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Tucannon River Spring Chinook Hatchery Evaluation

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TUCANNON RIVER SPRING CHINOOK SALMON HATCHERY EVALUATION PROGRAM

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ABSTRACT

This report summarizes activities of the Washington Department of Fish and Wildlife Lower Snake River Hatchery Evaluation Program on Tucannon River spring chinook from April 1997 to April 1998.

In 1997, 259 salmon were trapped at the Tucannon Fish Hatchery (TFH); 97 were collected for the hatchery broodstock and 162 were passed upstream of the trap. Eight salmon collected for broodstock died before spawning. Seventeen natural and 26 hatchery females were spawned for a total eggtake of 144,237. Percent mortality from egg to unfed fry was 79.4%. Fecundity for natural and hatchery females was 3,609 and 3,315 eggs/female, respectively.

Thirty-nine salmon passed upstream of the TFH adult trap were recovered as prespawning mortalities. Five radio tagged salmon that entered the Tucannon River were tracked throughout the summer. In addition, we tagged and tracked another eight salmon from the TFH trap. Of the 13 radio tagged salmon, three were confirmed spawners while four were prespawning mortalities.

Seventy-three salmon redds were counted in the Tucannon River. Based on adult trapping, redd counts and mortalities, river escapement was estimated to be 351 salmon.

An exercise experiment was conducted in 1997/1998. The goal was to condition the fish to fast river currents following release. Fish were released from TFH, Curl Lake and directly into the river from a transport truck. A portion of each release group was Passive Integrated Transponder (PIT) tagged for juvenile migrant and exercise experiment evaluation. Experimental results not available for reporting period.

Subyearling chinook parr production was estimated between 2,845 and 6,046 fish based on two estimation methods. We also operated a downstream migrant trap to estimate natural smolt migration. Approximately 90 naturally produced spring chinook (1995 brood year) migrated out of the Tucannon River during the spring of 1997.

We continued our study to determine if small remote acclimation ponds located in the upper Tucannon River watershed produced higher relative survival than direct stream releases of smolts in the same areas. Based on results to date, we believe upstream releases should continue. In addition, direct stream releases, showing no obvious disadvantage in downstream survival, should also be used to further distribute release points where acclimation ponds are not feasible.

Monitoring survival rate differences between natural and hatchery reared salmon continues. Smolt-to-adult survival rates (SAR) for natural salmon are about four times higher than hatchery salmon. However, hatchery salmon survive about four times greater than natural salmon from parent to adult progeny. Natural fish are currently below the replacement level. Due to the low SAR's, the mitigation goal of 1,152 salmon of Tucannon River stock has not been achieved.

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SECTION 1: INTRODUCTION

Congress authorized implementation of the Lower Snake River Fish and Wildlife Compensation Plan (LSRCP) in 1976. As a result, Lyons Ferry Hatchery (LFH) was constructed and Tucannon Fish Hatchery (TFH) was modified. One objective of these hatcheries was to compensate for the loss of 1,152 Tucannon River spring chinook salmon caused by hydroelectric projects on the Snake River. In 1984, Washington Department of Fish and Wildlife (WDFW) began evaluation of these two hatcheries in meeting the mitigation goal and identifying factors that would improve performance of the hatchery fish. This report summarizes work performed by the WDFW LSRCP Spring Chinook Evaluation Program from April 1997 through April 1998.

1.1 Facility Descriptions

LFH is located at the confluence of the Palouse and Snake rivers at river kilometer (rkm) 90. LFH is used for adult broodstock holding and spawning, and early life incubation and rearing. All juvenile fish are marked (adipose fin clipped and coded wire-tagged (CWT)) and returned to TFH for acclimation. TFH, located at rkm 59 on the Tucannon River, has an adult collection trap on site. Juveniles rear at TFH through winter. In spring, a portion of the fish are released on site and the remainder are transported upstream for release. The 1996 brood year production goal was 132,000 fish for release as yearlings at 30 g/fish or 15 fish per pound (fpp).

1.2 Tucannon River Watershed Characteristics

The Tucannon River, a third-order stream, flows through varied habitats which affect distribution of salmonids. Stream elevation rises from 150 m at the mouth to 1,640 m at the headwaters. Total area watershed is about 1,120 km^2. Five unique strata were distinguished by predominant land use, river habitat, and landmarks (Table 1). Habitat ratings were based on summer rearing conditions.

Eight continuous reading thermographs were installed throughout the river to record daily minimum and maximum water temperatures in the Tucannon River from May through September. In addition, river discharges were periodically measured at Tucannon Hatchery (rkm 59), Smith Hollow Bridge (rkm 12.7), and the downstream migrant trap (rkm 3).

Table 1. Description of five strata within the Tucannon River.

Strata	Land Ownership Usage	Spring Chinook Habitat	Rkm Description
Lower	Private Agriculture/Ranching	Not-Usable (temperature limited)	(0.0-21.0) Mouth to HWY 12 Br.
Marengo	Private Agriculture/Ranching	Marginal (temperature limited)	(20.1-39.9) HWY12 Br. To Marengo Br.
Hartsock	Private Agriculture/Ranching	Fair to Good	(39.9-55.5) Marengo Br. To Cummings Br.
HMA (Habitat Mgt Area)	State/Forest Service Recreational	Good/Excellent	(55.5-74.5) Cummings Br. To Panjab Cr.
Wilderness	Forest Service Recreational	Excellent	74.5-86.3) Panjab Cr. To Ruckerts Camp

SECTION 2: ADULT SALMON EVALUATION

2.1 Broodstock Trapping, Mortality, and Spawning

Broodstock trapping-The annual collection goal for broodstock is 50 natural and 50 hatchery adults collected throughout the run. Jacks may also be collected. Returning hatchery salmon are identified by absence of the adipose fin. The TFH adult trap was operated daily from 6 May to 12 September, 1997. In 1997, 259 salmon (99 natural and 160 hatchery origin) were trapped (Table 2, Appendix A). The hatchery retained 97 (43 natural and 54 hatchery) for broodstock, and the remainder were passed upstream of the trap to spawn. Adults collected for broodstock were injected with erythromycin and oxytetracycline (0.5 ml / 4.5 kg) when trapped; jacks were given half dosage. While the fish were held they received formalin drip treatments to control fungus at 1:7,000 every other day.

Broodstock mortality-Eight salmon (8.25%) collected for broodstock died from unknown causes before spawning in 1997 (Table 3). Percent prespawning mortality in 1997 was comparable to the mortality experienced since broodstock holding began at LFH in 1992.

Broodstock spawning-Spawning at LFH occurred weekly from 19 August to 23 September, with peak eggtake on 16 September. A total of 144,237 eggs were collected (Table 4). Percent mortality to eye-up was 76.3%, which left 34,164 eggs in the incubators. An additional loss of 4,514 sac-fry occurred before fish were transferred to the rearing ponds, which left 29,650 1997 brood year (BY) fish for production. Mortality from egg to fry ponding was 79.4%. The extreme egg loss in 1997 was caused by water temperature shock to the eggs when

transferred from initial water hardening at 11.7 °C immediately into chilled water in the incubator stacks at 2.8 °C. Chilled water in previous years was about 6.5 °C without extreme egg loss. Procedures for egg incubation in the future have been modified. Fertilized eggs were disinfected with iodophor during water hardening, and fungus on the incubating eggs was controlled with formalin applied every other day at 1:700 mg/L.

Seventeen natural and 26 hatchery females were spawned in 1997 (Table 4). Overall fecundity (age 4 and age 5) for natural and hatchery females was 3,609 and 3,315 eggs/female, respectively. Mean fecundities in 1997 were similar to the average number of eggs/female from 1990-1996 (Table 5).

During spawning, evaluation staff collected and cryogenically preserved semen from 10 natural origin salmon (Table 6). The majority of semen collected will be saved for potential future use if run sizes get critically low. Evaluation of frozen semen will be conducted prior to using it in regular production lots to ensure maximum survival.

Table 2. Numbers of spring chinook salmon arrivals, fish passed upstream, and collected for broodstock at the TFH trap in 1997.

	Arrived		Passed Upstream		Collected	
Week of	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery
5/18-5/24	1	1			1	1
5/25-5/31	1	1	1	1		
6/01-6/07	10	3	9	3	1	
6/08-6/14	10	21	5	13	5	8
6/15-6/21	39	65	27	37	12	28
6/22-6/28	13	30	4	22	9	8
6/29-7/05	3	15	1	15	2	
7/06-7/12	1	4		3	1	1
7/13-7/19		1		1		
7/20-7/26	5	4		3	5	1
7/27-8/02		2		2		
8/03-8/09						
8/10-8/16		1				1
8/17-8/23	1	1		1	1	
8/22-8/30	1	2			1	2
8/31-9/06	5	2	3	2	2	
9/07-9/13	13	3	6	3	7	
Totals[a]	**103**	**156**	**56**	**106**	**47**	**50**

a Numbers listed were recorded during trapping and collection. Three right ventral clipped fish and one bad adipose clip were found in broodstock. These fish were called "natural" when trapped. Adjusted trap numbers would be 99 natural, 160 hatchery, with 43 natural and 54 hatchery collected for broodstock.

Table 3. Numbers of prespawning mortalities and percent of the number collected for broodstock at TFH and held either at TFH (1985-1991) or LFH (1992-1997).

Year	Natural male	Natural female	Natural jack	Percent of Collected	Hatchery male	Hatchery female	Hatchery jack	Percent of Collected
1985	3	10	0	59.1	-	-	-	-
1986	15	10	0	21.6	-	-	-	-
1987	10	8	0	17.8	-	-	-	-
1988	7	22	0	25.0	-	-	9	100.0
1989	8	3	1	17.9	5	8	22	34.3
1990	12	6	0	30.0	14	22	3	52.0
1991	0	0	1	2.4	8	17	32	64.0
1992	0	4	0	8.5	2	0	0	4.0
1993	1	2	0	6.0	2	1	0	6.4
1994	1	0	0	2.8	0	0	0	0.0
1995	1	0	0	10.0	0	0	3	9.1
1996	0	2	0	5.7	2	1	0	6.7
1997	0	4	0	9.3	2	2	0	7.4

Table 4. Number of fish spawned and estimated egg collection, egg and sac-fry mortality, and the number of fry ponded of Tucannon spring chinook salmon at LFH in 1997.

Week Ending	Natural salmon spawned male	Natural salmon spawned female	Natural salmon mortality [a] male	Natural salmon mortality [a] female	Estimated Eggs taken	Hatchery salmon spawned male	Hatchery salmon spawned female	Hatchery salmon mortality [a] male	Hatchery salmon mortality [a] female	Estimated Eggs taken
30 Aug				1			1[b]			0
06 Sep	1	3			10,719	1	1			5,118
13 Sep	2	7			24,691	4	5			17,243
20 Sep	6	5		1	18,299	16	14	1		46,278
27 Sep	12	2			7,644	4	5			14,245
Totals [c]	**21**	**17**		**2**	**61,353**	**25**	**26**	**1**		**82,884**
Eye-up Mortality					41,165					68,907
Sac-fry Mortality					1,753					2,761
Total fry Ponded					18,435					11,216

a Mortalities shown include only those fish that died once spawning had begun. Other pre-spawning mortalities for the year were reported in Table 2.

b Spawned female was a stray from the Powell rearing ponds, Lochsa River, Idaho - eggs were destroyed.

c Most males were live-spawned and tallied as spawned on the day they were killed.

Table 5. Average number of eggs/female (by age and combined) of Tucannon River natural and hatchery origin broodstock, 1990-1997. Combined fecundities differ slightly from Tables 22 and 23, because some females were not sampled.

	Age 4		Age 5		Combined	
Year	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery
1990	3,691	2,794	4,384	- - - -	3,953	2,794
1991	2,803	2,463	4,252	3,052	3,799	2,521
1992	3,691	3,126	4,735	3,456	3,806	3,139
1993 [a]	3,180	3,456	4,470	4,129	3,701	3,237
1994	3,688	3,280	4,906	3,352	4,187	3,314
1995	- - - -	3,584	5,284	3,889	5,284	3,604
1996	3,509	2,843	3,617	- - - -	3,515	2,843
Average	**3,427**	**3,078**	**4,521**	**3,575**	**4,035**	**3,065**
SD	365	399	530	431	589	367
1997	3,487	3,290	4,326	- - - -	3,627	3,290

a Most of the egg count data were lost. Data from 11 of the 50 females spawned was retained. Combined fecundity estimates for 1993 were derived from the total numbers by origin divided by the number of spawned females.

Table 6. Natural-origin semen cryogenic samples collected, September 1997.

