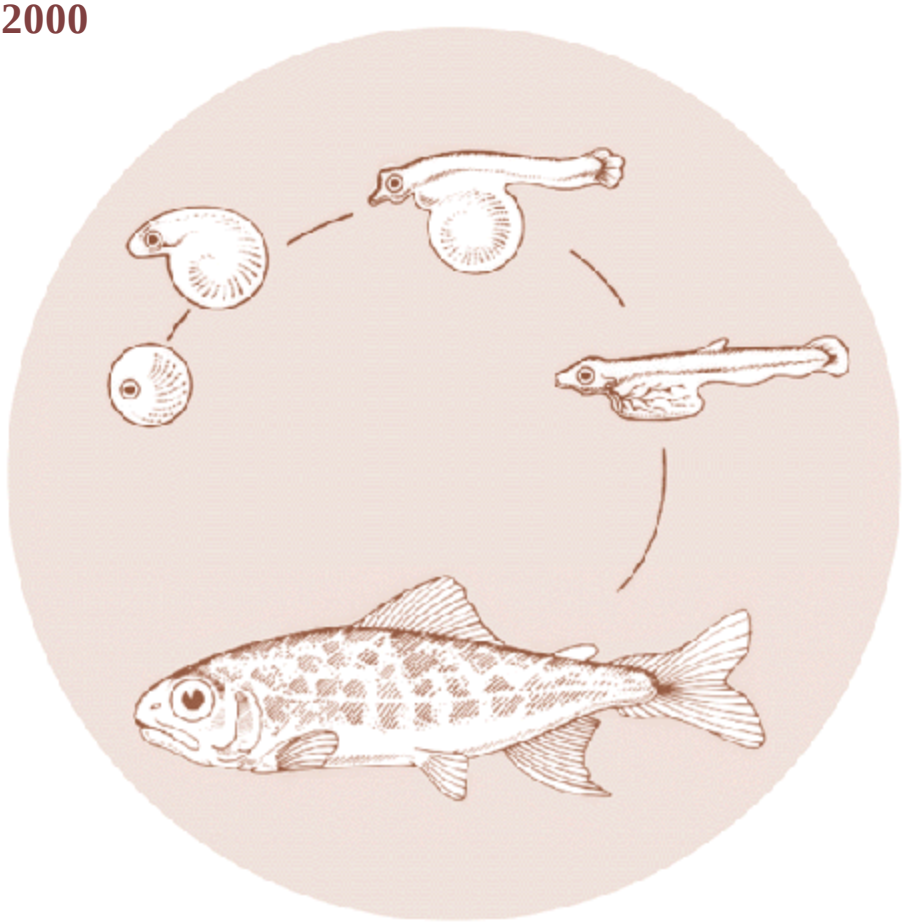
Grande Ronde Basin Chinook Salmon Captive Brood and Conventional Supplementation

Annual Report
2000



DOE/BP-00004523-3

March 2003

This Document should be cited as follows:

Carmichael, Richard, "Grande Ronde Basin Chinook Salmon Captive Brood and Conventional Supplementation", Project No. 1998-01006, 59 electronic pages, (BPA Report DOE/BP-00004523-3)

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

ANNUAL REPORT

PROJECT TITLE**:** Grande Ronde Basin Spring Chinook Salmon Endemic 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, 2000 through December 31, 2000

Contributors: Oregon Department of Fish and Wildlife
National Marine Fisheries Service
Nez Perce Tribe
Confederated Tribes of the Umatilla Indian Reservation

Oregon Department of Fish and Wildlife
One University Boulevard
211 Inlow Hall
Eastern Oregon University
La Grande, OR 97850

CONTENTS

Grande Ronde Basin Spring Chinook Salmon
Endemic Supplementation Program

Endangered Species Permit Number 1011 (formerly Permit # 973) authorizes ODFW to take listed spring chinook salmon juveniles from Catherine Creek (CC), Lostine River (LR) and Grande Ronde River (GR) for research and enhancement purposes. Modification 2 of this permit authorizes ODFW to take adults for spawning and the production and release of smolts for the Captive and Conventional broodstock programs. This report satisfies the requirement that an annual report be submitted. Herein we report on activities conducted and provide cursory data analyses for the Grande Ronde spring chinook salmon Captive and Conventional broodstock projects from 1 January – 31 December 2000.

CAPTIVE BROODSTOCK PROJECT

1) Activities Conducted

Captive Broodstock Population

A new cohort of fish (1999 cohort) was collected from Catherine Creek and Lostine River [none were found in Grande Ronde River (GR) in 2000] and 1580 fish were removed from the captive population in 2000: 1046 fish were spawned and 534 fish died from various causes. Fish are raised at Lookingglass Fish Hatchery (LFH), Bonneville Hatchery (BOH) and at Manchester Marine Laboratory (MML). Most fish removed from the population in 2000 were sent to either the Clackamas, La Grande or Manchester Fish Health laboratories for examination and determination of cause of death. A detailed account of the Fish Health Lab findings is provided in the Fish Health Monitoring and Disease section of this report. Here, we account for all fish remaining or removed from each cohort of the captive population from 1 January - 31 December 2000.

1994 Cohort

The last 1994 cohort fish (21) were removed from the captive population in 2000 (17 CC, 4 LR). Of these, seven were spawned or had semen cryopreserved (5 CC, 2 LR). An additional 11 died from disease (10 CC, 1 LR), two died from other or unknown causes (1 CC, 1 LR) and the cause of death for one CC fish has not yet been determined. No fish died from experimental procedures and all fish were accounted for.

1995 Cohort

One hundred 1995 cohort fish (71 CC, 29 LR) were removed from the captive population in 2000, leaving nine Catherine Creek and one Lostine River salmon remaining alive. Of those removed, 57 were spawned or had semen cryopreserved (43 CC, 14 LR), 37 died from disease (23 CC, 14 LR) and six died from other or unknown causes (5 CC, 1 LR). No fish died from experimental procedures and all fish were accounted for.

1996 Cohort

There are 55, 41 and 24 fish remaining alive from Catherine Creek, Grande Ronde River and Lostine River stocks, respectively. A total of 700 fish were removed from the captive

population in 2000 (229 CC, 227 GR, 244 LR). Of these, 473 were spawned or had semen cryopreserved (161 CC, 211 GR, 101 LR), 173 died from disease (52 CC, 2 GR, 119 LR) and 48 died from other or unknown causes (15 CC, 14 GR, 19 LR). The cause of death for an additional two fish has not yet been determined (1 CC, 1 LR) and four LR fish were unaccounted for. No fish died from experimental procedures.

1997 Cohort

There are 248, 264 and 226 salmon remaining alive from Catherine Creek and Grande Ronde River and Lostine River stocks, respectively. A total of 582 fish were removed from the captive population in 2000 (202 CC, 176 GR, 204 LR). Of these, 401 were spawned or had semen cryopreserved (123 CC, 154 GR, 124 LR), 120 died from disease (68 CC, 6 GR, 46 LR), 38 died from other or unknown causes (5 CC, 13 GR, 20 LR) and the cause of death for 16 fish (1 CC, 3 GR, 12 LR) has not yet been determined. No fish died from experimental procedures. Seven fish (5 CC, 2 LR) were unaccounted for.

1998 Cohort

There are 449, 473 and 390 fish remaining alive from Catherine Creek and Grande Ronde and Lostine rivers, respectively. A total of 166 fish were removed from the population in 2000 (43 CC, 20 GR, 103 LR). Of these, 108 were spawned or had semen cryopreserved (22 CC, 10 GR, 76 LR), 19 died from disease (7 CC, 7 GR, 5 LR) and 39 fish died from other or unknown cause (14 CC, 3 GR, 22 LR). No fish died from experimental procedures. Two fish were unaccounted for (1 GR, 1 LR).

Due to numerous water supply problems at LFH, all 1998 cohort fish (492 CC, 493 GR, 495 LR) were transferred to BOH on 2 and 4 February. All 1998 cohort fish (1,474) were inventoried and vaccinated for vibrio from 3-5 April 2000. No salinity tolerance tests were conducted on captive broodstock in 2000 due to the successful transfer of sentinel fish to MML in the three previous years. Following successful transfer of ten fish from each stock on 9 May, all remaining Saltwater Natural fish were transferred to MML on 17 May: a total of 485 fish (162 CC, 164 GR, 159 LR).

From 17-20 July 2000, all 964 fish at BOH and 481 fish at MML were tagged with Visual Implant (VI) tags: 326 Catherine Creek, 321 Grande Ronde River and 317 Lostine River fish were tagged at BOH and 162 Catherine Creek, 164 Grande Ronde River and 155 Lostine River fish were tagged at MML. At this time, each fish was checked for maturity and injected with erythromycin. One hundred ten fish were maturing (23 CC, 10 GR, 77 LR).

1999 Cohort

As in previous years, chinook salmon parr were collected during August 2000 using a technique that combines snorkeling to locate and herd fish and seining to capture then. Using this method, 503 spring chinook salmon parr from Catherine Creek and 500 from the Lostine River were collected for the Captive Broodstock project (Table 1). Three CC parr died at LFH within 24 hours of collection resulting in 500 CC fish being held for program purposes.

No fish were collected from the upper Grande Ronde River. Efforts to collect upper Grande Ronde River parr included pre-collection surveys of all normal collection areas and known cold water refugia lower in the river. Collection activities in the upper Grande Ronde River included all normal collection areas and the reach through the Vey Ranch. Later attempts to collect outmigrating GR parr in a screw trap at Spool Cart during September and October also failed to produce any fish.

During each day of collection, all collected fish were transferred to LFH, anesthetized with

Table 1. Take and disposition of 1999 cohort spring chinook salmon taken to Lookingglass Hatchery for captive broodstock in 2000.

	Stock	
Activity	Catherine Creek	Lostine River
Collection dates	14-16 August	21-23 August
Number collected	503	500
Number transported	503	500
Number ponded	503	500
Number PIT tagged and genetic samples taken	497	496
Number on station 31 December 2000	497	495

40-50 ppm MS-222, measured for lengths and weights (Table 2) and given an intraperitoneal injection of erythromycin at a rate of 20mg/kg body weight. These fish were allowed to recover and were then randomly assigned to treatment groups (Freshwater Natural, Freshwater Accelerated or Saltwater Natural) and placed in troughs according to stock (CC, GR or LR) and treatment group.

Approximately three months following collection, all fish were again weighed and measured, 134.2 kHz PIT tags were implanted and fin samples taken for genetic analysis. Prior to tagging, fish were collected from each trough and anesthetized with 40-50 ppm MS-222. Fish were tagged using needles sterilized in 70% ethanol for a minimum of ten minutes. Within one week of PIT-tagging, eight lost PIT tags were recovered from the captive brood troughs (1 CC, 7 LR).

Of the original 1,003 fish collected 992 fish were still alive at LFH as of 31 December 2000; 497 fish from Catherine Creek and 495 from Lostine River (Table 1). Of the 11 fish removed from the population and three CC fish died soon after transfer to LFH. Six fish died from other or unknown causes (3 CC, 3 LR). No fish died from experimental procedures. Two Lostine River fish are unaccounted for.

Table 2. Mean fork length (FL) and weight (W) and number of fish sampled (N) of 1999 cohort spring chinook salmon captive broodstock at time of capture and PIT-tagging, 2000.

	Stock							
	Catherine Creek				Lostine River			
Activity	Date	N	FL	W	Date	N	FL	W
Capture	14-16 August	502	77.2	5.3	21-23 August	498	83.3	6.8
Tagging	20-21 November	500	101.2	12.7	20-21 November	496	101.9	13.0

F_1 Generation Production

1998 Cohort

The 1998 cohort of F_1's was transferred from Lookingglass Fish Hatchery to acclimation sites in February/March 2000. Approximately 74,474 were released: 37,980 into Catherine Creek in April, 34,986 into Lostine River in April and 1,508 into Grande Ronde River in March.

1999 Cohort

The 1999 cohort of F_1's was transferred from Irrigon Fish Hatchery to Lookingglass Fish Hatchery in April 2000. Approximately 295,784 spring chinook salmon were transferred: 149,698 Catherine Creek stock, 143,478 Lostine River stock and 2,608 Grande Ronde River stock.

2) Monitoring and Evaluation of Captive Broodstock Program

Growth

Methods

Fork length and weight were measured on captive fish during inventories, maturity sortings, samplings and transfers. Once maturity sortings started (late May for 1994-97 cohorts and mid-July for 1998 cohort), only those fish classified as immature were examined and measured. Comparisons of measured fork length for nonspawning fish with targeted fork length can be found in Tables 3-8.

Captive Broodstock

A general trend in growth, as measured by fork length, has developed over the past five years. In the 1994-1998 cohorts, all stocks of fish reared under natural growth regimes have achieved actual fork lengths that closely approximated the targeted fork lengths at smoltification. Freshwater Accelerated groups, however, have been considerably smaller than their targeted lengths, remaining similar to the natural growth target lengths. However, four months after smolting all stocks and treatments of fish have been considerably shorter than their respective targeted lengths. To date, the program has been unable to achieve growth to targeted lengths beyond the smolt stage.

1994 Cohort

Fork length was monitored for both Freshwater Natural and Saltwater Natural treatments of Catherine Creek and Lostine River fish; Grande Ronde River fish were reared only under a Freshwater Natural regime, due to low numbers of fish captured (Table 3). For the first seven to eight months following collection, all stocks closely approximated the targeted length. Within four months following smoltification, (August 1996) all groups were shorter than the targeted length, ranging from 80% (GR) to 88% (CC) of the target. Over the next four years the disparity between targeted and actual fork length continued to increase. By August 1999 (age 5), all remaining fish ranged from 50% to 57% of their respective target lengths. There are no targeted lengths for captive broodstock fish surviving beyond age 5. There was only one immature fish sampled after May 2000.

1995 Cohort

At collection, 1995 cohort parr were approximately 99% of their targeted length for both Catherine Creek and Lostine River stocks (Table 4). No 1995 cohort fish were collected from Grande Ronde River. At smoltification, eight months following collection, lengths attained by all stocks reared under Freshwater Natural and Saltwater Natural treatment regimes approximated targeted lengths: 93% to 95% of the target. However, fish reared under the Freshwater Accelerated growth regime ranged from 68% to 72% of their targeted length. Four months following smoltification (August 1997) the disparity between actual and targeted lengths had

Table 3. Target and mean fork length (FL, mm) and sample size (n) of 1994 cohort spring chinook salmon captive broodstock from Catherine Creek, Lostine River and Grande Ronde River raised under Saltwater natural and Freshwater Natural growth regimes, August 1995 – May 2000.

		Catherine Creek				Lostine River				Grande Ronde River	
	Target	Saltwater		Freshwater		Saltwater		Freshwater		Freshwater	
Date	FL	FL	n	FL	n	FL	n	FL	n	FL	n
AUG 1995	80	81.9	498	81.9	498	69	499	69	499	--	--
SEP 1995	89	93.3	485	93.3	485	80.7	502	80.7	502	90.3	99
OCT 1995	96	101.4	50	101.4	50	99.9	50	99.9	50	97.8	109
NOV 1995	101	108.9	51	108.9	51	103.1	50	103.1	50	101.5	50
DEC 1995	104	107.1	50	107.1	50	107.2	50	107.2	50	103.8	50
JAN 1996	107	111.6	51	111.6	51	112	52	112	52	111.6	50
FEB 1996	112	118	50	118	50	115.7	50	115.7	50	114.1	51
MAR 1996	119	127.2	47	127.2	47	122.7	48	122.7	48	124.8	52
MAY 1996	--	140.3	53	81.9	498	69	499	69	499	--	--
JUL 1996	--	--	--	187.4	310	80.7	502	80.7	502	171.5	103
AUG 1996	220	191.9	163	192.5	298	182.5	149	190.6	273	175	99
JUL 1997	--	354	139	315.5	256	332.1	121	320.2	234	291	67
AUG 1997	480	355.2	102	323.8	253	334.1	103	329.1	232	298.2	67
SEP 1997	--	--	--	338.5	225	--	--	341.6	203	--	--
OCT 1997	--	--	--	353.3	192	--	--	358.6	144	324.4	61
NOV 1997	--	393.8	100	--	--	375.4	97	--	--	--	--
MAR 1998	--	454.3	25	399.6	34	425.3	24	418.2	120	378.6	28
JUN 1998	---	455.5	87	427	180	432.8	86	453.4	78	406.2	22
JUL 1998	--	428.5	42	419.2	124	421.8	67	462.5	59	408.4	19
AUG 1998	730	436.2	41	429.1	120	412.8	50	459.2	43	421.7	12
DEC 1998	--	459.3	37	472	105	433.4	43	509	29	449	8
MAR 1999	820	483.8	37	501.9	101	467.9	42	554.2	26	468.9	8
MAY 1999	--	446	11	502.6	54	424	14	587.9	17	471.2	6
AUG 1999	870	449.8	11	492.4	7	431.9	10	--	--	--	--
DEC 1999	--	456.8	10	490.7	9	407.5	4	--	--	--	--
MAR 1999	--	467.3	7	514.1	8	422	3	--	--	--	--
MAY 2000	--	485.3	6	542	8	430.3	3	--	--	--	--

Table 4. Target and mean fork length (FL, mm) and sample size (n) of 1995 cohort spring chinook salmon captive broodstock from Catherine Creek and Lostine River raised under Freshwater Accelerated, Freshwater Natural and Saltwater Natural growth regimes, August 1996 – December 2000.

