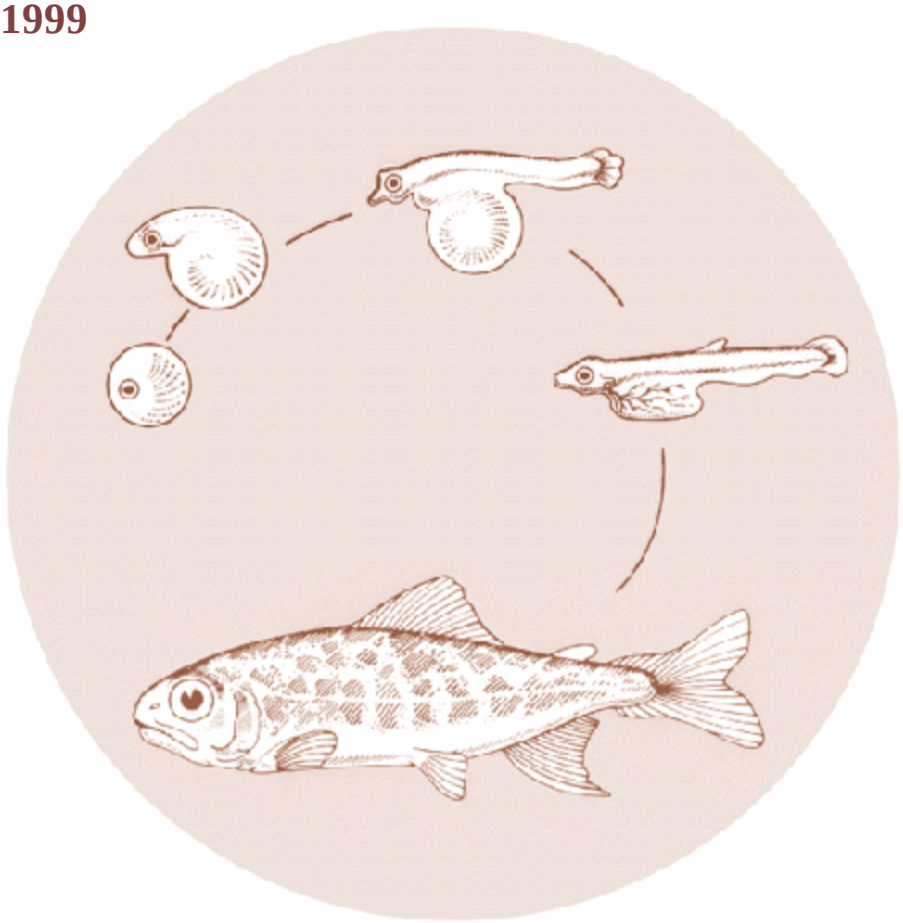
Grande Ronde Basin Chinook Salmon Captive Brood and Conventional Supplementation Programs

Annual Report
1999



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ANNUAL REPORT

PROJECT TITLE**:** Grande Ronde Basin Chinook Salmon Captive Brood and Conventional Supplementation Programs

Permit Holder: Oregon Department of Fish and Wildlife

Permit Number: Endangered Species Permit No. 1011

Permit Contact: Richard W. Carmichael

Permit Period: January 1, 1999 through December 31, 1999

Contributors: Oregon Department of Fish and Wildlife
National Marine Fisheries Service
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Permit Number 1011 (formerly Permit # 973) authorized ODFW to take listed spring chinook salmon juveniles from Catherine Creek and the Lostine and Grande Ronde rivers for scientific research and enhancement purposes. Special condition 2a specified the need for an annual report prior to initiation of next year's work.

Captive Broodstock Project

1) Activities conducted

1994 Cohort

As of 31 December 1998 there were 143, eight and 71 fish remaining alive from Catherine Creek, and the upper Grande Ronde and Lostine rivers stocks respectively. As of 31 December 1999 there were 17, 3 and 0 fish remaining alive from Catherine Creek, and the Lostine and upper Grande Ronde rivers respectively. Therefore, a total of 202 fish were removed from the population in 1999 (126 CC, 68 LR and 8 GR). Of these fish 158 were spawned or had semen cryopreserved (114 CC, 40 LR and 4 GR). An additional 26 died from disease (6 CC, 7 LR and 3 GR), 17 died from other or unknown causes (6 CC, 10 LR and 1 GR). No fish died from experimental procedures, but one LR fish was unaccounted for. Most fish removed from the population in 1999 were sent to either the Clackamas, La Grande or Manchester Fish Health Labs. Appendix A contains a detailed account of the Fish Health Lab findings.

1995 Cohort

As of December 31, 1998 there were 221 and 188 fish remaining alive from the Catherine Creek and Lostine River stocks respectively. As of 31 December 1999 there were 80 and 30 fish remaining alive from Catherine Creek and the Lostine River respectively. Therefore a total of 299 fish were removed from the population in 1999 (141 CC and 158 LR). Of these fish 206 were spawned or had semen cryopreserved (93 CC and 113 LR), 65 died from disease (32 CC, and 33 LR) and 26 died from other or unknown cause (14 CC and 12 LR). None died from experimental procedures, but two CC fish were unaccounted for. Most fish removed from the population in 1998 were sent to either the Clackamas, La Grande or Manchester Fish Health Labs. Appendix A contains a detailed account of the Fish Health Lab findings.

1996 Cohort

As of 31 December 1998 there were 470, 446 and 468 fish remaining alive from the Catherine Creek and the Lostine and Grande Ronde river stocks respectively. As of 31 December 1999 there were 283, 263 and 267 fish remaining alive from Catherine Creek, and the Lostine and upper Grande Ronde rivers respectively. Therefore a total of 571 fish were removed from the population in 1999 (187 CC, 183 LR, and 201 GR). Of these fish, 397 were spawned or had semen cryopreserved (146 CC 114 LR and 137 GR), 34 died from disease (15 CC, 12 LR and 7 GR) and 166 died from other or unknown cause (26 CC, 83 LR and 57 GR). No fish died from experimental procedures, but 5 LR fish were unaccounted for. Most fish removed from the population in 1998 were sent to either the Clackamas, La Grande or Manchester Fish Health Labs. Appendix A contains a detailed account of the Fish Health Lab findings.

1997 Cohort

As of 31 December 1998 there were 493 , 496 and 497 fish remaining alive from the Catherine Creek and the Lostine and Grande Ronde river stocks respectively. As of 31 December 1999 there were 450, 428 and 442 fish remaining alive from Catherine Creek, and the Lostine and upper Grande Ronde rivers respectively. Therefore a total of 166 fish were removed from the population in 1999 (43 CC, 68 LR, and 55 GR). Of these fish, 113 were spawned or had semen cryopreserved

(25 CC 48 LR and 40 GR), 14 died from disease (6 CC and 8 LR) and 39 died from other or unknown cause (12 CC, 12 LR and 15 GR). No fish died from experimental procedures and no fish were unaccounted for. Most fish removed from the population in 1998 were sent to either the Clackamas, La Grande or Manchester Fish Health Labs. Appendix A contains a detailed account of the Fish Health Lab findings.

A complete inventory and vibrio vaccinations of all 1997 cohort fish occurred on 12 to 14 April 1999. No salinity tolerance tests were conducted on captive broodstock in 1999 due to the successful transfer of sentinel fish to MML in 1997 and 1998. Following successful sentinel transfers, all remaining fish (158 CC, 160 LR and 167 GR) were transferred to MML on 21 May.

In early August a total of 978 fish at Bonneville Hatchery and 482 fish at Manchester Marine Laboratory were tagged with Visual Implant (VI) tags. At Bonneville Hatchery, 325 Catherine Creek, 324 Lostine River and 329 Grande Ronde River fish were tagged. At Manchester Marine Laboratory, 157 Catherine Creek, 159 Lostine River and 166 Grande Ronde River fish were tagged. At the time of the VI tagging a complete inventory, and maturity check was done, and all fish were given an injection of erythromycin.

1998 Cohort

Due to concerns about the contraction and expression of BKD in captive fish, a series of precautionary measures were initiated prior to parr collection in 1998. These precautionary measures included: 1) disinfection of all field equipment prior to entering the Lookingglass Hatchery grounds, 2) use of well water from Lookingglass Hatchery rather than creek water for transporting fish from their respective collection sites to Lookingglass Hatchery, and 3) injection of all collected parr upon their arrival at Lookingglass Hatchery with erythromycin at 20 mg/kg body weight. These precautionary measures are now a part of the Captive Broodstock program standard operating procedures and therefore were also used in 1999. Several measures were also taken to minimize disturbance at Lookingglass Hatchery. We used sanctuary nets when transferring fish to and from troughs, and plastic curtains have been hung around rearing troughs to minimize stress associated with outside disturbances.

As in previous years, juvenile salmon were collected using a passive seining technique that combines snorkeling and seining. Using this method, 500 spring chinook salmon parr from Catherine Creek and the upper Grande Ronde River, and 498 from the Lostine River were collected for the Captive Broodstock project during August and September 1999 (Table 1). During each day of collection all collected fish were transferred to Lookingglass Hatchery, anesthetized with 40-50 ppm MS222, length and weight measurements were taken (Table 2), and each fish was given an intraperitoneal injection of erythromycin at a rate of 20mg/kg body weight. These fish were then allowed to recover in fresh water prior to being placed in rearing troughs.

Approximately two and one-half months following collection, all fish were again weighed and measured, 134.2 kHz PIT tags inserted, and fin samples taken for genetics analysis. Prior to tagging fish were collected from each trough and anesthetized with 40-50 ppm MS222. Fish were tagged using needles that were sterilized in 70% ethanol for a minimum of ten minutes. Fish were allowed to recover in fresh water following these procedures and were then returned to their respective troughs.

Of the original 1,498 fish collected 1,480 fish were still alive at LFH as of 31 December 1999 (492, 495 and 493 fish from Catherine Creek, and the Lostine and Grande Ronde rivers respectively) Table 3. Of the 18 fish which have been removed from the population, five died from temperature - related stress during transfer to Lookingglasss Hatchery, three died immediately following PIT tagging, and 10 died from other or unknown causes (Table 4). All fish were accounted for and no fish died from experimental procedures

Table 1. Take of 1998 cohort parr spring chinook salmon from three separate populations in the Grande Ronde basin in 1999.

	Stock		
	Catherine Creek	Lostine River	Grande Ronde River
Dates of take	16-18 August	23-25 August	30 Aug – 1 Sept
Number collected & retained	500	498	500

Table 2. Mean fork lengths (FL), weights (W) and sample size (n) of 1998 cohort spring chinook salmon captive broodstock during their first four months of captivity.

		Stock								
		Catherine Creek			Lostine River			Grande Ronde River		
Activity	Date	N	FL (mm)	W (g)	N	FL (mm)	W (g)	N	FL (mm)	W (g)
Capture	8/16-18/99	500	75.1	6.1	-----	-----	-----	-----	-----	-----
	8/23-25/99	-----	-----	-----	498	74.6	6.4	-----	-----	-----
	8/30-9/1/99	-----	-----	-----	-----	-----	-----	500	60.0	3.2
Tagging	11/2-4/99	492	104.4	14.6	498	104.6	13.9	495	98.5	12.0

Table 3. Number and disposition of 1998 cohort spring chinook salmon taken to Lookingglass Hatchery for captive broodstock in 1999.

Activity	Stock		
	Catherine Creek	Lostine River	Grande Ronde River
Transported	500	498	500
Ponded	494	498	500
PIT tagged & genetic samples taken	492	496	495
On station (12/31/99)	492	495	493

Table 4. Activities associated with 1998 cohort captive broodstock removed from the population in 1999.

	Stocks		
Cause of loss	Catherine Creek	Lostine River	Grande Ronde River
Collection & transport	5	0	0
PIT-tagging	0	2	1
Disease	0	0	0
Other / Unknown	3	1	6
Total	8	3	7

2) Maturity and Spawning

Fish from the 1994 - 1996 cohorts were first examined for signs of maturity on May 24-26 at Bonneville Hatchery and the Manchester Marine Laboratory. The 1997 cohort fish were first examined for signs of maturity on August 2-5 at Bonneville Hatchery and Manchester Marine Laboratory. Additional maturity sorts were conducted for each cohort and stock based on guidelines in the 1999 Captive Broodstock AOP. No maturity sortings were done for 1998 cohort fish. Maturity data includes all fish which were assumed to be maturing whether they survived to gamete collection, died prior to gamete collection, or fish which were later determined to be immature and therefore returned to immature tanks.

Following maturity sortings, maturing fish were examined regularly for ripeness. These ripeness sortings took place at Bonneville Hatchery on seven occasions between 9 September and 19 October. No ripeness sorting was done at the Manchester Marine Laboratory.

Gametes were collected from fish from the 1994 –1997 cohorts in 1999. Males in excess of what was needed to spawn had their semen collected, cryopreserved and stored. Approximately one-half of these samples are being stored at Bonneville Hatchery and the other half are being stored the Regional repository at the Univesity of Idaho in Moscow, Idaho. All spawning was done using spawning matrices which were developed following guidelines identified in the 1999 captive broodstock AOP. One hundred twenty-nine matrices were used in 1999.

1994 Cohort

A total of 176 fish from the 94 cohort were determined to be maturing during 1999 (Table 5). Of the maturing fish, 158 ripened and were spawned (Table 6). No fish had their semen cryopreserved. All of the remaining 18 fish died prior to gamete collection. Of the 158 fish that were spawned, 152 were females and 6 were males. No cryopreserved semen from 1994 cohort males was used. A total of 263,933 eggs were collected; an average fecundity of 1,736 eggs per female. Of the eggs collected 205,181 (77.8 %) survived to the eyed stage (Table 7).

Table 5 . Number of 1994 cohort fish sorted as maturing in 1999. All fish were reared in a natural growth profile treatment.

			Treatment	
Sorting dates	Location	Stock	Freshwater	Seawater
May 24	Manchester	Catherine Creek	----	26
		Lostine River	----	25
May 26	Bonneville	Catherine Creek	44	----
		Lostine River	8	----
		Grande Ronde River	0	----
June 22	Manchester	Catherine Creek	----	0
		Lostine River	----	2
June 21	Bonneville	Catherine Creek	40	----
		Lostine River	12	----
		Grande Ronde River	2	----
July 16	Bonneville	Catherine Creek	5	----
		Lostine River	5	----
		Grande Ronde River	4	----
August 23	Bonneville	Catherine Creek	3	----
		Lostine River	0	----
		Grande Ronde River	0	----
All	All	Catherine Creek	92	26
All	All	Lostine River	25	27
All	All	Grande Ronde River	6	----
All	All	All	123	53

Table 6. Summary of 1994 cohort gamete collection during 1999.