Day Frozen	Male ID#	Fork Length	Brood Year	Genetic Number	Straws frozen Regular	Straws frozen Test	Sperm Motility(%)
02	195/196	76	93	BP-55	10	3	80
16	165/166	64	93	BP-72	10	3	80
16	163/164	69	93	BP-73	10	3	80
16	159/160	70	93	BP-70	10	3	80
16	177/178	85.5	93	BP-71	10	3	80
16	161/162	74.5	93	BP-74	10	3	80
16/23	118/119	69	93	BP-88	20	6	90/80
23	110/111	77	93	BP-84	10	3	90
23	114/115	75	93	BP-90	10	3	80
23	120/121	79	93	BP-86	10	3	80

2.2 Pre-spawning Mortality, Radio Tracking, and Natural Spawning

Pre-spawning mortality-In 1997, 162 salmon were passed upstream of the TFH adult collection trap. Of these, 39 (9 natural and 30 hatchery origin) were recovered as pre-spawning mortalities above the trap. Minimum estimated pre-spawning loss in 1997 for fish passed above the trap was 24.1%, the highest percentage documented to date (Table 7).

Table 7. Number and percent of pre-spawning mortalities recovered above the weir from fish passed upstream; total recovered in the river and percent of estimated run; number and percent of female mortalities, and estimated lost egg production from pre-spawning loss, 1990-1997.

	Recovered above weir		Total Recovered		Females recovered				Lost egg
Year	Number	%	Number	%	Natural	Hatchery	Total	%	production
1990	9	**2.8**	9	**1.2**	0	7	7	**77.8**	18,858
1991	7	**4.0**	8	**1.5**	0	7	7	**87.5**	17,619
1992	72	**15.7**	81	**10.8**	13	41	54	**66.7**	185,197
1993	54	**15.4**	56	**9.6**	7	30	37	**66.1**	123,017
1994[a]									
1995[a]									
1996	10	**20.0**	11	**4.5**	5	2	7	**63.6**	23,266
1997	39	**24.1**	45	**12.9**	5	24	29	**64.4**	97,605

a All fish were collected at trap, no pre-spawn mortalities were recovered in the river.

Radio Tracking-Eight salmon were radio-tagged at the adult trap. In addition five more were tracked that were part of University of Idaho radio telemetry study (Table 8). These fish were trapped and tagged at Bonneville Dam. Migration speed, timing and movements upstream were documented every 2-3 days (Appendix B).

Based on the limited recoveries of carcasses, it was not possible to determine if natural and hatchery radio tagged fish were spatially segregated in the river. Past carcass recoveries from spawning ground surveys suggest the majority of hatchery fish return to the TFH area and range up to 10 km upstream.

Of the 13 radio tagged salmon, only three were confirmed spawners. Origin of potential mates for the three fish that spawned was not determined. Another six may have spawned, but only their radio tags were found upon recovery. Four fish were confirmed pre-spawn mortalities.

Table 8. Radio tagging and recovery data of spring chinook salmon recovered in the Tucannon River in 1997 from either the University of Idaho (tagged at Bonneville Dam) or WDFW (tagged at the TFH Adult trap).

Channel/ Code	Tagging Information Date	Origin	Sex	F.L. (cm)	VI tag [a]	Recovery Data Date	Sex	F.L. (cm)	Spawned
University of Idaho									
15/135 [b]	4/16	hat.	M	70.0	F89	8/29	F	74.0	No
16/121	5/02	hat.	M	70.5	EB5	7/07 [c]	-	-	
17/101 [b]	4/23	hat.	M	74.0	E16	6/30	F	-	No
21/60	4/14	hat.	F	76.0	F48	9/19	F	75.0	Yes
22/81	4/15	wild	F	73.5	F55	9/19	F		Yes
WDFW									
2/16	6/11	wild	M	70.0		8/29 [d]	-	-	
2/27	6/19	wild	M	73.0		7/14	M	69.0	No
2/29	6/13	wild	F	68.0		9/15	F	68.0	Yes
2/58	6/17	wild	F	71.0		7/07	F	71.0	No
2/81	6/11	hat.	M	69.0		7/16 [d]	-	-	-
2/93	6/13	hat.	F	78.0		9/22 [d]	-	-	-
3/17	6/17	hat.	M	75.0		9/22 [d]	-	-	-
3/30	6/19	hat.	F	77.0		8/25 [d]	-	-	-

a WDFW did not insert VI tags. All VI tags recovered, except for fish 16/121.
b Fish was initially identified as male at tagging, but was confirmed to be a female upon carcass recovery.
c Only the non-functioning radio was recovered.
d Only the radio was recovered.

Natural spawning-Spawning ground surveys were conducted on the Tucannon River weekly from 27 August to 29 September to determine the temporal and spatial distribution of adult spawners. Seventy-three redds were counted, and 29 natural and 16 hatchery spawned carcasses were recovered (Table 9). Redd numbers within the historical index section (1954-1997) have declined dramatically in recent years (Appendix C), with much of the decline due to poor runs, collection of broodstock, and possible passage problems at the adult trap. Redd concentrations have shifted to downstream locations, and redd densities (redds/km) have declined (Table 10).

A spawning survey was also conducted in North Fork Asotin Creek on 30 September. No salmon redds, carcasses or live salmon were seen. Redd counts conducted since 1984 indicate that spring chinook salmon in Asotin Creek have been extirpated (Appendix C). Any adult salmon that return in future years will likely be strays from other basins.

Table 9. Numbers and general locations of salmon redds and carcasses recovered on the Tucannon River spawning grounds, 1997.

Stratum	Rkm [a]	Number of redds	Natural male	Natural female	Hatchery male	Hatchery female
Wilderness	84-78	0				
	78-74	2		1		
HMA	74-73	2		1		1
	73-68	4				1
	68-66	4		1		
	66-62	5		1		2
	62-59	5	3	5		2
	59-58	8	2	1		3
----------	TFH Trap	----------				
	58-56	15	3	4	1	3
Hartsock	56-52	8	1	3	1	
	52-47	8			1	
	47-43	8	1	1		1
	43-40	3		1		
Marengo	40-34	1				
Totals	**84-34**	**73**	**10**	**19**	**3**	**13**

a Rk description are as follows: 84-Sheep Creek; 78-Lady Bug Flat Campground; 75- Panjab Bridge; 73-Cow Camp Bridge; 68-Tucannon Campground; 66-Curl Lake; 62- Beaver/Watson Lakes Bridge; 59-Tucannon Hatchery Intake; 58-TFH Trap; 56-HMA Boundary Fence; 52-Bridge 14; 47-Bridge 12; 43-Bridge 10; 40-Marengo Bridge; 34-King Grade Bridge; 0-Tucannon River Mouth.

Table 10. Number of spring chinook salmon redds and redds/km (in parenthesis) by stratum and year in the Tucannon River, 1985-1997.

Year	Wilderness	HMA	Hartsock	Marengo	Total
1985	84 (7.12)	105 (5.33)	----	----	189
1986	53 (4.49)	117 (6.16)	29 (1.86)	0 (0.00)	200
1987	15 (1.27)	140 (7.37)	30 (1.92)	----	185
1988	18 (1.53)	79 (4.16)	20 (1.28)	----	117
1989	29 (2.46)	54 (2.84)	23 (1.47)	----	106
1990	20 (1.69)	94 (4.95)	64 (4.10)	2 (0.34)	180
1991	3 (0.25)	67 (2.95)	18 (1.86)	2 (0.34)	90
1992	17 (1.44)	151(7.95)	31 (1.99)	1 (0.17)	200
1993	34 (3.40)	123 (6.47)	34 (2.18)	1 (0.17)	192
1994	1 (0.10)	10 (0.53)	28 (1.79)	5 (0.86)	44
1995	0 (0.00)	2 (0.11)	3 (0.19)	0 (0.00)	5
1996	1 (0.10)	33 (1.74)	34 (2.18)	0 (0.00)	68
1997	2 (0.21)	43 (2.26)	27 (1.73)	1 (0.17)	73

2.3 Coded-Wire Tag, Age Composition, and Genetic Sampling

Broodstock collection, pre-spawn mortalities and recovered spawning ground carcasses provide representatives of the annual run that can be sampled for CWT groups (Tables 11 and 12), age composition (Table 13) and genetic samples. In 1997, we sampled about 51% of the estimated run for CWTs and age composition. Age composition comparison between natural and hatchery salmon in 1997 (broodstock and river recoveries) were not similar (Table 13). Age comparisons between collected broodstock and in-river recoveries were similar for hatchery fish, but different for natural fish. Fewer age-5 natural origin fish were collected for broodstock. Sex ratios were 1.05:1 and 0.96:1 females/male for natural and hatchery salmon, respectively. Electrophoretic samples (38 natural origin and 49 hatchery origin) and DNA samples (69 natural and 95 hatchery) were collected from the pre-spawn or spawning ground carcasses. Electrophoretic and DNA samples were stored for future analysis.

Table 11. Coded-wire tag codes of hatchery salmon sampled from the Tucannon River, 1997.

	Broodstock Collected			Tucannon River			
CWT code	Spawned	Died in Pond	Killed Outright	Dead in trap Trap	Pre-spawn Mortality	Spawned	Total
63-56-29	2						2
63-49-05	1				1		2
63-53-43	18	1			11	4	34
63-53-44	10	1			8	3	23
63-56-15	9				4	1	14
63-56-17	2				2	2	6
63-56-18	6				2		8
Strays	2 [a]	2 [b]				1 [c]	5
Lost tags					2	1	3
No tags					1	2	3
Not sampled [d]					1	2	3
Total	**50**	**4**			**32**	**16**	**102**

a One fish tagcode 10-35-18; one fish RV clip only, no adipose clip, no CWT found in snout.
b Two fish RV clip only, no adipose clip, no CWT found in snout.
c One fish tagcode 10-30-42.
d Two of three fish not sampled for CWT because head was eaten, one fish not CWT sampled because there was no adipose clip, but scale patterns indicate it to be a hatchery origin fish.

Table 12. Spring chinook salmon (natural and hatchery) sampled from the Tucannon River, 1997.

Estimated total escapement to Tucannon River:	**351**	**(160 natural, 191 hatchery)**
Broodstock collected	-97	(43 natural, 54 hatchery)
Fish dead in trap	- 0	(0 natural, 0 hatchery)
Total fish left in river	**248**	
In-river CWT sampled fish:		
Prespawning mortality	45	(13 natural, 32 hatchery)
Spawned carcasses recovered	38	(16 natural, 22 hatchery)
Spawning ground CWT sample	83	(29 natural, 54 hatchery)
Total number of carcasses sampled in 1997	**180**	

Table 13. Number, mean post-eye to hypural-plate length, and age (from coded-wire tags, scale impressions, or fitted by fork length) for all spring chinook salmon sampled from the Tucannon River and LFH, 1997.

Origin	Sampled at hatchery			Sampled from river			Total		
Age	Male	Female	%Age	Male	Female	%Age	Male	Female	%Age
Natural									
Age 3	--	--	--	--	--	--	--	--	--
Age 4	20	19	90.7	9	14	65.7	29	33	79.5
Length	57.8	59.1		56.5	57.0		57.5	58.1	
Age 5	1	3	9.3	5	7	34.3	6	10	20.5
Length	73.0	69.5		71.4	69.4		71.7	69.4	
Hatchery									
Age 3	2	--	3.7	--	--	--	2	--	2.0
Length	41.3						41.3		
Age 4	24	27	94.4	12	35	97.9	36	62	96.1
Length	59.8	59.3		59.0	59.5		59.6	59.4	
Age 5	1	--	1.9	--	1	2.1	1	1	2.0
Length	68.0				72.0		68.0	72.0	

2.4 Arrival and Spawn Timing Trends

Since inception of the program, peak arrival and spawn timing have been monitored to determine if the hatchery program has caused a shift in arrival or spawn timing (Table 14). Peak arrival dates were based on greatest number of fish trapped on a single day. Peak spawn in the hatchery was determined by the day where the most females were spawned. Peak spawning in the river was determined by the highest daily redd counts. Mean peak arrival was about one week later for hatchery fish compared to natural fish. Peak spawn dates have not differed from past years. In 1997, peak arrival was considerably later than mean arrival, but water temperatures were unusually cool in 1997, and possibly delayed migration to the adult trap.

Table 14. Peak dates of arrival of natural and hatchery salmon to the TFH adult trap and peak (date) and duration (number of days) for spawn timing in the hatchery and river, 1986-1997.

	Peak Arrival at Trap		Spawning in Hatchery			Spawning in River	
Year	Natural	Hatchery	Natural	Hatchery	Duration	Combined	Duration
1986	5/27	- - -	9/17	- - -	31	9/16	36
1987	5/15	- - -	9/15	- - -	29	9/23	35
1988	5/24	- - -	9/07	- - -	22	9/17	35
1989	6/06	6/12	9/15	9/12	29	9/13	36
1990	5/22	5/23	9/04	9/11	36	9/12	42
1991	6/11	6/04	9/10	9/10	29	9/18	35
1992	5/18	5/21	9/15	9/08	28	9/09	44
1993	5/31	5/27	9/13	9/07	30	9/08	52
1994	5/25	5/27	9/13	9/13	22	9/15	29
1995 [a]	- - -	6/08	9/13	9/13	30	9/12	21
1996	6/06	6/20	9/17	9/10	21	9/18	35
Mean	**5/25**	**6/02**	**9/13**	**9/11**	**31**	**9/14**	**40**
1997	6/15	6/17	9/09	9/16	30	9/17	50

a Too few natural salmon were trapped in 1995 to determine peak arrival.

