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Lyons Ferry Trout Evaluation Study

By Mark L. Schuck, Arthur E. Viola and Jerry Dedloff

Washington Department of
FISH AND WILDLIFE
Hatcheries Program
Assessment and Development Division

Report # H97-08

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1995-96 Annual Report

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ABSTRACT

In 1995, as part of the Lower Snake River Compensation Plan (LSRCP) mitigation program, Lyons Ferry Hatchery (LFH) produced 868,205 summer steelhead (182,038 pounds) with an average smolt size of 4.8 fish/lb. A total of 216,837 rainbow trout (72,088 pounds) were reared and stocked into 36 waters at an average size of 3.0 fish/lb. Additionally, 159,798 fry and 51,890 fingerling rainbow trout (7,182 pounds) were reared and provided to Idaho.

Seven groups of juvenile steelhead were branded, coded-wire tagged, fin clipped and released into three rivers. Two groups were released into the Tucannon River, one directly and one from Curl Lake Acclimation Pond (AP), to continue our study of smolt behavior and residualism. Two groups were released into the Touchet River from the Dayton AP for a contribution study; and three groups were released from LFH as a contribution study and for comparison with tributary releases.

We implanted Passive Integrated Transponder (PIT) tags in three groups of steelhead from Curl Lake AP, one group from the direct Tucannon River release and two groups from LFH. Relative emigration performance to collector dams on the Snake and Columbia rivers was measured and physical characteristics of successful emigrants characterized. The overall group performance of fish released into the Tucannon River, measured as detections at McNary Dam, for acclimated versus direct river releases was similar. All groups traveled downstream at a similar rate.

In an effort to decrease the number of residual steelhead in the Tucannon River which may adversely interact with wild salmonids, we kept 5,244 potential residual juvenile steelhead in Curl Lake AP instead of releasing them into the Tucannon River. High cold water flows and faulty equipment caused problems in operating the pond in 1996. Residual steelhead were present in the Tucannon River during June 1996 in the highest number since beginning pond management actions to reduce residualism in 1993.

Five thousand nine hundred-twenty adult steelhead were trapped at LFH during the summer and fall of 1995. Of those, 59.7% were female, 78.1% were one-ocean age fish (indicates years of ocean residency), and 0.14% were wild fish. We sampled 711 tagged/branded fish (12%). We spawned 330 females and 660 males which produced 1,614,636 eggs. One-ocean age females (n = 243) averaged 4,717 eggs per female and two-ocean age females (n = 50) averaged 5,953 eggs per female. There were no confirmed three-ocean age females spawned this year.

To recover coded-wire tags from study fish, we surveyed 8,658 steelhead anglers who caught 3,256 steelhead from area rivers. Estimates of angler effort, total harvest and tagged fish harvest are summarized. The average angler required 9.1 hours to catch a fish.

We estimate that releases of Washington's juvenile steelhead from LSRCP facilities in 1993 and 1994 returned 13,750 adult steelhead to the Snake, Tucannon, Grande Ronde, Asotin and Walla Walla rivers in 1995-96. That return is 295% of the goal established for Washington's steelhead mitigation program as defined by the Lower Snake River Compensation Plan.

Populations of naturally produced steelhead in LSRCP streams were seriously affected by a severe flood during February and by another minor flood in April 1996. The numbers of young-of-the-year (0-age) steelhead were reduced from previous years in most rivers. Older age fish (>0-age) were present in similar to slightly lower numbers than observed in previous years. Redd construction increased from 1995 where estimates could be made.

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ACKNOWLEDGMENTS

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.

Jerry Harmon and the other NMFS personnel at Lower Granite Dam perennially provide diligent reading of brands on returning adult steelhead. Their data proves invaluable each year in understanding the behavior of our returning steelhead.

Our Technicians, John Johnston and Michelle Varney, spent months tracking down anglers and removing snouts from coded-wire tagged steelhead. Their work forms the basis for the tedious, but very important, sport recovery portion of our tag recovery effort. Their efforts are appreciated.

We would like to thank Glen Mendel, Joe Bumgarner, Butch Harty and Geraldine Vander Haegen for reviewing the draft manuscript and providing valuable comments.

Finally, we would like to express our special appreciation to the staff of Lyons Ferry Complex 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.

1.0 INTRODUCTION

This annual report is one of a continuing series describing Washington Department of Fish and Wildlife's (WDFW)[1] progress toward meeting trout (resident and anadromous) mitigation goals established in the Lower Snake River Compensation Plan (LSRCP). The study period for this report was 1 July 1995 through 30 June 1996.

The LSRCP program began in Washington in 1981 with construction of Lyons Ferry Hatchery (LFH). Refurbishing of the Tucannon Hatchery followed in 1984-85. Three remote ponds were built along the Tucannon, Touchet and Grande Ronde rivers to acclimate juvenile steelhead before release. These facilities make up the Lyons Ferry Complex.

The Lyons Ferry Evaluation study assesses whether the complex produces fish that meet mitigation goals. It also determines what parts of the mitigation program may adversely affect salmonids listed under the Endangered Species Act (ESA) or other natural salmonid populations, and recommends actions to improve the facilities' effectiveness.

Recent declines in adult wild/natural steelhead escapement and an ongoing coast wide review by the National Marine Fisheries Service (NMFS) on the status of steelhead reinforces the need to monitor populations of wild salmonids in rivers receiving LSRCP mitigation. Our data on wild steelhead population density and size is used to assess the potential effects of hatchery fish on natural populations. Also, our work on residualism of hatchery steelhead, begun in 1991, has helped reduce the potentially negative effects of hatchery fish on natural salmonid populations.

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[1] The Washington Departments of Fisheries and Wildlife were merged in March, 1994. This work is a continuation of Washington Department of Wildlife's evaluation studies, but all references in this report will be to the new agency, WDFW.

2.0 METHODS/ RESULTS / DISCUSSION

2.1 Hatchery Operation Monitoring

2.1.1 Juvenile production

Our methods of sampling growth rates during the production year or when sampling before release in the spring are the same as past years (Schuck 1985). We measured pre-release fork length and weight, and visually classified each sampled fish as a smolt, transitional, parr or precocious male. Some fish were killed to determine sex. Table 1 summarizes production from Lyons Ferry and Tucannon hatcheries. Numbers represent individual fish stock performance over the entire rearing period.

Table 1: Trout produced and released from Lyons Ferry / Tucannon hatcheries, 1995-96.

Species[A]	Stock[A]	Number of eggs taken	Number of fry	Number released	%[B] survival	Fish lbs. produced
Lyons Ferry Hatchery						
RB	Spokane(94)	377,000	357,136	331,071 [C]	87.8	45,723
RB	Spokane(95)	0	56,112	51,890 [D]	92.5	1,860
SSH	Wal./Cot.(95)	511,283	309,956	265,449	27.8	53,031
SSH	LFH(95)	1,772,477 [F]	895,882	610,545 [E]	41.3	131,787
Tucannon Hatchery						
RB	Spokane(94)	232,000	224,120	153,001 [F]	81.0	34,616
RB	Spokane(94)	81,200	79,688	56,112 [G]	64.5	1,668
GB	Ford(94)	25,230	24,289	22,783 [H]		5,069
SSH	LFH(95)	0	145,031	144,486 [I]	99.8	0

A - RB = rainbow, SSH = summer steelhead, GB = German brown; Wal = Wallowa, Cot. = Cottonwood; LFH = Lyons Ferry Hatchery.
B - survival rate to release - includes all sizes of fish released.
C - Includes 199,912 fish (5,880 lbs) transferred to Idaho Fish and Game (IDFG); and 33,772 fish (1,806 lbs) planted in Spokane and Stevens Counties.
D - Received from the Tucannon Hatchery, marked, then transferred to IDFG.
E - Includes 145,031 fish (30,789 lbs) transferred to Tucannon Hatchery: Curl Lake
F - Includes 33,551 fish (565 lbs) planted in Rock Lake
G - Transferred to LFH for marking
H - Includes 12,278 fry (1,380 lbs) planted in Rock Lake.
I - Includes 5,244 fish (672 lbs) retained in Curl Lake A.P. as non-migrants

Egg-to-fry survival of steelhead used at LFH are highly variable between stocks and among years. Fish health, presence of pathogens and spawning conditions at remote spawning sites (Cottonwood AP adult trap) all affect egg survival. A summary is provided in Table 2 for recent production years. Eggs from 17 females (75,505) at Cottonwood AP and 6 females at LFH (26,174) were discarded because of the presence of IHN virus in ovarian fluid samples in 1996.

Table 2. Egg to fry survival, Lyons Ferry Hatchery 1989-96.

Stock	Brood Year	Eggs in/ or taken	Eggs retained for rearing	Fry Out	% Survival
Wallowa	1989	236,214	236,214	186,958	79.1
	1990	428,000	428,000	409,477	95.7
	1991	421,025	421,025	416,470	98.9
	1992	225,012	225,012	212,160	94.3
	1993	272,000	272,000	257,599	94.7
	1994	277,000	243,180	233,813	84.4
Wal/Cottonwood	1992	558,437	198,747	186,656	33.4
	1993	533,995	289,198	271,970	50.9
	1994	644,886	366,115	302,397	46.9
	1995	511,283	335,489	321,050	62.8
	1996	601,979	430,394	447,569	74.3
Lyons Ferry	1989	1,263,237	957,074	941,000	84.2
	1990	2,570,676	1,483,485	1,002,320	67.6
	1991	1,296,249	1,165,315	1,115,368	86.0
	1992	1,239,055	905,438	416,265	33.6
	1993	1,211,053	940,022	860,983	71.1
	1994	1,352,296	899,350	845,316	62.5
	1995	1,772,477	929,597	895,882	50.5
	1996	1,614,636	1,151,363	1,148,114	71.1

2.1.2 Fish marking

Groups of steelhead were marked in three different ways:

1) all fish were adipose clipped to designate hatchery fish,

In addition, some study groups of fish were marked with;

2) coded-wire tag (CWT), adipose and left ventral fin clipping and freeze branding for specific contribution and return rate studies,

3) Passive Integrated Transponder (PIT) tags in juvenile fish to monitor emigration success and to identify the characteristics of successful (migrating) smolts.

Adipose fins were clipped during August/September 1995. We coded-wire tagged and branded fish during February 1996. Tag loss was determined by sampling 800-1,000 fish from each tag group with a portable CWT detector. Freeze brands were examined for their presence and quality (light, burned, location). Tag codes and brands were reported to the Pacific States Marine Fishery Commission (PSMFC) for publication in their annual report.

Mean CWT loss was 3.00% (SD=1.37) in 1996 compared to tag loss of 0.9% (SD= 1.0) in 1995. In 1996, 3.00% (SD= 1.49) of freeze brands were unreadable compared to 1.19% (SD=0.4) in 1995. Tag/brand groups are detailed in Appendix A .

2.1.3 Fish releases

Fish release methods in 1996 were generally the same as 1994 and 1995 (Schuck et al 1996), with a combination of direct and acclimated releases associated with various studies and a facility's capability.

Pre-release samples were collected from Curl Lake, Dayton, and Cottonwood acclimation ponds in 1996 to characterize the pond population; samples were also taken from lakes at LFH (Tables 3 and 4). A post-release sample was taken from Curl Lake of non-migrant juvenile steelhead to characterize this group of fish (see section 2.2.2 Migration Success).

At Curl Lake AP an electronic fish counter was used to count how many fish left the pond. Numbers from the counter convinced us to leave the pond open and lower water levels much below past years in an attempt to encourage more fish to leave the pond. Problems with the counter caused it to incorrectly count fish exiting the pond. The error was discovered when we conducted a mark and recapture estimate of fish remaining in the pond after the exit had been blocked. The counter estimate differed from our mark and recapture estimate by more than 30,000 fish, while repeated mark and recapture estimates confirmed our first estimate.

When the fish remaining in the pond met our criteria for retaining potentially residual juvenile steelhead (fish were 80% males and hesitant to leave the pond), screens were replaced in the outlet structure (16 May 1996). We used a mark and recapture method to estimate that 139,242 steelhead smolts volitionally left Curl Lake AP in 1996, and 5,244 potentially residual juvenile steelhead were retained in the pond where they could not adversely affect wild salmonids. A sport fishery was opened in Curl Lake AP on the non-migrating fish.

Table 3. Mean lengths (with coefficient of variation), weights and condition factors for LFH origin steelhead releases, 1996.

	Number sampled	Mean length (mm)	Mean weight (g)	K
Dayton Pond				
AD clipped	184	199.1 (12.4)	83.1	1.01
ADLV clipped				
LA-IV-1	134	202.5 (9.9)	86.7	1.03
LA-IV-3	124	198.0 (10.6)	84.2	1.01
Cottonwood Pond [A]	475	194.5 (15.9)	80.6	1.02
Curl Lake				
AD clipped	348	214.6 (15.3)	100.4	0.98
ADLV clipped	167	197.6 (10.1)	77.4	0.98
Walla Walla				
AD clipped	211	228.2 (7.8)	109.7	0.91
Snake River				
ADLV clipped				
LA-IT-1	104	210.9 (10.1)	93.5	0.97
LA-IT-3	100	209.3 (8.6)	89.8	1.00
RA-IT-1	111	206.8 (11.0)	89.2	0.98
Tucannon River				
ADLV clipped				
RA-IV-1	177	208.2 (10.0)	90.5	0.98

A- All steelhead in Cottonwood Acclimation pond were AD clipped only.

Table 4. Mean fork lengths, weights and condition factors for smolted and non-smolted LFH steelhead at release, 1996.

	n (%)	Mean length (mm)	Mean weight (g)	K	% male/female (n)
Dayton Pond					
Sampled 03/22/96					51.5/48.5 (130)
Smolts	97 (21.9)	215.9	103.5	1.01	
Transitional	293 (66.3)	198.9	82.5	1.02	
Parr	34 (7.7)	162.0	44.0	0.99	
Precocious males	18 (4.1)	199.6	90.9	1.14	
Cottonwood Pond					
Sampled 03/26/96					62.6/37.4 (163)
Smolts	121 (25.5)	220.1	110.8	1.00	
Transitional	334 (70.3)	188.0	72.1	1.01	
Parr	16 (3.4)	132.4	22.3	0.94	
Precocious males	4 (0.1)	213.3	104.0	1.04	
Curl Lake					
Sampled 03/25/96					54.2/45.8 (153)
Smolts	232 (45.0)	225.0	111.4	0.96	
Transitional	251 (48.7)	197.3	78.1	0.99	
Parr	5 (1.0)	133.8	22.6	0.94	
Precocious males	27 (5.2)	195.2	85.4	1.11	
Walla Walla					
Sampled 04/16/96					no fish sampled for sex
Smolts	189 (89.6)	229.6	111.8	0.91	
Transitional	22 (10.4)	216.3	92.0	0.89	
Parr	0	0	0	0	
Precocious males	0	0	0	0	

2.2 Hatchery Smolt Emigration

We calculated relative smolt survival during their down river migration in the Snake and Columbia Rivers from freeze brands collected and expanded at the Snake and Columbia River Dams (Fish Passage Center 1996). A Passage Index[2] for each brand group is provided.

2.2.1 Migration through dams

Passage estimates at McNary Dam for freeze brand groups released in 1993-96 are summarized in Table 5. While the indices at Lower Monumental Dam (first dam below their release sites) for groups released from LFH and Curl Lake AP and Marengo were much higher, they could not be compared directly with passage indices from previous years which represent passage at McNary Dam, (third dam below these release sites) and are therefore not presented here for comparison. Median passage of the smolts released from LFH, Curl Lake AP and Marengo occurred at McNary Dam 12, 37 and 13 days after release, respectively. Ninety-five percent passage had occurred by 20 May (31 days), 15 June (45 days) and 22 May (37 days) for LFH, Curl Lake AP and Marengo releases, respectively.

Table 5. Estimated passage of freeze branded/tagged Lyons Ferry Hatchery steelhead at McNary Dam, 1993-96. (FPC 1994-1997)

Brand	Release site	Passage index	Number [a] released	% of release	Size (#/lb)	Stock
1993						
RA-H-1	Touchet R.	6,006	20,226	29.7	4.8	LFH
RA-H-2	Touchet R.	5,079	19,943	25.5	4.8	LFH
RA-IC-1	Tucannon from Curl	3,080	21,653	14.2	5.0	LFH
LA-IC-1	Tucannon @ Curl	3,285	28,771	11.4	4.7	LFH
LA-IC-3	Tuc. @ Marengo	3,776	29,040	13.0	4.5	LFH
LA-H-1	Walla Walla R.	5,808	18,254	31.8	4.8	LFH
LA-H-2	Walla Walla R.	3,419	18,889	18.1	4.4	LFH

[2] Passage Index is a relative indicator of group passage within a migration year and does not represent survival. Passage indices are calculated by dividing daily fish collection by the proportion of flow passing through the sampled unit or powerhouse. No estimates of fish guidance efficiency of smolts at the dams are made, thereby precluding the estimation of group survival/ total emigration at a particular dam.

Table 5. (Continued)

Brand	Release site	Passage index	Number [a] released	% of release	Size (#/lb)	Stock
1994						
RA-7U-1	Tucannon from Curl	2,526	16,682	15.1	4.3	LFH
RA-7U-3	Tucannon from Curl	2,614	16,661	15.7	4.3	LFH
LA-7U-1	Tucannon from Curl	1,934	16,665	11.6	4.3	LFH
RA-IT-1	Walla Walla R.	4,872	20,165	24.2	3.7	LFH
RA-IT-3	Walla Walla R.	5,502	20,093	27.4	3.9	LFH
LA-IT-1	Walla Walla R.	5,910	20,002	29.5	3.7	LFH
1995						
LA-IJ-1	Tucannon from Curl	1,864	18,021	10.3	5.3	LFH
RA-IJ-1	Tucannon from Curl	1,485	17,966	8.3	5.3	LFH
RA-IJ-3	Tucannon from Curl	2,165	16,942	12.8	5.3	LFH
LA-H-1	LFH	4,817	39,728	12.1	3.9	LFH
LA-IC-1	Touchet @ Dayton	4,024	19,831	20.3	3.8	LFH
LA-IC-3	Touchet @ Dayton	2,617	19,841	13.2	3.8	LFH
RA-IC-1	Touchet @ Dayton	2,859	20,146	14.2	3.8	LFH
RA-H-1	Walla Walla R	4,621	24,719	18.7	3.7	LFH
RA-H-2	Walla Walla R	6,918	24,796	27.9	3.7	LFH
1996						
RA-IT-1	Snake R. from LFH	3,529	19,945	17.7	5.3	LFH
LA-IT-1	Snake R. from LFH	4,292	19,850	21.6	5.3	LFH
LA-IT-3	Snake R. from LFH	5,318	19,076	27.9	5.1	LFH
LA-IV-1	Touchet @ Dayton	8,137	38,616	21.1	4.5	LFH
LA-IV-3	Touchet @ Dayton	5,355	38,262	14.0	4.3	LFH
RA-IV-1	Tucannon @Marengo	3,259	29,611	11.0	5.0	LFH
RA-IV-3	Tucannon from Curl	2,338	27,202	8.6	4.9	LFH

a - Adjusted for brand loss

2.2.2 Migration Success

Our 1996 PIT tag results provide the fourth year of a migration study which had four objectives: 1) characterize migrant and non-migrant juvenile steelhead, 2) determine if fish which failed to migrate from an acclimation pond were truly non-migrants, 3) determine if our estimates of residualism for different release groups and strategies were reasonable, and, 4) determine if precocious male steelhead volitionally exiting an acclimation pond smolted and migrated from the river toward the ocean.

Five groups of 100-350 LFH steelhead were PIT tagged in April and early May at Curl Lake AP and LFH (Tables 6, 7). The emigration performance of four groups released into the

Tucannon River were compared with each other and with the fifth group released from LFH.

