	-	Passed
04/13/92	H	F	-	Passed
04/13/92	H	M	-	Passed
04/16/92	W	F	61	Passed
04/16/92	H	M	-	Passed
04/16/92	H	F	-	Passed
04/16/92	W	F	56	Held
04/20/92	W	M	58	Held
04/20/92	W	F	76	Held
04/20/92	W	F	58	Passed
04/20/92	W	F	-	Passed
04/20/92	H	F	-	Passed
04/20/92	H	M	-	Passed
05/01/92	W	F	-	Passed
05/01/92	W	F	-	Passed
05/01/92	W	F	-	Passed
05/01/92	W	M	-	Passed
05/11/92	W	M	-	Passed



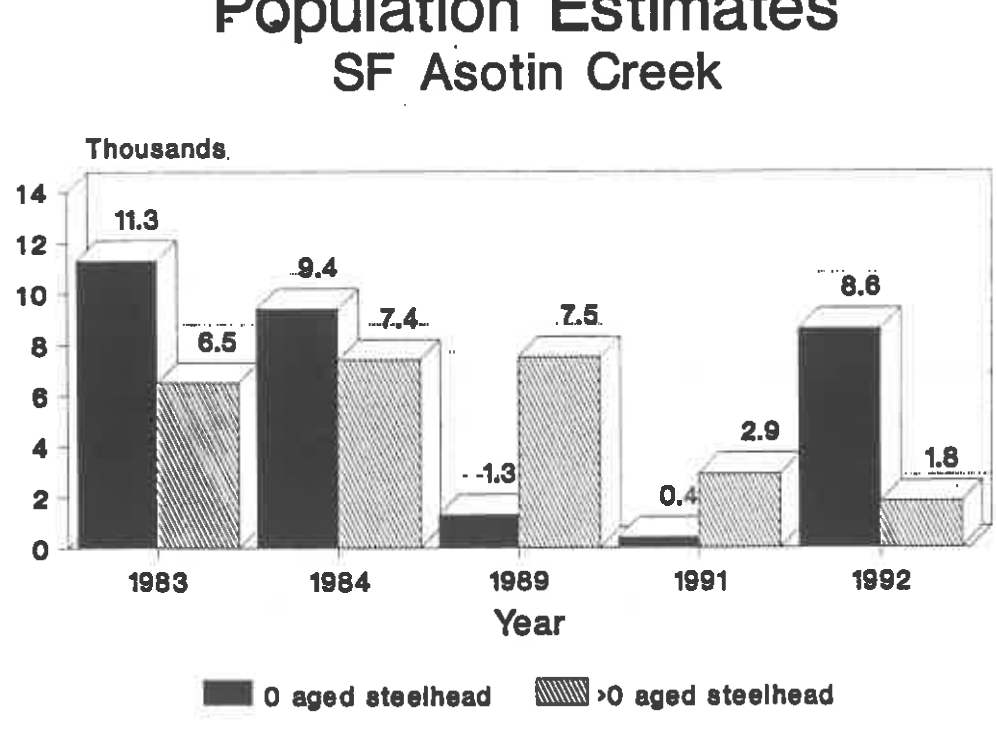
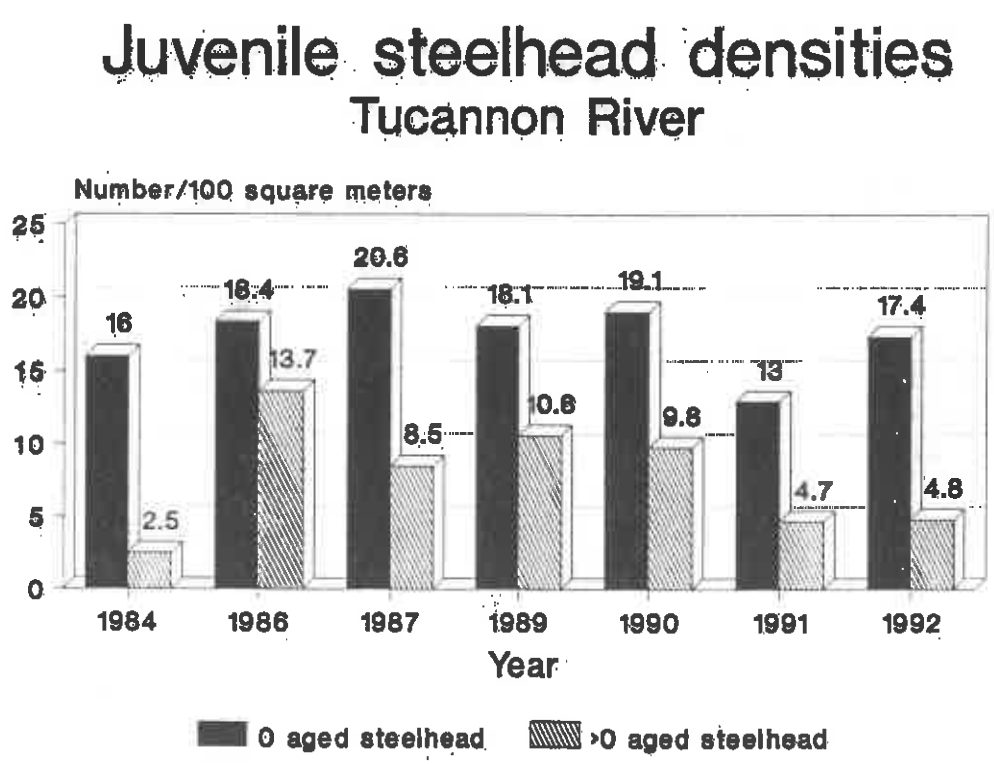