			Catherine Creek						Lostine River					
	Target FL		Saltwater Natural		Freshwater Natural		Freshwater Accelerated		Saltwater Natural		Freshwater Natural		Freshwater Accelerated	
Date	Natural	Accel-erated	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n
AUG 1996	80	80	85.2	496	85.2	496	85.2	496	79	481	79	481	79	481
SEP 1996	89	93	87.3	167	87.1	165	89.6	160	87.5	159	87	160	88.4	156
DEC 1996	104	133	101.6	25	101.7	27	111.8	25	103.1	25	102.2	25	103.7	25
JAN 1997	107	146	107.8	27	105.5	28	108.7	26	104	28	105.6	26	108.5	31
APR/MAY 1997	128	186	120.6	167	121.5	164	126.6	158	118.7	159	120.3	159	133.7	152
JUL 1997	--	--	--	--	142.9	163	147.9	154	--	--	142.8	155	162	148
AUG 1997	220	278	149.3	120	155.2	143	152	138	158.9	142	158.5	149	170.9	137
SEP 1997	--	--	171.9	112	--	--	--	--	185.4	137	--	--	--	--
DEC 1997	--	--	227	28	--	--	--	--	242.3	34	--	--	--	--
MAR 1998	--	--	259	26	262.5	40	249	37	280.6	35	272.5	37	273.9	38
JUN 1998	--	--	292.9	98	287.9	138	262.7	129	314	129	333.7	144	323.1	113
JUL 1998	--	--	297.3	75	290.5	116	270.7	125	315.9	93	335.2	118	329.3	106
AUG 1998	480	538	302.9	76	304.2	109	280.8	105	322.8	79	346.6	115	334.4	90
DEC 1998	--	--	353.7	73	379.3	87	362.2	61	364.4	69	412.4	78	390.3	44
MAR 1999	620	678	392.1	72	434.6	85	412.8	54	409.8	64	463.4	74	437.4	40
MAY 1999	--	--	399.2	47	445.6	57	427.1	43	415.9	33	500.5	66	470.9	38
AUG 1999	730	788	417.3	40	439.5	29	412.4	18	439.2	20	483.5	12	440.3	8
NOV/DEC 1999	--	--	441.9	36	471.3	28	443.3	18	458	18	493.4	8	469.5	6
MAR 2000	820	878	483.3	25	509.3	27	490.1	17	480.9	16	554.6	8	555.8	5
MAY 2000	--	--	475.2	30	535.2	27	497.8	16	500.1	14	596.9	7	530.7	3
AUG 2000	870	928	425	4	473	3	407.5	2	--	--	--	--	--	--
DEC 2000	--	--	434.7	3	496.7	3	475.3	3	578	1	--	--	--	--

increased with natural growth fish being about 71% and accelerated growth about 58% of their respective targeted lengths. Over the next three years this disparity between actual and targeted length increased. In August 2000 natural growth groups averaged 52% and accelerated growth groups averaged 47% of their respective targeted lengths. Sample size at that time, however, was very small; seven natural growth fish and two Freshwater Accelerated growth fish.

1996 Cohort

At collection, 1996 cohort parr were approximately 96%, 102% and 74% of the mean length of previously captured fish from Catherine Creek, Lostine River and Grande Ronde River stocks, respectively (Table 5). At smoltification, approximately eight months following collection, all Freshwater and Saltwater Natural groups closely approximated targeted lengths: 95% of their target. Freshwater Accelerated growth groups, however, were only slightly larger than natural growth groups and considerably smaller than the targeted lengths, averaging 77% of their targeted length. Four months following smoltification (August 1998) the disparity between actual and targeted lengths for all groups increased to 86% of the targeted length for Freshwater Natural and Saltwater Natural and 73% of the targeted length for Freshwater Accelerated. Over the next two years the disparity between actual and targeted lengths continued, so that by August 2000 the natural growth groups averaged 71% and Freshwater Accelerated groups averaged 66% of targeted lengths.

1997 Cohort

At collection, 1997 cohort parr were approximately 96% of their targeted length for Catherine Creek and Lostine River stocks and 73% for the Grande Ronde River stock (Table 6). At smoltification, approximately eight months following collection, the lengths attained by all Freshwater and Saltwater Natural groups closely approximated the targeted lengths: 102% of the targeted length. Freshwater Accelerated growth groups, however, were slightly smaller than natural growth groups and considerably smaller than the targeted lengths, averaging 69% of their targeted length. Four months following smoltification (August 1999) growth of all natural growth groups decreased, achieving only 89% of targeted length. The disparity between actual and targeted lengths for Freshwater Accelerated growth groups increased during the same period, to 65% of the targeted length. Over the next year the disparity between actual and targeted lengths continued so that by August 2000 the natural growth groups averaged 85% and Freshwater Accelerated groups averaged 72% of targeted lengths.

1998 Cohort

Due to water supply problems at Lookingglass Hatchery there was no difference in water temperatures between Natural and Freshwater Accelerated growth groups and therefore no separation in growth rates. At collection, 1998 cohort parr from the Catherine Creek and Lostine River stocks were approximately 94% of their targeted length and Grande Ronde River fish were 75% of their targeted length (Table 7). During PIT-tagging in early November, parr from Catherine Creek and Lostine River stocks were approximately 103% of their targeted length and Grande Ronde River fish were 98% of their targeted length. At smoltification, approximately eight months following collection, Grande Ronde River fish had caught up with the other two stocks and all natural growth groups closely approximated the targeted lengths: 98% of the target. Three months following smoltification (July 2000) the disparity between actual and targeted lengths for all groups increased to 85% of targeted length.

Table 5. Target and mean fork length (FL, mm) and sample size (n) of 1996 cohort spring chinook salmon captive broodstock from Catherine Creek, Lostine River and Grande Ronde River raised under Freshwater Accelerated, Freshwater Natural and Saltwater Natural growth regimes, August 1997 -December 2000.

			Catherine Creek						Lostine River						Grande Ronde River					
	Target FL		Saltwater Natural		Freshwater Natural		Freshwater Accelerate		Saltwater Natural		Freshwater Natural		Freshwater Accelerate		Saltwater Natural		Freshwater Natural		Freshwater Accelerate	
Date	Nat-ural	Accel-	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n
AUG 1997	80	80	76.8	49	76.8	49	76.8	49	81.4	121	81.4	121	81.4	121	--	--	--	--	--	--
SEP 1997	89	93	--	--	--	--	--	--	--	--	--	--	--	--	65.6	115	65.6	115	65.6	115
OCT 1997	96	107	90.4	167	87.3	168	89.4	163	95.7	167	94	156	92.4	167	77.3	165	79.3	162	77.7	164
DEC 1997	104	133	104.6	25	102.7	25	106.6	25	102.5	25	102.4	25	104.5	25	92.9	25	94	25	95.1	25
JAN 1998	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	25
APR 1998	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 1998	220	278	178.4	159	205	166	204.9	162	173.1	160	194.5	164	200.1	164	183.4	158	197.2	165	200.1	165
SEP 1998	--	--	194.5	158	231.9	166	231.4	162	188	153	221	163	224.3	158	202.9	153	221.1	165	222.4	165
DEC 1998	--	--	271.1	36	308.8	43	306.2	38	264	37	320.1	43	314	37	278.4	36	297.6	36	296.2	45
APR 1999	--	--	331.9	38	402.9	45	393.5	35	322.3	33	382.4	39	375.9	43	331.7	38	384.1	44	368.5	37
MAY 1999	--	--	339.8	121	392.9	110	389.9	114	335.8	123	387.4	128	384.8	124	345.1	104	370.7	116	369.4	132
AUG 1999	480	538	377.8	30	421.7	25	409.7	25	361.7	30	404.1	28	412.3	23	378.5	30	391	24	388.1	26
DEC 1999	--	--	416.8	29	475.6	30	477.1	27	412	23	472.2	26	454.7	37	429.6	25	434	30	425.2	37
MAR 2000	620	678	447.8	26	--	75	--	77	443.3	71	545.2	33	527.3	29	507.5	25	496.6	24	502	26
MAY/JUN 2000	--	--	479	110	548.5	72	534.8	74	472.1	61	555.8	74	542.6	77	505.3	91	526.6	82	521.5	88
AUG 2000	730	788	472	25	561.1	11	547.7	17	438.4	17	529.1	11	524.6	8	479.1	23	487.1	8	486.3	12
DEC 2000	--	--	494.7	33	592.3	11	569.4	17	460.1	9	543.6	8	527.7	7	506.6	21	510.1	8	503.7	12

Table 6. Target and mean fork length (FL, mm) and sample size (n) of 1997 cohort spring chinook salmon captive broodstock from Catherine Creek, Lostine River and Grande Ronde River raised under Freshwater Accelerated, Freshwater Natural and Saltwater Natural growth regimes, August 1998 – December 2000.

			Catherine Creek						Lostine River						Grande Ronde River					
	Target FL		Freshwater Accelerated		Freshwater Natural		Freshwater Accelerated		Freshwater Accelerated		Freshwater Natural		Freshwater Accelerated		Freshwater Accelerated		Freshwater Natural		Freshwater Accelerated	
Date	Natural	Accelerated	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n
AUG 1998	80	80	76.1	167	75.7	167	77.7	166	75.9	167	76.9	167	76.5	166	--	---	--	---	--	---
SEP 1998	89	93	--	---	--	---	--	---	--	---	--	---	--	---	65.4	166	64.4	167	64.9	167
OCT 1998	96	107	93.5	165	96.6	167	97	164	95.2	163	95	167	95.7	166	87.7	167	86.2	167	86.3	165
DEC 1998	104	133	99.9	164	101.8	166	105.8	164	96.8	42	98	42	103.4	42	97	42	95.1	42	99.6	42
APR 1999	128	186	132.7	158	130.4	164	129.3	161	128.7	161	126.6	164	126.9	165	134.2	168	133.8	165	131.1	164
AUG 1999	220	278	205	150	187.3	151	182.3	147	196.8	142	187	147	178.2	140	209.2	153	193.8	149	183.1	147
DEC 1999	--	--	304.8	39	280.5	39	277.1	42	299.2	40	282.6	38	272.3	41	323	42	289.9	37	282.8	38
MAR 2000	--	--	359.4	35	343.4	38	342.3	38	332.9	38	358.9	36	339.8	36	373.1	37	361.3	36	362	36
MAY 2000	--	--	382.5	150	367.3	140	360.3	143	368.8	129	374.5	143	364.3	138	392.1	150	384.7	140	375.3	143
AUG 2000	480	538	408.1	29	406	25	381.9	25	393.4	26	396.6	25	383.5	24	431.4	25	403.4	25	392.8	24
DEC 2000	--	--	444.1	109	449.8	74	443.9	64	431.7	57	440.7	76	436.6	92	475.3	89	458.2	85	467.8	90

Table 7. Target and mean fork length (FL, mm) and sample size (n) of 1998 cohort spring chinook salmon captive broodstock from Catherine Creek, Lostine River and Grande Ronde River, August 1999 – December 2000.

			Catherine Creek				Lostine River				Grande Ronde River			
	Target FL		Saltwater		Freshwater		Saltwater		Freshwater		Saltwater		Freshwater	
Date	Natural	Accel-erated	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n
AUG 1999	80	80	75.1	500	75.1	500	74.6	498	74.6	498	60	500	60	500
NOV 1999	101	120	104.4	492	104.4	492	104.6	498	104.6	498	98.5	495	98.5	495
FEB 2000			109.2	492	109.2	492	107	495	107	495	101.9	493	101.9	493
APR 2000	128	186	127	165	128.3	326	124.9	163	124.5	327	124.1	165	123	328
JUL 2000	220[a]	278[a]	189	162	188	326	189	155	187	317	189	164	186	321
SEP 2000			240.4	30	--	--	237.8	30	--	--	243.7	30	--	--
DEC 2000			302.8	116	296	303	299.1	121	291.5	271	308	162	298.9	311

[a] Target fork lengths are for August 2000.

Table 8. Target and mean fork length (FL, mm) and sample size (n) of 1999 cohort spring chinook salmon captive broodstock from Catherine Creek and Lostine River raised under Freshwater Accelerated, Freshwater Natural and Saltwater Natural growth regimes, August 2000 – November 2000.

			Catherine Creek						Lostine River					
	Target FL		Saltwater Natural		Freshwater Natural		Freshwater Accelerated		Saltwater Natural		Freshwater Natural		Freshwater Accelerated	
Date	Natural	Accel-erated	FL	n	FL	n	FL	n	FL	n	FL	n	FL	n
AUG 2000	80	80	76.9	168	77.3	168	77.4	167	83.7	167	83.4	166	82.6	167
NOV 2000	101	120	100.8	167	99.8	166	103.1	167	101.3	166	102.4	165	102.1	165

1999 Cohort

At collection, 1999 cohort parr were approximately 97% and 104% of their targeted length for Catherine Creek and Lostine River stocks, respectively (Table 8). No 1999 cohort fish were collected from Grande Ronde River in 2000. During PIT-tagging in mid-November 2000, parr from natural growth groups were approximately 99% and 101% of their targeted length for Catherine Creek and Lostine River fish. Freshwater Accelerated fish averaged 86% of their targeted length. Although the Freshwater Accelerated group does not appear to be reaching its targeted length at age, we do appear to be getting a significant separation in size between fish in the natural and accelerated growth regimes, as we planned but were unable to do with previous cohorts.

F_1 Generation

1998 Cohort

The 1998 cohort of the captive broodstock F_1 generation was released in April 2000 at a mean size that approximated that of wild spring chinook salmon smolts in the Grande Ronde Basin (Table 9). Catherine Creek smolts had a mean length of 123.2 mm and mean weight of 21.8 g. Mean length and weight of the Lostine River fish were 121.1 mm and 21.7 g, respectively. The Grande Ronde River fish were the largest stock, with mean length and weight of 127.1 mm and 23.3 mm, respectively. The increased size of the Grande Ronde fish is likely due to low density in the raceway, since only 1508 fish were released.

Table 9. Mean, minimum, maximum and standard deviation (SD) of length and weight at time of release (April 2000) of 1998 cohort F_1 generation captive broodstock spring chinook salmon from Catherine Creek, Lostine River and Grande Ronde River.

	Length (mm)				Weight (g)			
Stock	Mean	Min	Max	SD	Mean	Min	Max	SD
Catherine Creek	123.2	74	174	12.8	21.8	11	40.8	6.7
Lostine River	121.1	67	187	11.9	21.7	5.5	42	6.5
Grande Ronde River	127.1	69	182	12.4	23.3	12.6	41.4	6.1

1999 Cohort

The 1999 cohort of the captive broodstock F_1 generation was sampled in April and May 2000 (Table 10). The Catherine Creek spring chinook salmon were a mean of 54.9 mm and 1.74 g in April and 68.2 mm and 3.61 g in May 2000. The Lostine River fish were a mean of 53.8 mm and 1.69 g and 66.5 mm and 3.67 g in April and May, respectively. As was seen in the 1998 cohort, the Grande Ronde River fish are also the largest stock with mean lengths and weights of 54.9 and 68.2 mm and 1.74 and 3.61 g in April and May 200, respectively. However, the increased size of the Grande Ronde fish is likely due to low density in the raceway, since only 2560 fish were released.

Table 10. Mean, minimum, maximum and standard deviation (SD) of length and weight at samples in April and May 2000 of 1999 cohort F_1 generation captive broodstock spring chinook salmon from Catherine Creek, Lostine River and Grande Ronde River.

