Johnson Creek Artificial Propagation and Enhancement Project Operations and Maintenance Program

Brood Year 1998: Johnson Creek Chinook Salmon
Supplementation

Biennial Report 1998 - 2000

May 2003

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BROOD YEAR 1998: JOHNSON CREEK CHINOOK SALMON SUPPLEMENTATION REPORT

JOHNSON CREEK ARTIFICIAL PROPAGATION ENHANCEMENT PROJECT OPERATIONS AND MAINTENANCE PROGRAM

Period Covered: July 1998 through April 2000

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ABSTRACT

The Nez Perce Tribe, through funding provided by the Bonneville Power Administration, has implemented a small scale chinook salmon supplementation program on Johnson Creek, a tributary in the South Fork of the Salmon River, Idaho. The Johnson Creek Artificial Propagation Enhancement project was established to enhance the number of threatened Snake River summer chinook salmon (*Oncorhynchus tshawytscha*) returning to Johnson Creek through artificial propagation.

Adult chinook salmon collection and spawning began in 1998. A total of 114 fish were collected from Johnson Creek and 54 fish (20 males and 34 females) were retained for Broodstock. All broodstock were transported to Lower Snake River Compensation Plan's South Fork Salmon River adult holding and spawning facility, operated by the Idaho Department of Fish and Game. The remaining 60 fish were released to spawn naturally. An estimated 155,870 eggs from Johnson Creek chinook spawned at the South Fork Salmon River facility were transported to the McCall Fish Hatchery for rearing. Average fecundity for Johnson Creek females was 4,871. Approximately 20,500 eggs from females with high levels of Bacterial Kidney Disease were culled. This, combined with green-egg to eyed-egg survival of 62%, resulted in about 84,000 eyed eggs produced in 1998. Resulting juveniles were reared indoors at the McCall Fish Hatchery in 1999. All of these fish were marked with Coded Wire Tags and Visual Implant Elastomer tags and 8,043 were also PIT tagged. A total of 78,950 smolts were transported from the McCall Fish Hatchery and released directly into Johnson Creek on March 27, 28, 29, and 30, 2000.

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INTRODUCTION

This brood year report details the methods and results from supplementation activities associated with the Johnson Creek Artificial Propagation Enhancement (JCAPE) project for the 1998 brood year. Methods and results for brood year 1998 are divided into several categories. These include adult trapping, holding and spawning, incubation, rearing, tagging, and release of the brood year 1998 juveniles as smolts into Johnson Creek. Monitoring and Evaluation (M&E) activities associated with the JCAPE project for brood year 1998 are detailed in a separate report.

BACKGROUND

The Johnson Creek summer chinook salmon (*Oncorhynchus tshawytscha*) population has experienced significant decline in population numbers over the past five decades. Escapement levels in Johnson Creek have declined from a recorded high of 486 redds in 1960 to a low of five redds observed in 1995. Since Snake River spring/summer chinook salmon were listed as a threatened species under the Endangered Species Act (ESA) we are in an emergency situation. Unprecedented efforts were needed to prevent species extinction and preserve fish for the future. Artificial propagation programs are one measure to attempt to enhance populations and increase natural production in Snake River tributaries. The National Marine Fisheries Service (NMFS) draft recovery plan (NMFS 1995) states that "supplementation programs should be initiated and/or continued for populations identified as being at imminent risk of extinction, facing severe inbreeding depression, or facing demographic risks".

Due to critically low abundance of summer chinook salmon in Johnson Creek, the Nez Perce Tribe (NPT), through funding provided by the Bonneville Power Administration (BPA), initiated the development of an artificial propagation enhancement project for Johnson Creek in 1998. This decision resulted from a number of factors including: increased emphasis on wild/natural production and stock recovery; consultation and requirements resulting from listing of Snake River chinook populations as threatened under the ESA; and preferred strategies for use of artificial propagation identified in *Wy-Kan-Ush-Mi Wa-Kush-Wit, Spirit of the Salmon* (CRITFC 1996).

The Nez Perce Tribe, as the lead fisheries management agency for the JCAPE project, submitted a Section 10 Permit Application (Lothrop 1998) under the ESA to the NMFS for the purpose of supplementing the Johnson Creek chinook salmon population in 1998. NMFS gave approval for the JCAPE project to trap returning adult salmon in Johnson Creek for the purpose of broodstock collection and subsequent rearing and release of their progeny back into Johnson Creek. The JCAPE project was allowed to rear up to 100,000 smolts per year through this approval.

The United States Fish and Wildlife Service, Lower Snake River Compensation Plan Office (LSRCP) and the Idaho Department of Fish and Game (IDFG), McCall Fish Hatchery were approached about utilizing existing rearing facilities at the McCall Fish Hatchery for the JCAPE project for the 1998 brood year. The LSRCP (owner) and IDFG (operator) of the McCall Fish Hatchery agreed to allow the JCAPE project to incubate and rear up to 150,000 brood year 1998 Johnson Creek fish at the existing McCall Fish Hatchery. In addition, the JCAPE project was

allowed to hold and spawn Johnson Creek adult broodstock at the South Fork Salmon River (SFSR) adult trapping and spawning facility that is associated with the McCall Fish Hatchery. The approval by NMFS and the ability to utilize existing facilities at the McCall Fish Hatchery allowed the JCAPE project to collect broodstock in 1998.

DESCRIPTION OF PROJECT AREA

Johnson Creek begins near Deadwood Summit at an elevation of about 7,200 feet and flows northward approximately 35 miles to its confluence with the East Fork South Fork Salmon River near the community of Yellowpine at an elevation of 4,500 feet (Figure 1). Elevations range from 4,500 to 8,500 feet. The sub-basin area is 153,800 acres, primarily National Forest land with some private inholdings. Over half of the sub-basin is inventoried roadless area. The predominant vegetation is mixed conifer forest with interspersed grass and sedge meadows. The upper one-third of the Johnson Creek sub-basin has extensive meadow areas, the middle one-third is characterized by steep cascading sections, and the lower one-third of the sub-basin is lower gradient and located in a wide-bottomed valley. Most of the historic and current chinook salmon spawning and rearing has been observed in this lower section (NOAA 2004 draft). Runoff is characterized by high flows in the spring followed by a decreasing hydrograph with the lowest flows typically in early fall through late winter. Mean annual precipitation varies from between 15 and 58 inches. Most of this precipitation falls in the form of snow from October through April. Summer temperatures can reach near 100 at the lowest elevations, while winter lows are often well below zero (USFS 1995, USFS 1990).

