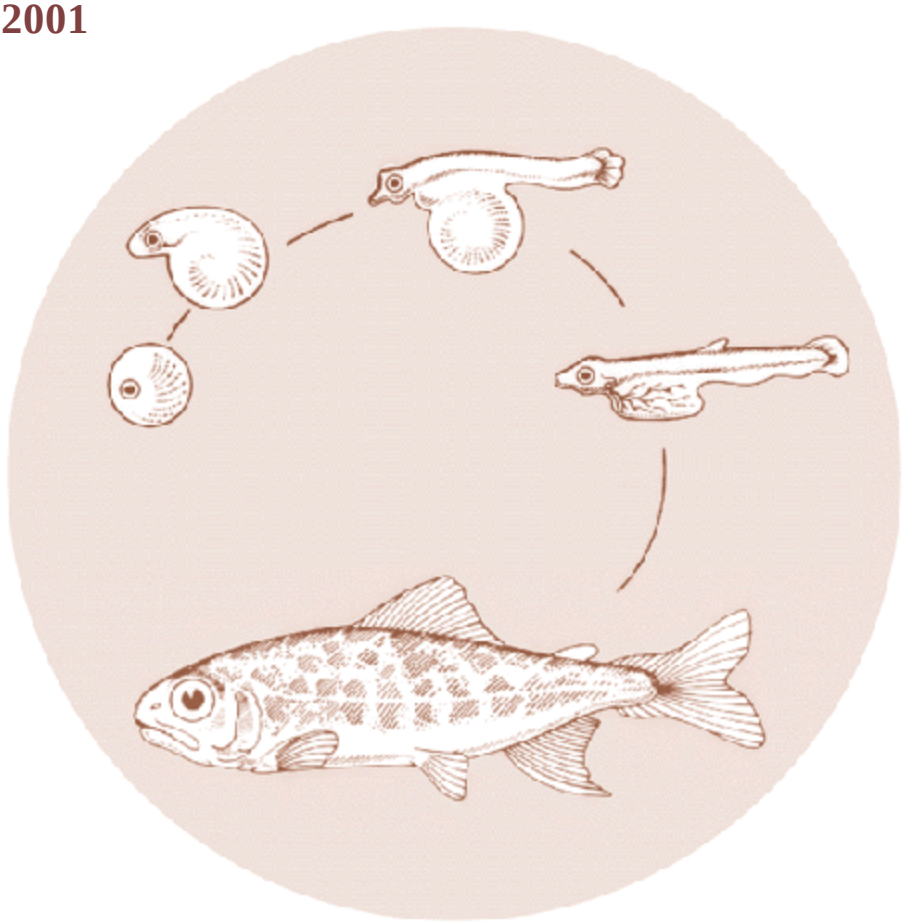
Grande Ronde Basin Chinook Salmon Captive Brood and Conventional Supplementation Programs

Annual Report
2001



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2001 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: 1 January through 31 December 2001

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

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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 2001.

CAPTIVE BROODSTOCK PROJECT

The Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Project is designed to rapidly increase numbers of salmon in stocks that are in imminent danger of extirpation. Parr are captured in Catherine Creek, upper Grande Ronde River and Lostine River and reared to adulthood in captivity. Upon maturation, they are spawned (within stocks) and their progeny reared to smoltification before being released into the natal stream of their parents. This program is conducted jointly by ODFW, National Marine Fisheries Service, the Nez Perce Tribe and Confederated Tribes of the Umatilla Indian Reservation.

1) Activities Conducted

Captive Broodstock Population

The 2000 cohort was collected from Catherine Creek, upper Grande Ronde River and Lostine River and 1573 fish were removed from the captive population in 2000: 1105 fish were spawned and 468 fish died from various causes (Table 1). 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 2001.

1994 Cohort

A total of 498, 110 and 499 fish were collected from Catherine Creek and upper Grande Ronde and Lostine rivers, respectively, in 1995. As of 31 December 2001, there were no 1994 cohort from any stock remaining alive – all were removed in 2000. Of the 1,107 fish taken into captive populations, 619 survived to gamete collection – spawned or had semen cryopreserved. An additional 171 fish died from disease, 219 died from other or unknown causes, 98 died from operational causes. No mortalities remain to be examined by Pathology.

Table 1. Number of fish collected, number of mortalities due to BKD, other diseases, operational, unknown, other undetermined causes, fish spawned (gametes collected) during 2001 and number remaining for each cohort and stock of the Grande Ronde Basin chinook salmon captive broodstock, as of 31 December 2001.

Cohort/stock		Number collected	Mortalities						Gametes collected	Number remaining
			BKD	Other diseases	Operational	Unknown	Other	Undetermined[1]		
1994	Catherine Creek	498								0
	Grande Ronde River	110								0
	Lostine River	499								0
1995	Catherine Creek	500	1			1			7	0
	Grande Ronde River	0								-
	Lostine River	481		1					1	0
1996	Catherine Creek	500	14	1		1		13	23	3
	Grande Ronde River	500	1					2	38	0
	Lostine River	501	12					2	10	5
1997	Catherine Creek	500	39			1	1	4	135	63
	Grande Ronde River	500	29	2		3		7	211	14
	Lostine River	500	33	3		2	1	11	163	17
1998	Catherine Creek	500	4	3		2	2	3	152	283
	Grande Ronde River	500	76	5		5	11	64	155	165
	Lostine River	498	3	1		2	1	4	121	262
1999	Catherine Creek	503			42	4	1	2	30	459
	Grande Ronde River	0								-
	Lostine River	500	1	2	6	5	1	3	59	427
2000	Catherine Creek	503	1		3	2		1	0	496
	Grande Ronde River	502			5		2	1	0	494
	Lostine River	503	1	5	5	6		4	0	482

[1] Undetermined are mortalities that have not yet been examined and will be changed as complete pathology data are obtained.

1995 Cohort

A total of 500 and 481 fish were collected from Catherine Creek and Lostine River, respectively, in 1996. Only one Grande Ronde River chinook salmon was collected, and it was returned to the river when no more salmon were captured and collection efforts were abandoned. As of 31 December 2001, there were no 1995 cohort fish from any stock remaining alive. Of the 981 fish removed from the captive populations, 510 survived to gamete collection. An additional 261 fish died from disease, 171 died from other or unknown causes, 39 died from operational causes. No mortalities remain to be examined (undetermined) by Pathology.

1996 Cohort

A total of 500, 500 and 501 fish were collected in 1997 from Catherine Creek and upper Grande Ronde and Lostine rivers, respectively. As of 31 December 2001, there were eight 1996 cohort fish remaining alive. Of the 1,493 fish removed from the captive populations, 998 have survived to gamete collection. An additional 223 fish died from disease, 228 died from other or unknown causes, 12 died from operational causes and 32 mortalities remain to be examined by Pathology.

1997 Cohort

A total of 500 fish were collected in 1998 from each of Catherine Creek and upper Grande Ronde and Lostine rivers, respectively. As of 31 December 2001, 94 fish remained alive. Of the 1,406 fish removed from the captive populations, 1,023 survived to gamete collection. An additional 157 fish died from disease, 82 died from other or unknown causes, 21 died from operational causes and 123 mortalities remain to be examined (undetermined) by Pathology.

1998 Cohort

A total of 500, 500 and 498 fish were collected in 1999 from Catherine Creek and upper Grande Ronde and Lostine rivers, respectively. As of 31 December 2001, there were 710 fish remaining alive. Of the 788 fish removed from the captive populations, 541 survived to gamete collection. An additional 42 fish died from disease, 44 died from other or unknown causes, 16 died from operational causes and 145 mortalities remain to be examined (undetermined) by Pathology.

1999 Cohort

A total of 503 and 500 fish were collected in 2000 from Catherine Creek and Lostine River, respectively. As of 31 December 2001, there were 886 fish remaining alive. Of the 117 fish removed from the captive populations, 92 survived to gamete collection. No fish died from disease, 13 died from other or unknown causes, two died from operational causes and ten mortalities remain to be examined (undetermined) by Pathology.

2000 Cohort

During each day of collection, all collected fish were transferred to LFH, anesthetized with 40-50 ppm MS-222, measured for length and weight (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 (natural or accelerated pre-smolt growth) 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 and 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

Table 2. Take and disposition of 2000 cohort spring chinook salmon collected and transported to Lookingglass Fish Hatchery (LFH) for captive broodstock in 2001.

	Stock		
Activity	Catherine Creek	Grande Ronde River	Lostine River
Collection dates	6-9 AUG	20-22 AUG	13-16 AUG
Number collected	503	502	503
Number transported	503	502	503
Number ponded	503	502	503
Number PIT tagged and genetic samples taken	499	497	489
Number at LFH on 31 December 2001	496	494	482

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).

A total of 503, 502 and 503 spring chinook salmon parr were collected from each Catherine Creek and Grande Ronde and Lostine rivers in August 1999. Of the original 1,508 fish collected 1475 fish were still alive at LFH as of 31 December 2000; 496 fish from Catherine Creek and 494 from Grande Ronde River and 482 from Lostine River (Tables 1 and 2). Of the 36 fish removed from the population, two fish died from BKD, five from other diseases, 13 from operational causes, eight from other causes, two from unknown causes and six are still undetermined.

F_1 Generation Production

1999 Cohort

The 1999 cohort of F_1's was transferred from Lookingglass Fish Hatchery to acclimation sites in February/March 2001. Approximately 274,301 fish were transported from LFH to acclimation sites: 137,522 Catherine Creek, 2,570 Grande Ronde River and 134,209 Lostine River. Approximately 273,276 fish were released into the natal stream of their parents: 136,833 into Catherine Creek on 8-9 March, 133,883 into Lostine River on 26 February and 2,560 into Grande Ronde River on 27 February.

2000 Cohort

The 2000 cohort of F_1's was transferred from Irrigon Fish Hatchery to Lookingglass Fish Hatchery on 16-23 March 2001. Approximately 412,189 spring chinook salmon were transferred: 128,900 Catherine Creek stock, 62,824 Lostine River stock and 220,465 Grande Ronde River stock. As of 31 December 2001, there were approximately 404,059 fish remaining: 126,272 Catherine Creek, 61,492 Lostine River stock and 216,295 Grande Ronde River stock.

2001 Cohort

The 2001 cohort of F_1's was spawned at Bonneville Fish Hatchery, incubated to the eyed stage at Oxbow Fish Hatchery and hatched at Irrigon Fish Hatchery (Table 3). Approximately 929,099 eggs were collected: 227,690 Catherine Creek, 266,739 Lostine River and 434,670 Grande Ronde River. Approximately 817,697 eggs reached the eyed stage: 199,990 Catherine Creek, 242,360 Lostine River and 375,347 Grande Ronde River.

Table 3. Number of green eggs collected, eyed eggs and percent survival to the eyed stage for 2001 cohort captive broodstock spring chinook salmon from Catherine Creek, Grande Ronde River and Lostine River, 2001.