Group #1 fish volitionally left Curl Lake AP between 8 April and 15 May 1996. Group #1 was comprised of three subgroups of about 115 fish each which were tagged approximately every two weeks to represent fish throughout the emigration period. Fish were captured and tagged as in previous study years (Schuck et al. 1995, 1996)

Group #2 was comprised of fish that failed to emigrate from Curl Lake AP. These fish were collected from the pond on 16 May by cast-net and placed in a holding box. They were then tagged and released into the Tucannon River in the same way as volitional migrants.

Group #3 was entirely precocious male fish collected from Curl Lake pond on 16 May, tagged and released immediately upon recovery from anesthesia into the Tucannon River.

Group #4 was comprised of fish tagged and released directly from LFH into the Tucannon River at Marengo (RM 24.7) approximately 15 miles downstream of Curl Lake Pond.

Group #5 consisted of fish tagged with two different sizes of tag. Half were branded and tagged with standard length coded-wire tags. The other half were branded and tagged with length and one-half coded-wire-tags. The two sub-groups represent production at LFH with the nested tag length groups designed to compare survival of the fish and our ability to detect the extra length tag with hand held field sampling equipment. Fish were collected from a raceway at LFH, and PIT tagged like the other groups.

Table 6. Description of PIT tag groups released into the Tucannon and Snake rivers, 1996.

	Curl Lake AP				
	Migrants (Group #1)	Non-migrants (Group #2)	Precocious (Group #3)	Marengo (Group #4)	LFH (Group #5)
Date(s) tagged	8 & 22 April 15 May	29 May	29 May	15 April	19 April
# of fish tagged (n)	352	347	103	350	350
Fish PIT tagged	**% of total (n)**	**% of total (n)**	**% of total (n)**	**% of total (n)**	**% of total (n)**
Smolts	56.0 (197)	14.4 (50)		14.6 (51)	15.4 (54)
Transitional	34.9 (123)	72.1 (250)		79.1 (277)	74.6 (261)
Parr	1.1 (4)	8.6 (30)		2.6 (9)	4.9 (17)
Precocious males	8.0 (28)	4.9 (17)	100 (103)	3.7 (13)	5.1 (18)

Tag detections at the Snake and Lower Columbia River dams were obtained from the PTAGIS central database, maintained by the PSMFC, through 6 November 1996. Unique tags were recovered at Lower Monumental, McNary, John Day and Bonneville dams. Two 1994 Curl

Lake AP volitional emigrants were detected at Lower Monumental Dam in 1996: one fish was 222 mm at release and fully smolted, the second fish a 164 mm parr at release. These recoveries represented 0.6% of the tag group released. Four detections were from 1995 releases; three fish were 116-159 mm non-migrant parr which were tagged from Curl Lake and released into the Tucannon River, and one fish a 196 mm transitionally developed voluntary migrant from Curl Lake AP. All remaining detections were from groups released in 1996. A summary of the number of PIT tags detected at least once at one of the Snake or Columbia River dams during the spring of 1996 is provided in Table 8. Also included in the table are measurements characteristic of detected and undetected tagged fish. The numbers of tags detected include all locations and indicate minimum survival from release to Lower Monumental Dam.

Table 7. Characteristics of PIT tag groups released into the Tucannon and Snake rivers, 1996.

	Curl Lake AP			Marengo	LFH	
	Vol Migr. (Group #1) mean (n)	Non-migr. (Group #2) mean (n)	Precoc. (Group #3) mean (n)	(Group #4) mean (n)	(Group #5) Std CWT mean (n)	1½ CWT mean (n)
Length (cm)						
Smolts	228.2 (197)	215.2 (50)		214.2 (51)	217.8 (32)	215.6 (22)
Transitional	209.0 (123)	189.5 (250)		202.3 (276)	201.4 (129)	200.9 (132)
Parr	139.7 (4)	128.6 (30)		152.1 (9)	154.2 (4)	157.8 (13)
Precocious	201.3 (28)	191.9 (17)	204.0 (103)	195.7 (13)	197.6 (10)	196.2 (8)
Weight (g)						
Smolts	109.5 (197)	87.2 (50)		94.1 (51)	103.6 (32)	99.9 (22)
Transitional	89.3 (123)	66.7 (250)		81.9 (276)	85.8 (129)	84.1 (132)
Parr	27.9 (4)	20.1 (30)		35.4 (9)	38.9 (4)	40.2 (13)
Precocious	87.0 (28)	70.9 (17)	85.6 (103)	86.7 (13)	89.2 (10)	93.3 (8)
K factor						
Smolt	0.904	0.849		0.943	0.983	0.970
Transitional	0.934	0.909		0.968	1.020	1.017
Parr	0.991	0.909		0.987	1.056	1.011
Precocious	1.053	0.994	0.980	1.127	1.154	1.217

In 1996, of the fish released from Curl Lake, significantly more ($P < .05$, t-test) tagged smolts were detected at the dams than tagged transitional fish. This behavior closely follows the 1994 results we observed for Curl Lake AP. Smolts released from LFH were detected in greater numbers than were transitional fish, however the difference was not significant. Also, seven parr and one precocious male released as part of the LFH tag study were detected; the first year that either of these groups were detected. No precocious males from the precocious tag group were detected. Eight times more volitional emigrants (smolts and transitionals) from Curl Lake AP were detected than non-migrants. Again in 1996, more fish released from LFH, both on-station and into the Tucannon at Marengo, were detected than any of the Curl Lake AP groups. The condition factor (K) of both detected Tucannon groups was lower than the K

Table 8. Percent detected and characteristics at time of release of detected and undetected PIT tagged fish released into the Tucannon and Snake rivers, 1996.

Release location	Curl Lake AP						Marengo [A]		LFH			
	Volitional Migrants		Non-migrants		Precocious males				Std CWT		1 ½ CWT	
	detect	undetect	detect	undetect	detect	undetect	detect	undetect	detect	undetec	detect	undetect
% detected (n)												
Smolt	38.1(75)	61.9(122)	18.0(9)	82.0(41)			60.8(31)	39.2(20)	65.6(21)	34.4(11)	61.9(13)	18.1(8)
Transitional	21.1(26)	78.9(97)	1.2(3)	98.8(247)			39.7(110)	60.3(166)	46.5(60)	53.5(69)	46.9(62)	53.1(70)
Parr	-	100 (4)	-	100 (30)			-	100 (9)	25.0(1)	75.0(3)	42.8(6)	57.2(8)
Precocious	-	100 (28)	-	100 (17)	-	100.(103)	-	100 (13)	10.0(1)	90.0(9)	0	100 (8)
TOTAL	28.6(101)	71.4(252)	3.5(12)	96.5(335)	-	100.(103)	40.3(141)	59.7(209)	47.4(83)	52.6(92)	46.3(81)	53.7(94)
Mean length (mm)												
Smolt	231.7	226.2	220.9	214.0			214.8	213.2	217.6	218.4	218.7	215.1
Transitional	207.8	210.5	208.7	189.3			204.9	200.5	201.9	200.9	199.5	202.2
Parr	-	139.7	-	128.6			-	152.1	158.0	153.0	169.3	151.6
Precocious	-	201.3	-	191.9	-	204.0	-	195.7	204.0	196.9	-	196.2
Mean weight (g)												
Smolt	114.8	106.2	92.6	86.0			94.6	93.4	103.4	104.0	102.0	102.3
Transitional	86.4	90.1	79.1	66.5			83.8	80.5	84.9	86.7	81.8	86.1
Parr	-	27.9	-	20.1				35.3	37.2	39.4	49.7	34.7
Precocious	-	87.0	-	71.0	-	85.6	-	86.7	91.0	88.9	-	93.3
Mean K-factor												
Smolt	0.912	0.899	0.848	0.849			0.938	0.949	0.987	0.976	0.960	0.998
Transitional	0.934	0.934	0.855	0.909			0.955	0.976	1.008	1.031	1.009	1.024
Parr	-	0.991	-	0.909			-	0.987	0.940	1.094	1.023	0.994
Precocious	-	1.053	-	0.994	-	0.985	-	1.127	1.070	1.164	-	1.217

A Marengo is a RM 24.7 on the Tucannon River, approximately 15 miles below Curl Lake AP.

of LFH detected groups but the difference was not statistically significant ($P > .05$, t-test). Detected fish were generally longer and heavier than undetected fish in the groups, as previously observed. Tagged fish which were detected, quickly emigrated from the Tucannon River with most PIT tag detections occurring at a dam within 30 days of release (Table 9).

Table 9. Migration timing and rates for PIT tagged steelhead released by LFH, 1996.

Release site (group)	Travel time mean # days	Travel time miles/day	First detection (Travel days/ date detected)	Last detection (Travel days/ date detected)
Curl Lake				
Curl Vol. 1 [a]	32.6	1.9	8.2 days/4-16-96	69.8 days/6-17-96
Curl Vol. 2	25.6	2.4	14.6 days/ 5-07-96	44.1 days/ 6-05-96
Curl Vol. 3	14.0	4.4	6.3 days/ 5-21-96	40.3 days/ 6-24-96
Curl 1+2+3	26.6	2.3		
Curl Non-migr.	14.0	4.4	6.3 days/ 6-04-96	31.7 days/ 6-30-96
Marengo	17.0	2.8	2.5 days/ 4-17-96	57.3 days/ 6-11-96
Lyons Ferry				
Standard Tag	9.8	1.8	1.4 days/4-20-96	44.7 days/ 6-03-96
1 ½ tag	8.5	2.1	1.5 days/ 4-20-96	33.6 days/ 5-23-96

a - refers to subgroup migrants tagged over the spring out-migration, see Table 6.

Results from our 1996 release of PIT tags generally followed the 1994 and 1995 results. Size, condition factor and degree of smoltification are strongly related to emigration performance from the acclimation pond. In general, longer, leaner, more silvery fish were detected at the dams more often than their counterparts within the release population. That same relationship is not as strong for releases of groups from Lyons Ferry Hatchery. Our ability to distinguish smolts from transitionally colored fish is less accurate at LFH. Fish held in raceways before release are more uniform in color and lack the strong silver coloration and slender body of smolts from Curl Lake. There was no significant difference ($P < .05$, t-test) in detection rates between the two LFH tag groups. Again in 1996, fish acclimated in Curl Lake AP which failed to emigrate from the pond during the spring, didn't emigrate effectively when PIT tagged and placed in the river. This behavior of "non-migrant" PIT tagged fish is consistent with results of our residualism studies in 1991-1993 (Viola et al. 1992; Martin et al. 1993)

The absence of parr and precocious males in the migrant PIT tagged study groups from previous years caused us to question whether their absence from the detections was the result of inadequate group size. We therefore increased the number of tagged precocious males in 1996. As has been observed in previous years, no precocious males tagged in late May from Curl Lake were detected at any of the dams. It is interesting to note, however, that one precocious male and seven parr released from LFH were detected at Lower Monumental Dam this year, as well as several parr from previous years. These results are consistent with our belief that hatchery origin parr grow and smolt over time and may emigrate in years after their release. However, we still believe that non-migrating fish can better be used in put-take fisheries than by being released into rivers where they could compete with natural origin salmonids for food and space, and potentially prey on smaller fish.

2.3 Estimates of Residual Steelhead

We estimated the number and percentage of all hatchery reared juvenile steelhead released into the Tucannon River that residualized during the spring of 1996. Also, the number of residual hatchery steelhead present in an index area of the Grande Ronde River was estimated. The methods used on the Grande Ronde were similar to those used in 1994 (Schuck and Viola 1995), but we used a different method on the Tucannon River than in the past. A brief summary of methods for 1996 is presented below.

2.3.1 Residual steelhead in the Tucannon River

We divided the Tucannon River into two sections: *1) Upper*: from Panjab Bridge (RM 45.6) downstream to one mile above Marengo (19.8 miles), and; *2) Lower*: from 1 mile above Marengo downstream to 1 mile below king Grade (5.8 miles). Because of ESA constraints on the number and location of stocked hatchery trout, we planted 4,000 rainbow trout to act as marked fish for a mark and recapture estimate in the *Lower* section only. We then conducted our estimates of residual hatchery steelhead as follows:

1. During the last week of May, one week after planting the rainbow trout, we fished both the *upper* and *lower* sections.

2. In the upper section, we calculated catch per unit of effort (CPE). We assumed that the CPE was directly related to the residual steelhead abundance.

3. In the lower section, we calculated CPE and estimated the population of residual steelhead and rainbows using a Petersen mark and recapture method (Ricker 1958) with the rainbow as the marked portion. The 4,000 marked rainbows were subtracted from the estimate to provide the population estimate of residual steelhead.

4. We calculated the number of residual steelhead per mile in the lower section and related this to the CPE. We applied this relation to estimate the population of residual steelhead in the upper section as follows:

$$\frac{CPE_{upper}}{CPE_{lower}} x \frac{Population_{lower}}{5.8miles_{lower}} x19.9miles_{upper} = Population_{upper}$$

: Where miles are river length for upper and lower sections

5. The estimated populations from both sections were summed to provide the total estimated population of residual steelhead in the sampled portion of the Tucannon River.

A total of 169,706 steelhead were released into the Tucannon River at two different locations. We released 30,464 fish directly into the river at Marengo (RM 24.7). We also placed 145,031 steelhead into Curl Lake AP (RM 40.7) and released 139,242 of those fish. As previously stated, 545 fish died or were killed while sampling the pond and the remaining 5,244 fish were suspected to be potential residual steelhead and were not released. Using the methods described above, we estimated that 8,898 (29.2%) fish remained in the river from the direct river release at Marengo, and that 19,528 (14.0%) fish remained in the river from the fish released from Curl Lake AP. Added together these suggest that 28,426 juvenile steelhead (16.8 % of the total released) remained in the Tucannon River on 31 May 1996.

From 1993 to 1996, we managed Curl Lake AP to reduce excessive residualism of juvenile hatchery steelhead in the Tucannon River. We retained 14,950 (23% of fish placed in pond), 23,745 (14.8%), 14,212 (8.9%) and 5,244 (3.6 %) potential residual fish from entering the river in each year, respectively.

Residualism of juvenile steelhead acclimated in Curl Lake and released into the Tucannon River was higher this year than any of the previous three years (Table 10). It is unclear why this occurred, however, it was most likely a combination of reasons. In 1996 hatchery personnel installed an electronic fish counter into the outlet channel of the acclimation pond. Probable malfunctions of the counter and an inadequate sample size of fish for sex ratios reduced our effectiveness at retaining potential residual fish in the pond. By mid-May in previous years the pond had been slowly lowered and active migrants had separated from potentially residual fish; the sex ratio of fish remaining in the pond was approximately 80% male : 20% female. At that time the screen was replaced and emigration from the pond prevented. This year, we managed Curl Lake exactly as in the previous three years until 16 May 1996. On 16 May the electronic fish counter indicated that 75,000 fish (50.3% of what was originally put in the pond) remained in the pond. Examination of 50 fish (a minimum kill-sample) showed them to be 60% male : 40% female. Because of unusually cold spring weather, which we believed would preclude vigorous emigration from the pond, and the counter's indication that many fish remained in the pond we continued to allow emigration. Also, we lowered the pond more than in previous years. In retrospect, we believe our sample size was to small, the estimate of sex ratio was wrong, and we may have forced potentially residual fish from the pond by aggressively lowering the pond water level. On 29 May the sex ratio of fish remaining in the pond was 75% male : 25% female. Although the counter indicated that 39,000 fish remained, we replaced the outlet screen and conducted a mark and recapture estimate of the fish in the pond: only an estimated 5,244 fish remained. We are confident of our estimate and believe the counter malfunctioned. Despite the problems we experienced this year, the percent of fish that residualized from the Curl Lake release was less than half the percent which residualized from the direct release at Marengo.

Moreover, we believe the unusually cold, wet and over-cast weather during spring delayed emigration from the Tucannon River. Therefore, our estimate of residual fish was made before all migrants left the river. We probably over-estimated residualism of steelhead in the Tucannon River but have no accurate means to adjust our estimate for emigrants after 1 June.

Table 10. Curl Lake AP management and in-river residualism, 1991-1996.

Year	1991 [a]	1992 [a]	1993	1994	1995	1996
Fish Acclimated in Curl Lake AP	120,560	60,098	65,000	160,443	160,573	145,031
Fish retained [b] (% of acclimated)	0 (0)	0 (0)	15,111 (23.2)	23,745 (14.8)	14,212 (8.9)	5,244 (3.6)
Fish released into the river	120,560	60,098	49,889	136,698	146,361	139,242
Residual fish [c] (% of released)	20,616 (17.1)	6,190 (10.3)	2,022 (3.1)	9,628 (7.0)	10,075 (6.9)	19,528 (14.0)

a: Curl Lake was not managed to reduce in river residualism in these years.
b: Potential residual fish
c: Juvenile steelhead present in the Tucannon River (non-migrants) about 1 June of each year.

2.3.2 Residual steelhead in the Grande Ronde River

During June and July 1996 we estimated the number of hatchery reared residual steelhead present in a 1 mile index area of the Grande Ronde River near Cottonwood Creek. We sampled the river from approximately 1/4 mile above to 3/4 mile below WDFW's Cottonwood AP. The size and flow of the Grande Ronde River precludes a more extensive estimate of residualism.

We caught hatchery reared juvenile steelhead with hook and line, marked them with a caudal punch and released them on 29 June. Fish were recaptured with hook and line on 7 July. We used the Petersen mark and recapture method (Ricker 1958) to estimate that 816 $\pm$ 52 (α =.05) hatchery reared juvenile steelhead were present within the 1 mile index section of river. This was the third year that an estimate was made (Table 11).

Table 11. The numbers of hatchery reared residual steelhead present in an index area of the Grande Ronde River near Cottonwood Creek, WA, 1994-96.

Year	Number Released	Fish/lb	Number ± 95% CI Residuals	% of release
1994	273,000	4.8	1,961	0.72
1995	206,182	5.0	831 ± 28	0.40
1996	250,000	5.6	816 + 52	0.33

Estimates vary among years. It is possible that differences in the number and size of fish released annually (Table 11), could account for some of the difference in estimated residualism. Water flows in the Grande Ronde River during the springs of 1995 and 1996 were considerably greater than in 1994. Increased flow may have encouraged more fish to emigrate or at least move downstream of the index area. The Cottonwood AP is not managed to reduce the abundance of residual steelhead in the Grande Ronde River.

2.4 Adult Steelhead Returns

2.4.1 Adult traps

Tucannon Hatchery trap

A flood during February 1996 destroyed the instream trap and weir. A temporary weir and instream trap was installed for spring chinook salmon after most adult steelhead had already passed the former trap site and spawned. However 16 steelhead were handled in the trap (Appendix B). Full time trapping for steelhead will resume in 1997.

Touchet River trap

No steelhead were trapped on the Touchet River in 1996 because of damage to the trap during the February 1996 flood.

Lyons Ferry Hatchery trap

Adult steelhead were trapped at Lyons Ferry Hatchery from 4 August through 6 November 1995. Mortality during trapping and holding was 136 fish (2.3%). After trapping ended, all trapped fish were inspected for fin clips and readable brands, and sex and origin determined. Snouts were collected from a sample of fish that had a ventral fin clip and an unreadable or no visible brand. We trapped 3,537 females (59.7%) and 2,383 males (40.3%). Eight were wild fish (0.14%), 711 (12%) were tagged or branded fish (Appendix C), and the rest were untagged hatchery fish.

