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Project Contact: Rich Carmichael

Authors: Timothy L. Hoffnagle
Donald Hair
Sally Gee

Agency: Northeast Region Fish Research, Oregon Department of Fish and
Wildlife, La Grande, OR 97850

Contributors: NOAA Fisheries
Nez Perce Tribe
Confederated Tribes of the Umatilla Indian Reservation

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EXECUTIVE SUMMARY

The Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program is designed to rapidly increase numbers of Chinook salmon in stocks that are in imminent danger of extirpation in Catherine Creek (CC), Lostine River (LR) and upper Grande Ronde River (GR). Natural parr are captured and reared to adulthood in captivity, spawned (within stocks) and their progeny reared to smoltification before being released into the natal stream of their parents. This program is co-managed by ODFW, National Marine Fisheries Service, Nez Perce Tribe and Confederated Tribes of the Umatilla Indian Reservation. Presmolt rearing was initially conducted at Lookingglass Fish Hatchery (LFH) but parr collected in 2003 and later were reared at Wallowa Fish Hatchery (WFH). Post-smolt rearing is conducted at Bonneville Fish Hatchery (BOH - freshwater) and at Manchester Research Station (MRS - saltwater).

The CC and LR programs are being terminated, as these populations have achieved the goal of a consistent return of 150 naturally spawning adults, so the 2005 brood year was the last brood year collected for these populations. The Grande Ronde River program continued with 300 fish collected each year. Currently, we are attempting to collect 150 natural parr and incorporate 150 parr collected as eggs from females with low ELISA levels from the upper Grande Ronde River Conventional Hatchery Program. This is part of a comparison of two methods of obtaining fish for a captive broodstock program: natural fish vs. those spawned in captivity. In August 2007, we collected 152 parr (BY 2006) from the upper Grande Ronde River and also have 155 Grande Ronde River parr (BY 2006) that were hatched from eyed eggs at LFH. During 2008, we were unable to collect natural parr from the upper Grande Ronde River. Therefore, we obtained 300 fish from low ELISA females from the upper Grande Ronde River Conventional Program. In October 2008 we obtained 170 eyed eggs from the upper Grande Ronde River Conventional Hatchery Program. We will attempt to collect natural parr in August 2009.

This year 752 fish were removed from the captive population: 629 fish survived to gamete production and 123 fish died from various causes prior to spawning. Growth of the Captive Broodstock fish was similar to previous years. The saltwater fish have grown more slowly than those reared in freshwater. A total of 720 fish were sorted as maturing and 629 (87.4%) of them survived to spawn. We collected gametes from 273 females and 350 males from the 2002-2006 brood years in 2008, using 111 spawning matrices and collected 474,187 green eggs (1,737 eggs/female). All ripe males were spawned and no semen was collected for cryo-preservation.

Of the 474,187 eggs collected for the BY 2008 F₁ generation, 448,373 (94.6%) survived to the eyed stage. 68,612 (15.3%) were culled from females with high ELISA OD values for BKD prevention.

For BY 2007, we collected a total of 477,048 eggs from all three populations and 407,369 (85.4%) reached the eyed stage, while 95,024 eyed eggs (23.3%) were culled for BKD prevention. Eyed eggs were hatched at Lookingglass Fish Hatchery, producing 267,131 fry. As parr, 153,371 fish were coded-wire tagged (CWT).

For the 2006 F₁ brood year, we collected 177,890 eggs and 149,073 (83.8%) reached the eyed stage. 83,826 eyed eggs (56.2%) were culled at the eyed stage for BKD prevention. 61,044 fry were produced (93.6%), 53,688 (88 %) survived to smolt.

There were 54 bacterial kidney disease (BKD) mortalities at BOH and MRS, combined in this reporting period. Overall, there were fewer BKD mortalities in 2008 due to a reduced number of fish coming into the Captive Broodstock Program and a shift away from collecting wild parr to using eyed eggs from low ELISA females from the Conventional Hatchery Program. Unknown causes of death accounted for 32 deaths at MRS and BOH, combined in 2008.

We continually examine and modify the operations of the Captive Broodstock Program to make improvements wherever possible. We continue to have difficulty with prevention and treatment of BKD outbreaks and continue to use erythromycin and azithromycin to treat this disease. We are also continuing to investigate other possible treatments and prophylactic measures. To reduce the incidence of BKD in offspring of the Captive Broodstock Program, we continue to allow culling of eyed eggs from females with high BKD ELISA values (generally >0.800 OD units but the cull level varies annually, depending on the distribution of ELISA values, number of eggs collected, and management considerations). We are also using ultrasound to determine maturity and sex of fish early in the maturation process and are now able to determine maturity and sex of most maturing fish 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.

The Technical Oversight Team, which includes personnel from ODFW, NPT, CTUIR, and NMFS, and had five regular meetings in 2008 and continues to guide the daily activities associated with the Captive Broodstock Program. Tim Hoffnagle (ODFW Fish Research) is the representative for the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program to the regional Chinook Salmon Captive Propagation Technical Oversight Committee, a group of biologists from state, federal, and tribal agencies in Idaho, Oregon, and Washington that is facilitated by the Bonneville Power Administration and coordinates regional work.

INTRODUCTION

BPA Fish and Wildlife Program Project Number 2007-404-00 provides funding for the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program, in Catherine Creek (CC), Lostine River (LR) and upper Grande Ronde River (GR). The Captive Broodstock Program is designed to rapidly increase numbers of Chinook salmon in stocks that are in imminent danger of extirpation. Natural parr are captured and reared to adulthood in captivity. Upon maturation, these fish are spawned (within stocks) and their progeny reared to smoltification before being released into the natal stream of their parents. This program is co-managed by ODFW, National Marine Fisheries Service, Nez Perce Tribe and Confederated Tribes of the Umatilla Indian Reservation. This report covers activities conducted, and provides cursory data analyses for the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program from 1 January – 31 December 2008. Detailed information on historic and present population status, project background, goals and objectives, significance to regional programs and relationships to other programs are available in the 1995-2002 Project Status Report (Hoffnagle et al. 2003). More detailed analyses covering all previous project activities is available in the 1995-2002 Project Status Report (Hoffnagle et al. 2003) and subsequent annual reports (ODFW 2004; 2005; 2006; 2007; 2008a).

DESCRIPTION OF STUDY AREA & FACILITIES

The Grande Ronde River Basin drains approximately 10,700 km² of northeast Oregon and southeast Washington, with headwaters in the Blue and Wallowa mountains. It enters the Snake River at RK 272, upstream from Asotin, WA. Catherine Creek and the Lostine River are two of the larger tributaries to the Grande Ronde River. Catherine Creek flows directly into the Grande Ronde River at RK 224, downstream from La Grande, OR. The Lostine River flows into the Wallowa River near the town of Wallowa and the Wallowa River enters the Grande Ronde River at RK 132.