Stock	Green eggs	Eyed eggs	Percent survival to eyed stage
Catherine Creek	227,690	199,990	87.8
Grande Ronde River	434,670	375,347	86.4
Lostine River	266,739	242,360	90.9

2) Monitoring and Evaluation of Captive Broodstock Program

Growth

Fork length and weight were measured on captive fish during inventories, maturity sortings, samplings and transfers. Once maturity sortings started (late May for 1995-98 cohorts and mid-July for 1999 cohort), only those fish classified as immature were examined and measured. Here we provide information on size of the 1995-1999 cohorts by stock and treatment during April, July (immature fish, only) and September/October (spawning fish, only). Mean fork length and weight for each stock and treatment of the 2000 cohort is provided for time of capture (August) and PIT-tagging (November).

Growth of the captive broodstock fish continues to be slower than expected when this program was designed (Tables 4-9). Pre-smolt growth was expected to result in simulated natural fish attaining a mean fork length of 120 mm by the time of smoltification. This is the only group that has attained its target size. The accelerated growth treatment group was expected to reach 186 mm at smoltification. Although the 1999 cohort accelerated growth fish were significantly larger than the natural growth fish, mean length did not approach the target at the April inventory (Table 8). The 2000 cohort fish are also showing a significant difference in mean length between the accelerated and natural treatment groups but it again appears unlikely that the accelerated group will meet the target, which may be unattainable under the environmental constraints at LFH (Table 9).

Post-smolt growth in both freshwater and saltwater has also been slower than expected (Tables 4-8). The anticipated growth rate would have the natural growth fish reaching 128 mm fork length at the time of smoltification, 220 mm in August of their third year, 480 mm in August of their fourth year, 730 mm in August of their fifth year and 870 mm in August of their sixth year. The accelerated growth fish should be 186 mm at smoltification and 278, 538, 788 and 928 mm in August of their third, fourth, fifth and sixth years, respectively.

In nearly all stocks and cohorts, the saltwater fish continue to grow more slowly than those in freshwater. The 2000 cohort is the second cohort to be reared under true accelerated and natural growth regimes and is demonstrating a separation in size of fish reared under the accelerated and natural growth treatments (Table 9).

F_1 Generation

1999 Cohort

The 1999 cohort of the captive broodstock F_1 generation was released in April 2001 at a mean size that was larger than that of wild spring chinook salmon smolts (approximately 110 mm and 14 g) in the Grande Ronde Basin (Table 10). Catherine Creek smolts had a mean length

Table 4. Mean fork length (FL) and weight (W) in April (all fish), July (immature fish) and September/October (time of spawning of mature fish) of 1995 cohort chinook salmon collected from Catherine Creek, Grande Ronde River and Lostine River and reared under either a freshwater accelerated (FA), freshwater natural (FN) or saltwater natural (SN) growth regime at Bonneville Fish Hatchery (freshwater) or Manchester Marine Laboratory (saltwater), 2001.

Stock, growth	April		July (immature)		September/October (mature)			
					Male		Female	
regime	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)
Catherine Creek								
FA	493.5	2171.0	-	-	440.0	1143.0	592.0	2984.0
FN	509.7	1970.1	-	-	-	-	527.0	1960.0
SN	442.5	1290.1	-	-	531.0	1678.0	-	-
Grande Ronde River								
FA								
FN	No Grande Ronde River fish collected							
SN								
Lostine River								
FA	-	-	-	-	-	-	-	-
FN	-	-	-	-	-	-	-	-
SN	564	1918.1	-	-	-	-	-	-

Table 5. Mean fork length (FL) and weight (W) in April (all fish), July (immature fish) and September/October (time of spawning of mature fish) of 1996 cohort chinook salmon collected from Catherine Creek, Grande Ronde River and Lostine River and reared under either a freshwater accelerated (FA), freshwater natural (FN) or saltwater natural (SN) growth regime at Bonneville Fish Hatchery (freshwater) or Manchester Marine Laboratory (saltwater), 2001.

Stock, growth	April		July (immature)		September/October (mature)			
					Male		Female	
regime	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)
Catherine Creek								
FA	600.5	2940.7	-	-	-	-	600.0	2663.0
FN	603.7	3086.2	-	-	-	-	619.0	3081.0
SN	499.4	1823.3	-	-	-	-	536.0	1851.0
Grande Ronde River								
FA	535.5	2274.5	-	-	-	-	542.0	2281.0
FN	550.6	2407.7	-	-	-	-	589.0	2693.0
SN	535.7	2323.4	466.8	1554.3	551.0	2014.0	544.0	2165.0
Lostine River								
FA	525.6	2237.5	-	-	-	-	562.0	2855.0
FN	566.0	2437.2	-	-	-	-	594.0	2778.0
SN	471.8	1477.1	-	-	595.0	1996.0	495.0	1528.0

Table 6. Mean fork length (FL) and weight (W) in April (all fish), July (immature fish) and September/October (time of spawning of mature fish) of 1997 cohort chinook salmon collected from Catherine Creek, Grande Ronde River and Lostine River and reared under either a freshwater accelerated (FA), freshwater natural (FN) or saltwater natural (SN) growth regime at Bonneville Fish Hatchery (freshwater) or Manchester Marine Laboratory (saltwater), 2001.

Stock, growth	April		July (immature)		September/October (mature)			
					Male		Female	
regime	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)
Catherine Creek								
FA	502.5	1922.8	503.8	1949.5	566.0	2386.0	547.0	2147.0
FN	504.4	1886.4	515.2	2100.8	472.0	1565.0	555.0	2129.0
SN	476.4	1531.5	494.5	1747.3	504.0	1514.0	525.0	1871.0
Grande Ronde River								
FA	532.3	2562.9	502.4	2039.1	542.0	2048.0	576.0	2536.0
FN	543.8	2661.8	506.8	1993.5	526.0	1846.0	584.0	2685.0
SN	518.2	2214.9	-	-	511.0	1597.0	557.0	2309.0
Lostine River								
FA	529.8	2245.9	483.3	1797.3	543.0	1904.0	566.0	2381.0
FN	549.5	2527.9	494.8	1915.8	505.0	1703.0	574.0	2539.0
SN	477.0	1628.7	477.0	1537.5	514.0	1680.0	517.0	1797.0

Table 7. Mean fork length and weight in April (all fish), July (immature fish) and September/October (time of spawning of mature fish) of 1998 cohort chinook salmon collected from Catherine Creek, Grande Ronde River and Lostine River and reared in either freshwater (FW) or saltwater (SW) at Bonneville Fish Hatchery (freshwater) or Manchester Marine Laboratory (saltwater), 2001.

Stock, growth	April		July (immature)		September/October (mature)			
					Male		Female	
regime	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)
Catherine Creek								
FW	360.6	713.8	-	-	419.0	955.0	-	-
SW	354.8	671.5	400.5	915.69	402.0	848.0	-	-
Grande Ronde River								
FW	374.0	797.7	-	-	423.0	918.0	-	-
SW	368.3	728.7	398.2	964.22	409.0	813.0	-	-
Lostine River								
FW	362.7	694.0	-	-	433.0	1005.0	-	-
SW	353.0	653.1	399.9	978.0	414.0	892.0	445.0	1076.0

Table 8. Mean fork length (FL) and weight (W) in April (all fish), July (immature fish) and September/October (time of spawning of mature fish) of 1999 cohort chinook salmon collected from Catherine Creek, Grande Ronde River and Lostine River and reared under either a freshwater accelerated (FA), freshwater natural (FN) or saltwater natural (SN) growth regime at Bonneville Fish Hatchery (freshwater) or Manchester Marine Laboratory (saltwater), 2001.

Stock, growth regime	April		July (immature)		September/October (mature) Male		Female	
	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)	FL (mm)	W (g)
Catherine Creek								
FA	132.1	27.5	180.8	84.3	195.0	92.0	-	-
FN	118.6	19.8	170.8	69.3	183.0	72.0	-	-
SN	119.2	21.2	181.1	80.9	177.0	63.0	-	-
Grande Ronde River								
FA								
FN	No Grande Ronde River fish collected							
SN								
Lostine River								
FA	134.7	29.2	185.5	85.1	202.0	97.0	-	-
FN	119.7	20.5	181.1	79.7	192.0	81.0	-	-
SN	118.5	20.4	181.2	81.6	187.0	78.0	-	-

Table 9. Mean fork length (FL) and weight (W) at time of capture and PIT-tagging of 2000 cohort chinook salmon collected from Catherine Creek, Grande Ronde River and Lostine River and reared under either an accelerated or simulated natural growth regime at Lookingglass Fish Hatchery, 2001.

Stock, growth regime	Capture (August)		Tagging (November)	
	FL (mm)	W (g)	FL (mm)	W (g)
Catherine Creek				
Accelerated	71.1	4.6	106.0	15.7
Natural	69.8	4.3	95.5	10.8
Grande Ronde River				
Accelerated	62.5	2.8	96.6	12.0
Natural	63.0	2.9	88.8	8.7
Lostine River				
Accelerated	78.0	6.3	107.4	16.8
Natural	77.1	6.0	99.0	12.1

Table 10. Mean, minimum, maximum and standard deviation (SD) of length and weight at time of release (April 2001) 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
Catherine Creek	122.7	80	207	11.1	23.2	7.3	63.2	5.9
Lostine River	121.3	87	168	8.2	23.8	11.1	128.0	9.6
Grande Ronde River	135.8	98	172	14.0	32.6	19.3	63.2	8.7

of 122.7 mm and mean weight of 23.2 g. Mean length and weight of the Lostine River fish were 121.3 mm and 23.8 g, respectively. The Grande Ronde River fish were largest, with mean length and weight of 135.8 mm and 32.6 g, respectively. The increased size of the Grande Ronde fish is likely due to low density in the raceway, since only 2560 fish were released.

2000 Cohort

The 2000 cohort of the captive broodstock F_1 generation was sampled in March and October 2001 (Table 11). Catherine Creek spring chinook salmon were a mean of 36.3 mm and 0.53 g in March and 115.2 mm and 19.16 g in October 2001. The Lostine River fish were a mean of 36.1 mm and 0.54 g and 116.0 mm and 21.22 g in March and October, respectively. The Grande Ronde River fish had mean lengths and weights of 35.5 and 113.1 mm and 0.49 and 19.79 g in March and October 2001, respectively.

2001 Cohort

No length or weight sampling of the F_1 2001 cohort was conducted.

Table 11. Mean, minimum, maximum and standard deviation (SD) of length and weight at samples in March and October 2001of 2000 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
				March 2001				
Catherine Creek	36.3	31	47	1.8	0.53	0.3	1.0	0.09
Lostine River	36.1	31	43	2.1	0.54	0.3	1.0	0.13
Grande Ronde River	35.5	29	42	1.9	0.49	0.3	0.8	0.09
				October 2001				
Catherine Creek	115.2	74	186	9.3	19.16	5.4	56.0	5.53
Lostine River	116.0	73	188	8.5	21.22	9.8	61.6	5.52
Grande Ronde River	113.1	73	173	9.1	19.79	5.3	45.3	5.29

Fish Health Monitoring and Disease

In 2001, there were 262 mortalities due to bacterial kidney disease (BKD) from all locations and cohorts combined. This disease, caused by *Renibacterium salmoninarum* (Rs), was, again, the leading cause of death. Collectively these numbers are roughly the equivalent of losing one half of an entire cohort parr collection (N=500) for most years. The impact of BKD and our attempts to minimize its impacts to this program have been documented in each annual report.

