FISHERY RESEARCH

CAPTIVE REARING PROGRAM FOR SALMON RIVER CHINOOK SALMON

PROJECT PROGRESS REPORT
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Prepared by:

Eric J. Stark, Senior Fisheries Research Biologist
Matthew R. Campbell, Fisheries Genetics Program Manager
Christine C. Kozfkay, Principal Fisheries Research Biologist
Kyle J. Freischmidt, Senior Fisheries Technician

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Captive Rearing Program for Salmon River Chinook Salmon

Project Progress Report

2011 Annual Report

By

Eric J. Stark
Matthew R. Campbell
Christine C. Kozfkay
Kyle J. Freischmidt

Idaho Department of Fish and Game
600 South Walnut Street
P.O. Box 25
Boise, ID 83707

To

U.S. Department of Energy
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ABSTRACT

During 2011, the Idaho Department of Fish and Game (IDFG) continued to monitor the reproductive performance of captive-reared Chinook salmon *Oncorhynchus tshawytscha* released to spawn in natal streams. All captive rearing ended and the last remaining brood year (BY05) was released as mature adults to their natal waters in 2010. Evaluation of the contribution of released captive-reared Chinook to natural adult returns remains the last evaluation for this project. Thus, tissue samples from Chinook salmon adults were collected at the EFSR adult trap again in 2011 to assess production levels from volitional spawning events resulting from program releases conducted in 2006-2008. In this report, we include results from the 320 genetic tissue samples that were genotyped and analyzed for genetic parentage from Chinook salmon adults that returned to the EFSR in 2010. Of these adults, 275 were captured at the EFSR adult trap, and an additional 45 samples were collected from carcasses found below the trap. Of the 320 adult samples, 304 were successfully genotyped (273 trap adults and 31 carcass samples). In total, only 162 adults assigned to one or two parents with zero locus mismatches, for an overall assignment rate of 53%. Most of these adults (n = 148, 91.4%) were produced from natural parents. A total of 13 adult returns in 2010 assigned to at least one captive-reared parent (7.4%): one jack (RY 2007) and 12 age-4 (RY2006). Although natural-origin Chinook contributed more progeny to the 2010 adult return, captive-reared adults released to spawn in 2006 did demonstrate reproductive success. Captive-reared adults (n = 140) constructed 12 redds in 2006 and genetic results thus far indicate that these redds produced 15 progeny that returned as natural adults in 2009 and 2010. This magnitude of production equates to 1.3 recruits per redd. Age-5 progeny from the 2006 spawn year will return in 2011, which may contribute additional captive-reared production.

Authors:

Eric J. Stark
Senior Fisheries Research Biologist

Matthew R. Campbell
Fisheries Genetics Program Manager

Christine C. Kozfkay
Principal Fisheries Research Biologist

Kyle J. Freischmidt
Senior Fisheries Technician

INTRODUCTION

In 1992, Snake River Chinook salmon were listed as threatened under the Endangered Species Act (ESA; National Marine Fisheries Service [NMFS] 1992). Many sources of mortality have contributed to the decline in natural/wild Snake River Chinook salmon over several decades. However, until smolt-to-adult survival increases, our challenge is to preserve the existing metapopulation structure (by preventing local or demographic extinctions) of these stocks to ensure they remain extant to benefit from future recovery actions. This project is developing technology that may be used in the recovery of the listed Snake River spring/summer Chinook salmon evolutionarily significant unit (ESU), which consists of 31 subpopulations (i.e. breeding units or stocks); (McClure et al. 2003). Preserving the metapopulation structure of this ESU is consistent with the various Snake River Salmon Recovery Plans (NMFS 1995; Schmitten et al. 1997; McClure et al. 2003), and supports the Northwest Power and Conservation Council's (NPCC) goal of maintaining biological diversity while doubling salmon and steelhead runs (NPCC 1994).

Idaho and Oregon state, tribal, and federal fish managers met during 1993 and 1994 to discuss captive culture research and implementation in the Snake River basin. The outcome of those meetings was to initiate two programs: 1) the Oregon Department of Fish and Wildlife (ODFW) would initiate a captive broodstock program using selected Grande Ronde River Chinook salmon populations, and 2) the Idaho Department of Fish and Game (IDFG) would initiate captive rearing research using selected Salmon River Chinook salmon populations. Captive fish culture techniques begin by bringing naturally produced juveniles (eggs, parr, or smolts) into captivity and rearing them to sexual maturity in a hatchery. At this point, the two programs use different techniques. The F_1 generation in a captive rearing program (IDFG) is returned to their natal streams and allowed to spawn naturally. Alternately, the F_1 generation from a captive broodstock program (ODFW) is spawned in the hatchery, where the resulting F_2 progeny are held until release. The F_2 generation is then released to its natal stream to emigrate volitionally while a subset remains in captivity for the next generation. The primary focus of these programs is to evaluate the effectiveness of the two forms of captive culture to meet population conservation objectives. Implicit within each research project is the objective to develop and test appropriate facilities and fish culture protocols specific to the captive culture of Chinook salmon for conservation management of depressed populations.

Little scientific information regarding captive culture techniques for Pacific salmonids was available at the inception of these programs, but a substantial amount of new literature was published in the ensuing years. The Chinook Salmon Captive Propagation Technical Oversight Committee (CSCPTOC) was formed to convey this new information between the various state, federal, and tribal entities involved in the captive culture of Chinook salmon. The CSCPTOC meets quarterly, which allows an adaptive management approach to all phases of the program and provides a forum of peer review and discussion for all activities and culture protocols associated with this program. Flagg and Mahnken (1995) provided an initial literature review of captive rearing and captive broodstock technology, which provided the knowledge base upon which the program was designed. Using this work, the IDFG captive rearing program for Salmon River Chinook salmon was initiated to further develop this technology by monitoring and evaluating captive-reared fish during rearing and post-release spawning phases. Since the program's inception, studies documenting the spawning behavior of captive-reared Chinook salmon (Berejikian et al. 2001b), coho salmon *O. kisutch* (Berejikian et al. 1997), and Atlantic salmon *Salmo salar* (Fleming et al. 1996) have been published. Other studies have also compared the competitive behavior of male captive-reared and natural coho salmon during spawning (Berejikian et al. 2001a), and the competitive differences between newly emerged fry

produced by captive-reared and natural coho salmon (Berejikian et al. 1999). Finally, Hendry et al. (2000) reported on the reproductive development of sockeye salmon *O. nerka* reared in captivity.

The IDFG captive rearing program was developed as a way to increase the number of naturally spawning adults and maintain metapopulation structure in selected populations at high risk of extinction while avoiding the impacts of multigenerational hatchery culture described in Reisenbichler and Rubin (1999). The strategy of captive rearing is to prevent cohort collapse in the target populations by returning captive-reared adults to natural spawning areas to augment depressed natural escapement (or replace it in years when no natural escapement occurs). This maintains the continuum of generation-to-generation smolt production and provides the opportunity for population maintenance or increase, should environmental conditions prove favorable for that cohort. However, the success of the captive rearing approach to produce adults with the desired morphological, physiological, and behavioral attributes to spawn successfully in the wild remains somewhat elusive (Fleming and Gross 1992, 1993; Joyce et al. 1993; Flagg and Mahnken 1995).

The IDFG captive rearing program was initiated in 1995 with the collection of brood year (BY) 1994 Chinook salmon parr from three study streams. Since then, naturally spawned Chinook salmon progeny from BY95-BY05 have been reared in captivity to continue the project. Hassemer et al. (1999, 2001), Venditti et al. (2002, 2003a, 2003b, 2005), Baker et al. (2006a, 2006b, 2007), Stark et al. (2008, 2009), and Stark and Gable (2010) summarize project activities from inception through 2010. The streams selected for inclusion in the captive rearing program include the Lemhi River (LEM), the East Fork Salmon River (EFSR), and the West Fork Yankee Fork Salmon River (WFYF). Project activities were completed on the LEM in 2003 with the release of mature BY99 adult fish, enabling increased monitoring intensity on the WFYF through 2003, and shifting primarily to the EFSR from 2004 through present day (Figure 1).

All three study streams were selected because of their water temperature and water quality. Water temperatures are ideal for juvenile Chinook salmon rearing in all three streams, while water quality ranges from sufficient to ideal. Stream habitat quality ranges from relatively pristine to areas of riparian degradation caused by sedimentation, grazing, mining, logging, road building, and irrigation diversion. The EFSR drains a relatively sterile watershed of granitic parent material associated with the Idaho batholith. The lower 30 km of the EFSR runs through ranch and grazing property developed during the last century, but the upper reaches reflect near pristine conditions with little historical disturbance.

The goal of the captive rearing program is to evaluate the potential of captive rearing technology for the conservation of Snake River spring/summer Chinook salmon. There are two primary project objectives needed to accomplish this goal: 1) develop and implement culture practices and facility modifications necessary to rear Chinook salmon to maturity in captivity having morphological, physiological, and behavioral characteristics similar to natural fish; and 2) evaluate the spawning behavior and success of captive-reared individuals under hatchery and natural conditions. These objectives divide the program into two functional units (fish culture and field evaluations), but the success of the program is dependent on the synchronous development of both. This report documents remaining field evaluation activities from January 1, 2010 through December 31, 2010. This project was coordinated with the Northwest Power and Conservation Council's Fish and Wildlife Program (NPCC 2000), identified as project 2007-40-300. Funding was provided through the Bonneville Power Administration under contract 44419.