2.5 Total Escapement

Total escapement to the Tucannon River from 1985-1997 has been based on annual redd counts, broodstock collection and pre-spawn mortalities (Table 15). Escapement estimates for 1997 were calculated by adding the number of fish passed upstream of the TFH adult trap (162), the estimated fish below the weir assuming 2.0 fish/redd ratio (86), the number of pre-spawn mortalities below the weir (6), and the number of broodstock collected (97).

The fish/redd ratio used in our escapement estimate for 1997 is based on the sex ratio of collected broodstock. Normally, the fish/redd ratio is calculated by dividing the number of fish passed upstream minus pre-spawn mortalities by the number of redds above the trap. In 1997, that formula computed a 3.8 fish/redd ratio, expanding the run estimate by 77 fish; a 22% increase in run size. The number of live fish observed during spawning ground surveys suggested this ratio would over-estimate the run. We therefore used the conservative estimate of 2.0 fish/redd for calculating total escapement.

Table 15. Estimated spring chinook salmon escapement to the Tucannon River, 1985-1997.

Year	Total Redds Above Weir	Total Redds Below Weir	Fish/ Redd Ratio [a]	Estimated Fish in the River	Broodstock Collected		Pre-Spawning Mortalities		Total Escapement	Percent Natural
					Natural	Hatchery	Natural	Hatchery		
1985	189	--	2.85	539	22	--	--	--	561	100.0
1986	163	37	2.85	570	116	--	--	--	686	100.0
1987	149	36	2.85	527	101	--	--	--	628	100.0
1988	90	27	2.85	333	126	7	--	--	466	96.1
1989	74	32	2.85	302	78	102	--	--	482	77.2
1990	96	84	3.36	605	66	68	--	6	745	66.4
1991	40	50	4.25	383	41	89	--	8	521	49.1
1992	130	70	2.92	575	47	50	22	50	753	55.4
1993	131	61	2.27	433	50	47	11	43	586	53.6
1994 [b]	2	42	1.59	70	36	34	--	--	140	70.0
1995 [b]	0	5	2.13	11	10	33	--	--	54	38.9
1996 [c]	11	57	2.00	35	35	45	7	3	247	66.0
1997 [c]	30	43	2.00	248	43	54	9	30	351	45.6

a From 1985-1989 the TFH adult trap was not operated full time, thereby underestimating total fish passed upstream. The 1985-1989 fish/redd ratios were calculated from the 1990-1993 average, excluding 1991 because of large jack run.

b In 1994 and 1995, no fish were passed upstream. Fish/redd ratio based on assumption of one female/redd and a female/male sex ratio of 1.59 and 0.95 fro 1994 and 1995, respectively (from broodstock collection).

c High pre-spawning loss of fish passed upstream. Assumed a fish/redd ratio of 2.00 based on broodstock.

SECTION 3: JUVENILE MONITORING AND EVALUATION

3.1 Hatchery Rearing, Evaluation and Release

Hatchery rearing and evaluation-Length and weight samples were periodically collected throughout the rearing cycle on 1996 BY juveniles (Table 16). No morphometric, meristic, or electrophoretic samples were collected from any 1996 BY juveniles. Forty fish were killed for organosomatic index prior to release. All 1996 BY juveniles were adipose clipped and CWT marked on 23 and 24 September, 1997. After CWT marking, LFH transported about 79,000 fish to TFH on 15 October.

Table 16. Summary of sample sizes (N), mean lengths, coefficient of variations (CV), and condition factors (k) of 1996 BY juveniles sampled at LFH and TFH.

Date	Sample Location	Pond #	N	Mean Length	CV	K
06/30/97	LFH	1	253	76.3	6.41	1.19
10/31/97	TFH	1	200	102.3	7.26	1.26
10/31/97	TFH	2	208	105.5	5.80	1.26
10/31/97	TFH	4	214	102.8	5.68	1.25
10/31/97	TFH	5	214	103.6	4.98	1.25
12/30/97	TFH	1	166	114.3	6.37	1.31
12/30/97	TFH	2	157	114.4	5.64	1.27
12/30/97	TFH	4	158	116.4	9.65	1.27
12/30/97	TFH	5	163	113.9	6.62	1.25
02/19/98	TFH	1	194	126.4	7.47	1.26
02/19/98	TFH	4	400	128.4	7.08	1.17
02/20/98	TFH	5	400	126.1	6.41	1.22
02/23/98	TFH	2	186	129.3	6.27	1.25
03/10/98	TFH	2	401	132.0	6.95	1.21

Transported fish were placed in four, 12.3 m circular ponds at TFH. These ponds were utilized to conduct an exercise experiment on the 1996 BY juveniles. Depending on input water flow, three of the four ponds had mean water velocities ranging from 4.5 to 18 cm/sec with the control pond ranging from 1 to 6 cm/sec. All four ponds were set with identical water flow,

although, flows ranged from 12.4 to 22.2 L/sec over the rearing period. In addition, velocity treatment ponds had floating circular pond covers. Pond covers were made with sealed plastic pipe and green tarp; each measured 2.4 m in diameter. Increased velocities and pond covers more closely simulate the river environment which may enhance smolt survival. Fish in each pond were marked with unique CWT codes. A complete report on the 1997/1998 exercise experiment will be completed in the future.

Increased mortality of 1996 BY juveniles at TFH was observed in 1997/1998. The majority of the fish died from fungus on the caudal fin or "tail rot". Formalin treatments and increased water temperatures curtailed the loss. Mortality in the three treatment ponds ranged from 4.3-6.3% while the control pond was 0.4%. Higher sustained velocities or fecal/waste buildup behind the floating covers (or both) in the treatment ponds may have been the reason for the higher mortality rates.

Hatchery releases-About 47,800 1996 BY juveniles were transported from the TFH to Curl Lake rearing pond on 26 February. The volitional release from Curl Lake coincided with a volitional release of 14,335 juveniles from TFH between 11 March to 18 April (Table 17). An electronic counter was installed at the Curl Lake outlet to monitor migration. Only 20% of the fish left the pond before the release period was complete. An estimated 50% of the fish left the circular pond at TFH before the release period was complete. All remaining fish (Curl Lake and TFH) were forced out on 18 April. An estimated 14,101 fish were direct stream released (Curl Lake Intake, Panjab Bridge) on 3 April. Length, weight and condition factor (k) of all release groups were similar (Table 18). A portion of each release group was PIT tagged for juvenile migrant and exercise experiment evaluation. PIT tag results will be presented in future reports.

Table 17. Summary of yearling spring chinook releases in the Tucannon River, 1994-1996 BY's.

Release (BY) Year	Release type [a]	Release Date	CWT Code [b]	Number CWT	Ad-only marked	Additional VI tag/cross [c]	lbs	fish/ lb
1996 (94)	H-Acc	3/16-4/22	56/29	89,437		RR, Mixed	5,123	17.7
	P-Acc	3/27-4/19	57/29	35,334	35	RG, Mixed	2,628	15.2
	Direct	3/27	43/23	5,263		LG, Mixed	369	13.3
Total				**130,034**	**35**			
1997 (95)	H-Acc	3/07-4/18	59/36	42,160	40	RR, Mixed	2,411	17.5
	P-Acc	3/24-3/25	61/41	10,045	50	RB, Mixed	537	18.8
	Direct	3/24	61/40	9,811	38	LB, Mixed	593	16.6
Total				**62,144**	**128**			
1998 (96)	H-Acc	3/11-4/17	03/60	14,308	27	Mixed	902	15.9
	C-Acc	3/11-4/18	61/25	23,065	62	Mixed	1,498	15.8
	C-Acc	3/11-4/18	61/24	24,554	50	Mixed	1,557	15.8
	Direct	4/03	03/59	14,101	52	Mixed	863	16.4
Total				**76,028**	**191**			

a Release types are: TFH Acclimation Pond (H-Acc); Portable Acclimation Pond (P-Acc); Curl Lake Acclimation Pond (C-Acc); and Direct Stream Releases (Direct).

b All tag codes start with agency code 63.

c Codes listed in column are as follows: VI-Visual Implant (elastomer); RR-Right Red, LG-Left Green, RG-Right Green, LB-Left Blue, RB-Right Blue; Crosses: Mixed - wild x hatchery progeny.

Table 18. Characteristics of fish released into the Tucannon River, 1998.

Release Location	TFH	Curl Lake	Curl Lake Intake	Panjab Br.
Release Type	Acclimated	Acclimated	Direct	Direct
Sample Date	4/03	4/03	4/02	4/02
Release Date	3/11-4/18	3/11-18	4/03	4/03
Release Number	14,308	46,819	7,050	7,050
Sample size	109	200	402	397
Mean length	137.4	135.2	134.5	134.9
SD	8.2	8.9	9.6	9.1
CV	6.0	6.6	7.1	6.7
Fish/lb	16.3	15.9	16.5	16.3
Mean weight	27.8	28.6	27.6	27.8
SD	5.1	5.8	6.0	5.5
K-factor	1.06	1.14	1.12	1.12

3.2 Parr Production and Smolt Trapping

Parr production-Two types of total count snorkel surveys were conducted in 1997. One consisted of snorkeling by specific habitat type (riffle, run, pool or side channel), while the other was more comprehensive and included varied habitat within each snorkel site. Comparison population estimates were made between the two types to determine which should be used in the future (Table 19). Habitat type surveys provide more detail on fish densities within a given habitat (Appendix D), but require annual habitat surveys to make population estimates. From the 1997 results, we could not determine which type was better because spring chinook densities were so low. However, we believe comprehensive snorkel sites provide a less biased estimate. Biases may exist in the habitat type sites because of site selection. For example, poor quality pools may have been passed during site selection, with the selection towards higher quality pools with higher densities of fish, inflating the population estimate. More comparisons will be made in 1998.

Table 19. Population (N) and confidence interval (C.I.) estimates, number of sites (n) and area snorkeled for subyearling chinook within the Tucannon River, 1997, based on two snorkel types.

Stratum	"Habitat"				"Comprehensive"			
	N	C.I.	n	Area (m^2)	N	C.I.	n	Area (m^2)
Marengo	97	95	15	2,075	176	349	3	1,214
Hartsock	1,996	1,391	26	3,286	1,368	1,008	8	2,846
HMA	3,330	2,007	32	4,379	1,177	715	15	5,328
Wilderness	623	1,073	20	1,213	124	246	5	1,062
TOTAL	**6,046**	**2,818**	**93**	**10,953**	**2,845**	**1,262**	**31**	**10,450**

Smolt trapping-A rotary screw trap operated intermittently at rkm 3 on the Tucannon River between 28 March and 3 July 1997 to estimate numbers of spring chinook migrants. During each trap week, we attempted to determine trap efficiency by clipping a portion of the caudal fin on captured migrants and releasing them upstream about 1 km. The percent of marked fish recaptured estimated weekly trapping efficiency. When insufficient fish were captured for trap efficiency estimates, data from other time periods with similar flows and turbidity were used. To estimate potential juvenile migrants when the trap was not operated, we calculated the number of fish trapped per hour three days before and after, and then divided that by the average trap efficiency of those two weeks.

Few natural spring chinook salmon were captured in 1997(Table 20, Appendix E). Based on our estimates, we calculated that 90 naturally produced yearling spring chinook migrated out of the Tucannon River (1995 BY). These few surviving natural migrants were produced from five redds in 1995, and were heavily scoured by a 30-year flood in February 1996 which severely impaired their survival. In addition, less than 50% of the hatchery fish released were estimated to

have passed the migrant trap (Table 21). This may be due to errors in the estimate because of non-continuous trapping. However, based on descaling (Table 20) and other injuries noted on hatchery migrants captured, we believe that some mortality occurred, though less than 50%. Size of natural and hatchery fish captured were similar to previous years. Smaller hatchery fish appeared to migrate later in the season (Table 22).

Table 20. Monthly and total population estimates for natural and hatchery origin emigrants from the Tucannon River, 30 March through 2 July, 1997. Percent survivals based on TFH release numbers.

Month	Natural	Hatchery		
		Direct Stream	Curl Lake	Tucannon FH
April	0	465	547	2,401
May	0	2,531	2,247	19,891
June	85	115	63	34
July	5	0	0	0
Total	90	3,111	2,857	22,326
% Survival		31.7	28.4	52.9

Table 21. Total number of fish sampled and the percent of those descaled by month between natural and hatchery salmon captured in the downstream migrant trap, spring 1997. Hatchery salmon were released from TFH, Curl Lake, and directly to the river at two upstream locations above the hatchery (Big 4 campground, Panjab Bridge).

Month	Natural		Hatchery							
			TFH		Curl Lake		Direct Stream		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
April	0	0.0	132	24.2	50	14.0	41	22.0	223	21.5
May	0	0.0	131	25.2	48	18.8	49	10.2	228	20.6
June	11	0.0	5	0.0	4	25.0	10	10.0	19	10.5

Table 22. Mean fork length (standard deviation, sample size) and condition factor (K-factor) by week of natural and hatchery spring chinook from the Tucannon River, 1997.

