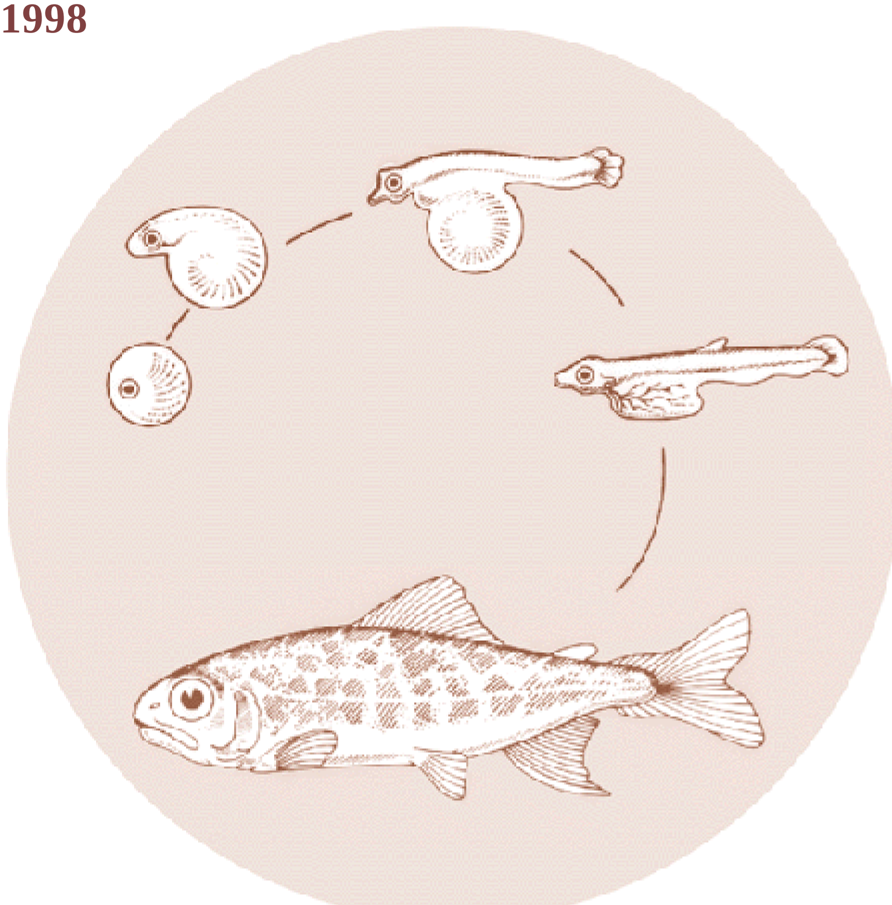
Grande Ronde Basin Chinook Salmon Captive Brood and Conventional Supplementation Programs

Annual Report
1998



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ANNUAL REPORT

PROJECT TITLE: Grande Ronde Supplementation Program

Permit Holder: Oregon Department of Fish and Wildlife

Permit Number: Endangered Species Permit No. 1011

Permit Contact: Richard W. Carmichael

Permit Period: January 1, 1998 through December 31, 1998

Contributors: Oregon Department of Fish and Wildlife
National Marine Fisheries Service
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CONTENTS

Captive Broodstock Project

Conventional Broodstock Project

Appendices

Grande Ronde Endemic Supplementation Program

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 years work.

Captive Broodstock Project

1) Activities conducted

1994 Cohort

As of 31 December 1997, 292, 38 and 236 fish from Catherine Creek, and the upper Grande Ronde and Lostine rivers respectively, were alive and rearing at either Bonneville Fish Hatchery or the Manchester Marine Laboratory. As of 31 December 1998 there were 142, eight and 71 fish remaining alive from Catherine Creek, and the upper Grande Ronde and Lostine rivers stocks respectively. Therefore a total of 345 fish were removed from the population in 1998 (150CC, 30GR, and 165 LR). Of the fish removed from the population in 1998, 170 were spawned or had semen cryopreserved (104CC, 61 LR and 5 GR), 126 died from disease (23CC, 80LR and 23GR), and 44 died from 'other' causes (18CC, 24LR and 2GR) and five Catherine Creek 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.

1995 Cohort

As of 31 December 1997, 398 and 419 fish from Catherine Creek, and the Lostine River respectively, were alive and rearing at either Bonneville Fish Hatchery or Manchester Marine Laboratory. As of December 31, 1998 there were 220 and 190 fish remaining alive from the Catherine Creek and Lostine River stocks respectively. Therefore a total of 407 fish were removed from the population in 1998 (178CC, and 229 LR). Of the fish removed from the population in 1998, 203 were spawned or had semen cryopreserved (82 CC and 121 LR), 160 died from disease (73 CC, 87 LR), 41 died from 'other' causes (20 CC and 21 LR), and three Catherine Creek 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 1997, 496, 500 and 495 fish from Catherine Creek, and the Lostine and Grande Ronde rivers respectively, were alive and rearing at Lookingglass Fish Hatchery. As of 31 December 1998 all remaining fish were rearing at either Bonneville Fish Hatchery or Manchester Marine Laboratory. At that time there were 470, 447 and 466 fish remaining alive from the Catherine Creek and the Lostine and Grande Ronde river stocks respectively. Therefore a total of 109 fish were removed from the population in 1998 (27CC, 53LR, and 29GR). Of the fish removed from the population in 1998, 54 were spawned or had semen cryopreserved (12CC, 31LR and 11GR), three died from disease (1CC, 1LR and 1GR), 39 died from causes (12CC, 14LR and 13GR), two Grande Ronde fish were lost to experiments, and 11 fish were unaccounted for (2CC, 7LR and 2GR). Most moralities that occurred during 1998 were sent to either the Clackamas, La Grande or Manchester Fish Health laboratories. Appendix A contains a detailed account of the Fish Health laboratory findings.

A complete inventory was conducted on 30 April and 1 May. At that time there were 495 Catherine Creek, and 496 Lostine and 495 Grande Ronde river fish. All fish were also given vibrio vaccinations at that time.

Salinity tolerance tests were initiated with surrogates on April 9 to test the readiness of fish destined for Manchester Marine Laboratory. By 10 May we had not achieved the 100% survival required to initiate salinity tolerance tests on captive broodstock. Therefore, on 12 May ten fish from each captive brood stock and eleven surrogates were sent to Manchester Marine Laboratory as sentinels. All fish from each stock survived and only the Lostine River fish failed to show active feeding behavior. Therefore, on 19 May all Catherine Creek and Grande Ronde River fish destined for sea water rearing were sent to Manchester Marine Laboratory. Also on 19 May a second group of ten Lostine River sentinels were sent to Manchester Marine Laboratory. These fish survived and began actively feeding soon after transfer. On 21 May all remaining Catherine Creek and Grande Ronde River fish were sent to Bonneville Fish Hatchery. On 27 May all Lostine River fish destined for sea water rearing were sent to Manchester Marine Laboratory and all remaining Lostine River fish were transferred to Bonneville Fish Hatchery.

In early August a total of 987 fish at Bonneville Fish Hatchery and 447 fish at Manchester Marine Laboratory were tagged with Visual Implant (VI) tags. At Bonneville Fish Hatchery, 328 Catherine Creek, 329 Lostine River and 330 Grande Ronde River fish were tagged. At Manchester Marine Laboratory, 159 Catherine Creek, 160 Lostine River and 158 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.

1997 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 Fish Hatchery grounds, 2) use of well water from Lookingglass Fish Hatchery rather than creek water for transporting fish from their respective collection sites to Lookingglass Fish Hatchery, and 3) injection of all collected parr upon their arrival at Lookingglass Fish Hatchery with erythromycin at 20 mg/kg body weight.

Prior to collecting juveniles, we snorkeled stream sections to confirm the absence of adults and salmon redds. When adults or redds were observed, no sampling was conducted in the immediate area. We collected juveniles using a passive seining technique whereby snorkelers herded salmon downstream into a seine. This method eliminates dragging a seine through sections of a stream and minimizes time fish are in contact with the seine. Using this method, fifteen hundred spring chinook salmon parr were collected for captive broodstock during August and September 1998; 500 from each stock, Catherine Creek, and the Lostine and Grande Ronde rivers (Table 1).

Table 1. Take of 1997 cohort parr spring chinook salmon from three separate populations in the Grande Ronde basin in 1998.

	Stock		
	Catherine Creek	Lostine River	Grande Ronde River
Dates of take	17-19 Aug	24-26 Aug	8-10 Sept
Number collected & retained	500	500	500

Several measures were taken to minimize disturbance at Lookingglass Fish 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.

Approximately one and one-half months after fish were placed in Canadian troughs at Lookingglass Fish Hatchery we PIT-tagged and collected fin samples for genetic analysis from all fish (Table 2). Prior to being tagged 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. Length and weight of each fish were measured immediately after tagging and then fin clips were taken for genetic samples. Fish were allowed to recover in fresh water and then were returned to their respective troughs.

Table 2. Number and disposition of 1997 cohort spring chinook salmon taken to Lookingglass Fish Hatchery for captive broodstock in 1998.

	Stock		
	Catherine Creek	Lostine River	Grande Ronde River
Transported	500	500	500
Ponded	500	500	500
PIT-tagged & genetic samples taken	496	497	500
On station (12/31/98)	493	496	497

During each day of collection all collected fish were anesthetized with 40-50 ppm MS222 and their lengths and weights were measured (Table 3). These measurements were made to provide hatchery personnel with information to help them meet rearing protocols. At this time each fish was also 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 the rearing troughs.

Table 3. Mean fork lengths (FL), weights (W) and sample size (n) of 1997 cohort spring chinook salmon captive broodstock during their first four months of captivity.

		Stocks								
		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	17-19 Aug	500	76.5	5.5	-----	-----	-----	-----	-----	-----
	24-26 Aug	-----	-----	-----	500	76.4	5.6	-----	-----	-----
	8-10 Sept	-----	-----	-----	-----	-----	-----	500	64.9	3.6
Tagging	20-22 Oct	496	95.7	10.5	497	95.3	10.6	500	86.7	8.0
Sampling	7-8 Dec	494	102.5	12.9	126	99.4	11.8	126	97.2	11.3

During the first four months in captivity a total of fourteen 1997 cohort captive brood fish died or were unaccounted for (Table 4).

Table 4. Activities associated with 1997 cohort captive broodstock removed from the population in 1998.

	Stocks		
Cause of loss	Catherine Creek	Lostine River	Grande Ronde River
Collection & transport	0	0	0
PIT-tagging	0	1	1
Disease	2	0	1
Other (other or unaccounted for)	5	3	1
Total	7	4	3

2) Maturity and Spawning

Fish from the 94 and 95 cohort were examined for signs of maturity on three occasions at Bonneville Fish Hatchery and Manchester Marine Laboratory (15-17 June, 13-15 July and 17-19 August). Cohort 96 fish were examined for signs of maturity on two occasions at Bonneville Fish Hatchery (5-6 August and 2-3 September) and three occasions at Manchester Marine Laboratory (5-6 August, 31 August – 1 September, and early October). No maturity sortings were done for 1997 cohort fish. Maturity data includes all fish which were assumed to be maturing whether they survived to gamete collection or died prior to gamete collection.

Following maturity sortings, maturing fish were examined regularly for ripeness. These ripeness sortings took place at Bonneville Fish Hatchery on eight occasions between 11 September and 28 October. No ripeness sorting was done at the Manchester Marine Laboratory.

Spawning occurred using 1994, 1995 and 1996 cohorts in 1998. 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 Fish Hatchery and the other half are being stored at Oasis Genetics in Hermiston, Oregon. All spawning was done using spawning matrices which were developed following guidelines identified in the Section 10 permit application. Seventy-one matrices (female x male) were used: six 1x1, seven 1x2, eleven 1x3, fourteen 1x4, three 2x2, eleven 2x3, six 2x4, seven 3x2, three 3x3, and three 4x2.

<u>1994 Cohort</u>

A total of 186 fish from the 94 cohort were determined to be maturing during 1998 (Table 5). Of the maturing fish, 170 ripened and were either spawned (159), or had their semen cryopreserved (11) (Table 6). Of the remaining 16 fish, 12 died prior to gamete collection, one never ripened and was returned to the general population, and three are unaccounted for. Of the 159 fish that were spawned, 120 were females and 39 were males. An additionally cryopreserved semen from two 1994 cohort males was used. A total of 161,230 eggs were collected; an average fecundity of 1,344 eggs per female. Of the eggs collected 92,845 (57.6%) survived to the eyed stage (Table 7).