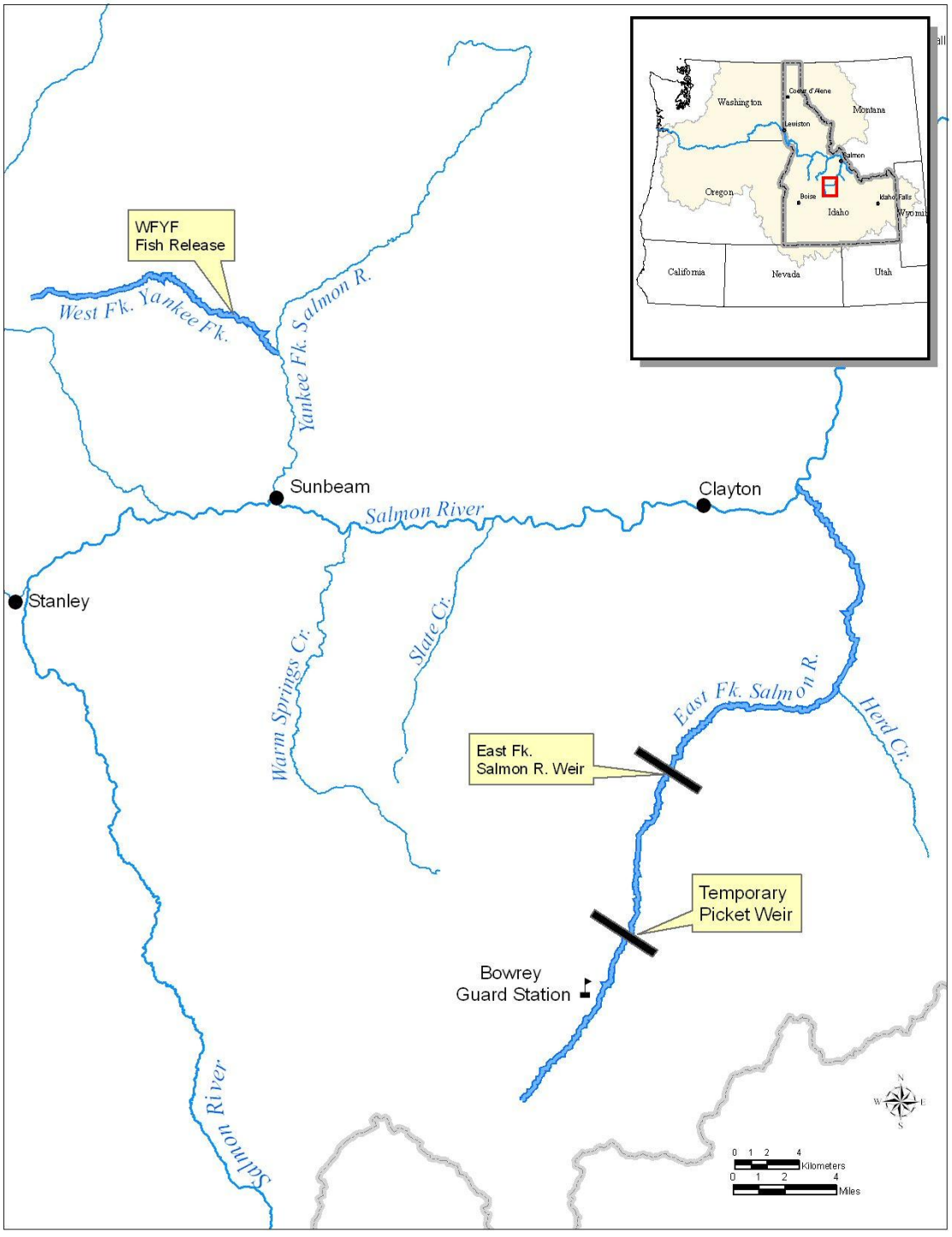

Figure 1. Location of study streams included in the Idaho Department of Fish and Game Captive Rearing Program for Salmon River Chinook salmon.

METHODS

Captive culture ended in 2010 when the last remaining brood year (BY05) was transported from the NOAA Manchester saltwater facility to Idaho for release into study streams for volitional spawning. Detailed facility specifications are referenced in previous project annual reports (Hassemer et al. 1999, 2001; Venditti et al. 2002, 2003a, 2003b, 2005; Baker et al. 2006a, 2006b, 2007; Stark et al. 2008, 2009; and Stark and Gable 2010). Freshwater culture methods at Eagle FH; and juvenile and adult rearing, marking, and transportation methods are summarized in Baker et al. (2007). No further fish health monitoring or brood year growth and survival summaries remain. Studies comparing the emergence survival of progeny of natural spawning captive-reared versus wild Chinook were completed in 2010. Captive-rearing project evaluations were performed only on the EFSR in 2011. The Sawtooth FH satellite facility on the EFSR (EFSR adult trap) was utilized for all adult return collections. The facility is located near Big Boulder Creek, approximately 29 river kilometers upstream from the confluence with the main Salmon River.

Volitional Spawning

In 2011, no captive-reared adults were released into their natal streams for volitional spawning; the last release was in 2010. Thus, all spawning observations were comprised of redd count surveys throughout the upper EFSR and carcass recoveries below the EFSR adult trap of natural/wild adult returns. Annual Chinook salmon aerial redd counts were conducted by IDFG in both the WFYF and EFSR trend sites in 2011. Instead, because of safety concerns, redds were surveyed via ground counts by IDFG or Shoshone-Bannock Tribe Fisheries (SBT) crews.

EFSR Trapping—Adult Returns

In 2011, the EFSR adult trap was operated to collect genetic samples from returning natural Chinook salmon. During high flows, the trap was checked regularly between 0700 and 2000 (every 2-3 hours) to assure proper settings and operation. The trap box was raised each morning and fish were netted. Chinook salmon were placed in a separate holding tank for further data collection. All other fishes were identified to species, measured to FL, genetic samples were collected on salmonids, and all fish were subsequently released upstream of the trap.

Trapped Chinook salmon were placed in an anesthetic bath containing MS-222 (50 mg/L) buffered with sodium bicarbonate. After each Chinook salmon was sedated, it was checked for visible marks, scanned for a coded-wire tag, gender was determined, and FL was measured to the nearest 0.1 cm. If the fish was not a recapture, it received a numbered jaw tag (installed around the lower-left mandible), and a genetic sample was taken from the caudal fin with the aid of a hole punch and preserved in 95% ethanol. The hole punch and any forceps used to remove the sample were subsequently swabbed with isopropyl alcohol between specimens to reduce the possibility of DNA cross-contamination. The fish was then placed into a freshwater recovery bath until ready for release upstream of the trap. Total Chinook salmon numbers were reported to the IDFG Hatchery Trapping Database daily. To determine if the trap was altering the movements of migrating adult Chinook salmon, the area downstream of the trap was monitored by snorkeling periodically from July through September, and all observed fish were enumerated by species. Snorkeling efforts were concentrated in the river channel from the pool immediately below the trap to about 250 m downstream of the Big Boulder Creek confluence.

Parentage Genetic Analyses

This project relies on genetic tagging technology to determine the contribution of naturally spawning captive-reared adult Chinook in the EFSR to natural/wild adult returns. Genetic markers were chosen because they do not require any time, effort, or expense to apply; since fish are "tagged with genetic markers inherited from their parents" (ISRP/ISAB 2009-1). In addition, genetic markers should have no effects on survival or behavior. Lastly, they have the advantage of much higher tagging rates and are less invasive.

Parentage genetic analysis will be used to assign offspring (returning adults) to their parents (natural spawners or captive-reared spawners); (ISRP/ISAB 2009-1, pg. 69). Natural/wild returning adult Chinook (parents) have been captured at the EFSR adult trap since 2004 and tissues collected from each fish. In addition, tissues have also been collected from all mature adult captive-reared Chinook released to spawn naturally (parents) in the EFSR above the trap. Lastly, natural/wild returning adult Chinook (offspring/progeny) will continue to be captured at the EFSR adult trap through 2014 and tissues collected from each fish.

Fin clips from adult Chinook salmon collected from the EFSR adult trap and from spawned-out adults will be genotyped and analyzed for genetic parentage to determine if they were the progeny of captive-reared parents previously released to spawn naturally in the EFSR. Genetic material from these adults will be analyzed with samples from all captive-reared adults released to spawn, all previous years' natural adult returns, and all carcasses recovered from the study area. These samples will be used in parental analyses through the use of microsatellite markers (parental exclusion analysis: Estoup et al. 1998; Bernatchez and Duchesne 2000; Eldridge et al. 2002).