Sample Period	Natural Chinook Fork Length Mean (SD, N)	Natural Chinook K-factor	Hatchery Chinook Fork Length Mean (SD, N)	Hatchery Chinook K-factor
4/02-4/04			130.8 (3.8, 6)	1.09
4/07-4/11			124.1 (8.5, 14)	1.04
4/14-4/18			132.4 (12.4, 91)	1.06
4/21-4/25			135.9 (21.9, 70)	1.06
4/28-5/02			140.8 (22.5, 79)	1.04
5/05-5/09			130.1 (12.9, 88)	1.03
5/12-5/16			137.4 (19.5, 51)	1.03
5/19-5/23			126.9 (13.1, 26)	1.06
5/26-5/30			122.6 (13.1, 31)	1.06
6/02-6/06			125.0 (14.0, 7)	1.05
6/09-6/13	96.0 (7.5, 3)	1.19	113.8 (15.2, 10)	1.13
6/16-6/20	88.8 (7.8, 5)	---	110.5 (16.3, 2)	---
6/23-6/27	95.0 (8.5, 2)	---		
6/30-7/03	105.0 (- -, 1)	---		

3.3 Acclimation vs Direct Release Study

We continued our study to determine if small remote acclimation ponds located in the upper Tucannon River watershed produced higher relative survival than direct stream releases of smolts in the same areas. It also allowed us to monitor if releases upstream of the hatchery preformed as well as fish released from the hatchery. The basis behind this study was to hopefully change the spawning distribution of returning adult hatchery fish to areas upstream of the TFH.

Performance of PIT tagged fish was evaluated from detections at Lower Monumental, McNary, John Day and Bonneville dams. Results from the 1997 outmigration were slightly different than both 1995 and 1996 (Table 23). Fish released from TFH had slightly higher detection rates than other release locations. Overall, detection rates were down when compared to 1995 and 1996 because of higher spill levels at mainstem dams in 1997. The 1998 results were incomplete for the report period.

Based on our initial results, we believe upstream releases should continue. In addition, direct stream releases, showing no obvious disadvantage in downstream survival, should also be used to further distribute release points where acclimation ponds are not feasible.

Table 23. Cumulative unique detection summaries of PIT tagged salmon released from various locations on the Tucannon River in 1995, 1996, and 1997 at downstream Snake and Columbia River Dams.

Release site	Release type	Pond type	Release date	River kilometer	Release number	Cumulative detection
1995 Detections						
TFH	acclim.	raceway	3/15-4/15	58	200	53 (26.5%)
Curl Lake	acclim.	raceway	3/20	66	202	41 (20.3%)
Curl Lake	direct	- -	3/20	66	197	55 (27.9%)
Ladybug Flat C.G.	direct	- -	3/20	77	199	34 (17.3%)
Winchester Cr.	acclim.	circular	3/20	78	198	25 (12.6%)
Winchester Cr.	acclim.	circular	3/31	78	197	30 (15.2%)
1996 Detections						
TFH	acclim.	raceway	3/16-4/22	58	496	121 (24.4%)
Curl Lake	acclim.	raceway	3/27	66	241	62 (25.7%)
Curl Lake	acclim.	circular	3/27	66	243	70 (28.8%)
Curl Lake	direct	- -	3/27	66	242	71 (29.3%)
Curl Lake	acclim.	raceway	4/10	66	250	71 (28.4%)
Curl Lake	acclim.	circular	4/10	66	246	60 (24.4%)
Panjab Cr.	direct	- -	3/27	74	235	55 (23.4%)
1997 Detections						
TFH	acclim.	raceway	3/07-4/18	58	500	80 (16.0%)
Curl Lake	acclim.	raceway	3/24	66	485	58 (12.0%)
Big 4 C.G.	direct	- -	3/24	65	499	67 (13.4%)
Panjab Cr.	direct	- -	3/24	74	500	56 (11.2%)
1998 Detections						
TFH	acclim.	Round P.	3/11-4/17	58	401	NA
Curl Lake (non-ex)	acclim.	Lake	3/11-4/18	66	400	NA
Curl Lake (exercise)	acclim.	Lake	3/11-4/18	66	400	NA
Curl Lake	direct	- -	4/03	66	402	NA
Panjab Cr.	direct	- -	4/03	74	397	NA

	Acclimated	Direct
'95	130	90
'96	380	125
'97	140	130

SECTION 4: SURVIVAL RATES AND FISHERY CONTRIBUTION

4.1 Survival Rates

From juvenile population and spawning ground surveys, smolt trapping and fecundity estimates, point estimates of population sizes have been calculated for various life stages (Table 24 and 25). Survival rates between life stages have been calculated from population estimates for both natural and hatchery salmon. As expected, juvenile (egg-parr-smolt) survival rates for hatchery fish were considerably higher than naturally reared salmon (Table 26). However, smolt-to-adult survival rates (SAR) of natural salmon were about four times higher than hatchery reared salmon (Table 27 and 28). The mean SAR's (natural=0.62%; hatchery=0.13%) from 1985-1992 broods were below the assumed SAR of 0.87% established under the LSRCP. Hatchery SAR's need substantial improvement to meet the mitigation goal of 1,152 salmon. While larger smolts (5-8 fpp) would probably improve smolt-to-adult survival rates of hatchery fish, returning age composition would shift to younger fish. This would further segregate natural and hatchery fish life history characteristics.

Table 24. Estimates of **natural** Tucannon spring chinook salmon abundance by life stage for 1985-1997 broods.

Brood year	Females in river (natural/hatchery)	Mean [a] fecundity (natural/hatchery)	Number of eggs	Number [b] of fry	Number of smolts	Progeny [c] (returning) (adults)
1985	270 / - -	3,883 / - -	1,048,410	90,200	35,600	409
1986	309 / - -	3,916 / - -	1,210,044	102,600	58,200	465
1987	282 / - -	4,095 / - -	1,154,790	79,100	44,000	224
1988	168 / - -	3,882 / - -	652,176	69,100	37,500	545
1989	133 / 4	3,883 / 2,606	526,863	58,600	25,900	147
1990	192 / 106	3,993 / 2,694	1,052,220	64,100	49,500	94
1991	98 / 67	3,741 / 2,517	535,257	54,800	26,000	7
1992	163 / 131	3,854 / 3,295	1,059,847	103,292	50,800	192
1993	126 / 106	3,701 / 3,237	807,598	86,755	49,600	122
1994	38 / 5	4,187 / 3,314	175,676	12,720	6,000	
1995	5 / 0	5,284 / - -	26,420	0	90	
1996	64 / 20	3,516 / 2,843	280,463	5,725		
1997	43 / 29	3,609 / 3,315	251,322			

a 1985 and 1989 mean fecundity of natural females is average of 1986-88 and 1990-93.

b Number of fry estimated from electrofishing (1985-1989), Line transect snorkel surveys (1990-1992), and Total Count snorkel surveys (1993-1997).

c Numbers do not include down river harvest estimates or out of basin recoveries.

Table 25. Estimates of Tucannon spring chinook salmon abundance (spawned and reared in the hatchery) by life stage for 1985-1997 broods.

Brood year	Females Spawned (natural/hatchery)	Mean [a] fecundity (natural/hatchery)	Number of eggs	Number of fry	Number of smolts	Progeny [b] (returning) (adults)
1985	4 / --	3,883 / --	14,843	13,401	12,922	45
1986	57 / --	3,916 / --	187,958	177,277	153,725	328
1987	48 / --	4,095 / --	196,573	164,630	152,165	185
1988	49 / --	3,882 / --	182,438	150,677	145,146	447
1989	28 / 9	3,883 / 2,606	133,521	103,420	99,057	243
1990	21 / 23	3,993 / 2,694	147,583	89,519	85,797	28
1991	17 / 11	3,741 / 2,517	91,275	77,232	74,058	25
1992	28 / 18	3,854 / 3,295	156,359	151,727	87,752 [c]	83
1993	21 / 28	3,701 / 3,237	168,366	145,303	138,848	195
1994	22 / 21	4,187 / 3,314	161,707	148,148	130,069	
1995	6 / 15	5,284 / 3,604	85,722	63,935	62,272	
1996	18 / 19	3,516 / 2,843	117,287	81,326		
1997	17 / 25	3,609 / 3,315	144,237	29,650		

a 1985 and 1989 mean fecundity of natural females is average of 1986-88 and 1990-93.

b Numbers not include down river harvest estimates or out of basin recoveries.

c Number of smolts is less than actual release number. 57,316 parr were released in October 1993, with an estimated 7% survival. Total number of hatchery fish released from the 1992 brood year was 140,725.

Table 26. Percent survival rates by brood year for juvenile salmon and the multiplicative advantage of hatchery reared salmon over naturally reared salmon in the Tucannon River.

Brood Year	Natural Fish			Hatchery Fish			Hatchery Advantage		
	Egg to Fry	Fry to Smolt	Egg to Smolt	Egg to Fry	Fry to Smolt	Egg to Smolt	*Egg to Fry*	*Fry to Smolt*	*Egg to Smolt*
1985	8.6	39.5	3.4	90.3	96.4	87.1	*10.5*	*2.4*	*25.6*
1986	8.5	56.7	4.8	94.3	86.7	81.8	*11.1*	*1.5*	*17.0*
1987	6.8	55.6	3.8	83.8	92.4	77.4	*12.3*	*1.7*	*20.4*
1988	10.6	52.2	5.8	82.6	96.3	79.6	*9.1*	*1.8*	*13.7*
1989	11.1	44.2	4.9	77.5	95.8	74.2	*7.0*	*2.2*	*15.1*
1990	6.1	77.2	4.7	60.7	95.8	58.1	*10.0*	*1.2*	*12.4*
1991	10.2	47.5	4.9	84.6	95.9	81.1	*8.3*	*2.0*	*16.6*
1992	9.7	49.2	4.8	97.0	57.8	56.1	*10.0*	*1.2*	*11.7*
1993	10.7	57.2	6.1	86.3	95.6	82.5	*8.1*	*1.7*	*13.5*
1994	7.2	47.2	3.4	88.3	87.8	80.4	*12.2*	*1.9*	*23.6*
1995	0.0	0.0	0.3	74.6	97.4	72.6	---	---	---
1996	2.0			69.3	94.7	64.8	*34.7*		
1997				20.6					
Mean	7.6	47.9	4.3	77.7	91.1	74.6	*12.1*	*1.8*	*17.0*
SD	3.5	18.7	1.6	19.9	11.0	10.0	*7.7*	*0.4*	*4.8*

While SAR's were lower for hatchery salmon, overall survival of hatchery salmon to return as adults was higher than naturally reared fish because of the early life survival advantage the hatchery environment offers (Table 26). Naturally produced fish are below the replacement level (Table 29). Based on adult returns from the 1985-1992 broods, naturally reared salmon produced 0.6 adults for every spawner, while hatchery reared fish produced 2.5 adults.

Table 27. Adult returns and SAR's of **natural** salmon to the Tucannon River for brood years 1985-1993 (1993 incomplete).

Brood Year	Estimated number of smolts	Number of Adult Returns, known (expanded)			SAR (%)	
		Age 3	Age 4	Age 5	w/jacks	no jacks
1985	35,600	8 (20)	110 (274)	36 (115)	1.15	1.09
1986 [a]	58,200	1 (2)	117 (374)	28 (89)	0.80	0.80
1987	44,000	0 (0)	52 (164)	22 (60)	0.51	0.51
1988	37,500	1 (3)	126 (343)	74 (199)	1.45	1.44
1989	25,900	5 (14)	40 (107)	23 (26)	0.57	0.51
1990	49,500	3 (8)	63 (72)	12 (14)	0.19	0.17
1991	26,000	0 (0)	4 (5)	1 (2)	0.03	0.03
1992	50,800	2 (2)	85 (159)	16 (31)	0.38	0.37
1993	49,600	1 (2)	63 (120)	- - (- -)	0.25	0.24
Mean of 1985-1992 broods					**0.64**	**0.62**

a One known (expanded to two) age six salmon was recovered.

Table 28. Adult returns and SAR's of **hatchery** salmon to the Tucannon River for brood years 1985-1993 (1993 incomplete).

Brood Year	Estimated number of smolts	Number of Adult Returns, known (expanded)			SAR (%)	
		Age 3	Age 4	Age 5	w/jacks	no jacks
1985	12,922	9 (20)	24 (25)	0 (0)	0.33	0.19
1986	153,725	80 (85)	101 (226)	8 (17)	0.21	0.16
1987	152,165	8 (18)	70 (150)	8 (17)	0.12	0.11
1988	146,200	46 (98)	140 (296)	25 (53)	0.31	0.24
1989	99,057	7 (15)	100 (211)	14 (17)	0.25	0.23
1990	85,800	3 (6)	16 (20)	2 (2)	0.03	0.03
1991	74,058	4 (5)	20 (20)	0 (0)	0.03	0.03
1992	87,752	11 (11)	51 (68)	2 (4)	0.09	0.08
1993	138,848	11 (15)	94 (180)	- - (- -)	0.14	0.13
Mean of 1985-1992 broods					**0.17**	**0.13**

Table 29. Parent-to-progeny survival estimates of Tucannon River spring chinook salmon from 1985 through 1993 brood years (1993 incomplete).