	Length (mm)				Weight (g)			
Stock	Mean	Min	Max	SD	Mean	Min	Max	SD
				21 April 2000				
Catherine Creek	54.9	41	63	3.7	1.74	0.6	2.7	0.44
Lostine River	53.8	39	63	4.5	1.69	0.4	2.8	0.62
Grande Ronde River	58.5	42	68	3.7	2.29	1.2	3.1	0.42
				26 May 2000				
Catherine Creek	68.2	50	80	4.8	3.61	1.8	5.7	0.81
Lostine River	66.5	47	80	4.7	3.67	2.2	5.7	0.75
Grande Ronde River	73.2	55	85	3.9	5.07	3.2	7.0	0.83
				October 2000				
Catherine Creek	117.7	72	177	10.5	19.28	6.4	57.8	4.94
Lostine River	115.4	75	179	8.5	18.62	5.1	48.3	4.31
Grande Ronde River	131.0	87	174	13.1	26.49	9.9	40.7	6.29

Fish Health Monitoring and Disease

Captive Broodstock

The primary cause of mortality among the captive broodstock in 2000 was bacterial kidney disease (BKD) caused by *Renibacterium salmoninarum*. We implemented new measures to control the effects of BKD among the captive broodstock including vaccination with a new BKD vaccine and culling of eggs from females with high BKD titers (BKD ELISA >1.0). Though our program has exceeded some production goals and not suffered the catastrophic losses to BKD observed in some other captive broodstock programs, BKD continues to have a significant impact on both the numbers and genetic diversity of our broodstock. Since BKD is transmitted vertically through infected eggs its impact continues into the F_1 generation causing losses and potentially impacting survival after release. We continue to seek new techniques and therapies to control BKD among the captive broodstock both to benefit our program and to share what we learn with other captive broodstock programs.

We also found that *R. salmoninarum* was causing mortality among the captive broodstock without the classic signs of bacterial kidney disease. A set of consistently observed disease symptoms was classified as "enlarged hindgut syndrome" (EHS). The most obvious and consistent signs included, an enlarged hindgut, vasodilatation of the hindgut and abdominal cavity and inflammation of the meninges. Additional signs included pinpoint hemorrhages of the eye, inflammation of the pseudobranch, inflammation of the tissue lining the optic nerve canal and gill hemorrhage. Fish with EHS were often observed to suddenly lose equilibrium, after which they survived for periods ranging from one day to many weeks. These symptoms were observed both in fish with no kidney lesions (or clinical levels of BKD antigen when examined by BKD ELISA)

and fish with classical BKD pustules. Samples of the inflamed meninges examined with gram-stain and BKD DFAT revealed the presence of *R . salmoninarum*. In one case histological sections of the enlarged hindgut also revealed the presence of *R. salmoninarum*. Thus, it appears that EHS is another manifestation of disease caused by *R. salmoninarum*. Other researchers (Hoffmann et al. 1984; Speare et al. 1993) have also noted *R. salmoninarum* infections of the meninges, optic nerve and eye. It has also been proposed that the meninges may be infected via the eye. The bacteria first infects the eye and then moves up the optic nerve and into the brain cavity (Speare et al. 1993).

The 1998 and 1999 cohorts of captive brood pre-smolts were vaccinated with an experimental BKD vaccine, Renogen, manufactured by Aqua Health Ltd. It has been tested on both laboratory and commercial populations of salmon in Canada and was recently approved for use by Canadian regulatory authorities. The vaccine employs live bacteria (*Arthrobacter* sp.), closely related to *R. salmoninarum*, to immunize the fish against BKD. The vaccine appeared to be safe, with no unusual losses observed after vaccination, except in precocial males. After the 1999 cohort was vaccinated, *Arthrobacter* sp. was recovered from two dead precocial males. Aqua Health Ltd. confirmed that they had also observed some mortality among precocious males after vaccination. Precocial males are typically immune-suppressed and so were probably unable to clear the *Arthrobacter* sp. from their bodies. In studies of normal fish it has been shown that no *Arthrobacter* sp. is detectable after 3-4 weeks. The loss of a small number of precocial males does not represent a significant threat to the Captive Broodstock Program. These fish were vaccinated in November and there was little chance that the precocial males would have survived to spawn the following September. Since they were immunosupressed it is likely that they would have died of some other disease (probably BKD) and acted as a source of infection for the rest of the cohort. All fish in each cohort were injected, thus there is no control group for comparison, so it is difficult to assess the effectiveness of the vaccine. In previous cohorts significant losses to BKD did not begin until 12-15 months post-capture. Since we are just entering this period for the 1998 cohort it is still too early to make a valid comparison of losses due to BKD with earlier cohorts.

Bonneville Fish Hatchery

The leading cause of mortality at BOH was BKD, in the form of low-level chronic loss and small epizootics (Table 11). Fish lost to senescence are mature fish that died before being spawned, no specific pathogen was identified and it was assumed that death was the result of the general physical decline associated with maturation. Wasting is seen in immature fish that become emaciated even though presented with feed. We detected some intestinal parasites, such as *Hexamita* sp., in a few of the wasting mortalities. It was unclear if the parasitic infestation was the cause of the fish's poor condition or if the fish's poor condition was a result of parasitic infection.

Manchester Marine Laboratory

The majority of mortalities at MML rearing site were due to BKD (Table 12). Surprisingly, the Grand Ronde River stock suffered no BKD losses at MML during 2000. There continue to be large numbers of mortalities of unknown etiology occurring at MML. Some mortalities showed signs of bacterial septicemia but no pathogen was isolated. A few mortalities with stomachs bloated with water were observed as well as one mortality with food impacted in the intestine.

Table 11. Causes of mortality in captive broodstock spring chinook salmon at Bonneville Hatchery, 1 January – 31 December 2000.

Stock / Cohort	Bacterial Kidney Disease: Typical kidney pathology	Bacterial Kidney Disease: Enlarged hindgut syndrome	Senescence[a]	*Aeromonas/ Pseudomonas* Septicemia	Handling	Wasting[b]	*Hexamita* sp.	Trauma	Unknown	Fungus	Total
Catherine Creek											
1994	8	0	1	0	0	0	0	0	0	0	9
1995	13	0	0	1	0	0	0	0	0	0	14
1996	29	0	2	0	0	0	0	0	2	0	33
1997	64	5	0	0	0	0	0	0	5	0	74
1998	3	3	0	2	0	1	0	1	12	0	22
Total	117	8	3	3	0	1	0	1	19	0	152
Grande Ronde River											
1996	1	0	1	0	0	1	0	0	4	0	7
1997	1	5	0	0	0	0	0	0	4	0	10
1998	0	1	0	3	0	2	3	0	1	0	10
Total	2	6	1	3	0	3	3	0	9	0	27
Lostine River											
1994	0	0	0	0	0	0	0	0	0	1	1
1995	9	0	0	0	0	0	0	0	0	0	9
1996	95	3	0	1	0	0	0	0	2	0	101
1997	4	5	3	0	0	0	0	0	4	0	16
1998	0	0	0	3	1	11	1	0	7	0	23
Total	2	6	1	3	0	3	3	0	9	0	27
Grand Total	227	22	7	10	1	15	4	1	41	1	329
Percentage of Total Mortalities	69.0	6.7	2.1	3.0	0.3	4.6	1.2	0.3	12.5	0.3	
	All BKD	75.7									

[a] Senescence: fish which were sexually mature but died before being spawned, assumed to be due to the general physical decline that is associated with sexually maturity in *Oncorhynchus* spp.
[b] Wasting: immature fish showing signs of starvation (ample amounts of food were presented to all fish)

Table 12. Causes of mortality in captive broodstock spring chinook salmon at Manchester Marine Laboratory, 1 January – 31 December 2000.

Stock / Cohort	BKD	Unknown	UBS[a]	Bloat	Precocious	*Flexibacter* sp.	Totals
Catherine Creek							
1994	4	0	0	0	0	0	4
1995	8	1	0	0	0	0	9
1996	26	4	0	2	0	0	32
1997	0	0	1	0	0	0	1
1998	0	0	0	0	0	0	0
Total	38	5	1	2	0	0	46
Grande Ronde River							
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	5	1	1	0	0	7
1997	0	11	0	1	0	0	12
1998	0	0	0	0	0	0	0
Total	0	16	1	2	0	0	19
Lostine River							
1994	0	1	0	0	0	0	1
1995	7	0	0	0	0	0	7
1996	22	6	1	4	0	1	34
1997	54	8	2	0	0	0	64
1998	1	1	0	0	1	0	3
Total	84	16	3	4	1	1	109
Grand total	122	37	5	8	1	1	174
Percentage of total mortalities	70.1	21.3	2.9	4.6	0.6	0.6	

[a] Unidentified bacterial septicemia: fish that showed signs of bacterial septicemia but no pathogen was isolated.

Lookingglass Fish Hatchery

Only a few mortalities have occurred among the 1999 captive brood cohort at LFH (Table 13). No pathogens were detected among any mortalities. This continues the previously observed pattern of very low losses to pathogens during the first year of captivity. The four vaccination-related mortalities were precociously mature males (discussed above).

Table 13. Causes of mortality among 1999 cohort captive broodstock spring chinook salmon at Lookingglass Fish Hatchery, 1 January – 31 December 2000.

	Handling	Jumpout	Dropout	Vaccination	Unknown	Totals
Catherine Creek	3			4[a]		7
Grande Ronde River						0
Lostine River		1	1		1	3
Totals	3	1	1	4[a]	1	10

[a] Precocious males

F_1 Generation

La Grande fish pathology personnel monitored the progeny of captive brood spawned in 1998 and 1999 for fish health. Three spring chinook stocks were monitored: Lostine River, Catherine Creek and Grande Ronde River. The 1999 cohort was monitored at Lookingglass Hatchery in January and February 2000 and at acclimation sites, prior to release. The 1999 cohort was monitored initially at Irrigon Fish Hatchery where the BY99 F_1's were initially ponded and given one 21-day erythromycin (Aquamycin) medicated feeding prior to transfer to Lookingglass Fish Hatchery. Monitoring of this cohort continued at Lookingglass Hatchery during April-December 2000. A scheduled second 28-day Aquamycin medicated feeding was given in July/August.

The main disease problem with the 1999 cohort was bacterial kidney disease (BKD) which was manifested by increased loss in raceways containing progeny from moderate/clinical BKD females. However, external cold water disease bacteria infections (flexibacteriosis) and external fungus were other significant disease findings. There were no increased loss problems with the 1998 cohort captive brood progeny.

1998 Cohort

Only one case of clinical bacterial kidney disease was found in all three of these stocks: one of 24 (4.2%) Catherine Creek mortalities. This fish was from raceway 18 (BKD segregation raceway). The remaining 23 mortalities/moribund and 69 grab-sampled fish from Catherine Creek all had ELISA values ≤0.140 OD units. There were no cases of clinical BKD in the Lostine River stock at Lookingglass Hatchery or at the acclimation site. All 20 mortalities/moribund fish and 66 grab-sampled Lostine River fish examined in 2000 had low ELISA values (≤0.141 OD units). One Grande Ronde River mortality at Lookingglass Hatchery and four post hauling mortalities from the Grande Ronde acclimation site all had values ≤0.132 OD units. Ten grab-sampled Grande Ronde fish all had ELISA values ≤0.124 OD units.

Erythrocytic inclusion body syndrome (EIBS) inclusions were not detected in any of these fish. All samples tested for virus or replicating agents were negative. There were no significant bacterial fish pathogens detected in kidney cultures in 2000. Gill wet mounts of grab-sampled fish during monthly monitoring and at preliberation revealed areas of bumpy gill tips and hyperplasia. Seven of 16 (43.7%) grab-sampled Catherine Creek fish at the preliberation examination had moderate to heavy bumpy gill tips with low-level hyperplasia. Four of 16 (25.0%) grab-sampled Lostine River fish at the preliberation examination had moderate to heavy bumpy gill tips with low-level hyperplasia. Histological analysis of gill tissue was conducted by Dr. Jerry Heidel (OSU Veterinary Diagnostic Laboratory) on two fish with bumpy gill tips from the Catherine Creek acclimation site. He found mild to extensive cell hyperplasia as well as

scattered, mixed inflammatory cells on gills from these fish. The histopathology report said these gill changes could be associated with infectious agents, water chemistry or chemical or physical irritants. The external parasites *Ambiphrya* (*Scyphidia*) and *Epistylus* were detected in wet mount microscopy of body scrapings at various levels but not on gills during monthly monitoring and preliberation examinations in 2000.

1999 Cohort

A pre-transfer examination on 23 March 2000 at Irrigon Fish Hatchery revealed the presence of *Renibacterium salmoninarum* (*Rs*) by the direct fluorescent antibody test (DFAT) at high to clinical levels in 2/3 (66.6%) of the mortalities/moribund Catherine Creek and 3/7 (42.8%) Lostine River fry that were progeny of clinical females. This was the beginning of what continued to be a problem at Lookingglass Fish Hatchery throughout 2000 in the high-risk progeny from clinical BKD females. Due to space limitations the progeny from moderate level females were mixed with progeny from clinical females at LFH.

The first examinations of these fish at LFH were in response to increased loss (early April 2000). Severe tail erosion was observed in 90% of mortalities/moribund fish examined (late April) and *Flavobacterium psychrophilum* (cold water disease bacteria) were isolated from these tail erosion lesions. This loss was attributed to delayed onset of external bacterial infection (flexibacteriosis) causing these tails to erode following the stressful process of being transferred from Irrigon Fish Hatchery to Lookingglass Fish Hatchery.

Routine monthly monitoring activities began at LFH in May 2000. Infectious hematopoietic necrosis virus (IHNV) and other culturable viruses were not detected through December 2000. However patterns developed revealing the prevalence of BKD by raceway, which generally showed a correlation with maternal BKD levels (Table 14). Increased loss due to BKD in Lostine River (raceways 6 and 7) and Catherine Creek (raceways 10 and 11) fish (most were progeny of moderate/clinical females) followed the coded wire tagging/adipose fin clipping process in June 2000. External fungus was also observed following marking especially in raceway 10 (Catherine Creek). Peak losses due to BKD occurred in early July in raceways 10 and 11, where losses were as high as 0.5-1.0%/day and in raceways 6 and 7 (Lostine River) with losses at 0.4%/day. Following Aquamycin-medicated feeding, losses dropped to around 0.04%/day for raceways10 and 11 and around 0.02%/day for raceways 6 and 7. These data support what is known regarding *Rs* and the known mechanism of vertical transmission (parent to progeny) within the egg.

3) Measures Taken to Minimize Disturbance to ESA-listed Fish

Collections

Juvenile spring chinook salmon are collected from the wild as parr using a method that employs snorkelers to find and herd fish into a seine. This method of fish capture reduces habitat disturbance, stress of all captured fish and capture of nontarget fish, such as adult chinook salmon and juvenile steelehead, which may be found in the same area of stream. Several protocols are employed to reduce disturbance to nontarget ESA-listed fish. The use of snorkelers means that sampling is conducted only in sites where juvenile chinook salmon are seen, which reduces the number of sampling efforts and nontarget catch. Snorkelers herd chinook salmon into the net and avoid chasing other species, further reducing nontarget catch. Chinook salmon parr are then quickly netted out of the seine and placed in a 19L bucket and all nontarget fish are then

Table 14. Number and percentage of total mortalities and percentage of mortalities with clinical BKD in each raceway / BKD segregation group of 1999 cohort F_1 spring chinook salmon from Lostine River, Grande Ronde River and Catherine Creek stocks, 2000.

		Total mortality		Clinical BKD (ELISA OD ≥ 1.000)		
Raceway	BKD segregation	Number	Percent	Number checked	Number infected	Percent
			Lostine River			
2	Low	158	0.46	16	0	0
3	Mod/Clinical	125	0.62	22	9	40.9
4	Low	113	0.33	21	1	4.8
5	Low/Mod/Clinical	106	0.73	24	10	41.7
6	Mod/Clinical	2177	11.62	20	20	100
7	Mod/Clinical	2201	12.42	27	27	100
			Grande Ronde River			
8	Low/Mod	12	0.46	7	0	0
			Catherine Creek			
9	Low/Mod/Clinical	118	0.49	26	2	7.7
10	Mod/Clinical	6362	26.62	30	29	96.7
11	Low/Mod/Clinical	2486	10.44	40	38	95.0
12	Low	102	0.40	24	1	4.2
13	Low	68	0.26	20	0	0
14	Low	70	0.28	25	0	0

immediately released at the site of capture. If adult chinook salmon are seen, the snorkelers immediately leave the water and move to a new site.

Captive Broodstock Rearing

We are now using the new PITTag2 program (NMFS), which has increased efficiency during data collection and decreased fish handling time. All data recorded during various fish handling activities (e.g., sampling, sorting, inventorying and spawning) were transferred into the new program.

Also, one early (June or July) maturity sort at BOH and MML was eliminated because it was found to be unnecessary. This also allowed us to further decrease fish handling.