In 1996, 330 adult female steelhead were spawned at LFH (Table 2). One-ocean age fish represented 82.7% of fish spawned, and 78.1% of returning coded-wire tagged fish. Two-ocean age fish made up 17.3% of fish spawned and 21.9% of returning coded wire tags. There were no confirmed three ocean age fish spawned in 1996. Average fecundity of one (n=243) and two (n=50) ocean age females was 4,717 and 5,953 eggs, respectively. The mean lengths of one and two ocean age steelhead spawned at LFH in 1996 were 60.0 cm (SD=4.5) and 70.6 cm (SD=4.7), respectively.

Fish originating from upstream hatcheries, injured fish, wild fish and fish not needed for broodstock were released (4,725 fish). We clipped the top lobe of the caudal fin of 4,576 of the fish released. This allowed us to identify these marked fish if they were harvested in the sport fishery (Appendix D). One hundred-thirteen clipped fish were sampled during the 1995-96 steelhead creel survey. Based on our mark sample rate, this expanded to 528 harvested fish (11.5% of clipped fish released).

Cottonwood Creek Trap

Between 25 March and 22 April 1996, 317 female (73.7%) and 113 male (26.3%) adult steelhead were trapped at the Cottonwood AP. Length and age data were collected from 119 hatchery origin spawned females. Mean length for one-ocean age females was 61.3 cm (n=81: SD=3.9), and 71.6 cm (n=38: SD=4.8) for two ocean-age females. All sampled fish were of hatchery origin. Average fecundity of one and two ocean age females was 4,394 and 5,919 eggs, respectively. One (n=85) and two (n=39) ocean age females contributed 61.5% and 38.5%, respectively, of the total egg take. All of the trapped fish were either spawned or killed on site to prevent potential swamping of wild spawning steelhead in Cottonwood Creek by hatchery fish.

2.4.2 Passage at dams

The National Marine Fishery Service (NMFS) monitored adult passage at Lower Granite Dam as part of their migration research (Jerry Harmon, NMFS, 1996). Adults coming into the trap were sampled for fin clips and freeze brands (Table 12). Low returns to Lower Granite Dam (LGD) of the freeze brand groups generally are consistent with low returns to other locations. Fish released in 1992 survived poorly and few two-salt age and no three-salt fish returned in the 1994 and 1995 run years. The 1993 release returned much better than the 1992 release, but not as well as expected. The 1994 release is showing a strong survival trend, likely continuing the trend from improved river flow and ocean rearing conditions of 1993.

Table 12. Adult returns of Lyons Ferry Hatchery steelhead to Lower Granite Dam in run years 1993-1995, from smolts released in 1992-1994 (numbers are freeze brand recoveries).

Brand	Release site	Number of adults observed Return year 1993	1994	1995 [A]	Total [B] adjusted adults	Smolts released	% survival
1992							
RA-IY-1	Touchet Acc. Pond	22	7	0	30	45,628	0.066
RA-S-2	Tucannon R. @ Curl	29	22	0	53	30,096	0.176
RA-S-1	Curl LK. Tucannon R.	28	12	0	41	30,098	0.136
LA-S-1	Tuc. R. @ Marengo	38	34	0	74	29,888	0.248
1993							
RA-H-1	Touchet Acc. Pond		46	71	118	20,328	0.580
RA-H-2	Touchet Acc. Pond		35	72	108	20,104	0.537
LA-IC-1	Tucannon R. @ Curl		89	99	196	30,001	0.653
RA-IC-1	Curl LK. Tucannon R.		96	111	210	21,960	0.956
LA-IC-3	Tuc. R. @ Marengo		63	72	139	29,876	0.465
LA-H-1	Walla Walla R.		25	48	77	19,440	0.396
LA-H-2	Walla Walla R.		10	27	39	19,800	0.197
1994							
RA-7U-1	Curl LK. Tucannon R.			42	45	16,682	0.269
RA-7U-3	Curl LK. Tucannon R			45	49	16,661	0.294
LA-7U-1	Curl LK. Tucannon R.			59	62	16,665	0.372
RA-IT-1	Walla Walla R.			94	97	20,165	0.481
RA-IT-3	Walla Walla R.			100	106	20,093	0.527
LA-IT-1	Walla Walla R.			75	77	20,002	0.385

A- The trap at Lower Granite Dam was inoperable during spring 1996, therefore passage numbers do not include spring fish as reported in other years.

B- Observed brands adjusted for brand loss as measured at release (see Appendix A).

2.5 Steelhead Creel Surveys

We surveyed anglers in the steelhead sport fishery within the LSRCP area of Washington during the recreational fishery on the Snake River and its tributaries (see Schuck et al. 1990 for methods). Anglers were interviewed to obtain catch composition data and to recover coded-wire tags from their fish. Sport fishing for steelhead was open on the Snake and Columbia rivers from 1 September 1995 through 31 March 1996, and on tributaries to the Snake River from 1 September 1995 through 15 April 1996. Anglers could keep only adipose clipped fish, some of which were also left ventral (LV) clipped indicating the presence of a coded-wire tag. The daily catch, possession, and annual limits were 2, 4, and 30 steelhead, respectively.

We conducted a joint survey of anglers on the upper Grande Ronde River of Washington and the lower Grande Ronde River of Oregon with Oregon Department of Fish and Wildlife (ODFW). Angler effort, catch rates, harvest and coded-wire tag recoveries and expansions were calculated by ODFW as described in Carmichael et al. (1988).

The objectives of our creel surveys on the Snake and Grande Ronde rivers were:

1. Estimate the portion of LFH steelhead in the sport catch. The following methods were used:

   a) Sample the sport harvest and collect information on the number of coded-wire tagged and un-tagged steelhead harvested. Collect the snouts from all LV clipped fish. 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 number of steelhead sampled during the creel surveys by the estimated total sport harvest. Sport harvest is estimated by WDFW from voluntarily returned catch record cards and from phone interviews.

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

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

3. Estimate angler exploitation rates of adult LFH steelhead, angler effort and catch rates: hrs/fish caught, hrs/fish kept and total harvest of all steelhead within the LSRCP area of Washington.

2.5.1 Lower Snake River and tributaries

We used adjusted WDFW state-wide steelhead harvest estimates for 1995/96 (Tables 13 and 14) to estimate our coded-wire tag sample rates and to estimate harvest by tag code for each fishery.

During the 1995-96 steelhead season, we surveyed 8,658 anglers that fished a total of 29,558 hours within the LSRCP area in Southeast Washington (Table 15). Catch rates ranged from 3.0 - 159.0 hours/fish. Mean catch rate for the entire LSRCP area of S.E. Washington for the 1995-96 season was 9.1 hours/fish. Characteristics of steelhead observed during the 1995-96 steelhead season are summarized in Table 16.

Table 13. Steelhead harvest estimates for WDFW management sections[A] on the lower Snake River, 1995-96 (WDFW 1997).

	Below Ice H. Dam	Ice Harbor Pool	L. Monumental Pool	L. Goose Pool	L. Granite Pool	Above Clarkston
May	0	0	0	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
Aug.	0	0	0	0	0	0
Sept.	32	180	839	107	329	88
Oct.	42	394	1,087	508	809	1650
Nov.	65	829	1,996	413	752	986
Dec.	9	180	399	181	97	273
Jan.	9	102	199	46	69	93
Feb.	0	5	32	14	5	23
Mar.	0	5	111	23	19	9
Apr.	0	0	0	0	0	0
Total	**157**	**1,695**	**5,453**	**1,292**	**2,080**	**3,122**

A. WDFW management sections: 164= Below Ice Harbor, 165= Ice Harbor Pool, 166= Lower Monumental Pool, 167= Little Goose Pool, 168= Lower Granite Pool, 228= Above Clarkston.

Table 14. Steelhead harvest estimates for rivers in S.E. Washington, 1995-96 (WDFW 1997).

	Tucannon	Touchet	Walla Walla	Grande Ronde	McNary Pool
May	0	0	0	0	0
June	0	0	0	0	6
July	0	0	0	0	0
Aug.	0	0	0	0	56
Sep.	24	0	128	81	246
Oct.	213	19	272	345	732
Nov.	182	90	685	201	271
Dec.	59	115	301	435	21
Jan.	53	122	154	352	0
Feb.	9	10	0	43	0
Mar.	31	237	22	1,129	0
Apr.	9	42	3	276	0
Total	**580**	**635**	**1,565**	**2,862**	**1,332**

Table 15. Steelhead creel survey results for fall 1995 and spring 1996.

Area	Anglers Interviewed	Hours Fished	Fish Caught	Hours/Fish Caught
McNary Pool	28	159.0	1	159.0
Wallula area	776	2,035.0	73	27.9
Walla Walla	576	1,272.2	239	5.3
Mill Creek	89	127.9	33	3.9
Ice Harbor Dam	898	2,616.6	95	27.5
Lower Mon. Dam	296	1,075.1	91	11.8
Touchet River	515	1,201.0	395	3.0
Tucannon River	555	1,533.0	471	3.3
Mouth of Tucannon R.	339	1,144.6	75	15.3
Little Goose Dam	2,489	10,621.3	805	13.2
Lower Granite Dam	6	34.5	1	34.5
Snake R. section 228 (boats anglers)	968	3,520.5	294	12.0
Snake R. section 228 (Shore anglers)	342	597.8	41	14.6
Grande Ronde (Mouth)	309	1,104.6	138	8.0
Grande Ronde (WA)[A]	444	2,449.4	499	4.9
Grande Ronde (OR)[B]	28	65.6	3,256	13.1
Total:	**8,658**	**29,558.1**	**3,256**	**9.1**

A: Bogan's (RM 26.2) to the Oregon border (RM 38.7).
B: Oregon border (RM 38.7) to Wildcat Creek (RM 53.3).

Table 16. Characteristic age, length, weight and sex composition of 235 Lyons Ferry Hatchery adult steelhead sampled during the 1995/96 creel survey.

Ocean residence	Percent Composition (n)	Mean length(cm) (n)	Mean weight(Kg) (n)	Percent Male (n)	Percent Female (n)
1 Year	48.3 (153)	61.3 (149)	2.2 (107)	37.7 (57)	62.3 (94)
2 Years	51.7 (82)	74.4 (81)	3.6 (47)	25.6 (21)	74.4 (61)
3 Years	0	---	---	---	---

n = sample size

One-ocean age steelhead comprised 37% and 83% of our sample of the sport harvest in the 1993-94 and 1994-95 surveys respectively (Schuck et al. 1995, Schuck et al. 1996). In the 1995-96, survey, 48% of the fish sampled were one-ocean age (Table 16). The lengths of one and two-ocean age fish overlapped in 1994-95 (Schuck et al. 1996) and again in 1995-96 (Figure 1). This overlap in length between age classes of fish in both survey years may be the result of poor ocean rearing conditions. Strong El Nino current patterns in 1992 and 1993 gave way to more favorable ocean rearing conditions from 1994 through 1996.

The relative composition of hatchery fish kept to hatchery and wild fish released was similar on the Tucannon and Touchet Rivers in 1995-96 (Table 17).

Table 17. Origin of adult steelhead sampled during the 1995-96 creel surveys on the Touchet, Tucannon, and Snake rivers.

River	Hatchery kept	Hatchery released	Hatchery Total	Wild released
Touchet	144 (61.5%)	90 (38.5%)	234 (80.4%)	57 (19.6%)
Tucannon	215 (65.0%)	116 (35.0%)	331 (87.8%)	46 (12.2%)
Snake	1,290 (83.2%)	109 (7.0%)	1,399 (90.2%)	152 (9.8%)

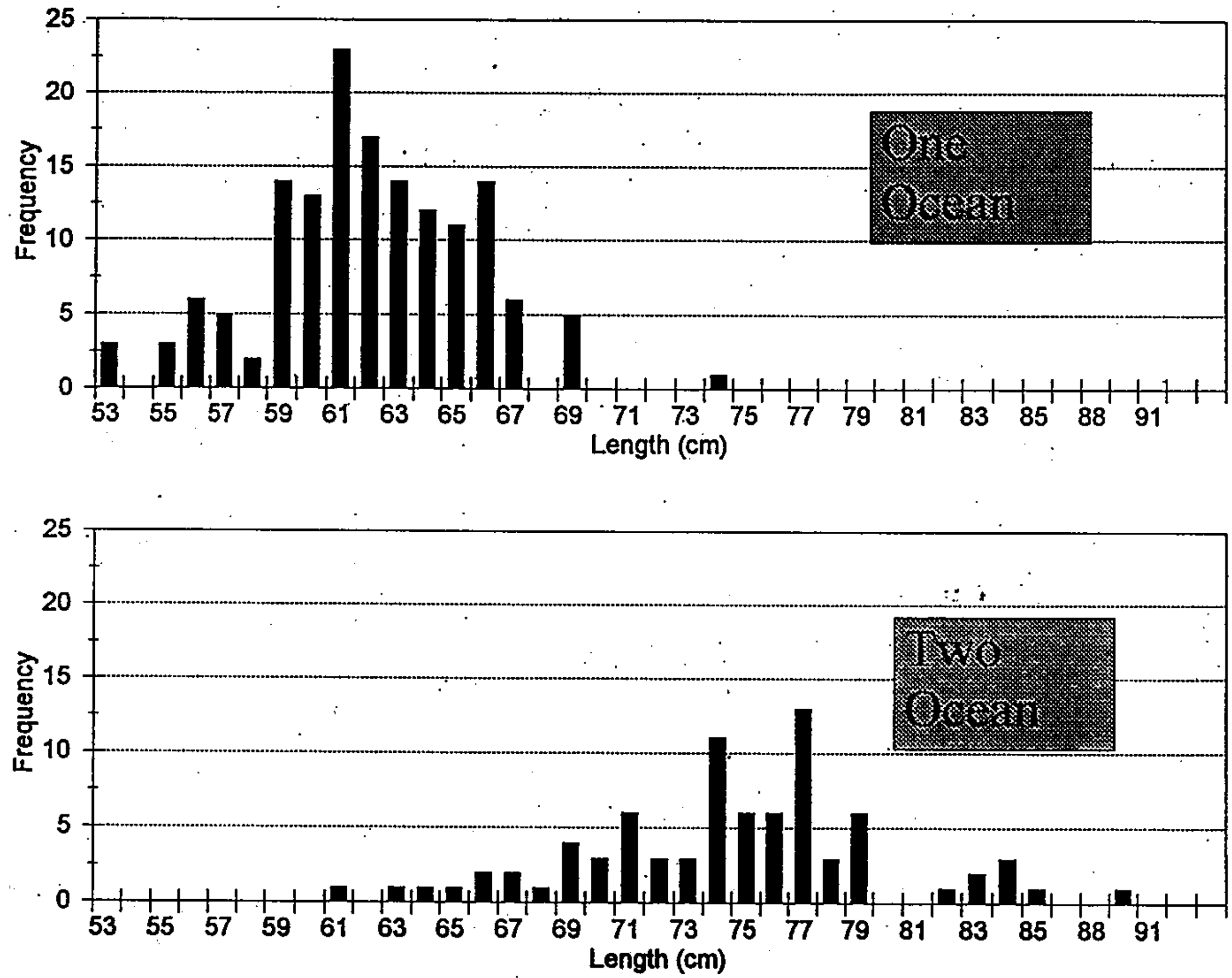

Figure 1. Length frequency of 317 one- and two-ocean age LFH origin steelhead collected during creel surveys, 1995-96.

2.5.2 Grande Ronde River

During the 1995-96 steelhead season, anglers fished 13,685.2 hours (about 2,400 angler days) on the Grande Ronde River from Bogan's Oasis (RM 26.2) upstream to the Oregon State line (RM 38.7) (Tables 18 and 19). The average angling day was 5.65 hours and 5.74.hours for week and weekend days, respectively. This is similar to the effort in the 1994-95 steelhead season, but less than the effort that occurred in the three seasons before 1994-95. Angler effort decreased during the last two years due to high muddy water flows.

Table 18. Estimated angler effort, catch rates, and harvest for steelhead anglers on a portion of the Grande Ronde River in Washington, 1994-95 (Flesher 1996).

Month	Effort Hours (95% CI)	Catch Rate-F/HR (95% CI)	Total Catch[A] (95% CI)	Fish Kept (95% CI)	Marked Fish Released (95% CI)	Unmarked Fish Released (95% CI)
1995						
Sept .[B]	573.6	0.0702	40.3	22.1	11.6	6.6
	(247.2)	(0.0367)	(21.1)	(9.0)	(12.4)	(11.0)
Oct.	2.551.7	0.0570	145.4	34.9	57.5	53.0
	(515.1)	(0.0187)	(47.8)	(40.2)	(36.6)	(25.0)
Nov.	914.1	0.0888	81.1	67.3	2.2	11.6
	(646.1)	(0.0523)	(47.8)	(44.7)	(5.0)	(16.5)
Dec.	507.1	0.2705	137.2	74.5	43.5	19.2
	(305.5)	(0.2622)	(132.9)	(75.9)	(55.1)	(20.7)
1996						
Jan.	1272.8	0.1260	160.4	113.3	31.2	15.9
	(270.1)	(0.0823)	(104.7)	(78.8)	(23.3)	(14.9)
Feb.	306.3	0.0767	23.5	16.0	7.5	0.0
	(97.4)	(0.0242)	(7.4)	(0.0)	(7.4)	(0.0)
Mar.	6012.2	0.2383	1432.7	494.8	857.2	80.7
	(686.2)	(0.0393)	(236.0)	(110.8)	(161.6)	(61.6)
Apr.	1547.4	0.1528	236.5	79.6	132.8	24.1
	(720.2)	(0.1302)	(201.4)	(89.0)	(130.3)	(22.4)
Total	13.685.2		2257.1	902.5	1143.4	211.1

A - Estimates for fish numbers are rounded to the nearest whole number.
B - No confidence interval calculated.

Washington anglers made up 2.8% of the anglers surveyed, while Oregon anglers comprised 19.9% and the remaining 77.3% were from other states. Most fish were caught in late March and early April near Cottonwood AP.

Table 19. Characteristic ocean age, mean fork length and sexual composition of 240 steelhead sampled from anglers creels on the Grande Ronde River ,WA, Spring 1996.

Ocean Age	N	Males Length (SD)	Males n (%)	Females Length (SD)	Females n (%)
1 Year [A]	156	61.9 (7)	56 (35.9)	60.6 (5)	100 (64.1)
2 Years [B]	84	73.0 (32)	18 (21.4)	71.5 (11)	66 (78.6)

A: One ocean steelhead were either 1:1 (years in freshwater : years in the ocean) or 2 : 1 .
B: Two ocean steelhead were either 1 : 2 or 2 : 2 .
C: No three ocean steelhead were sampled.

2.5.3 Economic value of Washington's Steelhead fishery

We estimated the number of angler days of recreation provided by the steelhead fishery in S.E. Washington's LSRCP rivers and streams. Angler days were calculated from estimates of sport harvest times an average catch rate for all S.E. Washington waters (9.1 hrs/fish: Table 15), divided by average angler day length (3.7 hours/complete trip) from our creel data base (WDFW 1996). Washington anglers harvested 19,441 fish (Tables 13, 14) from the Snake and tributary rivers of S.E. Washington, and McNary pool of the Columbia River in the 1995-96 season; and expended an estimated 176,913 hours (47,814 angler days) of effort.

We reviewed some available literature on the value of a sport caught fish and of a recreational angling day. Reading (1996) conducted an economic analysis of the value of the steelhead fishery in Idaho for the 1992-93 season. He found that the average angler expended between $41 to over $300 per day, fishing for steelhead. His figures included short term expenditures such as food, tackle and lodging, as well as durable goods like boats which were assigned a per day valuation (a percentage of the total cost); the expenditures were then adjusted by an economic multiplier to represent the value to Idaho's economy. Reading's average daily value for steelhead fishing in Idaho during 1992-93 was $168.66. Applying his figure to our estimated days of recreation, places the value of the 1995 season in S.E. Washington at over $8,064,000.