This report year includes mortality data from the 1998, 1999 and 2000 cohorts that were vaccinated with the BKD vaccine Renogen in April 2000. Unfortunately, although there may have been a delay in the onset of BKD, this disease still affected the 1998 cohort, particularly the Grande Ronde River stock. The 1999 and 2000 cohorts received Renogen in November (approximately three months after collection) and this timing difference may influence the effect of the vaccine. Continued diligence in diagnosis of disease, implementation of regularly scheduled medicated feedings and injections of erythromycin (maturing adults and in loss situations), when necessary, are important disease control measures. A possibility for future cohorts may be a medicated feeding of azithromycin (a potentially more effective drug) rather than an injection of erythromycin as soon as possible after collection. Aggressive culling of eggs from females with elevated Rs antigen levels for BKD prevention control in the captive progeny has been shown to reduce the impact of BKD and should be continued to the degree the program will allow on a yearly basis, balancing the fish health and gene conservation concerns of the program.

We also examined mortalities and spawned fish for the presence of *Myxobolus cerebralis* spores. We examined 55 Catherine Creek, 83 Grande Ronde River and 55 Lostine River salmon from the 1996 – 2000 cohorts (Table 12). Spores were observed in a five fish pool from the 1997 and 1999 cohorts of Lostine River salmon. Histology confirmation of these results is pending.

Table 12. Number of Oregon captive broodstock spring chinook salmon examined for spores of *Myxobolus cerebralis* in 2001[a]. These include mortalities from Bonneville and Lookingglass hatcheries.

	Number of Samples		
Cohort	Catherine Creek	Grande Ronde River	Lostine River
1996		1	
1997	5	25	20[b]
1998	10	50	3
1999	34	0	15[b]
2000	6	7	17
Total	55	83	55

[a]Some results pending for 2001.

[b]Spores observed in a five fish pool from the 1997 and 1999 cohorts. Histology confirmation is pending.

Bonneville Fish Hatchery

The main cause of death at Bonneville Hatchery was due to BKD - 171 of 277 (61.7%) mortalities from all stocks and cohorts combined (Table 13). The second leading cause of death was handling-related (45; 16.2%) followed by unknown causes of death (23; 8.3%). The Grande Ronde River 1998 cohort suffered the greatest loss (81 of 108; 75%) compared to all other stocks and cohorts, primarily due to BKD in October-December 2001.

Manchester Marine Laboratory

Bacterial kidney disease was the main cause of mortality at Manchester causing 89 of 156 (57.1%) combined mortalities for all stocks and cohorts (Table 14). Fifty-three of 156 (34%) were mortalities of unknown cause with the majority of these occurring in the Grande Ronde River stock (39; 73.6%). The Grande Ronde River 1998 cohort suffered an acute loss when 38 1998 cohort fish died between 24 - 29 September (Table 15). Most of these mortalities (31; 81.6%) were of unknown cause and five were due to BKD (ELISA values ≥ 0.800 OD units). Six of these 38 (15.8%) had ELISA values ranging from 0.300 - 0.611, indicating a significant amount of *Renibacterium salmoninarum* antigen was present but not yet at clinical levels. The proportion of the mortalities due to BKD increased to 100% by the second week in October. The stress of the acute loss event probably exacerbated an underlying BKD problem that caused a chronic BKD loss that continued through the end of December 2001 in the Grande Ronde 1998 cohort fish. Erythromycin (medicated fish pill) was fed from 1 - 21 December. In addition, the Grande Ronde 1998 cohort fish were injected with 40 mg/kg erythromycin on 7 January 2002. The 1998 cohort was the first in the captive program to be vaccinated with the BKD vaccine Renogen. The Grande Ronde 1998 cohort BKD losses (~18 months post-vaccination) and evidence of BKD in two Catherine Creek and five Lostine River 1998 cohort fish raise questions as to the effectiveness of this vaccine to control BKD. The vaccine may have delayed the onset of BKD in these fish but this is difficult to assess without unvaccinated groups.

2001 Adult Spawners at Bonneville Hatchery

All viral samples were negative for any virus or replicating agents and blood smears were negative for erythrocytic inclusion body syndrome (EIBS) viral inclusions. All females were sampled for BKD by ELISA. A significant bacterial kidney disease problem still exists for the 2001 captive broodstock spawning population (Figure 1). There were a high proportion of females from each stock (17.6% for Grande Ronde River and Lostine River and 18.6% for Catherine Creek) with ELISA values ≥ 0.800 OD units and all eggs from these females were culled. In addition, eggs from Catherine Creek females with ELISA OD levels of 0.4-0.799 (an additional 5.6% of the spawning females for a total of 24.2%) were also culled. Only eggs from females with ELISA OD levels <0.2 were retained for release as smolts: 62.1% of the Catherine Creek females, 72.4% Grande Ronde River and 61.8% Lostine River. The remaining offspring (13.7% Catherine Creek, 10% Grande Ronde River and 20.6% Lostine River) were retained for release as parr into an outlet stream for each tributary: Lookingglass Creek for the Catherine Creek parr, Sheep Creek for the Grande Ronde River parr and Bear Creek for the Lostine River parr.

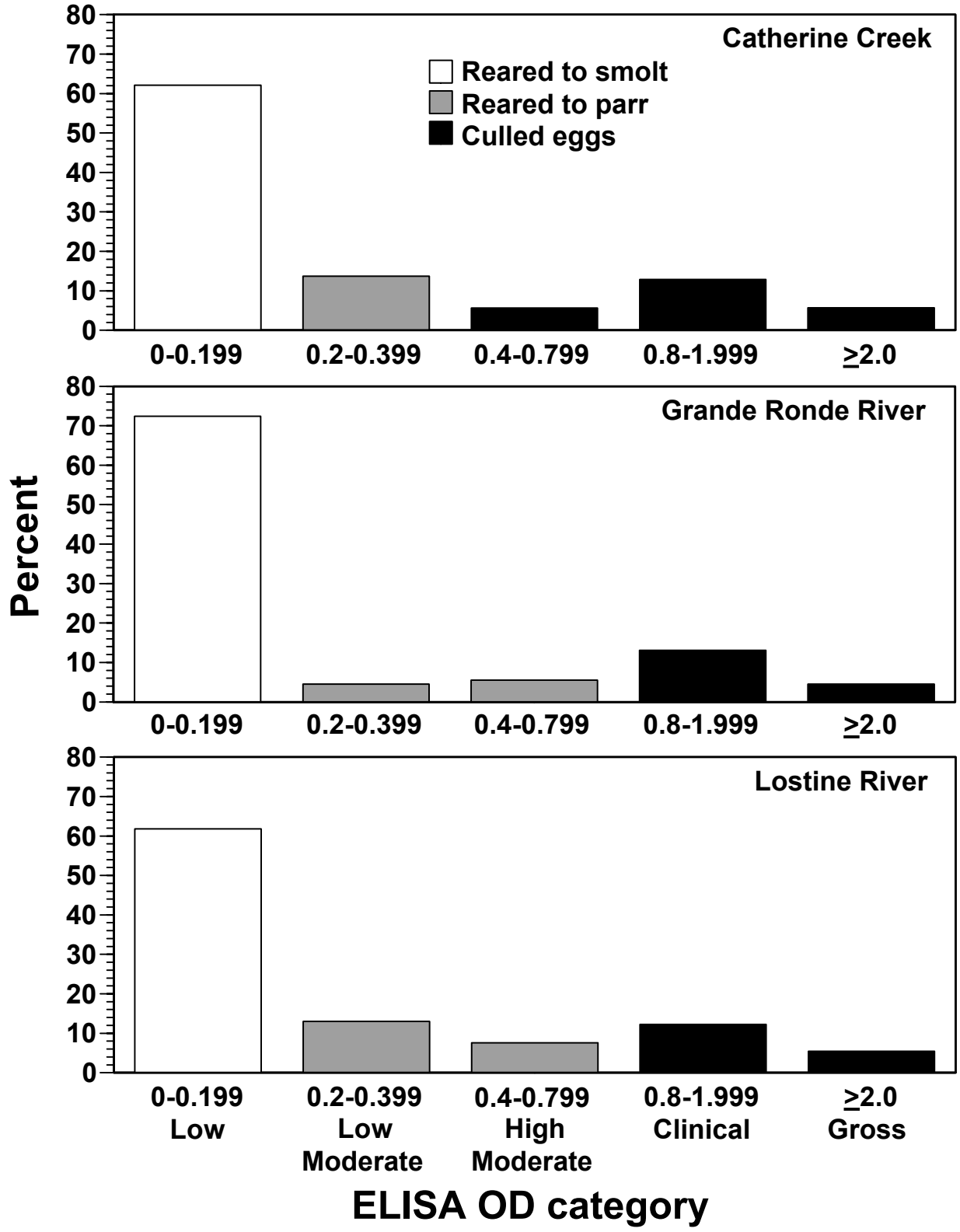

Figure 1. Percentage of spring chinook salmon females spawned in 2001 with ELISA OD levels in each ELISA category and disposition of the resulting offspring.

Table 13. Number of captive broodstock spring chinook salmon from each stock and cohort that died from each of the major causes of mortality at Bonneville Fish Hatchery, 1 January – 31 December 2001.

	Bacterial kidney disease									
Stock, cohort	Typical kidney pathology	Enlarged hindgut syndrome	Senescence[a]	*Aeromonas/ Pseudomonas* septicemia	Handling	Wasting[b]	Jump Out	Trauma	Unknown	Total
Catherine Creek										
1995	2	0	0	0	0	0	0	0	1	3
1996	8	0	0	1	0	0	0	0	1	10
1997	38	0	1	0	0	0	0	0	1	40
1998	3	3	1	0	0	1	0	0	2	10
1999	0	0	0	0	39	0	1	0	2	42
Unknown (95-97)	1	0	0	0	0	0	0	0	0	1
Total	52	3	2	1	39	1	1	0	7	106
Grande Ronde River										
1996	1	0	0	0	0	0	0	0	0	1
1997	21	2	0	0	0	0	0	0	3	26
1998	57	6	10	1	0	0	0	0	7	81
Total	79	8	10	1	0	0	0	0	10	108
Lostine River										
1996	10	0	0	0	0	0	0	0	0	10
1997	29	3	0	1	0	0	0	1	1	35
1998	1	0	1	1	0	0	0	0	1	4
1999	0	3	0	1	6	0	0	0	4	14
Total	40	6	1	3	6	0	0	1	6	63
Grand total	171	17	13	5	45	1	1	1	23	277
Percentage of total mortalities	61.7	6.1	4.7	1.8	16.2	0.4	0.4	0.4	8.3	
Percent BKD	67.9									

[a] Senescence: fish which were sexually mature but died for unknown reasons before being spawned. Mortality was assumed to be due to the general physical decline that is associated with sexually maturation in *Oncorhynchus* spp.