Table 5. Number of 1994 cohort fish sorted as maturing in 1998. All fish were reared in a natural treatment.

			Treatment	
Sorting dates	Location	Stock	Freshwater	Seawater
June 15-16	Manchester	Catherine Creek	----	45
		Lostine River	----	18
June 17-19	Bonneville	Catherine Creek	53	----
		Lostine River	12	----
		Grande Ronde River	2	----
July 13	Manchester	Catherine Creek	----	1
		Lostine River	----	15
July 15-16	Bonneville	Catherine Creek	1	----
		Lostine River	13	----
		Grande Ronde River	2	----
August 17	Manchester	Catherine Creek	----	3
		Lostine River	----	4
August 18-19	Bonneville	Catherine Creek	8	----
		Lostine River	7	----
		Grande Ronde River	2	----
All	All	Catherine Creek	62	49
All	All	Lostine River	32	37
All	All	Grande Ronde River	6	----
All	All	All	100	86

Table 6. Summary of 1994 cohort gamete collection during 1998.

Stock	Sex	Treatment	n	Mean FL (mm)	Mean WT (g)	Spawned	Cryoed
CC	M	FWng	26	426.6	1,092.1	18	8
CC	F	FWng	33	461.4	1,396.7	33	0
CC	M	SWng	7	486.9	1,233.5	7	1
CC	F	SWng	37	472.4	1,277.0	36	0
LR	M	FWng	10	474.6	1,409.6	8	2
LR	F	FWng	16	502.9	1,864.1	17	0
LR	M	SWng	5	460.4	976.7	6	0
LR	F	SWng	26	494.7	1,375.8	29	0
GR	M	FWng	1	360.0	735.5	1	0
GR	F	FWng	4	453.8	1,174.4	4	0
GR	M	SWng	0	-----	-----	0	0
GR	F	SWng	0	-----	-----	0	0
					Catherine Creek totals	94	9
					Lostine River totals	60	2
					Grande Ronde River totals	5	0
					Total fish contributing gametes from the 1994 cohort	159	11

Table 7. Summary of 1994 cohort egg collection and survival of eggs to the eyed stage in 1998.

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	FWng	33	43,747	1,326	16,524	1,001	75.6%
CC	SWng	36	49,226	1,367	30,670	852	62.3%
LR	FWng	17	27,722	1,631	16,557	974	59.7%
LR	SWng	30	36,370	1,254	27,219	939	74.8%
GR	FWng	4	4,165	1,041	1,875	469	45.1%
All	FWng	54	75,634	1,400	34,946	647	46.2%
All	SWng	66	85,596	1,317	57,889	891	67.6%
All	Fish	120	161,230	1,344	92,845	774	57.6%

1995 Cohort

A total of 226 fish from the 95 cohort were determined to be maturing during maturity sortings (Table 8). Two hundred one of these fish ripened and were either spawned (131) or had semen cryopreserved (70), (Table 9). Of the remaining 25 fish, 17 died prior to spawning, six were unaccounted for and two never ripened and therefore were returned to their respective treatment group tanks. Cryopreserved semen was used from one male. One Lostine River freshwater natural growth female matured and was spawned. She produced 1,111 eggs, of which 838 (75.4%) survived to the eyed egg stage.

Table 8. Number of 1995 brood fish sorted as maturing in 1998.

			Treatment		
			Freshwater		Seawater
Sorting dates	Location	Stock	Accelerated	Natural	Natural
June 15-16	Manchester	Catherine Creek	-----	-----	25
		Lostine River	-----	-----	37
June 17-19	Bonneville	Catherine Creek	4	22	----
		Lostine River	1	25	----
July 13	Manchester	Catherine Creek	-----	-----	0
		Lostine River	-----	-----	8
July 15-16	Bonneville	Catherine Creek	7	9	----
		Lostine River	7	3	----
August 17	Manchester	Catherine Creek	-----	-----	0
		Lostine River	-----	-----	1
August 18-19	Bonneville	Catherine Creek	14	13	----
		Lostine River	24	26	----
All	All	Catherine Creek	25	44	25
All	All	Lostine River	32	54	46
All	All	All	57	98	71

Table 9. Summary of 1995 cohort gamete collection during 1998.

Stock	Sex	Treatment	n	Mean FL (mm)	Mean WT (g)	Spawned	Cryoed
CC	M	FWng	41	308.4	404.0	37	4
CC	F	FWng	0	-----	-----	0	-----
CC	M	SWng	25	310.0	359.6	20	5
CC	F	SWng	0	-----	-----	0	-----
CC	M	FWfg	9	287.8	514.7	2	12
CC	F	FWfg	0	-----	-----	0	-----
LR	M	FWng	53	365.4	631.2	39	14
LR	F	FWng	0	-----	-----	0	-----
LR	M	SWng	44	336.1	436.2	32	12
LR	F	SWng	1	396.0	750.4	1	-----
LR	M	FWfg	22	366.5	632.4	0	23
LR	F	FWfg	0	-----	-----	0	-----
					Catherine Creek totals	59	21
					Lostine River totals	72	49
		Total fish contributing gametes from the 1995 cohort				131	70

1996 Cohort

A total of 54 fish from the 96 cohort were determined to be maturing during maturity sortings. All of these fish were either spawned (27) or had semen cryopreserved (27), (Table 10).

Table 10. Number of 1996 cohort fish sorted as maturing in 1998.

			Treatment		
			Freshwater		Seawater
Sorting dates	Location	Stock	Accelerated	Natural	Natural
August 5-6	Manchester	Catherine Creek	-----	-----	0
		Lostine River	-----	-----	5
		Grande Ronde River	-----	-----	0
August 3-4	Bonneville	Catherine Creek	0	0	----
		Lostine River	4	0	----
		Grande Ronde River	0	0	-----
August 31-Sept. 1	Manchester	Catherine Creek	-----	-----	2
		Lostine River	-----	-----	3
		Grande Ronde River	-----	-----	0
September 2-3	Bonneville	Catherine Creek	5	5	----
		Lostine River	12	7	----
		Grande Ronde River	7	4	-----
October 2	Manchester	Catherine Creek	-----	-----	0
		Lostine River	-----	-----	0
		Grande Ronde River	-----	-----	0
All	All	Catherine Creek	5	5	2
All	All	Lostine River	16	7	8
All	All	Grande Ronde River	7	4	0
All	All	All	28	16	10

Table 11. Summary of 1996 cohort male gamete collection during 1998. No 1997 cohort females had gametes collected in 1998

Stock	Sex	Treatment	n	Mean FL (mm)	Mean WT (g)	Spawned	Cryoed
CC	M	FWng	5	184.4	86.7	5	0
CC	M	SWng	2	153.5	41.1	2	0
CC	M	FWfg	5	202.8	119.4	3	2
LR	M	FWng	7	210.4	128.6	6	1
LR	M	SWng	8	171.9	53.9	7	1
LR	M	FWfg	16	215.1	1129.8	0	16
GR	M	FWng	3	197.0	112.8	4	0
GR	M	SWng	0	-----	-----	0	-----
GR	M	FWfg	7	193.4	98.2	0	7
					Catherine Creek totals	10	2
					Lostine River totals	13	18
					Grande Ronde River totals	4	7
					Total fish contributing gametes from the1996 cohort	27	27

<u>1997 Cohort</u>

No maturity sorting or spawning of 1997 cohort fish occurred during 1998.

3a) Growth/Size - lengths

Fork lengths were measured on a sample of captive fish during inventories, monthly samplings and transfers. Comparisons of measured fork length with targeted length can be found in Tables 12, 13, 14 and 15.

<u>1994 Cohort</u>

Growth as measured by fork length (Table 12), 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 12). Within four months following smoltification (e.g. by August 1996) all groups were shorter than the targeted length. The longest group (Catherine Cr., freshwater) was approximately 88% of targeted length and the shortest group (Grande Ronde, freshwater) was only 80% of the targeted length. One year later (August 1997) seawater groups ranged from 74% (Catherine Creek) to 70% (Lostine River) of targeted length. Freshwater groups were somewhat smaller ranging form 68% and 69% for Catherine Creek and Lostine River respectively to 62% of the targeted length for upper Grande Ronde River fish. By August 1998 the seawater groups ranged from 60% (Catherine Creek) to 57% (Lostine River) of the targeted length. By August 1998 all stocks and treatments were similar with respect to their targeted lengths, ranging from 57% to 63% of their respective targeted lengths.

<u>1995 Cohort</u>

Growth as measured by fork length (Table 13), was monitored in both freshwater and seawater, and with both natural and accelerated treatments. 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.

The accelerated growth groups were larger than natural growth groups (130.1 mm vs. 120.3 mm respectively) but considerably smaller (only 70.0%) than their targeted length of 186 mm. Four months following smoltification (e.g. August 1997) the disparity between actual and targeted lengths remained the same. Accelerated growth groups ranged from 55% (Catherine Creek) to 61% (Lostine River) of the targeted length. Seawater and freshwater natural growth groups ranged from 68% (Catherine Creek) to 72% (Lostine River) of the targeted length. By August 1998 accelerated growth groups ranged from 52% (Catherine Creek) to 62% (Lostine River) of the targeted length. Catherine Creek seawater and freshwater natural growth groups both averaged 63% of the targeted length. Lostine River fish, however, ranged from 67% (seawater) to 72% (freshwater) of the targeted length. Overall, the freshwater groups had somewhat better post-smolt growth than the saltwater groups. For all stocks it was difficult to achieve the targeted length for the accelerated treatment groups.

1996 Cohort

Growth as measured by fork length (Table 14), 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 anticipated length for Catherine Creek, and Lostine and Grande Ronde river stocks respectively. In addition to data collected during field collection, length data were collected on two other occasions in 1997. In October, length data were collected from all fish during PIT-tagging, and in December 25 fish per treatment, per stock were sampled (Table 14). By December 1997 both Catherine Creek and Lostine River freshwater and seawater reared natural growth groups were close to their targeted lengths (98% to 101% of their respective targeted lengths). Grande Ronde freshwater and seawater natural growth groups, however, were considerably smaller than their targeted lengths, ranging from 89% to 90% of their targeted lengths. By December all stocks in the accelerated growth groups were considerably smaller than anticipated, ranging from 72% (Grande Ronde) to 80% (Catherine Creek) of their targeted length. At that time the actual mean fork lengths of accelerated growth group fish (102.0 mm) were not appreciably different from the fork lengths of the natural growth group fish (100.0 mm).

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 fish ranged from 91% (Grande Ronde) to 99% (Catherine Creek) of the targeted length. Accelerated growth groups however were only slightly larger than natural temperature growth groups and considerably smaller than the anticipated lengths, ranging from 67% (Grande Ronde) to 71% (Catherine Creek & Lostine River) of the targeted length. Four months following smoltification (e.g. August 1998) the disparity between actual and targeted lengths for all natural growth groups increased, now ranging from 79% (Lostine River) to 93% (Catherine Creek) of targeted length. Accelerated growth groups ranged from 72% (Grande Ronde and Lostine rivers) to 74% (Catherine Creek) of the targeted length. Overall, the freshwater groups had somewhat better post-smolt growth than the saltwater groups. For all stocks it was difficult to achieve the targeted length for the accelerated treatment groups.

1997 Cohort

Growth as measured by fork length (Table 15), was monitored in both freshwater and seawater, and with both natural and accelerated treatments. At collection parr were approximately 96%, 96% and 73% of their anticipated length for Catherine Creek, and Lostine and Grande Ronde river stocks respectively. In addition to data collected during field collection, length data were collected on two other occasions in 1998. In October, length data were collected from all fish during PIT-tagging, and in December 42 fish per treatment, per stock were sampled (Table 15). By December 1998 both Catherine Creek and Lostine River freshwater and seawater reared natural growth groups were close to their targeted lengths (93% to 98% of their respective targeted lengths). Grande Ronde freshwater and seawater natural growth groups, however, were slightly smaller than their anticipated lengths, ranging from 91% to 93% of their targeted lengths. By December all stocks in the accelerated growth groups were considerably smaller than anticipated, ranging from 75% (Grande

Table 12. Mean fork length (FL) and sample size (n) of 1994 cohort spring chinook salmon captive broodstock.

		Stocks									
		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 rearing		Freshwater rearing		Seawater rearing		Freshwater rearing		Freshwater rearing	
		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

Table 13. Mean fork length (FL) of 1995 cohort spring chinook salmon captive broodstock.