Chinook salmon in the Grande Ronde Basin must migrate approximately 1,120 km between the ocean and spawning and rearing habitat in the upper basin. Their migration route takes them through eight dams and associated reservoirs on the Columbia and Snake rivers.

Prior to 2003, parr were collected and taken to Lookingglass Fish Hatchery (LFH) for pre-smolt rearing. Parr collected in 2003 and later were transported to Wallowa Fish Hatchery (WFH) Enterprise, OR. At WFH they are reared to smolt stage in 1.2 m diameter circular tanks on a simulated natural growth regime utilizing spring water that varies seasonally from 5 - 13° C.

Post-smolt rearing takes place at Bonneville Fish Hatchery (BOH - freshwater), on the Columbia River near Cascade Locks, OR, and at Manchester Research Station (MRS - saltwater), on Puget Sound near Port Orchard, WA. Detailed information on the study area and facilities is available in the 1995-2002 Project Status Report (Hoffnagle et al. 2003).

METHODS

Protocols that are being followed can be found in the 2008 Annual Operating Plan (ODFW 2008b).

Pre-smolt Collection and Rearing

The number of parr collected for each stock was reduced from 500 to 300 in 2006. The 2005 brood year was the last brood year collected for the Catherine Creek and Lostine River programs, as these populations have established the minimum adult returns necessary to use only the Conventional Broodstock Program. The Grande Ronde River program continued with 300 fish collected each year.

Beginning with the 2004 brood year, collected in 2005, we concluded the accelerated vs. natural growth regime evaluations and began to address our concerns with BKD. Currently, all fish are being reared in spring water on a natural temperature regime at WFH during the pre-smolt growth phase.

2006 Brood Year (January – April)

In August 2007, we collected 152 parr from the Upper Grande Ronde River using passive seining techniques. We collected the parr from throughout the known rearing area of each stock in order to incorporate as much genetic variability as possible into the captive broodstock. At the end of each day's collections, fish were transported to WFH where they were weighed, measured, injected with azithromycin, and separated into rearing/treatment regime groups. We also have a group (155) of 2006 brood year Grande Ronde River fish that were hatched from eyed eggs obtained from females with low (<0.2) ELISA values from the Conventional Program in October 2006. The eggs were transported from Lookingglass Fish Hatchery to WFH, where they were hatched and are being reared. BKD and other disease history for the two groups, as well as growth rate, size at maturation, survival and other hatchery parameters, will be evaluated and compared. These fish were transferred from WFH to BOH in April 2008.

2007 Brood Year (January – December)

During 2008, we were unable to collect natural parr from the Upper Grande Ronde River, despite our best efforts. We obtained 159 fish that were hatched from 170 eggs collected from low ELISA females from the Upper Grande Ronde River Conventional Program during October 2007. When it became apparent that we would not be able to collect any wild parr, we obtained an additional 150 fish from low ELISA females from the Upper Grande Ronde River Conventional Program in September 2008. One hundred fifty fish from each group, for a total of 300, were PIT-tagged and a genetic sample was collected from each fish during an inventory at WFH in mid-November 2008.

2008 Brood Year (October – December)

In October 2008 we obtained 170 eyed eggs from the GR stock Conventional Program at LFH. These are being held at LFH for incubation on UV treated river water. After hatching, when the fry have buttoned up, the fish will be transferred to WFH for rearing, as part of the egg vs. parr BKD experiment. We will attempt to collect natural parr in August 2009.

Post-smolt Rearing

At smoltification (April – May) during previous years, the salmon were transferred to either BOH for rearing in freshwater, or MRS for rearing in saltwater. However, the freshwater vs. saltwater rearing evaluation is ending, and all smolts will now be reared at BOH and be part of the egg vs. parr evaluation (see below). Therefore, no more smolts will be sent to MRS. All 2006 brood year smolts were transported to BOH in May 2008 and placed in separate tanks based on their origin (egg or parr).

During July, following transfer to MRS or BOH, maturing fish received a Visual Implant tag (VI tag) that has a unique 3 character code and tag color combination. This is used as a back up to identify the fish in case the PIT tag is lost. Because limited numbers of fish survive to ages five and six, individuals of the same stock may be combined with age 4 fish to conserve space. After transfer, fish are sampled twice a year at MRS and BOH and treated for disease, as needed. In the spring, all fish are inventoried, maturity status is assessed, lengths and weights measured and all remaining age 3 fish are VI-tagged. In the fall, after spawning, a subsample of lengths and weights are collected to monitor growth. Additional data are collected during subsequent maturity sorts (MRS and BOH), ripe sorts (BOH only), and any time a fish dies.

Following maturity sorts in April and May, all saltwater fish determined to be maturing are transferred to freshwater (BOH) where all mature fish are held for spawning in September and October. The sex ratio of maturing fish is calculated and that information is used to determine the number and type of spawning matrices necessary for each population and treatment during spawning (ODFW 2008b). One of our objectives is to maximize genetic diversity in these populations by maximizing the number of family groups and minimizing potential for sibling crosses. Whenever there are too few fresh males available for a spawning matrix, cryopreserved semen is used (ODFW 2008b). Spawning protocols change when cryopreserved semen is used, since fertilization rate is much lower.

Fertilized eggs are transported to Oxbow Fish Hatchery for incubation to the eyed stage. Once eyed, eggs are transported to LFH for hatching and rearing to the smolt stage. At smoltification, in early April, they are transferred to acclimation facilities and released into their parents' natal stream. All ODFW activities conducted after the eggs are fertilized are funded by the Lower Snake River Compensation Plan (U.S.F.W.S.).

Throughout the program, hatchery personnel and fish health specialists regularly monitor fish health and condition and inspect mortalities to determine cause of death. Disease treatments are carried out as appropriate. The most common and survival-threatening infection has proven to be BKD. This has prompted the development of the additional studies mentioned above and outlined below. Additional information on methods used in the project is available in the 1995-2002 Project Status Report (Hoffnagle et al. 2003) and subsequent annual reports (ODFW 2004; 2005; 2006; 2007; 2008a).

Egg vs. Parr Collection

The co-management agencies and appropriate facilities have agreed to conduct this experiment. It is aimed directly at the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program, in which BKD has been the largest cause of mortality, but will provide valuable information for developing future captive broodstock programs.