Genomic DNA was extracted from samples using the Nexttec Genomic DNA Isolation Kit from XpressBio (Thurmont, Maryland). All samples were genotyped with 13 standardized GAPS microsatellite loci (Oki100, OMM1080, Ots211, Ots212, Ots213, Ots201b, Ots208b, OtsG474, Ssa408, Ogo2, Ogo4, Ots3M, and Ots9; Seeb et al. 2007), and one additional non-standardized locus (Ots4). Fluorescently labeled PCR products were separated with an Applied Biosystems 3100 Fragment Analyzer and scored with GeneMapper software. All genotyping was quality controlled by utilizing positive (known genotype) and negative (without DNA) controls in each run. Repetitive genotyping of ~12% of randomly selected individuals will be completed to ensure reliability of genotyping results and for QA/QC measures.

Parentage (and thus age) of adults will be determined through assignment procedures back to the parental genotype database using either an exclusionary or maximum likelihood analysis (with a 1 mismatch cutoff) using the software program CERVUS 3.0 (www.fieldgenetics.com). This latest version of CERVUS has updated likelihood equations that increase the success of paternity assignment while accommodating genotyping error (Kalinowski et al. 2007). Parents included all natural adults passed above the EFSR adult trap and all captive-reared adults released above the EFSR picket trap between 2004 and 2007. In this report, we summarize the 2010 returns and their assignments back to parents returning from 2005 to 2007.

RESULTS AND DISCUSSION

Volitional Spawning

Between August 11 and September 18, 2011, IDFG Captive Chinook crews counted 21 Chinook salmon redds upstream of the EF adult trap (NS-1b), and an additional 63 were found within 6 km downstream of the trap during ground surveys (NS-1a); (Appendix A). Aerial surveys by IDFG Region 7 fish management personnel on September 8, 2011, found 16 redds in NS-1b, 86 redds in NS-1a and NS-2b combined, and an additional 36 redds from the mouth of the EFSR upstream to the mouth of Herd Creek (NS-2a); (Table 1). During intensive surveys conducted every 2-3 days, in the first 6 km below the EFSR adult trap (NS-1a), we also recovered a total of 75 Chinook carcasses. Forty-five were carcasses not previously sampled (untagged/unmarked); but 30 of the 75 carcasses were fish previously captured, jaw-tagged, and released above the EFSR adult trap (Appendix B). Fin rays were collected from a subsample of 44 of the carcasses, with 33 found to be age-5 (75%) and only 11 were age-4 (25%); (Figure 2). This is opposite the age structure (based upon length only) observed from Chinook captured in the EFSR adult trap.

Discharge (flow) of the EFSR during 2011 was above average during most of the year (Figure 3), similar to flows observed in 2010, but even higher. Discharge was drastically higher from late June through July. Similar to the 2009 and 2010 water years, low discharge during spring and high discharge during summer was likely the result of a wet, cold late spring, but in 2011 it was delayed even later. This delayed runoff likely resulted in cooler than average August and September stream temperatures during spawning.

EFSR Trapping—Adult Returns

During operation of the trap facility from June 15 through September 21, 2011, two hundred twelve adult Chinook salmon (62 females, 102 males, 44 jacks, 4 unknown) were captured and released upstream (Table 2). Fin clips were collected from all but one of these trapped Chinook. Four hatchery origin Chinook were trapped and subsequently relocated back to the mainstem Salmon River. These hatchery origin adults were likely strays from adjacent hatchery returns to either Sawtooth FH or Pahsimeroi Fish Hatchery, and thus recycled back into the fishery. An additional 365 non-target fish were trapped and passed upstream including bull trout *Salvelinus confluentus*, westslope cutthroat trout *O. clarkii lewisi*, rainbow trout *O. mykiss*, and mountain whitefish *Prosopium williamsoni* (Table 3).

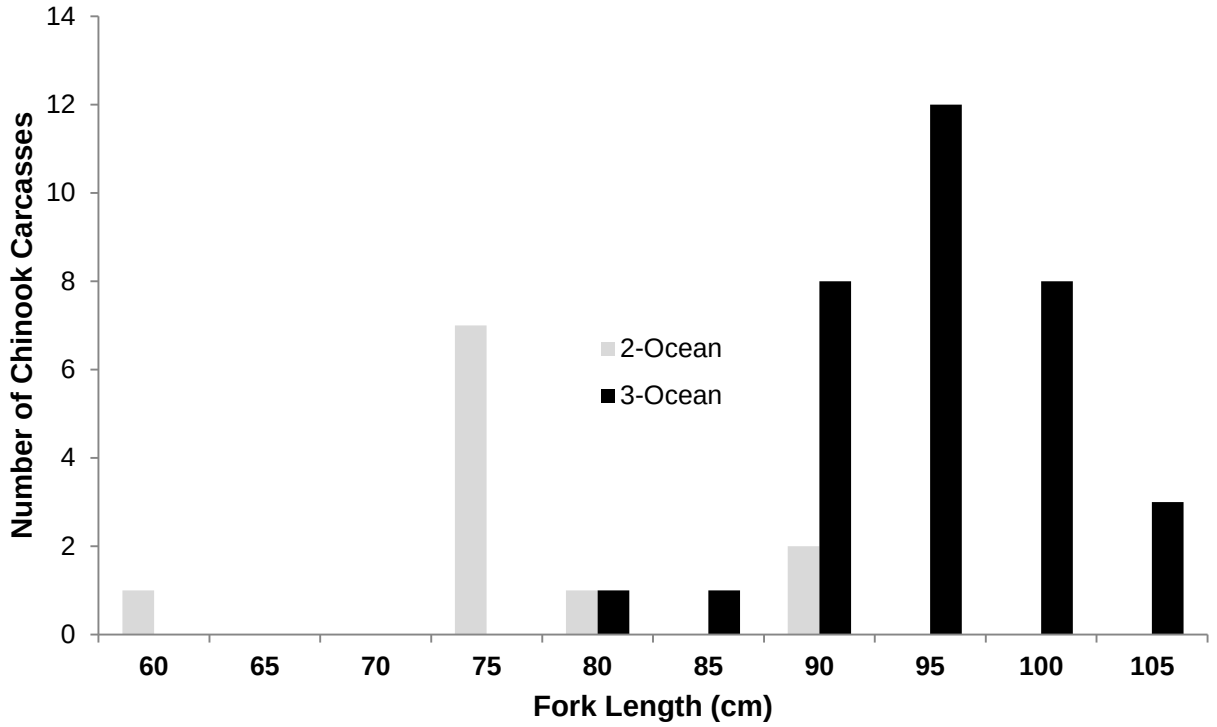

Figure 2. Age at length of a subsample of Chinook salmon collected as carcasses on the East Fork Salmon River (EFSR), August 11–September 18, 2011. Two-ocean and 3-ocean fish are four and five years old, respectively.

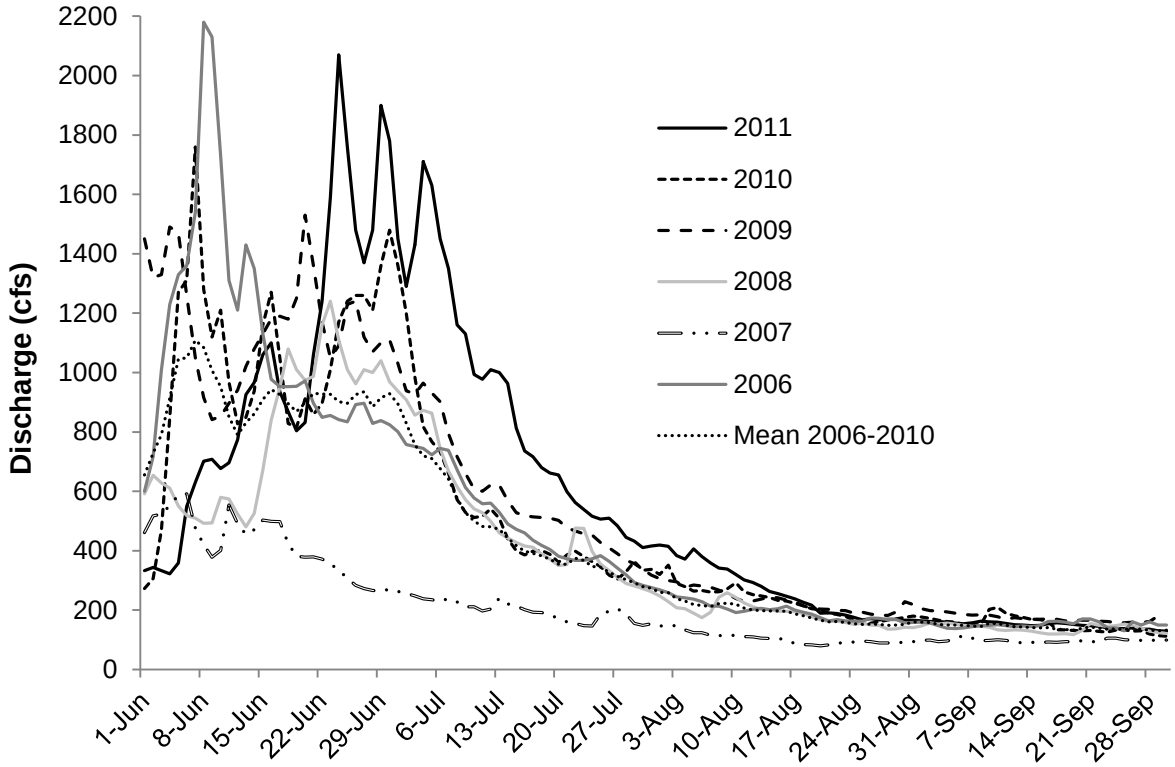

Figure 3. Discharge of the East Fork Salmon River (EFSR), June 1–September 30, 2011.