	Targeted FL (mm)		Catherine Creek						Lostine River					
			Seawater Nat.		Freshwater Nat.		Freshwater Accel.		Seawater Nat.		Freshwater Nat.		Freshwater Accel.	
	Natural	Accelerated	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	156	-----	-----	142.8	157	162.0	152
Aug '97	220	278	149.3	120	155.2	144	152.0	138	158.9	142	158.5	149	170.9	139
Sept '97	-----	-----	171.9	112	-----	-----	-----	-----	185.4	138	-----	-----	-----	-----
Dec. '97	-----	-----	227.0	28	-----	-----	-----	-----	242.3	34	-----	-----	-----	-----
Mar. '98	-----	-----	259.0	26	262.5	41	249.0	38	280.6	35	272.5	43	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

**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 14. Mean fork length (FL) of 1996 cohort spring chinook salmon captive broodstock.

	Targeted FL (mm)		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	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 ‘97	80	80	**	**	**	**	**	**	**	**	**	**	**	**	-----	-----	-----	-----	-----	-----
Sept ‘97	89	93	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	**	**	**	**	**	**
Oct ‘97	96	107	90.4	168	87.3	167	89.4	163	94.0	166	95.7	156	92.4	166	77.3	165	79.3	166	77.7	167
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

** 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 15. Mean fork length (FL) of 1997 cohort spring chinook salmon captive broodstock.

	Targeted FL (mm)		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	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	164	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

Ronde) to 80% (Catherine Creek) of their targeted length. At that time the actual mean fork lengths of accelerated growth group fish were slightly greater than the fork lengths of the natural growth group fish (99.4 mm for natural growth groups vs. 104.3 mm for accelerated growth groups

3b) Growth/Size - weights

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, usually in June or July, only those fish classified as immature were examined and weighed. Therefore, comparisons of weights can be found in Tables 16 through 19, and do not include fish known to be maturing or mature.

Table 16. 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

	Catherine Creek				Lostine River				Grande Ronde River			
	Seawater naural		Freshwater natural		Seawater naural		Freshwater natural		Seawater naural		Freshwater natural	
Date	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

Table 17. 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	161	9.2	157	9.0	150	9.4	147
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	156	-----	-----	35.6	157	51.4	152
Aug. '97	43.1	120	50.0	143	48.9	137	52.5	142	56.6	149	65.1	138
Sept. '97	75.2	112	-----	-----	-----	-----	92.0	137	-----	-----	-----	-----
Dec. '97	185.2	28	-----	-----	-----	-----	223.2	34	-----	-----	-----	-----
Mar. '98	253.5	26	251.5	41	219.7	38	309.3	35	293.5	43	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

** 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 18. 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	9.5	168	8.6	167	8.1	163	9.5	166	9.9	156	9.3	166	5.6	165	5.9	166	5.6	167
Dec '97	15.2	25	14.6	25	16.5	25	13.5	25	13.5	25	14.9	25	10.7	25	10.9	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	167	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

** 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 19. 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	166	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	164	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

4) Population Status

Population status summaries by brood year and stock can be found in Tables 20-23. A complete Fish Health Monitoring and Disease Treatment report can be found in Appendix A.

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 1998 there were 142, 71 and 8 fish remaining alive from Catherine Creek, and the Lostine and upper Grande Ronde rivers respectively. Of the 888 fish which have been removed from the population, 451 have been spawned or had semen cryopreserved (241 CC, 185 LR and 25 GR). An additional 132 died from disease (23 CC, 81 LR and 28 GR), and 272 died from other causes (81 CC, 147 LR and 44 GR), 13 died from experimental procedured (3 CC and 10 LR), and 20 were unaccounted for (10 CC, 5 LR and 5 GR) (Table 20).

1995 Cohort

A total of 500 and 483 fish were collected from Catherine Creek and the Lostine River respectively during August and September 1996. As of 31 December 1998 there were 220 and 190 fish remaining alive from Catherine Creek and the Lostine Rivers respectively. Of the 573 fish which have been removed from the population, 237 have been spawned or had semen cryopreserved (96 CC and 141 LR), 160 have died from disease (73 CC, and 87 LR) and 143 have died from other causes (88 CC and 55 LR), 20 died from experimental procedures, and 13 Catherine Creek fish were unaccounted for (Table 21).

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 1998 there were 470, 447 and 466 fish remaining alive from Catherine Creek and the Lostine and upper Grande Ronde rivers respectively. Of the 117 fish which have been removed from the population, 54 have been spawned or had semen cryopreserved (12 CC, 31 LR and 11 GR). An additional 3 died from disease (1 CC, 1 LR and 1 GR), 44 died from other causes (14 CC, 14 LR and 16GR), two Grande Ronde fish died from experimental procedures and 14 fish were unaccounted for (3 CC, 7 LR and 4 GR) (Table 22).

1997 Cohort

As of 31 December 1998 the 1997 cohort captive broodstock were being held at Lookingglass Fish Hatchery. Of the original fish collected 1,486 fish were still alive as of 31 December 1998 (493, 496 and 497 fish from Catherine Creek, and the Lostine and Grande Ronde rivers respectively). Of the 14 fish which have been removed from the population, 3 died from disease (2 CC and 1 GR), 8 died from other causes (3 CC. 3 LR and 2 GR), none died from experimental procedures, and three were unaccounted for (2 CC and 1 LR) (Table 23).

Tables 20a through 20c. Population status and associated causes[1/] of fish removal from the 1994 cohort spring chinook salmon captive broodstock population through 31 December 1998.

	Catherine Creek									
	Seawater rearing					Freshwater rearing				
Year removed	Ga.	Dis.	Exp	Oth	Un	Ga.	Dis.	Exp	Oth	Un
1995	0	0	0	2	2	0	0	0	3	2
1996	2	0	3	10	0	31	0	0	27	1
1997	46	0	0	10	0	58	0	0	11	0
1998	45	3	0	12	0	59	20	0	6	5
Total removed by cause	93	3	3	34	2	148	20	0	47	8
Total removed by stock & treat			135					223		
Total alive by stock & treat.			37					105		

	Lostine River									
	Seawater rearing					Freshwater rearing				
Year removed	Ga.	Dis.	Exp	Oth	Un	Ga.	Dis.	Exp	Oth	Un
1995	0	0	0	0	0	0	0	0	52	3
1996	0	0	10	12	0	22	0	0	13	0
1997	23	0	0	28	0	79	1	0	18	2
1998	34	1	0	16	0	27	79	0	8	0
Total removed by cause	57	1	10	56	0	128	80	0	91	5
Total removed by stock & treat			124				304			
Total alive by stock & treat.			46				25			

	Grande Ronde River				
	Freshwater rearing				
Year removed	Ga.	Dis.	Exp	Oth	Un
1995	0	0	0	2	0
1996	7	0	0	24	3
1997	13	5	0	16	2
1998	5	23	0	2	0
Total removed by cause	25	28	0	44	5
Total removed by stock & treat			102		
Total alive by stock & treat.			8		

[1/] Ga. = Gametes collected (either spawned or semen cryopreserved)
Dis. = Disease (usually BKD)
Exp. = Fish removed from the population for experimentation or other scientific purposes.
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.)
Un. = Fish which are unaccounted for.

Tables 21a through 21b. Population status and associated causes[1/] of fish removal from the 1995 cohort spring chinook salmon captive broodstock population through 31 December 1998.

	Catherine Creek														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1996	0	0	0	0	0	0	0	0	0	2	0	0	0	1	2
1997	2	0	10	41	6	6	0	0	12	0	6	0	0	14	0
1998	25	2	0	7	1	43	12	0	4	2	14	59	0	9	0
Total removed by cause	27	2	10	48	7	49	12	0	16	4	20	59	0	24	2
Total removed by stock & treat.	94					81					105				
Total alive by stock & treat.	73					86					61				

	Lostine River														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1996	0	0	0	2	0	0	0	0	1	0	0	0	0	4	0
1997	6	0	10	8	0	9	0	0	7	0	5	0	0	12	0
1998	44	11	0	12	0	53	11	0	3	0	24	65	0	6	0
Total removed by cause	50	11	10	22	0	62	11	0	11	0	29	65	0	22	0
Total removed by stock & treat.	93					84					116				
Total alive by stock & treat.	68					78					44				

[1/] Ga. = Gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usually BKD).
Exp. = Fish removed from the population for experimentation or other scientific purposes.
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.).
Un. = Fish which are unaccounted for.

Tables 22a through 22c. Population status and associated causes[1/] of fish removal from the 1996 cohort spring chinook salmon captive broodstock population through 31 december 1998.

	Catherine Creek														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1997	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
1998	2	0	0	9	0	5	0	0	2	1	5	1	0	1	1
Total removed by cause	2	0	0	10	0	5	0	0	2	1	5	1	0	2	2
Total removed by stock & treat.	12					8					10				
Total alive by stock & treat.	155					159					156				

	Lostine River														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	8	0	0	6	1	7	0	0	4	2	16	1	0	4	4
Total removed by cause	8	0	0	6	1	7	0	0	4	2	16	1	0	4	4
Total removed by stock & treat.	15					13					25				
Total alive by stock & treat.	151					154					142				

	Grande Ronde River														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1997	0	0	0	1	0	0	0	0	0	2	0	0	0	2	0
1998	0	0	2	12	1	4	0	0	0	1	7	1	0	1	0
Total removed by cause	0	0	2	13	1	4	0	0	0	3	7	1	0	3	0
Total removed by stock & treat.	16					7					11				
Total alive by stock & treat.	149					161					156				

[1/] Ga. = Gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usually BKD).
Exp. = Fish removed from the population for experimentation or other scientific purposes.
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.).
Un. = Fish which are unaccounted for.

Tables 23a through 23c. Population status and associated causes[1/] of fish removal from the 1997 cohort spring chinook salmon captive broodstock population through 31 December 1998.

	Catherine Creek														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1998	0	2	0	1	0	0	0	0	0	1	0	0	0	2	1
Total removed by cause	0	2	0	1	0	0	0	0	0	1	0	0	0	2	1
Total removed by stock & treat.	3					1					3				
Total alive by stock & treat.	164					166					163				

	Lostine River														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1998	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
Total removed by cause	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0
Total removed by stock & treat.	4					0					0				
Total alive by stock & treat.	163					167					166				

	Grande Ronde River														
	Seawater Natural					Freshwater Natural					Freshwater Accelerated				
Year removed	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un	Ga	Dis.	Exp	Oth	Un
1998	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Total removed by cause	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0
Total removed by stock & treat.	0					1					2				
Total alive by stock & treat.	167					166					164				

[1/] Ga. = Gametes collected (either spawned or semen cryopreserved).
Dis. = Disease (usually BKD).
Exp. = Fish removed from the population for experimentation or other scientific purposes.
Oth. = Other, a variety of mortality causes (e.g. jumpouts, handling, etc.).
Un. = Fish which are unaccounted for.

5) Measures taken to minimize disturbance

With the 1995 stocks we ceased monthly sampling for growth after March to minimize handling during smoltification and we postponed VI-tagging until fish had acclimated to final rearing conditions and then combined tagging with evaluation of maturity to minimize handling.

6) Problems

Bacterial Kidney Disease (BKD) and associated problems: Problems were experienced with outbreaks of BKD in various groups of fish and with attempts to preventat 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 caused scheduling problems for some sorting, sampling and inspection activities.

Embryos from females exhibiting high BKD ELISA values ($\geq$ 0.80) were kept separate from embryos from females with lower incidence of BKD. Only one group of embryos (20 eggs in all) from a Grande Ronde female had to be culled.

VI tag retention in BY95 fish: VI tag retention was lower than expected in the BY96 fish. Tag loss also varied between stocks (6% CC, 33% LR and 20% GR). Original tag insertion was posterior of the left eye and from the ventral surface of the fish. Repeat VI tagging was done as a dorsal insertion posterior of the right eye. Ventral insertion of the tags may have been part of the problem but did not provide an explanation for the variation in tag loss between stock. The tag manufacturers (Northwest Marine Technologies) did not seem to think that ventral insertion should cause a significant tag loss problem. Tagging procedures used by program personnel were observed by the tag manufacturer’s staff and they could find no problems with either tagging techniques or tag placement. The extent and variation in tag loss between stocks may have been a result of manufacturing inconsistencies between batches of tags produced.

Inability to get growth groups to the predicted size: As in previous years, we were unable to achieve the predicted growth (as measured in fork length) for fish reared under an accelerated growth regime. Though most natural growth groups, regardless of cohort or stock, closely approximated the predicted size at smoltification. All groups quickly fell behind growth predictions after smolting.