[b] Wasting: immature fish showing signs of starvation (ample amounts of food were presented to all fish).

Table 14. Number of captive broodstock spring chinook salmon from each stock and cohort that died from each of the major causes of mortality at Manchester Marine Laboratory, 1 January – 31 December 2001.

Stock, cohort	BKD	Unknown	Bloat	Dropout	Precocious	Over-eating	Total
Catherine Creek							
1996	18	1	1	0	0	0	20
1997	1	0	2	1	0	0	4
1998	2	1	1	0	0	0	4
1999	0	2	0	0	1	0	3
Total	21	4	4	1	1	0	31
Grande Ronde River							
1996	1	0	0	0	0	1	2
1997	13	2	0	1	0	0	16
1998	36	37	4	0	0	1	78[a]
Total	50	39	4	1	0	2	96
Lostine River							
1996	3	1	0	0	0	0	4
1997	10	5	0	0	0	1	16
1998	5	2	0	0	0	0	7
1999		2	0	0	0	0	2
Total	18	10	0	0	0	1	29
Grand total	89	53	8	2	1	3	156
Percentage of total mortalities	57.1	34.0	5.1	1.3	0.6	1.9	

[a] Includes 5 BKD, 31 unknown, 1 overeating and 1 bloat mort that died during an acute increased loss event and few days following the event (September 24-29).

Lookingglass Fish Hatchery

There were six 1999 cohort mortalities at LFH in 2001 (Table 16). No pathogens were detected among any of these mortalities. One of the mortalities (a precocial male) died approximately two months post-vaccination.

Thirty of the 2000 cohort died at Lookingglass Hatchery in 2001: two (6.7%) were BKD mortalities and five (16.7%; including one female) occurred after vaccination with Renogen and had *Arthrobacter* infections (Table 17). All other mortalities were primarily due to handing or unknown causes with no pathogenic agents being identified in these fish.

F_1 Generation

La Grande fish pathology monitored the progeny of Catherine Creek (CC), Grande Ronde River (GR) and Lostine River (LR) captive broodstock progeny spawned in 1999 and 2000 for fish health in 2001. The 1999 cohort was monitored at Lookingglass Hatchery in January and February 2001 and at each respective acclimation site prior to release. The 2000

Table 15. Number of 1998 cohort Grande Ronde River spring chinook salmon that died from various causes and percentage of mortalities caused by BKD at Manchester Marine Laboratory, 1 September – 31 December 2001.

	Bacterial kidney disease					
Dates	Number	Percentage of total mortality	Unknown	Bloat	Overeating	Total
1-15 SEP	0	0	0	0	0	0
16 – 30 SEP	5	13.2	31	1	1	38[a]
1 – 15 OCT	1	33.3	2	0	0	3
16 – 31 OCT	9	100	0	0	0	9
1 – 15 NOV	8	100	0	0	0	8
16 – 30 NOV	4	100	0	0	0	4
1 – 15 DEC	6	100	0	0	0	6
16 – 31 DEC	3	100	0	0	0	3
Total	36	50.7	33	1	1	71

[a]All of these mortalities occurred 24 - 29 September 2001.

Table 16. Causes of mortality among 1999 cohort captive broodstock spring chinook salmon at Lookingglass Fish Hatchery, 1 January - 31 May 2001.

Stock	BKD	Dropout	Precocial male[a]	Handling	Unknown	Totals
Catherine Creek		1	1	2	1	5
Grande Ronde River			No 1999 cohort fish collected			
Lostine River		1				1
Total	0	2	1	2	1	6

[a]One precocial male died ~2 months post-vaccination with Renogen.

Table 17. Causes of mortality among 2000 cohort captive broodstock spring chinook salmon at Lookingglass Fish Hatchery, 1 August - 31 December 2001.

Stock	BKD	Handling	*Arthrobacter*[a]	Dropout	Trauma[b]	Unknown	Totals
Catherine Creek	1	3				2	6
Lostine River	1	5	5		2	4	17
Grande Ronde River		5		2			7
Total	2	13	5	2	2	6	30

[a] Includes one female.
[b] One of these also had an injury and a low level Rs infection.

cohort was monitored at Irrigon Hatchery prior to transfer to Lookingglass Hatchery where monitoring continued from April-December 2001. Two scheduled erythromycin (Aquamycin) 28-day medicated feedings were given at Lookingglass Hatchery in May and August.

The 1999 cohort continued to have bacterial kidney disease. Bacterial kidney disease also caused chronic lower level losses for one raceway of 2000 cohort Lostine River fish from Moderate (0.2-0.799 OD units) females. The need to treat for *Yersinia ruckeri* (enteric redmouth) in Grande Ronde River fish and external fungus throughout all stocks were other significant disease findings for 2000 cohort fish.

1999 Cohort

The main health problem continued to be bacterial kidney disease, which caused increased loss in raceways containing progeny primarily from moderate/clinical BKD females (Table 18). Two of six Lostine River (Raceways 6 and 7) and Catherine Creek (raceways 10 and 11) raceways were affected. There was continued increased loss due to BKD following transfer of these groups to acclimation sites, as well. Pretransfer and preliberation sampling (160 grab-sampled fish) of Catherine Creek fish showed that 1.9% (3/160) had Rs ELISA values ≥1.000 and 2.5% (4/160) had ELISA values ranging from 0.600-0.999. All seven of these fish came from high BKD segregation raceways. Pretransfer and preliberation Rs ELISA values from 100 grab-sampled Lostine River fish showed that 2% (2/100) had low to moderate values (0.200-0.599) and both came from higher risk BKD segregation raceways. Preliminary outmigration data (Erick Van Dyke, ODFW Research) showed first time dam detection differences between the higher risk BKD segregation raceways that experienced increased loss and detections from other raceways (Table 19). PIT-tag detections for the raceways in which BKD outbreaks occurred (Catherine Creek Raceway 10 and Lostine River Raceway 7) were 4% and 27%, respectively. Mean PIT-tag detections for the all the other raceways were 51% for Catherine Creek and 48.7% for Lostine River. However, several raceways (3, 5 and 9) contained offspring of females with moderate, clinical and gross Rs ELISA values but did not break with BKD. Indeed, Raceway 5 (Lostine River) had a first time dam detection rate of 52.9%, the second highest of all raceways, including those from low Rs ELISA females. These data show the potential risk of BKD loss associated with rearing progeny from females with elevated Rs ELISA values and support what is known regarding vertical transmission of this bacteria. These data also show the importance of true segregation rearing of progeny from females with higher ELISA values since there is much uncertainty regarding which of these higher ELISA groups may break with BKD. This is important, since vertical transmission of Rs is a potential risk to offspring and mixed rearing of segregation groups increases the chance for subsequent horizontal transmission of Rs, should an outbreak occur. However, these data also show that progeny of high ELISA value females may be reared successfully to smoltification, particularly when reared at lower density, preserving the genes of the parents that produced them. The decision of when and where to cull continues to be a difficult one (see Problems and Solutions below).

2000 Cohort

There were no fish health problems detected during the pretransfer examination at Irrigon Hatchery on 12 March 2001. Clinical BKD was found at Lookingglass Fish Hatchery in one Lostine River raceway (Raceway 3; progeny of high-moderate BKD females) during the May monthly examination (Table 20). Chronic BKD mortality continued throughout 2001 in this raceway and by the end of 2001 the cumulative loss was 2.0%. Three BKD mortalities were also found in raceways 1 and 2 (progeny of low and low-moderate BKD females) in 2001. There

Table 18. Total mortality and percentage of total mortalities due to BKD (ELISA values ≥ 1.000 OD units) for each raceway/BKD ELISA segregation of 1999 cohort spring chinook salmon from Lostine River, Grande Ronde River and Catherine Creek, 2001. ELISA categories: L = low (0-0.199); M = moderate (0.2-0.799); C = clinical (0.8 – 1.999); G = gross (≥2.0).

Stock, raceway	Number of fish	ELISA categories in raceway	Mortality		Fish Health
			Total percent	Percent of total due to BKD	
Lostine River					
2	34.4	L	0.4	0 (0/29)	
3	20.2	M/C/G	0.8	58.1 (18/31)	
4	34.0	L	0.5	4.0 (1/25)	
5	14.5	L/M/C/G	0.9	47.1 (16/34)	
6	18.7	M/C/G	12.7	96.7 (29/30)	BKD Epizootic
7	17.7	M/C/G	13.6	100 (37/37)	BKD Epizootic
Grande Ronde River					
8	2.5	L/M	0.9	0 (0/8)	
Catherine Creek					
9	23.9	L/M/G	0.6	13.9 (5/36)	
10	23.9	M/C/G	29.9	95.0 (38/40)	BKD Epizootic
11	23.8	L/M/C/G	11.6	94.3 (50/53)	BKD Epizootic
12	25.7	L/M	0.5	3.1 (1/32)	
13	25.7	L/M	0.3	0 (0/25)	
14	24.7	L/M	0.4	3.3 (1/30)	

Table 19. Number of tagged 1999 cohort captive broodstock spring chinook salmon progeny released and percent detected at least once at Snake and/or Columbia river dams for each stock and raceway, 2001. ELISA categories are as for Table 18.

Stock	Raceway	ELISA categories	Number of tagged fish released	Percent detected
Lostine River				
	2	L	3,501	45%
	4	L	3,494	48%
	5	L/M/C/G	476	53%
	7	M/C/G	436	27%
Grande Ronde River				
	8	L/M	495	50%
Catherine Creek				
	10	M/C/G	469	4%
	12	L/M	6,801	49%
	13	L/M	6,823	51%
	14	L/M	6,822	53%

Table 20. Total mortality and percentage of total mortalities due to BKD (ELISA values ≥ 1.000 OD units) for each raceway/BKD ELISA segregation of 2000 cohort spring chinook salmon from Lostine River, Grande Ronde River and Catherine Creek, October – December 2001. ELISA categories: L = low (0-0.199); L/U = mixture of low and unknown; L/M = low-moderate (0.2-0.399); H/M = high-moderate (0.4 – 0.799).