Table 1. Number of redds observed from aerial counts and ground counts on the West Fork Yankee Fork Salmon River (WFYF) and East Fork Salmon River (EFSR).

Stream	Section Description	Number of Redds											
		2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
WFYF[a]	WFYF mouth to Lightning Cr [1]	4	10	10	18	5	1	0	7	1	1	7	3
	Lightning Cr to Cabin Cr [2]	0	3	1	7	0	0	0	0	0	0	0	0
	Total	**4**	**13**	**11**	**25**	**5**	**1**	**0**	**7**	**1**	**1**	**7**	**3**
EFSR[b]	Mouth of East Fork to Herd Cr (NS-2a) [3]	12	17	56	15	38	12	7	3	34	13		36
	Herd Cr to 3.5 mi downstream of EF Trap (NS-2b) [4]	20	59	79	60	37	18		31	40	24	110	86[c]
	3.5 mi downstream of EF Trap to EF Weir (NS-1a) [5]	18	48	100	93	55	32	19	21	50	13	119	
	EF Weir to Bowrey Guard Station (NS-1b) [6]	9	12	44	59	24	16	2	25	27	9	60	16
	Total	**59**	**136**	**279**	**227**	**154**	**78**	**28**	**80**	**151**	**59**	**289**	**138**

Section Start Waypoint - Section End Waypoint (WGS-84 datum; Zone 11):

[1]681207mE 4913151mN - 675543mE 4917302mN

[2]675543mE 4917302mN - 672961mE 4918255mN

[3]713337mE 4905174mN - 715846mE 4892489mN

[4]715846mE 4892489mN - 709618mE 4891548mN

[5]709618mE 4891548mN - 705656mE 4887911mN

[6]705656mE 4887911mN - 700640mE 4872303mN

[a] WFYF redds summarized above were from aerial counts (2000-2009) and ground counts (2010-2011).

[b] EFSR redds summarized above are all from aerial counts, except for the 2010 counts, which were ground counts.

[c] Aerial counts of SGS transects NS-2b and NS-1a were mistakenly counted as one combined transect in 2011.

Table 2. Disposition of natural origin adult Chinook salmon captured and passed upstream at the East Fork Salmon River (EFSR) adult trap facility during 2011.

Gender	Trapped	Recaptured	Total	Percent	
Female	62	1	63	29.2%	
Male	102	11	113	48.1%	
Jack	44	5	49	20.8%	
Unknown	4	0	4	1.9%	
Total	**212**	**17**	**229**		
Gender	**June**	**July**	**Aug**	**Sept**	**Total**
Female	0	23	39	0	62
Male	0	50	50	2	102
Jack	0	8	35	1	44
Unknown	0	1	3	0	4
Total	**0**	**82**	**127**	**3**	**212**
Gender	**Age 3 (<64 cm)**	**Age 4 (64-82 cm)**	**Age 5 (>82 cm)**	**Total**	
Female	0	29	33	62	
Male	0	87	15	102	
Jack	44	0	0	44	
Unknown	0	3	0	3	
Total	**44**	**119**	**48**	**211**	

* All totals do not include four ad-clipped (hatchery) fish & 1 wild fish w/ unknown gender and length.

Table 3. Summary of additional fish captured and passed upstream at the East Fork Salmon River adult trap during 2011.

Species	Trapped
Bull trout	251[a]
Westslope cutthroat trout	0
Rainbow trout	3[b]
Mountain whitefish	108[c]
Catostomus spp	1
Steelhead (juvenile)	2
Sockeye salmon	0
TOTAL	**365**

[d] Includes 2 trap mortalities
[e] Includes 1 rainbow/cutthroat hybrid
[f] Includes 6 trap mortalities

Parentage Genetic Analyses

In 2011, we genotyped and performed parentage genetic analyses of fin tissue samples from a total of 320 Chinook salmon adults that returned to the EFSR in 2010 (Table 4). Of these adults, 275 were captured at the EFSR adult trap. Thirty of these trapped adults (jaw-tagged) were later encountered as carcasses below the trap. An additional 45 samples were collected from carcasses found below the trap (untagged). Of the 320 adult samples, 304 were successfully genotyped (95%; 273 trap adults and 31 carcass samples).

Table 4. Number and type of genetic samples collected from 2010 adult Chinook salmon returns to the East Fork Salmon River and the number and percent of genetic samples successfully genotyped.

Collection Type	Collected	Genotyped Number	Genotyped %
Trapped	275	273	99.3%
Carcasses	45	31	68.9%
Carcasses[a]	30	N.A.	N.A.
TOTAL	320	304	95.0%

[a] Carcasses of fish previously trapped and jaw-tagged, (part of the 275 trapped), thus not resampled for genetics.

Of the successfully genotyped samples (n = 304), only 94 assigned to a parent pair (of either natural or captive parents) with 95% confidence and zero locus mismatches (Table 5). An additional nine fish assigned to a parent pair with less than 95% confidence (0 mismatches). These nine fish all assigned to captive-reared parent pairs, and they assigned with <95% confidence because multiple parent pairs were identified as possibilities, a result of high relatedness among some captive-reared adults. But through a process of elimination (incompatibilities with spawn years or dispositions), parentage was assigned to all nine of these fish. An additional 59 adults were assigned to a single parent with zero locus mismatches.

In summary, 162 adults assigned to one or two parents with zero locus mismatches, for an overall assignment rate of 53%. Most of these adults (n = 149, 92%) were produced from natural parents. A smaller number of adults were assigned to captive x captive crosses (n = 7), and natural x captive crosses (n = 6). The majority of all assignments (n = 142, 88%) were produced from fish that returned or were released in 2006 (age-4 in 2010). Of the fish assigned to natural parents, nine adults were produced from adults that returned in 2005 (age-5), 130 adults were produced from adults that returned in 2006 (age-4), and nine adults were produced from natural adults that returned in 2007 (age-3). Of the fish assigned to captive-reared parents, 12 adults were produced from adults released in 2006 (age-4) and one adult was produced from a jack that was released in 2007.

Of the single parent assignment adults (n = 59), one assigned to a SY04 natural, six to SY05 naturals, 49 to SY06 naturals, two to SY07 naturals, and one to a captive-reared adult released in 2007. The majority of the single assignment parents were assigned to a male parent only (72.7%). These results may be reasonable given that a large number of males that are trapped and released above the trap apparently migrate back downstream to below the trap and could contribute to natural production with unsampled (untrapped) females. In 2006,

approximately 15% of the adults captured, tagged, and released above the EFSR trap were recaptured in the adult trap. All but one of these adults were males. A total of 24 unique SY06 natural parents (20 males and four females) were identified as contributing to single assignments. This would suggest that approximately 30% of the adults captured, sampled, and released above the trap in 2006 migrated back downstream and contributed to reproduction below the trap. It would also suggest that some females are moving downstream to spawn, and we are missing a minimum of 24 parents that spawned below the trap (assuming 1 female to every 1 male).

These findings provide an explanation for the large number of single parent assignments, but provide no clear justification for the overall lack of assignment to any parent. Parentage assignment rates increased in recent years' adult returns (progeny) from 16% in 2007, 58% in 2008, 69% in 2009, but dropped slightly again in 2010 to 53%. While a small number of potential parents at the trap were unsuccessfully genotyped (<3%), an even lower genotyping error (<1%) could have contributed to some non-assignments. These results suggest that a significant number of unsampled parents contributed to the production of adults that returned to the trap in 2010. Potential sources of unsampled parents include precocial male production and adult returns (progeny) produced/spawned below the trap returned to the trap and thus their parents are effectively unsampled (genetically).

In 2010, carcasses were collected to determine if any captive-reared progeny were returning below the trap. Of the 75 carcasses recovered below the trap, 30 were adults that had been originally trapped, tagged, and released above the trap. Of these 30 tagged (previously trapped) carcasses recovered below the trap, 11 assigned to parents sampled at the trap in 2006. It is unknown as to whether these parents stayed above the trap or also moved below the trap. There were 45 untagged carcasses with 31 complete genotypes and only one of the 31 carcasses assigned to a parent pair with no mismatches. This sample assigned to a captive X natural cross. The unassignment of these carcasses indicates that there are a lot of missing parents spawning below the trap and likely a lot of production below the trap. It appears as if some of the progeny from these crosses are returning to the trap and may be subsequently moving below the trap following sampling. Precocial males and natural/wild strays could also be contributing to poor assignment rates and future genetic analyses can be performed to rule out strays. Only one of the carcasses assigned to a captive fish. Again, it is unclear as to whether the parents spawned above or below the trap but production from a captive fish was documented. Additional carcass collections will be recovered in future years to evaluate if additional captive fish are recovered below the weir.