Parr captured in nature for the Captive Broodstock Program are often infected with *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease, which may become very problematic once the salmon are in the program. The Salmon River Chinook Salmon Captive Rearing Program (Idaho) successfully reduced their incidence of BKD and other diseases/parasites by collecting eyed eggs from natural redds (P. Kline, IDFG, personal communication). The Confederated Tribes of the Umatilla Indian Reservation suggested using a similar approach for our program but to use eggs from low ELISA females from conventional hatchery programs instead of collecting eggs from nature. This approach is likely to reduce the incidence of disease but increases the risk of developing a domesticated hatchery stock. Also, since most future adult returns would come from only a few parents, there is a large genetic risk associated with a reduction in effective population size (Ryman-Laikre effect). Goals of the Captive Broodstock Program and Lower Snake River Compensation Plan include minimizing

genetic risks to these stocks. Therefore, we are comparing natural parr collected from the upper Grande Ronde River vs. parr produced from eggs taken from the Conventional Program broodstock spawned at Lookingglass Fish Hatchery for use in the Captive Broodstock Program. Disease history, growth rate, size at maturation, survival and other hatchery parameters of the salmon hatched from eyed eggs will be compared to those of the natural parr collected during parr collection.

RESULTS, DISCUSSION & RECOMMENDATIONS

Captive Broodstock Population Summary

Here, we account for all fish remaining or removed from each brood year of the captive population from 1 January - 31 December 2008. No fish from the 1994-2001 brood years were alive in 2008.

This year 752 fish were removed from the captive population: 629 fish survived to gamete production and 123 fish died from various causes prior to spawning (Table 1). Mortalities during 2008 were sent to the Clackamas, La Grande, or Manchester fish health laboratories for examination and determination of cause of death.

2002 Brood Year

We collected 513 parr from Catherine Creek, 503 from the Grande Ronde River, and 500 from the Lostine River in August 2003. Of the original 1,516 parr collected, 3 fish were still alive as of 31 December 2007 (Table 1). Of the 2 fish removed from the population in 2008, 1 female produced gametes, and 1 died from other/unknown causes. One Catherine Creek fish remained alive on 31 December 2008.

2003 Brood Year

Five hundred spring Chinook salmon parr were collected from each of Catherine Creek, the Grande Ronde River, and the Lostine River in August 2004, and 41 fish were still alive as of 31 December 2007 (Table 1). Of the 39 fish removed from the population in 2008, 24 produced gametes, 9 fish died from BKD, 2 fish died from diseases other than BKD, and 4 from other/unknown causes.

2004 Brood Year

In August 2005, we collected 302, 309, and 300 spring Chinook salmon parr from Catherine Creek, Grande Ronde River, and Lostine River, respectively. We had 373 fish remaining 31 December 2007 (Table 1). Of the 348 fish removed from the population, 277 produced gametes, 45 died from BKD, 4 from other diseases, 7 from operational causes, and 15 from other/unknown causes.

2005 Brood Year

A total of 750 naturally-produced parr from the 2005 brood year were collected in 2006: 300 Catherine Creek, 300 Lostine River, and 150 Grande Ronde River. An additional 180 GR 2005 brood year fish were hatched from eyed eggs obtained from low ELISA females in the upper Grande Ronde River Conventional Program. These fish were culled down to 150 fish in August for comparison to the GR natural parr collected. This resulted in 900 fish total for the 2005 cohort. There were 787 fish remaining as of 31 December 2007 (Table 1). Of the 301 that died

during 2008, 270 produced gametes, 4 died from operational causes, 5 died from diseases other than BKD, and 22 died from other/unknown causes.

2006 Brood Year

In October 2006 we obtained 168 GR 2006 brood year eyed eggs from low ELISA females in the Conventional Program at Lookingglass Fish Hatchery. These were transported to WFH for hatching and rearing. They were culled to 156 fish in August 2007 for comparison to the 157 natural parr collected from the Grande Ronde River. As of 31 December 2007, there were 306 fish remaining. Of the 58 fish that died in 2008, 57 produced gametes and 1 died of unknown causes.

2007 Brood Year

On 1 November 2007, we obtained 170 eyed eggs from low ELISA females in the Grande Ronde Basin Conventional Program at Lookingglass Fish Hatchery. These were transported to WFH for hatching and rearing. When it became apparent that we could not collect any wild parr, an additional 150 parr were obtained from LFH and transported to WFH. Four fish died in 2008, 2 from operational causes, and 2 from other/unknown causes. Three hundred fish remain alive as of 31 December 2008.

Growth

We measured fork length and weight of captive fish during inventories, maturity sorting, samplings, and transfers, to monitor growth. Between the first maturity sort (early/mid-April for 2002-2005 brood years and mid-July for 2006 brood year) and spawning only those fish classified as mature were examined and measured. During the last quarterly sample in late November, we measured length and weight of the fish that did not mature in 2008. Here we provide information on size of the fish in each brood year (2002-2006), by stock and treatment, during April (all fish) and September/October (spawning fish) (Tables 3-7). Growth of the Captive Broodstock fish was similar to previous years.

2002 – 2006 Brood Years

Post-smolt growth in both freshwater and saltwater has shown consistent patterns throughout the study (Tables 3-6). In nearly all stocks and brood years, the saltwater fish have grown more slowly than those in freshwater. Also, during post-smolt sampling, fish reared under the pre-smolt “natural growth regime” tend to become larger than the fish reared under an “accelerated growth regime” as pre-smolts.

2007 Brood Year

Mean fork length and weight for parr from Grande Ronde Conventional Egg Group 1 of the 2007 brood year increased by 34 mm, and 7.3 g from time of the June sample to PIT-tagging in November. Conventional Egg Group 2 fish were transferred from Lookingglass Fish Hatchery to WFH at the end of September and sampled in November. These fish were larger at the November sample because they were reared at Lookingglass Hatchery under a normal production regime, while the Group 1 fish were reared under a simulated natural regime at WFH.

2008 Brood Year (Egg Group)

In 2008/2009 we will hold eggs on stream water at LFH until they hatch, “button up” and are ready to feed. By that time the stream temperatures should have increased to almost the same

as the temperature of the water in the spring source at WFH. We will also manage feed and growth to produce fish more similar in size to the natural parr which will be collected in August.

Maturity and Spawning **(Using numbers collected by Captive Broodstock Program)**

The 2002-2005 brood years were first examined for signs of maturity on 15-17 April 2008 at BOH and 22-23 April 2008 at MRS. The 2006 brood year was first examined for signs of maturity on 22 July 2008. Additional maturity sorts were conducted for each brood year and stock based on guidelines in the 2008 Captive Broodstock Annual Operating Plan (AOP). A total of 720 fish were sorted as maturing (Table 9). Of these, 629 (87.4%) survived to spawn, 71 (9.9%) died prior to spawning, and 20 (2.8%) were found to be immature and were returned to rearing tanks. Fish were examined for ripeness at BOH weekly from 1 September - 13 October 2008. No ripe sorts were done at MRS, since all mature fish were transferred to BOH for spawning.