Brood Year	Natural Salmon			Hatchery Salmon			Hat. to Natural Advantage
	Number of Spawners	Number of Returns	Return/ Spawner	Number of Spawners	Number of Returns	Return/ Spawner	
1985	539	409	0.76	9	45	5.00	6.6
1986	570	465	0.82	91	328	3.60	4.4
1987	528	224	0.42	83	185	2.23	5.3
1988	334	545	1.63	78	447	5.73	3.5
1989	302	177	0.53	122	243	1.99	4.1
1990	605	94	0.16	78	28	0.36	2.3
1991	383	7	0.02	72	25	0.35	17.5
1992	575	193	0.34	83	81	0.98	2.9
1993	433	120	0.28	91	185	2.03	7.3
Geometric Mean			**0.35**			**1.69**	**4.97**

4.2 Fishery Contribution

An original goal of the LSRCP supplementation program was to enhance wild (natural) returns of salmon to the Tucannon River. An increase in the annual run would once again allow for limited harvest of the stock. Unfortunately, both natural and hatchery adult returns have been below program goals (1,152 annual run size). Based on CWT recoveries from the 1985-1993 brood years, only incidental catches of spring chinook from the Tucannon River have been taken in other fisheries (Table 30, Appendix E). Harvest accounts for about 3.9% of the hatchery fish annually. Another 1.5% stray to other rivers/hatcheries. Similar percentages have been assumed for natural fish.

Table 30. Estimated recoveries of adults from coded-wire tagged salmon released from the Tucannon River and percent return to the Tucannon or our-of-basin for 1985-1992 BY's.

Brood year	1985	1986	1987	1988	1989	1990	1991	1992 [a]
Smolts released	12,922	147,037	151,100	139,050	97,779	85,737	72,461	87,752
Agency (fishery/location)								
WDFW								
(Tucannon River)	60	335	234	464	246	25	24	45
(Kalama R., Wind R)		4		4				
(Fishtrap-Snake R.)				1				
(Treaty troll, Area 4b)		2			2			
(Lyons Ferry Hat.)								1
IDFG								
(Dworshak Hatchery)				1				
ODFW								
(Test net, Zone 4)	1	1		3	2			
(Ceremonial)		4	2	17	8		3	
(Three Mile, Umatilla R.)								2
CDFO								
(Non-treaty troll)		4						2
USFWS								
(Warm Springs Hat.)								3
Tucannon (%)	**98.3**	**95.7**	**99.2**	**94.7**	**95.4**	**100.0**	**88.9**	**84.9**
Out-of-Basin (%)	**1.7**	**4.3**	**0.8**	**5.3**	**4.6**	**0.0**	**11.1**	**15.1**

a Pre-smolts were released into Tucannon during the fall of 1993. Based on smolt trapping estimates in spring of 1994, only 4,343 of 57,316 survived to smolt. Release numbers reflect the estimated mortality.

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APPENDIX A

Spring chinook salmon captured, collected, or passed upstream at the Tucannon Hatchery traps in 1997. First day of trapping was 6 May, last day of trapping was 12 September. Reported days are when fish arrived, were collected or passed.

Date	Arrived		Collected		Passed Upstream	
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery
5/23		1		1		
5/24	1		1			
5/27		1				1
5/28	1				1	
6/01	4				4	
6/02	2	2	1		1	2
6/06	1	1			1	1
6/07	3				3	
6/09	1	3			1	3
6/10		4		4		
6/11	2	3			2	3
6/12	3	1	3	1		
6/13	2	6			2	6
6/14	2	4	2	3		1
6/15	5	7			5	7
6/16	9	11	4	6	5	5
6/17	9	16		5	9	11
6/18	7	5	4	4	3	1
6/19	3	11		5	3	6
6/20	5	14	3	7	2	7
6/21	1	1	1	1		
6/22	4	1			4	1
6/23		7		6		1
6/24	2	6	2			6
6/25	1	10	1			10
6/26	3	2	3	1		1
6/27	1	3	1	1		2
6/28	2	1	2			1
6/29		8				8
6/30		4				4
7/02	1		1			
7/03	1	2	1			2
7/04	1	1			1	1
7/06		2				2
7/08	1		1			
7/09		1		1		

Appendix A, continued,

Date	Arrived		Collected		Passed Upstream	
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery
7/11		1				1
7/16		1				1
7/21		2				2
7/22	2	1	2	1		
7/23	2	1	2			1
7/24	1		1			
7/28		1				1
8/01		1				1
8/16		1		1		
8/17		1				1
8/20	1		1			
8/26		1		1		
8/27	1	1	1	1		
9/02	2		2			
9/03	1	1			1	1
9/04	2	1			2	1
9/08	6	1	6			1
9/09	1	1			1	1
9/10	3	1			3	1
9/11	1				1	
9/12	2		1		1	
Totals	**103**	**156**	**47**	**50**	**56**	**106**
Corrected after broodstock spawning Totals	**99**	**160**	**43**	**54**	**56**	**106**

APPENDIX B

Movements of thirteen radio tagged spring chinook in the Tucannon River, 1997. Five were tagged by the University of Idaho at Bonneville Dam and eight were tagged by WDFW at the Tucannon Hatchery Weir.

Abbreviations used: pp=pinpoint, to locate fish within 10-20 m stream side
B/W=Beaver and Watson Lake CG=Campground HMA=(#'s are snorkel index sites).

Chan/ Code	Date	RK	Location	Comments
2/16	6/11	58.1	Tucannon Hatchery Weir	Tagged (wild male, 70cm)
	6/12-6/13	58.9	pool below HMA 6	
	6/16-6/19	59.1	in long pool, 150m below Hatchery Intake	
	6/20-6/23	59.2	Tucannon Hatchery Intake pool	pp
	6/24-7/08	59.1	in long pool, 150m below Hatchery Intake	pp
	7/09	59.0	HMA 6	pp, fish moved
	7/14	59.1	in long pool, 150m below Hatchery Intake	
	7/16	59.1	first pool below Hatchery Intake	saw fish, fungus patch on head
	7/17	61.6	.2 miles above Campground 7	
	7/21	70.8	.2 miles above Campground 9, below L.Tuc. R.	
	7/22-8/07	71.4	between Little Tucannon R. and new Campground 9	pp, fish moving around
	8/11	73.2	1st pullout/camp area above Cow Camp Bridge	
	8/13	73.3	90m below the top of HMA 20, right bank pool	pp
	8/14	73.4	near log Weir below Campground 10	
	8/18	74.2	Campground 10 under left bank debris pile	pp
	8/20-8/28	75.4	½ mi. above wild Campground 1	pp
	8/29	75.4	½ mi. above wild CG 1, above narrow road sign	tag recovered; no fish
2/27	6/19	58.1	Tucannon Hatchery Weir	Tagged (wild male, 73cm)
	6/20-7/08	58.1	between Weir and Tucannon Hatchery Bridge	pp, fish moving around
	7/09	58.1	right bank, above Tucannon Weir	pp; fish"looks bad"
	7/14	58.1	above Tucannon Hatchery Weir	Recover tag & fish(mortality)
2/29	6/13	58.1	Tucannon Hatchery Weir	Tagged (wild female, 68cm)
	6/16	58.6	just above Rainbow Lake outlet	
	6/17-6/24	58.8	pools 60-70m below HMA 6	fish moving around
	6/25-6/26	60.1	Day use area above Campground 6	
	6/27	64.3	lower end of Campground 8	
	6/30	64.3	Campground 8	
	7/01-7/17	63.8	pullout below Campground 8; large pool, undercut	
	7/21	62.3	Log jam at Beaver/Watson Intake	pp, fish looked good
	7/22	63.8	pullout below new Campground 7	
	7/24-7/28	62.0	100m above Beaver/Watson pullout	
	7/31	62.1	approx 200m above Beaver/Watson Bridge	
	8/04-8/07	62.3	in pool under downed alder 30m below B/W Intake	pp
	8/11	62.4	Beaver/Watson Intake	
	8/13-8/26	62.3	in pool under downed alder 30m below B/W Intake	pp, fish looks good
	8/28	62.5	120m above ponderosa pine above B/W Intake	pp, saw fish
	8/29	62.2	240m below Beaver/Watson Intake	pp
	9/02-9/10	61.6	.2 mi below Beaver/Watson pullout	pp, saw fish
	9/12	61.6	.2 mi below Beaver/Watson pullout, near redd 2-1	pp
	9/15	61.6	in brush about 10m below redd 2-1	recovered tag & fish (probably spawned)

Appendix B, continued.

Chan/ Code	Date	RK	Location	Comments
2/58	6/17	58.1	Tucannon Hatchery Weir	Tagged (wild female, 71cm)
	6/18	58.1	b/t the Tucannon Hatchery Bridge and the Weir	pp
	6/19	58.6	lower end of Rainbow Lake	
	6/20-6/25	58.2	Tucannon Hatchery Bridge	pp, fish moving around
	6/26-6/27	58.9	below HMA 6, right bank pool	pp
	6/30-7/03	58.7	pool 150m above Rainbow Lake outlet	pp
	7/07	58.5	400m below Tucannon Hatchery Intake	recover tag & part. eaten fish
2/81	6/11	58.1	Tucannon Hatchery Weir	Tagged (Hat. male, 69cm)
	6/12	58.1	left bank at Weir	
	6/13	58.9	HMA 6	
	6/16	59.1	in long pool, 150m below Hatchery Intake	
	6/17-6/18	58.8	pool 60m below HMA 6, left bank logjam	
	6/19-6/20	58.9	upper end of Rainbow Lake	
	6/23-7/01	58.8	pool 60m below HMA 6, left bank logjam	
	7/02-7/14	58.8	150m below HMA 6 in pool	pp
	7/16	58.8	150m below HMA 6 in pool	Recov. presumed fish; no tag
	7/17-9/10	58.8	150m below HMA 6 in pool	tag remained in same place
2/93	6/13	58.1	Tucannon Hatchery Weir	Tagged (Hat. female, 78cm)
	6/16	59.1	in long pool, 150m below Hatchery Intake	
	6/17-9/17	58.1	between Hatchery Weir and Hatchery Br.	pp
	9/22	58.1	50m above Tucannon Hatchery Weir	Recovered tag; no fish
3/17	6/17	58.1	Tucannon Hatchery Weir	Tagged (Hat. male, 75cm)
	6/18-9/22	58.1	between the Hatchery Weir and Hatchery Br.	pp
	9/22	58.1	50 m above Tucannon Hatchery Weir	Recovered tag; no fish
3/30	6/19	58.1	Tucannon Hatchery Weir	Tagged (Hat. female, 77cm)
	6/20	58.8	150m above Rainbow Lake outlet	
	6/23	58.3	200m below culvert below Rainbow L. outlet	
	6/24	58.8	moved up to pools below HMA 6	
	6/25	59.3	Tucannon Hatchery Intake	
	6/26	59.9	just above Campground 6	
	6/27	62.1	above Beaver/Watson Br. in pool next to road	
	6/30	62.5	½ mile below Campground 8	
	7/01	63.2	1 mile below Campground 8,at culvert crossing	
	7/02	61.0	.4miles below Campground 7	weaker signal
	7/03	64.0	1/4 mile below Campground 8	
	7/07	67.6	1/4 mile below Camp Wooten Br.	
	7/08	67.8	.15 miles below Camp Wooten Br.	
	7/09	68.7	just above Camp Wooten buildings	
	7/14	68.7	upper end Camp Wooten buildings at road curve	
	7/16	68.6	300m above Tucannon Campground Bridge	moving around a lot
	7/17	65.7	Curl Lake	
	7/21	70.6	.1 miles above Campground 9, under log jam	pp
	7/22-8/07	64.4	between Campground 7 and new Campground 8	pp; fish moving around a lot
	8/11	62.5	below turnout below Campground 7	pp
	8/13-8/14	62.5	15m below last loc.; 150m above B/W Intake	pp
	8/18-8/21	62.5	150m above B/W Intake	pp; fish looked good, moved
	8/25	62.5	150m above B/W Intake; in riffle	Recovered tag, no fish