Figure 3. Juvenile steelhead densities and population estimates, South Fork Asotin Creek 1983-92.



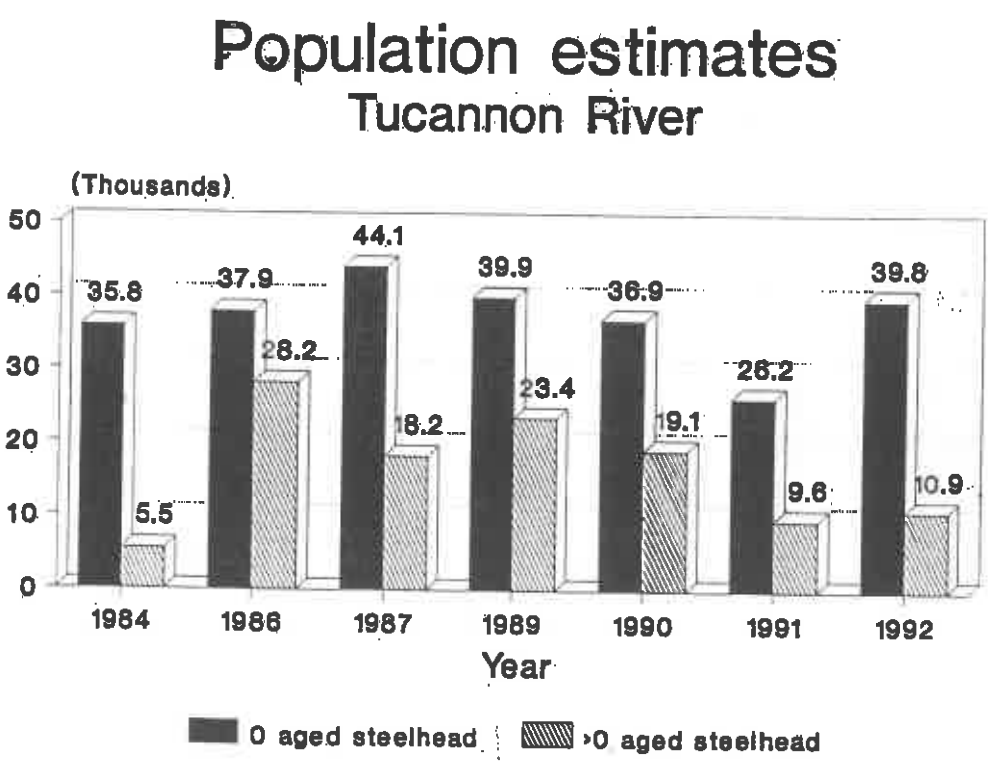


Figure 4. Juvenile steelhead densities and population estimates, Tucannon River 1984-92.