We collected gametes from 273 females and 350 males from the 2002-2006 brood years in 2008. All ripe males were spawned and no semen was collected for cryo-preservation (Table 9).

All spawning was done using spawning matrices developed following guidelines identified in the 2008 Captive Broodstock AOP. One hundred and eleven spawning matrices were used in 2008. A total of 474,187 green eggs were collected from 273 females (1,737 eggs/female).

2002 Brood Year

Three fish from the 2002 brood year were sorted as mature in 2008. Of these, 1 female was spawned, and two fish were returned as immature (Table 9). A total 438 eggs were collected (Table 10).

2003 Brood Year

Thirty-four fish from the 2003 brood year were sorted as mature. Of these, 14 females and 7 males and were spawned (Table 9). A total of 11,761 eggs were collected from this brood year (Table 10).

2004 Brood Year

Three hundred and twenty-five fish from the 2004 brood year were sorted as mature. Of these, 18 males were spawned, and 257 females were spawned (Table 9) which produced 459,877 green eggs (Table 10).

2005 Brood Year

Three hundred and one fish were sorted as mature. Of these, 1 female and 268 males were spawned (Table 9). This produced 2,111 green eggs (Table 10). The age 3 female was approximately four times as fecund as the age 5 female.

2006 Brood Year

Fifty-seven males were mature, and all were spawned (Table 9).

Incubation and F₁ Generation

(Using numbers collected and provided by Oxbow Hatchery and LSRCP)

Because the Captive Broodstock Program and Oxbow Fish Hatchery estimate egg numbers using different methods the numbers are not the same. In this document estimates of numbers of eggs incubated and survival to fry are calculated using data provided by Oxbow Fish Hatchery. We obtain data on number of parr coded wire tagged and smolts released from the Lower Snake River Compensation Program.

2008 F₁ Brood year

Of the 121,585 eggs collected from Catherine Creek stock 118,616 (97.6%) survived to the eyed stage. Of the 224,353 eggs collected from Grande Ronde River stock fish 213,298 (95.1%) survived to the eyed stage, and of the 128,249 eggs collected from Lostine River stock fish 116,459 (90.8%) survived to the eyed stage (Table 10). From the 474,187 eggs collected 68,612 (15.3%) were culled for BKD prevention (Table 11).

2007 F₁ Brood Year

The 2007 F₁ brood year was spawned at Bonneville Fish Hatchery, where we collected a total of 477,048 eggs from all three stocks (Table 12). These eggs were transported to Oxbow Fish Hatchery for incubation, where 407,369 (85.4%) reached the eyed stage. A total of 95,024 eyed eggs (23.3%) were culled at the eyed stage from females with high BKD ELISA OD values (Table 12). Eyed eggs were then transferred to Lookingglass Fish Hatchery where they hatched producing 267,131 fry. As parr, 153,371 fish were coded-wire tagged (CWT).

2006 F₁ Brood Year

The 2006 F₁ brood year was spawned at Bonneville Fish Hatchery, where we collected a total of 177,890 eggs from all three stocks (Table 13). These eggs were transported to Oxbow Fish Hatchery for incubation, where 149,073 (83.8%) reached the eyed stage. A total of 83,826 eyed eggs (56.2%) were culled at the eyed stage from females with high BKD ELISA OD values. Cut-off ELISA OD values for culling were ≥ 0.8 for Catherine Creek and upper Grande Ronde River and ≥ 0.4 for Lostine River fish. All Grande Ronde River eyed eggs were released as eggs into Meadow Creek. The remaining eyed eggs were then transferred to Lookingglass Fish Hatchery for hatching and 61,044 fry were produced for a 93.6% hatching rate from the retained eyed eggs. Of the fry, 53,688 (88 %) survived from fry to smolt. Ten thousand four hundred and seventy Lostine River smolts were released, and 43,218 Catherine Creek smolts were released from Lookingglass Fish Hatchery into Lookingglass Creek.

Fish Health Monitoring and Disease

There were 54 bacterial kidney disease (BKD) mortalities at BOH and MRS, combined in this reporting period. Overall, there were fewer BKD mortalities due to a reduced number of fish coming into the Captive Broodstock Program and a shift away from collecting wild parr to using eyed eggs from low ELISA females in the Conventional Program. Unknown causes of death accounted for 32 deaths at MRS and BOH, combined in 2008.

Bonneville Fish Hatchery

Bacterial kidney disease was the leading cause of mortality at BOH. Overall, 52 of 103 (50.5%) mortalities were categorized as being caused by BKD (Table 14). Most BKD mortality occurred in the Catherine Creek 2004 brood year where 41/45 (91.1%) mortalities were found to be due to this disease. All four Grande Ronde River 2003 brood year mortalities were also due to BKD. In the Lostine River 2003 and 2004 brood years, 2/4 (50%) and 4/9 (44.4%) of the mortalities, respectively, were due to BKD. Of all stocks combined, 22/103 (21.3%) died of unknown causes, 11/103 (10.7%) died from *Aeromonas/Pseudomonas* septicemia and 10/103 (9.7%) of the mortalities were attributed to failure to osmoregulate. The remaining causes of mortality were senescence (7) and wasting (1). Samples collected for whirling disease analysis in 2008 that were positive for *Myxobolus cerebralis* are as follows: 1/2 (50%) Lostine River 2003, 8/53 (15.1%) Lostine River 2004 and 1/8 (12.5%) Lostine River 2005. All 42 Grande Ronde River 2004, seven Grande Ronde River 2005 and eight Catherine Creek 2005 fish tested negative for whirling disease.

Manchester Research Station

Mortalities due to unknown causes were the leading cause of mortality at MRS. Overall, 10 of 16 (62.5%) mortalities died of unknown cause (Table 15). Bacterial kidney disease caused two Grande Ronde River 2003 mortalities and bloat caused one mortality in each of the Grande Ronde 2003 and 2004 brood year fish. The remaining causes of mortality were dropout (1) and maturing in seawater (1).

Adult Spawners at Bonneville Hatchery 2008

All samples collected from spawning adults and analyzed for culturable viruses were negative. High BKD ELISA values were detected in Captive Broodstock females sampled at spawning in September and October of 2008, though not in all stocks (Figure 1). Catherine Creek, Lostine River and Grande Ronde River stocks had 27.2%, 18.1% and 0% of females with ELISA values ≥ 0.800 OD units, respectively.

Wallowa Fish Hatchery

There were no Grande Ronde River Captive Broodstock 2006 brood year mortalities at WFH in 2008. The 2006 brood year was transferred to BOH on 21 April 2008.

All Grande Ronde River Captive Broodstock 2007 brood year fish were produced from eyed eggs from the conventional program. There were three 2007 brood year mortalities at WFH in 2008 (Table 16). Causes of mortality were dropout (2) and killed (2). The killed fish were euthanized since they hadn't been eating well and weren't expected to live much longer; no specific fish pathogens were detected. Two days of prophylactic formalin treatments at 167 ppm were given following PIT tagging in November.