Stock	Sex	Treatment	N	Mean FL (mm)	Mean WT (g)	Spawned	Cryoed
CC	M	Fn	2	466.5	1,468.7	2	0
CC	F	Fn	84	531.0	2,150.0	85	0
CC	M	Sn	3	533.3	1,565.6	3	0
CC	F	Sn	24	515.1	1,608.0	24	0
LR	M	Fn	0	-----	-----	-----	-----
LR	F	Fn	23	592.6	3,176.2	24	0
LR	M	Sn	1	495.0	1,090.8	1	0
LR	F	Sn	15	528.5	1,753.6	15	0
GR	M	Fn	0	-----	-----	-----	-----
GR	F	Fn	4	488.8	1,606.4	4	0
GR	M	Sn	0	-----	-----	-----	-----
GR	F	Sn	0	-----	-----	-----	-----
Catherine Creek totals						114	0
Lostine River totals						40	0
Grande Ronde River totals						4	0
Total fish contributing gametes from the 1994 cohort						158	0

Table 7. Summary of 1994 cohort egg collection and survival of eggs to the eyed stage in 1999.

Stock	Treatment	N	Total collected	Ave. fecundity	Total survival to eyed stage (No)	Ave. survival to eyed stage (No)	Ave. survival to eyed stage (%)
CC	Fn	85	142,973	1,682	117,092	1,378	81.9
CC	Sn	24	33,747	1,406	20,604	859	61.1
LR	Fn	24	57,737	2,406	48,466	2,019	83.9
LR	Sn	15	25,461	1,697	17,446	1,163	68.5
GR	Fn	4	4,015	1,004	1,573	393	39.2
All	Fn	113	204,725	1,812	167,131	1,479	81.6
All	Sn	39	59,208	1,518	38,050	976	64.3
All	Fish	152	263,933	1,736	205,181	1,350	77.8

1995 Cohort

A total of 238 fish from the 95 cohort were determined to be maturing during maturity sortings (Table 8). Two hundred six of these fish ripened and were either spawned (194) or had semen cryopreserved (12). Of the remaining 32 fish, 28 died prior to spawning, 3 were unaccounted for and 1 never ripened and therefore was returned to its treatment group immature tank. Of the 194 fish that were spawned, 153 were females and 41 were males (Table 9). Cryopreserved semen was used from five males. A total of 244,441 eggs were collected; an average fecundity of 1,598 eggs per female. Of the eggs collected 173,574 (71.0 %) survived to the eyed stage (Table 10).

Table 8. Number of 1995 brood fish sorted as maturing in 1999.

Sorting dates	Location	Stock	Treatment			
			Freshwater		Seawater	Unknown
			Accelerated	Natural	Natural	Unknown
May 24	Manchester	Catherine Creek	-----	-----	21	
		Lostine River	-----	-----	29	
May 26-27	Bonneville	Catherine Creek	10	25	----	
		Lostine River	2	5	----	
June 22	Manchester	Catherine Creek	-----	-----	1	
		Lostine River	-----	-----	6	
June 21-22	Bonneville	Catherine Creek	21	22	----	
		Lostine River	17	40	----	1
July 28	Manchester	Catherine Creek	-----	-----	0	
		Lostine River	-----	-----	1	
July 15	Bonneville	Catherine Creek	1	4	----	1
		Lostine River	11	12	----	5
August 23	Bonneville	Catherine Creek	1	1	----	
		Lostine River	1	0	----	
All	All	Catherine Creek	33	52	22	1
All	All	Lostine River	31	57	36	6
All	All	All	64	109	58	7

Table 9. Summary of 1995 cohort gamete collection during 1999.

Stock	Sex	Treatment	N	Mean FL (mm)	Mean WT (g)	Spawned	Cryoed
CC	M	Fn	22	466.5	1,236.7	23	0
CC	F	Fn	25	518.4	1,805.6	25	0
CC	M	Sn	4	410.8	867.5	4	0
CC	F	Sn	14	497.5	1,572.2	14	0
CC	M	Fa	13	417.5	820.7	1	12
CC	F	Fa	14	489.2	1,552.9	14	0
LR	M	Fn	4	496.5	1,472.1	4	0
LR	F	Fn	48	533.8	2,047.0	49	0
LR	M	Sn	3	462.3	1,243.1	3	0
LR	F	Sn	28	490.1	1,524.9	29	0
LR	M	Fa	5	464.3	1,212.8	6	0
LR	F	Fa	21	516.5	1,866.0	22	0
Catherine Creek totals						81	12
Lostine River totals						113	0
Total fish contributing gametes from the 1995 cohort						194	12

Table 10. Summary of 1995 cohort egg collection and survival of eggs to the eyed stage in 1999.

Stock	Treatment	N	Total collected	Ave. fecundity	Total survival to eyed stage (No)	Ave. survival to eyed stage (No)	Ave. survival to eyed stage (%)
CC	Fn	25	43,118	1,725	31,187	1,247	72.3
CC	Sn	14	20,780	1,484	16,107	1,151	77.6
CC	Fa	14	21,016	1,501	9,197	657	43.8
LR	Fn	49	84,749	1,730	60,309	1,231	71.2
LR	Sn	29	41,688	1,438	32,545	1,122	78.0
LR	Fa	22	33,090	1,504	24,229	1,101	73.2
All	Fn	74	127,867	1,728	91,496	1,236	71.5
All	Sn	43	62,468	1,453	48,652	1,131	77.8
All	Fa	36	54,106	1,503	33,426	929	61.8
All	Fish	153	244,441	1,598	173,574	1,134	71.0

1996 Cohort

A total of 507 fish from the 96 cohort were determined to be maturing during maturity sortings (Table 11). Two hundred fourty-five (245) of these fish were spawned and 151 had semen cryopreserved, (Table 12). Of the remaining 111 fish, 75 died prior to spawning, 3 were unaccounted for and 33 never ripened and therefore were returned to their respective treatment group immature tanks. Of the 245 fish that were spawned, 2 were females and 243 were males (Table 12). Cryopreserved semen was used from 4 males. A total of 3,133 eggs were collected from 2 Freshwater / natural growth females; one Grande Ronde and one Lostine River. The average fecundity was 1,567 eggs per female (2,026 GR and 1,105 LR). Of the eggs collected 1,992 (98.2 %) of the GR and 89 (8.1%) of the LR survived to the eyed stage.

Table 11. Number of 1996 cohort fish sorted as maturing in 1999.

Sorting dates	Location	Stock	Treatment			
			Freshwater		Seawater	Unknown
			Accelerated	Natural	Natural	Unknown
May 25	Manchester	Catherine Creek	-----	-----	32	0
		Lostine River	-----	-----	26	0
		Grande Ronde River	-----	-----	45	0
May 27-28	Bonneville	Catherine Creek	33	43	-----	0
		Lostine River	12	24	-----	0
		Grande Ronde River	22	42	-----	0
June 23	Manchester	Catherine Creek	-----	-----	3	0
		Lostine River	-----	-----	11	0
		Grande Ronde River	-----	-----	0	0
June 22-23	Bonneville	Catherine Creek	24	14	-----	0
		Lostine River	25	28	-----	1
		Grande Ronde River	40	35	-----	0
July 28	Manchester	Catherine Creek	-----	-----	0	0
		Lostine River	-----	-----	2	0
		Grande Ronde River	-----	-----	0	0
July 15	Bonneville	Catherine Creek	9	8	-----	0
		Lostine River	9	4	-----	1
		Grande Ronde River	9	5	-----	0
All	All	Catherine Creek	66	65	35	0
All	All	Lostine River	46	56	39	2
All	All	Grande Ronde River	71	82	45	0
All	All	All	183	203	119	2

Table 12. Summary of 1996 cohort male gamete collection during 1999.

Stock	Sex	Treatment	N	Mean FL (mm)	Mean WT (g)	Spawned	Cryoed
CC	M	Fn	59	436.2	1,116.7	59	0
CC	F	Fn	0	-----	-----	0	0
CC	M	Sn	34	366.5	696.4	34	0
CC	F	Sn	0	-----	-----	0	0
CC	M	Fa	52	431.3	1,190.0	22	31
CC	F	Fa	0	-----	-----	0	0
LR	M	Fn	49	431.3	912.5	49	0
LR	F	Fn	1	425.0	983.7	1	0
LR	M	Sn	37	376.1	684.2	39	0
LR	F	Sn	0	-----	-----	0	0
LR	M	Fa	23	426.5	916.0	25	0
LR	F	Fa	0	-----	-----	0	0
GR	M	Fn	62	404.8	785.1	15	47
GR	F	Fn	1	468.0	1,274.3	1	0
GR	M	Sn	30	368.6	541.2	0	30
GR	F	Sn	0	-----	-----	0	0
GR	M	Fa	43	399.7	750.3	0	43
GR	F	Fa	0	-----	-----	0	0
Catherine Creek totals						115	31
Lostine River totals						114	0
Grande Ronde River totals						16	120

Total fish contributing gametes from the1996 cohort	245	151

1997 Cohort

A total of 124. fish from the 97 cohort were determined to be maturing during maturity sortings (Table 13). One hundred twelve (112) of these fish were either spawned (68) or had semen cryopreserved (44), (Table 14). Of the remaining 12 fish, 9 died prior to spawning and 3 never ripened and therefore were returned to their respective treatment group immature tanks. There were no ripe females; all fish used in spawning were males. Cryopreserved semen was not used from any 1997 cohort males.

Table 13. Number of 1997 cohort fish sorted as maturing in 1999.

			Treatment			
			Freshwater		Seawater	Unknown
Sorting dates	Location	Stock	Accelerated	Natural	Natural	Unknown
August 5	Manchester	Catherine Creek	-----	-----	7	0
		Lostine River	-----	-----	17	0
		Grande Ronde River	-----	-----	13	0
August 2-4	Bonneville	Catherine Creek	11	9	-----	1
		Lostine River	19	12	-----	1
		Grande Ronde River	17	16	-----	0
August 31	Bonneville	Catherine Creek	0	0	-----	0
		Lostine River	1	0	-----	0
		Grande Ronde River	0	0	-----	0
All	All	Catherine Creek	11	9	7	1
All	All	Lostine River	20	12	17	1
All	All	Grande Ronde River	17	16	13	0
All	All	All	48	37	37	2

Table 14. Summary of 1997 cohort male gamete collection during 1999.

Stock	Sex	Treatment	N	Mean FL (mm)	Mean WT (g)	Spawned	Cryoed
CC	M	Fn	7	192.3	89.8	7	0
CC	M	Sn	7	194.3	88.6	7	0
CC	M	Fa	6	192.2	96.4	6	4
CC	M	Unknown	1	195.0	83.3	0	1
LR	M	Fn	12	203.0	101.8	12	0
LR	M	Sn	16	208.4	112.7	16	0
LR	M	Fa	19	199.8	95.6	19	0
GR	M	Fn	13	201.2	103.9	1	12
GR	M	Sn	11	202.3	102.7	0	11
GR	M	Fa	16	196.3	101.7	0	16
Catherine Creek totals						20	5
Lostine River totals						47	0
Grande Ronde River totals						1	39
Total fish contributing gametes from the1996 cohort						68	44

1998 Cohort

No maturity sorting or spawning of 1998 cohort fish occurred during 1999.

3a) Growth – lengths and weights

Fork lengths were measured on captive fish during inventories, maturity sortings, samplings, and transfers. Fork length data was collected from fish which were assumed to be immature. Once maturity sortings started (late May for 1994-96 cohorts and early August for the 1997 cohort), only those fish classified as immature were examined and measured. Comparisons of measured fork length with targeted length can be found in Tables 15 - 19. Although fork lengths were measured from spawned fish those data are not included in tables 15-19.

Weights were measured on a sample of captive fish during inventories, monthly sampling and transfers. Weight data was collected from fish which were assumed to be immature. Once maturity sortings started (late May for 1994-96 cohorts, and early August for the 1997 cohort), only those fish classified as immature were examined and weighed. Therefore, comparisons of weights can be found in Tables 20 through 24 , and do not include fish known to be maturing or mature. Though weights were measured from spawned fish those data are not included in tables 20 - 24.

One general trend in growth as measured by fork length has developed over the past four years. In each cohort that has been in captivity for at least one year (1994-1997 cohorts) all stocks and treatments of fish have achieved actual fork lengths that closely approximate the targeted fork lengths at the smolt stage. However, four months after smolting all stocks and treatments of fish are considerably shorter than their respective targeted lengths. To date the program has been unable to achieve targeted natural lengths beyond the smolt stage.

1994 Cohort

Growth as measured by fork length (Table 15), was monitored in both freshwater and seawater treatments of Catherine Creek and Lostine River fish; upper Grande Ronde River fish were reared only in freshwater. For the first seven to eight months following collection the lengths attained by all stocks closely approximated the targeted length (Table 15). Within four months following smoltification (e.g. by August 1996) all groups were shorter than the targeted length, ranging from 80% (GR) to 88% (CC) of the targeted length. Over the next three years the disparity between targeted and actual fork length continued to increase. By August 1999 all remaining stocks and treatments ranged from 50% to 57% of their respective targeted lengths. The only divergence from this trend was the freshwater/natural growth LR fish which were approximately 70% of their targeted length in May 1999; no data was available for this particular group of fish in August 1999 because they had all been classified as maturing prior to August.

1995 Cohort

Growth as measured by fork length (Table 16), was monitored in both freshwater and seawater, and with both natural and accelerated treatments. At collection parr were approximately 99% of their targeted length for both Catherine Creek and Lostine River stocks. At smoltification, eight months following collection, lengths attained by all stocks reared in freshwater and seawater at natural temperatures closely approximated the targeted lengths. At that time fish ranged from 93% to 95% of the targeted length. Fish reared under an accelerated growth regime ranged from 99% to 104% of their targeted length. Four months following smoltification (e.g. August 1997) the disparity between actual and targeted lengths had increased with actual lengths for natural growth fish being about 71% and accelerated growth fish being about 58% of their respective targeted lengths. Over the next two years this disparity between actual and targeted length increased slightly. In August 1999 natural growth groups averaging 61%, and accelerated growth groups averaged 54% of their respective targeted lengths

1996 Cohort

Growth as measured by fork length (Table 17), was monitored in both freshwater and seawater, and with both natural and accelerated treatments. At collection parr were approximately 96%, 102% and 74% of their targeted length for Catherine Creek, and Lostine and Grande Ronde river stocks respectively. At smoltification, approximately eight months following collection, the lengths attained by all stocks reared in freshwater and seawater at natural temperatures closely approximated the targeted lengths. At that time, and for all stocks, the natural growth fish averaged 95% of their targeted length. Accelerated growth groups however were only slightly larger than natural growth groups and considerably smaller than the targeted lengths, averaging 77% of their targeted length. Four months following smoltification (e.g. August 1998) the disparity between actual and targeted lengths for all natural growth groups increased, now asveraging 86% of their targeted length. The disparity between actual and targeted lengths for accelerated growth groups decreased during the same period, averaging 73% of the targeted length. Over the next year the disparity between actural and targeted lengths continued so that by August 1999 the freshwater groups averaged 81% and accelerated groups averaged 75% of targeted lengths.