These results provide a complicated, and in some cases unresolved, picture of reproductive success of natural and captive-reared Chinook salmon in the EFSR. However, we do demonstrate reproductive success of captive-reared Chinook salmon released to spawn. Captive-reared adults (n = 140) constructed 12 redds in 2006, and genetic results thus far indicate that these redds produced 15 progeny that returned as adults in 2009 and 2010. This magnitude of production equates to 1.3 recruits per redd (Table 7). Furthermore, age-5 progeny from the 2006 spawn year will return in 2011, which may contribute additional captive-reared production. Despite detecting few adult returns produced from captive-reared adults thus far, our best probability of detection remains via adult returns in 2011-2012, because captive-reared releases in 2007 and 2008 demonstrated relatively strong spawning success (Appendix C). Lastly, remaining project field efforts will include continued capture and genetic sampling of adult returns at the EFSR adult trap, but will also concentrate on obtaining fresh genetic samples from carcasses recovered below the trap.

Table 5. Parentage assignments of adult Chinook returns to the East Fork Salmon River in 2010 (273 trapped, 31 carcasses). Summarized by assignment type, confidence, parent source crosses, and age.

Parentage Assignment Type	PROGENY ASSIGNMENTS												TOTAL ALL
	Captive x Captive				Captive x Natural				Natural x Natural				
	Jacks	Age 4	Age 5	Total	Jacks	Age 4	Age 5	Total	Jacks	Age 4	Age 5	Total	
2 Parents (95% conf)		1		1		2		2	7	81	3	91*	94
2 Parents (<95% conf)		5		5		4		4				0	9
1 Parent	1			1				0	2	49	6	57	59
TOTAL	**1**	**6**	**0**	**7**	**0**	**6**	**0**	**6**	**9**	**130**	**9**	**149***	**162**
												Invalid	**15**
												No Assignment	**127**
												Total	**304**
												Assignment Rate	**53%**

**One 2010 adult return assigned to a 2004 Natural x Natural (age-6).*

Table 6. Number of females, redds, and redds per female of both captive-reared (C) and natural/wild (N) Chinook in the East Fork Salmon River upstream of the adult trap; and subsequent progeny (adult returns) assigned to those spawn years.

Spawn Year[a,b]	Females		Redds[c]		Redds/Female		Progeny[d]		Recruits/Redd		Recruits/Female	
	C	N	C	N	C	N	C	N	C	N	C	N
2005	28	21	11	17	0.44	0.81	1	59	N.A.	3.5	N.A.	2.81
2006	71	21	12	16	0.21	0.78	15	137	1.3	8.3	0.21	6.52
2007	124	27	63	24	0.51	0.89	1	9	0.0	0.4	0.01	0.33
2008	111	64	55	45	0.50	0.70						
2009	113	60	10	49	0.18	0.82						
2010	5	72	1	60	0.20	0.83						
Total (mean)	**452**	**265**	**152**	**211**	**0.34**	**0.80**	**17**	**205**	**0.6**	**4.1**	**0.11**	**3.22**

[a] Brood years (spawn years) 2006 and 2007 are incomplete (i.e. - not all possible progeny have returned yet).

[b] Captive-reared 2008-2010 releases have not yet been genotyped, and therefore not yet included in the parentage analysis.

[c] Does not include redds counted below the EFSR adult trap (2009-66, 2010-119, 2011-63).

[d] All progeny assignments are one-parent assignments, 95% Confident, 0 or 1 Mismatch.

Table 7. Projected natural and captive-reared Chinook salmon production from spawn years 2005-2010 in the East Fork Salmon River.

Natural/Wild Chinook

Spawn Year	Females[a]		Redds[a]		Redds/ Female	Eggs/ Female	Egg Production[a]		Spawn to Eyed-egg Survival[b]	Eyed-egg Production		Eyed-egg to Smolt Survival[c]	Smolts		Smolt to Adult Survival[c]	Adult Return	
	Below	Above	Below	Above			Below	Above		Below	Above		Below	Above		Below	Above
2005	72	21	58	17	0.81	3,500	204,396	59,500	90.6%	185,182	53,907	5.0%	9,259	2,695	2.0%	185	54
2006	30	21	23	16	0.78	3,500	81,758	57,628	90.6%	74,073	52,211	5.0%	3,704	2,611	2.0%	74	52
2007	52	27	46	24	0.89	3,500	160,246	84,000	90.6%	145,183	76,104	5.0%	7,259	3,805	2.0%	145	76
2008	122	64	86	45	0.70	3,500	300,462	157,500	90.6%	272,218	142,695	5.0%	13,611	7,135	2.0%	272	143
2009	81	60	66	49	0.82	3,500	231,000	171,500	90.6%	209,286	155,379	5.0%	10,464	7,769	2.0%	209	155
2010	143	72	119	60	0.83	3,500	416,500	210,000	90.6%	377,349	190,260	5.0%	18,867	9,513	2.0%	377	190
MEAN	**83**	**44**	**66**	**35**	**0.81**	**3,500**	**232,394**	**123,355**	**90.6%**	**210,549**	**111,759**	**5.0%**	**10,527**	**5,588**	**2.0%**	**211**	**112**
TOTAL	**582**	**265**	**398**	**211**												**1,263**	**671**

Captive-reared Chinook

Spawn Year	Females[a]		Redds[a]		Redds/ Female	Eggs/ Female	Egg Production[a]		Spawn to Eyed-egg Survival[b]	Eyed-egg Production		Eyed-egg to Smolt Survival[c]	Smolts		Smolt to Adult Survival[c]	Adult Return	
	Below	Above	Below	Above			Below	Above		Below	Above		Below	Above		Below	Above
2005		28		11	0.39	1,700		18,700	70.5%	0	13,174	5.0%	0	659	2.0%	0	13
2006		71		12	0.17	1,700		20,400	70.5%	0	14,372	5.0%	0	719	2.0%	0	14
2007		124		63	0.51	1,700		107,100	70.5%	0	75,452	5.0%	0	3,773	2.0%	0	75
2008		111		55	0.50	1,700		93,500	70.5%	0	65,871	5.0%	0	3,294	2.0%	0	66
2009	4	113	4	10	0.09	1,700	6,800	17,000	70.5%	4,791	11,977	5.0%	240	599	2.0%	5	12
2010	0	5	0	1	0.20	1,700		1,700	70.5%	0	1,198	5.0%	0	60	2.0%	0	1
MEAN	**2**	**75**	**2**	**25**	**0.31**	**1,700**	**1,133**	**43,067**	**70.5%**	**798**	**30,340**	**5.0%**	**40**	**1,517**	**2.0%**	**1**	**30**
TOTAL	**4**	**452**	**4**	**152**												**5**	**182**

[a] The numbers of females, redds, and egg production below the trap in 2005-2008 were estimated based upon the 2009-2010 redd distribution (above/below).
[b] Mean survival rates estimated from emergence survival experiments (2007-2009).
[c] Optimistic mean survival rates from the literature.

LITERATURE CITED

Baker, D. B., J. Heindel, D. Vidergar, J. Gable, K. Plaster, J. Redding, and P. Kline. 2006a. Captive rearing program for Salmon River Chinook salmon, 2005. Project Progress Report to the Bonneville Power Administration, Contract Number 00004002. Portland, Oregon.

Baker, D. B., J. Heindel, D. Vidergar, J. Gable, J. Redding, and P. Kline. 2006b. Captive rearing program for Salmon River Chinook salmon, 2004. Project Progress Report to the Bonneville Power Administration, Contract Number 00004002. Portland, Oregon.

Baker, D. B., J. Heindel, D. Vidergar, E. Stark, J. Gable, K. Plaster, and P. Kline. 2007. Captive rearing program for Salmon River Chinook salmon, 2006. Project Progress Report to the Bonneville Power Administration, Contract Number 00024657. Portland, Oregon.

Berejikian, B. A., E. P. Tezak, S. L. Schroder, C. M. Knudsen, and J. J. Hard. 1997. Reproductive behavioral interactions between wild and captively reared coho salmon (*Oncorhynchus kisutch)*. ICES Journal of Marine Science 54:1040-1050.

Berejikian, B. A., E. P. Tezak, S. L. Schroder, T. A. Flagg, and C. M. Knudsen. 1999. Competitive differences between newly emerged offspring of captive-reared and wild coho salmon. Transactions of the American Fisheries Society 128:832-839.

Berejikian, B. A., E. P. Tezak, L. Park, E. LaHood, S. L. Schroder, and E. Beall. 2001a. Male competition and breeding success in captively reared and wild coho salmon (*Oncorhynchus kisutch)*. Canadian Journal of Fisheries and Aquatic Sciences 58:804-810.

Berejikian, B. A., E. P. Tezak, and S. L. Schroder. 2001b. Reproductive behavior and breeding success of captively reared Chinook salmon. North American Journal of Fisheries Management 21:255-260.

Bernatchez, L., and P. Duchesne. 2000. Individual-based genotype analysis in studies of parentage and population assignment: how many loci, how many alleles? Canadian Journal of Fisheries and Aquatic Sciences 57:1-12.