F₁ Generation

La Grande Fish Health Services personnel monitored the 2006 brood year F₁ progeny at LFH in January - March 2008 and mortalities provided from acclimation sites. The 2007 brood year progeny were monitored throughout rearing in 2008 at Lookingglass Hatchery. Two scheduled 28 day Aquamycin medicated feedings were given to the Catherine Creek and Grande Ronde River BKD moderate groups. The first feeding started on 16 April and the second one started on 22 July. One 28 day Aquamycin feeding was given to all BKD lows starting on 22 July.

2006 brood year

There was one BKD mortality detected throughout rearing in the Catherine Creek F₁ smolts released in 2008 (Table 17). All BKD ELISA values from dead or moribund Catherine Creek fish throughout rearing to the end of February were ≤ 0.075 OD units. However, one of 10 (10%) mortalities examined during the pre-liberation examination in March at Lookingglass Hatchery had gross signs of BKD and a BKD ELISA value of 2.283 OD units. This fish was from raceway 4 (moderate-high BKD segregation). All 60 grab-sampled fish from the pre-liberation examination had BKD ELISA values ≤ 0.082 OD units. All samples collected for virus throughout rearing to release were negative. Internal fungus was detected in 1/30 (3.3%) dead or moribund fish (January-March 2008).

There were no significant fish health problems detected in the Lostine River F₁ smolts released in 2008 (Table 17). All samples collected for virus throughout rearing to release were negative. All Lostine River BKD ELISA values from dead or moribund fish throughout rearing were ≤ 0.070 OD units. All 30 grab-sampled fish from the pre-transfer examination had BKD ELISA values ≤ 0.076 OD units. We examined five Captive Broodstock F₁ mortalities from the Lostine River acclimation site; all BKD ELISA values were ≤ 0.057 OD units indicating these fish did not have a BKD problem.

2007 brood year

There were no significant disease problems detected in the Catherine Creek, Grande Ronde River or Lostine River 2007 brood year fish at LFH in 2008 (Table 18). There were no BKD mortalities among the 82 dead or moribund fish tested by ELISA in 2008 (all values were ≤ 0.134 OD units). All samples collected from 2007 brood year F₁ fish for virus testing in 2008 were negative for culturable viruses. *Flavobacterium psychrophilum* (cold water disease bacteria) was detected at low levels in 1/86 (1.2%) Catherine Creek and 1/76 (1.3%) Grande Ronde River dead or moribund fish (March – December 2008). In July 2008, the hatchery crew reported seeing some black areas near the dorsal fin of fish in several raceways at LFH. This was confirmed by Fish Health examinations in July. The highest level of this was in the Catherine Creek F₁ stock, though the Grande Ronde River and Lostine River F₁ stocks also had some to a lesser degree as well as raceways of conventional production fish. This subsided on its own, and a specific cause was never determined.

DISCUSSION AND MANAGEMENT RECOMMENDATIONS

Fish Health and Disease

We continue to have difficulty with prevention and treatment of BKD outbreaks. We continue to use erythromycin and azithromycin to treat this disease in the form of injections, pills, and treated feed. We are continuing to investigate other possible treatments and prophylactic measures to deal with this disease in the Captive Broodstock and their offspring. We are also examining a reduction in the use of antibiotics, as antibiotic resistance is a concern.

To reduce the incidence of BKD in offspring of the Captive Broodstock Program, the Technical Oversight Team (TOT) continues to allow culling of eyed eggs from females with high BKD ELISA values (generally >0.800 OD units but the cull level varies annually, depending on the distribution of ELISA values, number of eggs collected, and management considerations). We anticipate that these practices will reduce vertical transmission of BKD. 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.

Maturity Sorts & Spawning

We are using ultrasound to determine maturity and sex of fish early in the maturation process. We are now able to determine maturity and sex of most maturing fish 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. A second maturity sort is carried out in late May or early June to determine if any additional fish have started to mature. Conducting only one maturity sort on most fish in April reduces the stress on the fish that is caused by multiple handlings. Use of ultrasound allows us to further decrease fish handling.

Coordination

The TOT continues to guide the daily activities associated with the Captive Broodstock Program. The TOT includes personnel from ODFW, NPT, CTUIR, and NMFS, and had five regular meetings in 2008. The regional Chinook Salmon Captive Propagation Technical Oversight Committee (TOC) is a group of biologists from state, federal, and tribal agencies in Idaho, Oregon, and Washington that is facilitated by the Bonneville Power Administration and coordinates regional work: Tim Hoffnagle (ODFW Fish Research) is the representative to the TOC for the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program.

Database Management

The Captive Broodstock database is expanding rapidly as new brood years are 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 require access to the database or data summaries. We have responded to changing data needs by filling requests by users to create new tables (additional data), additional forms or modifications to existing forms to facilitate data entry, and assisted personnel develop new queries to retrieve needed data. We currently have a problem with the Captive Broodstock database. The database works well on all of the individual computers, but synchronization across the internet has not worked for most of 2008. We have not been able to fix the problem, and currently synchronize using replicas on “flash drives” as a temporary solution. We have purchased a new server to replace the server purchased in 2002, but have not received it yet.

Figure 1. Percent of females in each BKD ELISA category during spawning of the Catherine Creek (top), upper Grande Ronde River (middle), and Lostine River (bottom) stocks, 2008.

Table 1. Fish alive on 1 January 2008, mortalities, number that matured and survived to gamete collection, and number remaining for each brood year and stock^a of the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program as of 31 December 2008.

Cohort	Stock	Number alive 1 JAN	Mortalities					Matured and survived to gamete production	Total morts	Number remaining 31 DEC
			BKD	Operational	Other	Other diseases	Unknown			
2002	CC	2						1	1	1
	GR	0						0	0	0
	LR	1			1			0	1	0
2003	CC	16	1		1	1	1	10	14	2
	GR	10	6		1			3	10	0
	LR	15	2			1	1	11	15	0
2004	CC	133	41				4	77	122	11
	GR	140		4	1	3	7	119	134	6
	LR	100	4	3		1	3	81	92	8
2005	CC	284			3		5	112	120	164
	GR	243			2	3	3	65	73	170
	LR	260		4	2	2	7	93	108	152
2006	GR	306					1	57	58	248
2007 ^b	GR	<u>304</u>	<u>—</u>	<u>2</u>	<u>2</u>	<u>—</u>	<u>—</u>	<u>0</u>	<u>4</u>	<u>300</u>
Totals		1814	54	13	13	11	32	629	752	1062

^a Stocks: CC = Catherine Creek, GR = upper Grand Ronde River, LR = Lostine River.