1997 Cohort

Growth as measured by fork length (Table 18), was monitored in both freshwater and seawater, and with both natural and accelerated treatments. At collection parr were approximately 96% of their targeted length for Catherine Creek, and Lostine River stocks and 73% for the Grande Ronde River stock. At smoltification, approximately eight months following collection, the lengths attained by all stocks reared in freshwater and seawater at natural temperatures closely approximated the targeted lengths. At that time natural growth fish averaged 102% of the targeted length. Accelerated growth groups however were actually slightly smaller than natural temperature growth groups and considerably smaller than the targeted lengths, averaging 69% of their targeted length. Four months following smoltification (e.g. August 1999) the disparity between actual and targeted lengths for all natural growth groups increased, now averaging 89% of targeted length. The disparity between actual and targeted lengths for accelerated growth groups increased during the same period, now averaging only 65% of the targeted length.

1998 Cohort

Growth as measured by fork length (Table 19), was monitored in both freshwater and seawater, and with both natural and accelerated treatments. At collection parr were approximately 94%, 93% and 75% of their targeted length for Catherine Creek, and Lostine and Grande Ronde river stocks respectively. In addition to data collected during field collection, length data were also collected from all fish in early November during PIT-tagging. At that time parr were approximately 103%, 104% and 98% of their targeted length for Catherine Creek, and Lostine and Grande Ronde river stocks respectively.

Table 15. Mean fork length (FL) and sample size (N) of 1994 cohort spring chinook salmon captive broodstock.

		Stock					
		Catherine Creek		Lostine River		Grande Ronde River	
Date	Targeted FL(mm)	FL (mm)	N	FL (mm)	N	FL (mm)	N
Aug '95	80	81.9	498	69.0	499	-----	-----
Sept '95	89	93.3	485	80.7	502	90.3	99
Oct '95	96	101.4	50	99.9	50	97.8	109
Nov '95	101	108.9	51	103.1	50	101.5	50
Dec '95	104	107.1	50	107.2	50	103.8	50
Jan '96	107	111.6	51	112.0	52	111.6	50
Feb '96	112	118.0	50	115.7	50	114.1	51
Mar '96	119	127.2	47	122.7	48	124.8	52

		Seawater		Freshwater		Seawater		Freshwater		Freshwater	
		FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N
May '96	-----	140.3	53	-----	-----	-----	-----	-----	-----	-----	-----
July '96	-----	----	-----	187.4	310	-----	-----	-----	-----	171.5	103
Aug '96	220	191.9	163	192.5	298	182.5	149	190.6	273	175.0	99
July '97	-----	354.0	139	315.5	256	332.1	121	320.2	234	291.0	67
Aug '97	480	355.2	102	323.8	253	334.1	103	329.1	232	298.2	67
Sept '97	-----	-----	-----	338.5	225	-----	-----	341.6	203	-----	-----
Oct '97	-----	-----	-----	353.3	192	-----	-----	358.6	144	324.4	61
Nov. '97	-----	393.8	100	-----	-----	375.4	97	-----	-----	-----	-----
Mar. '98	-----	454.3	25	399.6	34	425.3	24	418.2	120	378.6	28
June '98	------	455.5	87	427.0	180	432.8	86	453.4	78	406.2	22
July '98	-----	428.5	42	419.2	124	421.8	67	462.5	59	408.4	19
Aug. '98	730	436.2	41	429.1	120	412.8	50	459.2	43	421.7	12
Dec. '98	-----	459.3	37	472.0	105	433.4	43	509.0	29	449.0	8
Mar. '99	820	483.8	37	501.9	101	467.9	42	554.2	26	468.9	8
May '99	-----	446.0	11	502.6	54	424.0	14	587.9	17	471.2	6
Aug. '99	870	449.8	11	492.4	7	431.9	10	-----	-----	-----	-----
Dec. '99	-----	456.8	10	490.7	9	407.5	4	-----	-----	-----	------

Table 16. Mean fork length (FL) and sample size (N) of 1995 cohort spring chinook salmon captive broodstock.

			Catherine Creek						Lostine River					
	Targeted FL (mm)		Seawater Nat.		Freshwater Nat.		Freshwater Accel.		Seawater Nat.		Freshwater Nat.		Freshwater Accel.	
	Natural	Accel.	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N
Aug '96	80	80	**	**	**	**	**	**	**	**	**	**	**	**
Sept '96	89	93	87.3	167	87.1	165	89.6	160	87.5	159	87.0	160	88.4	156
Dec '96	104	133	101.6	25	101.7	27	111.8	25	103.1	25	102.2	25	103.7	25
Jan '97	107	146	107.8	27	105.5	28	108.7	26	104.0	28	105.6	26	108.5	31
Apr/May '97	128	186	120.6	167	121.5	164	126.6	158	118.7	159	120.3	159	133.7	152
July '97	-----	-----	-----	-----	142.9	163	147.9	154	-----	-----	142.8	155	162.0	148
Aug '97	220	278	149.3	120	155.2	143	152.0	138	158.9	142	158.5	149	170.9	137
Sept '97	-----	-----	171.9	112	-----	-----	-----	-----	185.4	137	-----	-----	-----	-----
Dec. '97	-----	-----	227.0	28	-----	-----	-----	-----	242.3	34	-----	-----	-----	-----
Mar. '98	-----	-----	259.0	26	262.5	40	249.0	37	280.6	35	272.5	37	273.9	38
June '98	-----	-----	292.9	98	287.9	138	262.7	129	314.0	129	333.7	144	323.1	113
July '98	-----	-----	297.3	75	290.5	116	270.7	125	315.9	93	335.2	118	329.3	106
Aug. '98	480	538	302.9	76	304.2	109	280.8	105	322.8	79	346.6	115	334.4	90
Dec. '98	-----	-----	353.7	73	379.3	87	362.2	61	364.4	69	412.4	78	390.3	44
Mar. '99	620	678	392.1	72	434.6	85	412.8	54	409.8	64	463.4	74	437.4	40
May '99	-----	-----	399.2	47	445.6	57	427.1	43	415.9	33	500.5	66	470.9	38
Aug. '99	730	788	417.3	40	439.5	29	412.4	18	439.2	20	483.5	12	440.3	8
Nov/Dec 99	-----	-----	441.9	36	471.3	28	443.3	18	458.0	18	493.4	8	469.5	6

**All fish were collected in August but were not split into treatment groups until September.
Respective sizes, by stock, when captured in August were: **CC** = 85.2 mm (n= 496); and **LR**= 79.0 mm (n= 481).

Table 17. Mean fork length (FL) and sample size (N) of 1996 cohort spring chinook salmon captive broodstock.

			Catherine Creek						Lostine River						Grande Ronde River					
	Targeted FL (mm)		Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated	
Date	Natural	Accel.	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	Nn	FL (mm)	N	FL (mm)	N
Aug '97	80	80	**	**	**	**	**	**	**	**	**	**	**	**	-----	-----	-----	-----	-----	-----
Sept '97	89	93	-----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	**	**	**	**	**	**
Oct '97	96	107	90.4	167	87.3	168	89.4	163	95.7	167	94.0	156	92.4	167	77.3	165	79.3	162	77.7	164
Dec '97	104	133	104.6	25	102.7	25	106.6	25	102.5	25	102.4	25	104.5	25	92.9	25	94.0	25	95.1	25
Jan. '98	107	146	110.6	25	115.2	25	118.9	25	110.5	25	114.5	25	116.1	25	105.2	25	102.8	25	110.0	25
Apr. '98	128	186	123.4	165	126.4	167	131.6	163	123.5	165	123.5	166	132.3	165	119.2	165	116.2	165	125.2	165
Aug. '98	220	278	178.4	159	205.0	166	204.9	162	173.1	160	194.5	164	200.1	164	183.4	158	197.2	165	200.1	165
Sept. '98	-----	-----	194.5	158	231.9	166	231.4	162	188.0	153	221.0	163	224.3	158	202.9	153	221.1	165	222.4	165
Dec. '98	-----	-----	271.1	36	308.8	43	306.2	38	264.0	37	320.1	43	314.0	37	278.4	36	297.6	36	296.2	45
Apr. '99	-----	-----	331.9	38	402.9	45	393.5	35	322.3	33	382.4	39	375.9	43	331.7	38	384.1	44	368.5	37
May '99	-----	-----	339.8	121	392.9	110	389.9	114	335.8	123	387.4	128	384.8	124	345.1	104	370.7	116	369.4	132
Aug. '99	480	538	377.8	30	421.7	25	409.7	25	361.7	30	404.1	28	412.3	23	378.5	30	391.0	24	388.1	26
Dec. '99	-----	-----	416.8	29	475.6	30	477.1	27	412.0	23	472.2	26	454.7	37	429.6	25	434.0	30	425.2	37

** All fish were collected in August and September but were not split into treatment groups prior to length and weight data being taken in the field. Respective sizes, by stock, when captured in August and September were: **CC** = 76.8 mm (n = 49); **LR** = 81.4 mm (n = 121) and **GR** = 65.6 mm (n = 115).

Table 18. Mean fork length (FL) and sample size (N) of 1997 cohort spring chinook salmon captive broodstock.

			Catherine Creek						Lostine River						Grande Ronde River					
	Targeted FL (mm)		Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated	
Date	Natural	Accel.	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N	FL (mm)	N
Aug '98	80	80	76.1	167	75.7	167	77.7	166	75.9	167	76.9	167	76.5	166	----	---	----	---	----	---
Sept '98	89	93	----	---	----	---	----	---	----	---	----	---	----	---	65.4	166	64.4	167	64.9	167
Oct '98	96	107	93.5	165	96.6	167	97.0	164	95.2	163	95.0	167	95.7	166	87.7	167	86.2	167	86.3	165
Dec '98	104	133	99.9	164	101.8	166	105.8	164	96.8	42	98.0	42	103.4	42	97.0	42	95.1	42	99.6	42
Apr. '99	128	186	132.7	158	130.4	164	129.3	161	128.7	161	126.6	164	126.9	165	134.2	168	133.8	165	131.1	164
Aug. '99	220	278	205.0	150	187.3	151	182.3	147	196.8	142	187.0	147	178.2	140	209.2	153	193.8	149	183.1	147
Dec. '99	-----	-----	304.8	39	280.5	39	277.1	42	299.2	40	282.6	38	272.3	41	323.0	42	289.9	37	282.8	38

Table 19. Mean fork length (FL) and sample size (N) of 1998 cohort spring chinook salmon captive broodstock.

			Catherine Creek		Lostine River		Grande Ronde River	
Date	Targeted FL (mm)		FL (mm)	N	FL (mm)	N	FL (mm)	N
	Natural	Accel.						
Aug. '99	80	80	75.1	500	74.6	498	60.0	500
Nov. '99	101	120	104.4	492	104.6	498	98.5	495

All 1998 cohort stocks were reared under the same treatment while at Lookingglass Hatchery in 1999 due to a variety of water supply problems.

Table 20. Mean weight (W) and sample size (N) of 1994 cohort spring chinook salmon captive broodstock.

	Catherine Creek				Lostine River				Grande Ronde River			
Date	W (g)		N		W (g)		N		W (g)		N	
Sept. '95	-----		-----		6.8		447		8.1		72	
Sept 29, 95	10.3		485		10.6		58		-----		-----	
Oct. '95	13.7		50		13.3		50		11.3		108	
Nov. '95	15.6		49		13.7		49		12.4		50	
Dec. '95	15.4		50		15.4		50		13.8		50	
Jan. '96	17.0		51		17.0		52		16.7		50	
Feb. '96	18.3		50		18.1		50		16.4		50	
Mar. '96	25.9		46		23.3		46		24.0		51	
	Seawater naural		Freshwater natural		Seawater naural		Freshwater natural		Seawater naural		Freshwater natural	
	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N
July. '96	-----	-----	87.9	301	-----	-----	85.1	274	-----	-----	66.8	102
Aug. '96	93.1	163	90.2	299	81.6	150	91.8	273	-----	-----	69.6	7
July '97	618.3	139	471.9	254	501.0	122	482.4	225	-----	-----	365.5	67
Aug. '97	634.8	101	502.1	253	492.5	103	533.0	232	-----	-----	354.0	67
Sept. '97	-----	-----	556.4	224	-----	-----	560.2	209	-----	-----	-----	-----
Oct. '97	-----	-----	592.9	193	-----	-----	615.3	144	-----	-----	489.8	60
Nov. '97	827.8	100	-----	-----	740.0	97	-----	-----	-----	-----	-----	-----
Mar. '98	1,399.5	25	963.2	34	1,118.8	24	1,016.8	120	-----	-----	786.1	28
June '98	1,408.4	87	1,149.0	180	1,115.9	86	1,409.3	78	-----	-----	1,010.1	22
July '98	1,060.4	42	1,035.5	124	1,017.6	67	1,442.9	59	-----	-----	1,041.0	19
Aug. '98	1,123.7	71	1,244.5	172	946.9	50	1,434.9	43	-----	-----	1,161.6	13
Dec. '98	1,410.0	37	1,557.8	105	1,174.1	43	1,997.5	29	-----	-----	1,437.1	8
Mar. '99	1,854.5	37	2,074.7	101	1.607.8	42	2,779.5	26	-----	-----	1,741.8	8
May '99	1,282.1	11	2,012.8	54	1,063.8	14	3,655.0	17	-----	-----	1,694.8	6
Aug. '99	1,405.8	11	1,765.7	7	1,160.1	10	-----	-----	-----	-----	-----	-----
Dec. '99	1,388.1	10	1,706.0	9	830.5	4	-----	-----	-----	-----	-----	-----

Table 21. Mean weight (W) and sample size (N) of 1995 cohort spring chinook salmon captive broodstock.

	Catherine Creek						Lostine River					
	Seawater Nat.		Freshwater Nat.		Freshwater Accel.		Seawater Nat.		Freshwater Nat.		Freshwater Accel.	
	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N
Aug. '96	**	**	**	**	**	**	**	**	**	**	**	**
Sept. '96	9.0	167	9.1	165	9.4	160	9.2	155	9.0	150	9.4	146
Dec. '96	12.8	23	12.7	25	19.2	22	13.3	22	12.5	23	13.7	25
Jan. '97	14.7	27	14.3	28	16.2	26	13.6	28	14.4	26	16.3	31
Mar. '97	16.0	28	17.7	25	23.1	23	17.5	25	15.6	25	21.1	25
Apr 30 – May 1, '97	19.9	167	20.5	164	24.7	156	20.9	159	21.9	159	27.2	152
July. '97	-----	-----	33.9	163	40.9	154	-----	-----	35.6	157	51.4	148
Aug. '97	43.1	120	50.0	143	48.9	138	52.5	142	56.6	149	65.1	137
Sept. '97	75.2	112	-----	-----	-----	-----	92.0	137	-----	-----	-----	-----
Dec. '97	185.2	28	-----	-----	-----	-----	223.2	34	-----	-----	-----	-----
Mar. '98	253.5	26	251.5	40	219.7	37	309.3	35	293.5	37	294.7	38
June '98	371.3	98	348.3	138	263.4	129	459.0	129	586.9	144	512.6	113
July '98	374.6	75	344.6	116	282.1	125	442.8	93	565.7	118	554.8	106
Aug. '98	391.7	76	389.0	109	315.7	105	437.0	79	613.9	115	581.1	92
Dec. '98	652.1	73	808.0	87	719.2	61	677.0	69	1,040.0	78	895.8	44
Mar. '99	974.6	72	1,301.5	85	1,110.9	54	1,120.1	64	1,562.0	74	1,308.9	40
May '99	939.8	47	1,343.8	57	1,195.4	43	1,129.2	33	1,980.9	66	1,682.3	38
Aug. '99	1,087.9	40	1,255.0	29	1,047.0	18	1,344.8	20	1,742.4	12	1,327.7	8
Nov/Dec. '99	1,272.3	36	1,605.2	28	1,302.0	18	1,422.5	18	1,913.0	8	1,571.1	6

** All fish were collected in August but were not split into treatment groups until September. Respective weights, by stock, when captured in August were: **CC** = 8.0 g (n= 166); and **LR**= 6.0 g (n= 479).