Figure 1: Map of the Johnson Creek Watershed and JCAPE Sites

METHODS AND MATERIALS

Adult Take Estimates

An agreement with LSRCP and IDFG allowed for up to 150,000 smolts to be produced at the McCall Fish Hatchery in 1998. This level of production would require a total of 40 females. Take estimates were derived by predicting the expected total adult escapement to Johnson Creek for 1998. Adult escapement for Johnson Creek was predicted using the information in table 1. The predicted adult escapement value was applied to the Johnson Creek Broodstock Sliding Scale (Table 2) to set the rate at which broodstock would be retained.

Table 1: Johnson Creek 1998 Adult Escapement Prediction

Estimate Source	SFSR Adult Prediction	Johnson Creek Multiplication Factor ²	Johnson Creek Adult Prediction
TAC Estimate ¹	335	0.13	43
IDFG Cohort Estimate ¹	582	0.13	76
<p>1- IDFG data provided by Sharon Kiefer on 4/2/98</p> <p>2- Johnson Creek Multiplication Factor is based on the following assumptions: Annual redd count numbers for Johnson Creek versus annual redd count numbers for the SFSR indicate that Johnson Creek redd numbers range from 5% to 49 % of those in the SFSR. Averages for Johnson Creek from 1957 to 1995 are 24%, while the 1986 to 1995 average is 13% (of those in the SFSR). In 1998, 13% was used as the multiplication factor as this represents the most recent data available for the two streams.</p>			

Table 2: Johnson Creek Broodstock Sliding Scale for 1998

Estimated Adult Escapement (wild/natural plus hatchery)	Maximum % of wild/natural adults to be retained in broodstock	Comments
>301	30%	-Wild/natural take should be large enough to maintain a 1:1 wild/natural to hatchery pairing for spawning. -No limit on the number of supplementation fish allowed above the weir to be spawned naturally.
151 to 300	40%	-No limit on the number of supplementation fish allowed above the weir to be spawned naturally.
30 to 150	50%	-No limit on the number of supplementation fish allowed above the weir to be spawned naturally.
<30	<p>Escapement below 30 adults may result in different management actions that will need to be decided upon by fisheries managers of Johnson Creek. Actions may include:</p> <ul style="list-style-type: none"> - take all fish for broodstock - outside stock supplementation - initiate a captive broodstock program 	

Trapping Operations

Adult salmon trapping activities occur in Johnson Creek approximately five miles upstream of the confluence of the EFSFSR (see Figure 1) at an elevation of 4,889 ft. The weir is installed as soon water flows are low enough (approximately 700 cfs) to allow for safe installation and operated through mid September until no fish have been trapped for ten (10) consecutive days. The weir is located on privately owned property of the Bryant Ranch, and is used by agreement with the owners of the property.

A picket style weir is installed, which consists of a guide fence and an in-stream trap box (see figures 2 and 3). The guide fence blocks upstream passage of adult chinook salmon and funnels them into the trap box. The trap box consists of an aluminum framework filled with the same type of pickets as used in the guide fence. The dimensions of the box are approximately 8' x 8' x 8'. The trap box is covered with plywood for shade cover and to prevent the possibility of fish jumping out of the trap box.

The trap is checked everyday for the presence of adult salmon. Individual fish are netted out of the trap and placed in an anesthetizing tub. Each fish is anesthetized with Tricane Methane Sulfonate (MS-222) at a concentration of 90 mg/l in 30 gallons of water. Once anesthetized, fish are visually and electronically scanned for tags and marks, fork length and mid eye to hyperle length (MEH) are recorded, a sequentially numbered opercle tag is applied, and a paper punch sample of tissue is taken from the caudal fin for genetic analysis.

Adult chinook salmon are retained for broodstock based on age and sex. Age class determination is based on length frequency data from the SFSR. Adult salmon that are to be retained as broodstock are given an additional opercle punch. Each adult retained for broodstock, excluding jacks, is inoculated for bacterial kidney disease with 0.3cc erythromycin.

Fish released above the weir to spawn naturally are held in fresh water upstream of the weir until equilibrium is regained. They are then released and observed until swimming out of sight. Fish released upstream are not injected with erythromycin.

Figure 2: Johnson Creek Weir

Figure 3: V - Shaped Entrance to Trap-box on Johnson Creek Weir

Transport and Adult Holding

An agreement with the IDFG, McCall Fish Hatchery allowed adult chinook retained as broodstock from Johnson Creek to be held and spawned at the South Fork Salmon River (SFSR) adult holding facility (Figure 1). This site is located on the west side of the South Fork Salmon River, approximately five kilometers west of Warm Lake, Idaho at an elevation of 5,069 feet.

All fish kept for broodstock were transported about 35 miles (1.25 hours) to the SFSR facility for holding. Fish were transported in an aluminum tank mounted on a one-ton flatbed truck. The tank had a holding capacity of approximately 400 gallons and was equipped with an aerator and oxygen supply. The tank was filled with river water prior to fish work up, and supplied with oxygen at approximately 8 liters per minute. They were then netted out of the tank and placed in the raceways with the SFSR fish. The SFSR facility has two raceways which are 90 feet long, 10 feet wide and 3.5 feet deep, with approximately 3,150 cubic feet of water. Males and females were held in separate raceways.

Spawning

Adult salmon held at the SFSR facility are typically spawned two (2) days a week from mid August through the first week of September. Prior to spawning each day, a crowd rack is placed in the upper end of the female pond with no fish above it. All SFSR and Johnson Creek females are then crowded from the bottom end of the pond up to the first crowd rack. Individual fish are caught by hand and checked for ripeness, green (un-ripe) females are placed downstream of the second crowd rack and ripe SFSR females are placed upstream of the first crowd rack. Ripe Johnson Creek females are counted and placed in the spawning shed female live-well.

Once the female salmon have been sorted for ripeness, more than twice as many Johnson Creek males than the number of ripe Johnson Creek females are placed in the male live-well. Spawning equipment, such as buckets and strainers, are prepared. The females are double checked for ripeness, euthanized with a blow to the head, placed horizontally on a table and rinsed off. A spawning knife is inserted in the females vent prior to picking her up to prevent eggs from discharging. The female is then picked up and held vertically over a colander, the abdomen is cut to release the eggs. Ovarian fluid is collected at this time for disease testing and the carcass is set aside for further disease sampling. The eggs are then divided equally into the number of colanders matching the number of males to be used. Sperm is then applied, one male per colander. The individual colanders of eggs are placed in separate buckets of fresh water to activate the sperm. After one minute, the eggs of an individual female are combined into one colander and placed back into fresh water for another few minutes to insure fertilization. The eggs are then drained and poured gently into a bucket of water and Argentine at 200 ppm and allowed to water harden for one hour. Ice is added to the water hardening buckets to maintain temperature. After one hour of water hardening, the eggs are rinsed, poured into a numbered egg tube and then stacked in a cooler for the transport. Eggs are driven approximately 55 miles (one hour) to the McCall Fish Hatchery.