Eldridge, W. H., M. D. Bacigalupi, I. R. Adelman, L. M. Miller, and A. R. Kapuscinski. 2002. Determination of relative survival of two stocked walleye populations and resident natural-origin fish by microsatellite DNA parentage assignment. Canadian Journal of Fisheries and Aquatic Sciences 59:282-290.

Estoup, A., K. Gharbi, M. SanCristobal, C Chevalet, P. Haffray, and R. Guyomard. 1998. Parentage assignment using microsatellites in turbot (*Scophthalmus maximus*) and rainbow trout (*Oncorhynchus mykiss*) hatchery populations. Canadian Journal of Fisheries and Aquatic Sciences 55:715-725.

Flagg, T. A., and C. V. W. Mahnken. 1995. An assessment of the status of captive broodstock technology for Pacific Salmon. Final report to the Bonneville Power Administration, Project No. 93-56, Contract No. DE-AI79-93BP55064. Portland, Oregon.

Fleming, I. A., and M. R. Gross. 1992. Reproductive behavior of hatchery and wild coho salmon (*Oncorhynchus kisutch*): does it differ? Aquaculture 103:101-121.

Fleming, I. A., and M. R. Gross. 1993. Breeding success of hatchery and wild coho salmon (*Oncorhynchus kisutch*) in competition. Ecological Applications 3(2):230-245.

Fleming, I. A., B. Jonsson, M. R. Gross, and A. Lamberg. 1996. An experimental study of the reproductive behaviour and success of farmed and wild Atlantic salmon (*Salmo salar*). Journal of Applied Ecology 33:893-905.

Hassemer, P. F., P. Kline, J. Heindel, and K. Plaster. 1999. Captive rearing initiative for Salmon River Chinook salmon, 1998. Project Progress Report to the Bonneville Power Administration, Contracts 97-BI-97538 and 98-BI-63416, Portland, Oregon.

Hassemer, P. F., P. Kline, J. Heindel, K. Plaster, and D. A. Venditti. 2001. Captive rearing initiative for Salmon River Chinook salmon, 1999. Project Progress Report to the Bonneville Power Administration, Contracts 97-BI-97538 and 98-BI-63416, Portland, Oregon.

Hendry, A. P., A. H. Dittman, and R. W. Hardy. 2000. Proximate composition, reproductive development, and a test for trade-offs in captive sockeye salmon. Transactions of the American Fisheries Society 129:1082-1095.

ISRP/ISAB (Independent Scientific Review Panel and Independent Scientific Advisory Board). 2009-1. Tagging Report: A comprehensive review of Columbia River Basin tagging technologies and programs. (http://www.nwcouncil.org/library/isab/isrpisab2009-1.pdf).

Joyce, J. E., R. M. Martin, and F. P. Thrower. 1993. Successful maturation of captive chinook salmon broodstock. Progressive Fish-Culturist 55:191-194.

Kalinowski, S. T., M. L. Taper, and T. C. Marshall. 2007. Revising how the computer program CERVUS accommodates genotyping error increases success in paternity assignment. Molecular Ecology 16: 1099-1006.

McClure, M., and 11 co-authors. 2003. Independent Populations of Chinook, steelhead, and sockeye for listed evolutionarily significant units within the interior Columbia River basin (Discussion Draft). Interior Columbia Basin Technical Recovery Team.

NMFS (National Marine Fisheries Service). 1992. Threatened status for Snake River spring/summer chinook salmon, threatened status for Snake River fall chinook salmon. Final Rule. Federal Register 57:78 (April 22, 1992):14563-14663.

NMFS (National Marine Fisheries Service). 1995. Proposed Recovery Plan for Snake River Salmon. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. NMFS Protected Resources Division. Portland, Oregon.

NPCC (Northwest Power and Conservation Council). 1994. Columbia River Basin Fish and Wildlife Program. Portland, Oregon.

NPCC (Northwest Power and Conservation Council). 2000. Columbia River Basin Fish and Wildlife Program. Portland, Oregon.

Reisenbichler, R. R., and S. P. Rubin. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. ICES Journal of Marine Science 56:459-466.

Schmitten, R., W. Stelle, and M. Brentwood. 1997. Draft Snake River Salmon Recovery Plan. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Seeb, L. W., A. Antonovich, M. A. Banks, T. D. Beacham, M. R. Bellinger, S. M. Blankenship, M. Campbell, N. A. Decovish, J. C. Garza, C. M. Guthrie III, T. A. Lundrigan, P. Moran, S. R. Narum, J. J. Stephenson, K. J. Supernault, D. J. Teel, W. D. Templin, J. K. Wenburg, S. F. Young, and C. T. Smith. 2007. Development of a standardized DNA database for Chinook salmon. Fisheries 32:540–552.

Stark, E. J., D. Baker, J. Gable, and J. Heindel. 2008. Captive rearing program for Salmon River Chinook salmon, 2007. Project Progress Report to the Bonneville Power Administration, Contract Number 00029463. Portland, Oregon.

Stark, E. J., J. Gable, D. Baker, and J. Heindel. 2009. Captive rearing program for Salmon River Chinook salmon, 2008. Project Progress Report to the Bonneville Power Administration, Contract Number 00035399. Portland, Oregon.

Stark, E. J., and J. Gable. 2010. Captive rearing program for Salmon River Chinook salmon, 2009. Project Progress Report to the Bonneville Power Administration, Contract Number 00039364. Portland, Oregon.

Venditti, D. A., C. Willard, C. Looney, P. Kline, and P. Hassemer. 2002. Captive rearing program for Salmon River chinook salmon, 2000. Project Progress Report to the Bonneville Power Administration, Contract Number 00000167-00001, Portland, Oregon.

Venditti, D. A., C. Willard, T. Giambra, D. Baker, and P. Kline. 2003a. Captive rearing program for Salmon River chinook salmon, 2001. Project Progress Report to the Bonneville Power Administration, Contract Number 00004002. Portland, Oregon.

Venditti, D. A., C. Willard, C. James, D. Baker, and P. Kline. 2003b. Captive rearing program for Salmon River Chinook salmon, 2002. Project Progress Report to the Bonneville Power Administration, Contract Number 00004002. Portland, Oregon.

Venditti, D. A., D. Baker, J. Heindel, C. James, and P. Kline. 2005. Captive rearing program for Salmon River Chinook salmon, 2003. Project Progress Report to the Bonneville Power Administration, Contract Number 00004002. Portland, Oregon.

APPENDICES

Appendix A. Summary of Chinook salmon redds observed during ground counts in the East Fork Salmon River (EFSR) during 2011. Locations are GPS waypoints (WGS-84 datum).

Stream	Redd Name	Date Observed	Location		Section Name	SGR Trend Transect
			Easting	Northing		
EFSR	R001KJFEF	8/19/11	44.09121	114.44366	N2	NS-1b
EFSR	R002KJFEF	8/19/11	44.09137	114.44263	N2	NS-1b
EFSR	R003JMBEF	8/16/11	44.14302	114.39671	N02	NS-1a
EFSR	R005KJFEF	8/20/11	44.14025	114.40069	N02	NS-1a
EFSR	R006KJFEF	8/20/11	44.14023	114.40079	N02	NS-1a
EFSR	R007KJFEF	8/20/11	44.13957	114.40164	N02	NS-1a
EFSR	R008JMBEF	8/16/11	44.13781	114.40546	N02	NS-1a
EFSR	R009KJFEF	8/11/11	44.13763	114.40604	N02	NS-1a
EFSR	R010JMBEF	8/16/11	44.13643	114.40669	N02	NS-1a
EFSR	R011JMBEF	8/16/11	44.13353	114.41223	N02	NS-1a
EFSR	R012JMBEF	8/16/11	44.13353	114.41223	N02	NS-1a
EFSR	R013KJFEF	8/20/11	44.13293	114.41305	N02	NS-1a
EFSR	R014KJFEF	8/20/11	44.13037	114.41765	N02	NS-1a
EFSR	R015KJFEF	8/20/11	44.13049	114.41785	N02	NS-1a
EFSR	R016KJFEF	8/21/11	44.12888	114.41833	N01	NS-1a
EFSR	R017KJFEF	8/21/11	44.12878	114.41953	N01	NS-1a
EFSR	R018KJFEF	8/21/11	44.12885	114.42027	N01	NS-1a
EFSR	R019KJFEF	8/21/11	44.12868	114.42070	N01	NS-1a
EFSR	R020KJFEF	8/21/11	44.12868	114.42070	N01	NS-1a
EFSR	R021KJFEF	8/21/11	44.12740	114.42062	N01	NS-1a
EFSR	R022KJFEF	8/21/11	44.12712	114.42066	N01	NS-1a
EFSR	R023KJFEF	8/21/11	44.12663	114.42091	N01	NS-1a
EFSR	R024JMBEF	8/16/11	44.12576	114.42148	N01	NS-1a
EFSR	R025KJFEF	8/11/11	44.12206	114.42490	N01	NS-1a
EFSR	R026KJFEF	8/11/11	44.11879	114.42513	N01	NS-1a
EFSR	R027KJFEF	8/21/11	44.11872	114.42809	N01	NS-1a
EFSR	R028JMBEF	8/16/11	44.11869	114.42822	N01	NS-1a
EFSR	R029JMBEF	8/16/11	44.11854	114.42852	N01	NS-1a
EFSR	R030KJFEF	8/21/11	44.11796	114.42924	N01	NS-1a
EFSR	R031KJFEF	8/22/11	44.11796	114.42924	N3	NS-1b
EFSR	R032KJFEF	8/22/11	44.08144	114.45193	N3	NS-1b
EFSR	R035KJFEF	8/22/11	44.08783	114.44398	N3	NS-1b
EFSR	R037JMBEF	8/24/11	44.07679	114.45690	N4	NS-1b
EFSR	R040JMBEF	8/24/11	44.07391	114.45859	N4	NS-1b
EFSR	R041JMBEF	8/24/11	44.07332	114.45870	N4	NS-1b
EFSR	R042JMBEF	8/24/11	44.07322	114.45879	N5	NS-1b
EFSR	R043JMBEF	8/25/11	44.14062	114.40044	N02	NS-1a
EFSR	R044JMBEF	8/25/11	44.13785	114.40250	N02	NS-1a
EFSR	R045JMBEF	8/25/11	44.13741	114.40388	N02	NS-1a