Table 22. Mean weight (W) and sample size (N) of 1996 cohort spring chinook salmon captive broodstock.

	Catherine Creek						Lostine River						Grande Ronde River					
	Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated	
Date	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N
Aug '97	**	**	**	**	**	**	**	**	**	**	**	**	----	----	----	----	----	----
Sept '97	----	----	----	----	----	----	----	----	----	----	----	----	**	**	**	**	**	**
Oct '97	8.6	168	9.5	167	8.1	163	9.5	156	9.9	166	9.3	166	5.9	165	5.6	165	5.6	165
Dec '97	15.2	25	14.6	25	16.5	25	13.5	25	13.5	25	14.9	25	10.9	25	10.7	25	11.4	25
Jan. '98	16.3	25	18.4	25	21.0	25	16.2	25	18.1	25	20.1	25	14.0	25	12.8	25	16.6	25
Apr. '98	23.3	165	24.5	167	26.8	163	22.4	165	22.9	166	27.4	165	19.5	165	18.7	165	22.3	165
Aug. '98	75.4	159	123.7	166	123.7	162	68.6	160	103.4	164	111.9	164	78.7	158	99.0	165	103.0	165
Sept. '98	102.8	158	177.5	166	176.6	162	87.7	153	152.3	163	158.0	158	109.9	153	155.0	165	156.5	165
Dec. '98	298.0	36	428.3	43	411.9	38	276.7	37	463.4	43	446.4	37	316.4	36	385.4	36	365.2	45
Apr. '99	578.5	37	1,060.5	45	1,008.3	35	530.7	33	888.1	39	814.6	43	574.6	37	933.1	44	820.3	37
May '99	569.4	121	890.4	110	908.8	114	577.0	123	836.8	128	811.9	124	580.0	104	796.2	116	774.7	133
Aug. '99	809.3	30	1,117.5	25	1,055.2	25	768.3	30	970.7	28	1,073.6	23	879.0	30	913.0	24	875.6	26
Dec. '99	1,169.1	29	1,595.9	31	1,568.1	27	999.3	23	1,592.9	26	1,425.1	37	1,366.2	25	1,212.6	30	1,182.3	37

** All fish were collected in August and September but were not split into treatment groups prior to length and weight data being taken in the field. Respective sizes, by stock, when captured in August and September were: **CC** = 5.4 g (n = 49); **LR** = 6.4 g (n = 121) and **GR** = 4.0 g (n = 115).

Table 23. Mean weight (W) and sample size (N) of 1997 cohort spring chinook salmon captive broodstock.

	Catherine Creek						Lostine River						Grande Ronde River					
	Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated		Seawater Natural		Freshwater Natural		Freshwater Accelerated	
Date	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N
Aug ‘98	5.5	167	5.3	167	5.7	166	5.4	167	5.7	167	5.6	166	----	----	----	----	----	----
Sept ‘98	----	----	----	----	----	----	----	----	----	----	----	----	3.6	166	3.5	167	3.6	167
Oct ‘98	9.8	165	10.5	167	11.1	164	10.6	163	10.1	166	11.0	166	8.1	167	7.9	167	8.0	165
Dec ‘98	11.6	164	12.3	166	14.3	164	10.5	42	11.1	42	13.8	42	11.0	42	10.6	42	12.2	42
Apr. '99	30.5	158	30.3	164	30.5	161	29.9	161	27.9	164	29.0	165	32.6	168	32.7	165	31.8	164
Aug. '99	129.1	150	97.3	151	87.7	147	114.3	142	95.3	147	80.0	140	143.1	153	111.0	149	90.4	147
Dec. '99	437.1	39	333.5	39	322.5	42	421.6	40	336.7	39	301.5	41	556.4	42	388.3	37	337.1	39

Table 24. Mean weight (W) and sample size (N) of 1998 cohort spring chinook salmon captive broodstock.

	Catherine Creek		Lostine River		Grande Ronde River	
Date	W (g)	N	W (g)	N	W (g)	N
Aug. '99	6.1	500	6.4	498	3.2	500
Nov. '99	14.6	492	13.9	498	12.0	491

Due to a variety of water supply problems all 1998 cohort stocks were reared under the same treatment while at Lookingglass Hatchery in 1999.

4) Population Status

Population status summaries by brood year and stock can be found in Tables 25 - 29. A complete Fish Health Monitoring and Disease Treatment report can be found in the 'Fish Health Monitoring and Disease' section of this report.

1994 Cohort

A total of 500, 499 and 110 fish were collected from Catherine Creek, and the Lostine and upper Grande Ronde rivers respectively in August and September 1995. As of 31 December 1999 there were 17, 3 and 0 fish remaining alive from Catherine Creek, and the Lostine and upper Grande Ronde rivers respectively. Of the 1,089 fish which have been removed from the populations, 605 have been spawned or had semen cryopreserved (354 CC, 222 LR and 29 GR). An additional 159 died from disease (30 CC, 98 LR and 31 GR), 301 died from other or unknown causes (85 CC, 166 LR and 50 GR) and 21 died from experimental procedure (12 CC and 9 LR). Two CC and 1 LR fish are unaccounted for.

1995 Cohort

A total of 500 and 481 fish were collected from Catherine Creek and the Lostine River respectively during August and September 1996. No fish were collected from the upper Grande Ronde River. As of 31 December 1999 there were 80 and 30 fish remaining alive from Catherine Creek and the Lostine River respectively. Of the 871 fish which have been removed from the population, 443 have been spawned or had semen cryopreserved (189 CC and 254 LR), 225 have died from disease (105 CC, and 120 LR), 181 have died from other or unknown cause (114 CC and 67LR), and 20 have died from experimental procedures (10 CC and 10 LR). Two CC fish are unaccounted for.

1996 Cohort

A total of 500 fish from each of the three stocks, Catherine Creek, and the Lostine and upper Grande Ronde rivers respectively were collected in August and September 1997. As of 31 December 1999 there were 283, 263 and 267 fish remaining alive from Catherine Creek and the Lostine and upper Grande Ronde rivers respectively. Of the 688 fish which have been removed from the population, 451 have been spawned or had semen cryopreserved (158 CC, 145 LR and 148 GR), 38 have died from disease (16 CC, 14 LR and 8 GR), and 194 have died from other or unknown causes (43 CC, 74 LR and 77 GR). No fish died from experimental procedures. Five LR fish were unaccounted for.

1997 Cohort

Five hundred spring chinook salmon parr from each of the three stocks were collected for the Captive Broodstock project during August and September 1998. As of 31 December 1999 there were 450, 428 and 442 fish remaining alive from Catherine Creek, and the Lostine and Grande Ronde rivers respectively. Of the 180 fish which have been removed from the population, 113 have been spawned or had semen cryopreserved (25 CC, 48 LR and 40 GR), 17 have died from disease (8 CC, 8 LR and 1 GR) and 49 have died from other or unknown causes (17 CC, 15 LR and 17 GR). No fish died from experimental procedures. One LR fish is unaccounted for.

1998 Cohort

As in previous years, juvenile salmon were collected using a passive seining technique that combines snorkeling and seining. Using this method, 500 spring chinook salmon parr from Catherine Creek and the upper Grande Ronde River and 498 from the Lostine River were collected for the Captive Broodstock project during August and September 1999. As of 31 December 1999 there were 492, 495 and 493 fish remaining alive from Catherine Creek, and the Lostine and Grande Ronde rivers respectively. Of the 18 fish which have been removed from the population, five LR fish died, presumably as a result of temperature - related trauma, three died shortly after PIT tagging, and 10 died from other or unknown causes. No fish died from experimental procedures and all fish were accounted for.

Tables 25. Population status and associated causes [1/] of fish removed from the 1994 cohort spring Chinook salmon captive broodstock populations through 31 December 1999.

Catherine Creek

	Saltwater / Natural					Freshwater / Natural				
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR
1995	0	0	0	2	2	0	0	0	8	0
1996	1	0	12	3	0	32	0	0	27	0
1997	46	0	0	10	0	58	0	0	11	0
1998	44	3	0	13	0	59	21	0	5	0
1999	27	1	0	2	0	87	5	0	4	0
No. removed by cause	118	4	12	30	2	236	26	0	55	0
No. removed by stock and treat.			166					317		
No. alive by stock and treat.			8					9		

Lostine River

	Saltwater / Natural					Freshwater / Natural				
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR
1995	0	0	0	0	0	0	0	0	53	0
1996	0	0	9	15	0	22	0	0	13	0
1997	19	0	0	32	0	79	1	0	18	0
1998	35	1	0	17	0	27	79	0	8	0
1999	16	13	0	10	1	24	4	0	0	0
No. removed by cause	70	14	9	74	1	152	84	0	92	0
No. removed by stock and treat.			168					328		
No. alive by stock and treat.			3					0		

Grande Ronde River

	Freshwater / Natural				
Year removed	Gam.	Dis.	Exp.	Oth.	NR
1995	0	0	0	2	0
1996	7	0	0	28	0
1997	13	5	0	16	0
1998	5	23	0	3	0
1999	4	3	0	1	0
No. removed by cause	29	31	0	50	0
No. removed by stock and treat.			110		
No. alive by stock and treat.			0		

Gam. = gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usuallly BKD)
Exp. = Fish removed from the population for experimental or scientific purposes
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.)
NR. = Missing but **n**o record of mortality

Tables 26. Population status and associated causes [1/] of fish removal from the 1995 cohort spring Chinook salmon captive broodstock population through 31 December 1999.

	Catherine Creek														
	Saltwater / Natural					Freshwater / Natural					Freshwater / Accel.				
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR
1996	0	0	0	0	0	0	0	0	1	0	0	0	0	6	0
1997	2	0	10	46	0	7	0	0	13	0	6	0	0	14	0
1998	25	2	0	7	0	42	12	0	4	0	14	59	0	9	0
1999	18	12	0	8	2	48	11	0	1	0	27	9	0	5	0
No. removed by cause	45	14	10	61	2	97	23	0	19	0	47	68	0	34	0
No. removed by stock and treat.			132					139					149		
No. alive by stock and treat.			35					28					17		

	Lostine River														
	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated				
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR
1996	0	0	0	2	0	0	0	0	1	0	0	0	0	4	0
1997	6	0	10	8	0	8	0	0	7	0	5	0	0	12	0
1998	44	11	0	12	0	54	11	0	3	0	24	65	0	6	0
1999	32	9	0	10	0	53	13	0	2	0	28	11	0	0	0
No. removed by cause	82	20	10	32	0	115	24	0	13	0	57	76	0	22	0
No. removed by stock and treat.			144					152					155		
No. alive by stock and treat.			17					8					5		

Gam. = gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usuallly BKD)
Exp. = Fish removed from the population for experimental or scientific purposes
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.)
NR. = Missing but no record of mortality

Tables 27. Population status and associated causes [1/] of fish removal from the 1996 cohort spring Chinook salmon captive broodstock population through 31 December 1999.

Catherine Creek

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated				
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR
1997	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0
1998	2	0	0	10	0	5	0	0	2	0	5	1	0	1	0
1999	34	2	0	4	0	59	6	0	9	0	53	7	0	13	0
No. removed by cause	36	2	0	15	0	64	6	0	11	0	58	8	0	17	0
No. removed by stock and treat.			53					81					83		
No. alive by stock and treat.			114					86					83		

Lostine River

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated				
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	8	1	0	6	2	7	0	0	5	2	16	1	0	6	1
1999	39	5	0	26	0	50	2	0	7	0	25	5	0	24	0
No. removed by cause	47	6	0	32	2	57	2	0	12	2	41	6	0	30	1
No. removed by stock and treat.			87					73					78		
No. alive by stock and treat.			80					94					89		

* One of the 5 'NR' fish died classified as an 'unknown treatment' fish since the original PIT tag was never found.

Grande Ronde River

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated				
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR
1997	0	0	0	1	0	0	0	0	2	0	0	0	0	2	0
1998	0	0	0	14	0	4	0	0	0	0	7	1	0	1	0
1999	30	1	0	24	0	64	5	0	10	0	43	1	0	23	0
No. removed by cause	30	1	0	39	0	68	5	0	12	0	50	2	0	26	0
No. removed by stock and treat.			70					85					78		
No. alive by stock and treat.			96					82					89		

Gam. = gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usuallly BKD)
Exp. = Fish removed from the population for experimental or scientific pu
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.)
NR. = Missing but no record of mortality

Tables 28. Population status and associated causes [1/] of fish removal from the 1997 cohort spring Chinook salmon captive broodstock population through 31 December 1999.

Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.
1998	0	2	0	1	0	0	0	0	1	0	0	0	0	3	0	0
1999	7	6	0	1	0	7	0	0	7	0	10	0	0	4	0	1
No. removed by cause	7	8	0	2	0	7	0	0	8	0	10	0	0	7	0	1
No. removed by stock and treat.			17					15					17			1
No. alive by stock and treat.			150					152					149			450

Lostine River

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated					? Treat
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam& Dis
1998	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
1999	16	2	0	3	0	12	3	0	7	0	19	2	0	2	0	2
No. removed by cause	16	2	0	6	1	12	3	0	7	0	19	2	0	2	0	2
No. removed by stock and treat.			25					22					23			2
No. alive by stock and treat.			141					146					143			428

Grande Ronde River

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated					? Treat
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	None
1998	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0
1999	11	0	0	4	0	13	0	0	8	0	16	0	0	3	0	0
No. removed by cause	11	0	0	4	0	13	1	0	8	0	16	0	0	5	0	0
No. removed by stock and treat.			15					22					21			0
No. alive by stock and treat.			152					145					145			442

Gam. = gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usuallly BKD)
Exp. = Fish removed from the population for experimental or scientific purposes
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.)
NR. = Missing but no necord of mortality

Tables 29. Population status and associated causes [1/] of fish removal from the 1998 cohort spring Chinook salmon captive broodstock population through 31 December 1999.