Inability to use surrogates as true representatives of captive brood fish: Our original objective was to rear a group of non-captive brood fish as surrogates for use in tests of seawater tolerance or any unproven procedures prior to performing these procedures on captive broodstock. Due to differences in size, growth rate and smoltification timing between all stocks, surrogates have not proven as beneficial as we had hoped. The surrogate portion of our program may be terminated in 1999.

Cryopreservation and reactivation of cryopreserved sperm: Due to personnel changes at Bonneville Fish Hatchery cryopreservation and reactivation of cryopreserved fish sperm expertise was lost. Prior to spawning this expertise had to be replaced and responsibilities shifted.

7) Analyses

None.

8) 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.

Conventional Broodstock Project

This section details adult collection, retention for broodstock, hatchery spawning/gamete collection, F1 generation, fish health and disease 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) Description of Activities Conducted

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 24). All live fish that were trapped were given an opercular punch. This enabled identification at the hatchery of tributary origin and indicated previous handling at the weir during spawning ground surveys. Fish that were collected generally appeared to be in good condition, but some displayed cuts and bruises of varying severity. Causes of the injuries were undetermined, but some appeared fresh enough to have occurred in the vicinity of the trap. A 865-mm male captured at Catherine Creek on 4 September had blackened skin tissue extending from the adipose fin to the caudal fin. This appeared to have developed prior to trapping. One dead chinook washed up on the weir at the upper Grande Ronde site on 10 June, 1998 (and was not recorded as collected at the weir on Table 24). One fish died after being squeezed between pickets at the Lostine weir on 10 July, 1998.

Retention for broodstock

The 1997 criteria we operated under in 1998 allowed no more than 33% of the naturally-produced salmon returning to each tributary to be retained for broodstock. Fish were selected for broodstock systematically (one of every three 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.

Table 24. Data collected from adult chinook salmon trapped on the Lostine River, Catherine Creek, and upper Grande Ronde River in 1998.

Stream	ID	Date	Marks	Gender	FL (mm)	Pass/ Keep	Jaw Tagged Color	#	Opercle Punch	Genetic Site	ID #	Disposition	Notes
CC		9-Jun-98											Trap opened
CC	1	13-Jun-98	None	M	855	Pass		N	2 ROP	CC	98001		Wrong punch applied
CC	2	13-Jun-98	None	F	838	Pass		N	3 ROP	CC	98002		Wrong punch applied
CC	3	13-Jun-98	None	F	844	Pass		N	3 ROP	CC	98003		Wrong punch applied
CC	4	13-Jun-98	None	M	698	Pass		N	3 ROP	CC	98004		Wrong punch applied
CC	5	13-Jun-98	None	M	890	Pass		N	3 ROP	CC	98005		Wrong punch applied
CC	6	18-Jun-98	None	F	844	Keep	Blue	800	1 ROP	CC	98006	Released in stream	
CC	7	18-Jun-98	None	M	868	Keep	Blue	801	1 ROP	CC	98007	Released in stream	
CC	8	18-Jun-98	None	M	778	Pass		N	1 ROP	CC	98008		
CC	9	19-Jun-98	None	F	870	Pass		N	1 ROP	CC	98009		
CC	10	20-Jun-98	None	F	800	Pass		N	1 ROP	CC	98010		
CC	11	22-Jun-98	None	M	761	Pass		N	1 ROP	CC	98011		
CC	12	22-Jun-98	None	M	895	Keep	Blue	802	1 ROP	CC	98012	Released in stream	
CC	13	22-Jun-98	None	F	830	Keep	Blue	803	1 ROP	CC	98013	Released in stream	
CC	14	23-Jun-98	None	F	810	Pass		N	1 ROP	CC	98014		
CC	15	23-Jun-98	None	F	819	Pass		N	1 ROP	CC	98015		
CC	16	26-Jun-98	None	M	800	Pass		N	1 ROP	CC	98016		
CC	17	29-Jun-98	None	F	790	Keep	Blue	804	1 ROP	CC	98017	Released in stream	
CC	18	29-Jun-98	None	M	880	Pass		N	1 ROP	CC	98018		
CC	19	1-Jul-98	None	M	920	Keep	Blue	805	1 ROP	CC	98019	Released in stream	
CC	20	2-Jul-98	None	F	830	Pass		N	1 ROP	CC	98020		
CC	21	2-Jul-98	None	M	920	Pass		N	1 ROP	CC	98021		
CC	22	3-Jul-98	None	F	855	Pass		N	1 ROP	CC	98022		
CC	23	3-Jul-98	None	M	875	Keep	Blue	806	1 ROP	CC	98023	Released in stream	
CC	24	4-Jul-98	None	F	690	Keep	Blue	807	1 ROP	CC	98024	Released in stream	
CC	25	7-Jul-98	None	F	865	Pass		N	1 ROP	CC	98025		
CC	26	6-Jul-98	None	M	861	Pass		N	1 ROP	CC	98026		
CC	27	7-Jul-98	None	M	720	Pass		N	1 ROP	CC	98027		
CC	28	4-Sep-98	None	M	865	Pass		N	1 ROP	CC	98028		
CC		30-Sep-98											Trap closed
GR		16-May-98											Trap opened
GR	1	4-Jun-98	None	F	855	Pass		N	2 ROP	GR	98001		
GR	2	9-Jun-98	None	F	835	Pass		N	2 ROP	GR	98002		
GR	3	9-Jun-98	None	M	980	Pass		N	2 ROP	GR	98003		
GR	4	9-Jun-98	None	F	890	Keep	Orange	406	2 ROP	GR	98004	Mortality 7/06/98	Gender confirmed
GR	5	14-Jun-98	None	F	875	Pass		N	2 ROP	GR	98005		

Table 24. Data collected from adult chinook salmon trapped on the Lostine River, Catherine Creek, and upper Grande Ronde River in 1998

(cont.).

Stream	ID	Date	Marks	Gender	FL (mm)	Pass/ Keep	Jaw Tagged Color	#	Opercle Punch	Genetic Site	ID #	Disposition	Notes
GR	6	15-Jun-98	None	M	880	Pass		N	2 ROP	GR	98006		
GR	7	15-Jun-98	None	M	985	Keep	Orange	407	2 ROP	GR	98007	Mortality 6/27/98	Gender confirmed
GR	8	15-Jun-98	None	M	970	Pass		N	2 ROP	GR	98008		
GR	9	16-Jun-98	None	F	880	Pass		N	2 ROP	GR	98009		
GR	10	16-Jun-98	None	F	835	Keep	Orange	408	2 ROP	GR	98010	Mortality 7/03/98	Gender confirmed
GR	11	16-Jun-98	None	F	900	Pass		N	2 ROP	GR	98011		
GR	12	16-Jun-98	None	M	710	Pass		N	2 ROP	GR	98012		
GR	13	18-Jun-98	None	M	855	Keep	Orange	409	2 ROP	GR	98013	Released in stream	
GR	14	18-Jun-98	None	F	910	Pass		N	2 ROP	GR	98014		
GR	15	19-Jun-98	None	M	960	Pass		N	2 ROP	GR	98015		
GR	16	19-Jun-98	None	M	860	Pass		N	2 ROP	GR	98016		
GR	17	20-Jun-98	None	F	785	Keep	Orange	410	2 ROP	GR	98017	Released in stream	
GR	18	20-Jun-98	None	F	870	Pass		N	2 ROP	GR	98018		
GR	19	21-Jun-98	None	F	880	Pass		N	2 ROP	GR	98019		
GR	20	22-Jun-98	None	F	870	Keep	Orange	412	2 ROP	GR	98020	Mortality 7/03/98	Gender confirmed
GR	21	22-Jun-98	None	F	825	Pass		N	2 ROP	GR	98021		
GR	22	24-Jun-98	None	F	740	Pass		N	2 ROP	GR	98022		
GR	23	28-Jun-98	None	F	785	Keep	Orange	413	2 ROP	GR	98023		
GR	24	29-Jun-98	None	M	880	Keep	Orange	414	2 ROP	GR	98024		
GR	25	29-Jun-98	None	F	810	Pass		N	2 ROP	GR	98025		
GR	26	30-Jun-98	None	F	850	Pass		N	2 ROP	GR	98026		
GR	27	30-Jun-98	None	M	890	Pass		N	2 ROP	GR	98027		
GR	28	2-Jul-98	None	M	850	Pass		N	2 ROP	GR	98028		
GR	29	9-Jul-98	None	M	815	Keep	Orange	415	2 ROP	GR	98029		
GR	30	10-Jul-98	None	F	845	Keep	Orange	416	2 ROP	GR	98030		
GR	31	10-Jul-98	None	F	870	Pass		N	2 ROP	GR	98031		
GR	32	10-Jul-98	None	M	780	Pass		N	2 ROP	GR	98032		
GR	33	19-Jul-98	None	M	940	Pass		N	2 ROP	GR	98033		
GR		23-Jul-98											Trap closed
LR		17-Jun-98											Trap opened
LR	1	19-Jun-98	None	F	880	Pass		N	3 ROP	LR	98001		
LR	2	22-Jun-98	None	M	861	Pass		N	3 ROP	LR	98002		
LR	3	28-Jun-98	None	M	995	Pass		N	3 ROP	LR	98003		
LR	4	30-Jun-98	None	F	850	Pass		N	3 ROP	LR	98004		
LR	5	30-Jun-98	None	F	850	Keep	Yellow	557	3 ROP	LR	98005		

Table 24. Data collected from adult chinook salmon trapped on the Lostine River, Catherine Creek, and upper Grande Ronde River in 1998 (cont.).

Stream	ID	Date	Marks	Gender	FL (mm)	Pass/ Keep	Jaw Tagged Color	Jaw Tagged #	Opercle Punch	Genetic Site	ID #	Disposition	Notes
LR	6	30-Jun-98	None	M	690	Keep	Yellow	558	3 ROP	LR	98006		
LR	7	1-Jul-98	None	F	790	Pass		N	3 ROP	LR	98007		NPT -retain no more fish.
LR	8	2-Jul-98	None	M	1020	Pass		N	3 ROP	LR	98008		
LR	9	9-Jul-98	None	M	810	Pass		N	3 ROP	LR	98009		
LR	10	10-Jul-98	None	F	830	Pass		N	3 ROP	LR	98010		
LR	11	10-Jul-98	None	F	888	Mort		N	N	LR	98011	Unknown	Gilled between pickets
LR	12	12-Jul-98	None	F	930	Pass		N	3 ROP	LR	98012		
LR	13	12-Jul-98	None	M	910	Pass		N	3 ROP	LR	98013		
LR	14	13-Jul-98	None	F	785	Pass		N	3 ROP	LR	98014		
LR	15	15-Jul-98	None	M	885	Pass		N	3 ROP	LR	98015		
LR	16	16-Jul-98	None	F	745	Pass		N	3 ROP	LR	98016		
LR	17	1-Aug-98	None	F	835	Pass		N	3 ROP	LR	98017		
LR	18	1-Aug-98	None	F	895	Pass		N	3 ROP	LR	98018		
LR	19	2-Aug-98	None	M	556	Pass		N	3 ROP	LR	98019		
LR	20	2-Aug-98	None	M	890	Pass		N	3 ROP	LR	98020		
LR	21	10-Sep-98	None	M	805	Pass		N	3 ROP	LR	98021		
LR	22	14-Sep-98	None	M	950	Pass		N	3 ROP	LR	98022		
LR	23	21-Sep-98	None	M	757	Pass		N	3 ROP	LR	98023		
LR		1-Oct-98											Trap closed

NOTES:

Stream:
CC = Catherine Creek
GR = upper Grande Ronde River
LR = Lostine River
ROP = right opercle punch

Gender:
F - female
M - male

[1/]. Fish that were killed by the weir were considered “take” (and were counted as “kept” under ESA).

2) Measures Taken to Minimize Disturbance

To minimize disturbances to ESA-listed fish at each adult collection site, we implemented a number of precautions. Each trap was placed so that fish could follow the main flow and locate the trap entrance quickly. Each site was staffed continuously and the weir and trap was 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 their time under anaesthetic. Weekly stream surveys to look for congregations of fish below the weir were done while walking on shore 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, avaiding handling live fish etc.; see: "ESA Section 10 Permit 1152" for details). These measures were generally effective although some problems were encountered. Those are described in section 4.