Figure 4: Spawning at IDFG's South Fork Salmon River Facility

Nutrient Enrichment

Carcasses from Johnson Creek adult fish spawned artificially are disposed of back into Johnson Creek (see Figure 5). Fish are distributed throughout the natural spawning areas. Natural spawning areas are chosen as disposition points to stimulate natural nutrient enhancement to the stream. Scales and fin ray samples are taken from carcasses to provide specific age information of the Johnson Creek stock. Tails are removed to indicate fish used as broodstock rather than natural spawners. Any carcasses due to mortality other than spawning activities were disposed of in the same manner.

Figure 5: Carcasses Returned to Johnson Creek for Nutrient Enrichment

Egg Incubation and Rearing

Eggs collected from Johnson Creek adults are transported to the McCall Fish Hatchery for incubation and subsequent rearing. The McCall Fish Hatchery is located on the north side of the North Fork of the Payette River, in the town of McCall, Idaho at an elevation of 4,971 ft.

Eggs from each individual Johnson Creek female are placed in a single tray of an 8-tray vertical stack incubator and that position is recorded for future reference. Eggs are treated daily with formalin at 1,667 parts per million (ppm) to control fungus. Treatments start two days after the eggs go into the incubators and are continued until the eggs hatch.

Once eggs have absorbed 550 daily temperature units (DTU) (Piper et al, 1982), they are examined to verify they are at a strong eyed stage. If a strong eye development is present, that lot of eggs is shocked. Egg shocking is a process in which an undeveloped or dead egg's fragile inner membrane is broken causing the egg to turn opaque. A live or healthy egg is quite sturdy once it is eyed and will not be hurt from the shocking process. This process consists of pouring a tray of eggs into a watered up trough, siphoning the eggs through a length of garden hose into a bucket, and returning the eggs to the tray and incubator until the next day when they will be picked.

McCall Hatchery personnel separate dead eggs from live eggs and enumerate them with an automatic egg sorter and counter. The egg counter picks eggs up into a wheel that passes them through a light beam. If the light beam does not pass through the dead or opaque egg, a burst of air rejects that egg. The remaining or live eggs pass to the other side of the wheel where a

constant air jet ejects the live eggs. As the eggs are ejected, they pass through a counting eye that enumerates both the live and dead eggs. The live eggs are then returned to the incubators.

The eggs remain in the incubators through the sac fry life stage. Chinook salmon eggs generally require 1,000 DTU to hatch. Sac fry generally absorb their yolk sacs at approximately 1,750 DTU. McCall Fish Hatchery protocol calls for fish to be put into early rearing vats once yolk sacs are absorbed and started on feed a few days later.

The early rearing vats, or raceways, are 40' x 4' x 2' (water depth) with 320 cubic feet of rearing space. The vats are set up at half length, or 20' x 4' x 2', with a water flow of 80 gallons per minute (gpm), when the fry are first set out into the vats. Once the fry start feeding aggressively, cleaning baffles are installed. The baffles are reinforced aluminum plates installed into the vats every four feet. They fit into the vat at a slight upstream angle and are two inches off the bottom of the vat. This forces all the water to flow through the bottom two inches, greatly increasing the flow along the bottom and flushing fecal material and uneaten food down through the raceway. The vats are extended to full length and flow is increased to 130 gpm as fish densities increase. The fry remain in the vats until large enough to mark with visual implant elastomer (VIE) tags before being transferred outside to the collection basin. Fish are tagged and transferred to the collection basin when they reach at least 35.0 fish per pound (fpp).

The collection basin is 101' x 15' x 4' (water depth) and straddles the tail end of McCall Fish Hatchery two outdoor rearing ponds. The water from both outdoor rearing ponds flows through the collection basin at a flow of 16 cubic feet per second (cfs). The fish remain in the collection basin until outplanted as smolts in mid March.

Tagging

Johnson Creek fish are marked 100% with coded wire tags (CWT) and VIE tags. CWT tags are injected into the snout and VIE tags are inserted in the adipose tissue behind the eye following standard tagging protocols. CWT and VIE tagging is performed by the IDFG marking crew on two separate occasions. Crews mark all fish and are therefore able to enumerate all the fish at that time. These hand counts are used to update fish production numbers initially provided by the automatic egg counter.

A portion of these fish are also PIT tagged prior to release. PIT tagging is conducted by NPT personnel. Fish are PIT tagged using the protocol described in Nelson and Vogel (1999). During PIT tagging, NPT personnel also conduct a tag retention study of CWT and VIE tags. The retention study involves an individual looking only for CWT tags and another looking only for VIE tags. Tag retention study protocols are described in Nelson and Vogel (1999).

Smolt Release

Johnson Creek smolts are transported and released into Johnson Creek at the end of March or the beginning of April depending on weather and road conditions. Fish are netted out of the collection basin and placed in transport tanks mounted on one-ton flatbed trucks. The tanks have a capacity of approximately 400 gallons and are equipped with an aerator and a supplemental oxygen supply system. Fish are loaded at 300 pounds per tank and transported approximately 100 miles (3.5 hours) to Johnson Creek. The direct release site is approximately 8 river miles upstream of the confluence of Johnson Creek and the EFSFSR near Wapiti Meadows Ranch.

RESULTS

Adult Take Estimate

In 1998, the JCAPE project needed 40 adult females to produce the 150,000 Johnson Creek smolts from the 1998 brood year. Based on a predicted adult escapement to Johnson Creek of between 43 and 76 adults, adult broodstock were collected at the 50 % take level in 1998 as indicated in the Johnson Creek Broodstock Sliding Scale (Table 2).

Adult Salmon Trapping

The 1998 trapping season began with the installation of the weir on July 13. The first fish was trapped on July 15 and the last fish was trapped September 4 (Appendix A). The weir was removed September 10, about a week after the last fish was captured.

A total of 114 adult summer chinook salmon were trapped (Table 3). Every other adult chinook, by age and sex, was retained for broodstock and transported to SFSR for holding. Fish not retained as broodstock were released above the weir for natural spawning. A total of 54 fish were retained for broodstock and 60 were released upstream. Appendix A details all trapping activity and specifics for each fish handled.

Table 3: Trap Numbers by Age*, Sex, and Disposition

Disposition	Age 3	Age 4		Age 5		Total
	Jacks	Males	Males	Females	Females	
Retained	1	2	1	17	33	54
Released	2	2	1	21	34	60
Total Trapped	3	4	2	38	67	114

By retaining every other fish, broodstock were retained in proportion to that of the overall escapement. In doing so, fish were retained as a representative sample of the run (Figure 6). The only exception to this representative sample would be fish which passed upstream of the weir location prior to the installation of the weir.