^b 2007 cohort ponded March and October 2008.

Table 2. Take and disposition of 2007 brood year spring Chinook salmon collected and transported to Wallowa Fish Hatchery for the Captive Broodstock Program in 2008.

Activity	Eyed eggs from Grande Ronde River Conventional Hatchery Program Group 1	Eyed eggs from Grande Ronde River Conventional Hatchery Program Group 2
Collection dates	1 November 2007	25 September 2008
Number collected	170 (eyed eggs)	N/A ^a
Number ponded	159	150
Number PIT-tagged and genetic samples taken	150	150
Number at WFH on 31 December 2008	150	150

^a These fish were collected as parr from the raceway at Lookingglass Hatchery.

Table 3. Mean fork length (FL, mm) and weight (W, g) in April (all fish), and September/October (spawning fish) of 2002 brood year Chinook salmon collected from Catherine Creek, Grande Ronde River, and Lostine River, and reared under various treatments^a in freshwater at Bonneville Fish Hatchery, or saltwater at Manchester Research Station, 2008.

Stock	Treatment ^a	April (all fish)			September/October (mature)					
		N	FL	W	Male			Female		
		N	FL	W	N	FL	W	N	FL	W
CC	SA	No fish remain alive								
CC	SN	2	452.0	1111.9				1	436.0	864.30
LR	SA	1 ^b	483.0	1156.40						
LR	SN	No fish remain alive								

^a Treatment codes, first letter: F= freshwater, S=saltwater.

Treatment codes, second letter: A=accelerated, N=natural.

^b This fish was determined to be immature and was not spawned.

Table 4. Mean fork length (FL, mm) and weight (W, g) in April (all fish) and September/October (spawning) of 2003 brood year Chinook salmon collected from Catherine Creek, Grande Ronde River, and Lostine River, and reared under various treatments^a in freshwater at Bonneville Fish Hatchery, or saltwater at Manchester Research Station, 2008.

Stock	Treatment ^a	N	April (all fish)		September/October (mature)					
			FL	W	Male			Female		
					N	FL	W	N	FL	W
CC	FA	4	496.8	1663.80	1	502.0	1474.50	2	539.5	1745.75
CC	FN	2	522.0	1509.75				1	550.0	1882.00
CC	SA	4	448.0	1147.25	1	526.0	1520.50	2	426.0	877.40
CC	SN	3	486.0	1415.43	1	509.0	1515.80	2	472.0	1076.75
GR	FA	1	398.0	789.70				1	403.0	679.20
GR	FN				no fish remain alive					
GR	SA	1	421.0	954.00				1	438.0	899.50
GR	SN	2	484.0	1484.75				1	551.0	1949.20
LR	FA	3	508.0	1762.00	2	516.5	1674.45			
LR	FN	5	535.2	2157.90	1	666.0	2625.10	2	527.5	1973.90
LR	SA	3	463.3	1162.07				2	473.0	1050.40
LR	SN	4	484.8	1582.95	1	416.0	1683.20	1	549.0	1848.80

^a Treatment codes, first letter: F= freshwater, S=saltwater.

Treatment codes, second letter: A=accelerated, N=natural.

Table 5. Mean fork length (FL, mm) and weight (W, g) in April (all fish) and September/October (spawning) of 2004 brood year Chinook salmon collected from Catherine Creek, Grande Ronde River, and Lostine River, and reared under various treatments^a in freshwater at Bonneville Fish Hatchery, or saltwater at Manchester Research Station, 2008.

Stock	Treatment ^a	April (all fish)			September/October (mature)					
		N	FL	W	Male			Female		
		N	FL	W	N	FL	W	N	FL	W
CC	FD	53	506.2	1864.52	2	468.0	1309.75	38	511.8	1726.79
CC	FV	50	514.5	1962.10	1	480.0	1408.80	36	523.5	1768.84
GR	FW	67	586.1	3206.48	8	578.6	2499.11	58	593.3	2747.50
GR	SW	61	488.2	1803.66	4	477.0	1542.13	49	497.5	1659.73
LR	SC	29	505.7	1977.78	2	501.0	1565.70	18	527.7	1936.37
LR	SD	29	512.4	2077.87	2	532.0	1917.70	18	530.1	1963.68
LR	SV	28	510.6	1982.77				21	509.1	1697.07
LR	SW	1	599.0	3192.10				1	604.0	2815.30

^a Treatment codes, first letter: F= freshwater, S=saltwater.

Treatment codes, second letter: W=unassigned, D=drug, V=vaccine, C=control.

Table 6. Mean fork length (FL, mm) and weight (W, g) in April (all fish) and September/October (spawning) of 2005 brood year Chinook salmon collected from Catherine Creek, Grande Ronde River, and Lostine River, and reared either in freshwater at Bonneville Fish Hatchery or saltwater at Manchester Research Station, 2008.

Stock	Treatment ^a	April (all fish)			September/October (mature)					
		N	FL	W	Male			Female		
		N	FL	W	N	FL	W	N	FL	W
CC	FW	118	380.1	866.42	112	383.5	720.36			
GR	FE	23	413.8	1116.59	19	414.9	902.97	1	498.0	1602.80
GR	FP	48	405.9	1080.81	45	409.8	908.56			
LR	SW	102	389.3	955.08	70	404.0	780.30			

^a Treatment codes, first letter: F= freshwater, S=saltwater.

Treatment codes, second letter: W=unassigned, E=Conventional Broodstock Program eggs, P=natural parr.

Table 7. Mean fork length (FL, mm) and weight (W, g) in April (all fish), July (all fish), and September/October (spawning) of 2006 brood year Chinook salmon collected as parr from the Grande Ronde River (FP) or from Conventional Broodstock Program spawning at Lookingglass Hatchery (FE), and reared in freshwater at Bonneville Fish Hatchery, 2008.

Stock	Treatment	April (all fish)			July (all fish)			September/October (mature males)		
		N	FL	W	N	FL	W	N	FL	W
GR	FE	155	125.9	24.81	155	193.6	104.28	39	197.1	101.49
GR	FP	151	110.0	16.22	151	180.7	81.68	18	177.6	74.04

Table 8. Mean fork length (FL, mm) and weight (W, g) in June (inventory) and November (PIT tagging) of 2007 brood year Chinook salmon collected from Lookingglass Hatchery Grande Ronde River Conventional Broodstock Program and reared at Wallowa Fish Hatchery, 2008.

Group	Inventory (June)			Tagging (November)		
	Number	FL	W	Number	FL	W
1	159	55.7	2.21	150	90.1	9.52
2				150	107.1	15.85

Table 9. Number of Chinook salmon maturing from each stock, brood year, and treatment, number surviving to gamete collection, percent of maturing fish that survived to gamete collection, and number of males from which semen samples were collected for cryopreservation in 2008.