Catherine Creek

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated					No Treat.
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Oth.
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
No. removed by cause	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
No. removed by stock and treat.			0					0					0			8
No. alive by stock and treat.			0					0					0			492

Lostine River

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated					No Treat.
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Oth.
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
No. removed by cause	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
No. removed by stock and treat.			0					0					0			3
No. alive by stock and treat.			0					0					0			495

Grande Ronde River

	Saltwater / Natural					Freshwater / Natural					Freshwater / Accelerated					No Treat.
Year removed	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Gam.	Dis.	Exp.	Oth.	NR	Oth.
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
No. removed by cause	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
No. removed by stock and treat.			0					0					0			7
No. alive by stock and treat.			0					0					0			493

Gam. = gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usuallly BKD)
Exp. = Fish removed from the population for experimental or scientific purposes
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.)
NR. = Missing but no record of mortality

5) Fish Health and Disease: Captive Broodstock Program

The leading cause of mortality among the captive broodstock in 1999 was bacterial kidney disease. This continues the pattern observed since the beginning of this project. Other pathogens and parasites observed included parasitic copepods (*Salmincola* sp.), fungus (*Saprolegnia* sp.) and cold water disease (*Flavobacterium psychrophilum*). The whirling disease parasite, *Myxobolus cerebralis*, was definitively identified in two fish from the Lostine stock. There were also numerous mortalities due to unknown factors.

Mortalities by facility

Lookingglass

None of the mortalities observed among the captive broodstock at Lookingglass Hatchery from 1/12/98-1/12/99 were caused by disease. There is no evidence of any clinical (an infection that produces symptoms) BKD in the 1998 cohort. All DFAT and ELISA tests on mortalities have been negative.

However, developing effective strategies for BKD management continue to be an important issue. Even though clinical BKD is not evident in the population, the period that fish are at Lookingglass Hatchery is likely to be when they are first exposed to *R. salmoninarum*. This suggests that one of the most effective times to interrupt the spread of BKD among the population is when they are at Lookingglass Hatchery.

Another important issue is a reliable pathogen free water supply. Exposure to untreated surface water always entails some risk of introducing pathogens into the fish population. May through September is the most critical period because it is likely that pathogen loads in Lookingglass Creek are higher at this time than during the cooler winter months.

Table 30. Mortalities observed at Lookingglass Hatchery 1/1/99-12/31/99.

	Temperature stress	Handling	Tagging	Dropout	Unknown	Suffocation*	Total
CC97				1			1
GR97				1			1
LR97				1			1
CC98	5	1					6
GR98			1	3	1		5
LR98			2			1	3
Total	5	1	3	6	1	1	17

- Caused by turbidity associated with a high water event.

Bonneville Hatchery

Losses at Bonneville Hatchery were dominated by BKD. Other pathogens associated with the decline of fish before spawning, such as fungus were also observed. Causes of mortality by stock/cohort group are listed in Table 31.

Table 31. Mortalities observed at the Bonneville captive brood facility 1/1/99-12/31/99.

	Cause of Death										
	BKD	APS	Trauma	Jumpout	Handling	SEN	Fungus	Wasting	Unknown	CWD	Total
CC94	2	1	0	0	0	0	0	0	7	0	10
CC95	17	2	0	0	0	2	1	0	3	0	25
CC96	13	0	1	1	0	9	0	1	16	0	41
CC97	6	1	1	0	3	0	0	0	6	0	17
GR94	2	0	0	0	0	1	0	0	2	0	5
GR96	1	2	1	0	0	41	1	1	8	0	55
GR97	0	0	0	0	4	4	0	0	5	0	13
LR94	6	3	1	0	0	0	0	0	0	0	10
LR95	25	0	0	0	0	0	1	0	3	0	29
LR96	6	1	1	0	0	18	1	1	17	1	46
LR97	0	4	1	1	0	1	4	1	7	1	20
TOTALS											
Count	78	14	6	2	7	76	8	4	74	2	271
%of morts	28.8	5.2	2.2	0.7	2.6	28.0	3.0	1.5	26.6	0.7	

CC: Catherine Creek Stock, GR: Grande Ronde Stock, LR: Lostine River Stock
BKD: Bacterial kidney disease, caused by *Renibacterium salmonarum*
APS: Bacterial septicemia caused by *Aeromonas* sp. or *Pseudomonas* sp.
Trauma: Physical injury not related to handling
Jumpout: Fish that jumped out of the tank
SEN: Senescence, ripe fish that died with no obvious pathogen identified, numbers in parenthesis represent the number of hormone-injected fish included.
Fungus: Fungal infection by *Saprolegnia* sp. or other aquatic fungi
Wasting: Emaciated fish that appeared to have starved even though food was available
Unk: Unknown cause of death, no pathogen or physical injury identified as the cause of death
CWD: Cold water disease, caused by *Flavobacterium psychrophilium*

Manchester Marine Lab (MML)

The majority of mortalities at MML were from unknown pathogens or factors. The most common identifiable pathogen at MML was *R. salmoninarum*. Causes of mortality by stock/cohort group are listed in Table 32.

Table 32. Mortalities observed at Manchester Marine Lab (MML) by stock/cohort group and cause of death.

Stock/ Cohort	Unknown	BKD	Respiratory distress	Overeating	Jumpout	Drop out	Wasting	Total
CC94	1	1	0	0	0	0	0	2
CC95	7	10	0	0	0	0	0	17
CC96	4	1	0	0	0	0	0	5
CC97	1	0	0	0	0	0	0	1
GR96	9	0	0	1	0	0	0	10
GR97	1	0	0	0	2	0	0	3
LR94	7	8	0	0	0	0	0	15
LR95	7	7	0	0	0	0	1	15
LR96	9	5	16	1	0	0	0	31
LR97	0	1	0	0	0	1	0	2
Total	46	33	16	2	2	1	1	101
% of Morts	45.5	32.7	15.8	2.0	2.0	1.0	1.0	

CC: Catherine Creek Stock, GR: Grande Ronde Stock, LR: Lostine River Stock
Wasting: Emaciated fish that appeared to have starved even though food was available
Drop out: Immature fish that fail to gain weight

Incidence of disease among 1999 spawners

No viral infections were detected among any stock/cohort of spawners in 1999. This is the second year of monitoring at spawning which has yielded negative results.

Levels of BKD among spawners ranged from negative to grossly infected (Table 33). There was no statistically significant difference in mean survival to eye-up of eggs among negative, moderate, high and gross BKD positive fish (Table 34). This may be due to the high level of variability observed in survival to eye-up of all groups of fish. Other factors appear to have been more significant in egg survival than the BKD status of the females.

Pathogens and Parasites observed

Renibacterium salmoninarum (Bacterial Kidney Disease-BKD)

We assess the presence and severity of *R. salmoninarum* infections in dead fish primarily by means of an enzyme-linked immunosorbent assay (ELISA). Classification of disease state is by optical density values from ELISA tests. These values are based on how much anti- *R. salmoninarum* antibody binds to a sample of kidney tissue. The values are correlates rather than absolute measures of the degree of disease in the fish. Negative values represent the absence of *R. salmoninarum* bacteria from a sample. There are no actual values of 0.0 observed due to the nature of the test. Subclinical values represent levels of *R. salmoninarum* where the bacteria is present in the sample but not at high enough levels to cause clinical disease in the fish. Clinical values represent levels of *R. salmoninarum* that cause the symptoms of BKD and possible death of the fish. Gross values represent extremely high levels of *R. salmoninarum* that are typically associated with severe symptoms of BKD. Due to variability in test media and conditions ELISA values from different labs are not absolutely comparable

Bacterial kidney disease continues to be the main identifiable cause of mortality in the captive brood program. The disease is present at chronic levels in all stock/cohort groups. Its long incubation time and the fact that there is no antibiotic available that will eliminate *R. salmoninarum* from infected fish complicate management of the disease. The progress of BKD in the population follows a pattern of chronic loss punctuated by occasional periods of increased loss (Figures 1 and.2). Studies have shown that it can take up to 150 days for fish to show signs of BKD infection when they occupy the same tank as a fish with acute BKD (Murray et al., 1992; Bell et al., 1984). It has also been shown that fish shed few *R. salmoninarum* bacteria until they develop acute BKD with an ELISA value of 1.0 or greater (McKibben and Pascho, 1999). The pattern of progression of BKD in the population is:

1. An initial period of up to one year after capture when few or no deaths due to BKD are observed in the population.
2. An increased loss event, followed by continued chronic losses punctuated by episodes of increased loss.

Table 33. Renibacterium salmoninarum antigen levels of spawners in 1999. Classification of disease state is by optical density values from ELISA tests. The values are correlates rather than absolute measures of the degree of disease in the fish.

Stock	Total	Negative <0.2	Subclinical 0.2-0.8	Clinical 0.8-1.99	Gross >2.0
All	749	552	118	50	29
%		73.7	15.8	7.1	3.9
Females	308	174	79	36	19
%		56.5	25.6	11.2	6.2
All CC	352	259	54	20	19
%		73.6	15.3	5.6	5.4
CC Females	163	104	34	14	11
%		63.8	20.9	8.7	6.7
All GR	138	120	17	1	0
%		87	12.3	1	0
GR female	4	2	2	0	0
%		50	50	0	0
All LR	259	172	47	30	10
%		66.4	18.1	11.7	3.9
LR female	141	68	43	22	8
%		48.2	30.5	15.8	5.7

Negative: No *R. salmoninarum* present.
Subclinical: *R. salmoninarum* present in the sample but not at high enough levels to cause clinical disease.
Clinical: *R. salmoninarum* present at levels that cause the symptoms of BKD and possible death of the fish.
Gross: Extremely high levels of *R.salmoninarum* typically associated with severe symptoms of BKD.
CC: Catherine Creek stock, GR: Upper Grande Ronde Stock, LR: Lostine River Stock

Table 34. Survival to eye-up of eggs by BKD status of spawners. The mean percentage survivals for all groups are not significantly different (P=0.05).

BKD status	n	Mean % survival	Standard deviation	Maximum	Minimum	Median
Negative	174	27.4%*	31.4%	100.0%	0.4%	10.5%
Subclinical	77	71.6%*	32.2%	99.3%	0.0%	88.8%
Clinical	42	64.3%*	34.1%	99.3%	0.0%	79.0%
Gross	12	62.7%*	38.3%	97.4%	0.0%	38.3%

* No statistically significant difference (P=0.05).

Based on these observations and a review of relevant literature we hypothesize that the progress of the disease among the population is as follows:

1. There is a relatively low level of *R. salmoninarum* infection in the fish when they are collected (W. Groberg estimated about 5%). These fish have not developed clinical BKD so they shed few bacteria.

2. The fish that were infected with *R. salmoninarum* when collected develop clinical infections of BKD and begin shedding bacteria. Other fish are exposed to the bacteria and begin to develop the disease. The transmission efficiency of BKD appears to be relatively low so only a few new fish are infected by each individual shedding bacteria.

3. Fish with clinical BKD die or recover (the rate of recovery is unknown but suspected to be low). The BKD infection in newly infected fish progresses slowly (~ 6 months to clinical infection). There is little or no shedding of bacteria and few or no new infections at this time.

4. The fish that were infected at the last outbreak develop clinical BKD and begin shedding bacteria. . Other fish are exposed to the bacteria and begin to develop the disease. The transmission efficiency of BKD appears to be relatively low so only a few new fish are infected by each individual shedding bacteria.

5. The disease continues to progress among the population cycling among steps 2-4. At each round of infection more fish become infected and losses increase.

A computer simulation of this model shows a pattern of progress of the disease similar to that observed in the captive brood (Figure 3). The simulation incorporates losses to spawning and other non-BKD causes. One factor not included in this model is the development of resistance to BKD by some of the population. This is probably reflected in that the total numbers of mortalities observed are less than those predicted by the model. The majority of spawners are BKD negative, indicating that some fish are not infected even after spending up to 5 years in tanks where there are chronic losses to BKD. This could be due to resistance to BKD infection or perhaps the slow progress of the disease. The model also fails to predict the long latent period where few or no fish are lost to BKD. The latent period appears to last for 12-13 months after capture. The 1994 cohort lacks this long latent period. In the 1994 cohort early losses to BKD were observed which appear to have led to an earlier spread of the disease among the population. This suggests that either some event starts the progression of BKD in the population or that the progression of the disease among the population during the early part of captivity is slower than we anticipated.

We tracked 20 fish that we observed with blebs (small dermal hemorrhages) or other symptoms of BKD during the first maturity sort (Table 35). There is no exact relationship known between the severity of BKD infection and external symptoms. Some fish with blebs may never develop systemic infections.

There were 21 BKD mortalities from 5/27-9/15/99. Only 6 of these 21 mortalities were identified as having external BKD symptoms at the 26 May 1999 maturity sort. This suggests that while

external symptoms may be an indicator of *R. salmoninarum* infection they are not an absolutely accurate predictor of a fish developing clinical BKD.
A total of 14 of the 20 fish with BKD symptoms were successfully spawned. The number of fish with clinical or gross BKD levels at spawning was 7 of the 14 surviving fish. At spawning, 5 of 14 surviving fish that had "true negative" ELISA values. These fish received 2-3 injections of Erythromycin at 20mg/kg between the initial sort and spawning.

Figure 1. Monthly and cumulative losses due to BKD among the 1994 cohort at the Bonneville captive brood facility.