Meyer (1982) completed a study analyzing the value of both commercial and sport caught salmon and steelhead from the Columbia River. Meyer calculated a value per fish for ease of comparison between the two very different types of fishery. His figures (adjusted by the Consumer Price Index of 1980 to 1995 of $1.00 = $2.04) for sport caught steelhead were the range of $261-$436. Applying Meyers figures to the estimate of sport caught steelhead in 1995-96, suggests the value of the fish at $5,074,000 - $8,476,000. Both methods point to the value of the sport fishery in Washington which harvests fish produced primarily by the LSRCP program. It is difficult to provide a cost benefit analysis of the LSRCP program in Washington. Washington anglers harvest fish produced by other programs and states as they pass through various fisheries. A complete economic analysis of the region is far beyond the scope of this report, and our ability. We believe the fisheries provided by LSRCP program and other hatchery programs represent a significant contribution to the economy of local communities and to the State of Washington.

2.6 Contribution of LFH Steelhead to Fisheries

We collected snouts from 235 sport caught steelhead with left ventral fin clips and coded wire tags. All snouts, except Grande Ronde River recoveries, were examined by Idaho Fish and Game personnel for CWTs. All CWTs recovered by WDFW personnel and estimates of the expanded harvest by individual tag code are presented in Appendix E, Table 1. Estimates of CWTs harvested in the Grande Ronde River are presented in Appendix E, Table 2.

We estimated harvest and the percent smolt-to-adult survival for adult Lyons Ferry Hatchery steelhead within the Columbia River and Snake River basins (Table 20). This information is based on sampling programs conducted by Federal, State and Tribal agencies.

For the tag codes recovered from releases in 1993, all groups released met the production escapement goal of 0.5% smolt to adult survival, to the LSRCP area (Table 21).

Several trends are evident when smolt to adult steelhead survivals to the Tucannon River (Figure 2) and to the LSRCP area (Figure 3) are compared from fish released at different locations on the Tucannon River in 1991, 1992 and 1993. Larger fish released directly into the Tucannon River survived better than fish acclimated and released from Curl lake. In all three years, groups released directly into the river were larger (3.8 fish/lb) than the acclimated fish (5.0 fish/lb) released from Curl Lake. This difference may account for the difference in survival. Because of data limitations we have not determined whether direct or acclimated fish of the same size will perform differently, nor did we determine which location (Curl Lake or Marengo) results in the highest survival. However, we can conclude that direct stream releases of large steelhead into the Tucannon River have returned adults to the Tucannon River at or above the project goal of 0.5% smolt to adult survival to the Snake River area, and at a higher survival rate than for nearly all releases from Curl Lake in the past. Fish acclimated in and released from Curl Lake did meet the LSRCP survival goal for the 1991 and 1993 releases, but their return to the Tucannon River was only fraction of the total return. Fish acclimated in Dayton pond and released into the Touchet River survived at the highest percentage of all groups (Table 20) in all three years (Schuck et al. 1995, Schuck et al. 1996). This high survival rate is likely a result of at least two fewer dams which smolts must pass when compared with Tucannon River and LFH releases. Tables 20 and 21 of this report and Table 19 of the 1994-95 annual report show how survival varies among release years.

Table 20. Adult returns of LFH juvenile steelhead and their smolt to adult survival (in italics) to fisheries in the Columbia and Snake rivers, fall 1995 and spring 1996.

Release year			1993			
Release site	Touchet R. Dayton AP	Tucannon R. From Curl Lk.	Tucannon R. @ Curl Lk.	Tucannon R. @ hatchery	Tucannon R. @ Marengo	Walla Walla R.
CWT code	63/59/41 63/46/49	63/48/16	63/48/15	63/48/47	63/48/17	63/59/42 63/59/44
Brand	RA-H-1,2	LA-IC-1	RA-IC-1	No brand	LA-IC-3	LA-H-1,2
No. released	40,331	29,701	21,916	4,565	29,517	38,905
Fishery						
L. Col. Sport	25 *0.062*	22 *0.074*				7 *0.018*
Mid- Col. Sport	10 *0.025*	18 *0.061*	5 *0.023*		18 *0.061*	18 *0.046*
Zone 6 Net	38 *0.094*	3 *0.010*	10 *0.046*	4 *0.088*	27 *0.091*	38 *0.098*
L. Ferry Hatchery	53 *0.131*	19 *0.064*	19 *0.087*		16 *0.054*	48 *0.123*
Snake R. Sport	78 *0.193*	14 *0.047*	64 *0.292*		16 *0.054*	33 *0.085*
Tucannon Sport	12 *0.030*	12 *0.040*	18 *0.082*		18 *0.061*	2 *0.005*
Idaho Sport						
W.Walla Sport						17 *0.043*
Touchet Sport	73 *0.181*					
Ocean						1 *0.000*
Miscellaneous other	8 *0.020*	3 *0.010*	8 *0.037*		6 *0.020*	7 *0.018*
LSRCP Total	**216** ***0.536***	**45** ***0.152***	**101** ***0.461***	**0** ***0.000***	**50** ***0.169***	**100** ***0.257***
Grand Total	297 *0.736*	91 *0.306*	124 *0.566*	4 *0.088*	101 *0.342*	171 *0.440*

a: Numbers released have been adjusted for tag loss.

Table 20 (continued)

Release year	1994	
Release site	Tucannon R. From Curl Lk.	Walla Walla R.
CWT code(s)	63/54/09 63/54/08 63/54/07	63/53/12 63/53/13 63/53/14
Brand	RA-7U-3 LA-7U-1 RA-7U-1	RA-IT-1 LA-IT-1 RA-IT-3
No. released	49,258	59,537
Fishery		
L. Col. Sport	22 *0.045*	115 *0.193*
Mid- Col. Sport	34 *0.069*	68 *0.114*
Zone 6 Net	29 *0.059*	91 *0.153*
L. Ferry Hatchery	56 *0.114*	497 *0.835*
Snake R. Sport	57 *0.116*	277 *0.465*
Tucannon Sport	60 *0.122*	45 *0.076*
Mill Creek Sport		30 *0.050*
W.Walla Sport		382 *0.642*
Miscellaneous other	21 *0.043*	6 *0.010*
LSRCP Total	**117** ***0.238***	**1,231** ***2.083***
Grand Total	138 *0.280*	1,396 *2.362*

Note: Numbers released have been adjusted for tag loss.
Percent smolt to adult survival in italics

Table 21. Adult returns of LFH juvenile steelhead released in 1993, and their smolt to adult survival (in italics) for run years 1994 and 1995.

Release year			1993			
Release site	Touchet R. Dayton AP	Tucannon R. From Curl Lk.	Tucannon R. @ Curl Lk.	Tucannon R. @ hatchery	Tucannon R. @ Marengo	Walla Walla R
CWT code	63/59/41 63/46/49	63/48/16	63/48/15	63/48/47	63/48/17	63/59/42 63/59/44
Brand	RA-H-1,2	LA-IC-1	RA-IC-1	No brand	LA-IC-3	LA-H-1,2
No. released (a)	40,331	29,701	21,916	4,565	29,517	38,905
Fishery						
L. Col. Sport	38	36	21		2	17
	0.094	*0.121*	*0.096*		*0.007*	*0.044*
Mid- Col. Sport	28	22	7		23	58
	0.069	*0.074*	*0.032*		*0.078*	*0.149*
Zone 6 Net	113	48	52	4	46	98
	0.280	*0.162*	*0.237*	*0.088*	*0.156*	*0.252*
L. Ferry Hat.	242	83	77	3	64	191
	0.600	*0.279*	*0.351*	*0.066*	*0.217*	*0.491*
Snake R. Sport	134	29	94	3	34	70
	0.332	*0.098*	*0.429*	*0.066*	*0.115*	*0.180*
Tucannon Sport	25	18	28		29	2
	0.062	*0.061*	*0.128*		*0.098*	*0.005*
W.Walla Sport	9					40
	0.022					*0.103*
Touchet Sport	167				2	
	0.414				*0.007*	
Grande Ronde Sport			3		18	
			0.014		*0.061*	
Idaho Sport		19	38		19	19
		0.064	*0.173*		*0.064*	*0.049*
Ocean Harvest						1
						0.003
Miscellaneous other	21	10	13		12	13
	0.052	*0.034*	*0.059*		*0.041*	*0.033*
LSRCP Total	**577**	**149**	**240**	6	**166**	**322**
	1.431	***0.502***	***1.095***	***0.131***	***0.562***	***0.828***
Grand Total	756	255	320	10	237	496
	1.874	*0.859*	*1.460*	*0.219*	*0.803*	*1.275*

Note: (a) Numbers released have been adjusted for tag loss.

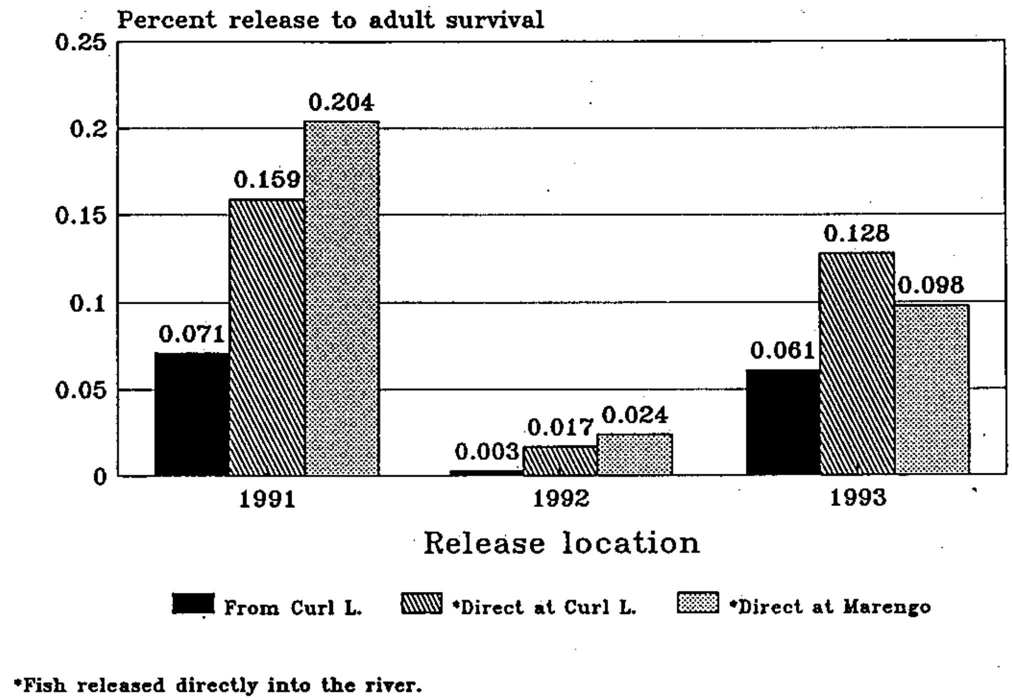

Figure 2. Steelhead release to adult survival to the Tucannon River for fish released in 1991,1992 and 1993.

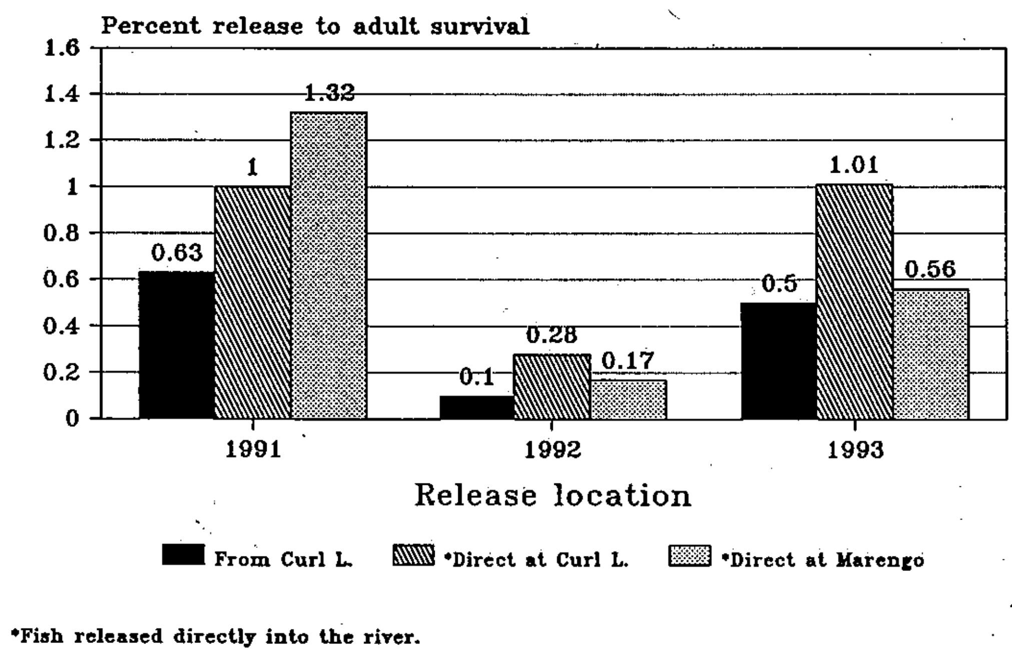

Figure 3. Steelhead release-to-adult survival to the LSRCP area for Tucannon River fish released in 1991,1992 and 1993.

2.7 Returns to Spawning Grounds

We estimated steelhead spawning escapement into the Touchet and Tucannon rivers and Asotin Creek in 1996. Steelhead spawning grounds were surveyed to estimate the number of redds/mile as discussed by Schuck et al.(1993). Index areas established in 1992, 1993 and 1995 were used in 1996 (Appendix F). Redds/mile from survey sections was multiplied by miles of available spawning area in each river to obtain an estimated number of redds constructed. Total redds were then multiplied by 0.81 females/redd (Johnson 1987) to determine the number of females spawning in each river. The proportions of the total run that females and hatchery fish represented were determined from creel surveys and historical information. The number of female spawners was divided by the proportion of females to determine run size for each river. The number of males in the spawning runs were calculated by subtracting the number of females from the total run size for each river. The numbers of wild and hatchery fish in the Touchet and Tucannon rivers' spawning runs were calculated by applying the ratio of wild to hatchery fish. No estimate of the ratio of wild to hatchery spawners was available for Asotin Creek.

Mean redds per mile decreased and increased on the North and South Forks of Asotin Creek in 1996 compared to 1995, respectively (Figure 4).

Mean redds per mile increased, and decreased on the South and Wolf Forks of the Touchet River, respectively, in 1996 as compared to 1995 (Figure 5). The steelhead redds per mile on the North Fork of the Touchet river was not estimated because of unusually high and turbid water.

Mean redds per mile in the Tucannon River in 1996 was similar to that estimated in 1994 and 1995 (Figure 6). However, the distribution of redds within the river changed. In 1995 and 1996, more redds were found upstream of the former location of the Tucannon weir/ trap than in 1994. The percent of redds in the middle and upper river increased from 14% in 1994 to 54.7 % in 1996 (Table 22). This shift in redd location is likely the result of removal of the Tucannon weir/ trap in 1994 which allowed unrestricted passage to the river above the hatchery during the spring of 1995; and new trapping equipment and methods on the Tucannon in 1996 which improved passage conditions.

Table 22. Distribution of steelhead redds in the Tucannon River in 1994-1996.

	Location of Redds			
	Upper and Middle Sections [a]		Lower Section [b]	
Year	Number	(%)	Number	(%)
1994	25	14.0	154	86.0
1995	72	41.4	102	58.6
1996	105	54.7	87	45.3

a: Above the weir and trap location.
b: Below the weir and trap location.

Spawning surveys from previous years on the Tucannon River suggest that operation of the weir/trap in the river adjacent to the hatchery substantially reduced adult steelhead spawning in the middle and upper river. We suspected that in 1994 after modifications to the weir/trap, adult steelhead were either blocked or intimidated by the weir and dropped back down-river to spawn. Decreased spawning and juvenile steelhead production in the middle and upper river were serious concerns. This year the weir was removed during the majority of the steelhead spawning run (until 1 May) to allow unrestricted passage of steelhead, and to re-populate that section of the river upstream of the weir. The results from our spawning surveys indicate that we have begun to achieve this objective.

Table 23 provides an estimate of hatchery and wild steelhead escapement into portions of the Touchet and Tucannon rivers, and estimated hatchery males and females in the population. Spawning activity is discussed further in the section, "Trends in naturally produced juvenile steelhead, 1983-1996 ".

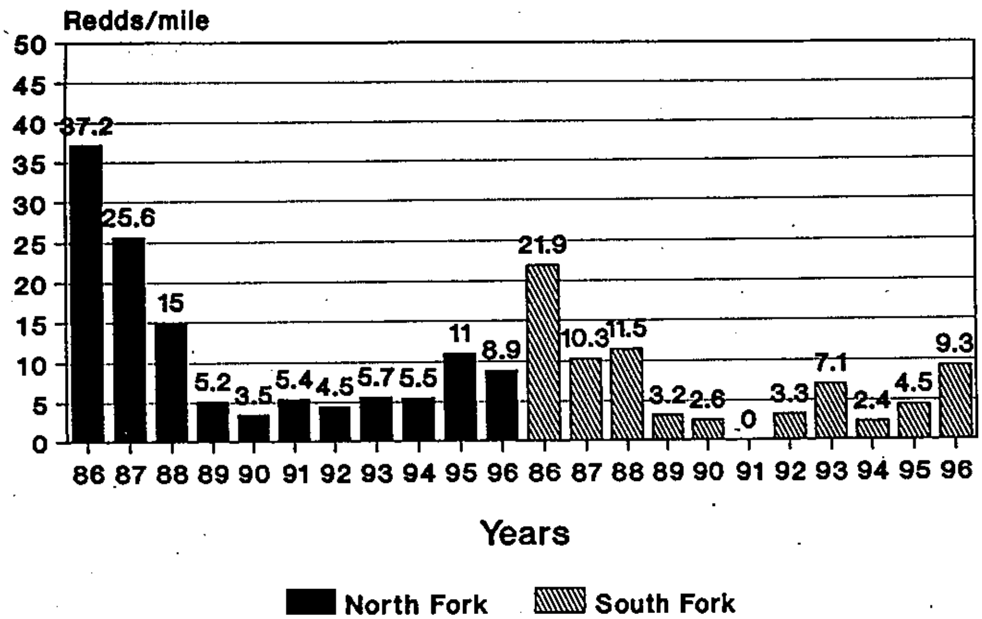

Figure 4. Steelhead redds per mile in index areas of Asotin Creek, 1986-95.

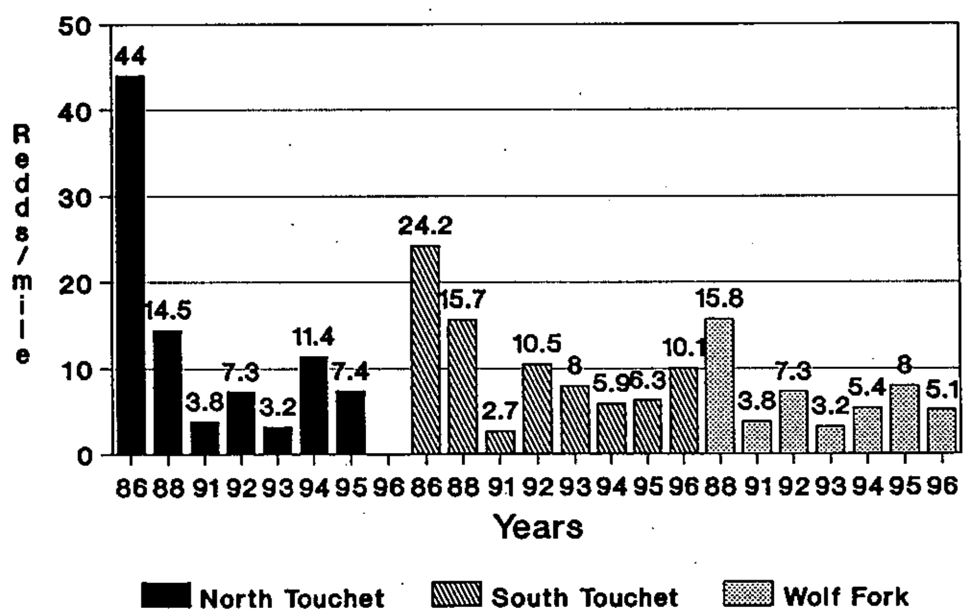

Figure 5. Steelhead redds per mile in index areas of the forks of the Touchet River, for selected years 1986-96.