Figure 6: Number of Fish Retained in Proportion to Number of Fish Trapped in 1998

Run Timing, Daily Water Flow and Water Temperature Measurements

The adult return on Johnson Creek peaked in late August. Of 114 fish trapped, 88 fish (77%) were trapped after August 7. This is only a measure of when the fish entered the trap, however, and does not reflect escapement prior to trap installation or fish that spawned below the weir. Delays in Section 10 permit issuance prevented installation at an earlier date. It is probable that several fish moved upstream of the weir prior to installation. Adult salmon carcass surveys conducted above the weir recovered 28 unmarked carcasses. We suspect that these fish passed prior to weir installation, or may have escaped from the trap box before a jump barrier was installed on the trap box.

There also appears to be a relationship to water flow, water temperature and when fish moved into the trap. As the water flow decreased the number of fish entering the trap increased (Figure 7). Water temperature also seemed to influence adult escapement. Fish moved into the trap in greater numbers during a period of cooler water temperatures during the spawning period. In fact, the lowest daily mean water temperature recorded during the trapping season coincides with the highest number of fish trapped in one day (Figure 7). This information will be used to monitor changes in run timing and its relationship to river flows as the JCAPE Project is implemented.

Figure 7: Run Timing in Relation to Daily Average Water Flow and Water Temperature

Tag Detections

Two of the adults trapped in 1998 were radio tagged and marked with visual elastomer implant (VEI) tags. These fish were tagged as part of a University of Idaho adult chinook salmon study. VEI tag numbers were D21 and D24.

Length/Age Frequencies

In 1998, the majority (92.1% or 105 fish) of the fish trapped were five year old (three-ocean) fish. Only six (5%) four year old (two ocean) fish and three (2.6%) three year old fish or jacks (one ocean) were trapped (Figure 8). These age class determinations are based solely on length measurements of each fish and may not truly represent the ages of the fish sampled. Age distributions are based on IDFG SFSR adult returns. Analysis of scales taken from carcasses sampled in 1998 show similar age composition to those determined by length/age distributions (Table 4). Of 96 scale samples analyzed from the 1998 brood year, 2.1% were jacks, 4.2% were four years old and 93.7% were five years old (Fryer 2001).

Figure 8: Fork Length Frequencies for Fish Trapped on Johnson Creek in 1998

Table 4: Age Composition of Brood Year 1998 Adult Chinook Salmon in Johnson Creek

Age Method	Age 3	Age 4	Age 5
Fork Length	2.60%	5.30%	92.10%
Scale Analysis	2.10%	4.20%	93.70%

Injuries/Pre-spawning Mortality

Injury to adult chinook salmon was minimal, but included minor jaw and snout damage which occurred in the trap box. Such injuries appeared to have little or no effect on the fish.

No direct mortalities occurred during holding in the trap box or during transport. There were two occurrences of female pre-spawning mortality in the holding pond at the SFSR facility. The circumstances surrounding these mortalities are unknown. Two males died within five days after semen samples were taken from them for the Tribe's cryopreservation project, and before being actively used in the fertilization process for production. The cause of death for these two fish is unknown, but most likely the result of handling stress. One other male pre-spawning mortality occurred in the holding pond and was most likely attributed to handling stress. In summary, 3 of 20 or 15% of males and 2 of 34 or 5.9% of females retained for broodstock did not contribute towards meeting supplemental efforts. These numbers are consistent with the ten-year (1988-1997) average for prespawning mortality for IDFG SFSR fish at 16.8% for males and 11.5% for females. (MFH 1983-1999).

Adult Spawning

Fish retained for broodstock were spawned between August 11, 1998 and September 4, 1998. Eggs from 32 females were fertilized with sperm from 17 males. Our objective was to use sperm from two males to fertilize the eggs of one female whenever possible. However, the poor male to female ratio often did not allow for this and in fact forced reuse of most of the males. There were also sperm samples taken from four of the males for the Tribe's cryopreservation project (Armstrong and Kucera 1999).

Fecundity

A total of 155,780 green eggs were taken from 32 females. Fecundity for individual females could not be determined due to combination of eggs from more than one female in incubator trays prior to counting. However, average fecundity for Johnson Creek females was calculated at 4,871.

Disease Testing

IDFG pathologists collected disease samples from all females artificially spawned for Johnson Creek production. BKD was the primary disease of concern with the females being sampled. Eggs taken from females with a high level of BKD (greater than 0.8 ELISA value) were culled to prevent contamination to progeny of fish with low to moderate levels. Unfortunately, eggs were often mixed in the incubator trays and in one instance progeny from a high BKD fish were mixed with those of a low BKD fish. All of those eggs were then culled (Appendix D). Future management will remedy this problem by incubating progeny of each female separately. This will also allow us to determine fecundity and survival rates from individual females. A total of 20,477 eggs were culled from brood year 1998 fish.

Prior to 1998, no disease history had been established for the Johnson Creek wild/naturally spawning population. In 1998, 32 samples were collected from the wild female broodstock, of which 47 percent tested positive for BKD, indicating an existing level of this disease in Johnson Creek (Table 5). Virtually all of the infectious diseases affecting hatchery chinook salmon in the Columbia River basin are thought to occur in wild fish or in the natural environment. Most Columbia River basins have or have had the major diseases of concern. For example, BKD is prevalent in essentially all hatchery and wild stocks of salmonids in the Columbia River basin (Jim Winton, USGS, personal communication, 1999).

Table 5: BKD Disease Results from Johnson Creek Wild/Natural Broodstock

1998 BKD Results	Number of Samples	Percent Positive
High BKD ELISA¹	4	13%
Moderate BKD ELISA¹	1	3%
Low BKD ELISA¹	10	31%
Negative BKD ELISA¹	17	53%
Total Positive Samples	15	47%
¹ BKD ELISA values for 1998: High > 0.8; Moderate 0.25 - 0.8; Low = 0.1 - 0.25 All samples were collected and analyzed by Idaho Department of Fish and Game personnel from the Fish Health Lab in Eagle, Idaho.		

Scale and Otolith Sampling

Otoliths and scales were also taken from carcasses at the spawning facility for aging purposes. Otoliths have not yet been analyzed, however scales have been read. The scales were analyzed as part of an age and age-at-length study along with scales from other year classes of Johnson Creek fish and fish from other streams in the SFSR Basin (Fryer 2001).

Nutrient Enhancement

Carcasses from 49 artificially spawned adults and five (5) adult pre-spawning mortalities were returned to Johnson Creek for decomposition. Natural spawning areas were chosen as distribution points to stimulate natural nutrient enrichment to the stream. Decomposition of adult salmon carcasses is an important component of the aquatic ecosystem in Johnson Creek. Mundy (1998) discusses that smolt productivity may be related to the amount of marine nutrients found in a river system, while Mathisen et al. (1988), the NRC (1996), and Larkin and Slaney (1997) reported the carbon and marine nutrients brought by adult chinook salmon back to their spawning streams and lakes are important for productivity. Schmidt et al. (1998) found that sockeye salmon *Oncorhynchus nerka* carcasses account for an estimated 90% of the phosphorus above the baseline loading. Increased adult abundance and subsequent carcass decomposition will benefit juvenile fish rearing in Johnson Creek and the surrounding ecosystem.