3) Maturity and Spawning Activities

Hatchery spawning and gamete collection

No fish were spawned in 1998. The NPT cryopreserved sperm from Lostine River fish collected under CRITFC Permit 1134 (Table 26). Half of these samples are being stored at Washington State University and half at the University of Idaho. No samples were collected from Catherine Creek or the upper Grande Ronde River.

Table 26. Collection of fish and disposition of semen collected from male spring chinook salmon from the Lostine River in 1998 (covered under associated CRITFC Permit 1134).

Collection Date	Collection Site	Females Collected	Males Collected	Sperm Taken?	Sperm sample #	Sample Disposition
26-Aug-98	Stream	8[1/]	1	Y	98001LR	Cryopreserved
26-Aug-98	Stream	0	1	Y	98002LR[2/]	Cryopreserved
26-Aug-98	Stream	0	1	Y	98003LR	Cryopreserved

[1/] All females were netted, identified for sex and then immediately released.
[2/] This fish had a poor adipose clip.

F_1 generation

On 1 January 1998 there were 12,464 Lostine fry in incubation trays from conventional program adults collected in 1997. Trays were not disturbed during late incubation/hatching/yolk absorption (and therefore no mortality was reported from 1 January until they were moved to troughs). No dead fry were observed when 12,464 fry were transferred from incubators to Canadian troughs. Mortality in the troughs was 196 fish until they were placed in outside raceways on 7 April, 1998. Losses in the outside raceways were 222 fish until 31 December 1998, for a total of 12,046 live fish at the end of the year. All fish were coded-wire-tagged and adipose-clipped on 24 June, 1998. Tag retention and fin clip checks will be done in 1999.

4) Problems Encountered

Injuries

Concern about the injuries seen on fish collected to weir sites caused us to change operations at traps in the Grande Ronde River. 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 trap 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 sites, camouflage netting was put over both traps to provide cover. A similar technique may be used in 1999 over the V-entrances to the traps, particularly during periods of low flow.

Pre-spawning mortality

On 13 July 1998, comanagers met to discuss whether to continue retention of fish for broodstock because of low numbers of retained fish and pre-spawning mortality concerns. We reviewed autopsy information from four mortalities at Lookingglass Fish Hatchery provided by ODFW Fish Health, reviewed trapping procedures and how collections might be made safer for fish, and discussed the likelihood of meeting the minimum number of fish required for spawning. The NPT informed comanagers that they were not comfortable retaining additional fish at Lookingglass Fish Hatchery. Comanagers decided to collect fish for about another week to allow comanagers to review information with policy personnel and determine if any change in run timing would provide additional fish for spawning.

On 23 July, 1998, comanagers decided to return all adult salmon previously retained for brood stock. We continued to operate the trap at Catherine Creek and the Lostine River where marking of additional fish would be useful in making population estimates on the spawning grounds. On the upper Grande Ronde River, where access to spawning areas was restricted by lack of landowner consent, we decided to close the trap, as it was unlikely further trapping would provide additional information for population estimate resulting from spawning ground surveys. Catherine Creek and upper Grande Ronde River fish were returned to their respective streams on 23 July, 1998. Lostine River fish were returned 30 July, 1998.

Minimum broodstock needs

Population estimates above the weirs were much larger than the number of fish caught in the traps. Observations of 70-90% of the fish above the weirs did not have an opercle punch, suggesteing that we did not trap a large portion of the population that passed the weir site. The percentages of the total estimated spawning populations collected at the Catherine Creek, upper Grande Ronde River, and Lostine River weirs were 28, 39 and 17, respectively. 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. Although 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, it is unlikely that such a large proportion of the population passed the trap site during these periods. This suggested that we put the weir in too late to capture the early part of the run. Fish passage records for Lower Granite Dam suggested that significant numbers of fish 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 1999 in an effort to increase the proportion of adults captured. Low flow conditions resulting from irrigation diversions on the Lostine River and Catherine Creek may also have resulted in temperature or physical (low water) barriers to spawning grounds, causing marked fish to be underrepresented in carcass recoveries, and producing an inflated population estimate.

Maturation timing

The Grande Ronde female that died on 6 July was ripe. The other three mortalities were maturing. Upon examination of the rest of the fish in the tanks at Lookingglass Fish Hatchery, two of the threee males from Catherine Creek were also ripe when returned to their stream at the end of July. We plan to document and monitor the maturation process in the future by inspection at each scheduled handling event.

Trap operations

Heavy rainfall events on 2-4 July caused high water at all three sites. Pickets were lifted for about 48 hours at the upper Grande Ronde site, and about 24 hours at the Lostine weir. A heavy rainfall event on 7-9 September also caused problems at the Catherine Creek site. As a consequence of these rainfall events, some washing out around pickets occurred that may have allowed some fish passage at Catherine Creek and the upper Grande Ronde. Some of the washing out may have resulted from presence of plastic sheeting or wood we placed on the weir to direct water to the trap during the later part of the summer when flows are low. In the future, when conditions suggest that the stream may rise, these materials will be lifted to reduce the likelihood of scouring beneath the pickets.

We had some minor problems with trap operation. At Catherine Creek a chinook salmon jumped into the upper portion of the pickets above the second stringer and became wedged there. The fish was observed by the trap monitor and appeared to be in good condition when removed. It was netted, processed as captured, and released. Because the third stringer was not installed, the spacing between the bars was not consistent, which may have increased the likelihood of this occurrence. We installed the third stringer, and the problem was not observed again. We intend to utilize all three stringers in the future, even when the water is low. At the Lostine site, one large female chinook became wedged between pickets approaching the weir from downstream. The pickets and spaces between them were inspected and measured to make sure spacing was even and appropriate. Obvious faults could not be found. No additional problems were encountered with this site in the weir.

Low flow conditions resulted in the two Lostine traps being nonfunctional. Rather than preventing passage, pickets were pulled from 24-29 July, 1998. On 29 July, a third trap was delivered from River Masters, Inc., installed, and trapping continued until 1 October, 1998.

The weir may have had some minor efects on some non-target species. 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. One of the two bull trout captured at the Lostine became wedged in one of the corners between two of the pickets. The weir manufacturers addressed this design flaw and corrections were made. At Catherine Creek less than adult 10 mountain whitefish were found dead against the weir.

5) 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.

6) Preliminary Analyses of Data

No analyses of adult collection operations have been.

7) Research Coordination

We 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.

8) Spawning Ground Surveys and Weir Effect

Spawning ground surveys were conducted by ODFW weekly for about 3 weeks during spawning to document redd numbers and collect information from carcasses (Table 27). 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 is 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 28). No evidence of a delay in migration was observed. Fish generally passed the weirs during relatively high water events.

Table 27. Results of spawning ground surveys for spring chinook salmon in the upper Grande Ronde River, the Lostine River and Catherine Creek in 1998.

Stream	Number of redds	Percent below weir	Dead fish observed	Live fish observed	Population estimate [1]
upper Grande Ronde River[2]	25	8	30	42	91
Lostine River	35	20	36	37	172
Catherine Creek	34	0	19	42	101

1/ Population estimates are based on mark-recapture data.
2/ Much of the spawning habitat in the upper Grande Ronde river was not surveyed due to lack of landowner permission for access.

Table 28. Chinook salmon observations during foot and snorkel surveys of a one mile section below each weir in 1998.

Stream	Survey Type	Start Date	End date	# of surveys	Live Chinook observed
upper Grande Ronde River	Foot	27-Jun-98	23-Jul-98	7	0
Catherine Creek	Foot	2-Jul-98	24-Sep-98	31	5
Lostine River	Foot	17-Jun-98	1-Oct-98	104	9
Lostine River	Snorkel	29-Jul-98	5-Aug-98	2	9

9) Fish Health and Disease

Juveniles

Monthly monitoring of the Lostine River 97 brood year spring chinook salmon juveniles in raceway 6 at Lookingglass Fish Hatchery started in June of 1998. Protocols used for other stocks at Lookingglass are being followed. Five grab-sampled healthy fish per raceway are taken every other month to: 1) check for the presence or absence of erythrocytic inclusion body syndrome (EIBS), culturable viruses, and external parasites, 2) monitor the status of *R. salmoninarum* antigen and gill condition, and 3) evaluate levels of plasma glucose. Bacterial and viral analyses, including tests for *R. salmoninarum*, are performed on all (up to ten) mortalities for the month. Total mortalities available for necropsy by month include ten in June of 1998, seven in July, eight in August, three in September, none in October, six in November, and two in December. No bacteria known to be pathogenic to fish have been cultured from any of these mortalities. The ELISA test for *R. salmoninarum* antigen was run on a total of 32 mortalities and 20 grab-sampled fish from June to

December, 1998. Optical density values on samples through October ranged from 0.091 to 0.117, indicating no ongoing infection by *R. salmoninarum* in any of these fish at the time they died or were sacrificed. In November, there was one clinical level (OD>1.0) mortality out of six with an Rs ELISA of 2.789 OD units. In December one of two mortalities had clinical BKD with an Rs ELISA value of 3.333. With the exception of these two cases which did have some gross signs of BKD (gray kidney) the remaining mortalities were all ≤ 0.138 OD units. Four mortalities were negative for BKD by the DFAT. Viral analyses on mortality/moribund and grab-sampled healthy fish have been negative. No external parasites have been observed, and EIBS was absent in the grab-sampled healthy fish. Hyperplastic gill filaments were observed in grab-sampled fish starting in October and continued to be observed through monitoring in December. This same observation has been made for the Imnaha and Rapid River juveniles at this facility, but the cause of this gill condition is unknown.

Adults

Four adult mortalities from the upper Grande Ronde River were necropsied at Lookingglass Fish Hatchery in July of 1998 (Table 29). Two of these fish were maturing females, one was a mature female, and one was a maturing male. Two fish died as a result of massive fungal infections which covered 60 to 70% of the entire body. The other two fish displayed secondary fungal infections, but the cause of death was attributed to wounds in the head and snout areas. Causative agents for Furunculosis and BKD were not detected at levels high enough to cause disease. All ELISA OD values were low at ≤ 0.109. Two fish had a low level of *Ceratomyxa shasta* spores present in the lower intestine. The remaining endemic broodstock adults from Catherine Creek, upper Grande Ronde River, and Lostine River were returned to their respective streams as maturing adults following decisions to terminate artificial spawning of these in 1998, and were not sampled.

Prescriptions

For the spring chinook salmon adults in the conventional broodstock project in 1998, protocols and prescriptions identical to those for prophylactic disease treatments in 1997 were continued. Prescriptions were obtained for all three endemic broodstock programs: 1) Catherine Creek (201W98), 2) upper Grande Ronde (80W98), and 3) Lostine River (200W98). Brood prescriptions were obtained for treatment of bacterial kidney disease (erythromycin @ 10mg/kg) and furunculosis (oxytetracycline @10mg/kg). Formalin prescriptions were also obtained for control of external fungal infections at 1:6000 for one hour during 2-7 days per week, depending upon severity of infection. In addition, the juveniles were given two 28-day prophylactic aquamycin feedings following INAD protocol on 8 April –5 May and 25 July – 22 August, 1998.

Table 29. Summary of necropsy findings for four upper Grande Ronde River Endemic Broodstock mortalities.

Mortality Date	Sex	Maturity	Jaw Tag #	ELISA OD_{405nm}	Significant Clinical Findings
27-Jun-98	M	Maturing	407	0.106	Whole body fungus (60% of body. Six inch lesion on lower left jaw.
03-Jul-98	F	Maturing	412	0.109	Whole body fungus (70% of body).
03-Jul-98	F	Maturing	408	0.096	Dorsal head and ventral/pectoral lesions. Fungus dorsally from head to dorsal fin, ventrally between the pectoral fins, and ventrally from ventral to anal fin. Bloody intestinal tract.
06-Jul-98	F	Mature	406	0.095	Deep head/snout lesion covered with fungus. Head and snout, dorsal fin, ventral fins, and caudal area all covered with fungus. Aeromonad/pseudomonad bacteria at high levels in the kidney.

11) Anticipated Program Changes in 1999

We plan to manage the trapping, collection, handling, spawning of adults in 1999 in the same manner as we did in 1998 program with the following exceptions.

We plan to install the weirs on or about April 15th instead of May 15th in an effort to collect fish from across the entire run. This action will be dependent on flow conditions in each tributary.

We will implement the changes in the holding facilities described in Section 4, Problems Encountered, immediately upon installation of the weirs 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 than twice daily, especially during rain events, to minimize the possibility of injury to the fish due to containment.