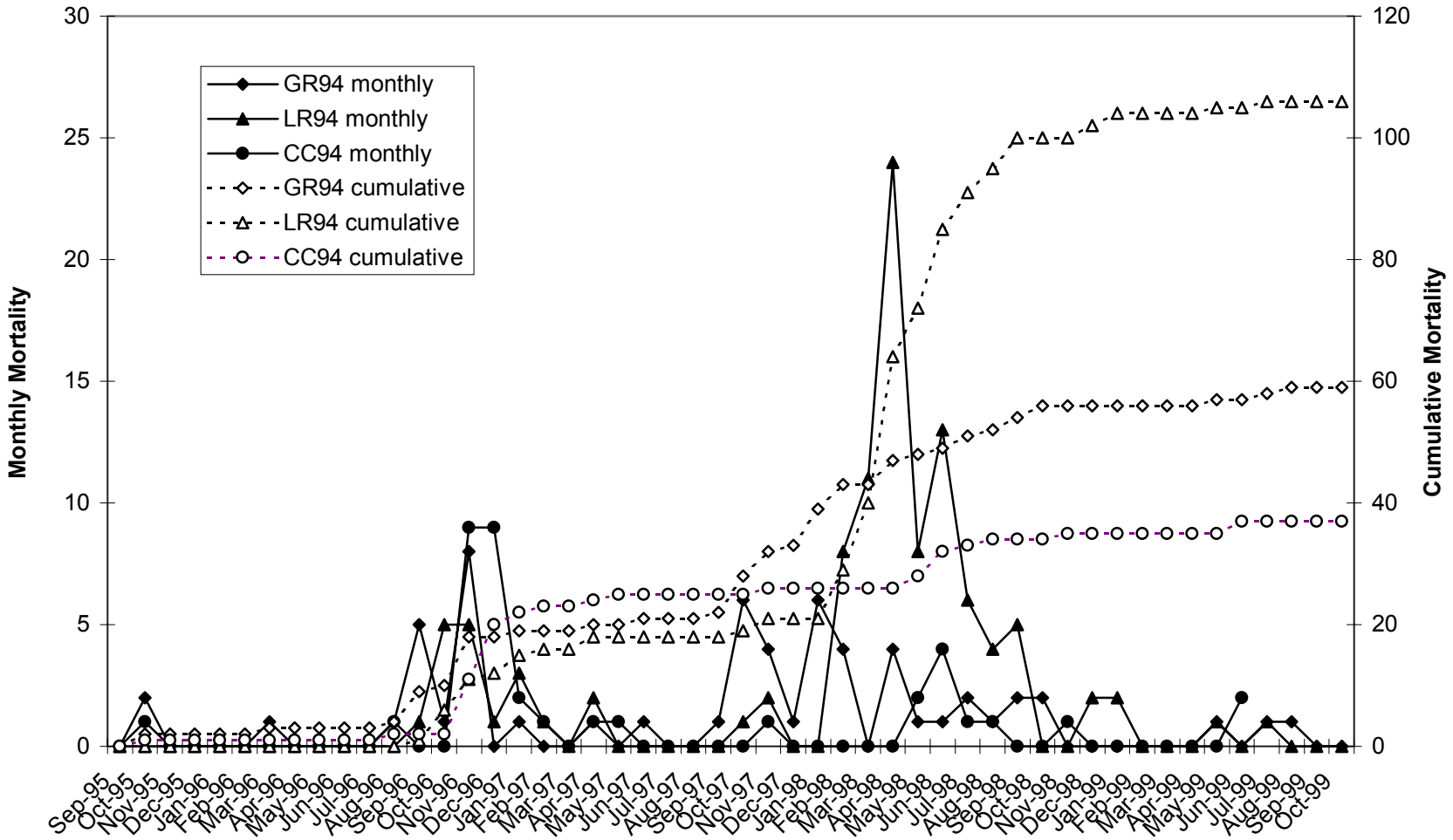

Figure 2. Monthly and cumulative losses to BKD among the 1995 captive brood cohort at the Bonneville Captive Brood Facility.

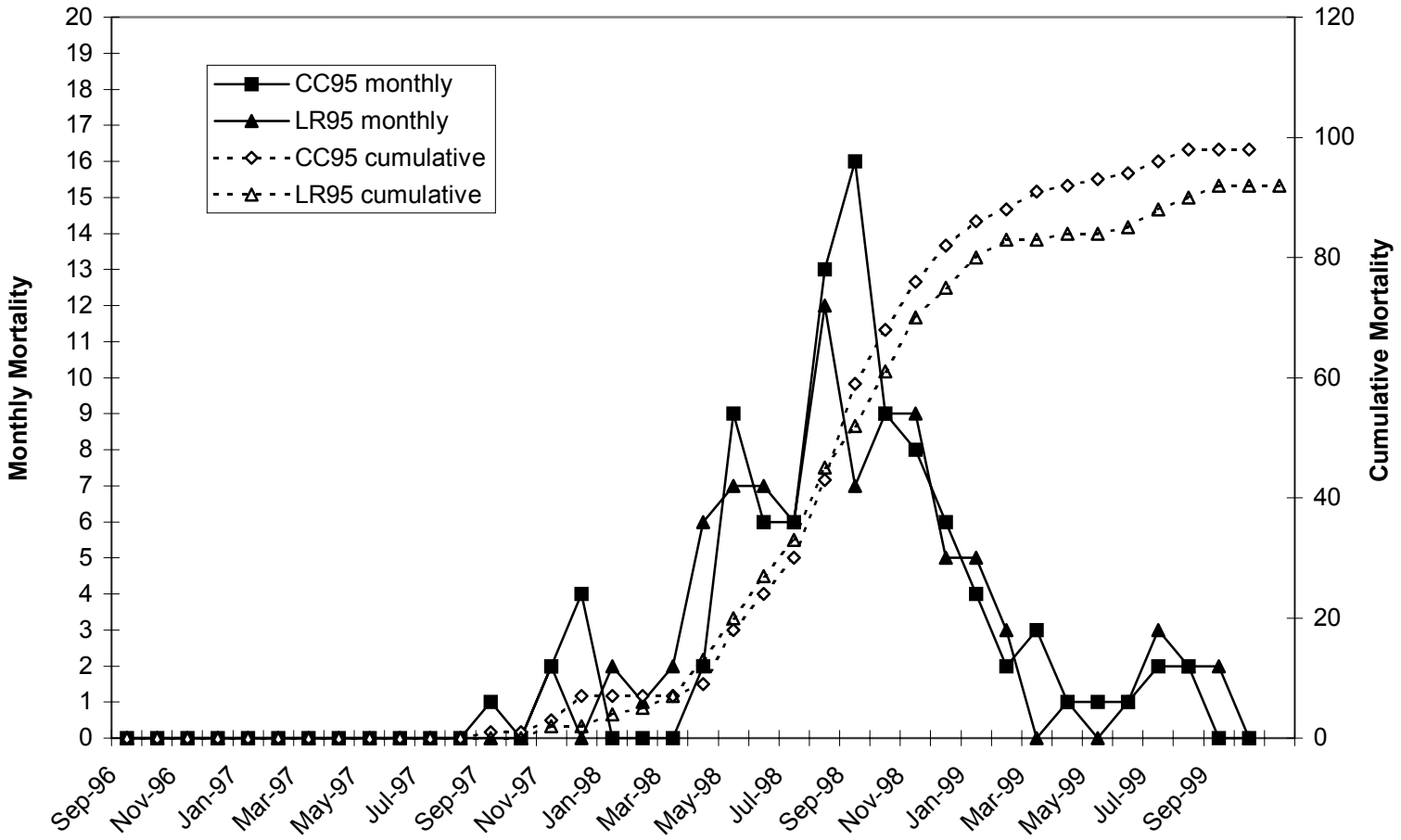

Figure 3. Comparison of observed and predicted progress of BKD among captive broodstock.

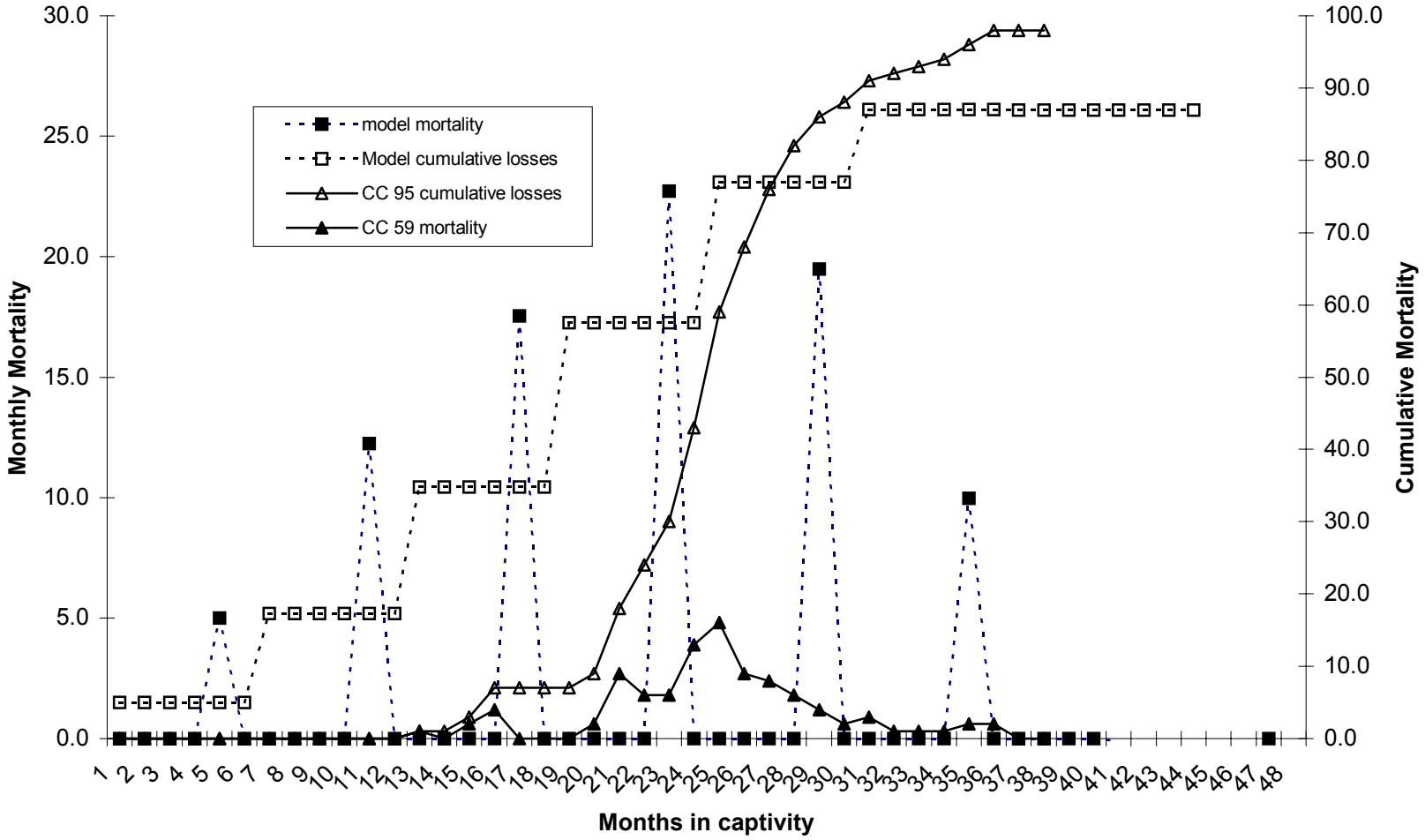

Table 35. Eventual fate of fish with external symptoms of BKD observed during the initial maturity sort on 5/26/99. All fish received a 20mg/kg injection of Erythromycin during the sort and an additional 2-3 20mg/kg injections before spawning. ELISA values for clinical levels of BKD infections are in bold, gross infections are underlined.

PIT tag	Symptoms on 5/26/99	Mort Date	ELISA Value
507B141828	3 blebs	Spawned	0.136
507B116151	Blebs on right sides and fins	9/4/99	-
507B180451	2 blebs	Spawned	**2.525**
4154552B4C	Damaged eye, 4 blebs	6/7/99	**3.527**
223B6C7F1E	Hemorrhaging/redness on anal fin	Spawned	**0.829**
221D792D01	1 bleb	Spawned	**2.894**
221E056E3D	1 bleb	Spawned	0.648
4156523A19	4 Blebs	Spawned	**2.945**
2242605B3E	4 Blebs	Spawned	**2.846**
221C176E41	1 bleb	Spawned	0.170
221E197979	Large lump (abscess) on right side	8/1/99	**3.38**
223B525528	5 blebs	Spawned	**0.819**
41563E5D43	1 bleb	Spawned	0.111
4157382871	1 bleb	Spawned	**1.288**
41570A4265	Bulge on side (abscess)	7/9/99	**3.32**
41545B181A	Blebs on side	Spawned	0.498
4156787A47	Bulging eyes, lesions on snout and nares	7/27/99	**3.27**
221C1A585D	6 blebs	5/27/99	**3.57**
4154535365	1 bleb	spawned	0.113
41573A7811	1 bleb	spawned	0.130

Bacterial septicemia (APS), *Aeromonas* sp. and *Pseudomonas* sp.

These bacteria are common environmental bacteria often associated with decomposition. They can also cause typical bacteria septicemia in fish. This makes the interpretation of the presence of this organism somewhat difficult. Fish that died from other causes may also have these bacteria present during the decomposition process. The incidence of *Aeromonas-Pseudomonas* septicemia among the captive broodstock was relatively low and since it is a commonly present bacterium no special measures are required to control the spread of these bacteria.

Coldwater Disease*, Flavobacterium psychrophilum*

This fish pathogen is widely distributed and occurs frequently in juvenile fish. This bacterium caused little mortality among the captive broodstock and no special measures are required for control.

Fungus

No fungal infections or mortalities associated with fungus were observed until maturing fish were exposed to Tanner Creek water. Fungal infections were absent from tanks supplied with well water. The lack of fungal infections in these tanks was emphasized by the presence of fish with healed injuries, which if they occurred in most surface water systems, would be expected to lead to fatal fungal infections. Risk of fungal infection should be considered when making decisions on when to

place maturing fish in Tanner Creek water. Formalin treatments were generally effective in controlling fungal infections in spawning fish.

Whirling Disease, *Myxobolus cerebralis*

The Grand Ronde and Imnaha Basins are the only drainages in Oregon where M. cerebralis occurs in naturally produced fish. There is great concern about the potential damage to salmonid populations from whirling disease if it were introduced to other drainages in Oregon. The captive broodstock program has gone to great lengths to prevent any release of the whirling disease organism (*Myxobolus cerebralis*) from stocks held outside of the Grande Ronde Basin. Since *M. cerebralis* requires and intermediate host (an aquatic oligochete) to complete its life cycle, there is no fish- to- fish or parent- to- progeny transfer of the disease. The major risk of transmission is the release of spores into the environment where they could come into contact with the intermediate host. Spores of *M. cerebralis* are microscopic and typically found in the cartilaginous or bony tissues of an infected fish.

Sampling for *M. cerebralis* infection is a two- step process. A 20 mm diameter head core sample is collected from roughly between the eyes of the fish, starting at the top of the head and ending at the roof of the mouth. The entire head is collected from small fish. The sample is split, one half is frozen and the other half preserved in 10% buffered formalin. The frozen samples are analyzed in 5 fish pools. The samples are digested and an extraction process collects spores from the sample for examination. The samples are examined microscopically and any spores present are identified by morphological characteristics. If *M. cerebralis* spores are present in the pooled sample it is recorded as a presumptive positive. In presumptive positive five-fish pools the formalin-preserved sample for each fish is sectioned, stained and microscopically examined for the presence of *M. cerebralis* spores. If the spores found have the correct morphological characteristics and are found in bone or cartilage the fish is recorded as a confirmed positive (AFS, 1994).

Interpretation of the significance of presumptive positives can be difficult. If no *M. cerebralis* spores are found in the histological sections it does not guarantee that none of the fish were infected. Since only 2-5 very thin sections of one-half of the sample is examined it is possible that the section did not contain spores that were present in other parts of the sample (especially at very low levels of infection).

The Lostine River stocks had two fish with confirmed infections of *M. cerebralis*. To this date, no fish with clinical signs of whirling disease (spinal deformities, darkened tail, whirling swimming patterns) have been observed among the captive broodstock. No confirmed or presumptive positive samples have been collected from the Catherine Creek or Upper Grande Ronde stocks. Another non-pathogenic mxyosporean, *Henneguya* sp. , has been identified in pooled samples from Lostine River and Upper Grande Ronde Stocks.