Incubation Green-Egg to Eyed-Egg Survival

Eggs taken from Johnson Creek broodstock were incubated at the McCall Fish Hatchery. Eggs eyed-up at approximately 600 thermal units (TU) and were then shocked, picked, and enumerated. Overall green-egg to eyed-egg survival for 1998 was 62% (Table 6). Eggs from females with high levels (ELISA) of Bacterial Kidney Disease (BKD) were culled and destroyed as recommended by the IDFG fish pathologist. Culled eggs were not used in the green-egg to eyed-egg survival calculation.

Records from McCall Fish Hatchery show green-egg to eyed-egg survival between 80% and 93% (brood years 1989 - 1998) with an average of 89% (MFH 1991 -2001). The low eye-up percentage of Johnson Creek eggs can possibly be attributed to the effects of transportation and

handling of the adults. Fifteen of the 32 females were spawned within a day of, or on the same day, that they were trapped and transported (Appendix B).

Another potential reason for the low green-egg to eyed-egg survival is the low number of males available for spawning. There were only 17 males available to spawn with 32 females. Appendix C shows ten (58%) of the males were used more than once and five (29%) more than twice. On September 4th, the last day of spawning, a single male was used to spawn six females simply because he was the only male still alive (Lot 8). However when comparing the spawning matrix to eye-up success some of the lowest eye-up occurred when there was a low incidence of reuse. Likewise, the previously mentioned Lot 8 had the third highest eye-up (Table 6). Attempts to maintain a 1:1, male to female spawning ratio were difficult to achieve because of holding the Johnson Creek adults with SFSR adults. This may have lead to additional handling and subsequent stress on the males and females.

Table 6: Green-Egg to Eyed-Egg Survival & Fecundity

Lot #	Date Spawned	# Eyed	# Green	% Eye-Up	# Culled
1	8/11/1998	3,453	4,333	79.69%	0
3	8/18/1998	4,437	8,835	50.22%	0
4	8/21/1998	10,244	19,530	52.45%	10,389
5	8/25/1998	20,764	25,673	80.88%	3,178
6	8/28/1998	8,060	15,202	53.02%	6,910
7	9/1/1998	17,839	34,395	51.87%	0
8	9/4/1998	19,160	27,425	69.86%	0
Total:		83,957	135,393	62.01%	20,477
Number of Females Spawned = 32. Fecundity (# Green Eggs/Females) = 4,871					

Rearing

Johnson Creek fish were initially reared indoors at the McCall Fish Hatchery. McCall Fish Hatchery personnel applied rearing practices used for SFSR juveniles to the Johnson Creek fish.

Hatching began at approximately 925 TU. Fry were set out in the rearing vats between 1725 and 1750 TU. Initial feeding began between 1,750 and 1,775 TU approximately three days after set out. Flows for the rearing vats were set at 80 gallons per minute and were loaded at 30,000 to 55,000 fish per vat, depending on the number of fish on hand. The vats started at half-length and were extended to full length when the density index (DI) reached 0.30 to 0.35, around mid February (Appendix E).

Initial growth rates were slow, only 0.003-inch to 0.004-inch per day, due to cold water temperatures of only 37°F to 39°F. The fry were started on BioDiet #2 and #3 feed and remained on #3 until they reached 700 fish per pound. BioDiet feed has been used successfully at McCall Fish Hatchery, using modified feed rates. The feed conversion for Johnson Creek fish averaged 1.32:1 for the duration of the fry-rearing stage (Appendix E).

SFSR fish are usually moved to the outside rearing ponds between mid June and mid July. Johnson Creek fish, however, were held inside in the rearing vats in order to keep them separate from SFSR fish until outdoor space was made available in the collection basin and VIE tagging

was completed. Density indices for the McCall Fish Hatchery are usually kept below 0.35. Density indices for Johnson Creek fish exceeded 0.40 in June, August, September and October due to a lack of rearing space (Appendix E). Johnson Creek fish were allowed more rearing capacity as soon as it came available. Johnson Creek fish were moved to the collection basin at the end of the outdoor raceways in late November 1999. They were held there until their release in March 2000.

Tagging

Brood year 1998 Johnson Creek fish were marked with coded wire tags (CWT) in the nose and red visual implant elastomer (VIE) tags in the adipose tissue behind the left eye. Coded wire tagging was performed in July 2001 and VIE tagging in November 2001 by the IDFG marking crew.

In addition, 8,043 (approximately 10%) of these fish were also PIT tagged with 14 mortalities from handling and marking. PIT tagging was conducted by NPT personnel over a three-day period, on February 14, 15, and 16, 2000.

During PIT tagging, NPT personnel also conducted a tag retention study of CWT and VIE tags. A total of 2,592 fish were interrogated for CWT tags and 2,271 fish were interrogated for VIE tags. The retention rate for CWT tags was 97.99 percent and 94.54 percent for VIE tags. Overall, 99.86 percent of the fish were tagged with either CWT, VIE or both. A more detailed summary of the tag retention study is found in Vogel and Nelson (2003 draft).

Smolt Release

The JCAPE Smolts were released into Johnson Creek on March 27, 28, 29, and 30, 2000. A total of 78,950 smolts were released back into Johnson Creek. Fish were transported from McCall Hatchery to Johnson Creek in an aluminum tank mounted on a one-ton flatbed truck. The tank had a holding capacity of approximately 400 gallons and was equipped with an aerator and oxygen supply. The tank was filled river water from the hatchery raceways and supplied with oxygen at approximately 9 liters per minute. Fish were loaded into the tanks at approximately 300 lbs. per tank. PIT tagged fish were trucked and released on March 27 by JCAPE personnel. The remaining fish were trucked and released the following three days by JCAPE and other NPT production personnel. At the time of release Johnson Creek smolts averaged 28.66 fish per pound (fpp) and an average fork length was 114.7 mm (Table 7). These fish were released directly into Johnson Creek without acclimation.

Table 7: Smolt Releases in Johnson Creek

Date	Release Time	Tank Temp (°C)	River Temp (°C)	Number Released	Release Location
3/27/00	11:45	4	7	8,500*	Cox Ranch
3/28/00	13:00	4	5	30,000	Wapiti Meadows
3/29/00	12:35	4	3	30,000	Wapiti Meadows
3/30/00	12:30	4	3	10,400	Wapiti Meadows

* 8,043 of these fish carried PIT tags.