Lastly, preliminary evidence shows that the BKD vaccine given to 1998 cohort and 1999 fish may be reducing BKD outbreaks. This will reduce the amount of erythromycin treatment given to the fish, both by injection and feeding, thus improving feeding of the fish.

4) Spawning Activities

Fish from the 1994-1997 cohorts were first examined for signs of maturity on 24-26 May 2000 at BOH and MML. The 1998 cohort fish were first examined for signs of maturity on 17-20 July 2000 at BOH and MML (1999 cohort fish were not checked for maturity). Additional maturity sorts were conducted for each cohort and stock based on guidelines in the 2000 Captive Broodstock Annual Operating Plan (AOP). Maturity data includes all fish which were assumed to be maturing whether they survived to gamete collection, died prior to gamete collection or were later determined to be immature and returned to immature tanks. Following the final maturity sort in mid-August, maturing fish were examined for ripeness at BOH approximately weekly from 16 August - 12 October 2000. No ripe sorts were done at MML, since all mature fish were transferred to BOH.

Gametes were collected from the 1994 –1998 cohorts in 2000. Males in excess of those needed to spawn had their semen collected and cryopreserved. Approximately one-half of these samples are being stored at BOH and the other half at the regional repository at the University of Idaho, Moscow.

All spawning was done using spawning matrices developed following guidelines identified in the 2000 Captive Broodstock AOP and modifications to these guidelines following TOT recommendations in early September (Table 15). One hundred eighty-seven spawning matrices were used in 2000.

Table 15. Spawning categories with associated sex ratios and spawning matrices used for spawning in the Captive Broodstock Program.

Spawn Category	Spawning Population Sex Ratio (Female / Male)	Spawning Ratio (F:M)	Spawning Criteria and Comments
A	X > 77.5 / 22.5	4 : 1	4 x 4; 1 fresh, and 12 cryo (1 fresh with 3 cryo / female) 50% eggs w/ fresh
B	77.5 / 22.5 ≥ X > 69.5 / 30.5	3 : 1	3 x 4; 1 fresh, and 9 cryo (1 fresh with 3 cryo / female) 50% eggs w / fresh
C	69.5 / 30.5 ≥ X > 63.0 / 37.0	2 : 1	2 x 4; 1 fresh, and 6 cryo (1 fresh with 3 cryo / female) 50% eggs w / fresh
D	63.0 / 37.0 ≥ X > 58.5 / 41.5	3 : 2	Matrix matches spawning matrix ratio
E	58.5 / 41.5 ≥ X > 55.0 / 45.0	4 : 3	Matrix matches spawning matrix ratio
F	55.0 / 45.0 ≥ x > 45.0 / 55.0	1 : 1	Matrix matches spawning matrix ratio
G	45.0 / 55.0 ≥ X > 41.5 / 58.5	3 : 4	Matrix matches spawning matrix ratio
H	41.5 / 58.5 ≥ X > 37.0 / 63.0	2 : 3	Matrix matches spawning matrix ratio
I	37.0 / 63.0 ≥ X > 27.0 / 73.0	1 : 2	Matrix matches spawning matrix ratio
J	27.0 / 73.0 ≥ X > 22.5 / 77.5	1 : 3	Matrix matches spawning matrix ratio
K	22.5 / 77.5 ≥ X	1 : 4	Matrix matches spawning matrix ratio

1994 Cohort

Fifteen fish from the 1994 cohort were determined to be maturing during 2000 and seven ripened and were spawned (Tables 16 and 17). The remaining eight fish died prior to gamete collection. No fish had their semen cryopreserved. All seven spawned fish were females. Cryopreserved semen from 33 males of this cohort was used with females from different cohorts. A total of 8,221 eggs were collected; an average fecundity of 1,174 eggs / female. Of the eggs collected 4,429 (53.9%) survived to the eyed stage (Table 18).

1995 Cohort

Eighty-one 1995 cohort fish were determined to be maturing during maturity sorts: 57 of these fish ripened and were spawned and none had semen cryopreserved (Tables 19 and 20). Of the remaining 24 fish, 21 died prior to spawning and three never ripened and were returned to their respective immature tanks. Of the spawned fish, there were 56 females and one male.

Cryopreserved semen from 10 males was used to fertilize eggs from females of other cohorts. A total of 80,804 eggs were collected; an average fecundity of 1,443 eggs per female. Of the eggs collected 50,618 (62.6%) survived to the eyed stage (Table 21).

1996 Cohort

A total of 547 1996 cohort fish were determined to be maturing during maturity sorting: 473 were spawned and none had semen cryopreserved (Tables 22 and 23). Of the remaining 74 fish, 67 died prior to spawning, five were unaccounted for and two never ripened and were returned to their respective treatment group immature tanks. Of the spawned fish, 395 were females and 78 were males. Cryopreserved semen was used from nine 1995 cohort males to fertilize eggs from females of other cohorts. A total of 668,863 eggs were collected; an average fecundity of 1,693 eggs per female. Of the eggs collected 544,498 (81.4%) survived to the eyed stage (Table 24).

1997 Cohort

A total of 422 fish from the 1997 cohort were determined to be maturing during maturity sorts: 400 were spawned and two had semen cryopreserved (Tables 25 and 26). Of the remaining 20 fish, 17 died prior to spawning, two never ripened and were returned to their respective immature tanks and one was unaccounted for. All fish spawned were males. Cryopreserved semen was used from five 1997 cohort males for females from different cohorts.

1998 Cohort

One hundred ten 1998 cohort males were determined to be maturing during maturity sorts: 101 were spawned and 7 had semen cryopreserved (Tables 27 and 28). The remaining two fish died prior to spawning.

1999 Cohort

No maturity sorting or spawning of BY1999 fish occurred during 2000.

Table 16. Number of 1994 cohort spring chinook salmon of each stock reared at Bonneville Fish Hatchery (freshwater) and Manchester Marine Laboratory (saltwater) sorted as maturing in 2000.

			Treatment	
Sorting Date	Location	Stock	Freshwater Natural	Saltwater Natural
22 May	Bonneville			
		Catherine Creek	8	
		Lostine River	0	
		Grande Ronde	0	
25 May	Manchester			
		Catherine Creek		5
		Lostine River		2
Totals				
	Total Catherine Creek		8	5
	Total Lostine River		0	2
	Total Grande Ronde River		0	0
Grand Total			8	7

Table 17. Mean fork length and weight of spawners and number spawned / semen cryopreserved of 1994 cohort spring chinook salmon for each stock, treatment and sex, 2000.

Stock	Treatment	Sex	N	Mean FL (mm)	Mean Wt (g)	Spawned	Semen cryo-preserved
Catherine Creek							
	FN	M	0	--	--	0	0
		F	5	571.2	2,491.2	5	0
	SN	M	0	--	--	0	0
		F	0	--	--	0	0
	Total CC					5	0
Lostine River							
	FN	M	0	--	--	0	0
		F	0	--	--	0	0
	SN	M	0	--	--	0	0
		F	2	443.5	896.4	2	0
	Total LR					2	0
Grande Ronde River							
	FN	M	0	--	--	0	0
		F	0	--	--	0	0
	SN	M	0	--	--	0	0
		F	0	--	--	0	0
	Total GR					0	0
Total 1994 cohort fish contributing gametes						7	0

Table 18. Total number of females and eggs collected from 1994 cohort spring chinook salmon and mean fecundity, total number surviving to eyed stage, mean eyed eggs / female and mean percentage of eggs surviving to eyed stage in each stock and treatment during 2000 spawning.

Stock / Treatment	N	Total Collected	Mean Fecundity	Number surviving to eyed stage	Mean number surviving to eyed stage	Mean percentage surviving to eyed stage
Catherine Creek						
FN	4	6,436	1,609	3,780	945	58.7
SN	0	--	--	--	--	--
Lostine River						
FN	0	--	--	--	--	--
SN	3	1,785	595	649	216	36.3
Grand Ronde River						
FN	0	--	--	--	--	--
Totals						
Total FN	4	6,436	1,609	3,780	945	58.7
Total SN	3	1,785	595	649	216	36.3
Grand Total	7	8,221	1,174	4,429	633	53.9

Table 19. Number of 1995 cohort spring chinook salmon of each stock reared at Bonneville Fish Hatchery (BOH: freshwater) and Manchester Marine Laboratory (MML: saltwater) sorted as maturing in 2000.

		Treatment			
Sorting Date / Location	Stock	Freshwater Accelerated	Freshwater Natural	Saltwater Natural	Unknown
22-25 May / Manchester Marine Lab					
	Catherine Creek			22	0
	Lostine River			6	0
22-25 May / Bonneville Fish Hatchery					
	Catherine Creek	7	16		0
	Lostine River	0	0		0
21 June / Manchester Marine Lab					
	Catherine Creek			0	0
	Lostine River			5	0
5-6 July / Bonneville Fish Hatchery					
	Catherine Creek	5	8		0
	Lostine River	3	7		0
15-16 August / Bonneville Fish Hatchery					
	Catherine Creek	2	0		0
	Lostine River	0	0		0
Totals					
	Catherine Creek Total	14	24	22	0
	Lostine River Total	3	7	11	0
Grand total		17	31	33	0

Table 20. Mean fork length and weight of spawners and number spawned / semen cryopreserved of 1995 cohort spring chinook salmon for each stock, treatment and sex, 2000.

Stock	Treatment	Sex	N	Mean FL (mm)	Mean Wt (g)	Spawned	Semen cryo-preserved
Catherine Creek							
	FN	M	0	--	--	0	0
		F	22	548.6	2,334.3	22	0
	SN	M	1	459.0	1,248.1	1	0
		F	9	488.9	1,315.7	9	0
	FA	M	0	--	--	0	0
		F	11	515.8	1,857.2	11	0
	Total					43	0
Lostine River							
	FN	M	0	--	--	0	0
		F	5	570.8	2,494.0	5	0
	SN	M	0	--	--	0	0
		F	7	537.0	2,056.9	7	0
	FA	M	0	--	--	0	0
		F	2	528.0	2,209.5	2	0
	Total					14	0
Total 1995 cohort fish contributing gametes						57	0

Table 21. Total number of females spawned and eggs collected from 1995 cohort spring chinook salmon and mean fecundity, total number surviving to eyed stage, mean eyed eggs / female and mean percentage of eggs surviving to eyed stage in each stock and treatment during 2000 spawning.

Stock	Treatment	N	Total eggs collected	Mean fecundity	Total number to eyed stage	Mean number to eyed stage	Mean percentage surviving to eyed stage
Catherine Creek							
	FN	22	37,995	1,725	19,147	870	50.4
	SN	9	10,210	1,134	4,959	551	48.6
	FA	11	12,725	1,157	11,346	1,031	81.0
	Total	42	60,930	1451	35,452	844	58.2
Lostine River							
	FN	5	6,779	1,356	5,349	1,070	78.9
	SN	7	11,678	1,668	9,488	1,355	81.2
	FA	2	1,417	709	329	165	23.2
	Total	14	19,874	1420	15,166	1083	76.3
Totals							
	Total FN	27	44,774	1,658	24,496	907	54.7
	Total SN	16	21,888	1,368	14,447	903	66.0
	Total FA	13	14,142	1,088	11,675	898	82.3
Grand Total		56	80,804	1,443	50,618	904	62.6

Table 22. Number of 1996 cohort spring chinook salmon of each stock reared at Bonneville Fish Hatchery (freshwater) and Manchester Marine Laboratory (saltwater) sorted as maturing in 2000.

	Treatment			
Sorting Date / Location / Stock	Freshwater Accelerated	Freshwater Natural	Saltwater Natural	Unknown
22-25 May / Manchester Marine Lab				
Catherine Creek			52	0
Lostine River			28	0
Grande Ronde River			67	0
22-25 May / Bonneville Fish Hatchery				
Catherine Creek	0	0		0
Lostine River	0	0		0
Grande Ronde River	37	43		0
7 June / Bonneville Fish Hatchery				
Catherine Creek	49	53		0
Lostine River	43	43		0
Grande Ronde River	0	0		0
21 June / Manchester Marine Lab				
Catherine Creek			1	0
Lostine River			5	0
Grande Ronde River			0	0
5-6 July / Bonneville Fish Hatchery				
Catherine Creek	5	6		0
Lostine River	24	16		0
Grande Ronde River	39	31		0
15-16 August / Bonneville Fish Hatchery				
Catherine Creek	2	2		0
Lostine River	0	1		0
Grande Ronde River	0	0		0
Totals				
Catherine Creek Total	56	61	53	0
Lostine River Total	67	60	33	0
Grande Ronde River Total	76	74	67	0
Grand Total	199	195	153	0

Table 23. Mean fork length and weight of spawners and number spawned / semen cryopreserved of 1996 cohort spring chinook salmon for each stock, treatment and sex, 2000.

Stock	Treatment	Sex	N	Mean FL (mm)	Mean Weight (g)	Spawned	Semen cryo-preserved
Catherine Creek							
	FN	M	4	461.3	1,369.4	4	0
		F	54	559.7	2,331.8	54	0
	SN	M	22	485.6	1,423.3	22	0
		F	26	533.0	1,975.1	26	0
	FA	M	5	505.6	1,644.4	5	0
		F	50	550.6	3,159.4	50	0
	Total					161	0
Lostine River							
	FN	M	6	533.8	1.888.8	6	0
		F	26	561.3	2,346.1	26	0
	SN	M	9	482.7	1,324.5	9	0
		F	17	519.7	1,909.4	17	0
	FA	M	9	514.9	1,951.1	9	0
		F	34	552.2	2,226.6	34	0
	Total					101	0
Grande Ronde River							
	FN	M	8	517.0	1,836.1	8	0
		F	63	539.8	2,134.3	63	0
	SN	M	8	506.3	1.609.8	8	0
		F	59	518.2	1,886.3	59	0
	FA	M	7	531.6	1,919.3	7	0
		F	66	528.2	2,634.9	66	0
						211	0
Total 1996 cohort fish contributing gametes						473	0

Table 24. Total number of females spawned and eggs collected from 1996 cohort spring chinook salmon and mean fecundity, total number surviving to eyed stage, mean eyed eggs / female and mean percentage of eggs surviving to eyed stage in each stock and treatment during 2000 spawning.

Stock	Treatment	N	Total collected	Mean fecundity	Number surviving to eyed stage	Mean number surviving to eyed stage	Mean percentage surviving to eyed stage
Catherine Creek							
	FN	54	99,618	1,845	79,068	1,464	79.3
	SN	26	44,714	1,720	33,881	1,303	75.8
	FA	50	86,708	1,734	79,081	1,582	91.2
	Total	130	231,040	1,777	192,030	1,477	83.1
Lostine River							
	FN	26	53,312	2,0580	37,099	1,427	69.6
	SN	17	28,491	1,676	18,481	1,087	64.9
	FA	34	53,721	1,580	40,815	1,202	76.1
	Total	77	135,524	1760	96,395	1,252	71.1
Grande Ronde River							
	FN	63	100,308	1,592	86,515	1,373	86.2
	SN	59	99,114	1,680	85,703	1,453	86.5
	FA	66	102,877	1,559	83,795	1,270	81.5
	Total	188	302,299	1,608	256,013	1,362	84.7
Totals							
	Total FN	143	253,238	1,771	202,682	1,417	80.0
	Total SN	102	172,319	1,689	138,065	1,354	80.1
	Total FA	150	243,306	1,622	203,751	1,358	83.7
Grand Total		395	668,863	1,693	544,498	1,378	81.4

Table 25. Number of 1997 cohort spring chinook salmon of each stock reared at Bonneville Fish Hatchery (freshwater) and Manchester Marine Laboratory (saltwater) sorted as maturing in 2000. Note: all fish were males.

	Treatment			
Sorting Date / Location / Stock	Freshwater Accelerated	Freshwater Natural	Saltwater Natural	Unknown
22-25 May / Manchester Marine Lab				
Catherine Creek			37	0
Lostine River			21	0
Grande Ronde River			49	0
22-25 May / Bonneville Fish Hatchery				
Catherine Creek	30	31		0
Lostine River	9	23		0
Grande Ronde River	36	46		0
Unknown Stock	0	0		1
21 June / Manchester Marine Lab				
Catherine Creek			0	0
Lostine River			4	0
Grande Ronde River			0	0
5-6 July / Bonneville Fish Hatchery				
Catherine Creek	15	19		0
Lostine River	34	38		0
Grande Ronde River	18	9		0
15-16 August / Bonneville Fish Hatchery				
Catherine Creek	0	0		0
Lostine River	1	0		0
Grande Ronde River	1	0		0
Totals				
Catherine Creek Total	45	50	37	0
Lostine River Total	44	61	25	0
Grande Ronde River Total	55	55	49	0
Unknown Stocks total	0	0	0	1
Grand Total	144	166	111	1

Table 26. Mean fork length and weight of spawners and number spawned / semen cryopreserved of 1997 cohort spring chinook salmon for each stock and treatment, 2000. Note: all fish were males.