Adult return predictions

Although we have limited methods to project run size, we attempted to use an estimator to guide our use of the sliding scale for broodstock management. In 1999, we expect approximately 36% of the 1998 run size based on the projected returns of wild chinook to Lower Granite Dam as a percentage of last years run size. There are numerous areas for variability in this estimator. However, all estimators of the 1999 run size place us in the lowest escapement category of the sliding scale (See permit 1011). Adult collection ratios and spawning criteria will be the same as in 1998.

Table 30. Projected adult returns and broodstock collections for supplemented tributaries in 1999.

Stream	1999 total run	Estimated trapped	Number retained	Number of females kept
upper Grande Ronde	32	26	13	5

Catherine Creek	36	29	11	4
Lostine River	61	49	19	8

Appendix A.
Fish Health Monitoring and Disease

Overview

Mortality

From January 1, 1998 to December 31, 1998, a total of 486 spring/summer chinook salmon captive broodstock mortalities from three stocks of fish, Lostine River (LR), Catherine Creek (CC), and upper Grande Ronde River (GR), were necropsied at fish pathology laboratories in La Grande, Clackamas, and Manchester. Rapid River (RR) surrogates from Lookingglass Fish Hatchery were also necropsied at La Grande. The cohorts represented by these mortalities spanned four years from 1994-1997. Cohort year 94 mortalities totaled 167 fish, cohort year 95 mortalities totaled 203 fish, cohort year 96 mortalities totaled 103 fish, and cohort year 97 mortalities totaled 13 fish. Since all mortalities were not examined in these laboratories cumulative mortality rates cannot be determined. An informative statistic, however, is the bacterial kidney disease (BKD) mortality (through September10, 1998) as the percentage of the total number of fish captured for the Oregon captive broodstock program. This information was presented at the 1998 Northwest Fish Culture Conference (Groberg et al. 1998). For the 94 cohort year, the percentages were 49.1%, 20.0%, and 7.2% for GR, LR, and CC, respectively. For the 95 cohort year, values were 12.7% and 11.4% for LR and CC, respectively. All values for the 94 and 95 cohort years would be greater if cumulative BKD mortality were calculated and BKD mortality through December 31, 1998 were included.

Relying strictly on the totaled data from the 486 mortalities in 1998, however, the three leading causes of death, as detailed in Table 1, in decreasing order of magnitude for all four stocks and four cohort years combined include:

1. Three-hundred four BKD mortalities.
2. One-hundred sixteen unknown-cause mortalities.
3. Thirty aeromonad-pseudomonad septicemia (APS) mortalities.

Of particular concern is BKD, accounting for 63% of the overall mortality for all locations, cohort years, and stocks combined. By location, with all cohort years and stocks combined, BKD caused 10% of the total mortality at Lookingglass Fish Hatchery, 15% of the total mortality at Manchester Marine Laboratory, and 77% of the total mortality at Bonneville Fish Hatchery. In addition, *Renibacterium salmoninarum* (Rs), the bacterial agent of BKD, was found in moderate levels in several mortalities at Bonneville, and thus it was probably a contributing factor to death. For all stocks and cohort years at Bonneville combined, 12/41 (29.3%) of the unknown-cause mortalities had enzyme-linked immunosorbent assay (ELISA) values ranging from 0.318-0.801 optical density (OD) units, three of 30 APS mortalities had ELISA OD values ranging from 0.326-0.722, two of four (50.0%) anorexia mortalities had OD units of 0.442 and 0.735, and one of two (50.0%) coldwater disease (CWD) mortalities had a value of 0.576. The percentage reported for Bonneville consists only of fish reared at Bonneville, not fish reared at Manchester in saltwater and transferred to Bonneville for maturation.

Other causes of death for all locations, cohort years, and stocks combined were minimal, including anthropogenic disturbances (accidental deaths, trauma, and tagging), anorexia (starvation), CWD, fungus, and jumpouts. Overall, eight fish died from anthropogenic causes, four from anorexia, two from CWD, two from fungus, and two from jumpout mortality. In addition, salinity tolerance tests (STT) at Lookingglass Fish Hatchery accounted for mortality in 18/21 (85.7%) RR cohort year 96 surrogates that died. Viral agents were not detected in any fish assayed. All samples from all rearing locations, cohort years, and stocks sent to the Corvallis Laboratory in 1998 for analysis of *Myxobolus cerebralis* (whirling disease) were negative for spores (Table 2). Of the 808 fish examined, 392 fish tested were from the Lostine River, where *M. cerebralis* has previously been detected in natural juvenile spring chinook salmon and brook trout. Results are pending on 391 additional fish.

Spawned and Sacrificed

From September 10, 1998 to October 28, 1998, 368 total fish were spawned. Kidney samples were taken by personnel from the Clackamas Laboratory and analyzed by the ELISA at the La Grande Laboratory. In all, 16 LR94 males, 46 LR94 females, 118 LR95 males, one LR95 female, one LR96 male, 34 CC94 males, 69 CC94 females, 77 CC95 males, one CC96 male, one GR94 male, and four GR94 females were sampled from saltwater (SW), freshwater (FW), and accelerated (A) growth regimes (Table 3). Among LR94 spawned females, 48.3% of SW-reared fish had ELISA OD values at or below 0.199, whereas only 17.7% of FW-reared adults were in this range. The SW fish did not have any clinical BKD, however, in contrast to the FW-reared fish with 29.4% in the clinical category. The LR94 female trend was reversed in the LR94 males; 16.6% in the SW compared to 70.0% in the FW for the 0-0.199 ELISA OD range, 66.7% in the SW compared to 30.0% in the FW for the 0.2-0.999 range, and 16.7% clinical BKD in the SW with no clinical BKD in the FW growth strategy. No noticeable differences existed between SW and FW in adult males or females of CC94 fish (no clinical BKD was diagnosed) and the GR94 females were reared only in FW. For the males spawned in 1995, BKD had a higher prevalence in the LR fish, with 18.6% clinical in the SW growth regime, 9.4% in the FW, and 13.6% in the A growth. CC95 males had only one instance of clinical BKD at 2.4% prevalence in the FW group. Otherwise, trends were the same for the LR and CC95 males. The largest percentages were in the 0-0.199 range across all growth strategies, but percentage within the 0.2-0.999 range rose in both stocks for the A growth regime.

Three fish, one CC95 and two LR95, were sacrificed. These fish had already been live spawned as precocious males and were reconditioned over the winter of 1998-98.

Disease Prophylaxis and Treatment

Bivalent vibrio vaccine was administered by intraperitoneal injection to all 96 cohorts and 96 surrogates at Lookingglass Fish Hatchery prior to transfer to Manchester Marine Laboratory and Bonneville Fish Hatchery. There were no mortalities attributed to this procedure.

Prophylactic treatments for BKD were administered via dietary aquamycin, erythromycin injections, or erythromycin pills at all locations for all stocks and cohort years (Table 4). At Bonneville, aquamycin was fed at 2.25% body weight every other day, and non-medicated feed was given at 1% body weight on alternate days in March to all stocks of the 94 cohort year. Medicated feed was terminated eight days after the start of feeding the LR94 because of presumed toxicity. In April, the same feeding regime was applied to CC94 and LR94 stocks at Manchester, but the program was terminated six days after the start of feeding because of presumed toxicity to both stocks. All stocks of 1994-1996 cohort years held at Manchester and Bonneville were given dorsal sinus injections of erythromycin at 10, 15, and 20 mg/Kg body weight, at regular intervals, with no apparent side effects or mortality. Erythromycin pills were mixed with the normal diet and fed to all stocks in the 96 cohort years, for 21 consecutive days during October and November, at both Bonneville and Manchester. At Bonneville, treatment of the LR96 fish were terminated after 14 days due to presumed toxicity. Treatment of the CC96 fish was stopped after 17 days for the same reason.

All stocks for cohort year 96 at Lookingglass were fed aquamycin at 2.25% (12^0C trough) and 4.5 % (8°C trough) body weight for 28 consecutive days in February. The medicated treatment of the LR96 fish, however, was adjusted to an every other day treatment with normal feed given on alternate days, in order to ameliorate any possible toxicity. Prophylactic intraperitoneal injections of erythromycin at 20 mg/Kg body weight were performed on a pilot group of RR97 surrogates when they were received, weighed, and measured at Lookingglass. No toxicity was observed, so the same procedure was performed on CC, LR, and GR cohort year 97 upon arrival at Lookingglass. No related side effects or mortalities were reported. A second injection of the CC97 with erythromycin at 20 mg/Kg body weight was administered in December as a response to an increase in BKD mortalities. Again, no adverse reactions were observed.

Captive Broodstock Work Group

On April 9, 1998, Groberg moderated a "Captive Broodstock Work Group on BKD" at Bonneville Hatchery. Several regional experts on the disease were present, including Tony Amandi, Lee Harrell, Rich Holt, Keith Johnson, Ron Pascho, and Christine Moffitt (who participated via conference call). The purpose of this meeting was to clarify issues and concerns about BKD so that the Technical Oversight Team (TOT) could be exposed to a large information base from which to draw in order to aid the quality and timeliness of the decision-making process. The four major categories discussed included: 1) erythromycin\aquamycin toxicity issues, 2) medicated feed issues, 3) alternative drug or therapeutic strategy issues, and 4) diagnosis, therapy, and treatment protocol issues.

One important conclusion reached regarding the toxicity issue was that size alone does not physiologically predispose a fish to die from toxicity, however behavioral differences predispose the larger, more aggressive fish to ingest more drugs, possibly causing dominant fish to be at a greater risk for toxicity than subordinate fish. Other general conclusions indicated that toxic effects via injection and oral drugs are the same, but toxicity signs may be different for each. Also, it was observed that there is a potential for stock-specificity in toxic events, because LR fish seem to have more toxic events that do GR or CC fish. Several experts reiterated that prophylactic treatment is essential for the survival of the fish in the Oregon captive broodstock program, because losses to toxicity are minor compared to the numbers of fish lost to BKD. In order to be effective, the drugs must linger in the fishes' systems to combat the chronic and hidden nature of the Rs antigen. Prevention, it was agreed, is the preferred strategy for BKD suppression, because treatment of an epizootic has virtually no effect.

The scarce availability of medicated feed was discussed, including the reasons for why companies have such varied doses of medication in feed, even within the same lot. No solid solutions were reached, but the possibility of making feed specifically for the Oregon captive broodstock program was discussed. Alternative drugs mentioned included azithromycin, and alternative feeding strategies included encapsulation of erythromycin. It was in response to this discussion that erythromycin pills were made and mixed with regular feed (see Disease Prophylaxis and Treatment and Table 4). It was also decided the initial treatment after the capture of parr from their natal streams should be administered as injections of erythromycin, conducted at the time of arrival at Lookingglass Fish Hatchery (see Disease Prophylaxis and Treatment and Table 4). This plan was carried out in an attempt to avoid an early medicated feed treatment. The hope was that this would allow for better growth in fish that were injected with erythromycin when compared to fish fed erythromycin in their diet.

Renibacterium salmoninarum **and Bacterial Kidney Disease Analyses**

<u>Mortality</u>

Lookingglass Hatchery 96 Cohort

One of five (20.0%) LR96 mortalities had clinical BKD, with an ELISA value of 2.535 OD units. This fish was also clinical by gross observation. The remaining three (60.0%) LR96 mortalities tested by ELISA were at or below 0.108 OD units, and one (20.0%) was not tested. One of two (50.0%) CC96 mortalities was at 0.099 units, and the other (50.0%) was not tested. Fourteen of 21 (66.7%) RR96 surrogate STT mortalities were assayed by ELISA. Values were at or below 0.125 OD units. The remaining seven fish (four STT mortalities and three unknown-cause mortalities) were not tested for Rs.

Lookingglass Hatchery 97 Cohort

Two of four (50.0%) CC97 and one of three (33.3%) GR97 fish exhibited gross signs of BKD. Of these, the GR and one CC fish were determined to be strongly positive for Rs by the direct fluorescent antibody test (DFAT). The remaining CC97 had an ELISA value of 2.899 OD units. The remaining two CC97 (50.0%), one tested by DFAT and one with an ELISA OD value of 0.109, and two more GR97 fish (66.7%), tested by DFAT, were negative for BKD. Two LR97 fish were necropsied and determined to be negative for BKD. One of these (50.0%) was an anthropogenic mortality with an ELISA OD value of 0.127, and the mortality of unknown-cause (50.0%) was negative for Rs by the DFAT. Additionally, four RR97 surrogates were necropsied. All ELISA values were at or below 0.131.