CONCLUSIONS

The JCAPE project started successfully in 1998 with the trapping of 114 adult chinook salmon. Fifty four of those fish were retained as broodstock which produced 155, 870 green eggs. Eggs survived to the eyed stage at 62%. Juveniles were successfully reared at the McCall Fish Hatchery and ultimately 78,950 smolts were released into Johnson Creek.

Despite the relative success of the 1998 brood year many improvements are needed to add to the success of the JCAPE project. Among the needs that have been identified are the following:

- Modifications to the weir and trap box are needed to make trapping more efficient and fish friendly.
- A permanent trapping facility on Johnson Creek would eliminate many of the problems encountered with the current trapping equipment. Trapping would be more efficient and more fish friendly and easier for NPT personnel to install and operate.
- A permanent holding facility would eliminate the need for fish transport thus greatly reducing the amount of stress placed on fish retained for broodstock. Johnson Creek fish would not have to cohabitate with SFSR fish in a foreign water source.
- Additional incubation space at the McCall Fish Hatchery would eliminate mixing of high and low BKD ELISA value eggs and prevent unnecessary culling.
- Additional rearing space at the McCall Fish Hatchery is needed to lower rearing densities to a healthier level.
- A permanent acclimation facility would benefit smolts by increasing their time in Johnson Creek before leaving the system.

Progeny of the 1998 brood year will return as adults in 2000, 2001, and 2002. The success of the JCAPE project will be further assessed at that time. Until then, the support and approval of the agencies governing the activities of JCAPE will continue to be solicited by JCAPE and NPT-DFRM administration. Adaptive management practices will continue to be used to improve the JCAPE project and increase its effectiveness restoring chinook salmon populations in Johnson Creek.

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APPENDICES

Appendix A: Adult Trapping Summary

Fish ID #	DATE TRAPPED	HANDLING TEMP (°C)	SEX	FORK LENGTH (CM)	MEH (CM)	AGE	DISPOSITION	CARCASS RECOVERY	DNA	OTOLITH	SCALES	% SPAWN	CRYO SAMPLE TAKEN
1701	7/15/98	13	MALE	109	86	5	SFSR	SFSR	YES	YES	NO	PSM	SFSR
1702	7/16/98	13	MALE	84	66	5	RELEASE	J.C.	YES	YES	YES	95	NO
1703	7/18/98	13	FEMALE	96	75	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1704	7/19/98	18	FEMALE	100	78	5	RELEASE	J.C.	YES	YES	YES	100	NO
1705	7/19/98	18	MALE	99	75	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1706	7/21/98	13	FEMALE	95	76	5	SFSR	SFSR	YES	YES	YES	PSM	NO
1707	7/22/98	13	MALE	91	72	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1708	TAG NOT USED												
1709	7/24/98	13	FEMALE	86	71.5	5	RELEASE	J.C.	YES	YES	J.C.	YES	J.C.
1710	7/25/98	12	FEMALE	99.5	81	5	SFSR	SFSR	YES	YES	YES	PSM	NO
1711	7/26/98	13	FEMALE	89	74	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1712	7/31/98	13.5	FEMALE	96	76	5	RELEASE	J.C.	YES	YES	YES	80	NO
1713	8/3/98	12	MALE	98	97	5	RELEASE	J.C.	YES	YES	YES	40	NO
1714	8/3/98	12	MALE	97	76	5	SFSR	SFSR	YES	YES	YES	HATCHERY	SFSR
1715	8/3/98	12	FEMALE	93	79	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1716	8/4/98	12	FEMALE	75	60	4	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1717	8/4/98	12	MALE	94	73	5	RELEASE	J.C.	YES	YES	YES	100	NO
1718	8/4/98	12	FEMALE	84	69	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1719	8/4/98	12	MALE	89	69	5	SFSR	NOTFOUND	YES	NO	NO	HATCHERY	SFSR
1720	8/4/98	12	FEMALE	92	75	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1721	8/5/98	13	FEMALE	103	84	5	RELEASE	J.C.	YES	YES	YES	100	NO
1722	8/5/98	13	MALE	103	81	5	RELEASE	J.C.	YES	YES	YES	UNKNOWN	J.C.
1723	8/5/98	13	MALE	88	71	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1724	8/5/98	13	FEMALE	85	68	5	RELEASE	J.C.	YES	YES	YES	UNKNOWN	NO
1725	8/6/98	13	MALE	94	76	5	SFSR	SFSR	YES	NO	NO	PSM	SFSR
1726	8/6/98	13	FEMALE	96	79	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1727	8/7/98	13	MALE	96	75	5	SFSR	SFSR	YES	YES	YES	HATCHERY	SFSR

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Fish ID #	DATE TRAPPED	HANDLING TEMP (°C)	SEX	FORK LENGTH (CM)	MEH (CM)	AGE	DISPOSITION	CARCASS RECOVERY	DNA	OTOLITH	SCALES	% SPAWN	CRYO SAMPLE TAKEN
1728	8/9/98	11	MALE	90	69	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1729	8/10/98	12	MALE	81	64	4	SFSR	SFSR	YES	YES	YES	HATCHERY	SFSR
1730	8/10/98	12	FEMALE	97	78	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1731	8/11/98	11	MALE	78	61	4	RELEASE	J.C.	YES	YES	YES	85	NO
1732	8/12/98	11	FEMALE	94	76	5	RELEASE	J.C.	YES	YES	YES	100	NO
1733	8/12/98	11	MALE	100	79	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1734	8/13/98	12	MALE	91	75	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1735	8/13/98	20	FEMALE	99	80	5	RELEASE	J.C.	YES	YES	YES	UNKNOWN	NO
1736	8/15/98	13	MALE	89	68	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1737	8/15/98	13	FEMALE	95	77	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1738	8/17/98	12	MALE	91	80	5	RELEASE	J.C.	YES	YES	YES	100	J.C.
1739	8/18/98	10	FEMALE	95.5	79	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1740	8/18/98	10	MALE	85	67	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1741	8/18/98	16	FEMALE	91.5	75	5	RELEASE	J.C.	YES	YES	YES	UNKNOWN	NO
1742	8/18/98	16	MALE	95	74	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	J.C.
1743	8/18/98	16	FEMALE	87	70.5	5	RELEASE	J.C.	YES	YES	YES	100	NO
1744	8/19/98	11	MALE	103	78	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1745	8/19/98	16	FEMALE	95	79	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1746	8/19/98	16	FEMALE	97	81.5	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1747	8/19/98	16	FEMALE	93.5	76.5	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1748	8/19/98	16	FEMALE	94.5	76.5	5	RELEASE	J.C.	YES	YES	YES	100	NO
1749	8/19/98	16	MALE	92	74	5	RELEASE	J.C.	YES	YES	YES	90	NO
1750	8/19/98	16	MALE	102.5	82	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1751	8/19/98	16	FEMALE	97	81	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1752	8/20/98	12	FEMALE	97	79	5	RELEASE	J.C.	YES	YES	YES	100	NO
1753	8/20/98	17	FEMALE	93	75.5	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1754	8/20/98	17	FEMALE	86	67	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO

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Fish ID #	DATE TRAPPED	HANDLING TEMP (°C)	SEX	FORK LENGTH (CM)	MEH (CM)	AGE	DISPOSITION	CARCASS RECOVERY	DNA	OTOLITH	SCALES	% SPAWN	CRYO SAMPLE TAKEN
1755	8/20/98	17	MALE	95.5	72	5	RELEASE	J.C.	YES	YES	YES	90	NO
1756	8/20/98	17	FEMALE	96	76	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1757	8/20/98	17	MALE	89	66.5	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1758	8/21/98	11	FEMALE	98	77	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1759	8/22/98	9	FEMALE	94	75	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1760	8/22/98	9	MALE	92	75	5	RELEASE	J.C.	YES	YES	YES	95	NO
1761	8/23/98	9	MALE	100	78	5	SFSR	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1762	8/23/98	14	MALE	62	47	3	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1763	8/23/98	14	FEMALE	92	75	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1764	8/23/98	14	FEMALE	90	75	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1765	8/23/98	14	FEMALE	93	78	5	SFSR	SFSR	NO	YES	YES	HATCHERY	NO
1766	8/23/98	14	FEMALE	89	73	5	RELEASE	J.C.	NO	YES	YES	100	NO
1767	8/24/98	10	FEMALE	97	76	5	RELEASE	J.C.	NO	YES	YES	100	NO
1768	8/24/98	10	FEMALE	99	80	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1769	8/24/98	10	FEMALE	95	77	5	RELEASE	J.C.	NO	YES	YES	100	NO
1770	8/24/98	12	FEMALE	95	77	5	SFSR	SFSR	NO	YES	YES	HATCHERY	NO
1771	8/24/98	12	FEMALE	94	76	5	RELEASE	J.C.	NO	YES	YES	100	NO
1772	8/24/98	12	FEMALE	78	63	4	RELEASE	NOTFOUND	NO	NO	NO	UNKNOWN	NO
1773	8/24/98	12	FEMALE	90	70	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1774	8/24/98	12	FEMALE	89	71	5	RELEASE	NOTFOUND	NO	NO	NO	UNKNOWN	NO
1775	8/24/98	12	FEMALE	93	74	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1776	8/24/98	12	MALE	91	74	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1777	8/25/98	8	FEMALE	98	78	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1778	8/25/98	8	FEMALE	94	74	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1779	8/25/98	8	MALE	80	62	4	SFSR	SFSR	YES	NO	YES	HATCHERY	NO
1780	8/26/98	9	MALE	59	45	3	RELEASE	J.C.	YES	YES	YES	100	NO
1781	8/26/98	9	FEMALE	90	70	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO

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Fish ID #	DATE TRAPPED	HANDLING TEMP (°C)	SEX	FORK LENGTH (CM)	MEH (CM)	AGE	DISPOSITION	CARCASS RECOVERY	DNA	OTOLITH	SCALES	% SPAWN	CRYO SAMPLE TAKEN
1782	8/26/98	9	MALE	87	66	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	J.C.
1783	8/26/98	13	FEMALE	95	76	5	RELEASE	J.C.	YES	YES	YES	UNKNOWN	NO
1784	8/26/98	13	FEMALE	90	70	5	RELEASE	J.C.	YES	YES	YES	95	NO
1785	8/26/98	13	FEMALE	93.5	74	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1786	8/26/98	13	FEMALE	86	67	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1787	8/26/98	13	MALE	82	62	4	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	J.C.
1788	8/26/98	13	FEMALE	87	67	5	RELEASE	J.C.	YES	YES	YES	100	NO
1789	8/26/98	13	FEMALE	95	74	5	RELEASE	J.C.	YES	YES	YES	UNKNOWN	NO
1790	8/26/98	13	MALE	85	65.5	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	J.C.
1791	8/27/98	7	FEMALE	94	76	5	RELEASE	J.C.	YES	YES	YES	100	NO
1792	8/27/98	16	FEMALE	86.5	67	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1793	8/27/98	16	MALE	107.5	81	5	RELEASE	J.C.	YES	YES	YES	100	J.C.
1794	8/27/98	16	MALE	100	74	5	RELEASE	J.C.	YES	YES	YES	100	J.C.
1795	8/28/98	9	FEMALE	98	77	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1796	8/28/98	9	FEMALE	94	73	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1797	8/28/98	9	MALE	89	65	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1798	8/28/98	9	FEMALE	91	75	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1799	8/28/98	9	MALE	103.5	78	5	RELEASE	J.C.	YES	YES	YES	50	NO
1800	8/28/98	9	MALE	92	67	5	RELEASE	J.C.	YES	YES	YES	100	NO
1801	8/28/98	16	FEMALE	91	70	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1802	8/28/98	16	FEMALE	90	68	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1803	8/29/98	9	MALE	99	75	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1804	8/29/98	9	MALE	105	82	5	RELEASE	J.C.	YES	YES	YES	80	J.C.
1805	8/29/98	18	FEMALE	88	59	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1806	8/29/98	18	MALE	63	48	3	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1807	8/31/98	17	MALE	107	81	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1808	9/1/98	11	FEMALE	92	74	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO

Appendix A: Adult Trapping Summary

Fish ID #	DATE TRAPPED	HANDLING TEMP (°C)	SEX	FORK LENGTH (CM)	MEH (CM)	AGE	DISPOSITION	CARCASS RECOVERY	DNA	OTOLITH	SCALES	% SPAWN	CRYO SAMPLE TAKEN
1809	9/1/98	11	MALE	101	78	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1810	9/2/98	11	FEMALE	88.5	71	5	RELEASE	J.C.	YES	YES	YES	100	NO
1811	9/2/98	11	FEMALE	90	73	5	RELEASE	J.C.	YES	YES	YES	100	NO
1812	9/2/98	17	FEMALE	86.5	70	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO
1813	9/3/98	10	FEMALE	97	78	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1814	9/3/98	11	FEMALE	85	75.5	5	SFSR	SFSR	YES	YES	YES	HATCHERY	NO
1815	9/4/98	10	FEMALE	95	74.5	5	RELEASE	NOTFOUND	YES	NO	NO	UNKNOWN	NO