Stock	Treatment	N	Mean FL (mm)	Mean Wt (g)	Spawned	Semen cryo-preserved
Catherine Creek						
	FN	47	408.8	828.5	47	0
	SN	36	406.8	865.7	36	0
	FA	41	397.6	840.0	41	0
	Total				124	0
Lostine River						
	FN	62	429.3	979.2	62	0
	SN	21	410.6	825.4	21	0
	FA	39	432.5	1,045.7	39	2
	Total				122	2
Grande Ronde River						
	FN	53	409.2	882.8	53	0
	SN	49	406.2	869.6	49	0
	FA	51	401.6	844.2	51	0
	Total				154	0
Total 1996 cohort fish contributing gametes					400	2

Table 27. Number of 1998 cohort spring chinook salmon of each stock reared at Bonneville Fish Hatchery (freshwater) and Manchester Marine Laboratory (saltwater) sorted as maturing in 2000. Note: all fish were males.

		Treatment		
Location	Stock	Freshwater	Saltwater	Unknown
Manchester Marine Lab				
	Catherine Creek		6	0
	Lostine River		33	0
	Grande Ronde River		2	0
Bonneville Fish Hatchery				
	Catherine Creek	17		0
	Lostine River	44		0
	Grande Ronde River	8		0
Totals				
	Catherine Creek Total	17	6	0
	Lostine River Total	44	33	0
	Grande Ronde River Total	8	2	0
Grand Total		69	41	0

Table 28. Mean fork length and weight of spawners and number spawned / semen cryopreserved of 1998 cohort spring chinook salmon for each stock and treatment, 2000. Note: all fish were males.

Stock	Treatment	N	Mean FL (mm)	Mean Wt (g)	Spawned	Semen cryo-preserved
Catherine Creek						
	FN	8	208.6	111.8	8	0
	SN	6	196.7	90.3	6	0
	FA	8	206.5	108.9	8	0
	Total				22	0
Lostine River						
	FN	17	204.4	101.8	17	0
	SN	26	197.4	90.3	26	0
	FA	26	203.9	100.2	26	7
	Total				69	7
Grande Ronde River						
	FN	1	191.0	88.0	1	0
	SN	2	197.5	88.1	2	0
	FA	7	205.4	103.6	7	0
	Total				10	0
Total 1998 cohort fish contributing gametes					101	7

5) Problems and Solutions

Bacterial Kidney Disease (BKD) and Associated Problems

Problems continue to be experienced with outbreaks of BKD in various groups of fish and with attempts to prevent BKD. Treatments have included erythromycin injections, erythromycin pills and Aquamycin-treated feed. In April 2000, all 1998 cohort fish were given an injection of an experimental BKD vaccine, Renogen. The 1999 cohort parr were vaccinated during PIT tagging in November 2000. If successful this vaccine should reduce BKD loss and reduce the amount of handling that is associated with erythromycin injections. It may also aid in achieving growth separation between natural and accelerated growth regimes by reducing the need for medicated feed treatments.

To further reduce the incidence of BKD in the Captive Broodstock Program, Oregon's Technical Oversight Team (TOT) made two decisions regarding culling of eggs. The first allows fish culture, health and research personnel to cull eggs, prior to fertilization, from females showing gross external and internal symptoms of BKD (e.g., lesions, bleeding, etc.). The second allows the culling of embryos from females exhibiting clinical BKD ELISA values ($\geq$0.80) to reduce horizontal transmission of BKD into the F_1 generation. We anticipate that this action will dramatically reduce the incidence and horizontal transmission of BKD in the F_1 generation, thus improving the health of these stocks. However, culling of whole egg lots reduces the genetic

diversity of the F_1 generation, so further work is needed to define the threat of horizontal BKD transmission to captive broodstock progeny and wild fish upon their release.

Inability to Achieve Temperature Separation and Treatment Objectives

Due to a variety of water supply and chiller problems at Lookingglass Hatchery in 1999 resulted we were unable to achieve temperature separation between the natural vs. accelerated treatments. This also resulted in the transfer of pre-smolts from LFH to BOH two months early (2-4 February 2000), the second year in a row that this scenario has had to be employed.

The water supply and chiller problems at LFH appear to have been fixed for the 1999 cohort and water temperature is different between natural and accelerated treatment groups. This has resulted in a significant difference in growth between these pre-smolt treatments for the first time. The TOT has also decided to eliminate the February medicated (erythromycin) feed treatment to further increase separation in size between natural and accelerated growth groups. Therefore, it appears that the 1999 cohort fish will be the first cohort to achieve the separation between the natural and accelerated growth treatment groups called for in our AOP.

Database Management

The captive broodstock database is expanding rapidly. New cohorts are being added to the program each year. Also, increased numbers of spawning fish and the complexity of spawning matirices have increased time demands for data entry, editing and tracking. Lastly, an increasing number of persons/agencies require access to the database or data summaries. These factors have resulted in the necessity to convert our present myriad of individual databases (mostly in Excel format) to a relational database (Access format). This conversion process was begun in November 2000 by program personnel and is expected to be completed by June 2000. The new database will allow read-only access to those needing the data for analyses and to develop quick summaries for various reports.

6) Hatchery Mortalities

Summaries of annual mortalities of Captive Broodstock fish by cohort and stock can be found in Tables 29-34. A complete fish health monitoring report can be found in the Fish Health Monitoring and Disease section of this report.

Captive Broodstock

1994 Cohort

A total of 498, 110 and 499 1994 cohort fish were collected from Catherine Creek, Grande Ronde River and Lostine River, respectively, in August and September 1995. As of 31 December 2000, there were no fish remaining alive from any stock of 1994 cohort fish (Table 29). Of the 1,107 fish collected, 614 (55.5%) were spawned or had semen cryopreserved (361 CC, 29 GR, 224 LR). The remaining 493 fish died prior to spawning: 171 (15.4% of collected fish) from disease (41 CC, 31 GR, 99 LR); 310 (28.0%) from other or unknown causes (93 CC, 50 GR, 167 LR) and 12 (1.1%) from experimental procedures (3 CC, 9 LR).

1995 Cohort

A total of 500 Catherine Creek and 481 Lostine River 1995 cohort fish were collected during August and September 1996. No 1995 cohort fish were collected from Grande Ronde

Table 29. Number of 1994 cohort spring chinook salmon of the Catherine Creek, Lostine River and Grande Ronde River stocks removed from the captive population each year due to gamete collection (Gam), disease (Dis), experimental (Exp), other causes and total and number remaining alive through 31 December 2000.

	Treatement									
	Saltwater Natural					Freshwater Natural				
Year	Gam	Dis	Exp	Other	Total	Gam	Dis	Exp	Other	Total
					Catherine Creek					
1995	0	0	0	2	2	0	0	0	8	8
1996	3	0	3	10	16	32	0	0	27	59
1997	46	0	0	10	56	58	0	0	11	69
1998	44	3	0	13	60	59	21	0	5	85
1999	27	1	0	2	30	87	5	0	4	96
2000	0	7	0	1	8	5	4	0	0	9
Total removed	120	11	3	38	172	241	30	0	55	326
		0 remaining alive					0 remaining alive			
					Lostine River					
1995	0	0	0	0	0	0	0	0	53	53
1996	0	0	9	15	24	22	0	0	13	35
1997	19	0	0	32	51	79	1	0	18	98
1998	35	1	0	17	53	27	79	0	8	114
1999	16	13	0	10	39	24	4	0	0	28
2000	2	1	0	1	4	0	0	0	0	0
Total removed	72	15	9	75	171	152	84	0	92	328
		0 remaining alive					0 remaining alive			
					Grande Ronde River					
1995						0	0	0	2	2
1996						7	0	0	28	35
1997	insufficient number of fish were					13	5	0	16	34
1998	captured - no Saltwater Natural group					5	23	0	3	31
1999	was created					4	3	0	1	8
2000						0	0	0	0	0
Total removed						29	31	0	50	110
							0 remaining alive			

Table 30. Number of 1995 cohort spring chinook salmon of the Catherine Creek and Lostine River stocks removed from the captive population each year due to gamete collection (Gam), disease (Dis), experimental (Exp), other causes (Oth) and total (Tot) and number remaining alive through 31 December 2000. Note: No 1995 cohort fish were collected from the Grande Ronde River.

	Treatment														
	Saltwater Natural					Freshwater Natural					Freshwater Accelerated				
Year	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot
							Catherine Creek								
1996	0	0	0	0	0	0	0	0	1	1	0	0	0	6	6
1997	2	0	10	46	58	7	0	0	13	20	6	0	0	14	20
1998	25	2	0	7	34	42	12	0	4	58	14	59	0	9	82
1999	18	12	0	8	38	48	11	0	1	60	27	9	0	5	41
2000	10	17	0	4	31	22	2	0	1	25	11	4	0	0	15
Total removed	55	31	10	65	161	119	25	0	20	164	58	72	0	34	164
	6 remaining alive					3 remaining alive					2 remaining alive				
							Lostine River								
1996	0	0	0	2	2	0	0	0	1	1	0	0	0	4	4
1997	6	0	10	8	24	9	0	0	5	14	6	0	0	12	18
1998	44	11	0	12	67	53	10	0	3	66	23	65	0	6	94
1999	32	9	0	10	51	53	15	0	2	70	28	11	0	0	39
2000	7	8	0	1	16	5	3	0	0	8	2	3	0	0	5
Total removed	89	28	10	33	160	120	28	0	11	159	59	79	0	22	160
	1 remaining alive					1 remaining alive					0 remaining alive				

Note: Two Catherine Creek Saltwater natural fish unaccounted for in 1999.
One Lostine River Freshwater natural fish unaccounted for in 2000.

River. As of 31 December 2000, there were 9 Catherine Creek and 1 Lostine River fish remaining alive (Table 30). Of the 971 fish removed from the captive population, 500 (51.5% of the collected fish) were spawned or had semen cryopreserved (232 CC, 268 LR), 263 (27.1%) died from disease (128 CC, 135 LR) and 185 (19.1%) died from other or unknown causes (119 CC, 66 LR). Twenty fish (2.1%) died from experimental procedures (10 CC, 10 LR) and 3 (0.3%) fish (2 CC, 1 LR) are unaccounted for.

1996 Cohort

A total of 500 1996 cohort parr were collected from each of Catherine Creek and Grande Ronde River and 501 were collected from Lostine River. As of 31 December 2000, there were 55, 41 and 24 fish remaining alive from Catherine Creek, Grande Ronde River and Lostine River, respectively (Table 31). Of the 1381 fish removed from the captive population, 923 (61.5% of the fish collected) were spawned (319 CC, 358 GR, 246 LR), 219 (14.6%) died from disease (68 CC, 18 GR, 133 LR), 234 (15.6%) fish died from other or unknown causes (58 CC, 83 GR, 93 LR) and 5 (0.3%) Lostine River fish were unaccounted for. No fish died from experimental procedures.

Table 31. Number of 1996 cohort spring chinook salmon of the Catherine Creek, Lostine River and Grande Ronde River stocks removed from the captive population each year due to gamete collection (Gam), disease (Dis), experimental (Exp), other causes (Oth) and total (Tot) and number remaining alive through 31 December 2000.

	Treatment														
	Saltwater Natural					Freshwater Natural					Freshwater Accelerated				
Year	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot
							Catherine Creek								
1997	0	0	0	1	1	0	0	0	0	0	0	0	0	2	2
1998	2	0	0	10	12	5	0	0	2	7	5	1	0	1	7
1999	34	2	0	4	40	59	6	0	9	74	53	7	0	13	73
2000	48	25	0	13	86	58	15	0	3	76	55	12	0	0	67
Total removed	84	27	0	28	139	122	21	0	14	157	113	20	0	16	149
	28 remaining alive					10 remaining alive					17 remaining alive				
							Lostine River								
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	8	1	0	6	15	7	0	0	5	12	16	1	0	6	23
1999	39	5	0	26	70	50	2	0	7	59	25	5	0	24	54
2000	26	24	0	19	69	32	57	0	0	89	43	38	0	0	81
Total removed	73	30	0	51	154	89	59	0	12	160	84	44	0	30	158
	13 remaining alive					7 remaining alive					9 remaining alive				
							Grande Ronde River								
1997	0	0	0	1	1	0	0	0	2	2	0	0	0	2	2
1998	0	0	0	14	14	4	0	0	0	4	7	1	0	1	9
1999	30	1	0	24	55	63	5	0	10	78	43	1	0	23	67
2000	67	8	0	0	75	71	1	0	3	75	73	1	0	3	77
Total removed	97	9	0	39	145	138	6	0	15	159	123	3	0	29	155
	21 remaining alive					8 remaining alive					12 remaining alive				

Note: Five Lostine River fish unaccounted for in 1998: 2 Saltwater Natural, 2 Freshwater Natural and 1 Freshwater Accelerated.

1997 Cohort

Five hundred spring chinook salmon parr were collected from each of the three stock streams during August and September 1998. As of 31 December 2000, there were 248, 264 and 226 fish remaining alive from Catherine Creek and Grande Ronde River and Lostine River stocks, respectively (Table 32). Of the 762 fish which have been removed from the captive population, 513 (34.2%) were spawned or had semen cryopreserved (148 CC, 194 GR, 171 LR), 136 (9.1%) died from disease (76 CC, 6 GR, 54 LR), 106 (7.1%) from other or unknown causes (25 CC, 34

GR, 47 LR) and seven fish (0.5%; 3 CC, 2 GR, 2 LR) are unaccounted for. No fish died from undetermined causes or from experimental procedures.

Table 32. Number of 1997 cohort spring chinook salmon removed of the Catherine Creek, Lostine River and Grande Ronde River stocks from the captive population each year due to gamete collection (Gam), disease (Dis), experimental (Exp), other causes (Oth) and total (Tot) and number remaining alive through 31 December 2000.

Year	Treatment														
	Saltwater Natural					Freshwater Natural					Freshwater Accelerated				
	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot
								Catherine Creek							
1998	0	2	0	1	3	0	0	0	1	1	0	0	0	3	3
1999	7	6	0	1	14	7	0	0	8	15	10	0	0	5	15
2000	36	0	0	2	38	47	26	0	1	74	40	38	0	3	81
Total removed	43	8	0	4	55	54	26	0	10	90	50	38	0	11	99
			112	alive				77	alive				68	alive	
								Lostine River							
1998	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0
1999	16	2	0	3	21	12	3	0	7	22	19	2	0	2	23
2000	21	39	0	25	85	62	3	0	3	68	41	4	0	3	48
Total removed	37	41	0	31	109	74	6	0	10	90	60	6	0	5	71
			57	alive				78	alive				96	alive	
								Grande Ronde River							
1998	0	0	0	0	0	0	1	0	0	1	0	0	0	2	2
1999	11	0	0	4	15	13	0	0	8	21	16	0	0	3	19
2000	49	0	0	13	62	54	3	0	2	59	51	2	0	2	55
Total removed	60	0	0	17	77	67	4	0	10	81	67	2	0	7	76
			90	alive				86	alive				91	alive	

Note: One fish unaccounted for in each of the Catherine Creek Saltwater Natural, Freshwater Natural and Freshwater Accelerated treatments in 1998.
Two Lostine River mortalities from unknown treatments (no PIT tag recovered) in 1999: 1 due to disease and 1 from unknown causes.
Two Grande Ronde River mortalities from unknown treatments (no PIT tag recovered).

1998 Cohort

Five hundred spring chinook salmon parr were collected from each of Catherine Creek and Grande Ronde River and 498 from the Lostine River in August and September 1999. As of 31 December 2000, there were 449, 473 and 393 fish remaining alive from Catherine Creek, Grande Ronde River and Lostine River, respectively (Table 33). Of the 183 fish removed from the captive population, 108 (7.2% of the collected fish) were spawned or cryopreserved (22 CC, 10 GR, 76 LR), 19 (1.3%) died from disease (7 CC, 7 GR, 5 LR) and 55 (3.7%) died of other or

unknown causes (22 CC, 9 GR, 24 LR). One Grande Ronde River fish is unaccounted for and no fish died from experimental procedures.

Table 33. Number of 1998 cohort spring chinook salmon of the Catherine Creek, Lostine River and Grande Ronde River stocks removed from the captive population each year due to gamete collection (Gam), disease (Dis), experimental (Exp), other causes and total and number remaining alive through 31 December 2000.