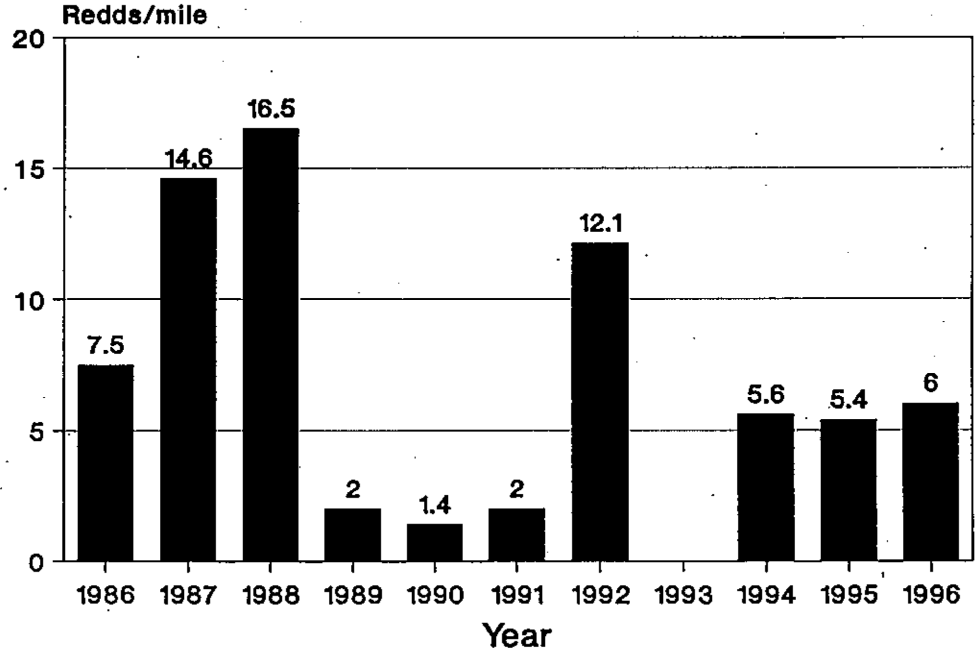

Figure 6. Steelhead redds per mile in index areas of the Tucannon River, 1986-96.

Table 23. Estimated steelhead spawner escapement into survey sections of the Touchet and Tucannon rivers, spring 1996.

River	**Wild**	Hatchery Male	Hatchery Female	Total Spawners
Touchet River [A]				
North Fk.	No estimate			
South Fk.	52	36	92	180
Wolf Fk.	16	12	31	59
Robinson Fk.	No estimate			
Total	**68**	**48**	**123**	**239**
Tucannon River [A]				
upper	6	12	19	37
middle	18	31	50	99
lower	21	36	58	115
Panjab Cr.	No estimate			
Cummings Cr.	18	30	49	97
Total	**63**	**109**	**176**	**348**

A: Information based on a combination of spawning surveys, trapping and creel survey information.

2.8 Contribution Toward LSRCP Goal

We estimate that LSRCP steelhead smolts released into SE Washington streams during 1993 and 1994 returned at least 13,750 adult steelhead to the LSRCP area of the Snake River Basin during the 1995 run year (Table 24). This return is 295% of the goal established for Washington's steelhead (USACOE 1975). The estimate is based on adult escapement and harvest of coded wire tag groups. Adult returns for untagged groups were estimated by using fishery and escapement rates for comparable coded wire tag groups (Table 20).

Table 24. Estimated adult steelhead returns to the LSRCP area in 1994, for specific rivers for the release years shown.

Release year	Asotin Creek	G. Ronde River	Snake River	Touchet River	Tucannon River	Walla Walla R.	Total
1993	428	919	781	595	337	214	3,274
1994	353	3,168	1,318	1,353	528	3,756	10,476
Total	**781**	**4,087**	**2,099**	**1,948**	**865**	**3,970**	**13,750**

2.9 Trends in Naturally Produced Juvenile Steelhead, 1983-1996

We sample established index sites within survey sections of three LSRCP rivers in S.E. Washington yearly to monitor the health of naturally produced salmonid populations (Appendix G). We measure population density and estimate population size. Following are the survey sections of Asotin Creek and the Touchet and Tucannon rivers which were sampled in 1996:

- North Fork Asotin Creek: From the confluence with the South Fork upstream 4.65 miles to the U.S. Forest Service boundary.
- South Fork Asotin Creek: From the confluence with the North Fork upstream 3.46 miles to first bridge crossing.
- North Fork Touchet River: From the confluence with the South Touchet upstream 11.1 miles.
- South Fork Touchet River: From the mouth upstream 15.7 miles.
- Wolf Fork of North Fork Touchet River: From the mouth upstream 10.3 miles.
- Tucannon River: From RM 24.7 (Marengo Bridge) upstream to the confluence with Panjab Creek (RM 45.6).

Annual variations in juvenile steelhead densities and population sizes depend on the extent of adult spawning and juvenile steelhead rearing success. These factors are affected by annual changes in river flows, water temperatures and habitat quality. Extremes of water flow, water temperature or changes in habitat quality, even if short lived, can obstruct spawning and decrease rearing success, causing changes in densities and population sizes. During February 1996 rain, warm temperatures and an unusually large snow pack resulted in a devastating flood in the Touchet and Tucannon rivers. This year we attempted to document the effects of this flood upon steelhead and the aquatic and riparian habitats on the Touchet and Tucannon rivers.

Since 1989, juvenile steelhead within established index sites (Appendix G) have been electrofished with a multiple removal method (Zippen 1958), and population estimates calculated (Mendel 1984, Hallock and Mendel 1985, Schuck and Mendel 1987, Schuck et al. 1990-1995). Also, representative reaches of each river were walked annually during spawning surveys, and steelhead redds per mile calculated (Schuck et al. 1993).

Habitat measurements had been collected in 1994 and were collected again in the summer of 1996 (four months after the flood) on the Touchet and Tucannon rivers. Nine sites on the Touchet River system (three sites each on the North, South and Wolf forks), and six sites on the Tucannon River (scattered throughout the middle and upper river) were sampled. Sites were 60 m in length and encompassed a 30 m juvenile steelhead population index site. Sites were chosen to closely correlate habitat quality with juvenile population size. Time and personnel constraints precluded a habitat survey of Asotin Creek. Methods used were as described in Viola et al. (1991) and Platts et al. (1983).

Mean densities of juvenile steelhead are presented in Appendix H. Spawning activity (measured in redds per mile) is presented in Figures 4-6 (years presented are when hydraulic conditions allowed a reliable survey to be conducted). In most cases results from 1996 are compared to 1994. A detailed discussion of results from years before 1994 can be found in Schuck et. al. (1991, 1993, 1994, 1995) and Viola et. al. (1991).

2.9.1 Asotin Creek

Electrofishing of six index sites within each survey section provide juvenile steelhead densities and population estimates for the survey section. On Asotin Creek, three of the six sites sampled on each of the North and South Forks survey sections were located in areas of artificial habitat improvement (Mendel and Taylor 1981); the other three were in areas where the habitat had not been altered (control). Mean densities (fish/100 m^2) for both zero (0) aged and greater than zero (>0) aged naturally produced juvenile steelhead were calculated for improved and unimproved areas. Population size was estimated by multiplying mean densities by river surface area 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 population estimates from both the improved and unimproved areas. These estimates were then divided by the total area available within the entire river survey section for that year. This provided a density for combined age classes.

Main Asotin Creek

No river survey sections have been established for main Asotin Creek. However, during 1996 we electrofished two sites which had been sampled in previous years. Mean densities (fish/100 m^2) for both 0 aged and > 0 aged, naturally produced steelhead were calculated (Appendix H). Densities of 0 aged steelhead increased on mainstem Asotin Creek in 1996 compared to 1995, but densities of >0 aged steelhead decreased.

North Fork Asotin Creek

In 1996, 5,400 less naturally produced 0 aged steelhead (41.9%) were present in the survey sections than in 1995 (Figure 7). The decrease of 0 aged fish in 1995 is relatively large considering that nearly as many redds (81%) were constructed in 1996 as in 1995. The difference in egg to juvenile survival suggests that rearing conditions were less than optimal or survival was density dependent on the North Fork in 1995. We believe the effects of the flood were instrumental in decreasing juvenile survival.

The abundance of >0 aged fish increased in 1996 by 3,700 fish; a 59.7% increase from levels that were present in 1995 (Figure 7). Apparently older age fish were not adversely affected by the flood and the resulting degraded habitat as were 0 aged steelhead.

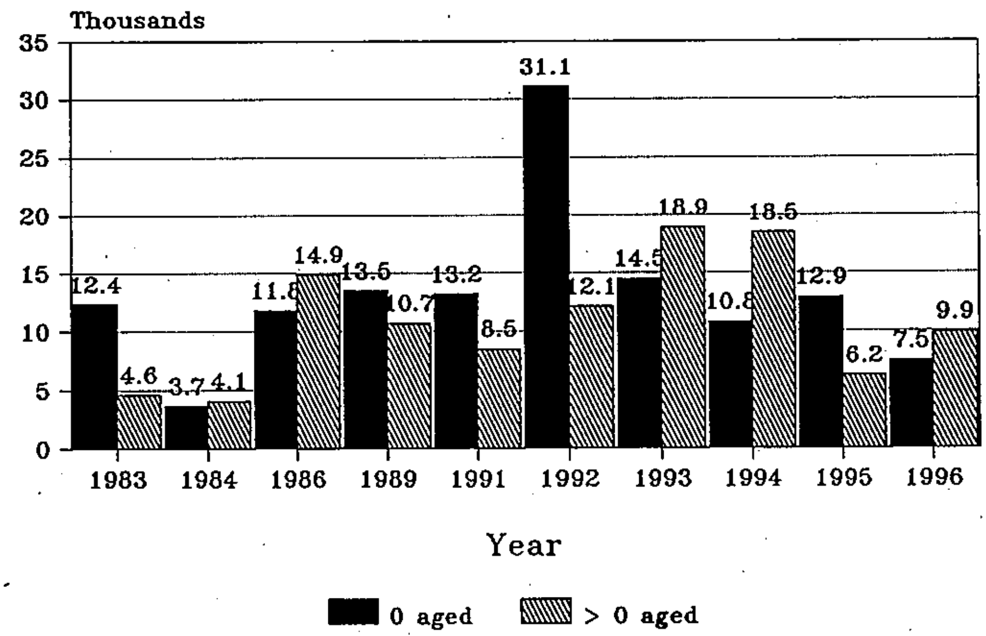

Figure 7. Estimates of juvenile steelhead abundance on the North Fork Asotin Creek from the confluence with the South Fork upstream 4.65 miles to the U.S. Forest Service boundary, 1983 - 1996.

South Fork Asotin Creek

In 1996, 1,300 less (46.4%) naturally produced 0 aged steelhead were present in the survey sections than in 1995 (Figure 8). The decrease of 0 aged fish in 1995 is unfortunate considering that 207 % more redds were constructed in 1996 than in 1995 (Figure 4). The difference in egg to juvenile survival is most likely due to the flood and the resulting degraded habitat on the South Fork Asotin Creek.

The abundance of >0 aged fish increased in 1996 by 2,400 fish; a 370% increase from levels that were present in 1995 (Figure 8). Again older age fish were seemingly unaffected by the flood and the resulting degraded habitat.

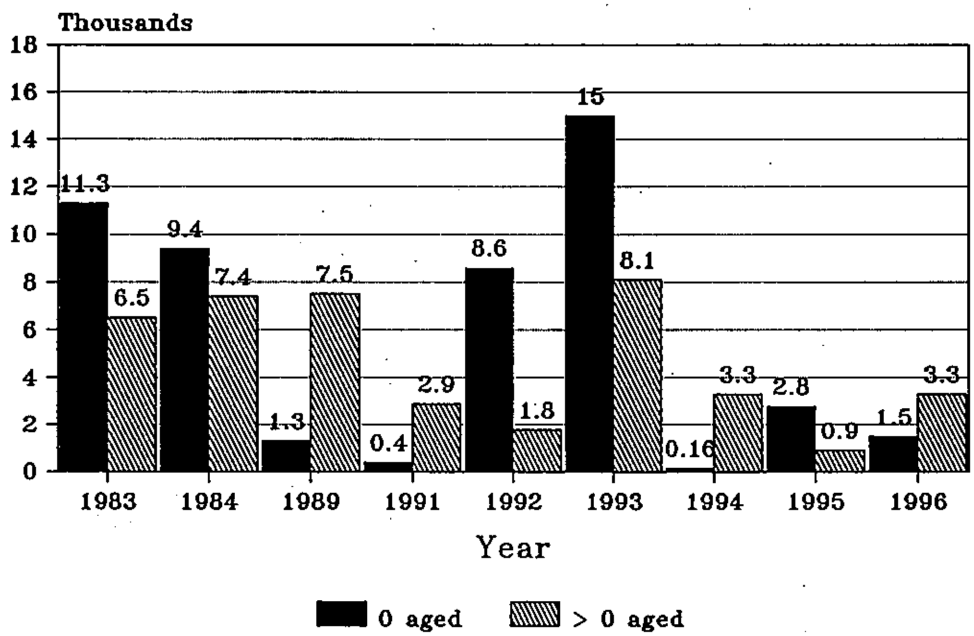

Figure 8. Estimates of juvenile steelhead abundance on South Fork Asotin Creek from the confluence with the North Fork, upstream 3.46 miles to the first bridge crossing, 1983 -1995.

2.9.2 Touchet River

Numbers of 0 aged juvenile steelhead were substantially less in 1996 after the flood on the North, South and Wolf Forks of the Touchet River when compared to fish present in the previous four years (Figures 9, 10, 11).

Older aged (>0 aged) juvenile steelhead were also notably less abundant in 1996 on the North Fork, slightly less abundant on the Wolf Fork and more abundant on the South Fork of the Touchet River when compared to the previous four years.

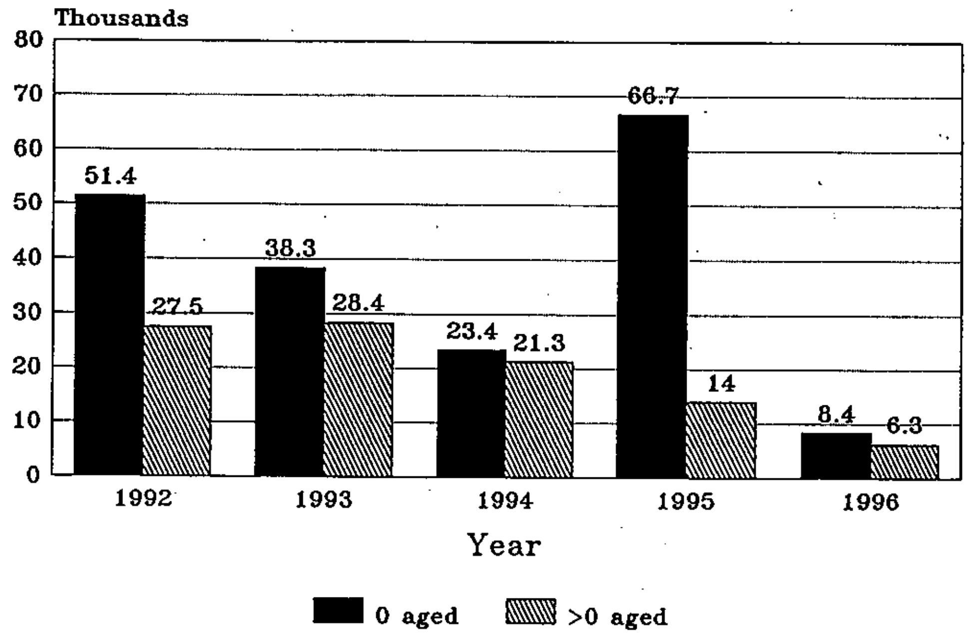

Figure 9. Estimates of juvenile steelhead abundance on North Fork Touchet River, from the mouth upstream 11.1 miles, 1992 - 1996.

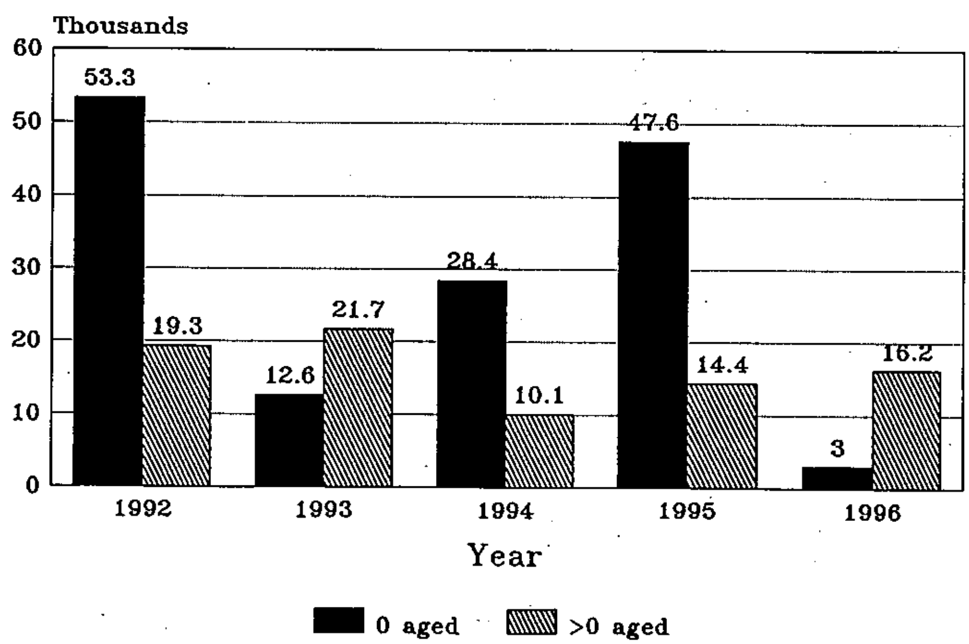

Figure 10. Estimates of juvenile steelhead abundance on South Fork Touchet River, from the mouth upstream 15.7 miles, 1992 - 1996.