Stock, Raceway	Number of fish	ELISA categories in raceway	Mortality		Fish Health
			Total percent	Percent of total due to BKD	
Lostine River					
1	35.2	L	0.4	8.7 (2/23)	
2	24.3	L/M	0.3	5.9 (1/17)	
3	18.9	H/M	2.0	85.2 (23/27)	Chronic BKD
Grande Ronde River					
7	50.3	L/U	0.04[a]	0 (0/23)	
8	50.1	L/U	0.05[a]	0 (0/18)	
10	51.6	L/U	0.03[a]	0 (0/5)	
11	50.1	L/U	0.04[a]	0 (0/19)	
Catherine Creek					
4	73.8	L	0.4	0 (0/20)	
5	50.9	L	0.2	0 (0/20)	
6	57.3	L	0.4	0 (0/22)	

were no BKD mortalities in the Catherine Creek or Grande Ronde River stock. In June there was an increase in the number of mortalities with external fungus. This was attributed to several factors, including warm temperature and high turbidity near the time of medicated feeding and underfeeding of the medicated feed. Medicated feed was underfed due to an underestimate of the number of fish in the raceways. *Yersinia ruckeri* (enteric redmouth disease) was discovered in 83.3% (5/6) of the Grande Ronde River fish in June during an increased loss examination. A 10-day oxytetracycline medicated feeding was implemented for all raceways of this stock. Hydrogen peroxide treatments were given to help control the fungus since formalin use was restricted in 2001 due to a review process for effluent dilution requirements by Oregon Department of Environmental Quality (DEQ). Formalin treatments were administered later in the summer following DEQ approval. By September the fungus problems had subsided and, for the remainder of the year, there were no fish health problems. All three stocks were negative for culturable viruses.

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 on 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 juvenile 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 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. We have also begun to use ultrasound and are testing the use of near infrared spectroscopy (NIR) to determine maturity and sex of fish early in the maturation process. It appears that we are now able to determine maturity and sex (of maturing fish, only) in early April. This allows us to transfer maturing fish from saltwater to freshwater at a more natural time, which should improve fecundity and egg quality of saltwater-reared fish. We hope that one of these methods will allow us to conduct one maturity sort in April and avoid further stress on the fish that is caused by each sort.

Lastly, it appears that we were premature in concluding that the BKD vaccine given to 1998 and 1999 cohorts had reduced BKD outbreaks. An outbreak of BKD severely reduced the 1998 cohort Grande Ronde River fish reared at MML and affected other stocks and cohorts at both MML and BOH. We are now examining the possibility of revaccinating the fish and/or using an alternative drug, azithromycin, which is able to enter cells to fight the bacteria and remains in the fish for a longer period of time. This should reduce the amount of drug treatment given to the fish, both by injection and feeding, thus improving feeding of the fish and reducing the stress of handling.

4) Spawning Activities

Fish from the 1995-1998 cohorts were first examined for signs of maturity on 21-25 May 2001 at BOH and MML. The 1999 cohort fish were first examined for signs of maturity on 23-24 July 2000 at BOH and MML (2000 cohort fish were not checked for maturity). Additional maturity sorts were conducted for each cohort and stock based on guidelines in the 2001 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 - 16 October 2001. No ripe sorts were done at MML, since all mature fish were transferred to BOH.

Gametes were collected from the 1995 –1999 cohorts in 2001. Males in excess of those needed to spawn had their semen collected and cryopreserved – only 13 semen samples were collected for cryopreservation in 2001. 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 21). One hundred eighty-five spawning matrices were used in 2001.

Table 21. Spawning categories with associated sex ratios and spawning matrices used for spawning in the Captive Broodstock Program, 2001.

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

1995 Cohort

Seven fish from the 1995 cohort were determined to be maturing during 2001 and all survived to gamete collection (Table 22). Five females and two males were spawned. No fish had their semen cryopreserved. A total of 4,639 eggs were collected; a mean fecundity of 1,160 eggs / female. Of the eggs collected 999 (15.7%) survived to the eyed stage (Table 23).

1996 Cohort

Seventy-two 1996 cohort fish were determined to be maturing during maturity sorts: 71 of these fish (13 males and 58 females) ripened and were spawned and no males had semen cryopreserved (Table 22). A total of 106,842 eggs were collected; a mean fecundity of 1,943 eggs per female. Of the eggs collected 81,060 (82.6%) survived to the eyed stage (Table 23).

1997 Cohort

A total of 554 1997 cohort fish were determined to be maturing during maturity sorting: 512 were spawned (97 males and 415 females), of which seven males (6 GR and 1 LR) had semen cryopreserved (Table 22). A total of 835,592 eggs were collected; a mean fecundity of 2,126 eggs per female. Of the eggs collected 636,925 (85.7%) survived to the eyed stage (Table 23).

Table 22. Number of spring chinook salmon from each cohort, stock and treatment sorted as mature, number surviving to gamete maturation, percent surviving to spawn and number of males from which semen samples were collected for cryopreservation, 2001.

Cohort	Stock	Treatment	Number sorted as mature	Number surviving to gamete maturation		% survived to spawn	Number of males cryoed
				Male	Female		
1995	CC	FA	2	1	1	100%	
		FN	3	0	3	100%	
		SN	1	1	0	100%	
	LR	SN	1	0	1	100%	
1996	CC	FA	10	0	10	100%	
		FN	9	0	9	100%	
		SN	4	0	4	100%	
	GR	FA	11	0	11	100%	
		FN	7	0	7	100%	
		SN	19	10	9	100%	
		unknown	1	0	1	100%	
	LR	FA	3	0	2	67%	
		FN	3	1	2	100%	
		SN	5	2	3	100%	
1997	CC	FA	42	9	27	86%	
		FN	39	5	31	92%	
		SN	66	22	41	95%	
	GR	FA	78	7	67	95%	
		FN	70	9	60	99%	
		SN	73	14	55	95%	6
		unknown	1	0	0	0%	
	LR	FA	78	12	59	91%	
		FN	70	7	57	91%	
		SN	34	12	16	82%	1
		unknown	3	0	2	67%	
1998	CC	FW	102	101	0	99%	
		SW	53	53	0	100%	
	GR	FW	112	106	0	95%	
		SW	55	49	0	89%	
	LR	FW	92	89	0	97%	1
		SW	32	31	1	100%	4
1999	CC	FA	13	13	0	100%	
		FN	10	10	0	100%	
		SN	8	8	0	100%	
	LR	FA	22	20	0	91%	
		FN	20	20	0	100%	
		SN	20	19	0	95%	1
		unknown	1	0	0	0%	

Table 23. Total and mean number of green and eyed eggs collected from (N) female spring chinook salmon of each cohort stock and treatment and mean percent survival of eggs to the eyed stage.

			Green eggs			Eyed eggs			
Cohort	Stock	Treatment	N	Total	Mean	N	Total	Mean	Percent survival
1995	CC	FA	1	1,615	1,615	1	922	922	57.1%
		FN	3	3,024	1,008	2	77	38	2.8%
1996	CC	FA	10	21,083	2,108	9	16,491	1,832	89.7%
		FN	9	20,697	2,300	7	14,320	2,046	90.0%
		SN	4	6,425	1,606	4	5,599	1,400	87.1%
	GR	FA	9	16,281	1,628	8	11,946	1,327	80.1%
		FN	7	14,689	2,098	7	13,322	1,903	90.7%
		SN	8	16,080	2,010	8	11,846	1,481	73.7%
	LR	FA	2	3,887	1,944	1	1,029	1,029	72.0%
		FN	2	4,329	2,165	2	3,712	1,857	85.7%
		SN	3	3,371	1,124	3	2,795	932	82.9%
1997	CC	FA	24	45,601	1,900	21	34,092	1,623	89.3%
		FN	31	59,030	1,904	28	44,587	1,592	83.5%
		SN	41	75,869	1,850	40	63,865	1,597	86.1%
	GR	FA	60	130,900	2,182	55	99,706	1,812	82.0%
		FN	59	141,361	2,396	46	98,511	2,142	88.8%
		SN	53	119,310	2,251	44	85,840	1,951	90.5%
		unknown	2	3,066	1,534	1	1,389	1,389	89.4%
	LR	FA	55	111,331	2,024	50	87,104	1,742	86.8%
		FN	50	116,896	2,338	46	96,336	2,094	91.2%
		SN	16	27,998	1,749	14	21,984	1,570	89.8%
		unknown	2	4,230	2,115	2	3,511	1,756	83.0%
1998	LR	SW	1	1,068	1,068	1	208	208	19.5%

1998 Cohort

A total of 446 fish from the 1998 cohort were determined to be maturing during maturity sorts: 430 were spawned (429 males and one female) and five (LR) had semen cryopreserved (Table 22). A total of 1,068 eggs were collected and 208 of those eggs (19.5%) survived to the eyed stage (Table 23).

1999 Cohort

Ninety-four 1999 cohort males were determined to be maturing during maturity sorts: 90 were spawned, of which one had semen cryopreserved (Table 22).

2000 Cohort

No maturity sorting or spawning of BY2000 fish occurred during 2001.

5) Problems and Solutions

Bacterial Kidney Disease (BKD) and Associated Problems

We continue to have difficulty with prevention and resolution of BKD outbreaks. Erythromycin was used to treat this disease in the form of injections, pills and treated feed. In April 2000, all 1998 cohort fish were given an injection of Renogen, an experimental BKD vaccine. The 1999 cohort parr were vaccinated during PIT tagging in November 2000. We were hopeful that the vaccine would help reduce BKD loss and the amount of handling associated with erythromycin injections. Early BKD losses for these two cohorts were lower than those of previous, unvaccinated cohorts, which we tentatively attributed to the BKD vaccine. However, an outbreak of BKD in late 2001 caused heavy losses in the 1998 cohort Grande Ronde River fish (and lighter, but substantial, losses in the other stocks) at both MML and BOH. This caused us to question the effectiveness of the vaccine. It is possible that the timing of vaccination in these fish reduced the efficacy of the vaccine or that fish will need to be revaccinated. We are examining this issue, as well as investigating other possible treatments and prophylactic measures to deal with this disease.

To further reduce the incidence of BKD in the Captive Broodstock Program, Oregon's Technical Oversight Team (TOT) continues to follow two standard practices regarding culling of eggs to reduce vertical transmission of BKD into the F_1 generation. The first allows culling, prior to fertilization, of eggs (with agreement of the fish culture, health and research personnel present at spawning) from females showing gross external and internal symptoms of BKD (e.g., lesions, bleeding, obviously infected and swollen kidney). The second practice allows culling of eyed eggs from females with high BKD ELISA values (generally $\geq$0.800 but the cull level varies), depending on the distribution of ELISA values, number of eggs collected and management considerations. We anticipate that these practices will dramatically reduce vertical transmission of BKD, thus improving the health of these stocks. However, the primary goal of this captive broodstock program is to conserve the genetic diversity of these stocks. Culling of entire egg lots is counterproductive to this effort. Therefore, further work is much needed to define the threat of vertical BKD transmission to captive broodstock progeny and to find new prophylactic measures and treatments for this disease. Use of azithromycin (injected into females, for water hardening eggs and/or at first feeding of offspring) is one method that we are investigating.

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 and 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 accelerated group has still not achieved the size expected when this program was designed but having a significant difference in size between the accelerated and natural growth regimes will allow us to compare those groups. The 2000 cohort is also showing growth differences between the two growth regimes.