	Treatment									
	Saltwater					Freshwater				
Year	Gam	Dis	Exp	Other	Total	Gam	Dis	Exp	Other	Total
					Catherine Creek					
1999	0	0	0	0	0	0	0	0	0	0
2000	6	1	0	2	9	16	5	0	12	33
Total removed	6	1	0	2	9	16	5	0	12	33
		158 remaining alive					300 remaining alive			
					Lostine River					
1999	0	0	0	0	0	0	0	0	0	0
2000	33	0	0	6	39	43	5	0	10	58
Total removed	33	0	0	6	39	43	5	0	10	58
		127 remaining alive					274 remaining alive			
					Grande Rone River					
1999	0	0	0	0	0	0	0	0	0	0
2000	2	0	0	1	3	1	0	0	0	1
Total removed	2	0	0	1	3	8	7	0	2	17
		164 remaining alive					316 remaining alive			

Note: Nine Catherine Creek mortalities from unknown treatments (no PIT tag recovered): 8 from other causes in 1999 and 1 from disease in 2000.
Eight Lostine River mortalities from unknown treatments (no PIT tag recovered): 3 from other causes in 1999 and 5 from other causes in 2000.
One Grande Ronde Freshwater fish unaccounted for in 2000.
Six Grande Ronde River mortalities from unknown treatments (no PIT tag recovered) from other causes in 1999.

1999 Cohort

In 2000, 503 spring chinook salmon parr were collected from Catherine Creek and 500 from Lostine River during August 2000. Of these, 992 (497 CC, 495 LR) were still alive at LFH as of 31 December 2000 (Table 34). Of the 11 fish removed from the population, three Catherine Creek fish were collection related mortalities, three Catherine Creek, three Lostine River mortalities were from other or unknown causes and two Lostine River fish were unaccounted for at PIT tagging. The three Catherine Creek 'other/unknown' mortalities were all precocial males that died about three weeks following injection with BKD vaccine. No fish died from experimental procedures.

Table 34. Number of 1999 cohort spring chinook salmon of the Catherine Creek and Lostine River stocks removed from the captive population each year due to gamete collection (Gam), disease (Dis), experimental (Exp), other causes (Oth) and total (Tot) and number remaining alive through 31 December 2000. Note: No 1999 cohort fish were collected from the Grande Ronde River.

	Treatment														
	Saltwater Natural					Freshwater Natural					Freshwater Accelerated				
Year	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot	Gam	Dis	Exp	Oth	Tot
								Catherine Creek							
2000	0	0	0	2	2	0	0	0	4	4	0	0	0	0	0
Total removed	0	0	0	2	2	0	0	0	4	4	0	0	0	0	0
	166 remaining alive					164 remaining alive					167 remaining alive				
								Lostine River							
2000	0	0	0	1	1	0	0	0	0	0	0	0	0	2	2
Total removed	0	0	0	1	1	0	0	0	0	0	0	0	0	2	2
	166 remaining alive					166 remaining alive					165 remaining alive				

F_1 Generation

1998 Cohort

The 1998 cohort of F_1's were held at Lookingglass Fish Hatchery from only 1 January until March in 2000. Mortality rates were low during this period for the Catherine Creek and Lostine River fish, but high for the Grande Ronde River fish. A total of 765 (1.8% of the total ponded in 1999) Catherine Creek, 480 (1.2%) Lostine River fish and 82 (4.9%) Grande Ronde River spring chinook salmon died during 2000. A total of 38,009 Catherine Creek, 35,031 Lostine River and 1,512 Grande Ronde River smolts were released in 2000 (Table 35).

Table 35. Total and mean fecundity of female Catherine Creek, Lostine River and Grande Ronde River chinook salmon spawned in 1998 and the number and percentage of the 1998 cohort reaching the eyed, hatch and smolt stage.

	Fecundity		Eyed Eggs		Hatching		Smolts	
Stock	Total eggs	Mean	Total	Percent survival	Total	Percent survival	Total	Percent survival
Catherine Creek	95,178	1,379	47,194	49.6	42,748	44.9	38,009	39.9
Lostine River	65,203	1,387	44,614	68.4	39,878	61.2	35,031	53.7
Grande Ronde River	4,145	1,036	1,855	44.8	1,683	40.6	1,512	36.5

1999 Cohort

Mortalities of the 1999 cohort of F_1's were low in 2000 (Table 36). A total of 16,042 (10.5% of the total ponded) Catherine Creek, 13,188 (8.8%) Lostine River fish and 130 (4.7%) Grande Ronde River spring chinook salmon died during 2000.

Table 36. Number of mortalities in 1999 cohort F_1 generation at Irrigon and Lookingglass fish hatcheries, total mortality in 2000 and percentage mortality of total ponded.

Stock	Irrigon Fish Hatchery	Lookingglass Fish Hatchery	Total mortalities	Percent mortality
Catherine Creek	4,189	11,853	16,042	10.5
Lostine River	5,340	7,848	13,188	8.8
Grande Ronde River	82	48	130	4.7

7) Data Analyses

The following are cursory analyses of the available data to make a preliminary examination of the effect of our treatments on specific indices pertaining to production of chinook salmon in the Captive Broodstock Program. More comprehensive analyses will be conducted when data collection is more complete. However, these analyses can give an overview of how well we are achieving the production goals of the program. When analyzing these data, we have included the Freshwater Accelerated treatment group as a separate entity, although it is very uncertain whether fish in this group often or ever were subjected to presmolt conditions that differed from the "natural" treatment groups.

We compare size of collected parr among stocks and growth among stocks and treatments. Other indices (mortality, survival, age of maturity, size of spawners, fecundity, fertility and egg weight) are compared among treatment groups and ages of fish.

Size at Collection

Size at collection of chinook salmon parr varied with stock and year. Catherine Creek parr (78.8 mm; 6.20 g) were significantly ($P<0.0001$) longer and heavier than both Lostine River (77.3 mm; 5.83 g) and Grande Ronde River (65.3 mm; 3.74 g) parr. Lostine River parr were also significantly longer and heavier than Grande Ronde River parr. However, Grande Ronde River parr had a significantly ($P<0.0001$) higher mean K (1.352) than those from both Catherine Creek (1.236) and the Lostine River (1.231), which did not significantly vary.

Age of Maturity

Age of maturity of males varied with treatment group ($P<0.0001$). Males from the Freshwater Accelerated group matured at an earlier mean age (2.9 years) than those of the Freshwater Natural (3.3 years) and Saltwater Natural treatment groups (3.2 years), which did not differ.

Age of maturity of females varied with treatment group ($P<0.0001$). Females from the Freshwater Accelerated group matured at an earlier mean age (4.1 years) than those of the Freshwater Natural and Saltwater Natural treatment groups (4.5 years, each), which did not differ.

Size of Spawners

Size of male spawners did not vary among treatment groups. Neither length (P=0.1383), weight (P=0.6322) nor K (P=0.1599) varied among the Freshwater Accelerated, Freshwater Natural nor Saltwater Natural treatment groups.

Size of female spawners did vary among treatment groups (P<0.0001). Females in the Saltwater Natural group were smaller (505.5 mm; 1647.0 g) and had lower K (1.23) than females in both the Freshwater Natural (534.1 mm; 2132.6 g; 1.36) and Freshwater Accelerated (533.3 mm; 2058.1 g; 1.33) groups, which did not differ from each other.

Fecundity

Mean fecundity varied among treatments (P<0.0001) but not with age of females (P=0.0559). Mean fecundity was higher in the Freshwater Natural group (1706.4 eggs/female) than either the Freshwater Accelerated (1561.1 eggs) or Saltwater Natural (1504.4 eggs) treatment groups, which were not different from each other. At least a portion of this difference in fecundity is due to differences in size of spawning females among treatment groups: fecundity was positively related to length, weight and K (P<0.0001).

Fertility

The fertilization rate (percent of total eggs that reach the eyed stage) of eggs varied among the treatment groups (P=0.0130). Mean fertility was higher in the Freshwater Accelerated group (79.9%) than either the Freshwater Natural (72.2%) or Saltwater Natural (72.2%) groups, which did not differ.

Mean fertility also varied with the use of fresh vs. cryopreserved semen (P<0.0001). Use of fresh semen resulted in a mean fertilization rate of 75.2%, while using cryopreserved semen resulted in only 33.5% fertilization.

The relationship of spermatocrit vs. fertility was also tested. Mean spermatocrit in the Freshwater Accelerated group (32.9) was higher than either of the other two groups and spermatocrit in the Freshwater Natural group (26.9) was higher than that of the Saltwater Natural group (24.4). However, there was no relationship (P=0.6726) between spermatocrit and fertilization rate.

Egg Weight

Mean weight of eggs varied between treatment groups (P=0.0001) and age of females (P=0.0002). Mean egg weight was less in the Saltwater Natural group (0.192 g) than either the Freshwater Natural (0.216 g) or Freshwater Accelerated (0.213 g) groups, which were not different from each other. Mean egg weight of 6-year old females (0.271 g) was greater than that of either the four-year old (0.207 g) or 5-year old (0.207 g) females, which did not differ. However, there were only seven 6-year old females in this analysis. Egg weight is also positively related to female length, weight and K (P<0.0001).

8) Coordination with Other Researchers

Oregon's Technical Oversight Team (TOT) continued to guide the daily activities associated with the captive broodstock program. The TOT includes personnel from ODFW, NPT, CTUIR and NMFS and had nine regular meetings plus an AOP meeting in 2000. The regional chinook salmon Technical Oversight Committee (TOC) helped coordinate regional work: Tim Hoffnagle is the ODFW representative to the TOC.

9) Spawning Survey Results and Effect of Weirs

No weirs are used with the Captive Broodstock Program.

10) Fish Provided to Educational or Public Outreach Programs

No ESA-listed fish were provided to or displayed at educational or public outreach programs.

References Cited

Hoffmann, R., W. Popp and S. Van de Graaff. 1984. Atypical BKD predominately causing ocular and skin lesions. Bulletin of the European Association of Fish Pathologists 4:7-9.

Speare, D. J., V. E. Ostland and H. W. Ferguson. 1993. Pathology associated with meningoencephalitis during bacterial kidney disease of salmonids. Res. Vet. Sci.: 54(1):25-31.

CONVENTIONAL BROODSTOCK PROJECT

The Conventional Broodstock Project deals with collection of wild adult chinook salmon for spawning and rearing of their progeny for release as smolts. It also involves rearing of the Captive Broodstock F_1 generation to smoltification. 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. This section details adult collection, retention for broodstock, hatchery spawning/gamete collection, rearing of pre-smolts and fish health and disease and problems encountered for the conventional broodstock project of the Grande Ronde Endemic Salmon Conventional Broodstock Program.

1) Activities Conducted

Trap Operations

Adult chinook salmon adults were collected using picket weirs on Catherine Creek, Lostine River and Grand Ronde River (Table 37). The Grande Ronde River trap was opened earliest (24 March 2000) and was run continuously until 31 July 2000. The Catherine Creek trap was opened on 30 March 2000, closed from 5 April-4 May due to high flows and closed for the year on 31 July 2000. The Lostine River trap was opened on 9 May and closed on 1 October 2000.

NMFS criteria for weir and trap facilities were followed in the development of the Lostine River picket weir. Similar trapping arrangements existed at all three sites. The Lostine River weir spans approximately 60 m across the river channel at a 45° angle with tripods spaced 2.4 m apart. The trap is designed with picket wings to guide fish into the trap and with a V-shaped fyke opening to inhibit escape. A resistance board weir was also used for several weeks at the Catherine Creek site and a modified panel weir (using a winch to raise and lower the panels) was used at the Lostine River. The holding cages are placed in an area deep enough to maintain fish

Table 37. Date of capture, marks, sex, fork length (FL, mm), disposition, tag color and number, opercle punch and identification number (ID) of adult spring chinook salmon captured in traps on Lostine River, Catherine Creek and upper Grande Ronde River, 2000.

Date	Marks	Sex	FL	Disposition[1]	Tag Color	Tag Number	Opercle Punch	ID	Notes
Lostine River: trap opened 9 May and closed 1 October 2000									
22 June	None	M	790	P			2 LOP	LR00-01	
23 June	None	M	472	P			2 LOP	LR00-02	
24 June	None	F	726	P			2 LOP	LR00-03	
24 June	None	M	487	P			2 LOP	LR00-04	
25 June	None	M	953	P			2 LOP	LR00-05	
26 June	None	F	537	P			2 LOP	LR00-06	
28 June	None	M	950	P			2 LOP	LR00-07	
29 June	None	F	775	P			2 LOP	LR00-08	
13 July	None	F	850	KS		L11	3 LOP	LR00-09	
13 July	None	M	755	KS		L12	3 LOP	LR00-10	
13 July	None	F	740	KS		L14	3 LOP	LR00-11	
14 July	None	F	780	P			1 LOP	LR00-12	
14 July	None	M	840	KS		L13	3 LOP	LR00-13	
15 July	None	M	841	P			1 LOP	LR00-14	
16 July	None	M	785	P			1 LOP	LR00-15	
16 July	AD	M	597	P			1 LOP	LR00-16	
17 July	None	M	471	KS		L15	3 LOP	LR00-17	
19 July	None	F	705	P			1 LOP	LR00-18	
20 July	None	M	804	P			1 LOP	LR00-19	
20 July	AD	M	603	KS		L16	3 LOP	LR00-20	
21 July	AD	M	591	P			2 LOP	LR00-21	
23 July	None	M	590	P			2 LOP	LR00-22	
29 July	AD	M	545	P			2 LOP	LR00-23	
29 July	AD	M	555	KS		L17	3 LOP	LR00-24	
31 July	None	M	775	KS		L18	3 LOP	LR00-25	
3 Aug	AD	M	576	KS		L19	3 LOP	LR00-26	
4 Aug	None	M	798	KS		L20	3 LOP	LR00-27	
21 Aug	None	M	735	P			2 LOP	LR00-28	
21 Aug	None	F	720	P			2 LOP	LR00-29	
25 Aug	None	M	759	P			2 LOP	LR00-30	
26 Aug	None	M	794	P			2 LOP	LR00-31	
26 Aug	None	M	808	KS		L21	3 LOP	LR00-32	
26 Aug	None	M	805	KS		L22	3 LOP	LR00-33	
26 Aug	AD	M	605	P			2 LOP	LR00-34	
30 Aug	AD	M	530	P			3 LOP	LR00-35	
30 Aug	None	M	753	P			3 LOP	LR00-36	
30 Aug	None	F	795	KS		L23	3 LOP	LR00-37	
31 Aug	None	F	703	KS		L24	3 LOP	LR00-38	

Table 37 continued.

Date	Marks	Sex	FL	Disposition[1]	Tag Color	Tag Number	Opercle Punch	ID	Notes
Lostine River continued									
31 Aug	AD	M	514	P			3 LOP	LR00-39	
31 Aug	None	M	776	P			3 LOP	LR00-40	
31 Aug	AD	M	561	P			3 LOP	LR00-41	
1 Sep	AD	M	600	KS		L25	3 LOP	LR00-42	
1 Sep	None	M	789	KS		L26	3 LOP	LR00-43	
1 Sep	AD	M	575	KS		L27	3 LOP	LR00-44	
1 Sep	None	M	831	KS		L28	3 LOP	LR00-45	
1 Sep	None	F	766	P			3 LOP	LR00-46	
1 Sep	None	F	781	P			3 LOP	LR00-47	
1 Sep	None	F	778	P			3 LOP	LR00-48	
1 Sep	None	F	772	KS		L29	3 LOP	LR00-49	
1 Sep	None	M	545	P			3 LOP	LR00-50	
1 Sep	AD	M	611	P			3 LOP	LR00-51	
1 Sep	None	F	693	KS		L30	3 LOP	LR00-52	
2 Sep	None	M	927	P			3 LOP	LR00-53	
2 Sep	None	M	798	P			3 LOP	LR00-54	
2 Sep	None	F	774	P			3 LOP	LR00-55	
2 Sep	None	F	705	P			3 LOP	LR00-56	
2 Sep	AD	M	534	P			3 LOP	LR00-57	
3 Sep	None	M	790	P			3 LOP	LR00-58	
3 Sep	None	F	752	P			3 LOP	LR00-59	
3 Sep	AD	M	607	P			3 LOP	LR00-60	
3 Sep	None	M	534	KS		L31	3 LOP	LR00-61	
3 Sep	None	M	835	KS		L32	3 LOP	LR00-62	
3 Sep	AD	M	584	KS		L33	3 LOP	LR00-63	
3 Sep	AD	M	675	P			3 LOP	LR00-64	
3 Sep	None	M	777	KS		L34	3 LOP	LR00-65	
4 Sep	None	M	528	P			3 LOP	LR00-66	
4 Sep	AD	M	584	KS		L35	3 LOP	LR00-67	
4 Sep	AD	M	614	KS		L36	3 LOP	LR00-68	
4 Sep	AD	M	512	P			3 LOP	LR00-69	
4 Sep	AD	M	577	P			3 LOP	LR00-70	
5 Sep	None	M	730	P			3 LOP	LR00-71	
5 Sep	Radio	M	806	KS		L37	3 LOP	LR00-72	
5 Sep	None	F	704	KS		L38	3 LOP	LR00-73	
5 Sep	AD	M	539	P			3 LOP	LR00-74	
5 Sep	AD	M	586	P			3 LOP	LR00-75	
6 Sep	AD	M	585	KS		L39	3 LOP	LR00-76	
6 Sep	AD	M	564	KS		L40	3 LOP	LR00-77	
6 Sep	None	M	770	P			3 LOP	LR00-78	
7 Sep	None	M	782	P			3 LOP	LR00-79	

Table 37 continued.