Manchester Marine Laboratory 94 Cohort

Eleven CC94 and 13 LR94 mortalities were submitted for necropsy. All ELISA OD values were at or below 0.144. Causes of mortality are listed as unknown (Table 1) because the culture results from Manchester have not been received.

Manchester Marine Laboratory 95 Cohort

Two of the eight (25.0%) CC95 fish submitted for necropsy were clinical for BKD by ELISA, with OD values of 2.418 and 1.952. The remaining six (75.0%) were at or below 0.151 OD units. Eighteen LR95 fish were submitted. Of these, nine (50.0%) were clinical for BKD by ELISA. One fish (5.6%) had a moderate level of Rs antigen with an OD value of 0.438, and the other eight (44.4%) fish had low OD values of 0.134 or less. Other causes of mortality are listed as unknown (Table 1) because the culture results from Manchester have not been received.

Manchester Marine Laboratory 96 Cohort

A total of seven CC96, ten GR96, and five LR96 mortalities were at or below 0.155 ELISA OD units. Causes of mortality are listed as unknown (Table 1) because the culture results from Manchester have not been received.

Bonneville Hatchery 94 Cohort

Of 30 CC94 fish submitted, ten were clinical for BKD; nine by ELISA and one by DFAT (ELISA results pending). The remaining 20 (66.7%) fish were at or below 0.208 OD units.

Eighty-eight LR94 fish were submitted for necropsy. Seventy-nine (89.8%) of these fish were clinical for BKD; 77 by ELISA and two by DFAT (ELISA results pending). Six (6.8%) unknown-cause mortalities had moderate to high levels of Rs antigen at 0.356-0.801 OD units, so Rs may have been a contributing factor in death. The last three (3.4%) fish died as a result of APS, with values of 0.070, 0.130, and 0.267 OD units.

Of 25 GR94 mortalities, 23 (92.0%) were clinical for BKD by ELISA, one (4.0%) unknown-cause mortality had a moderate to high Rs level with a 0.648 OD value (Rs was probably a factor in death), and the one remaining fish (4.0%) died of APS with an OD value of 0.071.

Bonneville Hatchery 95 Cohort

Eighty-six CC95 fish were submitted for necropsy. Of these, 72 (83.7%) were clinical BKD mortalities; 62 by ELISA, nine by DFAT (ELISA results pending), and one presumptively diagnosed as BKD because of a moderate Rs antigen level by DFAT, although ELISA results are needed for confirmation. The Rs antigen was a factor in the deaths of six (7.0%) other fish, ranging from moderate to high OD values of 0.495-0.735. Aeromonad-psuedomonad septicemias and CWD were the causes of death for two of these moderate Rs level fish, and the others died of anorexia or unknown causes. The remaining nine of 86 (10.5%) CC95 fish died from causes not related to BKD; two died from anthropogenic disturbances, and the rest were unknown-cause. The OD values available on five of these fish range from 0.094 to 0.190 (ELISA results pending for the other four).

Ninety-one LR95 fish were submitted for necropsy. Seventy-four (81.3%) of these were clinical for BKD; 65 by ELISA, and an additional nine were clinical by DFAT (ELISA results pending). Three unknown-cause mortalities (3.3%) had moderate to high Rs antigen levels ranging from 0.318-0.532, so Rs probably contributed to death. The remaining 16 fish died from unknown causes, anorexia, jumpout, and APS, with low ELISA OD values ranging from 0.081-0.230.

Bonneville Hatchery 96 Cohort

Five of the ten (50.0%) CC96 mortalities submitted had clinical BKD; two by DFAT, one by ELISA, and two by a presumptive diagnosis, with a low-level positive DFAT and gross observations (ELISA results pending). One (10.0%) CC96 fish had a moderately positive OD value of 0.325, but its death was attributed to APS. The remaining four (40.0%) CC96 fish exhibited low OD values, two fish with 0.084 and 0.090, respectively (ELISA results are pending on the other two fish). Unknown-cause and APS were diagnosed.

Twenty-two (61.1%) of 36 LR96 fish submitted for necropsy were clinical for BKD; one by ELISA, 13 by DFAT (ELISA results pending), and eight presumptively diagnosed with BKD due to a combination of gross observations and low-level positive DFAT's (ELISA results pending). Two (5.6%) fish infected with moderate levels of Rs antigen were submitted, but deaths were attributed to unknown causes and APS. The ELISA OD values were 0.595 and 0.326, respectively. The remaining 12 (33.3%) LR96 fish were negative for BKD, and died of unknown causes, anthropogenic disturbances, and APS. Seven of these 12 ranged from 0.069-0.099 OD units, three ranged from 0.139-0.279, and two have pending ELISA results.

Four of seven (57.1%) GR96 fish submitted were clinical for BKD by presumptive diagnoses (recorded gross observations and low-level positive DFAT results with ELISA results pending). Two (28.6%) of the three remaining fish died of APS, one of these with an OD unit of 0.092 and one with the ELISA result pending. The third (14.3%) fish died of unknown causes (ELISA results pending).

<u>Spawned and Sacrificed</u>

Lostine River 94 Cohort

<u>Saltwater (SW) Growth</u>

One of six (16.7%) males in the SW regime was clinical for BKD by ELISA (Table 4), four (66.7%) were in the 0.2-0.999 range, and one (16.7%) was in the 0-0.199 ELISA OD range at 0.156 OD units. No females were clinical for BKD, 15/29 (51.7%) were in the 0.2-0.999 range, and 14 (48.3%) were in the 0-0.199 range.

<u>Freshwater (FW) Growth</u>

No males in the FW regime were clinical for BKD by ELISA, three of 10 (30.0%) were in the 0.2-0.999 range, and seven (70.0%) were in the 0-0.199 ELISA OD range. Five of 17 (29.4%) females were clinical for BKD, nine (52.9%) were in the 0.2-0.999 range, and three (17.7%) were in the 0-0.199 range.

Lostine River 95 Cohort

<u>Saltwater (SW) Growth</u>

Eight of 43 (18.6%) males in the SW regime were clinical for BKD by ELISA, one (2.3%) was in the 0.2-0.999 range, and 34 (79.1%) were in the 0-0.199 ELISA OD range. The one female had an ELISA OD value of 0.646.

<u>Freshwater (FW) Growth</u>

Five of 53 (9.4%) males in the FW regime were clinical for BKD by ELISA, two (3.8%) were in the 0.2-0.999 range, and 46 (86.8%) were in the 0-0.199 ELISA OD range.

<u>Accelerated (A) Growth</u>

Three of 22 (13.6%) males in the A regime were clinical for BKD by ELISA, eight (36.4%) were in the 0.2-0.999 range, and 11 (50.0%) were in the 0-0.199 ELISA OD range.

<u>Sacrificed</u>

The two sacrificed males had ELISA OD values of 0.075 and 0.080.

Lostine River 96 Cohort

One FW male had an ELISA OD value of 0.114.

Catherine Creek 94 Cohort

<u>Saltwater (SW) Growth</u>

No males in the SW regime were clinical for BKD by ELISA, one of eight (12.5%) was in the 0.2-0.999 range at 0.333 OD units, and seven (87.5%) were in the 0-0.199 ELISA OD range. No females were clinical for BKD by ELISA, one of 36 (2.8%) was in the 0.2-0.999 range at 0.712 OD units, and the remaining 35 (97.2%) were in the 0-0.199 ELISA OD range.

<u>Freshwater (FW) Growth</u>

No males in the FW regime were clinical for BKD by ELISA, two of 26 (7.7%) were in the 0.2-0.999 range, and 24 (92.3%) were in the 0-0.199 ELISA OD range. No females were clinical for BKD, two of 33 (6.1%) were in the 0.2-0.999 range, and the remaining 31 (93.9%) were in the 0-0.199 range.

Catherine Creek 95 Cohort

Saltwater (SW) Growth

No males in the SW regime were clinical for BKD by ELISA, one (4.0%) was in the 0.2-0.999 range at 0.226 OD units, and 24 (96.0%) were in the 0-0.199 ELISA OD range.

Freshwater (FW) Growth

One of 42 (2.4%) males in the FW regime were clinical for BKD by ELISA, two (4.8%) were in the 0.2-0.999 range, and 39 (92.8%) were in the 0-0.199 ELISA OD range.

Accelerated (A) Growth

No males in the A regime were clinical for BKD by ELISA, two of ten (20.0%) were in the 0.2-0.999 range, and eight (80.0%) were in the 0-0.199 ELISA OD range.

Sacrificed

The one sacrificed male had an ELISA OD value of 0.093.

Catherine Creek 96 Cohort

The one A male had an ELISA OD value of 0.103.

Upper Grande Ronde River 94 Cohort

The one FW male had an ELISA OD value of 0.126. One of four (25.0%) FW females was clinical for BKD by ELISA, one (25.0%) was in the 0.2-0.999 range at 0.241 OD units, and two (50.0%) were in the 0-0.199 range.

Significant Findings

Data from Groberg et al. (1998) were presented at the Northwest Fish Culture Conferences in December, 1998. These data summarize various aspects of the Oregon captive broodstock program from its inception to September 10, 1998, with particular emphasis on BKD. Several points are directly relevant to this annual, although the entire year of 1998 is not covered. Some discussion of this time interval follows, incorporated into the 1998 annual material.

During late 1997 and early 1998, BKD emerged as a serious and major mortality factor in the Oregon captive broodstock program. In 94 cohorts, the populations of fish captured as parr from LR, GR, and CC were reduced to BKD mortality by 20% in the LR94 stock and 49% in the GR94 stock before any females matured (Groberg et al. 1998). All 184 BKD mortalities died at Bonneville Fish Hatchery, with the exception of six 94 cohorts, which died of BKD in their first months of captivity at Lookingglass Fish Hatchery. No cohort 94 mortality at Manchester was due to BKD during this period of time.

As of September 10, 1998, none of the 95 cohorts had died from BKD at Lookingglass, 11 were BKD mortalities at Manchester, and 107 were BKD mortalities at Bonneville. One-third of the juveniles within all stocks from the 95 cohort were transferred from Lookingglass to Manchester while two-thirds were transferred from Lookingglass to Bonneville. The BKD mortality for juveniles was nearly five-fold greater at Bonneville than at Manchester.

In spawned adults, the trend for severe Rs infection at Bonneville is evident only with the LR94 females spawned in 1998. In these, 29.4% reared at Bonneville had clinical infections, while those reared at Manchester showed no clinical infections (Table 3). It is very important to reiterate that the infection level in spawned females translates into infection level, and therefore survival, of their progeny. For LR94 spawned males, the trend was reversed from that of the females. None reared at Bonneville were clinically infected, and 16.7% reared at Manchester were clinically infected. The percentage of BKD mortalities reared at Manchester, however, represents only 1 of 6 fish. At Bonneville, the data is from only 10 fish. Thus, small samples sizes may not accurately depict a change in trend. Moreover, the percentage of LR94 males in the 0-0.199 range is consistent with the trend in the LR94 female clinical infection data. Seventy percent at Bonneville were in this very low range, and only 16.6% at Manchester are within this range.

The CC94 cohorts had low BKD mortality and Rs infection rates since capture. The mortality data is disproportionately higher at Bonneville than at Manchester, as with the LR94 cohorts. Over 87.5% of spawned males and females from both Manchester and Bonneville showed infection levels in the low 0-0.199 range (Table 3). None of either sex at either location were clinically infected.

The GR94 cohorts experienced difficulty with BKD since capture, and overall they suffered catastrophic mortality to the disease. Twenty-three of 25 (92.0%) fish that died in 1998 were BKD mortalities. Only four females survived to spawn in 1998, and one of those was clinically infected. The one spawned male was in the low range. As stated earlier, almost 50% of the captured population died from BKD before these few adults were spawned.

Trends with the 95 cohorts suggest that both the CC and LR have substantial infection rates, and mortalities in both stocks are disproportionately higher at Bonneville than at Manchester. For males spawned in 1998, there is a lack of strong evidence supporting differences in infection rates between fish reared at Manchester and Bonneville. There is some indication , however, that the LR fish are more severely infected than the CC stock.