Stock	Cohort	Treatment	Number sorted as mature	Number Returned as immature	Number surviving to gamete maturation		Percent survival to spawn	Number of cryoed males
					Female	Male *		
<u>Catherine Creek</u>								
	2002	SN	2	1	1		100.0	
	2003	FA	4		2	1	75.0	
	2003	FN	2		1		50.0	
	2003	SA	5	1	2	1	75.0	
	2003	SN	4	1	2	1	100.0	
	2004	FD	53		38	2	75.5	
	2004	FV	52	1	36	1	72.5	
	2005	FW	<u>117</u>	<u> </u>	<u> </u>	<u>112</u>	<u>95.7</u>	<u> </u>
		Subtotal	239	4	82	118	85.1	0

Table 9 continued.

Stock	Cohort	Treatment	Number sorted as mature	Number Returned as immature	Number surviving to gamete maturation		Percent survival to spawn	Number of cryoed males
					Female	Male*		
<u>Grande Ronde River</u>								
	2003	FA	1		1		100.0	
	2003	SA	1		1		100.0	
	2003	SN	2		1		50.0	
	2004	FW	67		58	8	98.5	
	2004	SW	63		49	4	84.1	
	2005	FE	37	14	1	19	87.0	
	2005	FP	47	1		45	97.8	
	2006	FE	39			39	100.0	
	2006	FP	<u>18</u>	<u>—</u>	<u>—</u>	<u>18</u>	<u>100.0</u>	<u>—</u>
		Subtotal	275	15	111	133	93.8	0
<u>Lostine River</u>								
	2002	SA	1	1			N/A	
	2003	FA	3		1	2	100.0	
	2003	FN	5		2	1	60.0	
	2003	SA	3		3		100.0	
	2003	SN	4		1	1	50.0	
	2004	SC	30		25	2	90.0	
	2004	SD	29		24	1	86.2	
	2004	SV	30		28		93.3	
	2004	SW	1		1		100.0	
	2005	SW	<u>100</u>	<u>—</u>	<u>—</u>	<u>93</u>	<u>93.0</u>	<u>—</u>
		Subtotal	<u>206</u>	<u>1</u>	<u>85</u>	<u>100</u>	<u>90.2</u>	<u>0</u>
		Total	720	20	278	351	89.9	0

* Includes males that had sperm cryopreserved (not used for spawning this year).

Table 10. Total and mean number of green and eyed eggs collected from female spring Chinook salmon of each brood year, stock, and treatment, and mean percent survival of eggs to the eyed stage, 2008.

Stock / cohort	Treatment	Number of Fish	Green Eggs (CBS estimate)		Green Eggs (Oxbow estimate)		Eyed eggs (Oxbow estimate)		Percent Survival
			Total	Mean	Total	Mean	Total	Mean	
Catherine Creek									
2002	SN	1	438	438	390	390	335	335	86
2003	FA	2	2,071	1,036	2,175	1,088	2,047	1,024	94
2003	FN	1	1,491	1,491	1,326	1,326	979	979	74
2003	SA	1	359	359	345	345	0	0	0
2003	SN	2	1,375	688	1,310	655	1,187	594	91
2004	FD	38	58,236	1,533	60,788	1,600	57,480	1,513	95
2004	FV	<u>36</u>	<u>57,615</u>	<u>1,600</u>	<u>60,652</u>	<u>1,685</u>	<u>56,588</u>	<u>1,572</u>	<u>93</u>
Sub total		81	121,585	1,501	126,986	1,568	118,616	1,464	93
Grande Ronde River									
2003	FA	1	270	270	293	293	283	283	97
2003	SN	1	153	153	174	174	0	0	0
2004	FW	58	144,751	2,496	150,859	2,601	138,140	2,382	92
2004	SW	48	77,068	1,606	79,687	1,660	72,497	1,510	91
2005	FE	1	<u>2,111</u>	<u>2,111</u>	<u>2,469</u>	<u>2,469</u>	<u>2,378</u>	<u>2,378</u>	<u>96</u>
Sub total		109	224,353	2,058	233,482	2,142	213,298	1,957	91
Lostine River									
2003	FN	2	2,760	1,380	2,905	1,453	2,774	1,387	95
2003	SA	3	1,550	517	1,674	558	1,373	458	82
2003	SN	1	1,732	1,732	1,569	1,569	1,500	1,500	96
2004	SC	25	37,683	1,507	39,084	1,563	32,064	1,283	82
2004	SD	23	37,984	1,651	39,589	1,721	36,456	1,585	92
2004	SV	28	43,648	1,559	45,709	1,632	39,882	1,424	87
2004	SW	<u>1</u>	<u>2,891</u>	<u>2,891</u>	<u>2,911</u>	<u>2,911</u>	<u>2,410</u>	<u>2,410</u>	<u>83</u>
Total		<u>83</u>	<u>128,248</u>	<u>1,545</u>	<u>133,441</u>	<u>1,608</u>	<u>116,459</u>	<u>1,403</u>	<u>87</u>
Grand Total		273	474,187	1,737	493,909	1,809	448,373	1,642	91

^a CBS estimate is based on a mean of 20 individual egg weights and total weight of all eggs collected.

^b Oxbow estimate is based on volumetric estimate.

Table 11. Number of eggs collected, mean fecundity, number of eyed eggs, fertilization rate (percent reaching the eyed stage), and percent of eyed eggs culled for BKD prevention for the 2008 F₁ brood year Captive Broodstock Chinook salmon from Catherine Creek, upper Grande Ronde River, and Lostine River.

Parameter	Catherine Creek	Grande Ronde River	Lostine River	Total
Eggs collected	121,585	224,353	128,249	474,187
Mean fecundity	1,501	2,058	1,545	1,736
Eyed eggs	118,616	213,298	116,459	448,373
Fertilization rate	97.6%	95.1%	90.8%	94.6%
Number eggs culled for BKD	33,377	283	34,952	68,612
Percent culled for BKD ^b	28.1%	0.1%	30.0%	15.3%

^b Percent culled equals number of eyed eggs culled / total number of eyed eggs, based on Oxbow Hatchery data.

Table 12. Number of eggs collected, mean fecundity, number of eyed eggs, fertilization rate (percent reaching the eyed stage), percent of eyed eggs culled for BKD prevention, number of fry, and hatching rate (percent of uncultured green eggs hatching) for 2007 F₁ brood year Captive Broodstock Chinook salmon from Catherine Creek, upper Grande Ronde River and Lostine River.