Date	Marks	Sex	FL	Disposition[a]	Tag Color	Tag Number	Opercle Punch	ID	Notes
Lostine River continued									
7 Sep	None	F	715	KS		L41	3 LOP	LR00-80	
8 Sep	None	M	716	KS		L42	3 LOP	LR00-81	
8 Sep	AD	M	542	P			3 LOP	LR00-82	
10 Sep	None	M	551	P			3 LOP	LR00-83	
10 Sep	AD	M	572	KL			3 LOP	LR00-84	
13 Sep	None	F	795	P			3 LOP	LR00-85	
13 Sep	None	M	800	P			3 LOP	LR00-86	
13 Sep	None	M	785	P			3 LOP	LR00-87	
13 Sep	None	M	700	P			3 LOP	LR00-88	
13 Sep	None	M	534	P			3 LOP	LR00-89	
13 Sep	None	M	530	P			3 LOP	LR00-90	
20 Sep	None	M	775	P			3 LOP	LR00-91	
Catherine Creek: trap opened 30 March, failed 5 April, reopened 4 May, closed 31 July 2000									
22 May	None	U	715	P			1 ROP	CC00-01	
26 May	None	U	735	P			1 ROP	CC00-02	
26 May	None	U	737	P			1 ROP	CC00-03	
28 May	None	U	665	KNS	Blue	713	1 ROP	CC00-04	
30 May	None	U	690	KNS	Blue	714	1 ROP	CC00-05	
2 June	None	U	723	P			1 ROP	CC00-06	
3 June	None	U	724	P			1 ROP	CC00-07	
3 June	None	U	740	KNS	Blue	716	1 ROP	CC00-08	
5 June	None	U	750	P			1 ROP	CC00-09	
6 June	None	U	800	KNS	Blue	700	1 ROP	CC00-10	
7 June	None	U	735	P			1 ROP	CC00-11	
7 June	None	U	740	KNS	Blue	706	1 ROP	CC00-12	Mortality[b]
7 June	None	U	705	P			1 ROP	CC00-13	
8 June	None	U	790	KNS	Blue	701	1 ROP	CC00-14	
8 June	None	F	735						Weir mort[b]
10 June	None	U	715	KNS	Blue	705	1 ROP	CC00-16	
15 June	None	U	800	P			1 ROP	CC00-17	Mortality[b]
26 June	None	U	840	P			1 ROP	CC00-18	
26 June	None	U	747	P			1 ROP	CC00-19	
26 June	None	U	535	P			1 ROP	CC00-20	
30 June	None	U	485	P			1 ROP	CC00-21	
14 July	None	U	665	P			1 ROP	CC00-22	
15 July	None	U	785	P			1 ROP	CC00-23	
21 July	None	U	715	P			1 ROP	CC00-24	
Grande Ronde River: trap opened 24 March and close 31 July 2000									
10 June	None	U	658	P			2 ROP	UGR00-	
14 June	None	U	687	P			2 ROP	UGR00-	

Table 37 continued.

Date	Marks	Sex	FL	Disposition[a]	Tag Color	Tag Number	Opercle Punch	ID	Notes
Grande Ronde River continued									
14 June	None	U	672	P			2 ROP	UGR00-	
16 June	None	U	773	P			2 ROP	UGR00-	
16 June	None	U	705	P			2 ROP	UGR00-	
16 June	None	U	785	P			2 ROP	UGR00-	
18 June	None	U	695	P			2 ROP	UGR00-	
19 June	None	U	700	P			2 ROP	UGR00-	
19 June	None	U	749	P			2 ROP	UGR00-	
28 June	None	U	775	P			2 ROP	UGR00-	
28 June	None	M	760	P				UGR00-	Mortality[b]
28 June	None	M	740	P				UGR00-	Mortality[b]
29 June	None	U	717	P			2 ROP	UGR00-	
2 July	None	U	701	P			2 ROP	UGR00-	
3 July	None	U	740	P			2 ROP	UGR00-	
13 July	None	U	660	P			2 ROP	UGR00-	
27 July	None	U	680	P			None	None	

[a] Disposition: KNS = transported to Lookingglass Hatchery, not spawned, KS = transported to Lookingglass Hatchery and spawned

[b] Fish that were killed by the weir were considered "take" (and were counted as "kept" under ESA).

during minimum flows and where flow is sufficient to attract fish. Shade material covers the top of the trap and a solid panel on the upstream side of the trap provides a refuge from stream current for captured fish. Foam pipe insulators cover metal edges inside the trap.

Weirs were staffed continuously and captured fish were processed daily (Table 37). Trapped fish were processed quickly to minimize time out of water and time under anesthetic. Handling was accomplished with the fish partially submerged whenever possible. All live fish that were trapped were given an opercle punch to enable hatchery personnel to identify the tributary of origin, time of capture or previous handling at the weir during spawning ground surveys.

Derivation of Take Estimates

All estimates of take were made by direct count of fish at the trapping facility, during frequent surveys of a 1.6 km reach below the weir or during three spawning ground surveys both above and below the weir.

Retention for Broodstock

As per the AOP, no more than 40% of the naturally-produced salmon returning to the Lostine River or Catherine Creek weirs were retained for broodstock. In the upper Grande Ronde River 50% were retained. Fish were selected for broodstock systematically according to sex

and age (jack or 4/5 year old). Fish retained for broodstock were either jaw-tagged with a stainless steel hog ring and individually numbered labels or opercular-tagged with Tyvek patches to indicate tributary of origin (by color and/or number sequence). Tyvek tags were easier to apply and appear to have had less effect (tissue erosion, tag loss) than jaw tags. Comanagers provided transportation from the weir to Lookingglass Fish Hatchery for adult chinook salmon retained for broodstock. All fish were transported on the day of their capture and no mortalities occurred during transportation in 2000. The fish were 'water-to water' transferred from the trap to the transport vehicle via a fish tube. Hauling water was treated with PolyAqua®, a water conditioner formulated to reduce disease outbreak and stress.

Temperature of the hauling water was monitored and the receiving facility manager signed fish transport documents for each transport. Once at Lookingglass Fish Hatchery, the fish were transferred from the transport truck to the holding tank using a dip net.

Smolt Releases

There were no Conventional Program fish collected in 1998, so there were no smolts released in 2000.

2) Monitoring and Evaluation of Conventional Broodstock Program

Fish Health Monitoring and Disease

Adults

All adult mortalities from Catherine Creek and the upper Grande Ronde River were necropsied shortly after transport to the ODFW Pathology Laboratory in La Grande (Table 38). The two mortalities from the upper Grande Ronde River (28 June 2000) resulted from jumping into a container without water. One mortality at Catherine Creek (9 June 2000) occurred from attempting to jump the weir and becoming wedged between the pickets. One fish from Catherine Creek developed a severe bacterial infection after being caught in an irrigation diversion ditch (19 June 2000). One fish from Catherine Creek came into the trap with an existing infection and after being passed upstream, later fell back and died.

Table 38. Summary of necropsy findings for Grande Ronde River Endemic Broodstock mortalities in 2000.

Mortality Date	Sex	Maturity	ELISA OD_{405nm}	Significant clinical findings
28 June 2000	M	Mature	0.117	Virus – Neg, Gut *C. shasta* Neg.
28 June 2000	M	Mature	0.120	Virus – Neg, Gut *C. shasta* Neg.
9 June 2000	F	Mature	0.116	Virus – Neg.
19 June 2000	M	Mature	0.130	Virus – Neg., Gut *C. shasta* low level
27 June 2000	F	Mature	0.129	Virus – Neg., Gut *C. shasta Neg.*

Prescriptions

Prescriptions were obtained from a consulting veterinarian via ODFW Fish Pathology staff for Lostine River, Catherine Creek and the upper Grande Ronde River stocks in 2000.

Fish selected for brood were injected with antibiotics at the weir site. Each fish transported to Lookingglass Fish Hatchery was given a dorsal sinus injection of erythromycin and an intraperitoneal injection of oxytetracycline (200mg/kg). Ripe fish at the traps were not injected. Fish held at Lookingglass Fish Hatchery for spawning were reinoculated the first week in August. Fish that were not collected for broodstock were released above the weir without antibiotic injection.

3) Measures Taken to Minimize Disturbance to ESA-listed Fish

Trap-related Problems

To minimize disturbance 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 were checked often to ensure that no fish were impinged upon the weir or became injured while attempting to pass the weir structure. Trapped fish were processed quickly to minimize time out of water and time under anesthetic.

Concern about the injuries seen on fish collected at weir sites caused us to change operations at traps in the Grande Ronde River basin. At the Catherine Creek and Grande Ronde River sites, we placed foam insulation over sharp metal edges and corners of weir parts. A tarp was put inside the trap to inhibit jumping and provide cover. Frequency of trap checks increased to reduce the amount of time that fish were in a trap and, thus, the opportunity for injury. At the Grande Ronde River weir, because of the unshaded nature of the trap site, camouflage netting was put over both traps to provide cover.

Surveys

Weekly stream surveys for congregations of fish below the weir were conducted from shore to avoid disturbing fish. During spawning ground surveys, we used the same procedures as in other systems containing listed fishes to minimize disturbance (e.g., leaving the stream whenever a fish is observed, avoiding handling live fish, etc.). See ESA Section 10 Permit Number 1152 for details.

4) Spawning Activities

Hatchery Spawning and Gamete Collection

Spawning of Lostine River brood fish occurred on 9 and 14 September with NPT staff assisting ODFW crews. Spawning matrices were developed for two natural jacks, 11 hatchery jacks, 12 natural males and eight natural females. From the eight females, 34,630 eggs were taken to Oxbow Fish Hatchery for incubation. Egg loss amounted to 3.1% (1,084) of the take. An estimated 28,541 smolts will result from this spawn. Inadequate numbers of broodstock were collected from Catherine Creek and Grande Ronde River, so broodstock taken to Lookingglass Fish Hatchery were returned to the streams of capture on 31 July.

The Nez Perce Tribe also cryopreserved sperm from Lostine River fish collected under CRITFC Permit Number 1134 (Table 39). Half of the sample from each male is being stored at Washington State University, Pullman, and half at the University of Idaho, Moscow. No cryopreserved sperm samples were taken from Catherine Creek or Grande Ronde River fish.

Table 39. Disposition of semen collected and cryopreserved from male spring chinook salmon from the Lostine River, 2000 (covered under associated CRITFC Permit Number 1134).

Collection Date	Collection Site	Males Collected	Hatchery Identification Number	Semen Sample Number
23 Aug	Lostine River	1	none	NPT-27-00
9 Sept	LGH	1	L21	NPT-70-00
9 Sept	LGH	1	L20	NPT-71-00
9 Sept	LGH	1	L18	NPT-72-00
9 Sept	LGH	1	L12	NPT-73-00
9 Sept	LGH	1	L26	NPT-74-00
9 Sept	LGH	1	L13	NPT-75-00
14 Sept	LGH	1	L37	NPT-76-00
14 Sept	LGH	1	L13	NPT-77-00
14 Sept	LGH	1	L21	NPT-78-00
14 Sept	LGH	1	L32	NPT-79-00
14 Sept	LGH	1	L27	NPT-80-00
14 Sept	LGH	1	L31	NPT-81-00
14 Sept	LGH	1	L20	NPT-82-00
14 Sept	LGH	1	L34	NPT-83-00
14 Sept	LGH	1	L22	NPT-84-00
14 Sept	LGH	1	L42	NPT-85-00
14 Sept	LGH	1	L15	NPT-86-00

5) Problems and Solutions

Injuries

Trapped chinook from Lostine River generally appeared to be in good condition. Only 8% of the collected fish displayed any type of injury or physical abnormality. Most injuries appeared to have occurred prior to entry into the trap. Evidence of gas supersaturation (headburn) was apparent on one of the fish collected. After the third week of August the majority of the trapped fish were ripe. Fish collected from Catherine Creek and Grande Ronde River also 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. In contrast to 1999, no cases of head burn were evident on any fish collected from Catherine Creek or Grande Ronde River in 2000.

Pre-spawning Mortality

Four chinook salmon died at weirs in 2000: two each at the Catherine Creek and upper Grande Ronde River weirs. No Lostine River brood fish died at the weir, en route to the hatchery or in the holding pond prior to spawning while at Lookingglass Fish Hatchery in 2000.

Two chinook salmon died at the upper Grande Ronde River weir due to trapping activities. Both fish jumped into and empty anesthetic tank, which was left in the trap. The first Catherine Creek mortality resulted when a fish attempted to jump over the picket weir and became wedged between pickets. The second entered the trap in poor condition; with considerable fungus on the body and extreme erosion of the caudal fin. It was released above theweir, but drifted back to the

weir and was recovered dead. It is unlikely that this fish would have survived to spawn even if not subjected to the stress of trapping and handling.

Actions have been taken to minimize injury and mortality due to weirs, including using taller pickets and covering the tops of the pickets with tarps, blocking off the entrance to the irrigation diversion with trap panels, removal of all equipment used for fish processing from inside the trap when not needed and passing fish without processing that appear to be severely fungused or in poor condition.

Minimum Broodstock Needs

Inadequate numbers of broodstock were collected from Catherine Creek and Grande Ronde River to attempt captive spawning in 2000. This may have been due to poor trap efficiency or installation of the trap too late. Fish passage records for Lower Granite Dam suggested that significant numbers of fish pass the dam and may pass the weir locations by 1 May in some, if not most, years. Earlier installation of all three weirs will be attempted in 2001 in an effort to increase the proportion of adults captured throughout the run. There were short periods when we pulled pickets to prevent damage to the weir by high discharge and periods when the weir was undercut at Catherine Creek after a high water event. However, it is unlikely that a large proportion of the population passed the trap during these periods. Fish were also probably jumping over the pickets at Catherine Creek and the upper Grande Ronde River until tarps were put down downstream of the pickets. Additionally, it appeared that low flow and high water temperatures in Catherine Creek and Grande Ronde River may have delayed upstream migration or caused fish to spawn in areas below the weirs that they normally wouldn't have used. Fish remaining below the weirs until after weir removal or migrating after removal of the weirs also made population estimates of fish above the weirs questionable. Low flow conditions resulting from irrigation diversion on Lostine River and Catherine Creek may also have resulted in temperature or physical (low water) barriers to spawning.

Maturation Timing

Lostine River fish spawned in 2000 were checked the first week in August, approximately one week later and every week thereafter until spawning was completed. Although no fish were spawned in 2000 from Catherine Creek or Grande Ronde River, we plan to document and monitor the maturation process in the future by inspection at each scheduled handling event.

Trap Operations

Spring thawing in 2000 resulted in high flows and debris loads in Catherine Creek, which resulted in the weir being washed out and inoperative for about a month (5 April-4 May 2000). The Grande Ronde River weir did not experience this problem. However, there may have been periods, during high water, when effectiveness was diminished at both weirs. Video recordings at the Catherine Creek weir revealed that pickets were not high enough to deter all fish from jumping over the pickets. This is likely one cause of the low efficiency of the picket weirs since 1997. To deter jumping over the weirs, we installed tarps floating downstream of the pickets. Weirs constructed in future years will use longer pickets. We installed a resistance board weir above the picket weir on Catherine Creek on 26 May 2000 to determine effectiveness of this equipment. By that time, however, it appeared that most fish had moved upstream past the weir. Similar problems were experienced at the Lostine River weir in 2000.

Spring (April-May) flows with high stream velocities and large amounts of woody debris, grass and leaves continue to wreak havoc with the weirs. We await weir designs that will withstand these conditions and continue to fish effectively and not need to be rebuilt during or after periods of high flow.