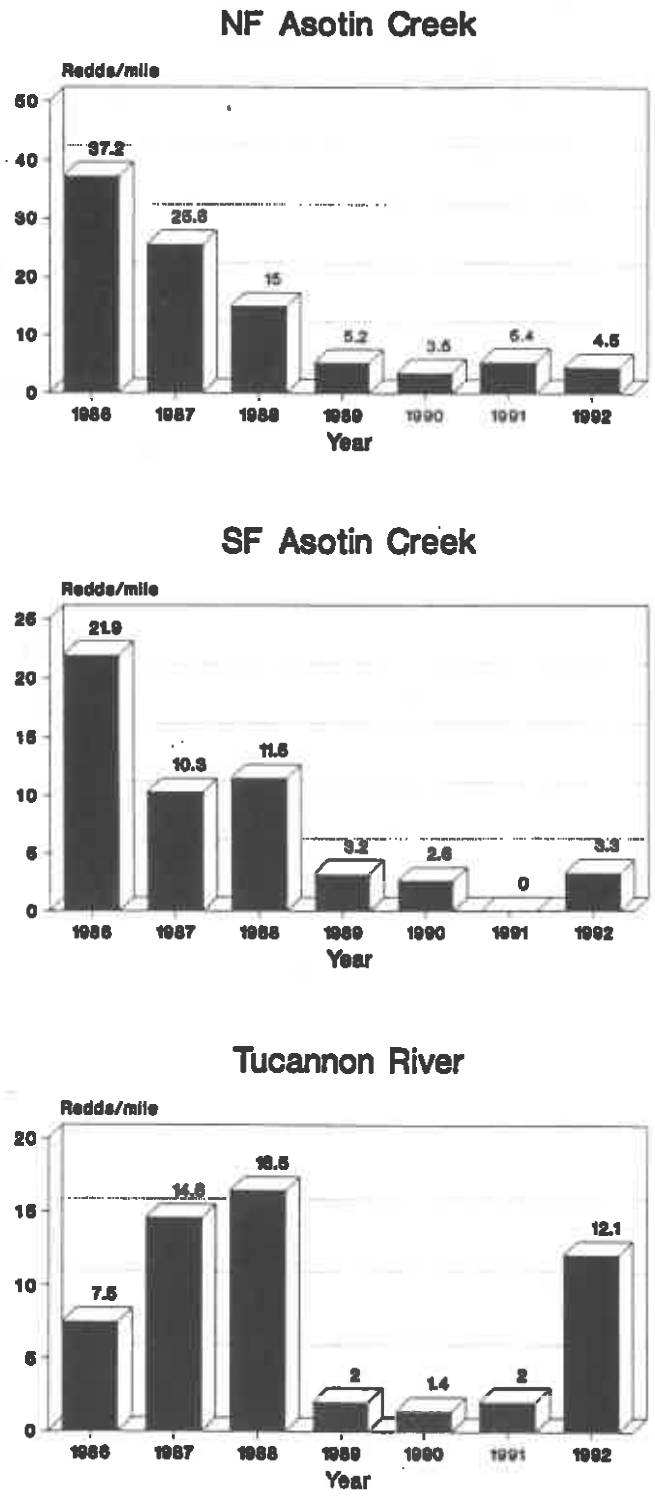
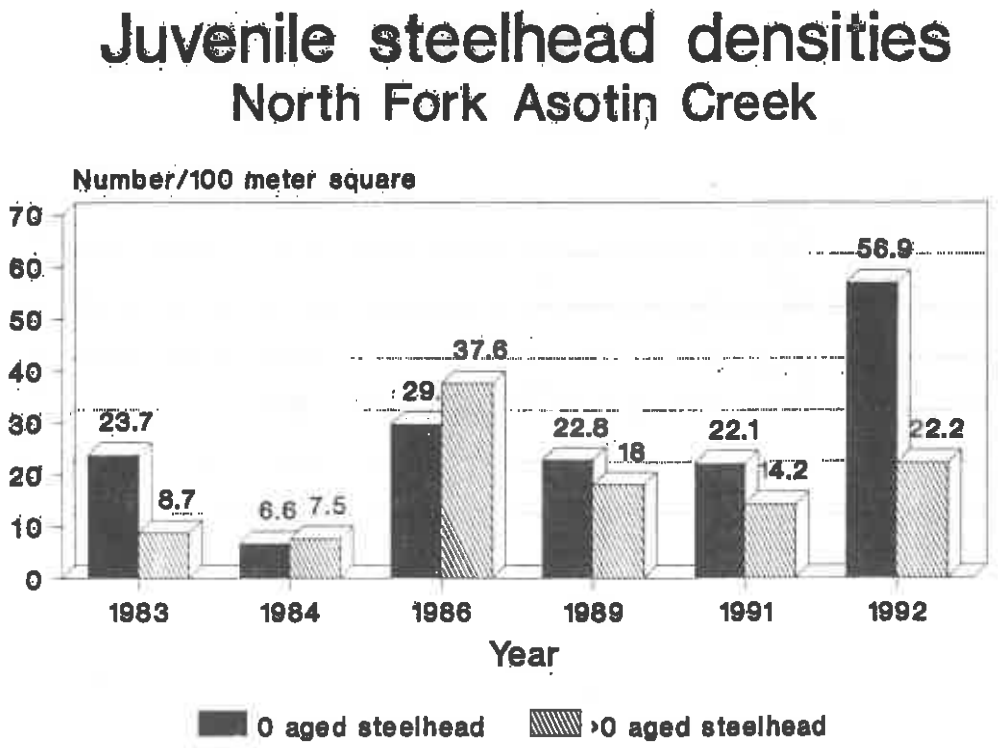