Appendix B, continued,

Chan/ Code	Date	RK	Location	Comments
15/135	4/16		Bonneville Dam	Tagged (Hat. male 70cm)
	6/12	1.8	passed Tucannon smolt trap (1:56pm)	fixed site
	6/13	12.5	Smith Hollow	
	6/16	34.1	King Grade	
	6/17	39.9	Marengo Bridge	
	6/18	43.3	Bridge 10 (above Howards)	
	6/19	48.9	just above Bridge 13	
	6/20	51.8	300m above Bridge 14	
	6/23	58.1	Tucannon Hatchery Weir, passed fish	"Headburn"; Hat. female
	6/24-6/25	58.1	right bank recovery area at Tucannon Weir	pp
	6/26-6/27	58.7	150m above Rainbow outlet in right bank pool	pp
	6/30	58.2	just above Tucannon Hatchery Bridge	
	7/01-7/09	58.1	between Tucannon Hatchery Weir and Hatchery Bridge	pp
	7/14-7/16	58.7	150m above Rainbow Lake outlet, in pool	
	7/17	59.2	Tucannon Hatchery Intake pool	
	7/21-722	58.7	150m above Rainbow Lake outlet, in pool	
	7/24	58.1	30m above Tucannon Hatchery Weir	pp, slow toad croaks
	7/28	58.9	HMA 6	rough estimate
	7/31	64.3	below Campground 7 at turnout	
	8/04	70.2	between cattleguard and Campground 9	pp, saw fish
	8/07	69.2	60m below trail to river above cattle chute	pp, saw fish
	8/11	69.1	cattle chute above Wooten lake	fish alive
	8/13-8/14	69.1	boundary fence above Wooten	pp,saw fish
	8/18	69.2	above Wooten boundary fence	pp, fungus on dorsal
	8/20-8/21	68.8	100m below Wooten boundary	
	8/25	69.2	cow chute pullout at upper end Tucannon 21	pp
	8/28	67.9	in logjam pool below Camp Wooten Bridge	pp, fungus on dorsal
	8/29	67.9	same pool as yesterday	Recovered tag & fish; did not spawn (Hat. female)
16/121	5/02		Bonneville Dam	Tagged (Hat. male, 70.5cm)
	6/05	1.8	passed Tucannon smolt trap (8:39pm)	fixed site
	7/07	58.1	2m below Tucannon Hatchery trap entrance	Recovered tag, no fish Radio not emitting signal
17/101	4/23		Bonneville Dam	Tagged (Hat. male 74.0cm)
	6/19	1.8	passed Tucannon smolt trap (1:04pm)	fixed site
	6/25-6/26	7.0	Starbuck, Kellogg Bridge	
	6/30	7.0	L.B. rootwad 75m below Kellogg Bridge	Recovered tag & fish (Hat. female--partially decomposed)
21/60	4/14		Bonneville Dam	Tagged (Hat. female 76cm)
	5/09	11.5	150m below Riveria road	
	5/11	23.6	Broughton/English property line	
	5/13	26.8	Becky Whites	
	5/14	31.1	mile post 5.5	
	5/15-5/16	34.1	mile post 7, King Grade	
	5/19	39.9	approx. 50 m above Marengo Bridge	
	5/20	42.1	approx. 100m above Bridge 9	
	5/22	46.4	mile post 15	
	5/23	48.9	Bridge 13	
	5/27	50.9	Hartsock 5	
	5/28	53.9	Behind Murphy Russel's house	

Appendix B; continued;

Chan/ Code	Date	RK	Location	Comments
21/60	5/30	57.1	lower end Campground 1	
	6/02	58.1	Just above Tucannon Hatchery Weir with another fish	
	6/03	58.1	20m below Tucannon Hatchery Weir, pool	
	6/06	58.0	100m below Weir, right bank in deep pool/run	pp
	6/06	57.9	approximately 150m below Weir in a pool	
	6/07	58.1	below Weir in a pool	
	6/09	58.1	just above Weir with 3 other fish	white snout
	6/11-6/16	59.1	in long pool, 150m below Hatchery Intake	
	6/17	59.2	Tucannon Hatchery Intake pool, below dam	
	6/18-6/19	59.1	in long pool, 150m below Hatchery Intake	pp; saw fish
	6/20-6/25	58.9	HMA 6, along right bank	pp
	6/26-6/27	59.2	Hatchery Intake pool	pp
	6/30	58.9	HMA 6	pp
	7/01	58.9	HMA 6 with 3 other fish	pp
	7/02-7/03	59.1	in long pool, 150m below Hatchery Intake	pp
	7/07-8/21	58.9	near HMA 6	pp; fish moving, looks good
	8/21-9/19	---	----------	tag stopped emitting signal
	9/19	58.9	HMA 6	Recovered tag& fish--spawned (62cmHat.female,100%spent)
22/81	4/15		Bonneville Dam	Tagged (wild female 73.5cm)
	6/02	1.8	passed Tucannon smolt trap (9:19pm)	fixed site
	6/06	17.9	mile post 2 above Kessels	
	6/09	30.0	between Broughton Land Co. and mile post 5	
	6/12	39.1	Grain silo below Marengo	
	6/13	39.1	Marengo cemetery	
	6/16	47.1	just below Bridge 12	
	6/17-6/18	50.6	Fowl Farm	
	6/19	50.7	100m upstream of Fowl Farm	
	6/20	50.6	above Fowl Farm	
	6/23	50.5	between quanset hut and Fowl Farm	
	6/24-7/14	50.6	Fowl Farm	pp; fish moving around
	7/16-9/08	50.5	90m above quanset hut; pool right bank	pp; saw fish; snorkled once
	9/10	51.5	big pool above Bridge 14	pp
	9/12	55.8	near redds below Cummings Creek Bridge	pp
	9/15-9/17	55.8	on redd, 40m below Cummings Creek Bridge	pp; saw fish
	9/19	55.8	60m below Cummings Creek Bridge	Recovered tag & fish--spawned (Wild female, 100% spent)

APPENDIX C

Historical 1954-1997 spring chinook index area redd counts in the Tucannon River, and total redd counts in North Fork Asotin Creek, 1984-1997.

Table 1. Tucannon River Spring Chinook Spawning Ground Survey Historical Index Area 1954 - 1997. From 1954 to 1997 spawning ground surveys have been conducted in an index area from Cow Camp Bridge to Camp Wooten Bridge (approx. 2.4 miles). Between 1954 and 1983 all data were collected from one day of spawning ground survey between 26 August to 28 September. Since 1985, one survey day was chosen from the many days of surveys during the season for use as the historical index. With 77% of the previous years surveys conducted between 8 and 15 September, we selected one survey annually within those dates from 1985 to present to be used as the historical index.

Year	Date	Redds	Live [a]	Dead [b]		Total
				Males	Females	
1954	3-Sep	33	52	3		55
1955	26-Aug	0	80	0		80
1956	N/A		NO SURVEY			
1957	5-Sep	168	232	51		283
1958	11-Sep	54	89	7		96
1959	3-Sep	27	56	1		57
1960	8-Sep	42	69	13		82
1961	11-Sep	102	63	23		86
1962	11-Sep	52	47	24		71
1963	10-Sep	21	25	11		36
1964	9-Sep	61	55	24		79
1965	9-Sep	24	20	4		24
1966	9-Sep	65	56	10		66
1967	8-Sep	40	41	8		49
1968	10-Sep	18	20	4		24
1969	10-Sep	61	55	28		83
1970	10-Sep	62	68	6		74
1971	7-Sep	6	11	1		12
1972	12-Sep	23	3	0		3
1973	11-Sep	24	18	3		21
1974	11-Sep	18	12	5		17
1975	10-Sep	37	28	8		36
1976	28-Sep	13	0	11		11
1977	15-Sep	19	3	4		7
1978	N/A		NO SURVEY			
1979	N/A		NO SURVEY			

Appendix C, Table 1, continued.

Year	Date	Redds	Live [a]	Dead [b]		Total
				Males	Females	
1980	8-Sep	38	47	3		50
1981	11-Sep	67	55	3		58
1982	N/A	27	5	11		16
1983	13-Sep	40	25	8		33
1984	11-Sep	31	26	15		41
1985	9-Sep	50	37	7	6	50
1986	9-Sep	20	31	0	2	33
1987	9-Sep	32	57	3	2	62
1988	14-Sep	7	16	3	3	22
1989	13-Sep	16	21	2	3	26
1990	12-Sep	13	24	7	0	31
1991	11-Sep	4	12	0	0	12
1992	9-Sep	27	37	1	1	39
1993	8-Sep	20	28	1	0	29
1994	8-Sep	1	1	0	0	1
1995	25-Sep	0	0	0	0	0
1996	11-Sep	0	1	0	0	1
1997	10-Sep	3	5	0	0	5

a Live fish include jacks which may be alive or dead. No distinction was made during early year survey data.
b From 1954-1985 no distinction was made between males and females. Dead carcasses found are all listed as males, though females were found.

Table 2. Number of salmon redds, live fish, and carcasses found on North Fork Asotin Creek from 1984-1997.

Year	84	85	86	87	88	89	90	91	92	93	94	95	96	97
Redds	21	8	1	3	1	0	2	0	0	2	0	0	0	0
Live Fish	12	7	3	6	0	0	0	0	0	0	0	0	0	0
Carcasses	5	1	0	0	0	0	0	0	0	1	0	0	0	0

APPENDIX D

List of index total count snorkel sites sampled in 1997 and habitat survey estimates. Surveys sites were conducted by "habitat" type (Table 1) and by "long" sites (Table 2) which consists of multiple habitat types within one site.

Table 1. Juvenile salmon counted by total count snorkel surveys and density estimates (fish/100 $m^{2)}$ for subyearling, yearling natural salmon, and yearling hatchery chinook by habitat type in the Tucannon River, 1997.

					Number of salmon			Fish/100 m^2		
			Habitat	Snorkeled	Natural		Hatchery	Natural		Hatchery
Stratum	Site	Date	Type	Area (m^2)	<0	>1+	>1+	<0	>1+	>1+
Marengo	MAR 01	Aug 06	Run	144.14	0	0	0	0.00	0.00	0.00
	MAR 02	Aug 06	Riffle	86.18	0	0	0	0.00	0.00	0.00
	MAR 03	Aug 06	Pool	213.53	1	0	0	0.47	0.00	0.00
	MAR 04	Aug 06	Pool	145.69	1	0	0	0.69	0.00	0.00
	MAR 05	Aug 06	Run	213.07	0	0	0	0.00	0.00	0.00
	MAR 06	Aug 06	Run	125.93	1	0	0	0.79	0.00	0.00
	MAR 07	Aug 06	Riffle	244.80	0	0	0	0.00	0.00	0.00
	MAR 08	Aug 06	Pool	144.97	5	0	0	3.45	0.00	0.00
	MAR 09	Aug 06	Pool	69.16	1	0	0	1.45	0.00	0.00
	MAR 10	Aug 06	Riffle	216.77	0	0	0	0.00	0.00	0.00
	MAR 11	Aug 06	Run	168.41	0	0	0	0.00	0.00	0.00
	MAR 12	Aug 06	Riffle	142.27	0	0	0	0.00	0.00	0.00
	MAR SC-1	Aug 06	S.C.	76.11	0	0	0	0.00	0.00	0.00
	MAR SC-2	Aug 06	S.C.	40.66	0	0	0	0.00	0.00	0.00
	MAR SC-3	Aug 06	S.C.	43.34	0	0	0	0.00	0.00	0.00
Hartsock	HART 01	Aug 05	Riffle	99.06	0	0	0	0.00	0.00	0.00
	HART 02	Aug 05	Pool	69.00	0	0	0	0.00	0.00	0.00
	HART 03	Aug 05	Run	161.42	3	0	0	1.86	0.00	0.00
	HART 04	Aug 05	Pool	79.27	7	0	0	8.83	0.00	0.00
	HART 05	Aug 05	Riffle	186.90	0	0	0	0.00	0.00	0.00
	HART 06	Aug 05	Run	149.93	2	0	0	1.33	0.00	0.00
	HART 07	Aug 05	Run	164.13	0	0	0	0.00	0.00	0.00
	HART 08	Aug 05	Pool	188.10	5	0	0	2.66	0.00	0.00
	HART 09	Aug 05	Riffle	236.90	0	0	0	0.00	0.00	0.00
	HART 10	Aug 05	Pool	142.20	15	0	0	10.55	0.00	0.00
	HART 11	Aug 05	Run	101.09	7	0	0	6.92	0.00	0.00
	HART 12	Aug 05	Riffle	188.70	0	0	0	0.00	0.00	0.00
	HART 13	Aug 05	Pool	144.32	12	0	1	8.31	0.00	0.69
	HART 14	Aug 04	Riffle	139.04	0	0	0	0.00	0.00	0.00
	HART 15	Aug 04	Run	121.50	3	0	1	2.47	0.00	0.82
	HART 16	Aug 04	Run	270.09	5	0	0	1.85	0.00	0.00
	HART 17	Aug 04	Pool	80.32	1	0	1	1.25	0.00	1.25
	HART 18	Aug 04	Riffle	89.73	0	0	0	0.00	0.00	0.00
	HART 19	Aug 04	Riffle	126.14	0	0	0	0.00	0.00	0.00
	HART 20	Aug 11	Pool	89.04	4	0	0	4.49	0.00	0.00
	HART 21	Aug 13	Run	102.60	0	0	0	0.00	0.00	0.00