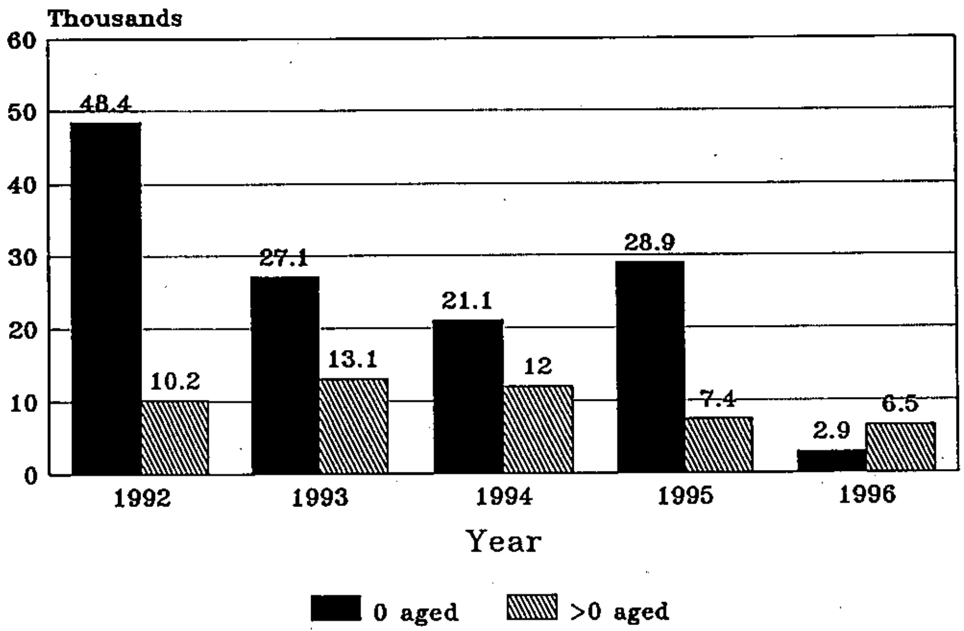

Figure 11. Estimates of juvenile steelhead abundance on Wolf Fork of the North Fork Touchet River, from the mouth upstream 10.3 miles, 1992 - 1996.

Steelhead redds per mile on South Fork after the flood in 1996 were more numerous when compared to the previous five years. Redds per mile on the Wolf Fork were less abundant than in 1995, similar to 1994 and greater than in 1993 (Figure 5). A survey of spawning activity was precluded on the North Fork because of an unusually long period of turbid water caused by heavy equipment working in the river.

Based on our limited sample of habitat, we conclude that mean channel widths of all forks of the Touchet River increased from 29.6 - 57.1%. Numbers of pools decreased 75.0 - 93.1% and the quality of remaining pools (based on Platts et al. 1983) decreased 26.9 -51.8%. In 1994 we found no eroding banks in any of the sample sites on any of the forks of the Touchet. An average of 47.8% of the same banks were eroding in 1996. Available cover, shade and riparian vegetation decreased drastically on all three forks of the Touchet River after the flood in 1996 as compared to pre-flood conditions in 1994 (Tables 25, 26 and 27).

2.9.3 Tucannon River

Numbers of 0 aged juvenile steelhead were greater in 1996 when compared to numbers present in the previous two years (Figure 12). Numbers of steelhead redds per mile after the flood in 1996 were similar to those present since 1994 (Figure 6). Although number of redds was not substantially different from recent years, 0 age juvenile steelhead were notably more abundant in 1996, compared to the previous two years. This suggests that redd destruction during the

Table 25. A comparison of habitat measurements for pre- and post-flood (1994 and 1996) for the North Fork Touchet River.

	Mean Channel Width (m)	Mean Depth (m)	Total Number Pools	Mean % Surface Area in Pools	Mean Pool Depth	Mean Pool Rating	% of Total Surface as Cover	Mean Percent Shade	Mean Percent Eroding Banks	Riparian % Veg. Left Bank	Riparian %Veg. Rt. Bank
Pre-flood 1994											
	9.64	0.21	41	2.2	0.27	2.19	18.8	30	0	97.5	99.8
STD	2.53	0.02		0.42	0.02	0.14	8.0	18.7		4.3	0.4
Post-flood 1996											
	12.61	0.23	10	1.0	0.26	1.6	9.4	13.8	43.8	62.5	73.8
STD	4.08	0.04		1.05	0.15	0.94	8.8	21	45.6	33.4	37.3
Percent Change	30.8	9.5	-75.6	-54.5	-3.7	-26.9	-50.0	-54.0		-35.9	-26.1

STD = standard deviation

Table 26. A comparison of habitat measurements for pre- and post-flood (1994 and 1996) for the South Fork Touchet River.

	Mean Channel Width (m)	Mean Depth (m)	Total Number Pools	Mean % Surface Area in Pools	Mean Pool Depth	Mean Pool Rating	% of Total Surface as Cover	Mean Percent Shade	Mean Percent Eroding Banks	Riparian % Veg. Left Bank	Riparian %Veg. Rt. Bank
Pre-flood 1994											
	10.31	0.18	36	15.56	0.26	2.3	9.4	17	0	72	90
STD	2.44	0.02		11.33	0.04	0.59	4.8	29.3		19.4	20
Post-flood 1996											
	16.2	0.15	9	1	0.23	1.1	3.8	15	50	46	52.4
STD	4.88	0.02		1.45	0.13	1.14	6.8	20.6	53.4	40.4	29.7
Percent Change	57.1	-16.7	-75.0	-93.6	-11.5	-52.2	-59.6	-11.8		-36.1	-41.8

STD = standard deviation

Table 27. A comparison of habitat measurements from pre- and post-flood (1994 and 1996) Wolf Fork of the NF Touchet River.

	Mean Channel Width (m)	Mean Depth (m)	Total Number Pools	Mean % Surface Area in Pools	Mean Pool Depth	Mean Pool Rating	% of Total Surface as Cover	Mean Percent Shade	Mean Percent Eroding Banks	Riparian % Veg. Left Bank	Riparian %Veg. Rt. Bank
Pre-flood 1994											
	8.59	0.23	29	2.33	0.3	2.37	11.63	55	0	86.67	99.33
STD	0.69	0.01		1.61	0.09	1.16	5.2	26.77		18.86	0.94
Post-flood 1996											
	11.13	0.25	2	0.2	0.22	1.33	8.11	41.67	47.8	41.67	43.33
STD	2.65	0.01		0.1	0.17	1	0.63	26.77	50.4	2.5	7.5
Percent Change	29.6	8.7	-93.1	-91.4	-26.7	-43.9	-30.3	-24.2		-51.9	-56.4

STD = standard deviation

Table 28. A comparison of habitat measurements for pre and post flood (1994 and 1996) for the Tucannon River

	Mean Channel Width (m)	Mean Depth (m)	Total Number Pools	Mean % Surface Area in Pools	Mean Pool Depth	Mean Pool Rating	% of Total Surface as Cover	Mean Percent Shade	Mean Percent Erroding Banks	Riparian % Veg. Left Bank	Riparian %Veg. Rt. Bank
Pre-flood 1994											
	13.24	0.21	76	6.1	0.42	1.68	19.0	40	7.5	97.5	98.8
STD	1.03	0.12		3.04	0.13	0.38	10.14	21.51	10	4.33	2.17
Post-flood 1996											
	13.27	0.36	29	2.09	0.81	1.81	10.2	30	19.4	87.5	97.5
STD	0.7	0.02		0.51	0.38	0.07	4.79	24.84	20.4	20.49	4.1
Percent Change	0.2	71.4	-61.8	-65.7	92.9	7.7	-46.3	-25.0	158.7	-10.3	-1.3

STD = standard deviation

minor April flood was not substantial and that rearing conditions in the Tucannon for 0 age fish were favorable in spring 1996. This may be a function of increased water quantity in 1996 as compared to 1994-95.

Older aged (>0 aged) juvenile steelhead were considerably less abundant in 1996 when compared to amounts present in the previous 10 years. Since rearing conditions seem to have been favorable for 0 age fish during 1996, older age fish may have suffered substantial mortality during the two spring floods, as 0 age and >0 age fish use different rearing habitat.

Based on our limited habitat sample, mean channel width remained stable. Although numbers of pools decreased by 68.1%, the quality of remaining pools, (Platts et al. 1983), improved 7.7% (Table 28). The amount of eroding banks increased over 1994 levels, while available cover, shade and riparian vegetation decreased drastically after the flood.

Cummings Creek
No river survey sections have been established for Cummings Creek. During 1996, we electrofished two sites which had been sampled in previous years and two new sites. Mean densities (fish/100 m^2) for both 0 aged and > 0 aged, naturally produced steelhead were calculated (Appendix H). Densities of 0 aged steelhead increased and densities of >0 aged steelhead decreased in Cummings Creek in 1996 compared to 1995.

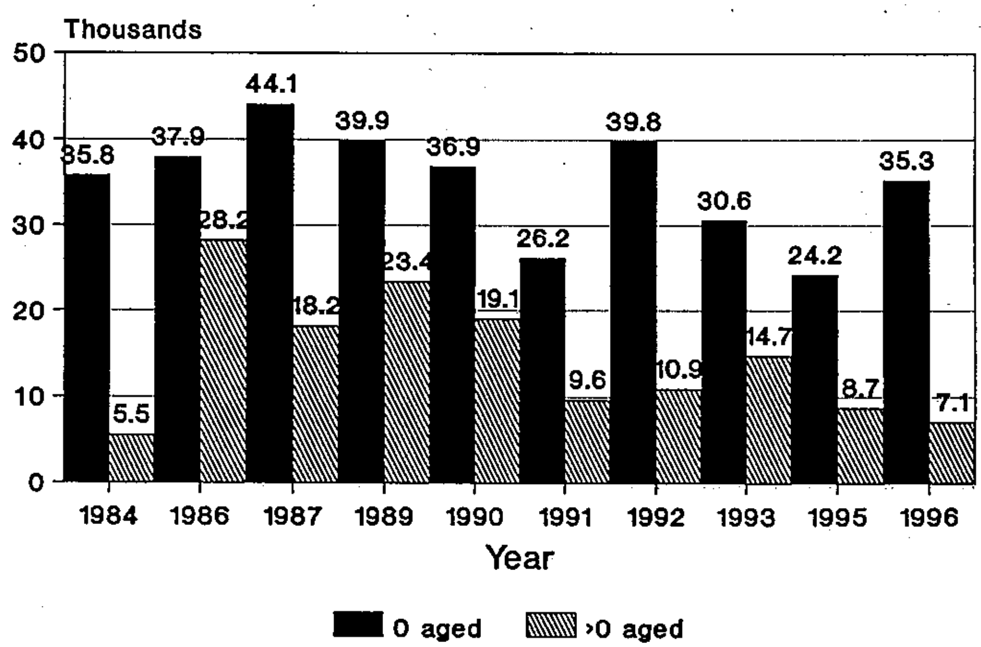

Figure 12. Estimates of juvenile steelhead abundance on the Tucannon River from Camp 1 upstream 11.6 miles to Panjab Bridge, for most years between 1984 - 1996.

Substantial changes in aquatic and riparian habitat occurred on both the Touchet and Tucannon rivers as a result of the 1996 flood. We believe that the salmonid rearing potential of the Touchet River was reduced by the flood and flood control efforts. Perhaps the greatest loss was the dramatic reduction in the quantity of pools and the widening of the river channel. Increased channel widths will decrease water depths, and increase water surface area. This will tend to elevate water temperatures in the summer and decrease water temperatures in winter; conceivably to extremes outside of the temperature tolerances of steelhead.

This was not the case on the Tucannon River. While we found a reduction in the total number of pools (Table 28), Bumgarner (1996) found an increase in the number and quality of large pools. Although reduced small pool abundance represents lost rearing habitat for young steelhead, and lost refuge for fish during the adverse temperature conditions of summer and winter, the increased quality and quantity of large pools may over-shadow the negative effects of decreased total pools.

The flood occurred in February whereas steelhead spawning occurred after the flood in March, April and May. Consequently, redd destruction caused by the flood is not likely responsible for the relatively low numbers of 0 aged fish on the Touchet River in 1996. This decrease in abundance may better be attributed to the effects of channel repair/control efforts with heavy equipment. Also, extensive siltation occurred due to the continuous heavy equipment activity in the river and increased bank erosion. Waters (1995) states: "Dense silt can cover redds, suffocating eggs and/or sac fry. Excessive silt changes river substrates by filling in spaces between gravels. This reduces the abundance and species diversity of aquatic invertebrates; the primary forage for young steelhead. The ultimate result is decreased productivity of the river". The decrease in abundance of greater than 0 aged steelhead should be attributed to a combination of the destructive physical forces of flood waters, flood control efforts with heavy equipment and lost productivity of the river.

Periodic floods are both natural and inevitable. However floods have been exceptionally frequent and destructive in Southeast Washington. Johnson (1995) in her doctoral dissertation states " Over time the combination of natural floods and human effort at flood control has degraded the integrity of the Tucannon river's channel and riparian lands. While the intent was to preserve property, not degrade riverine conditions, in the aftermath of the horrendous floods of 1964 and 1965, particularly, various agencies and valley landowners channelized and diked the Tucannon into a state of disequilibrium that has returned to haunt salmon and humans alike. Indeed efforts at flood control have destabilized the river system so that flood damage may be worse than it would have been under a natural river regime." The same can be said of the Touchet River.

Immediate reactions to the 1996 flood by local landowners mirrored actions of the past. Many short term efforts were made to move river cobble and rebuild dikes, and restore the river to its previous channel. These efforts destroyed riverine habitat and continued for months on the Touchet River. Initially local authorities disregarded and openly rejected help from state and federal Habitat Biologists and Hydrologists. Unlike the past, however, within a few months locals began working together with state and federal agencies. The result was a combination of dike and instream habitat enhancements that both protected property and restored some lost river habitat.

2.9.4 Comparison of electrofishing and snorkeling for estimating densities and populations of juvenile steelhead

We compared juvenile steelhead density/population data collected by snorkeling and our standard electrofishing three pass removal method. We snorkeled seven juvenile steelhead population sites one week before electrofishing them on the Tucannon River (Appendix I). Two divers snorkeled side-by-side from the lower end of each site upstream to the top. Each diver counted the number of 0 aged and >0 aged steelhead that they observed. Constant communications and an awareness of each diver's location minimized duplicate fish counts. Counts of fish from both divers were summed and then divided by the total number of 100 m^2 areas in the site to estimate the number of 0 aged and >0 aged fish per 100 m^2 (Table 29). The results from estimates calculated with electrofishing and snorkeling information were compared using a two sample T-test. The estimates of juvenile steelhead density derived from snorkeling and electrofishing were statistically equal for 0 aged fish ($P=0.54$) and statistically different for >0 aged fish ($P=.260$), in 1996.

The hypothetical snorkel and electrofishing estimates of 0 aged fish are similar, but we believe that both underestimate the actual population size (Figure 13). Because it was physically impossible to snorkel the shallowest of our sites, we do not have a representative sample of steelhead habitat in the shallow portions of the river. This bias would tend to underestimate 0-age steelhead. Also, while snorkeling the deeper sites, we often could not see young-of-the-year steelhead in the shallow water habitat where they are typically found, increasing sample bias for small fish. We therefore believe the abundance of 0 aged fish can not be reliably estimated by snorkeling. Likewise, electrofishing estimates are inaccurate for older age fish. Sites deep enough to be snorkeled for our comparison purposes were frequently so deep as to allow larger (older age) fish either to elude the electro-shocker's field or to enter deeper pools where field strength and capture efficiency are reduced. The hypothetical population estimates of >0 aged fish is greater than the estimate derived from electrofishing. To be consistent with our long term sampling methods, the estimates of juvenile steelhead reported for 1996 are based on electrofishing results from our sites, both deep and shallow.

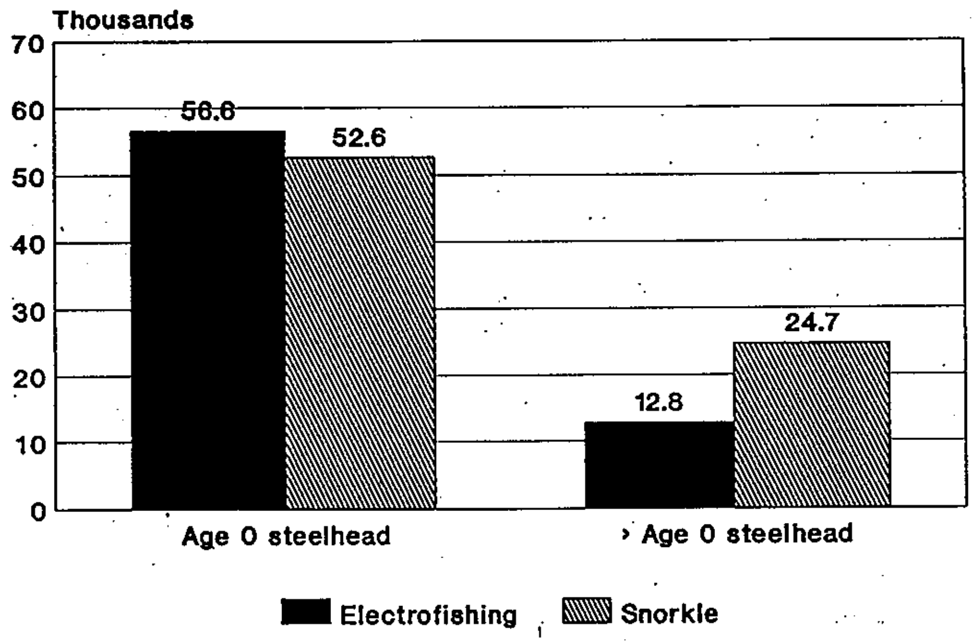

Figure 13. A comparison of hypothetical population estimates calculated by snorkel data and electrofishing for the Tucannon river in 1996.

Table 29. Mean density (fish/100 m^2) of juvenile steelhead in sites snorkeled and then electrofished on the Tucannon River, 1996.

Age Method	Mean Density	Sites n	S.D.	C.V.
0 aged				
Snorkeled	6.47	7	6.36	98.2%
Electrofished	11.96	7	8.47	70.8%
>0 aged				
Snorkeled	5.06	7	2.38	47.0%
Electrofished	3.31	7	2.48	74.7%

In conclusion, we consider snorkeling ineffective for estimating the abundance of 0 aged steelhead in our area rivers. If information is needed for 0 aged fish populations, electrofishing is still the most accurate and reliable method for the diversity of habitat conditions we must sample. However, snorkeling is more accurate for estimating abundance of older (>0) aged juvenile steelhead. If only older (parr and pre-smolt) fish need to be sampled, snorkeling is more effective and less time consuming for the habitats found in SE Washington rivers and streams. The method must meet the need. Unfortunately, these results appear to preclude reliable comparisons of any future snorkel estimate of juvenile steelhead densities and populations with historical estimates from electrofishing.

2.10 Catchable Trout Program

In 1995-96, 216,837 (72,088 pounds) catchable size rainbow trout were produced at the Lyons Ferry Complex (Appendix J). The catchable trout averaged 3.0 fish per pound in spring 1996. Also in 1995-96, 159,798 rainbow trout fry (3,652 pounds) and 51,890 fingerlings (3,530 pounds) were reared for Idaho's LSRCP program. This production represents slightly over 94% of the program goal of 84,000 pounds. The number of days of recreational opportunity these fish provided was not estimated in 1995-96.

3.0 CONCLUSIONS

Production from LSRCP trout facilities met their goal for steelhead but were just under production goal for rainbow trout. No viral or water supply problems disrupted production. Our continuing study of steelhead smolt residualism is providing information that will be applicable throughout the Columbia Basin. We retained only 5,244 potential residual steelhead in Curl Lake AP in 1996. Problems with an electronic counter compromised the effectiveness of our management, resulting in the highest number of residual steelhead in the Tucannon River since 1992. We believe that managing acclimation ponds to retain potentially residual juveniles reduces the presence of these fish in the river and their potential impact on wild salmonids, however the method is subject to many environmental and operational variables that can affect its success. We shall continue investigating acclimation pond management as part of our release strategy. PIT tag detections in 1996 again showed that successful smolts are the largest, leanest fish which emigrate from the river. A comparison of steelhead released from LFH with standard length tags and with length and one-half tags showed no apparent difference in migration success.