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 matrices 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 is now nearly completed and we are using the database to enter data. 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/Survival

Summaries of annual mortalities of Captive Broodstock fish by cohort and stock can be found in Table 1. 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. All 1994 cohort fish died prior to the beginning of 2001 (Table 1).

1995 Cohort

A total of 500 Catherine Creek and 481 Lostine River 1995 cohort salmon parr were collected during August and September 1996. No 1995 cohort fish were collected from Grande Ronde River. As of 31 December 2001, there were no 1995 cohort fish remaining alive (Table 1). In 2001 one fish died from BKD, one from other diseases and one for unknown reasons. Gametes were collected from eight fish.

1996 Cohort

During August 1997, 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 2001, there were eight fish (3 CC; 5 LR) remaining alive (Table 1). In 2001, 46 fish died for reasons other than gamete collection: 27 fish died from BKD, one from other diseases, one for unknown reasons and 17 fish remain to be examined for cause of death. Gametes were collected from 71 fish (23 CC; 38 GR; 10 LR).

1997 Cohort

Five hundred 1997 cohort spring chinook salmon parr were collected from each of the three stock streams during August and September 1998. As of 31 December 2001, there were 94 fish remaining alive: 63, 14 and 17 from Catherine Creek and Grande Ronde River and Lostine River stocks, respectively (Table 1). In 2001, 136 fish died for reasons other than gamete collection: 101 from BKD, five from other diseases, six for unknown reasons, two from other causes and 22 fish remain to be examined for cause of death. Gametes were collected from 509 fish (135 CC; 211 GR; 163 LR).

1998 Cohort

Five hundred 1998 cohort 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 2001, there were 710 (283CC; 165 GR; 262 LR) fish remaining alive (Table 1). In 2001, 186 fish died for reasons other than gamete collection: 83 from BKD, nine from other diseases, nine for unknown reasons, 14 from other causes and 71 fish remain to be examined for cause of death. Gametes were collected from 428 fish (152 CC; 155 GR; 121 LR).

1999 Cohort

During August 2000, 503 1999 cohort spring chinook salmon parr were collected from Catherine Creek and 500 from Lostine River. No Grande Ronde River fish were collected. Of these, 886 (459 CC, 427 LR) were still alive at LFH as of 31 December 2000 (Table 1). In 2001, 67 fish died for reasons other than gamete collection: 1 fish died from BKD, two from other diseases, 48 from operational causes, nine for unknown reasons, two from other causes and five fish remain to be examined for cause of death. Gametes were collected from 89 fish (30 CC; 59 LR).

2000 Cohort

During August 2001, 503 spring chinook salmon parr were collected from Catherine Creek and Grande Ronde River and 502 from Lostine River. Of these, 1472 (496 CC; 494 GR; 482 LR) were still alive at LFH as of 31 December 2000 (Table 1). In 2001 one fish died from BKD, one from other diseases and one for unknown reasons. Gametes were not collected from any 2000 cohort fish.

Captive Broodstock F_1 Generation

1999 Cohort

The 1999 cohort of F_1's were held at Lookingglass Fish Hatchery from 1 January through March in 2001, at which time they were transported to acclimation sites on the natal streams of their parents. Mortality rates were low during this period. A total of 273,276 smolts were released with an overall survival rate of 53.4% from green egg to smolt. (Table 24).

2000 Cohort

Mortalities of the 2000 cohort of F_1's were low in 2001 (Table 25). A total of 495,263 fry were ponded, of which 25,623 (5.2% of the total ponded) died in 2001: 17,641 at Irrigon Fish Hatchery and 7,982 at Lookingglass Fish Hatchery.

Table 24. Total and mean fecundity of female Catherine Creek, Lostine River and Grande Ronde River chinook salmon spawned in 1999 and the number and percentage of the 1999 cohort reaching the eyed, hatch and smolt stage.

		Eyed Eggs		Hatching		Smolts	
Stock	Total eggs	Total	Percent survival	Total	Percent survival	Total	Percent survival
Catherine Creek	262,350	194,875	74.3	153,481	58.5	136,833	52.2
Grande Ronde River	6,043	3,565	59.0	2,772	45.9	2,560	42.4
Lostine River	243,699	182,953	75.1	150,176	61.6	133,883	54.9

Table 25. Number of mortalities in 2000 cohort F_1 generation at Irrigon and Lookingglass fish hatcheries, total mortality in 2000 and percentage mortality of total ponded.

Stock	Number hatched	Mortalities: Irrigon Fish Hatchery	Mortalities: Lookingglass Fish Hatchery	Mortalities: Total	Percent mortality
Catherine Creek	119,800	5,541	2,578	8,029	3.5
Grande Ronde River	227,700	7,240	4,156	11,396	16.8
Lostine River	67,763	4,590	1,248	6,198	9.1

2001 Cohort

We collected a total of 929,210 eggs from all three stocks in 2001 (Table 26). Of those, 817,808 eggs reached the eyed stage – a mortality rate of 12.0%).

Table 26. Total number of eggs collected, number of eggs surviving to the eyed stage and number and percent mortality in 2001 cohort F_1 generation from Catherine Creek, Grande Ronde River and Lostine River stocks, 2001.

Stock	Eggs collected	Eyed eggs	Total mortalities	Percent mortality
Catherine Creek	227,926	200,226	27,700	12.2
Grande Ronde River	434,668	375,345	59,323	13.6
Lostine River	266,616	242,237	24,379	9.1

7) 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 (ODFW) is the representative to the TOC for the Grande Ronde Basin Spring Chinook Salmon Endemic Supplementation Program.

8) Spawning Survey Results and Effect of Weirs

No weirs are used with the Captive Broodstock Program.

9) Fish Provided to Educational or Public Outreach Programs

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

CONVENTIONAL BROODSTOCK PROJECT

The Conventional Broodstock Project is conducted in Catherine Creek, Grande Ronde River and Lostine River. Adults are collected at weirs, spawned at Lookingglass Fish Hatchery and their offspring released, as smolts, into their parent's natal stream. This project is conducted under this permit in Catherine Creek and Grande Ronde River. In Lostine River, it is conducted under Endangered Species Permit No. 1149, issued to the Columbia River Intertribal Fish Commission andand reported by the Nez Perce Tribe.

1) Activities Conducted

Trap Operations

Adult chinook salmon adults were collected using a modified picket weir across the bottom step of the fish ladder on Catherine Creek and a resistance board weir on Grande Ronde River. The Grande Ronde River trap was opened 31 March 2001. Warm water temperatures caused some fish to remain below the weir, so it was removed on 13 July 2001 to allow those fish to freely move upstream, if they chose to do so. The Catherine Creek trap was opened on 20 March 2001 and closed 4 September 2001.

The holding cage for the Grande Ronde River weir was placed in an area deep enough to maintain fish during minimum flows and where flow was 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. The Catherine Creek trap is cement-sided and also covered to provide shade.

Weirs were staffed continuously and captured fish were processed daily. 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 captured fish 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

An estimate of trap efficiency was made using data from three sources. We enumerated all fish captured at the trapping facility, we frequently surveyed a 1.6 km reach below the weir and we conducted three spawning ground surveys on each stream, 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 tagged (jaw-tags with a stainless steel hog ring and individually numbered labels or Tyvek patches on the opercles) to indicate tributary of origin (by color and/or number sequence). Tyvek tags were easier to apply and appear to have performed better (less 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 2001. 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 form Catherine Creek or Grande Ronde River in 1999, so there were no smolts released in 2001.

2) Monitoring and Evaluation of Conventional Broodstock Program

Conventional Broodstock Progeny

No Catherine Creek or Grande Ronde River Conventional Broodstock fish were produced in 1999 or 2000. In 2001, Catherine Creek and Grande Ronde River adults were collected and spawned (see Spawning Activities below). Approximately 261,548 eggs were collected and transferred to Oxbow Fish Hatchery or Irrigon Fish Hatchery for fertilization and incubation and approximately 149,258 eggs (70.7% of those collected) reached the eyed stage (Table 27). The Nez Perce Tribe also cryopreserved sperm from Lostine River fish collected under CRITFC Permit Number 1134. No cryopreserved sperm samples were taken from Catherine Creek or Grande Ronde River fish.

Table 27. Number of green and eyed eggs and percentage of viable eggs (surviving to eyed stage) for Catherine Creek, Grande Ronde River and Lostine River females spawned in 2001.

Stock	Green eggs	Eyed eggs	Percent viable
Catherine Creek	41,812	26,426	63.2
Grande Ronde River	29,580	25,339	85.6
Lostine River	139,768	56,012	69.8

Fish Health Monitoring and Disease

BY2000 Lostine River Juveniles

These were all progeny of low/low-moderate females (≤ 0.221 ELISA OD units). There were no health problems detected at Irrigon Fish Hatchery during a pretransfer examination on 12 March 2001. Fish health monitoring continued at Lookingglass Hatchery to the end of 2001. These fish received two 28-day Aquamycin medicated feedings (May and August). There were no BKD problems with these fish. All 27 dead/moribund fish examined during monthly monitoring had ELISA values ≤ 0.158 OD units. External fungus was also found on mortalities in this group of fish and treatments with hydrogen peroxide (and formalin later in the summer following DEQ approval) were initiated. No other significant fish health problems were detected.

Adult Spawners BY2001

All Rs ELISA values from Conventional Broodstock female spawners were ≤ 0.128 OD units. Therefore, all eggs from these females were categorized as BKD low (≤ 0.199 OD units)

for production. Infectious hematopoietic necrosis virus was isolated only from the Lostine River stock in 2.8% (1/36) females and confirmed to be a Type 2 isolate.

Adult Mortality BY2001

There were 12 Lostine River, five Catherine Creek and five Grande Ronde mortalities at Lookingglass Fish Hatchery but none were due to BKD (Table 28). Two mortalities found in Catherine Creek had Rs ELISA values ≥ 1.000 OD units. River discharge was lower and water temperature higher than normal, which contributed to several of the mortalities examined from the natural environment.

Prescriptions

Prescriptions were obtained for injections of oxytetracycline and erythromycin for the control of furunculosis and BKD from a consulting veterinarian via ODFW Fish Pathology staff for Lostine River, Catherine Creek and the upper Grande Ronde River stocks in 2001. Fish selected for brood were injected with antibiotics at the weir site. Each fish transported to Lookingglass Fish Hatchery was given an intraperitoneal injection of erythromycin (20 mg/kg) and oxytetracycline (10 mg/kg). Ripe fish at the traps were not injected. Fish held at Lookingglass Fish Hatchery for spawning were re-inoculated the first week in August. Fish that were not collected for broodstock were released above the weir without antibiotic injection. In addition, a prescription was obtained for the use of formalin for fungus control. However, due to a review process for effluent dilution requirements by the Oregon Department of Environmental Quality (DEQ) the use of formalin was restricted and hydrogen peroxide was used as an interim fungus control measure.

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. 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 was 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 were conducted to count fish congregating below the weir. These surveys 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.