Appendix A. Continued

Stream	Redd Name	Date Observed	Location		Section Name	SGR Trend Transect
			Easting	Northing		
EFSR	R050JMBEF	8/25/11	44.13400	114.40917	N02	NS-1a
EFSR	R051JMBEF	8/25/11	44.13315	114.41101	N02	NS-1a
EFSR	R053JMBEF	8/25/11	44.13147	114.41580	N02	NS-1a
EFSR	R055JMBEF	8/25/11	44.12959	114.41862	N02	NS-1a
EFSR	R056JMBEF	8/25/11	44.12877	114.41941	N01	NS-1a
EFSR	R058JMBEF	8/26/11	44.12889	114.24014	N01	NS-1a
EFSR	R059JMBEF	8/26/11	44.12846	114.42077	N01	NS-1a
EFSR	R061JMBEF	8/26/11	44.12554	114.42225	N01	NS-1a
EFSR	R063JMBEF	8/26/11	44.11877	114.42517	N01	NS-1a
EFSR	R064JMBEF	8/26/11	44.11853	114.42650	N01	NS-1a
EFSR	R065JMBEF	8/26/11	44.11853	114.42660	N01	NS-1a
EFSR	R066JMBEF	8/26/11	44.11870	114.42698	N01	NS-1a
EFSR	R067JMBEF	8/26/11	44.11872	114.42723	N01	NS-1a
EFSR	R068JMBEF	8/26/11	44.11708	114.42949	N01	NS-1a
EFSR	R069JMBEF	8/26/11	44.11692	114.42957	N01	NS-1a
EFSR	R070JMBEF	8/26/11	44.11680	114.42960	N01	NS-1a
EFSR	R071JMBEF	8/26/11	44.11657	114.42963	N01	NS-1a
EFSR	R072JMBEF	8/26/11	44.05676	114.46151	N6	NS-1b
EFSR	R075JMBEF	8/27/11	44.14306	114.39686	N02	NS-1a
EFSR	R076JMBEF	8/27/11	44.14219	114.39849	N02	NS-1a
EFSR	R077JMBEF	8/27/11	44.13108	114.41582	N02	NS-1a
EFSR	R079KJFEF	8/28/11	44.13019	114.41862	N02	NS-1a
EFSR	R080KJFEF	8/28/11	44.12947	114.41849	N02	NS-1a
EFSR	R081KJFEF	8/28/11	44.12706	114.42068	N02	NS-1a
EFSR	R082KJFEF	8/28/11	44.12669	114.42069	N02	NS-1a
EFSR	R083KJFEF	8/29/11	44.11362	114.43092	N1	NS-1b
EFSR	R084KJFEF	8/29/11	44.11262	114.43134	N1	NS-1b
EFSR	R085KJFEF	8/29/11	44.10863	114.43499	N1	NS-1b
EFSR	R086KJFEF	8/29/11	44.09386	114.44259	N1	NS-1b
EFSR	R087KJFEF	8/29/11	44.09293	114.44267	N2	NS-1b
EFSR	R088KJFEF	8/29/11	44.09117	114.44334	N2	NS-1b
EFSR	R089KJFEF	8/29/11	44.09056	114.44379	N2	NS-1b
EFSR	R090 KJFEF	8/30/11	44.08733	114.44402	N3	NS-1b
EFSR	R092 KJFEF	8/30/11	44.07059	114.45908	N5	NS-1b
EFSR	R093 KJFEF	8/31/11	44.14290	114.39658	N02	Ns-1a
EFSR	R094 KJFEF	8/31/11	44.14067	114.40065	N02	NS-1a
EFSR	R095 KJFEF	8/31/11	44.13329	114.41131	N02	NS-1a
EFSR	R096 KJFEF	8/31/11	44.13092	114.41576	N02	NS-1a
EFSR	R097 KJFEF	8/31/11	44.13040	114.41727	N02	NS-1a
EFSR	R098 KJFEF	8/31/11	44.05627	114.46140	N6	NS-1b

Appendix A. Continued

Stream	Redd Name	Date Observed	Location		Section Name	SGR Trend Transect
			Easting	Northing		
EFSR	R101 KJFEF	9/1/11	44.11804	114.42916	N01	NS-1a
EFSR	R104JMBEF	9/7/11	44.13007	114.41597	N02	NS-1a
EFSR	R105 KJFEF	9/7/11	43.99281	114.48608	C3	NS-1b
EFSR	R106JMBEF	9/17/11	44.13969	114.40166	N02	NS-1a
EFSR	R107JMBEF	9/18/11	44.14638	114.38338	N03	N.A.

Appendix B. Summary of Chinook salmon carcasses collected in the East Fork Salmon River (EFSR), August 11–September 18, 2011. Locations are GPS waypoints (WGS-84 datum).

Date		Length (cm)				Genetic #					Location		
Recovered	Trapped	Fork	Hypural	Sex	Fin Rays	Aging Lab	Captive Project	Adult Trap	Adult Trap Jaw Tag	SGR Trend Transect	Northing	Easting	Age (Ocean Years)
8/11/11		95	81	F	Y	11-01321	C001			NS-1a	44.12413	114.42354	5(3)
8/16/11		92	72	F	Y	11-01322	C002			NS-1a	44.07449	114.25412	5(3)
8/16/11	7/23/11	96	78	M	Y	11-01323	C003	025	024	NS-1a	44.07248	114.25453	5(3)
8/16/11		94	77	F	Y	11-01324	C004			NS-1a	44.07186	114.25445	5(3)
8/16/11		88	74	F	Y	11-01325	C005			NS-1a	44.07109	114.25537	NA
8/20/11		94	75	F	Y	11-01326	C006			NS-1a	44.13308	114.41465	5(3)
8/20/11	7/20/11	102	85	M	Y	11-01327	C007	016	016	NS-1a	44.13146	114.41465	5(3)
8/21/11	7/28/11	103	82	M	Y	11-01328	C008	071	072	NS-1a	44.12555	114.42327	5(3)
8/21/11		90	75	F	Y	11-01329	C009			NS-1a	44.11871	114.42722	5(3)
8/20/11	8/11/11	92	76	F	Y	11-01330	C010	121	122	NS-1b	44.08604	114.44474	5(3)
8/22/11	7/25/11	74	60	M	Y	11-01311	C011	037	036	NS-1b	44.08725	114.44415	4(2)
8/25/11		90	72	F	Y	11-01312	C012			NS-1a	44.14101	114.39909	5(3)
8/25/11	7/23/11	75	62	F	Y	11-01313	C013	021	020	NS-1a	44.14075	114.40016	4(2)
8/25/11		100	77	F	Y	11-01314	C014			NS-1a	44.14065	114.40033	5(3)
8/25/11		99	77	M	Y	11-01315	C015			NS-1a	44.13740	114.40252	5(3)
8/25/11		99	77	M	Y	11-01316	C016			NS-1a	44.13616	114.40714	5(3)
8/25/11		91	75	F	Y	11-01317	C017			NS-1a	44.13616	114.40714	5(3)
8/25/11	8/14/11	96	78	F	Y	11-01318	C018	138	139	NS-1a	44.13357	114.40969	5(3)
8/25/11		93	85	Unk	Y	11-01319	C019			NS-1a	44.13142	114.41399	5(3)
8/26/11		73	60	F	Y	11-01320	C020			NS-1a	44.12828	114.42107	4(2)
8/26/11		92	75	F	Y	11-00601	C021			NS-1a	44.12539	114.42324	5(3)
8/26/11		92	75	F	Y	11-00602	C022			NS-1a	44.12484	114.42360	5(3)
8/26/11	8/16/11	58	46	M	Y	11-00603	C023	146	147	NS-1a	44.12143	114.42426	4(2)
8/26/11		74	62	F	Y	11-00604	C024			NS-1a	44.11850	114.42633	4(2)
8/26/11	8/24/11	74	61	F	Y	11-00605	C025	191	193	NS-1a	44.11874	114.42741	4(2)
8/26/11		96	88	F	Y	11-00606	C026			NS-1a	44.11693	114.42958	5(3)
8/27/11		101	78	M	Y	11-00607	C027			NS-1a	44.14082	114.39950	5(3)
8/27/11		96	80	F	Y	11-00608	C028			NS-1a	44.13754	114.40430	5(3)
8/27/11		90	75	M	Y	11-00609	C029			NS-1a	44.13738	114.40608	5(3)
8/27/11	7/23/11	72	68	M	Y	11-00610	C030	029	028	NS-1a	44.13360	114.40967	4(2)
8/27/11		85	NC	M	N	NC	C031			NS-1a	44.13279	114.41309	
8/27/11		89	NC	F	N	NC	C032			NS-1a	44.13169	114.41485	
8/27/11		65	NC	M	N	NC	C033			NS-1a	44.13173	114.41502	
8/27/11		95	NC	F	N	NC	C034			NS-1a	44.13128	114.41594	
8/27/11		79	NC	F	N	NC	C035			NS-1a	44.13034	114.41546	
8/27/11	7/27/11	69	NC	M	N	NC	C036	049	048	NS-1a	44.11508	114.43009	
8/28/11		97	NC	F	N	NC	C037			NS-1a	44.12845	114.42102	
8/28/11		90	NC	F	N	NC	C038			NS-1a	44.12520	114.42351	

Appendix B. Continued.