Table 36. Results of whirling disease sampling of captive brood stock. The number of presumptive positives is the number of 5-fish pooled samples with spores identified as *Myxobolus cerebralis* (digest technique). Confirmed positives are individual fish which had *M. cerebralis* spores identified in histological sections.

Stock	Presumptive positive 5-fish pools	Fish confirmed positive	Total fish examined
Lostine River	8	2	186
Catherine Creek	0	0	123
Upper Grande Ronde	0	0	56

Parasitic copepods, *Salmincola sp*.

When captive broodstock are captured there are some *Salmincola sp*. present on their gills. However, the copepods do not seem to be very successful in reproducing in our culture system. Numbers have never been observed to increase to the point where *Salmincola sp.* loads reduced growth or caused other fish health problems. The Idaho captive brood program observed significant depression of growth at infestations of greater than 6 copepods on the gills on one side of the fish. We have instituted a monitoring program where a subsample of fish is examined at each handling. If numbers of *Salmincola* sp. exceed 5 /side or if the majority of fish examined approach this level, treatments will be initiated.

Some *Salmincola* sp. were observed on the gills of spawned fish. There was more than adequate time for the copepods to develop from the time maturing fish were placed in Tanner Creek water to spawning. It seems likely that these fish were infested after being placed in Tanner Creek water.

Table 37. Levels of copepod (*Salmincola sp.*) infestation in 1998 cohort at time of capture.

Stock	Number Examined	Number Positive (%)	Level (mean and range) per positive fish.
CC 98	100	8 (8%)	1.1 (1-3)
LR 98	92	4 (4.3%)	1.2 (1-2)
GR 98	65	1 (1.5%)	1.0 (1)

Mortalities caused by factors other than known pathogens or parasites

Handling

A few mortalities were directly caused by handling or tagging. However, it should be remembered that BKD is present in all stock/cohort groups. It has been shown by a number of researchers that stress associated with handling can lead to increased losses from BKD in populations of fish where *R. salmoninarum* is present.

Senescence

During spawning, a number of ripe male fish died with no identifiable pathogen present. There was some fungus on most mortalities but not at levels that would be expected to cause death. The testes

of many of these fish appeared partially spent. This led us to conclude that the fish died as a result of the physical decline normally associated with spawning pacific salmon. There were 17 fish in this group that had been injected with hormones to accelerate maturation. This may also have accelerated their physical decline. The hormone- injected fish were successfully spawned once but most did not survive to be spawned a second time. This suggests that while hormone injection may be successful in accelerating maturation we should not expect to collect milt from these fish more than once. Possible measures to reduce the number of ripe fish which die before being spawned include continued feeding of maturing fish to improve general condition and delaying introduction of Tanner Creek water to reduce chances of fungal infection.

Temperature stress

On the last day of Catherine Creek parr collection, 18 August 1999, five parr died a few minutes after transfer to rearing troughs at Lookingglass Hatchery. The mortalities appeared to be caused by temperature stress. Necropsy revealed no pathogens or predisposing conditions. The fish were transferred from 47^{o} F (8.5 ^{o}C) water in the transport container to 58 ^{o} F+ (14.5 ^{o} C) in the rearing trough after being weighed, measured and injected with erythromycin. The fish were upright upon being placed in the troughs and died minutes after that. This is the first time loss has occurred in captured captive broodstock parr at this point of the process. We immediately stopped and adjusted all the water baths to a 2 ^{o} F per container tempering sequence and no more mortalities were observed. The water temperatures at the hatchery were higher this year; 58 ^{o} F+ water rather than 54 ^{o} F or 57 ^{o} F water as in past years. Before planning collections temperature protocols, current water temperatures in the river and at the hatchery and time of day should be considered.

Unknowns

A large number of mortalities of unknown cause were observed at the Manchester facility. The fish were necropsied and samples were cultured for the presence of viruses and bacteria. No pathogens were identified from these fish.

There are a set of disease signs which are observed consistently among some mortalities (28 of 71 unknowns) from the Bonneville Hatchery facility. These mortalities are characterized by the fish losing equilibrium followed by death within a day or two. There is a sudden onset with no obvious decline in fish condition before loss of equilibrium. Externally the fish show no signs of disease or decline and appear to be in good condition. Necropsy of these mortalities shows hemorrhaging and aneurysms in the gills, hemorrhaging in the brain, vasodilatation of the coelomic and intestinal blood vessels and an enlarged (empty) hindgut. There are no other gross symptoms and the fish otherwise appear healthy and in good condition. We have not successfully isolated any known pathogenic bacteria or virus from these fish. To facilitate tracking of this set of disease signs we propose referring to it as enlarged hindgut syndrome (EHS).

Treatments

Treatments administered to the captive broodstock in 1999 included erythromycin feedings and injections, vaccination of the 1997 cohort against *Vibrio* sp. and formalin treatments to control fungal infections among maturing fish.

Discussion

Bacterial kidney disease (BKD) was reported as the main cause of mortality among captive broodstock in 1999. This is has been a consistent pattern throughout the history of the captive broodstock program. Of 865 mortalities for which cause of death was recorded (project start-February 1999) 443 were due to BKD. These levels of mortality not only reduce the genetic diversity present in the spawning population, they are also likely to confound the results of experimental treatments applied this study. This strongly suggests that we should take aggressive action to reduce mortalities due to BKD. Reducing BKD levels among the captive broodstock would not only increase the number of fish which survive to be spawned but would also likely increase the survival of the F1 generation due to reduced incidence of vertical transmission. The following measures should be considered in controlling BKD among the captive broodstock:

1. Develop non-lethal BKD assay. Identify BKD positive fish and return them to their natal streams before they are transferred to Bonneville or Manchester.
2. Pursue use of a BKD vaccine.
3. Culling of gross positives during handling events.
4. All fish receive at least 2 feedings or injections of erythromycin each year.
5. Modify procedures to minimize handling stress.
6. Pursue use of different antibiotics, such as azithromycin.

These measures would probably increase the workload of most sections of this project. However, it seems worthwhile to pursue control of BKD both to increase the number of spawners (and thus the effective population size) among the captive broodstock, help ensure the survival of their progeny, and help prevent the confounding of treatment effects among the different growth regimes employed in this study.

6) Measures taken to minimize disturbance

Ripeness sorting procedures were modified during 1999 so that fish were only handled once per week. In 1998 fish were usually handled at least twice per week

7) Problems

Bacterial Kidney Disease (BKD) and associated problems:

Problems were experienced with outbreaks of BKD in various groups of fish and with attempts to prevent BKD. Treatments included uses of Erythromycin injections, Erythromycin pills and Aquamycin treated feed. Evidence of erythromycin toxicity appeared during some treatments and resulted in termination of some treatments earlier than planned. Prophylactic treatments also resulted in rescheduling of some sorting, sampling and/or inspection activities.

Embryos from females exhibiting clinical BKD ELISA values ($\geq$ 0.80) were kept separate from embryos from females with lower ELISA values.

VI tag retention in BY97 fish:

VI tagging was done in early August with tags being implanted as a dorsal insertion posterior of the right eye. VI tag retention was excellent in the 97 cohort fish as we only found three fish with missing tags during sampling and sorting activities throughout the fall of 1999.

Inability to achieve temperature separation and therefore treatment objectives:

During 1999 a variety of water supply and chiller problems at Lookingglass Hatchery have resulted the project's inability to achieve temperature separation for the natural vs accelerated treatments. The water supply problems at Lookingglass Hatchery also resulted in the transfer of pre-smolts from Lookingglass Hatchery to Bonneville Hatchery three months early (e.g. On January 6 & 7 vs early April) in 1999.

Mixing of 1998 cohort stocks and treatments during transfer.

Due to severe weather and the resulting water supply problems at Lookingglass Hatchery, all 1997 cohort fish were transferred to Bonneville Hatchery on 6 and 7 January 1999. At some point in their captive life history 13 fish from the Grande Ronde and Lostine stocks, and primarily Saltwater/natural and Freshwater/accelerated treatments got mixed. The stocks and treatments were subsequently separated during the April inventory at BOH. Two fish in the LR tank had nonfunctional PIT tags so we were unable to positively identify, and therefore separate them. However, since these fish were found in the LR tank they were re-PIT tagged and placed back in with the LR fish.

As a result of this mixing all disciplines within the program that handle captive brood fish (e.g. culture, fish health, research and transport) reviewed existing handling protocols and developed new ones to prevent any future unintentional mixing of fish. These protocol were immediately implemented and have been incorporated into the 2000 Captive Broodstock AOP.

Mixing of eggs during spawning.

Misidentification of stocks and treatments during spawning, and handling errors during shocking and combining of eggs at eye-up resulted in mixing of 38,158 eggs in 1999. Of the mixed eggs 27,449 were mixed treatments within a stock (e.g.LR-Sn with LR-Fn), 3,236 were mixed between stocks (e.g. LR & CC) and 7,473 eggs were mixed between stocks and treatments (e.g. CC-Sn with LR-Fn). The mixing of 23,352 of these eggs was the result of misidentification of one male which was spawned with one matrix cell of eggs from each of four females. These eggs were then mixed with eggs from other females before the error was discovered. Subsequent conversations between research and fish culture personnel have resulted in a heightened awareness of the potential mixing problem and establishment of guidelines to assure that such mixing does not occur in the future.

Database management.

With increased numbers (e.g. cohorts) of fish being added to the program each year, and increased numbers and complexity of spawning fish, time demands for
data entry, editing and tracking has increased significantly. The needs for access to the data by an increasing number of persons/agencies may also result in the necessity to convert our present flat database (Excel) to a relational database (possibly 'Access'). This conversion process will also add a considerable work load to program personnel.

8) Analyses

See previous sections of this report.

9) Research coordination

Oregon's Technical Oversight Team (TOT) continued to guide the daily activities associated with the captive broodstock program. The TOT which includes personnel from ODFW, NPT, CTUIR, and NMFS had nine regular meetings plus an AOP meeting in 1998. The regional Technical

Oversight Committee (TOC) helped to coordinate regional efforts. The TOT chair participated in four TOC meetings during 1998.

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Conventional Broodstock Project

This section details adult collection, retention for broodstock, hatchery spawning/gamete collection, F1 generation, fish health and problems encountered for the conventional broodstock project of the Grande Ronde Endemic Salmon Program. The purpose of the conventional broodstock project is to provide a production boost at low to moderate levels of escapement, working in concert with the captive broodstock project at very low escapements, to increase the probability of persistence of these populations.

1) Activities Conducted

Trap Operations

Table 38. Trap operation in Grande Ronde River tributaries in 1999.

Date		Site	Activity	Comments
7	May	Catherine Creek	Open	
26	Sep		Close	Last fish captured 25 Aug
7	May	Upper Grande Ronde	Open	
22	Sep		Close	Only fish captured 14 Jul
19	Apr	Lostine River	Open	
1	Oct		Close	Last fish captured 27 Aug

Weir operation and adult collection

Chinook salmon adults were collected using a picket weir on each stream generally staffed 24 hours per day. Fish were processed daily (Table 39). All live fish that were trapped were given punches on the opercular plate to indicate either tributary of origin (at the hatchery) or previous capture at the weir (at recovery of carcasses during spawning ground surveys). Fish collected at the Lostine River were given punches of different numbers corresponding to different periods of collection to determine if date of passage was associated with probability of successful spawning (because the 1998 population estimate using marked to unmarked ratio was much larger than the population estimate based on redds built).

Fish that were collected generally appeared to be in fair to good condition, but some displayed cuts and bruises of varying severity. Causes of the injuries were undetermined, but a few appeared fresh enough to have possibly occurred in the vicinity of the trap. What appeared to be evidence of gas supersaturation (exposed tissue with dermis sloughed off, often around the head area ; “headburn”) was also evident on many fish. Necrotic areas were observed on at least half of the fish that were captured at Catherine Creek, usually on the distal end of the snout. Leading edges of fins, particularly the pectoral fins, were observed to have necrotic tissue. “Classic” necrotic areas consistent with extensive headburn was observed on 3 fish of the 16 fish collected at the Catherine Creek weir. The one fish captured at upper Grande Ronde showed no sign of headburn. At the Lostine River, 2 of the 13 chinook salmon collected appeared to have headburn.

Retention for broodstock

In 1999, because of the low number of fish expected to be trapped, comanagers decided not to retain fish for brood stock for Catherine Creek and the upper Grande Ronde tributaries. At the Lostine River weir, no more than 2 in 5 (40%) of the naturally-produced salmon returning to the weir were retained for brood stock.

Fish were selected for brood stock systematically (e.g., two of every five males, females, or jacks) from among fish captured at the traps. Fish selected for brood were injected with antibiotics (see fish health section for this and other treatments received). They were jaw-tagged with a stainless steel hog ring and individually numbered labels to indicate tributary of origin (by color and number sequence). Fish were transported to Lookingglass Fish Hatchery by ODFW on the day of capture. All arrived live at LFH and were transferred from the transport truck to the holding tank using a dipnet. All fish not used for brood were released to spawn upstream after data were collected.

2) Maturity and Spawning

Hatchery spawning and gamete collection

No fish were spawned in 1999. The NPT cryopreserved sperm from Lostine River fish collected under CRITFC Permit 1134 (Table 40). Half of the samples from each male are being stored at Washington State University and half at the University of Idaho. No sperm was collected from Catherine Creek or the upper Grande Ronde River fish.

F_1 generation

No F1 progeny of conventional fish were held in captivity in 1999.

Table 39. Data collected from adult chinook salmon trapped on the Lostine River, Catherine Creek, and upper Grande Ronde River in 1999.