We estimate that 13,750 adult LFH steelhead returned to the LSRCP area during the 1995 run year. Considerably more fish actually returned to the Columbia River Basin that were harvested in lower river and tributary fisheries. We estimated that the recreational value of the steelhead fishery in SE Washington in 1995-96 was between $5,074,000 and $8,476,000, but we could not calculate a cost/benefit ratio of Washington origin steelhead because of the contribution of Oregon and Idaho origin steelhead to the fishery.

Spawning escapement increased in 1995-96, with many streams benefitting from improved river flow and ocean survival conditions in 1993 and 1994. Unfortunately the severe flooding experienced in February 1996, and the smaller flood in April, destabilized river channels and decreased spring survival of young-of-the-year steelhead. A survey and comparison of habitat conditions on the Touchet and Tucannon rivers 1994 to 1996 showed the flood caused substantial damage.

We repeated our 1994 comparison of snorkeling and electrofishing as methods of sampling juvenile populations. Again, both methods sample populations with consistency, however we cannot strongly correlate estimates of 0 age or >0 age juveniles with the two methods. Our results indicate that electrofishing is not accurate for older age juvenile steelhead in sites with deep pools or where overall site depth decreases an electroshocker's efficiency. Snorkeling, by contrast, underestimates 0-age steelhead because of their preference for shallow complex habitat not easily sampled by snorkeling. We believe that the long term nature of our trend data is a valuable management tool, and that the mortality induced by electrofishing our index sites is insignificant at the population level. Therefore electrofishing should continue to be used on a limited basis, especially where 0-age population data is required, despite the presence of ESA listed species. All new sites should be sampled by snorkeling to reduce impacts to populations.

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5.0 APPENDICES

Appendix A.

Smolt Releases From Lyons Ferry/Tucannon Hatcheries, 1992-1996.

Location	R.M.	Number released	Pounds released	Date m/dd	Stock	Tag Code	Brand	Fin Clips	Size #/lb	CWT loss %	Brand loss %
1992											
Grande Ronde R.	29	213,622	39,622	4/3-19	Wallowa			AD	5.4		
G. Ronde in Oregon	41	25,425	5,650	4/20	Wallowa			AD	4.5		
G. Ronde in Oregon	41	24,500	4,900	4/21	Wallowa			AD	5.0		
Snake R. @ LFH	58	18,000	5,000	4/14	L.Ferry			AD	3.6		
Snake R. @ LFH	58	21,000	5,000	4/14	L.Ferry			AD	4.2		
Snake R. @ LFH	58	18,000	5,000	4/15	L.Ferry			AD	3.6		
Snake R. @ LFH	58	9,688	3,460	4/17	L.Ferry			AD	2.8		
Touchet @ Dayton	53	45,628	13,036	4/13	L.Ferry	63/59/47	RA-IY-1	AD-LV	3.5	0.6	3.3
Touchet @ Day ton	53	49,889	14,254	4/13	L.Ferry			AD	3.5		
Tucannon @ Curl	48	30,096	8,134	4/16	L.Ferry	63/42/63	RA-S-2	AD-LV	3.7	3.8	3.7
Tucannon from Curl	48	30,098	6,270	4/15	L.Ferry	63/42/60	RA-S-1	AD-LV	4.8	2.8	2.6
Tucannon from Curl	48	30,000	6,200	to	L.Ferry			AD	4.8		
Tucannon from Curl	48	9,958	2,075	4/30	Tucannon	63/44/12		LV	4.8	0.7	
Tucannon @ 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 River	25	21,000	5,000	4/14	L.Ferry			AD	4.2		
Walla Walla River	24	20,000	5,000	4/14	L.Ferry			AD	4.0		
Walla Walla River	23	15,210	3,900	4/15	L.Ferry			AD	4.0		
Walla Walla River	25	19,000	5,000	4/15	L.Ferry			AD	3.8		
Total		**631,002**	**145,796**					**Mean =**	**4.3**	**1.6**	**2.1**
1993											
Asotin Creek	0.5	18,000	4,000	4/15	Oxbow			AD-RV	4.5		
Asotin Creek	0.5	48,500	10,000	4/20	Oxbow			AD-RV	4.8		
Asotin Creek	0.5	51,000	10,000	4/21	Oxbow			AD-RV	5.1		
Asotin Creek	0.5	18,550	3,500	4/22	Oxbow			AD-RV	5.3		
Grande Ronde River	29	291,711	49,865	4/3-30	Wallowa			AD	5.9		
Snake R. @ LFH	58	29,400	6,000	4/23	L.Ferry			AD	4.9		
Snake R. @ LFH	58	27,000	5,000	4/24	L.Ferry			AD	5.4		
Snake R. @ LFH	58	12,250	2,500	4/24	L.Ferry			AD	4.9		
Snake R. @ LFH	58	49,500	10,000	4/21	Oxbow			AD-RV	4.9		
Snake River	66	36,300	8,950	4/14	Oxbow			AD-RV	4.1		
Snake River	66	21,500	5,000	4/16	Oxbow			AD-RV	4.3		
Snake River	66	23,000	5,000	4/20	Oxbow			AD-RV	4.6		
Snake River	66	24,500	5,000	4/21	Oxbow			AD-RV	4.9		
Snake River	66	24,500	5,000	4/22	Oxbow			AD-RV	4.9		
Touchet @ Dayton	53	20,104	4,189	4/3	L.Ferry	63/59/41	RA-H-2	AD-LV	4.8	0.2	0.8
Touchet @ Dayton	53	20,328	4,235	to	L.Ferry	63/46/49	RA-H-1	AD-LV	4.8	0.3	0.5
Touchet @ Dayton	53	34,607	7,209	4/30	L.Ferry			AD	4.8		
Touchet @ Dayton	46	35,960	7,400	4/24	L.Ferry			AD	4.9		
Tucannon @ Curl	41	30,001	6,400	4/22	L.Ferry	63/48/16	LA-IC-1	AD-LV	4.7	1.0	4.1
Tucannon from Curl	41	21,960	4,392	4/3-30	L.Ferry	63/48/15	RA-IC-1	AD-LV	5.0	0.2	1.4
Tucannon from Curl	41	27,100	5,420	4/3-30	L.Ferry			AD	5.0		
Curl Lake		7,640	1,528	retained	L.Ferry	63/48/15	RA-IC-1	AD-LV	5.0		
Curl Lake		7,500	1,500	retained	L.Ferry			AD	5.0		
Tucann from Hatch.	36	4,602	767	4/10	Tucann	63/48/47		LV	6.0		
Tucannon @ Marengo	26	29,876	6,600	4/22	L.Ferry	63/48/17	LA-IC-3	AD-LV	4.5	1.2	2.8
Walla Walla River	35	19,440	4,050	4/16	L.Ferry	63/59/42	LA-H-1	AD-LV	4.8	0.6	6.1
Walla Walla River	35	19,800	4,500	4/16	L.Ferry	63/59/44	LA-H-2	AD-LV	4.4	1.1	4.6

Appendix A (cont.)

Smolt Releases From Lyons Ferry/Tucannon Hatcheries, 1991-1995

Location	R.M.	Number released	Pounds released	Date m/dd	Stock	Tag Code	Brand	Fin Clips	Size #/lb	Tag loss %	Brand loss %
(1993 continued)											
Walla Walla River	36	22,000	5,000	4/23	L.Ferry			AD	4.4		
Walla Wálla River	36	22,000	5,000	4/23	L.Ferry			AD	4.4		
Wildcat Ck. in Oregon	1	25,097	5,150	4/15	Wallowa			AD	4.9		
Wildcat Ck. in Oregon	1	25,091	5,122	4/19	Wallowa			AD	4.9		
Total		**1,048,817**	**208,277**					**Mean =**	**5.0**	**0.7**	**2.9**
1994											
Asotin Creek	0.5	17,500	5,000	4/25	L.Ferry			AD	3.5		
Asotin Creek	0.5	12,960	3,600	4/26	L.Ferry			AD	3.6		
Grande Ronde River	29	273,000	56,875	4/08-27	Wallowa			AD	4.8		
Mill Creek	2.7	21,450	5,500	4/20	L.Ferry			AD	3.9		
Snake R. @ LFH	58	31,650	9,000	4/26	L.Ferry			AD	3.5		
Snake R. @ LFH	58	28,500	7,500	4/27	L.Ferry			AD	3.8		
Snake R. @ LFH	58	6,189	1,587	4/28	L.Ferry			AD	3.9		
Snake River	83	52,700	13,000	4/28	L.Ferry			AD	4.1		
Touchet @ Dayton	53	119,624	31,480	4/15-29	L.Ferry			AD	3.8		
Tucannon from Curl	41	16,661	3,875	4/11-5/16	L.Ferry	63/54/09	RA-7U-3	ADLV	4.3	1.3	8.4
Tucannon from Curl	41	16,665	3,876	4/11-5/16	L.Ferry	63/54/08	LA-7U-1	ADLV	4.3	2.0	4.4
Tucannon from Curl	41	16,682	3,880	4/11-5/16	L.Ferry	63/54/07	RA-7U-1	ADLV	4.3	1.2	6.7
Tucannon from Curl	41	85,351	19,849	4/11-5/16	L.Ferry			AD	4.3		
Curl Lake		9,937	2,686	retained	L.Ferry			ADLV	3.7		
Curl Lake		13,961	3,773	retained	L.Ferry			AD	3.7		
Tucann. from Hatch.	36	10,179	1,885	5/13-20	Tucann	63/48/57		LV	5.4	7.3	
Walla Walla River	25	20,165	5,450	4/18	L.Ferry	63/53/12	RA-IT-1	ADLV	3.7	0.5	2.9
Walla Walla River	24	20,002	5,406	4/19	L.Ferry	63/53/13	LA-IT-1	ADLV	3.7	1.4	2.9
Walla Walla River	30	17,965	4,242	4/18	L.Ferry			AD	4.2		
Walla Walla River	34	16,280	4,400	4/19	L.Ferry			AD	3.7		
Walla Walla River	27	22,000	5,500	4/20	L.Ferry			AD	4.0		
Walla Walla River	24	22,500	5,000	4/21	L.Ferry			AD	4.5		
Walla Walla River	35	20,900	5,500	4/21	L.Ferry			AD	3.8		
Walla Walla River	23	20,093	5,152	4/21	L.Ferry	63/53/14	RA-IT-3	ADLV	3.9	1.7	5.6
Wildcat Ck. in Or.	1.0	24,600	6,000	4/26	Wallowa			AD	4.1		
Wildcat Ck. in Or.	1.0	24,908	6,075	4/27	Wallowa			AD	4.1		
Total		**942,422**	**226,091**					**Mean=**	**4.0**	**2.2**	**5.2**
1995											
Asotin Creek	0.5	22,000	5,000	4/26	L.Ferry			AD	4.4		
Asotin Creek	0.5	13,800	3,000	5/01	L.Ferry			AD	4.6		
Grande Ronde River	29.0	206,182	41,236	4/05-28	Wallowa			AD	5.0		
Mill Creek	2.7	15,200	4,000	4/19	L.Ferry			AD	3.8		
Snake R. @ LFH	58.0	20,094	5,152	4/20	L.Ferry	63/57/28	LA-H-1	ADLV	3.9	1.08	NA
Snake R. @ LFH	58.0	20,076	6,084	4/20	L.Ferry	63/57/28	LA-H-1	ADLV	3.3	1.08	NA
Snake R. @ LFH	58.0	9,702	2,488	4/20	L.Ferry			AD	3.9		
Snake R. @ LFH	58.0	3,329	876	4/24	L.Ferry			AD	3.8		
Snake R. @ LFH	58.0	6,793	1,544	4/26	L.Ferry			AD	4.4		
Snake R. @ LFH	58.0	6,978	1,586	5/02	L.Ferry			AD	4.4		
Touchet @ Dayton	53.0	20,133	5,369	4/05-30	L.Ferry	63/57/14	LA-IC-1	ADLV	3.75	0.13	1.50
Touchet @ Dayton	53.0	20,221	5,392	4/05-30	L.Ferry	63/57/15	RA-IC-1	ADLV	3.75	0.37	0.37

Appendix A (cont.)

Smolt Releases From Lyons Ferry/Tucannon Hatcheries, 1991-1995.

Location	R.M.	Number released	Pounds released	Date m/dd	Stock	Tag Code	Brand	Fin Clips	Size #/lb	Tag loss %	Brand loss %
(1995 continued)											
Touchet @ Dayton	53.0	20,041	5,344	4/05-30	L.Ferry	63/57/16	LA-IC-3	ADLV	3.75	0.37	1.00
Touchet @ Dayton	53.0	60,315	16,084	4/05-30	L.Ferry			AD	3.75		
Tucannon from Curl	41.0	17,150	3,236	4/11-5/18	L.Ferry	63/57/48	RA-IJ-3	ADLV	5.3	3.53	1.21
Tucannon from Curl	41.0	18,288	3,451	4/11-5/18	L.Ferry	63/57/18	LA-IJ-1	ADLV	5.3	0.97	1.46
Tucannon from Curl	41.0	18,124	3,420	4/11-5/18	L.Ferry	63/57/17	RA-IJ-1	ADLV	5.3	0.74	0.87
Tucannon from Curl	41.0	92,508	17,454	4/11-5/18	L.Ferry			AD	5.3		
Curl Lake		7,298	1,225	retained	L.Ferry			AD	6.0		
Curl Lake		6,914	1,160	retained	L.Ferry			ADLV	6.0		
Walla Walla River	35.0	25,233	6,820	4/18	L.Ferry	63/54/42	RA-H-2	ADLV	3.7	0.74	1.73
Walla Walla River	30.2	25,067	6,775	4/18	L.Ferry	63/54/43	RA-H-1	ADLV	3.7	0.63	1.39
Walla Walla River	30.2	9,300	2,405	4/18	L.Ferry			AD	3.9		
Walla Walla River	36.1	15,600	4,000	4/19	L.Ferry			AD	3.9		
Walla Walla River	35.0	14,400	4,000	4/19	L.Ferry			AD	3.6		
Walla Walla River	30.2	16,400	4,000	4/20	L.Ferry			AD	4.1		
Walla Walla River	34.0	12,000	3,000	4/20	L.Ferry			AD	4.0		
Walla Walla River	34.0	15,990	4,100	4/21	L.Ferry			AD	3.9		
Walla Walla River	35.0	13,500	3,000	5/02	L.Ferry			AD	4.5		
Walla Walla River	36.1	11,385	2,475	5/02	L.Ferry			AD	4.6		
Wildcat Ck. in Or	1.0	50,051	10,010	4/24	Wallowa			AD	5.0		
Total		**814,072**	**183,686**					**Mean=**	**4.3**	**0.96**	**1.19**
1996											
Asotin Creek	0.5	38,500	7,945	4/19	L.Ferry			AD	4.8		
Grande Ronde River	28.7	249,530	49,906	4/30	Wallowa			AD	5.0		
Mill Creek	2.7	17,550	3,900	4/17	L.Ferry			AD	4.5		
Mill Creek	2.7	2,448	480	4/18	L.Ferry			AD	5.1		
Mud Creek	0.05	13,919	2,717	4/19	Wallowa			AD	5.1		
Snake R. @ LFH	58	5,000	980	4/18	L.Ferry			AD	5.1		
Snake R. @ LFH	58	20,153	3,802	4/19	L.Ferry	63/60/36	LA-IT-1	ADLV	5.3	3.2	1.5
Snake R. @ LFH	58	6,500	1,300	4/19	L.Ferry			AD	5.0		
Snake R. @ LFH	58	20,122	3,946	4/19	L.Ferry	63/60/35	LA-IT-3	ADLV	5.1	3.1	5.2
Snake R. @ LFH	58	20,167	3,805	4/19	L. Ferry	63/60/34	RA-IT-1	ADLV	5.3	1.7	1.1
Touchet @ Dayton	54	40,065	9,307	4/30	L. Ferry	63/60/31	LA-IV-3	ADLV	4.3	1.7	4.5
Touchet @ Dayton	54	40,017	8,893	4/30	L. Ferry	63/60/30	LA-IV-1	ADLV	4.5	1.8	3.5
Touchet @ Dayton	54	54,528	12,393	4/30	L. Ferry			AD	4.4		
Tucannon from Curl	40	111,371	22,729	5/29	L. Ferry			AD	4.9		
Tucan.@ Marengo	25.8	30,464	6,093	4/15	L. Ferry	63/60/33	RA-IV-1	ADLV	5.0	4.3	2.8
Tucannon from Curl	40	27,871	5,688	5/29	L. Ferry	63/60/32	RA-IV-3	ADLV	4.9	4.4	2.4
Walla Walla River	35	55,165	11,950	4/17	L. Ferry			AD	4.6		
Walla Walla River	30.2	30,775	6,950	4/16	L. Ferry			AD	4.4		
Walla Walla River	35	29,190	6,950	4/16	L. Ferry			AD	4.2		
Walla Walla River	30.2	1,805	354	4/18	L. Ferry			AD	5.1		
Walla Walla River	35	32,065	6,950	4/18	L. Ferry			AD	4.6		
Walla Walla River	30.2	21,000	5,000	4/17	L. Ferry			AD	4.2		
Total		**868,205**	**182,038**					**Mean =**	**4.8**		

Appendix B. Steelhead trapped at Tucannon Hatchery trap, spring 1996[a].

Date	Wild/Hatchery	Sex	Length(cm)	Water Temp.
05/11/96	W	M	51	49/40
05/12/96	H	M	61	48/43
05/16/96	H	M	64	50/44
05/17/96	H	F	61	49/44
05/19/96	H	M	64	49/42
05/21/96	H	M	56	48/40
05/27/96	W	F	56	55/41
05/27/96	W	M	58	55/41
05/27/96	W	M	91	55/41
06/05/96	H	F	56	57/45
06/11/96	H	F	64	59/47
06/18/96	H	F	53	56/47
06/19/96	H	F	71	58/45
06/25/96	H	F	61	65/49
06/27/96	H	F	66	60/50
07/01/96	H	M	56	65/50

A: All fish were passed upstream from the trap upon arrival

Appendix C: Brand and tag recoveries from the trap at LFH during the 1995 run year .

Brand	Tag Code	Stock	Release Year	Actual Tag Return
RA-H-1	63/46/49	LFH	1993	34
RA-H-2	63/59/41	LFH		16
RA-IC-1	63/48/15	LFH		18
LA-IC-1	63/48/16	LFH		18
LA-IC-3	63/48/17	LFH		15
LA-H-1	63/59/42	LFH		27
LA-H-2	63/59/44	LFH		18
Total				**146**
RA-IT-1	63/53/12	LFH	1994	174
RA-IT-3	63/53/14	LFH		138
LA-IT-1	63/53/13	LFH		153
RA-7U-1	63/54/07	LFH		12
RA-7U-3	63/54/09	LFH		22
LA-7U-1	63/54/08	LFH		18
Total				**517**
AD clipped only				4,929
ADRV		Oxbow		56
ADLV unknown [A]				46
Hatchery mortalities [B]				136
Killed outright [C]				81
Wild				8
Other tags/marks				
RA-7-1	63/14/55	LFH	1991	1
TOTAL				**5,920**

A - ADLV clipped steelhead with no CWT or visible brands.
B - Steelhead died before being sorted, unknown origin.
C - Killed during the salmon spawning process

Appendix D.