Appendix D, Table 1, continued,

Stratum	Site	Date	Habitat Type	Snorkeled Area (m^2)	Number of salmon			Fish/100 m^2		
					Natural		Hatchery	Natural		Hatchery
					<0	>1+	>1+	<0	>1+	>1+
Hartsock	HART SC-1	Aug 04	S.C.	41.10	0	0	0	0.00	0.00	0.00
	HART SC-2	Aug 04	S.C.	92.82	3	0	0	3.23	0.00	0.00
	HART SC-3	Aug 07	S.C.	75.94	0	0	0	0.00	0.00	0.00
	HART SC-4	Aug 07	S.C.	52.78	0	0	0	0.00	0.00	0.00
	HART SC-5	Aug 11	S.C.	94.30	7	0	0	7.42	0.00	0.00
HMA	HMA 01	Aug 04	Run	95.25	0	0	0	0.00	0.00	0.00
	HMA 02	Aug 04	Riffle	240.60	0	0	0	0.00	0.00	0.00
	HMA 03	Aug 04	Pool	155.95	3	0	1	1.92	0.00	0.64
	HMA 04	Aug 04	Riffle	217.14	0	0	0	0.00	0.00	0.00
	HMA 05	Aug 04	Run	158.12	0	0	0	0.00	0.00	0.00
	HMA 06	Aug 04	Pool	162.80	0	0	4	0.00	0.00	2.46
	HMA 07	Aug 04	Pool	158.86	0	0	1	0.00	0.00	0.63
	HMA 08	Aug 04	Riffle	135.63	0	0	0	0.00	0.00	0.00
	HMA 09	Aug 04	Run	151.31	0	0	0	0.00	0.00	0.00
	HMA 10	Aug 04	Run	167.86	1	0	0	0.60	0.00	0.00
	HMA 11	Aug 07	Pool	104.80	0	0	1	0.00	0.00	0.95
	HMA 12	Aug 07	Riffle	186.68	1	0	0	0.54	0.00	0.00
	HMA 13	Aug 07	Pool	84.17	4	0	0	4.75	0.00	0.00
	HMA 14	Aug 13	Riffle	149.44	0	0	0	0.00	0.00	0.00
	HMA 15	Aug 07	Run	112.87	5	0	0	4.43	0.00	0.00
	HMA 16	Aug 07	Riffle	220.89	0	0	0	0.00	0.00	0.00
	HMA 17	Aug 07	Pool	101.64	2	0	0	1.97	0.00	0.00
	HMA 18	Aug 07	Run	100.80	9	0	0	8.93	0.00	0.00
	HMA 19	Aug 07	Run	244.76	5	0	0	2.04	0.00	0.00
	HMA 20	Aug 07	Riffle	109.14	4	0	0	3.67	0.00	0.00
	HMA 21	Aug 07	Pool	112.95	3	0	0	2.66	0.00	0.00
	HMA 22	Aug 07	Run	96.53	7	0	0	7.25	0.00	0.00
	HMA 23	Aug 07	Pool	58.74	10	0	0	17.02	0.00	0.00
	HMA 24	Aug 07	Riffle	151.20	3	0	0	1.98	0.00	0.00
	HMA 25	Aug 11	Pool	163.51	7	0	0	4.28	0.00	0.00
	HMA 26	Aug 11	Riffle	212.87	0	0	0	0.00	0.00	0.00
	HMA 27	Aug 07	Run	96.07	8	0	0	8.33	0.00	0.00
	HMA SC-1	Aug 13	S.C.	133.76	0	0	0	0.00	0.00	0.00
	HMA SC-2	Aug 13	S.C.	101.00	0	0	0	0.00	0.00	0.00
	HMA SC-3	Aug 07	S.C.	36.98	0	0	0	0.00	0.00	0.00
	HMA SC-5	Aug 07	S.C.	127.50	3	0	0	2.35	0.00	0.00
	HMA SC-6	Aug 11	S.C.	28.75	3	0	0	10.44	0.00	0.00
Wilderness	WILD 01	Aug 18	Riffle	88.80	0	0	0	0.00	0.00	0.00
	WILD 02	Aug 18	Pool	60.26	8	0	0	13.28	0.00	0.00
	WILD 03	Aug 18	Run	102.09	30	0	0	29.39	0.00	0.00
	WILD 04	Aug 18	Riffle	73.92	0	0	0	0.00	0.00	0.00
	WILD 05	Aug 18	Run	85.56	0	0	0	0.00	0.00	0.00
	WILD 06	Aug 18	Pool	42.96	0	0	0	0.00	0.00	0.00
	WILD 07	Aug 18	Pool	36.73	0	0	0	0.00	0.00	0.00
	WILD 08	Aug 18	Run	83.52	0	0	0	0.00	0.00	0.00

Appendix D, Table 1, continued,

Stratum	Site	Date	Habitat Type	Snorkeled Area (m^2)	Number of salmon			Fish/100 m^2		
					Natural		Hatchery	Natural		Hatchery
					0	>1+	>1+	0	>1+	>1+
Wilderness	WILD 09	Aug 18	Riffle	78.20	0	0	0	0.00	0.00	0.00
	WILD 10	Aug 20	Run	80.56	0	0	0	0.00	0.00	0.00
	WILD 11	Aug 20	Pool	32.20	0	0	0	0.00	0.00	0.00
	WILD 12	Aug 20	Riffle	60.11	0	0	0	0.00	0.00	0.00
	WILD 13	Aug 20	Pool	67.32	0	0	0	0.00	0.00	0.00
	WILD 14	Aug 20	Riffle	92.73	0	0	0	0.00	0.00	0.00
	WILD 15	Aug 20	Run	46.80	0	0	0	0.00	0.00	0.00
	WILD SC-1	Aug 18	S.C.	66.51	7	0	0	10.53	0.00	0.00
	WILD SC-2	Aug 18	S.C.	33.57	0	0	0	0.00	0.00	0.00
	WILD SC-3	Aug 18	S.C.	31.50	0	0	0	0.00	0.00	0.00
	WILD SC-4	Aug 20	S.C.	14.49	0	0	0	0.00	0.00	0.00
	WILD SC-5	Aug 20	S.C.	35.36	0	0	0	0.00	0.00	0.00
Total Area Snorkeled - All Strata				10,953.18	206	0	7			

Table 2. Juvenile salmon counted by total count snorkel surveys and density estimates in fish/100m2 for subyearling, yearling natural salmon, and yearling hatchery chinook by general type in the Tucannon River, 1997.

Stratum	Site	Date	Habitat Type	Snorkeled Area (m^2)	Number of salmon			Fish/100 m^2		
					Natural		Hatchery	Natural		Hatchery
					0	>1+	>1+	0	>1+	>1+
Marengo	TUC 01	Aug 07	general	295.80	2	0	0	0.68	0.00	0.00
	TUC 02	Aug 07	general	508.09	0	0	0	0.00	0.00	0.00
	TUC 03	Aug 11	general	410.40	0	0	0	0.00	0.00	0.00
Hartsock	TUC 04	Aug 11	general	404.40	5	0	0	1.24	0.00	0.00
	TUC 05	Aug 11	general	309.00	3	0	0	0.97	0.00	0.00
	TUC 06	Aug 07	general	349.80	5	0	0	1.43	0.00	0.00
	TUC 07	Aug 07	general	357.60	1	0	0	0.28	0.00	0.00
	TUC 08	Aug 07	general	441.60	0	0	0	0.00	0.00	0.00
	TUC 08A	Aug 26	general	399.60	8	0	0	2.00	0.00	0.00
	TUC 09	Aug 11	general	403.20	0	0	0	0.00	0.00	0.00
	TUC 10	Aug 13	general	180.60	0	0	0	0.00	0.00	0.00
HMA	TUC 11	Aug 06	general	484.80	2	0	0	0.41	0.00	0.00
	TUC 12	Aug 06	general	382.80	6	1	0	1.57	0.26	0.00
	TUC 13	Aug 11	general	387.60	1	0	0	0.26	0.00	0.00
	TUC 14	Aug 13	general	352.20	2	0	1	0.57	0.00	0.28
	TUC 15	Aug 11	general	292.20	0	0	0	0.00	0.00	0.00
	TUC 16	Aug 11	general	256.80	0	0	0	0.00	0.00	0.00
	TUC 17	Aug 06	general	388.20	1	0	0	0.26	0.00	0.00
	TUC 18	Aug 06	general	214.93	0	0	0	0.00	0.00	0.00

Appendix D, Table 2, continued,

Stratum	Site	Date	Habitat Type	Snorkeled Area (m^2)	Number of salmon: Natural <0	Number of salmon: Natural 1+	Number of salmon: Hatchery 1+	Fish/100 m^2: Natural <0	Fish/100 m^2: Natural 1+	Fish/100 m^2: Hatchery 1+
HMA	TUC 19	Aug 06	general	406.20	1	0	0	0.25	0.00	0.00
	TUC 19A	Aug 26	general	256.20	5	0	0	1.95	0.00	0.00
	TUC 20	Aug 06	general	327.00	0	0	0	0.00	0.00	0.00
	TUC 20A	Aug 26	general	393.00	5	0	0	1.27	0.00	0.00
	TUC 21	Aug 06	general	318.68	0	0	0	0.00	0.00	0.00
	TUC 22	Aug 11	general	307.80	4	0	0	1.30	0.00	0.00
	TUC 23	Aug 26	general	559.20	2	0	0	0.36	0.00	0.00
Wilderness	TUC 24	Aug 25	general	222.00	2	0	0	0.90	0.00	0.00
	TUC 25	Aug 18	general	187.80	0	0	0	0.00	0.00	0.00
	TUC 26	Aug 18	general	283.20	0	0	0	0.00	0.00	0.00
	TUC 27	Aug 18	general	233.40	0	0	0	0.00	0.00	0.00
	TUC 28	Aug 27	general	135.60	0	0	0	0.00	0.00	0.00
Totals - All Strata				10,449.69	55	1	1			

Table 3. Estimates of area (m^2) for habitat types within four designated strata of the Tucannon River Watershed.

Stratum	Riffle	Run	Pool	Side Channel	Total
Wilderness	52,602	8,736	916	2,265	64,519
HMA	140,941	50,418	7,115	6,934	205,408
Hartsock	89,406	73,213	3,704	8,933	175,256
Marengo	31,352	20,982	2,236	6,260	60,830
Total	314,301	153,349	13,971	24,392	506,013

APPENDIX E

Estimate of yearling (natural and hatchery origin) spring chinook salmon emigrating from the Tucannon River from 31 March through 2 July, 1997. Periods when trap was not operating are indicated by NT (not trapping). Estimated number of salmon and estimated trapping efficiency during NT periods was based on the average of three days proceeding and following the break in trapping. Hatchery fish are designated by elastomer color and location (LB: left side-blue; RB right side-blue; RR right side-red).

	Number of fish captured				Number of fish estimated				Natural	Hatchery	Point Estimate			
Date	Natural	LB	RB	RR	Natural	LB	RB	RR	Trap Effic.	Trap Effic.	Natural	LB	RB	RR
3/31	0	0	0	0						0.176	0	0	0	0
4/01	0	0	0	0						0.176	0	0	0	0
4/02	0	0	0	1						0.176	0	0	0	6
4/03	0	0	0	0						0.176	0	0	0	0
4/04	0	0	0	5						0.176	0	0	0	28
4/05	NT	NT	NT	NT	0	0	0	2		0.176	0	0	0	11
4/06	NT	NT	NT	NT	0	0	0	2		0.176	0	0	0	11
4/07	0	0	1	2						0.176	0	0	6	11
4/08	0	0	0	0						0.176	0	0	0	0
4/09	0	1	1	2						0.176	0	6	6	11
4/10	0	0	1	1						0.176	0	0	6	6
4/11	0	1	0	4						0.176	0	6	0	23
4/12	NT	NT	NT	NT	0	2	3	7		0.176	0	11	17	40
4/13	NT	NT	NT	NT	0	2	3	7		0.188	0	11	16	37
4/14	NT	NT	NT	NT	0	2	3	7		0.200	0	10	15	35
4/15	0	1	3	6						0.200	0	5	15	30
4/16	0	4	1	8						0.200	0	20	5	40
4/17	0	4	10	21						0.200	0	20	50	105
4/18	0	13	14	20						0.200	0	65	70	100
4/19	NT	NT	NT	NT	0	6	8	18		0.200	0	30	40	90
4/20	NT	NT	NT	NT	0	6	8	18		0.194	0	31	41	93
4/21	NT	NT	NT	NT	0	6	8	18		0.188	0	32	43	96
4/22	NT	5	4	12						0.188	0	27	21	64
4/23	0	6	12	30						0.188	0	32	64	160
4/24	0	6	4	17						0.188	0	32	21	91
4/25	0	4	6	15						0.188	0	21	32	80
4/26	NT	NT	NT	NT	0	5	5	45		0.188	0	27	27	240
4/27	NT	NT	NT	NT	0	5	5	45		0.256	0	20	20	176
4/28	0	1	5	76						0.256	0	4	20	297
4/29	0	4	1	53						0.256	0	16	4	207
4/30	0	10	2	80						0.256	0	39	8	313
5/01	0	8	5	70						0.256	0	31	20	274
5/02	0	2	7	68						0.256	0	8	27	266
5/03	NT	NT	NT	NT	0	10	8	102		0.256	0	39	31	399
5/04	NT	NT	NT	NT	0	10	8	102		0.040	0	250	200	2550
5/05	0	16	10	123						0.040	0	400	250	3075
5/06	0	13	14	138						0.040	0	325	350	3450
5/07	0	11	12	132						0.040	0	275	300	3300
5/08	0	11	12	85						0.040	0	275	300	2125
5/09	0	14	5	52						0.040	0	350	125	1300
5/10	NT	NT	NT	NT	0	10	10	67		0.040	0	250	250	1675
5/11	NT	NT	NT	NT	0	10	10	67		0.229	0	44	44	292
5/12	0	10	9	67						0.229	0	44	39	292
5/13	0	7	10	35						0.229	0	31	44	153
5/14	0	4	9	28						0.229	0	17	39	122
5/15	0	5	5	14						0.229	0	22	22	61
5/16	0	0	6	10						0.229	0	0	26	44
5/17	NT	NT	NT	NT	0	3	4	11		0.229	0	13	17	48
5/18	NT	NT	NT	NT	0	3	4	11		0.176	0	17	23	62

Appendix E, continued.