Table 28. Summary of necropsy findings for Lostine River, Catherine Creek and Grande Ronde conventional broodstock spring chinook salmon mortalities from Lookingglass Fish Hatchery (unless otherwise noted), 2001.

Stock, mortality date	Sex	ELISA OD	Significant clinical findings	Comments
Lostine River				
30 JUN	M	0.086	Aeromonad-pseudomonad (APS) low level	
4 JUL	M	0.073	No systemic bacteria - injury related	Weir
9 JUL		0.078	*Aeromonas salmonicida* - moderate level	Fall back
13 JUL	F	0.076	Mixed bacteria - low level, Fungus head	
5 AUG	F	0.084	APS bacteria, head fungus & snout erosion	
15 AUG	F	0.074	APS bacteria, head fungus	
18 AUG	M	0.076	APS bacteria, severe caudal erosion	
22 AUG	F	0.073	APS bacteria	Spawned
26 AUG	F	0.075	Egg mass near injection site	Spawned
29 AUG	F	0.094	Some head fungus	
18 SEP	M	0.101	Fungus patches ~45% of body	
18 SEP	M	0.089	Fungus patches ~45% of body	
25 SEP	M	0.084	Patchy abrasions	
25 SEP	M	0.115	APS bacteria, Extensive body fungus	
Catherine Creek				
8 JUN	M	0.075	Slight red at base of anal fin	
24 JUN	F	0.075	Physical injury	
8 JUL	M	0.097	APS (low)	Jumpout
14 JUL	F	0.079	Fungus patches, APS (low)	
24 JUL	F	2.694	*Yersinia ruckeri* (heavy)	Creek
1 AUG	M	0.114	Some gill fungus	Creek
1 AUG	F	1.466	APS (heavy)	Creek
25 AUG	M	0.082	None	Jumpout
Grande Ronde River				
22 JUN	F	0.079	APS (heavy), headburn/fungus head	Weir
26 JUN	M	0.079	APS (moderate)	
5 JUL	M	0.084	APS (heavy), head fungus	Weir
6 JUL	M	0.12	APS (heavy, severe head fungus	Weir
6 JUL		ND[1]	Body opened already	Weir
6 JUL		ND[1]	Body opened already	Weir
6 JUL		ND[1]	Body opened already	Weir
7 JUL		ND[1]	Body opened already	Weir
7 JUL		ND[1]	Body opened already	Weir
13 JUL	F	0.084	APS (heavy)	Weir
8 AUG	M	0.085	APS (low), vent hemorrhaged, bloody fluid	
21 AUG	F	0.085	None	Jumpout
25 AUG	F	0.079	None	Jumpout
25 AUG	M	0.084	None	Jumpout

[1]ELISA sample not taken since the fish was opened up already.

4) Spawning Activities

In 2001, we were able to spawn conventional broodstock from all three stocks of concern (Catherine Creek, Grande Ronde River and Lostine River) for the first time. Spawning of conventional broodstock fish occurred from 16 August - 18 September 2001 with NPT and CTUIR staff assisting ODFW crews. Totals of 26 Catherine Creek (12 females, 11 4/5 year old males and 3 jacks), 16 Grande Ronde River (8 females and 4/5 year old 8 males) and 71 Lostine River (36 females and 4/5 year old 35 males) fish were spawned. Males ranged in size from 535-913 mm and 1.8-10.1 kg and females ranged from 635-870 mm and 2.6 – 6.4 kg (Table 29). Approximately 261,548 eggs were collected (Table 27).

Table 29. Mean and range (minimum and maximum) of length, weight and condition factor (K) of each sex and age of conventional broodstock spring chinook salmon spawned from Catherine Creek, Grande Ronde River and Lostine River, 2001.

Stock, sex	Age	Length (mm)		Weight (kg)		K	
		Mean	Range	Mean	Range	Mean	Range
Catherine Creek							
Female	4	716	635-765	3.95	2.61-4.66	1.08	0.76-1.50
	5						
Male	3	570	535-591	2.00	1.80-2.20	0.99	0.87-1.10
	4	707	647-730	3.60	2.90-4.20	1.07	1.02-1.15
	5	820		--	--	--	--
Grande Ronde River							
Female	4	733	665-785	4.21	2.96-5.37	1.06	1.00-1.12
	5						
Male	3						
	4	743	703-788	3.81	3.07-4.79	0.94	0.88-1.02
	5	812	809-815	5.39	4.88-5.90	1.01	0.92-1.09
Lostine River							
Female	4	762	680-799	4.96	3.25-5.90	1.11	1.00-1.21
	5	823	803-870	5.87	5.10-6.35	1.07	0.98-1.18
Male	3						
	4	746	645-797	4.92	3.40-6.92	1.13	1.02-1.39
	5	848	820-913	7.14	6.10-10.10	1.15	1.00-1.33

5) Problems and Solutions

Injuries

Fish collected from Catherine Creek and Grande Ronde River generally appeared to be in good condition but some displayed cuts and bruises of generally minor severity. Causes of

the injuries were undetermined but some appeared fresh enough to have occurred in the vicinity of the trap. No cases of head burn were evident on any fish collected from Catherine Creek or Grande Ronde River in 2001.

Pre-spawning Mortality

Eleven chinook salmon died in captivity prior to spawning. One chinook salmon died at the Catherine Creek weir and none at the Grande Ronde River weir in 2001. One jack, two male and two female Catherine Creek salmon and three male and two female Grande Ronde River chinook salmon died at Lookingglass Fish Hatchery prior to spawning.
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

For the first time, adequate numbers of broodstock were collected from Catherine Creek and Grande Ronde River to attempt a conventional hatchery program in 2001. However, the number of collected fish was low (26 Catherine Creek and 21 Grande Ronde River fish). In Catherine Creek, this was likely due to poor trap efficiency or late trap installation since spawning ground survey data estimated that nearly 400 adult chinook salmon passed the weir site but only 118 were captured. In the upper Grande Ronde River, some fish stopped their migration just below the weir during a period of low river discharge and warm temperatures. The weir was removed on 13 July to allow the fish holding downstream to move upstream if they wished. We also collected some fish by seining on 13 July and again on 30 July, when these fish did not move upstream after weir removal.

Fish passage records for Lower Granite Dam suggested that significant numbers of fish pass the dam and likely pass weir locations in Catherine Creek and upper Grande Ronde River by 1 May in some, if not most, years. Earlier installation of these weirs will be attempted in 2002 in an effort to increase the proportion of adults captured throughout the run. In 2001, 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. Very low flow and high water temperature in Grande Ronde River likely delayed upstream migration of some fish and caused them to spawn in areas below the weirs that they normally wouldn't have used.

Maturation Timing

Catherine Creek fish spawned earlier than Grande Ronde River fish (Table 30). One Catherine Creek female appeared to ripen on 16 August but when she was opened we discovered that her eggs were still in the skein and she had fluid in her abdomen and air bladder. The other nine Catherine Creek females ripened and were successfully spawned on 30 August and 5 September. Eight Grande Ronde River females were spawned from 30 August – 11 September.

Trap Operations

The trap at Catherine Creek was ineffective during the high flow period in 2001, as evidenced by the large number of unmarked of spring chinook salmon carcasses collected on the spawning ground surveys. A temporary weir was used in 2001 as the permanent weir was not completed in time.

Table 30. Number of age 3 male (jacks), age 4-5 male and female spring chinook salmon from Catherine Creek and Grande Ronde River spawned on each day of spawning at Lookingglass Fish Hatchery, 2001.

	Catherine Creek			Grande Ronde River		
Date	Jacks	Age 4-5 males	Females	Jacks	Age 4-5 males	Females
16 August		2	1			
23 August	2	1				
30 August		4	6		2	1
5 September	2	5	3		3	3
11 September		2			6	4

Trapping at the upper Grande Ronde River weir was more effective. Normal high spring flows did not occur, due to the lack of snow at higher elevations. Low water levels and high water temperatures in the upper Grande Ronde River in July-August 2001 resulted in the deaths of at least 19 adult spring chinook salmon. Some salmon held in pools below the weir and did not move further upstream and the comanagers decided to collect some of these fish for broodstock by seining. The weir was removed on 13 July to allow any remaining fish to move upstream. Appropriate weirs are expected to be completed in time for the 2002 spawning runs. These weirs are expected to allow for a much greater trapping efficiency.

Capture of Non-target Species

In addition to spring chinook salmon, four species of fish have been captured in the weirs on Catherine Creek and upper Grande Ronde River: summer steelhead *Oncorhynchus mykis*), mountain whitefish *Prosopium williamsoni*, bull trout *Salvelinus confluentus* and largescale sucker *Catostomus macrocheilus* (Table 31). Bull trout and mountain whitefish are rarely seen. Summer steelhead are seen in low to moderate numbers in both streams, depending on the installation date of the weirs and their efficiency. The weir on Catherine Creek in 2001 was more effective than those used in past years. Weirs to be completed and used beginning in 2002 will probably be even more effective in trapping summer steelhead and other species with minimal mortality. Largescale suckers are caught in large numbers (approximately several hundred) each year. These fish are caught during the spawning migration upstream and as they return downstream. Mortalities frequently occurred for this species prior to 2001 as they often became wedged between pickets. The different weir design used in 2001 (and to be used in subsequent years) resulted in far less mortality.

Table 31. Number of non-target species captured at weirs on Catherine Creek, the upper Grande Ronde River, and Lostine River, 2001.

Species	Catherine Creek	Upper Grande Ronde River
Bull trout	0	0
Summer steelhead	205	19
Mountain whitefish	0	0
Largescale sucker	approximately 200	approximately 200

6) Hatchery Mortalities

Ten chinook salmon died while at Lookingglass Fish Hatchery. One jack, two male and two female Catherine Creek salmon and three male and two female Grande Ronde River chinook salmon died at Lookingglass Fish Hatchery prior to spawning.

7) 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.

8) Spawning Ground 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 32). 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 the number of redds counted. Also, a mark recapture estimate (fish were opercle-punched at the weir) was calculated for those streams with weirs (CC, LR and GR).

One hundred thirty-three redds were recorded on Catherine Creek; 131 above the weir and two below (Table 32). We estimate that 397-434 adult (all mature fish $\geq$3 years old) chinook salmon returned to Catherine Creek to spawn. In Grande Ronde River, 15 redds were found: eight above and seven below the weir and escapement estimates ranged from 34-49 fish. Ninety-eight redds were found above the weir on Lostine River and 33 below, for a total of 131 redds and an estimated 377-427 adult salmon. There are no weirs on the Minam and Wenaha rivers, where 179 and 264 redds, respectively, were counted. Population estimates for adult chinook salmon in these streams were 584 and 861 adults, respectively.

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; within 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 little 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

Table 32. Results of spawning ground surveys for spring chinook salmon in Catherine Creek and Grande Ronde, Lostine, Minam and Wenaha rivers, 2001.