Expansions of top caudel clipped steelhead released from Lyons Ferry Hatchery in October and November of 1995

Section	Month	OCT	NOV	DEC	JAN	FEB	MAR	Total	EXPANDED
165	Sample rat	0.003a	0.077	0.067				Fish	HARVEST
	No. Fish	4	2	2				8.00	59.80
Section	Month	OCT	NOV	DEC	JAN	FEB	MAR	Total	EXPANDED
166	Sample rat	0.179	0.17	0.078				Fish	HARVEST
	No. Fish	2	1	1				4.00	29.90
Section	Month	OCT	NOV	DEC	JAN	FEB	MAR	Total	EXPANDED
167	Sample rat	0.197	0.167	0.267				Fish	HARVEST
	No. Fish	17	10	3				30.00	157.40
Section	Month	OCT	NOV	DEC	JAN	FEB	MAR	Total	EXPANDED
185	Sample rat	0.056	0.078	0.581	0.629	0.111	0.299	Fish	HARVEST
	No. Fish				1			1.00	1.60
Section	Month	OCT	NOV	DEC	JAN	FEB	MAR	Total	EXPANDED
189	Sample rat	0.423	0.487	0.509	0.674		0.214	Fish	HARVEST
	No. Fish	23	17	8	4		4	56.00	129.60
Section	Month	OCT	NOV	DEC	JAN	FEB	MAR	Total	EXPANDED
194	Sample rat	0.064	0.175	0.093	0.063			Fish	HARVEST
	No. Fish	1	6	2	1			10.00	87.30
Section	Month	OCT	NOV	DEC	JAN	FEB	MAR	Total	EXPANDED
228	Sample rat	0.064	0.103					Fish	HARVEST
	No. Fish	4						4.00	62.50
							Total	**113**	**528**

A: Sample rate on this month was to small to calculate a reliable expansion.

Appendix E. Coded-wire tag expansions for LSRCP areas of S.E. Washington

Table 1. Coded wire tag expansions, Snake River, fall 1995 and spring 1996.

				Sample	Rates					
Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR		NUMBER	SPORT
106			0.25	0.095				CWT	TAGS	HARVEST
			1	1				635312	2	15
			1	1				635314	2	15

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR		NUMBER	SPORT
164		0.024						CWT	TAGS	HARVEST
		0						0	0	0

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR		NUMBER	SPORT
165	0.61	0.058	0.057	0.061				CWT	TAGS	HARVEST
	1	1						070325	2	19
			1					104926	1	18
		1						104947	1	17
	1		1	1				635312	3	36
	1							635313	1	2
			1	1				635314	2	34
		1						NT	1	17

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR		NUMBER	SPORT
166	0.119	0.156	0.147	0.07				CWT	TAGS	HARVEST
	1							052158	1	8
		1						052159	1	6
			2					052161	2	14
	1							052937	1	8
	1							070321	1	8
	1							070323	1	8
			1					070325	1	7
		2						070326	2	13
	1							070328	1	8
		1						070330	1	6
		1						076103	1	6
			1					076104	1	7
		1						076106	1	6
		1						101032	1	6
		2						104603	2	13
	3	1	1					104623	5	38
	1							104628	1	8
	1							104702	1	8
		1						104703	1	6
		1						104711	1	6
		1						104712	1	6
		1						104714	1	6
	1							104724	1	8
	1	2						104726	3	21
				1				104924	1	14
	1	3						104926	4	28
		1						105004	1	6
		3						105006	3	19

Table 1. (continued) Coded wire tag expansions, Snake River, fall 1995 and spring 1996.

Section 166	SEPT 0.119	OCT 0.156	NOV 0.147	DEC 0.07	JAN	FEB	MAR	CWT	NUMBER TAGS	SPORT HARVEST
		2						105008	2	13
		1						105009	1	6
		1						105013	1	6
		1						105015	1	6
			1					105020	1	7
		1						231958	1	6
			1					232017	1	7
		1						233001	1	6
			1					233003	1	7
	1	1						634649	2	15
	1	1						634815	2	15
			2					634816	2	14
	1							634817	1	8
		2	1					635312	3	20
		3	4					635313	7	46
		2	6					635314	8	54
		1						635408	1	6
	1							635941 R2	1	8
			1					635944 R2	1	7
	1	4	3					NT	8	54

Section 167	SEPT	OCT 0.169	NOV 0.131	DEC 0.193	JAN	FEB	MAR	CWT	NUMBER TAGS	SPORT HARVEST
			1					052158	1	8
		1						070330	1	6
			1					104622	1	8
		1						104623	1	6
				1				105006	1	5
			1					105008	1	8
			1					233001	1	8
		2	1					634649	3	19
		1	1					634815	1	14
			1					634817	1	8
		1	1					635312	2	14
		1						635313	1	6
		1		1				635314	2	11
			1					635407	1	8
		1						635409	1	6
			1					635941 R1	1	8
		1						635941 R2	1	6
		1	1					635942 R1	2	14
		2						635944 R1	2	12
		2	1					NT	3	19

Table 1. (continued) Coded wire tag expansions, Snake River, fall 1995 and spring 1996.

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	CWT	NUMBER TAGS	SPORT HARVEST
168	0.033	0.046	0.001							
		1						070143	1	22
		1						070326	1	22
	1a							104710	1	1
	1a							104924	1	1
		1						105007	1	22
		1						105011	1	22
		1						634815	1	22
		1						635314	1	22
		1						635941 R2	1	22
	1							NT	1	8

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	CWT	NUMBER TAGS	SPORT HARVEST
185		0.053	0.067	0.443	0.32	0.1	0.198			
			1	2			3	634649	6	35
				3	2		4	635941 R1	10	33
				1	1			635941 R2	2	5
							1	LOST TAG	1	5

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	CWT	NUMBER TAGS	SPORT HARVEST
189		0.361	0.407	0.441	0.642		0.194			
		2	2					634649	4	10
		3	3	1				634815	7	18
		1	2	1	1			634816	5	12
		2	2	2	2			634817	8	18
		2	4	2	1			635312	9	21
		1		1	3			635313	5	10
		1	3	1	1			635314	6	14
		4	1		1			635407	6	15
		4	2				1	635408	7	21
		2	4	1	1		1	635409	9	24
			1					635941 R1	1	2
				1				635944 R2	1	2
		1	2					NT	3	8

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	CWT	NUMBER TAGS	SPORT HARVEST
194	0.023	0.059	0.162	0.09	0.058					
		2	8	3				635312	13	117
		1	11	6				635313	18	152
			11	1	2			635314	13	113
			1					635942 R2	1	6
				1				635944 R1	1	11
			2					NT	2	12

Table 1. (continued) Coded wire tag expansions, Snake River, fall 1995 and spring 1996.

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR		NUMBER	SPORT
228	0.034	0.054	0.08					CWT	TAGS	HARVEST
		1						070325	1	19
			1					070326	1	13
		1						070327	1	19
		1	1					070328	2	31
			1					070329	1	13
			1					076107	1	13
			1					104701	1	13
			1					634815	1	13
			1					635312	1	13
		1						635314	1	19
		2						635408	2	37
		5	3					NT	8	130

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR		NUMBER	SPORT
45	0.102	0.055	0.011					CWT	TAGS	HARVEST
		1						634816	1	18
		1						634817	1	18
	2							635312	2	20
	2	1						635313	3	38
	1							635314	1	10
	1							635941 R1	1	10
		1						635942 R2	1	18

Section	SEPT	OCT	NOV	DEC	JAN	FEB	MAR		NUMBER	SPORT
75	0.25	0.012						CWT	TAGS	HARVEST
	0	0						0	0	0

a : No expansion; sample rate too small.

Appendix E

Table 2. Observed and expanded numbers of ADLV + CWT marked steelhead recovered on the Grande Ronde River in Washington during the 1995-96 steelhead season.

Tag Code	Release site	Brood year	Number observed	Number expanded
07/03/25	Deer Cr.	93	2	5
07/03/27	Deer Cr.	93	2	6
07/03/28	Deer Cr.	93	1	11
07/03/30	Spring Cr.	93	1	4
23/19/58	Snake R. barged [A]	93	1	4
63/48/16	Curl L.	92	1	4
63/48/17	Marengo [B]	92	1	4
63/54/08	Curl L.	93	1	4

A Marked by National Marine Fisheries Service at Lower Granite Dam, then barged downstream and released in the Columbia River below Bonneville Dam, 10 May 1994.

B Released into the Tucannon River at Marengo (RM 24.7) on 11 April 1994.

Appendix F. Spawning Ground Surveys spring 1996.

River	Location	Miles	Redds/ Mile	Total Redds
Asotin Creek				
North Fork	From mouth upstream	6.0	8.9	53
South Fork	From the mouth upstream	7.0	9.3	65
Main	From the confluence bridge downstream to Charlie Creek	1.3	No estimate [A]	
Charlie Creek	From mouth upstream	7.7	No Estimate [A]	
Touchet River				
South Fork	From mouth upstream	15.7	10.1	159
North Fork	From confluence upstream	11.1	No Estimate [A]	
Wolf Fork	From mouth upstream	10.3	5.1	52
Robinson Fork of Wolf Fork	From mouth upstream	5.5	No Estimate [A]	
Tucannon River				
Cummings Ck	From mouth upstream	7.0	10.6	74
Upper	From Sheep Creek to Panjab bridge	4.7	6.1	29
Middle	From Panjab bridge downstream to hatchery	9.8	7.7	76
Lower	From hatchery downstream to Highway 12	17.5	5.0	87
Panjab Creek	From mouth upstream	3.4	No Estimate	

A: Estimate was prevented due to extremely high water conditions.

Appendix G. Juvenile density sample sites on Southeast Washington streams, 1996.

Site name	Site type	Site length (ft)	Road mile	Description and reference point
Main Asotin Ck.				
MA1-93	Control	108		Behind Thiesens Ranch 1/4 mi. above Headgate Park, along SCS shrub plot, 12 boulders in site.
MA2-93	Control	100		3/4 mi. below mouth of Charlie Ck. river is next to the road, 10 boulders in upper end of site.
North Fork Asotin Ck.				
NA-C4	Control	95	1.25	By small clearing past rusted road closure gate.Ref:0+90RB,alder
NA2c-83	3 Log Weirs	100	1.35	Across a large meadow. Ref: 0-13 LB alder.
NA-C2	Control	87	1.80	Above split in creek 300 ft. above NA4a. Ref:0+04 RB, Doug. fir.
NA4-84	18 Boulders	100	1.90	In first campgrd. above NA4a-83. Ref:0+00 RB, alder.
NA-C1	Control	83	2.60	Across the road from a rock face. Ref:1+16 RB, alder.
NA8-84	12 Boulders	75	3.00	Ref:0-18 LB, alder.
South Fork Asotin Ck.				
SA1-83	2 Log Weirs	119	0.40	300ft. above Campbell Grade Road. Ref:0+00 RB, alder.
SA-C3	Control	100	0.80	0.1 mile above Hodson's cattleguard Ref:1+29 RB, alder.
SA-C2	Control	99	1.95	By 20 ft. high eroding bank. Ref:0+25 RB, boulder.

Appendix G. (con't.)

Site name	Site type	Site length (ft)	Road mile	Description and reference point
SA6B-83	1 Log Weirs 8 Boulders	77	2.35	.15 miles below road closure gate. Ref: 0+00 LB, 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.
<u>Charlie Creek</u>				
CH-1	Index	126		8.9 miles above Cook's gate.
CH-1A	Index	93		Mid way between CH-1 and CH-2.
CH-2	Index	98		5.7 miles above Cook's gate.
CH-3	Index	107		3.9 miles above Cook's gate.
CH-4	Index	98		0.6 miles above Cook's gate
<u>Tucannon River</u>				
TN1-93	Control	98		1/4 mi. above Marengo Bridge.
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.
TNC5-84	Control	100	8.40	Day use area just above large B.P..Ref: 0+30LB, douglas fir
TNS1-96	Control	174		150 m upstream of Camp 8 outhouse.

Appendix G. (con't.)

Site name	Site type	Site length (ft)	Road mile	Description and reference point
TNS2-96	Control	98.4		100 m upstream of Camp 8 outhouse.
TN31-84	13 Boulders 1 Log Weir	153	11.10	Just below Panjab bridge. Ref: 0-62LB, bridge piling.
Cummings Ck.				
CC0.5-96	Control	99	0.5	0.5 Mile above gate, at site of old steelhead trap
CC1-93	Control	99	1.0	2.3Lower end of site is 10.6 meters above bridge.
CC1.5-96	Control	99	3.6	3.6 miles above the gate. First big canyon below Forest service fence at outfitters camp
CC.-93	1 Log Weir	85	4.1	Steep bank goes down from road to a flat, fairly open area along Ck., log weir at lower end of site.
North Fork Touchet R.				
NFT3-92	Index	100		1/10 mi. below South Fork Bridge.
NFT2-92	Index	100		1.7 mi. above Wolf fork Bridge.
NFT1-92	Index	45		7.1 mi. above Wolf Fork Bridge, at Touchet R. Road bridge crossing, ½2 mi. above pond.

Appendix G. (con't.)

Site name	Site type	Site length (ft)	Road mile	Description and reference point
South Fork Touchet R.				
SFT1-92	Index	102		6 mi. above Camp Nancy Lee Bridge, just below forks confluence
SFT1-96	Index	102		3.15 miles above Camp Nancy Lee Bridge, at cabins, before crossing.
SFT2-92	Index	96		2/10 mi. below Camp Nancy Lee Bridge.
SFT3-92	Index	100		Above Petty John Bridge.
Wolf Fork Touchet R.				
WFT1-92	Index	98		Blue Gate.
WFT2-92	Index	96		1/10 mi. below 1st bridge crossing, past Robinson's Fork.
WFTU-92	Index	65		1.3 mi. above Wolf Fork Bridge.

Appendix H. Juvenile steelhead densities for SE Washington rivers that are part of the LSRCP program.

	Juvenile steelhead per 100 square meters													
Years Sampled	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Tucannon River														
0 aged steelhead		16.0		18.4	20.6		18.1	19.1	13.0	17.4	14.6		11.0	15.8
>0 aged steelhead		2.5		13.7	8.5		10.6	9.8	6.5	4.8	7.0		4.0	3.2
Cummings Ck.														
0 aged steelhead											43.2	42.9	32.4	47.8
>0 aged steelhead											26.3	20.4	29.6	16.6
North Fork Asotin Ck.														
0 aged steelhead	23.7	6.6		29.7			22.8		22.1	56.9	36.8	20.4	23.4	13.0
>0 aged steelhead	8.7	7.5		37.6			18.0		14.2	22.2	28.1	34.9	11.2	17.4
South Fork Asotin Ck.														
0 aged steelhead	44.3	39.0					6.0		1.8	50.0	78.7	0.8	34.6	2.0
>0 aged steelhead	25.3	30.6					34.0		13.9	10.4	42.5	16.4	11.4	11.2
Main Asotin Ck.														
0 aged steelhead											49.1	36.8	47.7	62.8
>0 aged steelhead											22.1	39.6	13.1	12.2

Appendix H. (cont.)

	Juvenile steelhead per 100 square meters													
Years Sampled	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Charlie Ck.														
0 aged steelhead			73.0									19.0		64.4
>0 aged steelhead			37.6									20.0		15.3
North Fork Touchet R.														
0 aged steelhead										35.5	26.0	20.8	42.5	4.9
>0 aged steelhead										19.0	19.3	18.9	8.9	3.6
South Fork Touchet R.														
0 aged steelhead										42..8	8.7	16.2	31.1	1.9
>0 aged steelhead										15.5	15.0	5.8	9.5	10.2
Wolf Fork Touchet R.														
0 aged steelhead										41.1	21.8	20.2	25.0	2.3
>0 aged steelhead										8.7	10.5	11.5	6.4	5.3

Appendix I. Juvenile density snorkel sites on Southeast Washington streams, 1996.

Site name	Site type	Site length	Road [A] miles	Description and reference point.
Tucannon River				
TN1-93	Control	30 m	24.8	1/4 mi. above Marengo, open pasture joins brush, river bends, pool at top of site; Ref.: signs.
R4	Residual steelhead	30 m	27.8	Downstream from the 2nd bridge below the Wooten Wildlife area boundary. From the bridge Downstream 30 m; Ref.: signs.
R5	Residual steelhead	30 m	30.4	Forty nine meters upstream of bridge 11; Ref. signs.
TN-C1	Control	30 m	34.6	Near lower outhouse at camp 2. Ref. signs
TN3-84	12 Boulders	30 m	34.9	Day use above camp 3. Ref. signs.
TNC2-84	Control	30 m	36.3	5m below TN8-84 Ref. signs
TN8-84	14 Boulders	30 m	36.3	Below camp 6 foot bridge Ref. signs
TN9,10-84	31 Boulders 1 rock weir	30 m	36.5	Above camp 6 footbridge, Ref. signs.
TN13-84	10 Boulders	30 m	37.7	Upper end of camp 7 Ref. signs.
TNS1-96	Control	53 m	?	100-150 yards upstream of camp 8

Appendix I. (Cont.)

Site name	Site type	Site length	Road [A] miles	Description and reference point.
TNS2-96	Control	30 m	?	100-150 yards upstream of camp 8
TNC5-84	Control	30 m	42.9	Day use area just above large B.P..Ref: 0+30 LB, douglas fir Ref. signs.
TN31-84	13 Boulders 1 Log Weir	30 m	45.6	Just below Panjab bridge. Ref: 0-62 LB, bridge piling; Ref. signs.

A: Road miles upstream from the mouth.

Appendix J. Trout plants from Lyons Ferry and Tucannon Hatcheries, 1996.

COUNTY	LOCATION	No. of Plants	Pounds of Fish	No. Fish Planted
ADAMS	Cow Lake	1	2,045	7,567
	Sprague Lake	2	2,201	7,924
	TOTAL Rainbows		4,246	15,491
ASOTIN	Alpowa Creek	1	80	288
	Asotin Creek	1	650	1,950
	Golf Course Pond	2	4,440	12,464
	Headgate Pond	1	440	1,584
	Silcott Pond	1	1,600	4,000
	West Evans Pond	3	2,313	6,280
	TOTAL Rainbows		9,523	30,664
COLUMBIA	Blue Lake	2	780	2,886
	Dam Pond	1	800	2,000
	Dayton Jv. Pond	3	715	2,197
	Orchard Pond	1	400	1,000
	Rainbow Lake	7	8,625	26,541
	Spring Lake	5	2,005	6,924
	Touchet R.(GB)	1	3,689	10,505
	Tucannon R.	1	1,350	4,050
	TOTAL Rainbows		14,675	45,598
	Browns		3,689	10,505
FRANKLIN	Dalton Lake	2	6,000	15,000
	Marmes Pond	1	223	602
	TOTAL Rainbows		6,223	15,602
GARFIELD	Baker's Pond	1	305	946
	Casey Pond	1	140	504
	Deadman Creek	1	140	504
	Pataha Creek	1	520	1,872
	TOTAL Rainbows		1,105	3,826
SPOKANE	Badger Lake	1	3,890	10,503
	Williams Lake	1	6,400	17,280
			10,290	27,783

Appendix K. (cont)

COUNTY	LOCATION	No. of Plants	Pounds of Fish	No. Fish Planted
WALLA WALLA	Bennington Lake	3	5,606	20,160
	Coppei Creek	1	265	1,007
	Dry Creek	1	265	1,007
	Fishhook Pk. Pond	2	1,740	6,264
	Jefferson Pk. Pond	2	1,190	4,420
	Mill Creek	2	2,117	6,630
	Quarry Pond	2	8,000	20,000
	TOTAL Rainbows		19,183	59,488
WHITMAN	Garfield Pond	1	572	2,072
	Gilcrest Pond	1	572	2,072
	Pampa Pond	1	1,924	5,002
	Riparia Pond (RB)	1	400	1,000
	Riparia Pond (GB)	1	589	2,032
	Rock Lake	2	2,855	10,361
	Union Flat Creek	1	520	1,976
	TOTAL Rainbows		6,843	22,483
	Browns		419	2,030
	TOTAL RAINBOWS		**72,088**	**216,837**
	TOTAL BROWNS		**4,278**	**12,537**
	TOTAL FISH PLANTED		**76,366**	**229,374**