Summary and Conclusions

Very close scrutiny and analysis of the BKD epidemiology in this program is needed. To date, the severity of BKD has been far greater at Bonneville than Manchester. If this trend continues, consideration should soon be given to rearing more of the fish in saltwater at Manchester than in freshwater at Bonneville. To facilitate this scrutiny and these analyses, a fish health professional whose full-time duties are assigned to the Oregon captive broodstock program, should be appointed. This individual needs to have the credentials necessary to competently complete this assignment. These qualifications should, at a minimum, include: 1). certification as an American Fisheries Society Fish Pathologist, or a Doctor of Veterinary Medicine with training and experience in fish medicine, 2a). at least five years of experience in the diagnosis and treatment of BKD or, 2b). a completed Masters thesis, Ph.D. dissertation, or research on BKD with a published thesis or, 2c). peer-reviewed BKD research published or, 2d). BKD research with funding and supporting progress reports, and 3). documented professional training or formal education in epidemiology, pharmacology, and statistics. With these credentials, this fish health professional could make sound and scientifically-based recommendations and decisions concerning all treatments employed in this program, adding both centralized data collection and subsequent decision making and consistency to this program.

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Table 1. Summary of necropsies made on captive broodstock mortality in 1998 at the La Grande, Clackamas, and Manchester Fish Pathology Laboratories. Stocks are Lostine River (LR), Catherine Creek (CC), Grande Ronde River (GR), and Rapid River (RR). Cohort years include 1994 (94), 1995 (95), 1996 (96), and 1997 (97).

Laboratory/Hatchery	Clinical Findings and Probable or Possible Cause of Death[a]									Total
Stock/Cohort Year	BKD	Unk	APS	STT	Ant	Anx	CWD	Fun	JO	Mortality
La Grande/Lookingglass										
CC96		2								2
LR96	1	4								5
GR96										0
RR96		3		18						21
CC97	2	2								4
LR97		1			1					2
GR97	1	1			1					3
RR97		1			2				1	4
Clackamas/Bonneville										
CC94	10	7	11				1	1		30
LR94	79	6	3							88
GR94	23	1	1							25
CC95	72	9	1		2	1	1			86
LR95	74	9	2		1	3		1	1	91
CC96	5	2	3							10
LR96	22	6	7		1					36
GR96	4	1	2							7
Manchester/Manchester										
CC94		11								11
LR94		13								13
CC95	2	6								8
LR95	9	9								18
CC96		7								7
LR96		5								5
GR96		10								10
Total	304	116	30	18	8	4	2	2	2	486

[a] Multiple clinical findings were made in some mortalities, but a most likely cause of death was identified after analysis of the clinical findings.
BKD = bacterial kidney disease, Unk = unknown cause, APS = aeromonad-pseudomonad septicemias, STT = salinity tolerance test, Ant = anthropogenic cause, Anx = anorexia, CWD = coldwater disease, Fun = fungus, JO = jumpout.

Table 2. Number of Oregon captive broodstock spring chinook salmon by stock and cohort examined for spores of *Myxobolus cerebralis.* All were negative. Fish sampled include mortality, sacrificed, and spawned adults from Lookingglass Hatchery, Bonneville Hatchery, and Manchester Marine Laboratory. Of the 808 fish examined, 392 fish tested were from the Lostine River, where *M. cerebralis* has previously been detected in natural juvenile spring chinook salmon and brook trout[1]. Results from 391 fish, including 134 CC, 216 LR, and 41 GR are pending.

Cohort	Number of Samples		
	CC	LR[1]	GR
94	187	171	42
95	183	212	none
96	2	7	0
97	1	2	1
Total	373	392	43

Table 3. Proportions and percentages within three delineations of ELISA OD ranges for saltwater (SW), freshwater (FW), and accelerated (A) growth rearing strategies of the Oregon captive broodstock spring chinook salmon adults spawned at Bonneville Hatchery in 1998. Stocks include Lostine River (LR), Catherine Creek (CC), and upper Grande Ronde River (GR) fish, both male (M) and female (F), for the 1994 (94), 1995 (95), and 1996 (96) cohorts.

	Rearing Strategy					
Stock/Cohort Year/Sex ELISA OD Ranges	SW proportion	SW percent	FW proportion	FW percent	A proportion	A percent
LR94 F						
0-0.199	14/29	48.3	3/17	17.7	n/a	n/a
0.2-0.999	15/29	51.7	9/17	52.9	n/a	n/a
>1.0	0/29	0	5/17	29.4	n/a	n/a
LR94 M						
0-0.199	1/6	16.6	7/10	70.0	n/a	n/a
0.2-0.999	4/6	66.7	3/10	30.0	n/a	n/a
>1.0	1/6	16.7	0/10	0	n/a	n/a
LR95 F						
0-0.199	0/1	0	n/a	n/a	n/a	n/a
0.2-0.999	1/1	100.0	n/a	n/a	n/a	n/a
>1.0	0/1	0	n/a	n/a	n/a	n/a
LR95 M						
0-0.199	34/43	79.1	46/53	86.8	11/22	50.0
0.2-0.999	1/43	2.3	2/53	3.8	8/22	36.4
>1.0	8/43	18.6	5/53	9.4	3/22	13.6
LR96 M						
0-0.199	n/a	n/a	1/1	100.0	n/a	n/a
0.2-0.999	n/a	n/a	0/1	0	n/a	n/a
>1.0	n/a	n/a	0/1	0	n/a	n/a
CC94 F						
0-0.199	35/36	97.2	31/33	93.9	n/a	n/a
0.2-0.999	1/36	2.8	2/33	6.1	n/a	n/a
>1.0	0/36	0	0/33	0	n/a	n/a
CC94 M						
0-0.199	7/8	87.5	24/26	92.3	n/a	n/a
0.2-0.999	1/8	12.5	2/26	7.7	n/a	n/a
>1.0	0/8	0	0/26	0	n/a	n/a

Table 3. (Continued)

Stock/Cohort Year/Sex ELISA OD Ranges	Rearing Strategy SW proportion	SW percent	FW proportion	FW percent	A proportion	A percent
CC95 M						
0-0.199	24/25	96.0	39/42	92.8	8/10	80.0
0.2-0.999	1/25	4.0	2/42	4.8	2/10	20.0
>1.0	0/25	0	1/42	2.4	0/10	0
CC96 M						
0-0.199	n/a	n/a	n/a	n/a	1/1	100.0
0.2-0.999	n/a	n/a	n/a	n/a	0/1	0
>1.0	n/a	n/a	n/a	n/a	0/1	0
GR94 F						
0-0.199	n/a	n/a	2/4	50.0	n/a	n/a
0.2-0.999	n/a	n/a	1/4	25.0	n/a	n/a
>1.0	n/a	n/a	1/4	25.0	n/a	n/a
GR94 M						
0-0.199	n/a	n/a	1/1	100.0	n/a	n/a
0.2-0.999	n/a	n/a	0/1	0	n/a	n/a
>1.0	n/a	n/a	0/1	0	n/a	n/a

Table 4. Antibiotic treatments of Oregon captive broodstock for control of bacterial kidney disease, in the form of aquamycin diets (AD), erythromycin injections (EI followed by number, all, or remainder (rm) of fish at mg dosage per Kg body weight), and erythromycin pills (EP), in Lostine River (LR), Catherine Creek (CC), and upper Grande Ronde River (GR) juvenile and adult spring chinook salmon for the cohort years of 1994 (94), 1995 (95), 1996 (96), and 1997 (97). Treatments were administered at Bonneville Hatchery (BO), Manchester Marine Laboratory (MML), and Lookingglass Hatchery (LG). Presumed toxicity events are in bold italics.

Location	Stock and cohort year										
Start date	GR94	LR94	CC94	LR95	CC95	GR96	LR96	CC96	GR97	LR97	CC97
BO											
01/23/98	EI 5@10[a]										
02/05/98	EI rm@10[ab]										
02/20/98		EI 10@10[a]									
03/05/98		EI rm@10[ab]									
03/13/98	AD[c]		AD[c]								
03/31/98		***AD***[cd]									
04/27/98		EI 10@15[a]									
05/07/98		EI rm@15[ab]		EI 10@15[a]	EI 10@15[a]						
05/18/98				EI rm@15[abe]	EI rm@15[abe]						
05/21/98	EI all@15[a]		EI all@15[a]								
06/05/98		EI 10@20[a]									
06/16/98	EI all@20[af]	EI rm@20[abf]	EI all@20[af]	EI all@15[af]	EI all@15[af]						
07/15/98	EI all@20[af]	EI all@20[af]	EI all@20[af]	EI all@20[af]	EI all@20[af]						
08/03/98						EI all@20[a]	EI all@20[a]	EI all@20[a]			
08/17/98	EI all@20[af]	EI all@20[af]	EI all@20[af]	EI all@20[af]	EI all@20[af]						
09/15/98				EI all@20[g]	EI all@20[g]						
10/15/98	EI all@20[f]	EI all@20[f]	EI all@20[f]	EI all@20[f]	EI all@20[f]						
11/04/98						EP[h]	***EP***[hi]	***EP***[hj]			
12/16/98	EI all@20	EI all@20	EI all@20	EI all@20[m]	EI all@20		EI precocious males@20				
MML											
04/13/98		***AD***[ck]	***AD***[ck]								
05/21/98				EI all@10[a]	EI all@10[a]						
06/15/98		EI all@10[af]	EI all@10[af]	EI all@10[af]	EI all@10[af]						
07/15/98		EI all@10[afl]	EI all@10[af]	EI all@10[af]	EI all@10[af]						
08/05/98						EI all@15[a]	EI all@15[a]	EI all@15[a]			
08/17/98		EI all@15[em]	EI all@15[af]	EI all@15[afn]	EI all@15[af]						
09/15/98		EI all@20[em]	EI all@20[af]	EI all@20[af]	EI all@20[af]						
10/26/98						EP[h]	EP[h]	EP[h]			
12/16/98		EI all@20	EI all@20	EI all@20[o]	EI all@20						

Table 4. (Continued)

Location Start date	GR94	LR94	CC94	LR95	CC95	GR96	LR96	CC96	GR97	LR97	CC97
						Stock and cohort year					
LG											
02/08/98						AD[p]	***AD***[pq]	AD[p]			
08/17/98											EI all@20[rs]
08/24/98										EI all@20[t]	
09/08/98									EI all@20[u]		
12/08/98											EI all@20

[a] Indicates dorsal sinus injection of erythromycin at the dosage shown per Kg body weight.
[b] Re indicates remainder of population from which a previous 5 or 10-fish test group originated.
[c] Indicates 2.25% oral aquamycin via medicated feed fed every other day and non-medicated feed fed at 1% body weight on alternate days.
[d] *Indicates the aquamycin treatment was terminated after eight total days of medicated feed because of presumed toxicity.*
[e] First implemented the use of a hospital tank to isolate fish exhibiting external signs of BKD.
[f] Excludes sexually maturing (ripening) fish.
[g] LR95 and CC95 fish in hospital tanks received a dorsal sinus injection of 20 mg/Kg erythromycin and were sorted back into the tanks with their respective stock and cohort year.
[h] Indicated erythromycin fish pills fed with normal diet for 21 consecutive days.
[i] *Indicates erythromycin pills were terminated after 14 days because of presumed toxicity.*
[j] *Indicates erythromycin pills were terminated after 17 days because of presumed toxicity.*
[k] *Indicates the aquamycin treatment was terminated after six total days of medicated feed because of presumed toxicity.*
[l] Indicates a 10-fish test group was given a dorsal-sinus injection of erythromycin at 15 mg/Kg. These all survived so the next injection series at MML was at 15 mg/Kg in all fish.
[m] Indicates oral aquamycin (2.25 or 4.5%) via medicated feed was fed for 28 consecutive days.
[n] Indicates a 10-fish test group was given a dorsal-sinus injection of erythromycin at 20 mg/Kg. These all survived so the next injection series at MML was at 20 mg/Kg in all fish.
[o] Indicates a 5-fish test group was injected at 30mg/Kg with no indication of toxicity.
[p] Indicates 2.25% (54°F trough) and 4.5% (46°F trough) oral aquamycin via medicated feed was fed for 28 consecutive days.
[q] *The treatment was adjusted to every other day on 02/16/98, because of presumed toxicity, to complete the 28 day feeding on 03/14/98. Normal diet was fed on alternate days.*
[r] RR97 surrogates received a 20 mg/Kg intraperitoneal injection of erythromycin starting 8/10/98 upon arrival at LG when they were weighed and measured.
[s] CC97 surrogates received a 20 mg/Kg intraperitoneal injection of erythromycin starting 8/10/98 upon arrival at LG when they were weighed and measured.
[t] LR97 surrogates received a 20 mg/Kg intraperitoneal injection of erythromycin starting 8/10/98 upon arrival at LG when they were weighed and measured.
[u] GR97 surrogates received a 20 mg/Kg intraperitoneal injection of erythromycin starting 8/10/98 upon arrival at LG when they were weighed and measured