Parameter	Catherine Creek	Grande Ronde River	Lostine River	Total
Eggs collected	149,766	112,216	215,066	477,048
Mean fecundity	1,896	1,457	1,654	1,668
Eyed eggs	135,306	89,752	182,311	407,369
Fertilization rate	90.3%	80.0%	84.8%	85.4%
Number eggs culled for BKD	26,671	24,480	43,873	95,024
Percent culled for BKD ^a	19.7%	27.3%	24.1%	23.3%
Fry produced	106,117	63,423	97,591	267,131
Hatching rate	97.7%	97.2%	70.5%	85.5%
Parr CWT-tagged	100,753	52,618	88,323 ^b	153,371

^a Percent culled equals number eyed eggs culled / number of eyed eggs. All based on Oxbow Hatchery data.

^b Includes 26,130 fish that were not CWT and were released as parr.

Table 13. Number of eggs collected, mean fecundity, number of eyed eggs, fertilization rate (percent reaching the eyed stage), percent of eyed eggs culled for BKD prevention, number of fry, hatching rate (percent of uncultured green eggs hatching), number of parr coded-wire tagged, number of smolts released and egg-to-smolt survival rate for 2006 F₁ brood year Captive Broodstock Chinook salmon from Catherine Creek, upper Grande Ronde River and Lostine River.

Parameter	Catherine Creek	Grande Ronde River	Lostine River	Total
Eggs collected	100,485	3,731	73,674	177,890
Mean fecundity	1,211	746	1,169	1,042
Eyed eggs	88,616	2,174	58,283	149,073
Fertilization rate	88.2%	58.3%	79.1%	83.8%
Number eggs culled for BKD	38,225	796	44,805	83,826
Percent culled for BKD ^a	43.1%	36.6%	76.9%	56.2%
Fry produced	47,581	^b	13,463	61,044
Hatching rate	94.4%	^b	99.9%	93.6%
Parr CWT-tagged	43,747	^b	10,618	54,365
Smolts released	43,218 ^c	^b	10,470	53,688
Egg-to-smolt survival rate ^d	43.0%	^b	14.2%	30.2%

^a Percent culled equals number eyed eggs culled / total number of eyed eggs. All based on Oxbow Hatchery data.

^b All Grande Ronde River production was released as eyed eggs into Meadow Creek.

^c All Catherine Creek smolts were directly released from Lookingglass Fish Hatchery into Lookingglass Creek.

^d Total uncultured green eggs to smolt

Table 14. Causes of mortality in Captive Broodstock spring Chinook salmon at Bonneville Fish Hatchery, 1 January – 31 December 2008.

Stock, brood year	BKD	Senescence ^a	<i>Aeromonas</i> / <i>Pseudomonas</i> septicemia	Failure to osmoregulate	Unknown	Wasting	Total
<u>Catherine Creek</u>							
2003	1	0	1	0	1	0	3
2004	41	0	0	0	4	0	45
2005	<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>5</u>	<u>0</u>	<u>8</u>
Total	42	3	1	0	10	0	56
<u>Grande Ronde River</u>							
2003	4	0	0	0	0	0	4
2004	0	0	3	4	5	0	12
2005 (FE) ^b	0	2	0	0	2	0	4
2005 (FP) ^b	0	0	3	0	1	0	4
2006 (FE) ^b	0	0	0	0	1	0	1
2006 (FP) ^b	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total	4	2	6	4	9	0	25
<u>Lostine River</u>							
2002	0	0	0	0	0	1	1
2003	2	0	1	0	1	0	4
2004	4	0	1	3	1	0	9
2005	<u>0</u>	<u>2</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>0</u>	<u>8</u>
Total	6	2	4	6	3	1	22
Grand total	52	7	11	10	22	1	103
Percentage of total mortalities	50.5	6.8	10.7	9.7	21.3	1.0	

^a Senescence: fish which were sexually mature but died before spawning and assumed to be due to the general physical decline that is associated with sexually maturity in *Oncorhynchus* spp.

^b Source: FE =conventional egg, FP =natural parr.

Table 15. Causes of mortality in Captive Broodstock spring Chinook salmon at Manchester Research Station, 1 January – 31 December 2008.

Stock/ brood year	Cause of death				Maturing in Seawater	Total
	BKD	Bloat	Dropout	Unknown		
<u>Catherine Creek</u>						
2003	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>1</u>
Total	0	0	1	0	0	1
<u>Grande Ronde River</u>						
2003	2	1	0	0	0	3
2004	<u>0</u>	<u>1</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>3</u>
Total	2	2	0	2	0	6
<u>Lostine River</u>						
2004	0	0	0	2	0	2
2005	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>	<u>1</u>	<u>7</u>
Total	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>	<u>1</u>	<u>9</u>
Grand total	2	2	1	10	1	16
Percentage of total mortalities	12.5	12.5	6.3	62.5	6.2	

Table 16. Causes of mortality among 2007 brood year Captive Broodstock spring Chinook salmon at Wallowa Fish Hatchery, 1 March – 31 December 2008.

Stock	Source	Dropout	Killed	Total
Grande Ronde River	Wild parr ^a			
	Conventional egg	<u>2</u>	<u>2</u>	<u>4</u>
Total		2	2	4

^aAll 2007 brood year fish were produced from eyed eggs from the Conventional Broodstock Program.

Table 17. Bacterial kidney disease summary for mortalities from the 2006 F₁ brood year of Captive Broodstock Chinook salmon at Lookingglass Fish Hatchery during the period from tagging/final ponding in 2007 through release (Catherine Creek) or transfer to acclimation (Lostine River) in 2008.

Stock	Raceway	Number of fish	Maternal ELISA category	BKD			Total percent mortality	Comments
				N	+ ^a	%		
<u>Catherine Creek</u>								
	R3	25,400	Low/mod-low	33	0	0	0.40	
	R4	18,100	Moderate-high	38	1	2.6	0.39	
<u>Lostine River</u>								
	R10	10,500	Low/mod-low	34	0	0	0.78	

^a ‘+’ determined by ELISA values ≥ 1.0 OD units.

Table 18. Bacterial kidney disease summary for mortalities from the 2007 F₁ brood year of Captive Broodstock Chinook salmon at Lookingglass Fish Hatchery during the period from tagging/final ponding in 2008 through December 2008.

Stock	Raceway	Number of fish	Maternal ELISA category	BKD ^a			Total percent mortality	Comments
				N	+	%		
<u>Catherine Creek</u>								
	R4	72,600	Low	24	0	0	0.62	
	R5	28,500	Moderate	11	0	0	0.79	
<u>Grande Ronde River</u>								
	R8	52,800	Low & Moderate	24	0	0	0.75	
<u>Lostine River^b</u>								
	R13	62,400	Low	23	0	0	0.62	<0.2 for smolt program

^a Results through December 2008, '+' determined by ELISA values ≥ 1.0 OD units.

^b Lostine River fry out plant maternal ELISA category 0.2-0.399, Lostine River parr outplant all <0.200 OD units.

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