Figure 5. Spawning escapement for streams in Southeast Washington 1986-92.



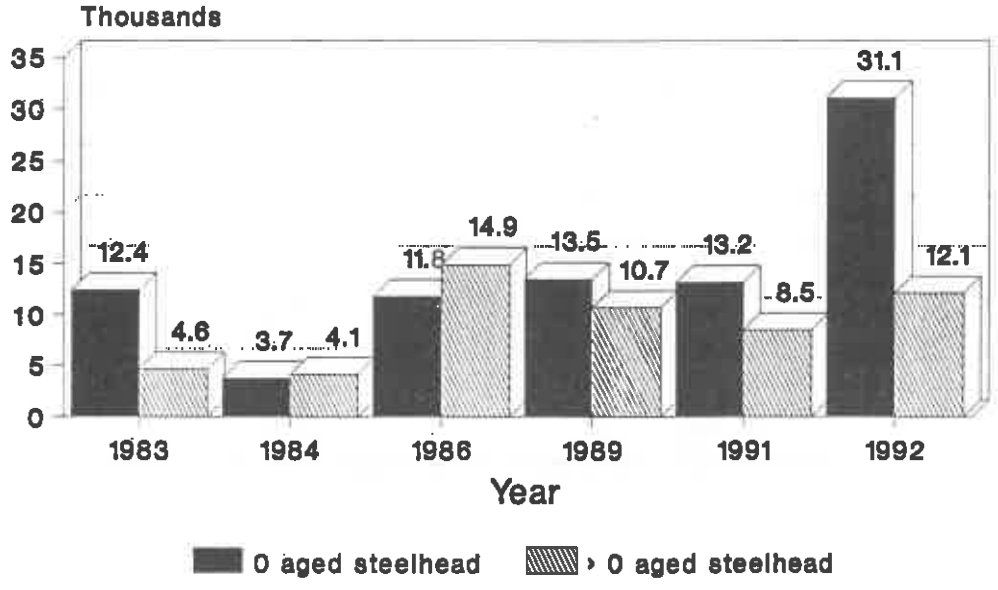


Figure 2. Juvenile steelhead densities and population estimates, North Fork Asotin Creek 1983-92.