Low flows in Lostine River likely create passage problems for migrating salmon during August and September. A large volume of water is diverted into 14 irrigation ditches each summer. If salmon marked and passed at the weir cannot negotiate the low water reaches above the weir, then the assumptions of mark and recapture are violated on the spawning grounds during carcass recovery. Therefore, low flow conditions not only adversely impact fish passage but also affect population estimates and management decisions based on them. Any factor causing under-representation of marked fish during carcass recovery would lead to an overestimation of population size.

Capture of Non-target Species

The weirs may have had some effect on non-target species. In addition to the 91 chinook salmon trapped and sampled at the Lostine River weir, bull trout *Salvelinus confluentus,* steelhead trout *Oncorhynchus mykiss,* mountain whitefish *Prosopium williamsoni* and largescale suckers *Catostomus macrocheilus* were also trapped and released upstream of the weir. Steelhead kelts were released downstream of the weir.

Earlier installation of the Grande Ronde River and Catherine Creek weirs resulted in more steelhead being captured on their way upstream to spawn and kelts on their way downstream. When two steelhead (one hatchery, one wild) migrating upstream were killed from wedging between the pickets, this trap was modified to prevent further occurrence.

Large aggregations of, presumably, post-spawn largescale suckers were observed immediately above weirs, suggesting that the weir inhibited downstream movement of these fish after spawning. At each of the Catherine Creek and Grande Ronde River sites, 50-100 dead suckers were found washed up against the weir over the season. Small groups like those observed at Lostine River were observed at Grande Ronde River but not Catherine Creek. No action was taken and the fish disappeared.

One bull trout was collected at the Catherine Creek trap. It appeared to be blind in one eye or have some other problem and was later found dead.

6) Hatchery Mortalities

Only one chinook salmon died while at Lookingglass Fish Hatchery. This fish was captured at the Catherine Creek weir and was released upstream of the weir. It then entered an irrigation diversion where it was discovered in poor condition. It was captured and transported to Lookingglass Fish Hatchery in an effort to allow it to recover but later died.

7) Data Analyses

No analyses of adult collection data have been conducted.

8) Coordination with Other Researchers

A Technical Oversight Team (TOT) guided daily activities associated with the Conventional Broodstock Project. This team is composed of members from ODFW, NPT and CTUIR and works in concert with the Captive Broodstock Project TOT for overall program coordination. Field work was also coordinated with ODFW's spawning ground surveys and with field work conducted by our early life history project in northeast Oregon.

9) Spawning Survey Results and Effect of Weirs

Spawning Ground Surveys

Spawning ground surveys were conducted by ODFW weekly for three weeks during spawning on Catherine Creek and Grande Ronde, Lostine and Minam rivers and for two weeks on Wenaha River to document redd numbers and collect information from carcasses (Table 40). During these surveys we counted live and dead fish and completed redds and sampled dead fish for scales and mark/recapture information. We used two methods to estimate escapement. A conversion factor of 3.26 fish / redd that was calculated for spring chinook salmon spawning in Lookingglass Creek (M. McLean, personal communication, CTUIR) and was applied to these data. Also, a mark recapture estimate (fish were opercle-punched at the weir) was calculated for those streams with weirs (CC, LR and GR).

Thirty-four redds were recorded on Catherine Creek; 26 above the weir and eight below (Table 40). We estimate that 44-111 adult (all mature fish) chinook salmon returned to Catherine Creek to spawn. In Grande Ronde River, 20 redds were found: nine above and 11 below the weir. Escapement estimates ranged from 23-65 fish. Fifty-three redds were found above the weir on Lostine River and 11 below, for a total of 64 redds and estimated 209-291 adult salmon. There are no weirs on the Minam and Wenaha rivers, where 139 and 138 redds, respectively, were counted. Population estimates for adult chinook salmon in these streams were 453 and 450, respectively.

Table 40. Results of spawning ground surveys for spring chinook salmon in Catherine Creek and Grande Ronde, Lostine, Minam and Wenaha rivers, 2000.

	Number of Redds					Population Estimate	
Stream	Above Weir	Below Weir	Total	Dead Fish Observed	Live Fish Observed	Mark / Recapture	3.26 Fish / Redd
Catherine Creek	26	8	34	10	55	44	111
Grande Ronde River	9	11	20	12	47	23	65
Lostine River	53	11	64	57	76	291	209
Minam River	--	--	139[a]	77	207	[b]	453
Wenaha River	--	--	138[a]	71	83	[b]	450

[a] There are no weirs on Minam or Wenaha rivers.
[b] There are no marked fish in Minam or Wenaha rivers.

Effect of Weirs on Redd Location

Examining the effect of weirs on location of redds is difficult since the weirs were, logically, placed as low as possible in each stream: the lowermost survey section for redd counts in Catherine Creek and Lostine River and the second lowermost section in Grande Ronde River. Also, specific location (river kilometer) was not recorded for each redd during surveys. Therefore, for years prior to weir installation (1997), it is impossible to determine whether redds found in the section in which the weir was later placed were above or below the present weir location.

Our data provide no evidence that the presence or operation of the weirs has changed spawning distribution, timing or behavior in Catherine Creek, Lostine River or Grande Ronde River. If the weirs were blocking migration to the upper sections of the stream, one would expect an increase in the percentage of redds located below (GR only) or within the section containing the weir. No pattern of changing use is apparent when examining the percentage of redds located above or within the section presently containing the weir between years before and after weir installation in 1997 (Figure 1). A t-test to compare the percentage of redds found within the weir section between pre- and post-weir years resulted in no difference for Catherine Creek (P=0.2410) and Lostine River (P=0.5008). In Grande Ronde River, there was no change in the percentage of redds in survey sections above the weir (P=0.3249), below the weir (P=0.2623) or within the weir section (P=0.1728).

Additionally, to address the potential of the weir to disrupt normal migration behavior, we surveyed a 1.6 km 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 41). More fish and redds were observed below the weirs in 2000 than previous years (Figure 2). However, when the weirs were removed, fish seemed to remain in downstream areas and did not move upstream in any substantial numbers. Therefore, the change in adult chinook salmon and redd distributions in 2000 may have been due to low water levels and high water temperatures, rather than the presence or absence of weirs.

Table 41. Adult chinook salmon observations during foot and snorkel surveys of a 1.6 km section below each weir on Grande Ronde River, Catherine Creek and Lostine River, 2000.

Stream	Survey Type	Date	Number of Surveys	Live Salmon Observed
Grande Ronde River	Foot	1 June - 24 August 2000	21	45
Catherine Creek	Foot	29 June - 22 August 2000	10	12
Lostine River	Foot	9 May - 1 October 2000	94	58
Lostine River	Snorkel	7 August - 22 August 2000	2	15

10) Fish Provided to Educational or Public Outreach Programs

No ESA-listed fish were provided to or displayed at educational or public outreach programs.

11) Anticipated Program Changes in 2001 and Beyond

We plan to manage the trapping, collection, handling and spawning of adults in 2001 in a similar manner as in 2000 with a few exceptions. First, we plan to install the weir on Catherine Creek on or about 7 March and the weir on Grande Ronde River on or about 24 March in an effort to collect steelhead and chinook from across the entire run. These actions will be dependent on flow conditions in each stream. Temporary weirs will again be used if the semi-permanent weirs are not completed.

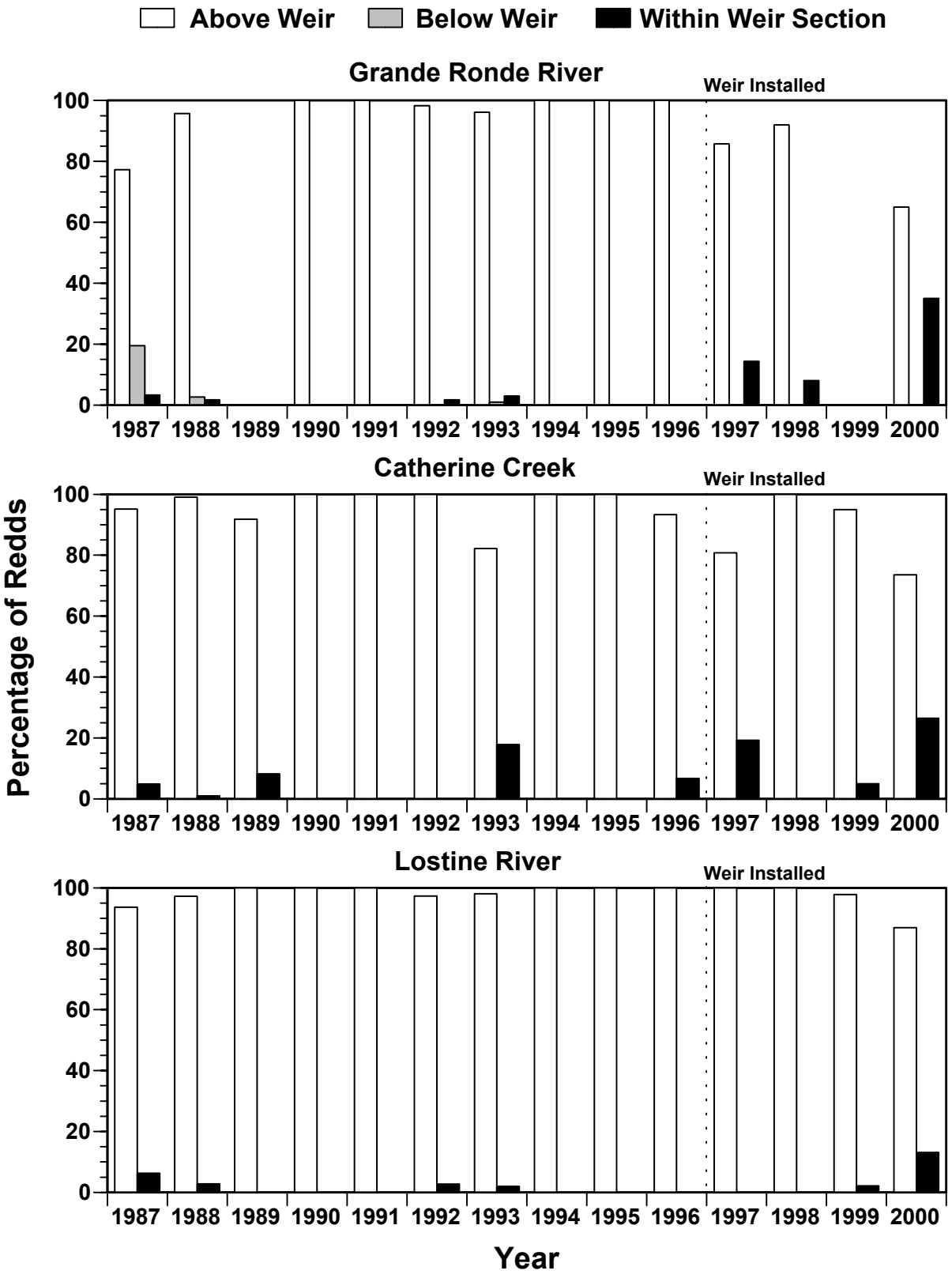


Figure 1. Percentage of redds observed in survey sections above, below (Grande Ronde River, only) and within the survey section containing the present weirs (installed in 1997) in Grande Ronde River, Catherine Creek and Lostine River, 1987-2000.

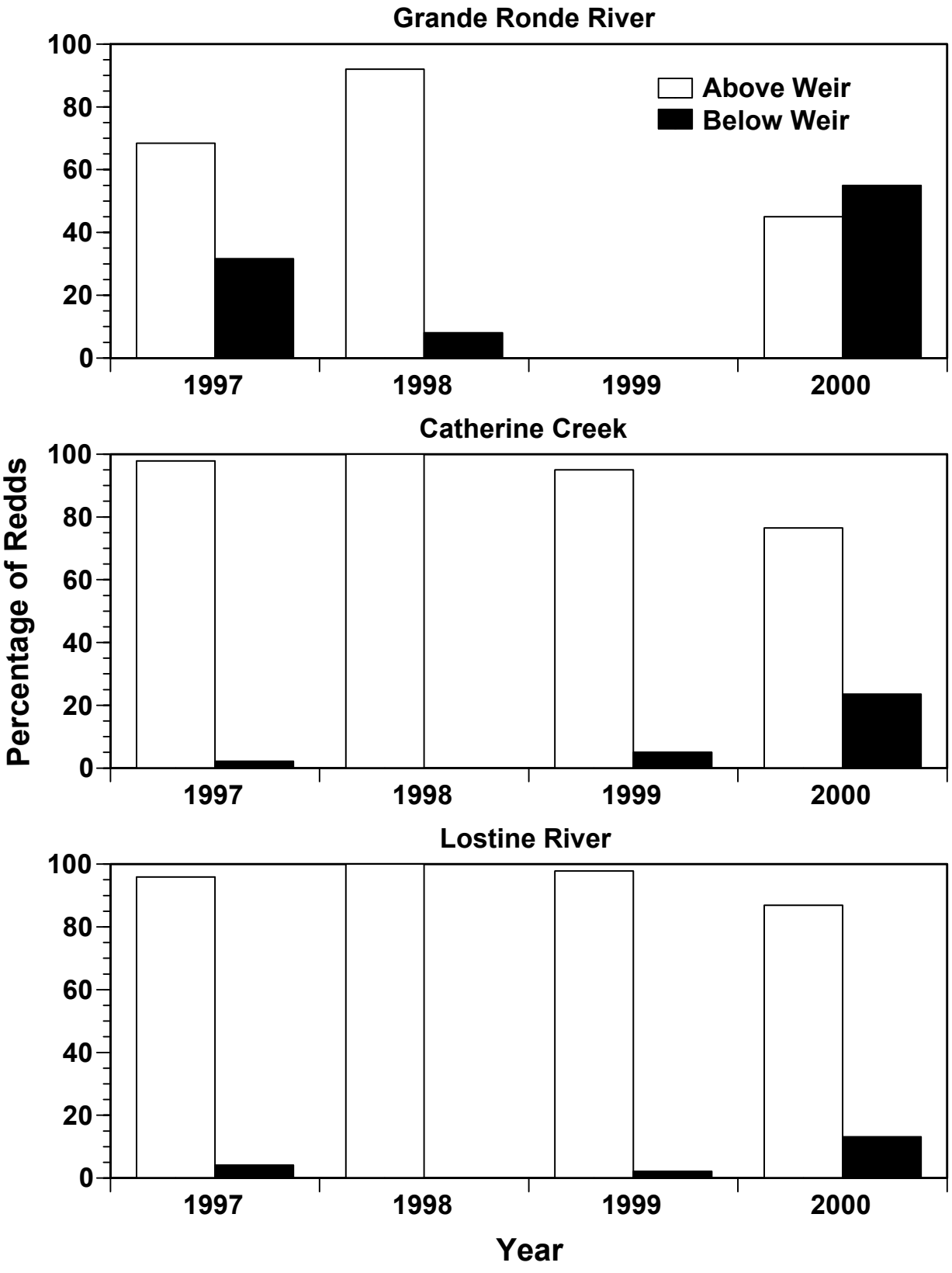


Figure 2. Percentage of redds observed above and below weirs in Grande Ronde River, Catherine Creek and Lostine River, 1997-2000.

Second, we will implement the changes in the holding facilities described in Trap Operations immediately upon installation of the weirs to discourage behavior in the traps and below weirs that may cause injury: minimize equipment in the trap area and pad sharp edges. In addition we plan to check the traps for the presence of adults more often than twice daily, particularly during rain events, to minimize the possibility of injury to the fish due to containment.

Third, a newly designed and manufactured panel weir will be installed at the Willet Site on Lostine River in 2001. We will set up the weir beginning in March in an attempt to fish across the entire chinook run. A winch system will allow the panels to recline during periods of high debris.

Adult Return Predictions

Although we have limited ability to accurately project run size, we attempted to do so to guide our use of the sliding scale for broodstock collection. In 2001, we expect the largest run in recent memory based on projected returns of wild chinook to Lower Granite Dam (Table 42). There are numerous areas for error in this estimator. However, all estimators of the 2001 run size place the expected number of adults in the highest escapement category of the sliding scale (See Endangered Species Permit Number 1011). Adult collection ratios and spawning criteria will be modified as more information becomes available and will conform to permit criteria.

Table 42. Projected adult (non-jack) returns and broodstock collections for supplementation in the Grande Ronde River, Catherine Creek and Lostine River, 2001.

Stream	2001 Total Estimated Run	Estimated Number to be Trapped*	Number to be Retained	Number of Females to be Kept
Grande Ronde River	593	474	100	50
Catherine Creek	959	767	100	50
Lostine River	928	742	100	50

* Assumed 80% trapping efficiency