Stream [1]	ID	Date	Marks	Gender [2]	FL (mm)	Pass/ Keep	Tag Color [3]	Tag #	Opercle Punch [4]	Genetic Site	Genetic ID#	Notes
CC		7 May										Trap opened
CC	1	13 May	None	Unk	745	Pass		N	1 ROP	CC	99001	
CC	2	15 Jun	None	Unk	805	Pass		N	1 ROP	CC	99002	Left maxilla damaged-old
CC	3	2 Jul	None	Unk	736	Pass		N	1 ROP	CC	99003	
CC	4	2 Jul	None	Unk	708	Pass		N	1 ROP	CC	99004	
CC	5	7 Jul	None	Unk	758	Pass		N	1 ROP	CC	99005	2”x3” head skin missing
CC	6	8 Jul	None	Unk	665	Pass		N	1 ROP	CC	99006	
CC	7	11Jul	None	Unk	777	Pass		N	1 ROP	CC	99007	
CC	8	13 Jul	None	Unk	768	Pass		N	1 ROP	CC	99008	
CC	9	14 Jul	None	Unk	704	Pass		N	1 ROP	CC	99009	
CC	10	15 Jul	None	Unk	716	Pass		N	1 ROP	CC	99010	
CC	11	17 Jul	None	Unk	610	Pass		N	1 ROP	CC	99011	Fungus on snout and pectoral fins
CC	12	17 Jul	None	Unk	730	Pass		N	1 ROP	CC	99012	
CC	13	21 Jul	None	Unk	757	Pass		N	1 ROP	CC	99013	
CC	14	28Jul	None	Unk	720	Pass		N	1 ROP	CC	99014	
CC	15	3 Aug	None	Unk	738	Pass		N	1 ROP	CC	99015	
CC	16	25 Aug	None	F	768	Pass		N	1 ROP	CC	99016	
CC		26 Sep										Trap closed
GR		7 May										Trap opened
GR	1	14 Jul	None	Unk	N/A	Pass		N	2 ROP	GR	99001	
GR		22 Sep										Trap closed
LR		19 Apr										Trap opened
LR	1	19 Jul	None	M	745	Pass		N	3 LOP	LR	99001	
LR	2	23 Jul	None	M	580	Pass		N	3 LOP	LR	99002	
LR	3	24 Jul	None	M	770	Pass		N	3 LOP	LR	99003	
LR	4	28 Jul	None	M	525	-		N	NA	LR	99004	Escaped from trap Jack
LR	5	29 Jul	None	F	774	Pass		N	2 LOP	LR	99005	
LR	6	29 Jul	None	F	760	Keep	Yel	561	2 LOP	LR	99006	Returned to river 5/ headburn
LR	7	29 Jul	None	F	735	Pass		N	2 LOP	LR	99007	
LR	8	29 Jul	None	F	734	Pass		N	2 LOP	LR	99008	
LR	9	29 Jul	None	M	930	Keep	Yel	560	2 LOP	LR	99009	Returned to river 5/ headburn
LR	10	10 Aug	None	F	813	Pass		N	2 LOP	LR	99010	
LR	11	11 Aug	None	F	650	Pass		N	2 LOP	LR	99011	
LR	12	13Aug	None	F	790	Pass		N	2 LOP	LR	99012	
LR	13	27 Aug	None	M	840	Pass		N	1 LOP	LR	99013	
LR		1-Oct										Trap closed

1/ CC = Catherine Creek; GR = upper Grande Ronde River; LR = Lostine River
2/ F = female; M = male; Unk = unknown
3/ Yel = yellow; Blu = blue; Red = red
4/ Number of holes; Side: L = left or R = right; Type of mark: OP = opercle
5/ Fish were returned because target brood stock number was not attained.

Table 40. Collection of fish and disposition of semen collected from male spring chinook salmon from the Lostine River in 1999 (covered under associated CRITFC Permit 1134).

Collection Date	Site	Females Collected [1]	Males Collected	Sperm Taken?	Sperm sample #	Sample Disposition
27-Aug	LR	0	1	Y	NPT-07-99-LR	Cryopreserved
27-Aug	LR	0	1	Y	NPT-08-99-LR [2]	Cryopreserved

[1] Any females were netted, identified for sex and then immediately released.
[2] Marked with 3 left opercle punches.

3) Fish Health and Disease: Conventional Broodstock Program

Juveniles

None

Adults

Three maturing female adult mortalities from Catherine Creek weir were necropsied in July of 1999 (Table 41). One died of severe fungal infection combined with head and jaw lesions and the other two were probable headburn mortalities with secondary fungus infection. One of three had a heavy level of *Ceratomyxa shasta* present in the lower intestine. Aeromonad-pseudomonad bacteria was detected systemically in all three at low to moderate levels. There were no signs of BKD and all ELISA values were low at ≤ 0.133 OD units. No endemic adults were held and spawned at Lookingglass Hatchery for the 1999 brood year.

Table 41. Summary of necropsy findings for three Catherine Creek Endemic Broodstock mortalities in 1999.

Mortality Date	Sex	Maturity	ELISA OD_{405nm}	Significant Clinical Findings
05-Jul-99	F	Maturing	0.112	Head and jaw lesion & severe fungus, caudal lesion and fungus. Found aeromonad-pseudomonad (APS) bacteria systemically. Found a heavy level of *Ceratomyxa shasta* in lower intestine.
20-Jul-99	F	Maturing	0.133	Probable headburn. Whole head fungus. APS bacteria.
22-Jul-99	F	Maturing	0.111	Probable headburn. Severe head lesion and fungus. APS bacteria systemically.

Prescriptions

Prescriptions were obtained for all three endemic broodstock programs in 1999: 1) Catherine Creek (201W99), 2) upper Grande Ronde (80W99), and 3) Lostine River (200W99). Brood prescriptions were obtained for treatment of bacterial kidney disease (erythromycin @ 20 mg/kg) and furunculosis (oxytetracycline @10mg/kg). Formalin prescriptions were also obtained for control of external fungal infections at 1:6000 for one hour for two to three days per week or more frequently as necessary to prevent external fungi infections.

4) Measures Taken to Minimize Trap-related Problems and Instream Disturbance

To minimize disturbances to ESA-listed fish at each adult collection site, we implemented a number of precautions. All traps were placed at an angle to the river so that fish could follow the main flow and locate the trap entrance quickly. Each site was staffed continuously and the weir and trap were checked often to ensure that no fish were impinged upon the weir or became injured while attempting to pass the weir structure. Processing of trapped fish occurred quickly to minimize their time out of water and the amount of time under anaesthetic. Activities that could be accomplished with the fish wholey or partially submerged were completed in that fashion.

Weekly stream surveys to look for congregations of fish below the weir were done while walking on the bank, when possible, to avoid disturbing holding fish. During spawning ground surveys, we used the same procedures as in other systems containing listed fishes to minimize disturbance (e.g. getting out of the stream whenever a fish is observed, avoiding handling live fish etc.; see: "ESA Section 10 Permit 1152" for details). These measures were generally.

5) Problems Encountered

Injuries

Concern about the injuries seen on fish collected at the Grande Ronde River weir site caused us to change operations in 1998 and 1999. At the Catherine Creek and upper Grande Ronde sites we placed foam insulation to cover sharp metal edges and corners on weir parts. A tarp was put inside the traps to inhibit jumping and provide cover. The frequency of checks for fish in the traps increased, so that if being inside the trap increased probability of injury, fish would be there shorter lengths of time. At the upper Grande Ronde River weir, because of the unshaded, exposed nature of the trap, camouflage netting was put over the trap to provide cover. Incidence was smaller and severity of injuries was lower in 1999 compared to 1998.

Pre-spawning mortality

Four dead chinook were recovered at or near the Catherine Creek weir during trap operations. Two of these were fish that had been trapped and marked at the weir. At recovery two had noticeable injuries on the head consistent with the symptoms of gas supersaturation ("headburn"). Another mortality was unmarked. The fourth consisted of a mostly-eaten carcass that was found downstream of the weir near the fish ladder.

Headburn was expected to be a problem during 1999. High spill volume at Snake and Columbia River dams occurred. During spawning ground surveys 1 prespawn female mort was sampled between the weir and the town of Lostine. According to the opercle punch pattern, the fish passed the NPT weir on 8/13. Low flows likely inhibited further upstream passage.

Minimum broodstock needs

Population estimates above the weirs were much larger than the number of fish caught in the traps. The percentages of the total estimated spawning populations collected at the Catherine Creek, upper Grande Ronde River, and Lostine River weirs were 33.3%, 0.0% and 16.3%, respectively. These figures were based on percentage of opercle-punched carcasses recovered above the weir on spawning

ground surveys. This may have been due to poor efficiency of the trap or installation of the trap too late to catch a cross section of the run. There were short periods when we pulled pickets to prevent damage to the weir, and periods when the weir was undercut at Catherine Creek after a high water event. This suggested that we may have put the weir in late, particularly at the Lostine River. For the Lostine River salmon chinook, which seem to continue to arrive at the weir site later in the season, this may not be as much of a problem as for the other two sites. Fish passage records for Lower Granite Dam suggested that small but perhaps significant numbers of chinook salmon pass the dam and may have passed the weir locations by 1 May in some, if not most, years.

Earlier installation of all three weirs will be attempted in 2000 in an effort to increase the proportion of adults captured. Low flow conditions resulting from irrigation diversions on the Lostine River (where the river has been so low as to have gone subterranean in some locations) may also have resulted in thermal or physical (low water) barriers to migration toward spawning grounds, causing marked fish to be underrepresented in carcass recoveries, and producing an inflated population estimate.

Maturation timing

No fish were spawned in 1999. We plan to document and monitor the maturation process in the future by inspection of fish at each scheduled handling event.

Trap operations

Very warm weather during some periods in May and June of 1999 resulted in high flows and debris loads in the Grande Ronde River and Catherine Creek. Both weirs were rendered inoperative due to high flows and debris beginning on May 22. The Grande Ronde weir was rebuilt and began fishing again on June 5. The Catherine Creek weir was rebuilt and began fishing again on June 10. High water was again a problem at Catherine Creek on June 15 and the weir was not operational from June 15-June 22.

Non-target species

The weir may have had some minor effects on some non-target species. Ability to keep the weir in at the Grande Ronde River and Catherine Creek resulted in more steelhead being captured on their way downstream (1999, 13; 1998 0; 1997, 0). Large aggregations of what were presumed to be post-spawn largescale suckers were observed immediately above weirs, suggesting that the weir inhibited downstream movement after spawning of these fish. At the Lostine River site hundreds to thousands of suckers were observed above the trap. Pulling of the pickets in some sections and use of a seine one day allowed downstream passage of a large proportion of the fish. Other days individuals were caught by hand and placed below the weir. At Catherine Creek and the Grande Ronde River about 50-100 dead suckers per site were found washed up against the weir over the season. Small groups like those observed on the Lostine were observed at the Grande Ronde River, but not the Catherine Creek. No action was taken, and the fish disappeared. Most probably passed the weir site during high water. The weir manufacturers addressed this design flaw and corrections were made.

6) Derivation of take estimates

All estimates of take were made by direct count of fish at the trapping facility, during frequent surveys for a one-mile reach below the weir, or during three spawning ground surveys both above and below the weir.

7) Preliminary Analyses of Data

No analyses of adult collection operations is required at this time.

8) Research Coordination

Comanagers utilized a Technical Oversight Team (TOT) to guide the daily activities associated with the conventional broodstock project. This team was composed of members from ODFW, NPT and CTUIR, and worked in concert with the captive broodstock TOT for overall program coordination. We also coordinated field work with the spawning ground survey project in NE Oregon and with field work conducted by our early life history project.

9) Spawning Ground Surveys and Weir Effect

Spawning ground surveys were conducted by comanagers weekly for about 3 weeks during spawning to document redd numbers and collect information from carcasses (Table 42). During these surveys we counted live fish, completed redds and sampled dead fish for scales and mark/recapture information. We have no substantial evidence that the presence or operation of the weirs has changed spawning distribution, timing or behavior. Changes in spawning distribution will be evaluated as a time series once sufficient data are available. However, we have limited data from below each weir site to evaluate any potential changes. In addition, to address the potential for the weir to disrupt normal migration behavior, we surveyed a one-mile section below each weir (or to the mouth on the Lostine River) two to seven times per week to determine if fish were congregating below weirs (Table 43). No evidence of a delay in migration was observed. Most fish passed the weirs during relatively high water events.

Table 42. Results of spawning ground surveys for spring chinook salmon in the upper Grande Ronde River, the Lostine River and Catherine Creek in 1999.

Stream	Number of redds	Percent below weir	Carcasses Above Weir Punched	Carcasses Above Weir No Punch	Carcasses Below Weir	Population estimates Mark/ Recapture	Population estimates Redds x 3.1 fish/redd
upper Grande Ronde River[2]	0	NA	0	1	0	NA	0
Lostine River	57	21	7	36	3	77	176
Catherine Creek	40	5	5	13	1	54	124

[1/] Actual redd counts, not expanded for areas or times when follow-up surveys were conducted

[2/] Population estimates are based on mark-recapture data.

[3/] Spawning habitat in Vey Meadows of the upper Grande Ronde River was not surveyed due to lack of landowner permission for access.

[4/] Source: P. Keniry, ODFW

Table 43. Chinook salmon observations during foot and snorkel surveys of a one-mile section above and below each weir in 1999.

Stream	Survey Type	Date range		No. of surveys	Live fish observed Adults	juveniles	Carcasses observed
upper Grande Ronde River	Foot	28-Jun	22-Sep	19	0	0	0
Catherine Creek	Foot	1-Jul	8-Sep	20	7	0	1
Lostine River	Foot/Above *	5-May	1-Oct	60	6	>100	1
Lostine River	Foot/Below *	5-May	1-Oct	60	4	>100	4
Lostine River	Snorkel	25-Aug	-	1	0	0	0

*Surveys on the Lostine River are conducted above and below the weir simultaneously.

10) Anticipated Program Changes in 2000 and beyond

We plan to manage the trapping, collection, handling, spawning of adults in 2000 in the same manner as we did in 1999 with the following exceptions:

We plan to install the weirs earlier and keep the weir fishing under high flow conditions in an effort to collect fish from across the entire run. This action will be dependent on flow conditions in each tributary. We may install the weir earlier to collect data on upstream migrating steelhead adults.

We continue to implement the changes in the holding facilities to discourage behavior in the traps that may cause injury. In addition we plan to check the traps for the presence of adults more often when fish are moving, especially during rain events, to minimize the possibility of injury to the fish due to fish activity in the trap.

Contractors are scheduled to complete weir designs and construction for weirs in Catherine Creek and the upper Grande Ronde that are able to effectively capture fish under high flow conditions. These are expected to be operational in 2001.

Adult return predictions

Although we have unproven methods to reliably project run size, we attempted to use an estimator to guide our use of the sliding scale for broodstock management. In 2000, we expect approximately a range of 1.9 to 3.9 times as many fish (per tributary) compared to the projected returns of wild chinook in 1999 (Table 44). There are numerous areas for variability in this estimator. However, all estimators of the 2000 run size place us in the lowest escapement category of the sliding scale (See permit 1011). Adult collection ratios and spawning criteria in 2000 are expected to be the same as in 1999. Collection efficiency and accuracy of the run predictions will significantly affect the actual smolt output.

Table 44. Projected adult (non-jack) returns, broodstock collection and smolt output for supplemented tributaries for the 2000 brood year.

Stream	2000 run [1/]	Estimated trapped [2/]	Number retained [3/]	Females kept [4/]	Expected smolts [5/]
upper Grande Ronde	61	49	24	12	34,000
Catherine Creek	139	111	44	22	61,200
Lostine River	170	136	54	27	74,800

1/ Estimate based on expected return of natural fish to each tributary as a proportion of the predictions to Lower Granite Dam for this return year. (Source: Annual Operations Plan for the Lower Snake River Compensation Plan, Captive Brood and Conventional Program).

2/ Based on an estimated 80% efficiency rate. Efficiencies in 1997 to 1999 have been lower.

3/ 50% retention rate for Grande Ronde and 40% for other tributaries.

4/ Assumes a 50:50 sex ratio.

5/ Estimated smolt production assumes 80% adult survival to spawn (rounded to the nearest whole fish), fecundity of 4000 eggs per female and 85% egg to smolt survival. Expected release is in 2002.