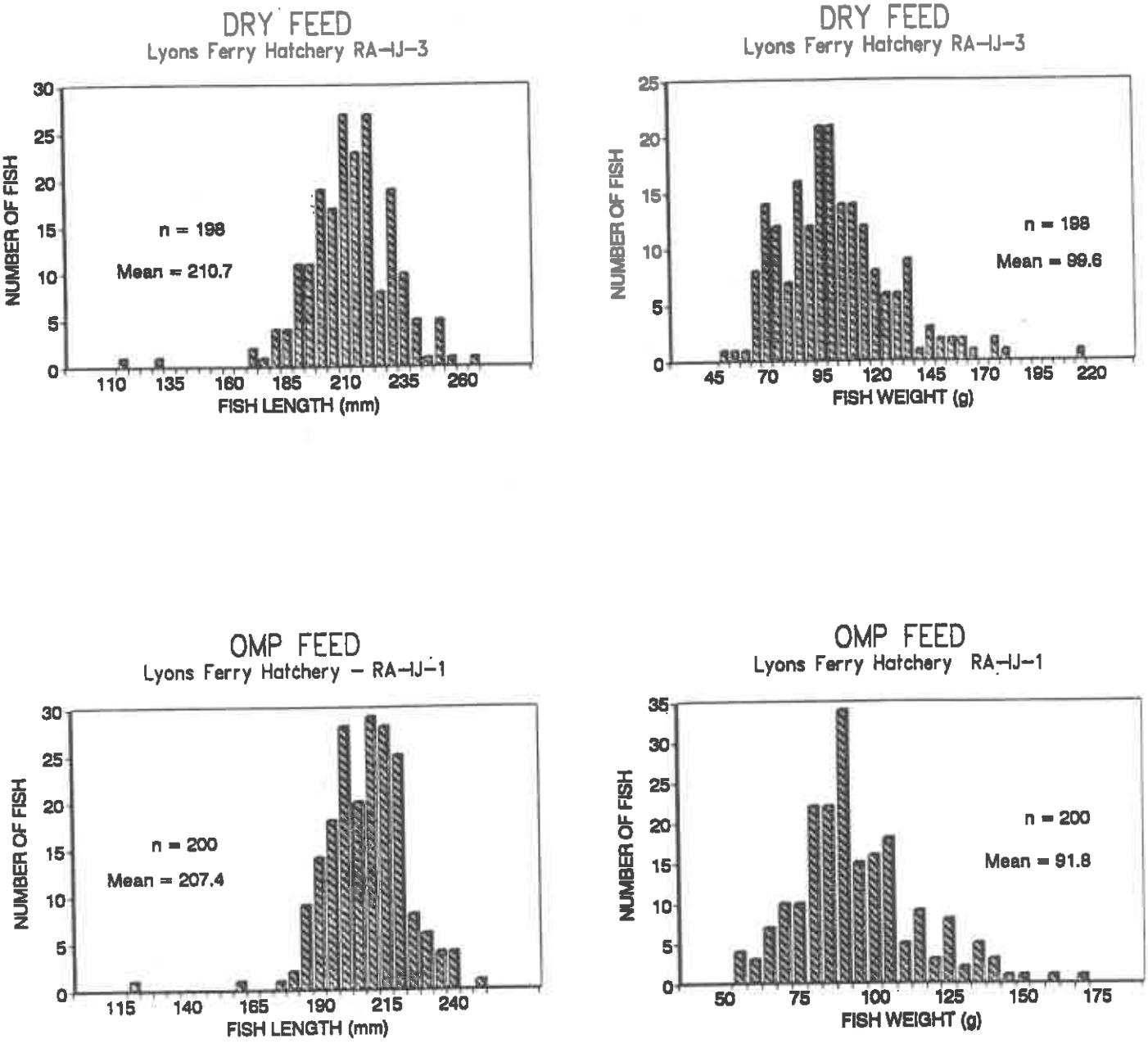


Figure 1. Length and weight histograms for feed study fish released from LFH in 1989.

Appendix D. (con't) Steelhead trapped at Tucannon Hatchery weir, Spring 1992.

Date	Wild/Hatchery	Sex	Length	Comments
04/03/92	H	F	-	Passed
04/07/92	W	M	56	Held
04/07/92	W	F	58	Passed
04/07/92	H	M	-	Passed
04/13/92	W	M	53	Passed
04/13/92	W	F	58	Passed
04/13/92	H	F	-	Passed
04/13/92	H	F	-	Passed
04/13/92	H	M	-	Passed
04/16/92	W	F	61	Passed
04/16/92	H	M	-	Passed
04/16/92	H	F	-	Passed
04/16/92	W	F	56	Held
04/20/92	W	M	58	Held
04/20/92	W	F	76	Held
04/20/92	W	F	58	Passed
04/20/92	W	F	-	Passed
04/20/92	H	F	-	Passed
04/20/92	H	M	-	Passed
05/01/92	W	F	-	Passed
05/01/92	W	F	-	Passed
05/01/92	W	F	-	Passed
05/01/92	W	M	-	Passed
05/11/92	W	M	-	Passed