	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	131	2	133	59	237	397	434
Grande Ronde River	8	7	15	8	59	34	49
Lostine River	98	33	131	121	251	377	427
Minam River	--	--	179[a]	52	142	N/A[b]	584
Wenaha River	--	--	264[a]	88	108	N/A[b]	861

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

containing the weir. Little 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 2). A t-test to compare the percentage of redds found within the weir section between pre- and post-weir years resulted in no significant difference for Catherine Creek (P=0.1258) and Lostine River (P=0.1462). In Grande Ronde River, there was no change in the percentage of redds in survey sections above the weir (P=0.1003) and below the weir (P=0.7172) but within the weir section the mean percentage of redds was significantly higher (P=0.0027) from 1997-2001 (16.8%) than from 1987-1996 (1.0%).

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 33). The number of fish and redds observed below the weirs in 2001 was similar to that in 2000 in Grande Ronde River but much lower in Catherine Creek (Figure 3). In 2001, low water and subsequent high temperatures prevented movement to or past the Grande Ronde weir by early July. However, when the Grande Ronde weir was removed, fish seemed to remain in downstream areas and did not move upstream. We are uncertain whether the presence of the weir, low water levels or high temperatures or some combination of these or other factors caused these fish to stop their migration below the Grande Ronde weir.

Table 33. Adult chinook salmon observations during foot and snorkel surveys of a 1.6 km section below each weir on Grande Ronde River and Catherine Creek, 2001.

				Live salmon observed	
Stream	Survey type	Date	Number of surveys	Total	Mean / survey
Grande Ronde River	Foot	31 May - 15 August 2001	19	269	14.2
Catherine Creek	Foot	31 May - 17 August 2001	14	21	1.5

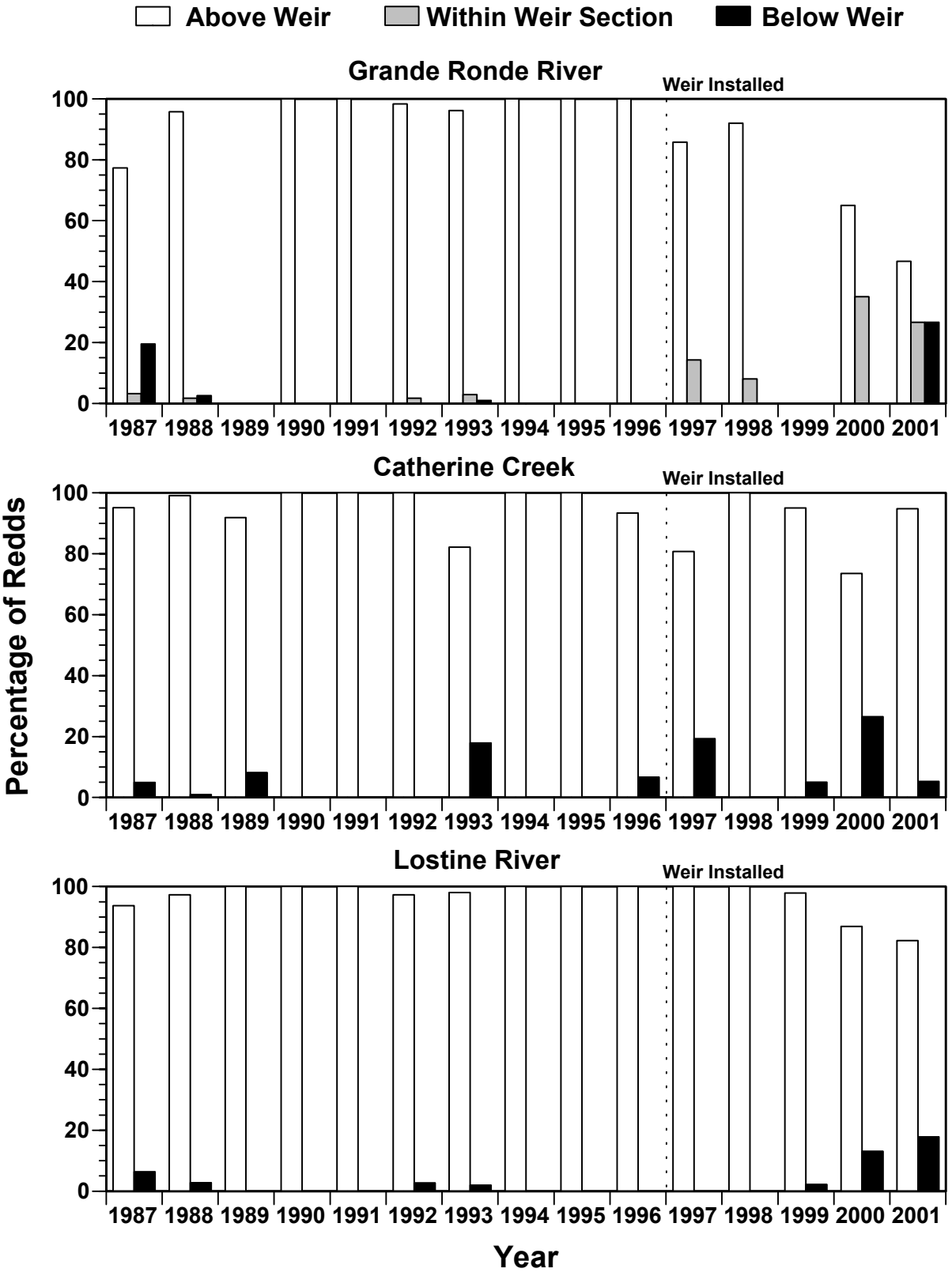

Figure 2. Percentage of redds observed in survey sections above, below (Grande Ronde River, only) and within the survey section containing the present weirs (installed in 1997) in Grande Ronde River, Catherine Creek and Lostine River, 1987-2001.

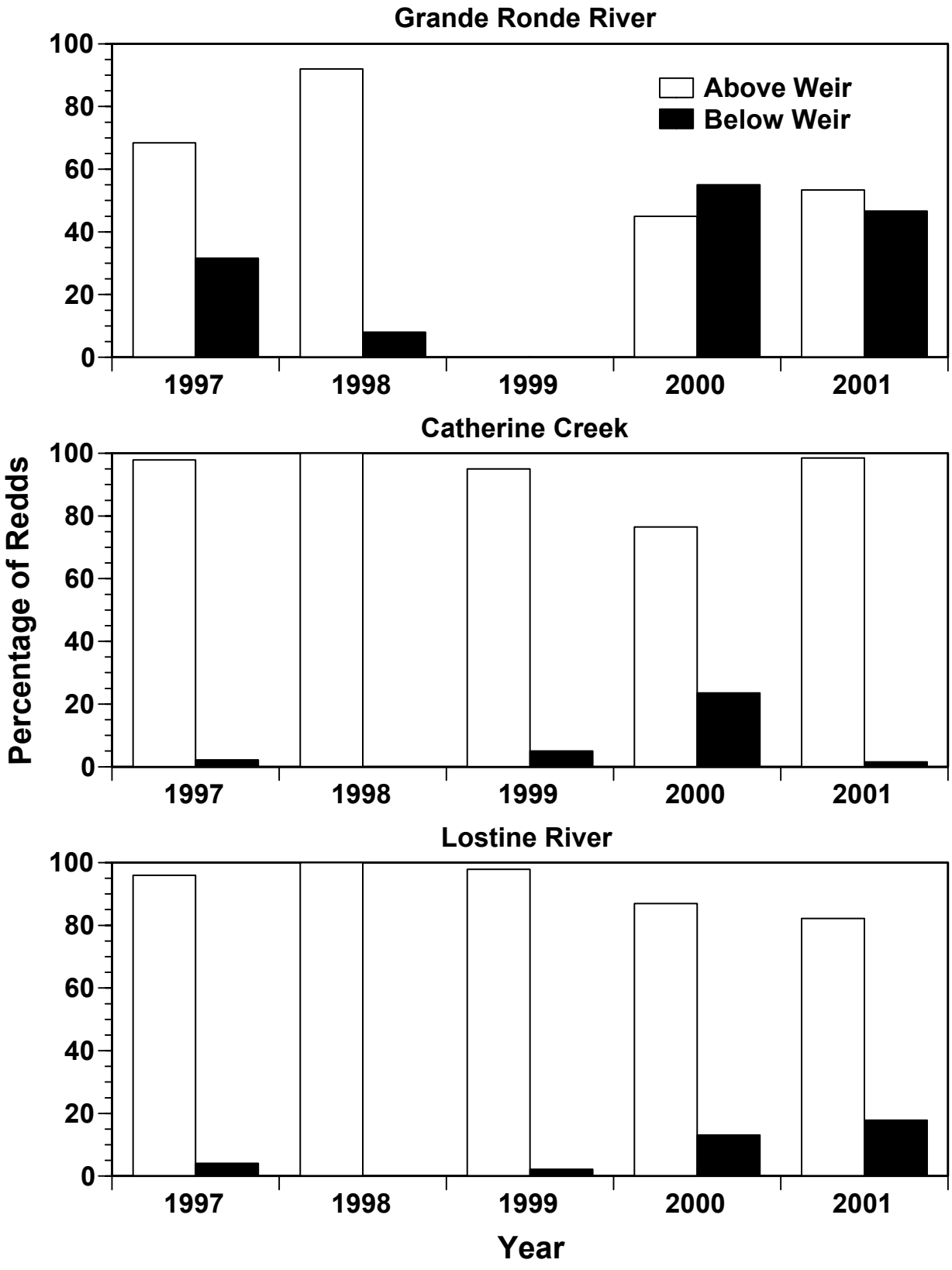

Figure 3. Percentage of redds observed above and below weirs in Grande Ronde River, Catherine Creek and Lostine River, 1997-2001.

9) Fish Provided to Educational or Public Outreach Programs

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

10) Anticipated Program Changes in 2002 and Beyond

We plan to manage the trapping, collection, handling and spawning of adults in 2002 in a similar manner as in 2001 with a few exceptions. First, we will continue to install the weir on Catherine Creek in early March and the weir on Grande Ronde River in late March in an effort to collect steelhead and chinook salmon from across the entire run. We will also make modifications necessary to improve our efficiency at these weirs. 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.

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.

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 2002, we expect a large run, based on projected returns of wild chinook salmon to Lower Granite Dam (Table 34). There are numerous areas for error in this estimator. However, all estimators of the 2002 run size place the expected number of adults in the highest escapement category of the sliding scale (See Endangered Species Permit Number 1011). Projected returns to the upper Grande Ronde River fall into the lowest escapement category of the sliding scale. Adult collection ratios and spawning criteria will be modified as more information becomes available and will conform to permit criteria.

Table 34. Projected adult (non-jack) returns and broodstock collections for supplementation in the Grande Ronde River, Catherine Creek and Lostine River, 2002.

Stream	Total estimated run	Estimated number to be trapped*	Percentage of wild run to be retained	Maximum number of wild fish to be retained	Maximum number of wild females to be retained
Grande Ronde River	70	56	50%	100	50
Catherine Creek	392	314	20%	100	50
Lostine River	495	396	20%	100	50

* Assumed 80% trapping efficiency