Appendix B: Green-Egg to Eyed-Egg Survival in Relation to Trap/Transport Date				
Lot	% Eye-UP	Female ID #	Date Spawned	Date Trapped/Transported
1	79.69	1730	8/11/98	8/10/98
3	50.22	1739	8/18/98	8/18/98
3	50.22	1737	8/18/98	8/17/98
4	52.45	1711	8/21/98	7/26/98
4	52.45	1746	8/21/98	8/19/98
4	52.45	1747	8/21/98	8/19/98
5	80.88	1775	8/25/98	8/24/98
5	80.88	1773	8/25/98	8/24/98
5	80.88	1703	8/25/98	7/18/98
5	80.88	1764	8/25/98	8/23/98
5	80.88	1768	8/25/98	8/24/98
6	53.02	1795	8/28/98	8/28/98
6	53.02	1792	8/28/98	8/27/98
7	51.87	1765	9/1/98	8/23/98
7	51.87	1726	9/1/98	8/6/98
7	51.87	1796	9/1/98	8/28/98
7	51.87	1753	9/1/98	8/20/98
7	51.87	1801	9/1/98	8/28/98
7	51.87	1805	9/1/98	8/29/98
7	51.87	1808	9/1/98	9/1/98
8	69.86	1802	9/4/98	8/28/98
8	69.86	1715	9/4/98	8/3/98
8	69.86	1770	9/4/98	8/24/98
8	69.86	1716	9/4/98	8/4/98
8	69.86	1813	9/4/98	9/3/98
8	69.86	1814	9/4/98	9/4/98
Total Eye-up:	62.01%			

Appendix C: Spawner Tracking Sheet

		Male ID #																		
Sample Date	Female ID #	1705	1714	1719	1727	1729	1733	1734	1740	1744	1750	1757	1762	1776	1779	1797	1807	1809	UNKNOWN	
8/11/98	1730																		X	X
8/18/98	1739	X					X													
8/18/98	1737		X						X											
8/21/98	1711	X																		
8/21/98	1746									X										
8/21/98	1751		X					X												
8/21/98	1756			X																
8/21/98	1747			X																
8/21/98	1758				X						X									
8/25/98	1720					X								X						
8/25/98	1775									X										
8/25/98	1773								X											
8/25/98	1703													X						
8/25/98	1764														X					
8/25/98	1768										X		X							
8/28/98	1798															X				
8/28/98	1777									X										
8/28/98	1795	X									X									
8/28/98	1792	X									X									
9/1/98	1765															X				
9/1/98	1726												X		X					
9/1/98	1796																	X		
9/1/98	1753											X								
9/1/98	1801													X			X			
9/1/98	1805																	X		
9/1/98	1808								X						X					
9/4/98	1802														X					
9/4/98	1715														X					

Appendix C: Spawner Tracking Sheet																			
		Male ID #																	
Sample Date	Female ID #	1705	1714	1719	1727	1729	1733	1734	1740	1744	1750	1757	1762	1776	1779	1797	1807	1809	UNKNOWN
9/4/98	1770														X				
9/4/98	1716														X				
9/4/98	1813														X				
9/4/98	1814														X				
Number of times used		4	2	2	1	1	1	1	3	3	4	1	2	3	9	2	1	2	1

Appendix D: BKD ELISA values for 1998

Sample Date	Female ID #	ELISA (Numeric)	ELISA (Qualitative)
8/11/98	1730	0.087	Negative
8/18/98	1739	0.092	Negative
8/18/98	1737	0.097	Negative
8/21/98	1711	0.095	Negative
8/21/98	1746	0.078	Negative
8/21/98	1751	1.67	High
8/21/98	1756	3.023	High
8/21/98	1747	0.092	Negative
8/21/98	1758	0.81	High
8/25/98	1720	0.76	Moderate
8/25/98	1775	0.126	Low
8/25/98	1773	0.105	Low
8/25/98	1703	0.111	Low
8/25/98	1764	0.102	Low
8/25/98	1768	0.09	Negative
8/28/98	1798	1.974	High
8/28/98	1777	0.1	Low
8/28/98	1795	0.122	Low
8/28/98	1792	0.136	Low
9/1/98	1765	0.102	Low
9/1/98	1801	0.09	Negative
9/1/98	1796	0.099	Negative
9/1/98	1753	0.097	Negative
9/1/98	1726	0.063	Negative
9/1/98	1805	0.092	Negative
9/1/98	1808	0.093	Negative
9/4/98	1802	0.117	Low
9/4/98	1715	0.092	Negative
9/4/98	1770	0.081	Negative
9/4/98	1716	0.169	Low
9/4/98	1813	0.092	Negative
9/4/98	1814	0.087	Negative
High > 0.8; Moderate 0.25 - 0.8; Low = 0.1 - 0.25. All samples were collected and analyzed by IDFG Fish Health Lab. Eggs from fish with high ELISA value were culled and destroyed. Eggs from fish with negative, low, or moderate values that were mixed with eggs with high values were culled and destroyed as well.			

Appendix E: Hatchery Production Summary for Johnson Creek Brood Year 1998

Month	Number	Fork L. MM	Fish/lb	Mortalities	% Mortality to Date	Feed Conversion (Piper et al. 1982)	Feed Conversion (Piper et al. 1982)	Density Index (Piper et al. 1982)	Flow Index (Piper et al. 1982)
December	14,456 ^A	36.49	841.9	223	1.52	2.11	2.11	0.08	0.14
January	59,894 ^A	36.95	810.10	599	1.35	0.96	1.19	0.33	0.58
February	78,346	38.60	698.90	428	1.57	1.74	1.51	0.20	0.47
March	78,067	42.36	494.90	279	1.96	1.96	1.74	0.26	0.62
April	77,862	52.58	371.10	205	2.23	1.92	1.81	0.32	0.78
May	77,572	53.45	269.20	290	2.54	1.95	1.86	0.39	0.96
June	77,412	63.45	163.50	160	2.74	1.30	1.60	0.54	1.33
July	76,772	72.98	107.90	640	3.55	1.04	1.39	0.35	1.74
August	76,672	87.40	62.50	100	3.67	0.88	1.16	0.51	2.51
September	76,574	95.30	45.70	99	3.80	1.15	1.16	0.43	1.05
October	76,513	97.40	38.70	61	3.87	1.16	1.16	0.49	1.21
November	79,077 ^B	101.10	40.80	46	3.81	0.00	1.32	0.07	0.10
December	79,052	105.00	36.00	25	3.84	1.34	1.32	0.08	0.11
January	79,015	112.00	30.90	37	3.88	0.86	1.25	0.09	0.12
February	79,002	111.80	29.70	13	3.9	2.14	1.29	0.09	0.12
March	78,950	114.70	28.60	N/A	3.96	1.32	N/A	N/A	N/A

^A Low numbers indicate initial set out.

^B Fish inventory numbers were adjusted up to match physical inventory numbers obtained from marking.