Date		Length (cm)				Genetic #					Location		
Recovered	Trapped	Fork	Hypural	Sex	Fin Rays	Aging Lab	Captive Project	Adult Trap	Adult Trap Jaw Tag	SGR Trend Transect	Northing	Easting	Age (Ocean Years)
8/28/11		90	NC	F	N	NC	C039			NS-1a	44.12458	114.42339	
8/28/11		68	NC	M	N	NC	C040			NS-1a	44.12135	114.42916	
8/28/11		100	NC	F	N	NC	C041			NS-1a	44.11846	114.42916	
8/29/11	7/25/11	71	NC	M	N	NC	C042	035	034	NS-1b	44.09986	114.44276	
8/29/11	7/28/11	77	NC	M	N	NC	C043	065	066	NS-1b	44.09621	114.44199	
8/29/11	7/27/11	70	NC	M	N	NC	C044	053	052	NS-1b	44.09382	114.44241	
8/29/11	7/26/11	52	NC	M	N	NC	C045	043	042	NS-1b	44.09074	114.44366	
8/30/11	7/27/11	72	NC	M	N	NC	C046	052	051	NS-1b	44.08939	114.44366	
8/30/11	7/26/11	94	NC	F	N	NC	C047	045	044	NS-1b	44.08096	114.45319	
8/30/11	8/12/11	98	NC	F	N	NC	C048	124	125	NS-1b	44.08070	114.45319	
8/30/11	7/23/11	98	NC	M	N	NC	C049	027	026	NS-1b	44.07751	114.45609	
8/30/11	8/1/11	80	NC	M	N	NC	C050	083	084	NS-1b	44.07347	114.45866	
8/31/11		92	NC	M	N	NC	C051			NS-1a	44.14278	114.39752	
8/31/11		85	NC	F	N	NC	C052			NS-1a	44.14100	114.39912	
8/31/11		73	NC	F	N	NC	C053			NS-1a	44.13955	114.40173	
8/31/11		89	NC	F	N	NC	C054			NS-1a	44.13779	114.40215	
8/31/11		88	NC	F	N	NC	C055			NS-1a	44.13783	114.40216	
8/31/11		93	NC	F	N	NC	C056			NS-1a	44.13718	114.40635	
8/31/11		91	NC	F	N	NC	C057			NS-1a	44.13623	114.40710	
8/31/11		81	NC	M	N	NC	C058			NS-1a	44.13447	114.40845	
8/31/11		100	NC	M	N	NC	C059			NS-1a	44.13348	114.40950	
8/31/11	8/21/11	75	NC	M	N	NC	C060	171	173	NS-1a	44.13342	114.41245	
8/31/11		105	NC	M	N	NC	C061			NS-1a	44.13140	114.41400	
8/31/11		86	NC	F	N	NC	C062			NS-1a	44.13146	114.41451	
8/31/11	8/9/11	90	NC	F	N	NC	C063	109	110	NS-1b	44.05092	114.46152	
8/31/11	8/27/11	76	NC	M	N	NC	C064	051	050	NS-1b	44.05071	114.46167	
8/31/11	8/21/11	82	NC	F	N	NC	C065	172	174	NS-1b	44.04902	114.46178	
9/1/11		82	NC	M	N	NC	C066			NS-1a	44.13029	114.46156	
9/1/11		89	NC	F	N	NC	C067			NS-1a	44.12913	114.41814	
9/1/11		77	NC	F	N	NC	C068			NS-1a	44.12891	114.41876	
9/1/11	8/21/11	100	NC	F	N	NC	C069	167	169	NS-1a	44.12864	114.42077	
9/1/11		94	NC	F	N	NC	C070			NS-1a	44.12733	114.42063	
9/1/11		98	NC	M	N	NC	C071			NS-1a	44.12662	114.42662	
9/1/11		79	NC	M	N	NC	C072			NS-1a	44.12195	114.42454	
9/1/11		92	NC	F	N	NC	C073			NS-1a	44.12135	114.42411	
9/3/11		96	NC	F	Y	11-01481	C074			NS-1a	44.14209	114.39850	5(3)
9/3/11		87	NC	F	Y	11-01482	C075			NS-1a	44.13781	114.40550	5(3)
9/5/11		86	NC	F	Y	11-01483	C076			NS-1a	44.12892	114.41850	5(3)
9/5/11	8/23/11	87	NC	F	Y	11-01484	C077	191	189	NS-1a	44.12662	114.42094	4(2)
9/7/11		73	59	M	Y	11-01485	C078			NS-1a	44.14315	114.39686	4(2)
9/7/11		86	72	F	Y	11-01486	C079			NS-1a	44.14121	114.39882	5(3)

Appendix B. Continued.

Date		Length (cm)				Genetic #					Location		
Recovered	Trapped	Fork	Hypural	Sex	Fin Rays	Aging Lab	Captive Project	Adult Trap	Adult Trap Jaw Tag	SGR Trend Transect	Northing	Easting	Age (Ocean Years)
9/7/11		90	74	F	Y	11-01487	C080			NS-1a	44.14049	114.40035	4(2)
9/7/11		98	83	F	Y	11-01488	C081			NS-1a	44.14049	114.40053	NA
9/7/11		81	68	F	Y	11-01489	C082			NS-1a	44.13914	114.40216	5(3)
9/7/11		93	77	F	Y	11-01490	C083			NS-1a	44.13007	114.41597	5(3)
9/7/11		93	72	F	Y	11-01491	C084			NS-1a	44.12920	114.41795	5(3)
9/7/11		76	63	F	Y	11-01492	C085			NS-1a	44.12260	114.42522	4(2)
9/7/11		79	62	M	Y	11-01493	C086		210	NS-1a	44.12122	114.42420	5(3)
9/9/11	8/24/11	90	73	F	Y	11-01494	C087	193	195	NS-1b	44.10574	114.43857	5(3)
9/9/11	8/6/11	77	61	M	N	11-01495	C088	096	097	NS-1b	44.08870	114.44410	
9/10/11		92	75	F	Y	11-01496	C089			NS-1a	44.14307	114.39693	5(3)
9/10/11		90	75	F	Y	11-01497	C090			NS-1a	44.13712	114.40613	5(3)

Appendix C. East Fork Salmon River (EFSR) Chinook salmon single and two-parent pair assignments, 2007-2010 adult returns.

Parent Source			Adult Returns (Progeny)								
Origin	Group	Year	2007 (n=89)	2008 (n=204)	2009 (n=191)	2010 (n=304)	2011 (n=210)	2012 (n=?)	2013 (n=?)	2014 (n=?)	Total
Captive	Spawn	2003		1							1
		2004		5							5
	Adult Release	2001									
		2002	0								0
		2003	0	0							0
		2004	0	0	0						0
		2005		1	0	0					1
		2006			2	6					8
		2007				1					1
		2008									0
		2009									0
		2010									0
	Total		0	7	2						9
Captive X Natural		2001									
		2002	0								0
		2003	0	0							0
		2004	0	0	0						0
		2005		0	0	0					0
		2006			1	6					7
		2007				0					0
		2008									0
		2009									0
		2010									0
		Total	0	0	1						1
Natural	Adult Returns	2001									
		2002	0								0
		2003	0	0							0
		2004	14	89	20						123
		2005		12	38	9					59
		2006			7	130					137
		2007				9					9
		2008									0
		2009									0
		2010									0
	Total		14	101	65	148					180
Total All			14	108	68	161					190

Represents a parent-progeny combination not biologically possible.

Fish have not yet been genotyped.

Future adult returns.

Prepared by:

Eric J. Stark
Senior Fisheries Research Biologist

Matthew R. Campbell
Fisheries Genetics Program Manager

Christine C. Kozfkay
Principal Fisheries Research Biologist

Kyle J. Freischmidt
Senior Fisheries Technician

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Daniel J. Schill
Fisheries Research Manager

Edward B. Schriever, Chief
Bureau of Fisheries