Date	Number of fish captured				Number of fish estimated				Natural Trap Effic.	Hatchery Trap Effic.	Point Estimate			
	Natural	LB	RB	RR	Natural	LB	RB	RR			Natural	LB	RB	RR
5/19	0	2	1	2						0.176	0	11	6	11
5/20	0	4	1	8						0.176	0	23	6	45
5/21	0	0	0	4						0.176	0	0	0	23
5/22	0	1	3	10						0.176	0	6	17	57
5/23	0	0	0	8						0.176	0	0	0	45
5/24	NT	NT	NT	NT	0	2	2	6		0.176	0	11	11	34
5/25	NT	NT	NT	NT	0	2	2	6		0.176	0	11	11	34
5/26	NT	NT	NT	NT	0	2	2	6		0.176	0	11	11	34
5/27	NT	NT	NT	NT	0	2	2	6		0.176	0	11	11	34
5/28	0	2	0	7						0.176	0	11	0	40
5/29	0	0	2	3						0.176	0	0	11	17
5/30	0	6	8	3						0.176	0	34	45	17
5/31	MT	NT	NT	NT	0	2	2	2		0.176	0	11	11	11
6/01	MT	NT	NT	NT	0	2	2	2		0.176	0	11	11	11
6/02	NT	NT	NT	NT	0	2	2	2		0.176	0	11	11	11
6/03	0	1	0	1					0.200	0.176	0	6	0	6
6/04	0	3	0	0					0.200	0.176	0	17	0	0
6/05	0	1	0	0					0.200	0.176	0	6	0	0
6/06	0	1	0	0					0.200	0.176	0	6	0	0
6/07	NT	NT	NT	NT	1	1	1	0	0.200	0.176	5	6	6	0
6/08	MT	NT	NT	NT	0	1	0	0	0.200	0.176	0	6	0	0
6/08	2	2	0	0					0.200	0.176	10	11	0	0
6/10	0	0	3	1					0.200	0.176	0	0	17	6
6/11	1	1	0	0					0.200	0.176	5	6	0	0
6/12	0	3	0	0					0.200	0.176	0	17	0	0
6/13	2	0	0	0					0.200	0.176	10	0	0	0
6/14	NT	NT	NT	NT	1	1	1	0	0.200	0.176	5	6	6	0
6/15	NT	NT	NT	NT	1	1	1	0	0.200	0.176	5	6	6	0
6/16	0	0	0	0					0.200	0.176	0	0	0	0
6/17	2	0	0	0					0.200	0.176	10	0	0	0
6/18	0	0	0	0					0.200	0.176	0	0	0	0
6/19	2	0	1	0					0.200	0.176	10	0	6	0
6/20	1	0	0	0					0.200	0.176	5	0	0	0
6/21	NT	NT	NT	NT	1	0	0	0	0.200		5	0	0	0
6/22	NT	NT	NT	NT	1	0	0	0	0.200		5	0	0	0
6/23	0								0.200		0	0	0	0
6/24	1								0.200		5	0	0	0
6/25	0								0.200		0	0	0	0
6/26	1								0.200		5	0	0	0
6/27	0								0.200		0	0	0	0
6/28	NT	NT	NT	NT	0	0	0	0	0.200		0	0	0	0
6/29	NT	NT	NT	NT	0	0	0	0	0.200		0	0	0	0
6/30	0								0.200		0	0	0	0
7/01	0								0.200		0	0	0	0
7/02	1								0.200		5	0	0	0

APPENDIX F

Contribution of 1985-1993 broods Tucannon River spring chinook salmon to various fisheries and returns to the Tucannon River. Estimated recoveries were obtained from PSMFC CWT database.

Table 1. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1985 brood salmon released (12,922) into the Tucannon River.

Year	Recovery Location	Agency	Observed	Estimated	FL
1988	Hatchery	WDFW	9	14	486
1989	Hatchery	WDFW	23	46	689
	Test Fishery Net	ODFW	1	1	660
TOTALS FOR TAGCODE 63-34-42			33	61	633

Table 2. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1986 brood salmon released into the Tucannon River. (Tagcode 63-41-46: 46,484 released). (Tagcode 63-41-48: 50,332 released). (Tagcode 63-33-25: 51,221 released).

Year	Recovery Location	Agency	Observed	Estimated	FL
1989	Hatchery	WDFW	20	22	487
1990	Hatchery	WDFW	19	66	669
	Spawning Ground	WDFW	5		704
	Test Fishery Net	ODFW	1	1	630
	Treaty Ceremonial	ODFW	1	2	680
1991	Hatchery	WDFW	1	1	840
	Spawning Ground	WDFW	2	14	800
TOTALS FOR TAGCODE 63-41-46			49	105	607
1989	Hatchery	WDFW	33	37	468
	Spawning Ground	WDFW	1		510
1990	Freshwater Sport	WDFW	1	4	
	Hatchery	WDFW	17	60	656
	Ocean Troll (non-treaty)	CDFO	1	4	761
	Spawning Ground	WDFW	11		667
	Treaty Ceremonial	ODFW	1	2	750
1991	Hatchery	WDFW	2	2	795
	Spawning Ground	WDFW	1	7	780
TOTALS FOR TAGCODE 63-41-48			68	116	572
1989	Hatchery	WDFW	21	22	454
	Treaty Troll	WDFW	1	2	550
1990	Hatchery	WDFW	22	76	664
	Spawning Ground	WDFW	10		666
1991	Hatchery	WDFW	1	1	680
TOTALS FOR TAGCODE 63-33-25			55	101	585

Appendix F, continued,

Table 3. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1987 brood salmon released (151,100) into the Tucannon River.

Year	Recovery Location	Agency	Observed	Estimated	FL
1990	Hatchery	WDFW	5	23	500
	Spawning Ground	WDFW	3		557
1991	Hatchery	WDFW	45	45	668
	Spawning Ground	WDFW	20	143	652
1992	Hatchery	WDFW	3	3	780
	Spawning Ground	WDFW	5	17	798
	Treaty Ceremonial	ODFW	1	2	860
TOTALS FOR TAGCODE 63-49-50			82	233	664

Table 4. Observed and estimated recoveries, and mean fork length (FL) in centimeters of 1988 brood salmon released into the Tucannon River. (Tagcode 63-01-42: 70,459 released). (Tagcode 63-55-01: 68,591 released).

Year	Recovery Location	Agency	Observed	Estimated	FL
1990	Fish Trap (freshwater)	WDFW	1		270
1991	Hatchery	WDFW	25	26	492
	Spawning Ground	WDFW	4	29	498
1992	Hatchery	WDFW	19	20	639
	Spawning Ground	WDFW	47	162	682
	Test Fishery Net	ODFW	1	1	640
	Treaty Ceremonial	ODFW	3	7	633
1993	Hatchery	WDFW	4	4	828
	Spawning Ground	WDFW	7	22	865
	Test Fishery Net	ODFW	1	1	830
	Treaty Ceremonial	ODFW	1	2	880
TOTALS FOR TAGCODE 63-01-42			113	273	634
1990	Hatchery	USFWS	1	1	240
1991	Hatchery	WDFW	12	12	478
1992	Freshwater Sport	WDFW	1	4	
	Hatchery	WDFW	20	21	618
	Spawning Ground	WDFW	38	131	685
	Test Fishery Net	ODFW	1	1	690
	Treaty Ceremonial	ODFW	2	4	700
1993	Hatchery	WDFW	3	3	830
	Spawning Ground	WDFW	11	34	819
	Treaty Ceremonial	ODFW	2	4	788
TOTALS FOR TAGCODE 63-55-01			91	216	661

Appendix F, continued,

Table 5. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1989 brood salmon released into the Tucannon River. (Tagcode 63-14-61: 75,661 released). (Tagcode 63-01-31: 22,118 released).

Year	Recovery Location	Agency	Observed	Estimated	FL
1992	Hatchery	WDFW	4	4	505
	Spawning Ground	WDFW	2	7	480
1993	Hatchery	WDFW	31	31	732
	Spawning Ground	WDFW	41	128	703
	Test Fishery Net	ODFW	2	2	705
	Treaty Ceremonial	ODFW	2	4	688
1994	Hatchery	WDFW	9	9	767
TOTALS FOR TAGCODE 63-14-61			91	184	705
1993	Hatchery	WDFW	6	6	722
	Spawning Ground	WDFW	18	56	719
	Treaty Ceremonial	ODFW	2	4	740
	Treaty Troll	WDFW	2	2	670
1994	Hatchery	WDFW	5	5	798
TOTALS FOR TAGCODE 63-01-31			33	73	731

Table 6. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1990 brood salmon released into the Tucannon River. (Tagcode 63-37-25: 13,480 released). (Tagcode 63-40-21: 51,149 released). (Tagcode 63-43-11: 21,108 released).

Year	Recovery Location	Agency	Observed	Estimated	FL
1994	Hatchery	WDFW	1	1	630
TOTALS FOR TAGCODE 633725			1	1	630
1993	Hatchery	WDFW	1	1	400
1993	Spawning Ground	WDFW	1	3	500
1994	Hatchery	WDFW	9	9	713
1995	Hatchery	WDFW	1	1	900
TOTALS FOR TAGCODE 634021			12	14	685
1993	Spawning Ground	WDFW	1	3	480
1994	Hatchery	WDFW	6	6	685
1995	Hatchery	WDFW	1	1	770
TOTALS FOR TAGCODE 634311			8	10	670

Appendix F, continued,

Table 7. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1991 brood salmon released into the Tucannon River. (Tagcode 63-46-25: 55,716 released). (Tagcode 63-46-47: 16,745 released).

Year	Recovery Location	Agency	Observed	Estimated	FL
1994	Hatchery	WDFW	1	1	470
1995	Hatchery	WDFW	11	11	729
	Treaty Ceremonial	ODFW	1	3	780
TOTALS FOR TAGCODE 634625			13	15	713
1994	Hatchery	WDFW	3	3	470
1995	Hatchery	WDFW	9	9	741
TOTALS FOR TAGCODE 634647			12	12	673

Table 8. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1992 brood salmon released into the Tucannon River. (Tagcode 63-48-10: 35,405 released). (Tagcode 63-48-23: 24,883 released). (Tagcode 63-48-55; 8,277). (Tagcode 63-49-05; 35,469).

Year	Recovery Location	Agency	Observed	Estimated	FL
1995	Hatchery	USFWS	1	1	420
	Hatchery	WDFW	6	6	495
1996	Hatchery	USFWS	1	1	760
	Hatchery	WDFW	16	16	708
TOTALS FOR TAGCODE 634810			24	24	645
1994	Mixed Net and Seine	CDFO	1	2	376
1995	Fish Trap (freshwater)	ODFW	1	1	540
1996	Hatchery	WDFW	2	2	730
TOTALS FOR TAGCODE 634823			4	5	594
1996	Hatchery	WDFW	4	4	700
1995	Fish Trap (freshwater)	ODFW	1	1	460
1996	Hatchery	WDFW	4	4	700
TOTALS FOR TAGCODE 634855			5	5	652
1995	Hatchery	WDFW	5	5	484
1996	Hatchery	USFWS	1	1	690
	Hatchery	WDFW	13	13	719
TOTALS FOR TAGCODE 634905			19	19	656

Appendix F, continued,

Table 9. Observed and estimated recoveries, and mean fork length (FL) in millimeters of 1993 brood salmon released into the Tucannon River. (Tagcode 63-53-43: 44,940 released). (Tagcode 63-53-44: 42,807 released). (Tagcode 63-56-18:18,158).

Year	Recovery Location	Agency	Observed	Estimated	FL
1996	Hatchery	WDFW	3	3	453
	Ocean Sport	CDFO	1	3	
TOTALS FOR TAGCODE 635343			4	6	453
1996	Hatchery	WDFW	2	2	480
TOTALS FOR TAGCODE 635344			2	2	480
1996	Hatchery	WDFW	2	2	500
TOTALS FOR TAGCODE 635618			2	2	500